CHAPTER 10

Flora and Fauna

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

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

Contents

Figures

Photographs

Tables

10. Flora and Fauna

10.1 Introduction

The purpose of this chapter is to identify ecological values within the impact assessment area (refer Figure 10.1), assess the potential impacts of the Inland Rail—Border to Gowrie Project (the Project) on those values and identify appropriate mitigation measures to address such impacts. The impact assessment area is defined in Section 10.4.1.

This chapter has been prepared to address the ecological requirements of the Terms of Reference (ToR). Consideration has also been given to matters raised by stakeholders through consultation, during the development of the draft EIS. Both the scientific and common names (where available) are used in the identification of flora and fauna species in this chapter. For the purpose of differentiation within text, fauna species are identified with common name first, followed by scientific name. Flora species are identified with scientific name first, followed by common name. This rule applies to open text only and has not been adopted for tabulated data.

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

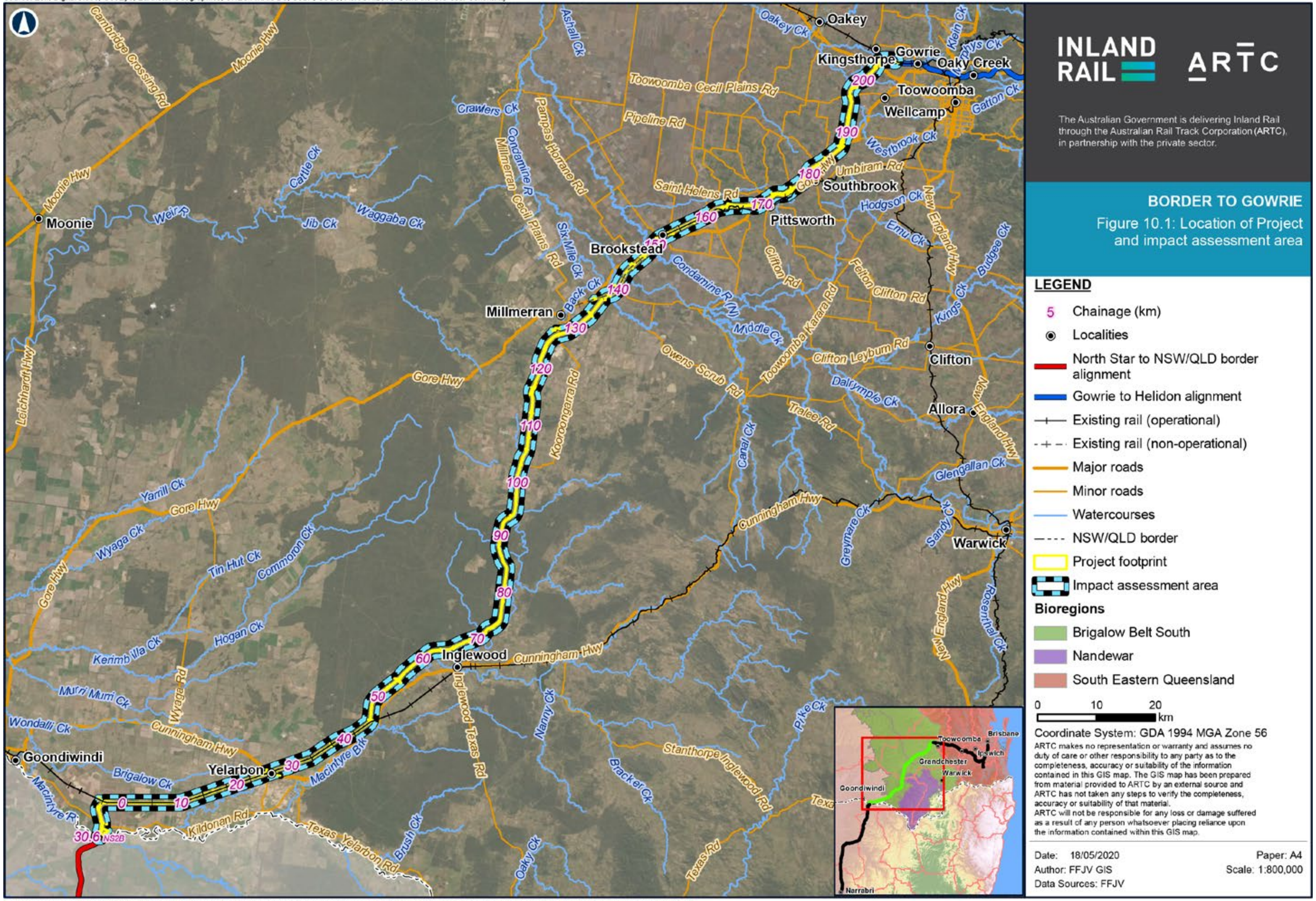
- Appendix J: Terrestrial Ecology Technical Report
- Appendix K: Aquatic Ecology Technical Report
- Appendix L: Matters of National Environmental Significance Technical Report
- Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy
- Appendix N: Draft Offset Strategy

10.2 Terms of Reference requirements

This chapter has been prepared to address sections 11.10 to 11.35 and sections 11.94 to 11.106 of the ToR. A compliance check of this chapter against each of the relevant components of the ToR is presented in Table 10.1. Compliance of the EIS against the full ToR is documented in Appendix B: Terms of Reference Compliance Table.

A stand-alone document pertaining to matters of national environmental significance (MNES) is provided as Appendix L: Matters of National Environmental Significance Technical Report in consideration of sections 11.10 to 11.35 of the ToR.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.1_LocationOfProject_v2.mxd Date: 18/05/2020 11:40

TABLE 10.1 COMPLIANCE AGAINST RELEVANT SECTIONS OF THE TERMS OF REFERENCE

	Flora and fauna Terms of Reference requirements	EIS section
EPBC Act		
Information requirements		
11.10	Consideration must be given to any relevant policy statements available from **environment.gov.au**, including: a) Matters of National Environmental Significance: Significant impact guidelines 1.15 b) Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy and c) any approved conservation advice, recovery plans and threat abatement plans (as relevant) for listed threatened species and ecological communities.	a) Section 10.3 and Section 10.12 b) Section 10.3 and Section 10.13 c) Section 10.3 and Section 10.10.2
11.11	The EIS must: a) assess all the relevant impacts that the action has, will have or is likely to have, including on receiving environments of the Project b) provide enough information about the action and its relevant impacts to allow the Commonwealth Minister to make an informed decision on whether or not to approve the action c) address the matters set out in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (Cwlth) (EPBC Regulations).	a) Section 10.9 b) Section 10.6, Section 10.10.2.1, Section 10.12.1, Section 10.13.1 and Appendix L: Matters of National Environmental Significance Technical Report c) Chapter 1: Introduction, Chapter 2: Project Rationale, Chapter 3: Legislation and Project Approvals Process, Chapter 5: Project Description, Chapter 22: Outline Environmental Management Plan and Appendix L: Matters of National Environmental Significance Technical Report
11.12	The MNES section of the EIS should bring together assessments of impacts from other chapters and produce a stand-alone assessment in a format suited for assessment under the EPBC Act.	Appendix L: Matters of National Environmental Significance Technical Report provides a 'stand-alone MNES document' as specified by the ToR.
11.13	The project should initially be assessed in its own right, followed by an assessment of the cumulative impacts related to existing major projects and/or development that is progressing through a publicly available planning and approval process. Cumulative impacts not solely related to the Project development should also be described.	Section 10.10.2.1, Section 10.12, Section 10.15 and Chapter 21: Cumulative Impacts
11.14	Predictions of the extent of threat (risk), impact and the benefits of any mitigation measures proposed, should be based on sound science and quantified where possible. All sources of information relied upon should be referenced.	Section 10.9, 10.10, Section 10.11.1, Section 10.12 References provided in-text and collated in Chapter 25: References
11.15	An estimate of the reliability of any predictions should be provided.	Section 10.11.1 and Section 10.13
11.16	Any positive impacts of the Project should be identified and evaluated.	Section 10.9.6 and Section 10.9.9
11.17	The extent of any new field work, modelling or testing should be commensurate with risk and should be such that when used in conjunction with existing information, provides sufficient confidence in predictions that well-informed decisions can be made.	Section 10.4.6
11.18	In accordance with Schedule 4 of the EPBC Regulations, feasible project alternatives must be discussed, including: a) if relevant, the alternative of taking no action; b) a comparative description of the impacts of each alternative on the triggered MNES protected by the controlling provision c) sufficient detail to make clear why any alternative or option is preferred to another.	Chapter 2: Project Rationale Appendix L: Matters of National Environmental Significance Technical Report

Flora and fauna Terms of Reference requirements		EIS section
11.19	Short, medium and long-term advantages and disadvantages of the alternatives or options must be discussed.	Chapter 2: Project Rationale Appendix L: Matters of National Environmental Significance Technical Report
11.20	The information provided must include details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: a) the person proposing to take the action b) for an action for which a person has applied for a permit, the person making the application. If the person proposing to take the action is a corporation, details of the corporation's environmental policy and planning framework must also be included.	Chapter 1: Introduction Appendix L: Matters of National Environmental Significance Technical Report
11.21	The economic and social impacts of the action, both positive and negative, must be summarised. Matters of interest should include: a) consideration at the local, regional and national levels b) any public consultation activities undertaken, and their outcomes c) any consultation with indigenous stakeholders d) identification of affected parties and communities that may be affected and a description of the views of those parties and communities e) project economic costs and benefits of the Project and project alternatives, including the basis for their estimation through cost/benefit analysis or similar studies; and f) employment and other opportunities expected to be generated by the Project in each of the construction and operational phases.	Chapter 2: Project Rationale Chapter 15: Social Chapter 16: Economics Appendix C: Stakeholder Engagement Report Appendix L: Matters of National Environmental Significance Technical Report
11.22	The EIS must provide background to the action and describe in detail all components of the action for example (but not limited to), the construction, operation and (if relevant) decommissioning components of the action. This must include the location of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on MNES.	Chapter 5: Project Description Appendix L: Matters of National Environmental Significance Technical Report
11.23	The description of the action must also include details on how the works are to be undertaken (including stages of development and their timing) and design parameters for those aspects of the structures or elements of the action that may have relevant impacts.	Chapter 1: Introduction Chapter 5: Project Description Appendix L: Matters of National Environmental Significance Technical Report
11.24	The EIS must also provide details on the current state of groundwater and surface water in the region as well as any use of these resources.	Chapter 12: Surface Water and Hydrology Chapter 13: Groundwater Appendix L: Matters of National Environmental Significance Technical Report
Listed threatened species and communities		
11.25	The EIS must describe the listed threatened species and ecological communities identified below (including EPBC Act status, distribution, life history and habitat).	Section 10.6 Appendix L: Matters of National Environmental Significance Technical Report

Flora and fauna Terms of Reference requirements		EIS section
11.26	The EIS must consider and assess the impacts to the listed threatened species and ecological communities identified in section 11.29 and 11.31 (including EPBC Act status, distribution, life history and habitat) and any others that are found to be or may potentially be present in areas that may be impacted by the Project. Impacts from each component of the Project of relevance to each listed threatened species or ecological community should be identified. Impacts may result from: (a) a decrease in the size of a population or a long-term adverse effect on an ecological community(b) reduction in the area of occupancy of the species or extent of occurrence of the ecological community (c) fragmentation of an existing population or ecological community (d) disturbance or destruction of habitat critical to the survival of the species or ecological community (e) disruption of the breeding cycle of a population (f) modification, destruction, removal, isolation or reduction of the availability or quality of habitat to the extent that the species is likely to decline (g) modification or destruction of abiotic (non-living) factors (such as water, nutrients or soil) necessary for the ecological community's survival (h) the introduction of invasive species that are harmful to the species or ecological community becoming established (i) interference with the recovery of the species or ecological community.	Section 10.6, Section 10.7, Section 10.8 and Section 10.9 Appendix L: Matters of National Environmental Significance Technical Report
11.27	The EIS should describe any mitigation measures proposed to reduce the impact on the listed threatened species and ecological communities and proposed mitigation measures. Supporting evidence should be provided to demonstrate the appropriateness of mitigation measures proposed. Where the likely success of mitigation measures cannot be supported by evidence, identify contingencies in the event the mitigation is not successful.	Section 10.10 Chapter 22: Outline Environmental Management Plan Appendix L: Matters of National Environmental Significance Technical Report
11.28	The EIS should describe any offsets proposed to compensate for residual impacts.	Section 10.13 Appendix L: Matters of National Environmental Significance Technical Report Appendix N: Draft Offset Strategy
List of potential listed threatened species and their status		
11.29	The EIS must address impacts on, but not limited to, the following listed threatened species for the proposed action: **Flora** a) Mt. Berryman phebalium (*Phebalium distans*) – critically endangered; b) king blue-grass (*Dichanthium queenslandicum*) – endangered; c) finger panic grass (*Digitaria porrecta*) – endangered; d) *Lepidium monoplocoides* – endangered; e) *Lepidium peregrinum* – endangered; f) *Tylophora linearis* – endangered; g) *Xerothamnella herbacea* – endangered; h) *Leucopogon* sp. (Coolmunda D.Halford Q1635) – endangered; i) *Microcarpaea agonis* – endangered; j) *Homopholis belsonii* – vulnerable; k) hawkweed (*Picris evae*) – vulnerable; l) *Macrozamia machinii* – vulnerable; a m) austral cornflower, native thistle (*Rhaponticum australe*) – vulneraable; n) brush sophora (*Sophora fraseri*) – vulnerable; o) tara Wattle (*Acacia lauta*) – vulnerable; p) Bertya opponens – vulnerable; q) satin-top grass (*Bothriochloa bunyensis*) – vulnerable; r) *Dichanthium setosum* – vulnerable; s) *Philotheca sporadica* – vulnerable; t) *Prostanthera* sp. (Dunmore D.M.Gordon 8A) – vulnerable; u) toadflax (*Thesium australe*) – vulnerable;	Section 10.5.2 and Section 10.6 Appendix L: Matters of National Environmental Significance Technical Report. In addition to species listed in the ToR, other species have also been included within this document where they have been identified through literature review and have a reasonable chance of occurring within the impact assessment area.

Flora and fauna Terms of Reference requirements		EIS section
11.29 (cont'd)	**Flora** (continued) v) hairy-joint grass (*Arthraxon hispidus*) – vulnerable; w) Ooline (*Cadellia pentastylis*) – vulnerable; x) stream clematis (*Clematis fawcettii*) – vulnerable; y) shiny-leaved ironbark (*Eucalyptus virens*) – vulnerable; z) *Macrozamia conferta* – vulnerable; aa) *Westringia parvifolia* – vulnerable; bb) tall velvet sea-berry (*Haloragis exalata* subsp. *Velutina*) – vulnerable; cc) macadamia nut (*Macadamia integrifolia*) – vulnerable; dd) *Sarcochilus hartmannii* – vulnerable; ee) blotched sarcochilus (*Sarcochilus weinthalii*) – vulnerable; ff) miniature moss-orchid (*Bulbophyllum globuliforme*) – vulnerable; gg) durikai mallee (*Eucalyptus infera*) – vulnerable;	Section 10.5.2 and Section 10.6 Appendix L: Matters of National Environmental Significance Technical Report
	Fauna a) regent honeyeater (*Anthochaera Phrygia*) – critically endangered; b) curlew sandpiper (*Actitis hypoleucos*) – critically endangered; c) swift parrot (*Lathamus discolour*) – critically endangered; d) silver perch (*Bidyanus bidyanus*) – critically endangered; e) spot-tailed quoll, tiger quoll (*Dasyurus maculatus maculatus*) – endangered; f) brigalow woodland snail (*Adclarkia cameroni*) – endangered; g) Australian painted snipe (*Rostratula australis*) – endangered; h) dulacca woodland snail (*Adclarkia Dulacca*) – endangered; i) Australasian bittern (*Botaurus poiciloptilus*) – endangered; j) black-throated finch (southern) (*Poephila cincta cincta*) – endangered; k) Condamine (Darling Downs) earless dragon (*Tympanocryptis condaminensis*) – endangered; l) northern quoll/digul (*Dasyurus hallucatus*) – endangered; m) koala (*Phascolarctos cinereus*) – vulnerable; n) red goshawk (*Erythrotriorchis radiatus*) – vulnerable; o) squatter pigeon (Southern Subspecies) (*Geophaps scripta scripta*) – vulnerable; p) painted honeyeater (*Grantiella picta*) – vulnerable; q) south-eastern long-eared bat (*Nyctophilus corbeni*) – vulnerable; r) greater glider (*Petauroides volans*) – vulnerable; s) grey-headed flying-fox (*Pteropus poliocephalus*) – vulnerable; t) Murray cod (*Maccullochella peelii*) – vulnerable; u) five-clawed worm-skink, long-legged worm skink (*Anomalopus mackayi*) – vulnerable; v) collared delma (*Delma torquata*) – vulnerable; w) yakka skink (*Egernia rugosa*) – vulnerable; x) Dunmall's snake (*Furina dunmalli*) – vulnerable; y) black-breasted button-quail (*Turnix melanogaster*) – vulnerable; z) large-eared pied bat (*Chalinolobus dwyeri*) – vulnerable; aa) brush-tailed rock-wallaby (*Petrogale penicillate*) – vulnerable; bb) long-nosed potoroo (*Potorous tridactylus tridactylus*) – vulnerable; cc) new holland mouse (*Pseudomys novaehollandiae*) – vulnerable; dd) border thick-tailed gecko (*Uvidicolus sphyrurus*) – vulnerable; ee) Bell's turtle (*Wollumbinia belli*) – vulnerable; ff) sharp-tailed sandpiper (*Calidris acuminata*) – migratory; gg) white-throated needletail (*Hirundapus caudacutus*) – migratory; hh) satin flycatcher (*Myiagra cyanoleuca*) – migratory; ii) fork-tailed swift (*Apus pacificus*) – migratory; jj) common sandpiper (*Actitis hypoleucos*) – migratory; kk) pectoral sandpiper (*Calidris melanotos*) – migratory; ll) oriental cuckoo (*Cuculus optatus)* – migratory; mm) Latham's snipe, Japanese snipe (*Gallinago hardwickii*) – migratory; nn) black-faced monarch (*Monarcha melanopsis*) – migratory; oo) eastern osprey (*Pandion cristatus*) – migratory;	Section 10.5.4 and Section 10.6. Appendix L: Matters of National Environmental Significance Technical Report In addition to species listed in the ToR, other species such as the Grey falcon (*Falco hypoleucos*) have also been included within this document where they have been identified through literature review and have a reasonable chance of occurring within the impact assessment area

Flora and fauna Terms of Reference requirements		EIS section
11.29 (cont'd)	**Fauna** (continued) pp) osprey (*Pandion haliaetus*) – migratory; qq) rufous fantail (*Rhipidura rufifrons*) – migratory; rr) common greenshank (*Tringa nebularia*) – migratory; ss) spectacled monarch (*Monarcha trivirgatus*) – migratory; tt) yellow wagtail (*Motacilla flava*) – migratory;	
11.30	The EIS must address how the impacts to each of the listed species is not inconsistent with relevant recovery plans, threat abatement plans and conservation advices.	Section 10.5.2, Section 10.5.4, Section 10.9, Section 10.10.2 and Section 10.13 Appendix L: Matters of National Environmental Significance Technical Report
List of potential listed threatened communities		
11.31	The EIS must address impacts on the following listed threatened ecological communities for the proposed action: a) Lowland Rainforest of Subtropical Australia – critically endangered b) Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland – critically endangered c) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (also known as Box-Gum Grassy Woodland and Derived Grassland) – critically endangered d) Brigalow (*Acacia harpophylla* dominant and codominant) – endangered e) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions – endangered f) Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions - endangered g) Weeping Myall Woodlands – endangered.	Section 10.5.3.3, Section 10.9, Section 10.11.1, Section 10.11.2, Section 10.12.1 and Section 10.13.1 Appendix L: Matters of National Environmental Significance Technical Report
11.32	The EIS must address how the impacts to each of the listed communities is not inconsistent with relevant recovery plans, threat abatement plans and conservation advices.	Section 10.5.3.3, Section 10.9, Section 10.10.2, Section 10.12.1 and Section 10.13.1 Appendix L: Matters of National Environmental Significance Technical Report
Offsets		
11.33	The EIS must describe any significant residual impacts of the action for each relevant matter protected by the EPBC Act, after all proposed avoidance and mitigation measures are taken into account.	Section 10.13.1 and Section 10.13.3 Appendix L: Matters of National Environmental Significance Technical Report Appendix N: Draft Offset Strategy
11.34	The EIS must propose offsets for all residual impacts to matters protected by the EPBC Act consistent with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy.	Section 10.13.1 and Section 10.13.3 Appendix L: Matters of National Environmental Significance Technical Report Appendix N: Draft Offset Strategy
Conclusion		
11.35	The EIS must include an overall conclusion for the action describing the acceptability of the impact of undertaking the action in the manner proposed on the protected matters, in the context of: a) the requirements of the EPBC Act b) the principles of ecologically sustainable development and the precautionary principle, c) the proposed avoidance, mitigation measures, and if relevant, offsets measures proposed to address any residual impacts.	Section 10.16 and Chapter 23: Conclusions

Flora and fauna Terms of Reference requirements		EIS section
Flora and fauna		
Existing environment		
11.94	Identify and describe matters of state environmental significance (MSES), state, ecological areas, regionally significant biodiversity and natural environmental values of the terrestrial and aquatic ecology likely to be impacted by the Project which have not been addressed in the section on MNES.	Section 10.4.7 Appendix J: Terrestrial Ecology Technical Report
Impact assessment		
11.95	Describe the likely impacts on the biodiversity and natural environmental values of affected areas arising from the construction and operation of the Project. Provide information based on relevant DES information guidelines that cover flora and fauna, aquatic ecology and groundwater dependent ecosystems (refer Appendix 1). The assessment should include, but not be limited to, the following key elements: a) MSES, matters of local environmental significance (MLES), and designated state and regional biodiversity values and conservation corridors of conservation significance. Reference should be made to the Biodiversity Planning Assessment and BioCondition assessment tools where appropriate (refer Appendix 1) b) terrestrial and aquatic ecosystems (including groundwater-dependent ecosystems) and their interaction with surface water and groundwater hydrology and areas surrounding watercourses and wetlands c) biological diversity including listed flora and fauna species and regional ecosystems, connectivity and essential habitat d) the existing integrity of ecological processes, and habitats of threatened, near-threatened or special least-concern species e) the integrity of landscapes and places, including wilderness and similar natural places f) actions of the Project that may require an authority under the NC Act and Water Act (e.g. riverine protection permits) and/or could be assessable development for the purposes of the VM Act, Fisheries Act (e.g. waterway barrier works) and the Planning Act g) any exposure to contaminants or the bio-accumulation of contaminants h) impacts on native fauna due to proximity to the site and site impacts (e.g. lighting, noise, vibration, waste and fencing) i) impacts to movement of native fauna due to barrier effect of linear infrastructure j) impacts on vegetation category areas identified on the regulated vegetation management maps under Queensland's vegetation management framework.	a) Section 10.5.8 and Section 10.9 b) Section 10.5.9, Section 10.5.10 and Section 10.9.11 c) Section 10.5.8, Section 10.9.1 and Section 10.9.5 d) Section 10.5.6 and Section 10.5.8 e) Section 10.5.1 and Section 10.5.6 f) Section 10.9.11, Section 10.10.2, Chapter 3: Legislation and Project Approvals Process and Appendix K: Aquatic Ecology Technical Report g) Section 10.9.10 and Section 10.9.11 h) Section 10.9.9 i) Section 10.9.8 j) Section 10.9.1, Section 10.9.5 and Section 10.9.7 Appendix J: Terrestrial Ecology Technical Report
Mitigation measures		
11.96	Describe any proposed measures to avoid, minimise or mitigate potential impacts on natural values, and enhance these values. Assess how the nominated quantitative indicators and standards may be achieved for nature conservation management. In particular, address measures to protect or preserve any threatened or near- threatened species.	Section 10.10 Appendix J: Terrestrial Ecology Technical Report
11.97	Assess the need for buffer zones and the retention, rehabilitation or construction of fauna movement corridors across the railway. Propose measures that would avoid the need for waterway barriers or mitigate the impacts of their construction and operation. With respect to the Macintyre River, reference should be made to the New South Wales Department of Primary Industries policy and guidelines for fish habitat conservation and management and the Queensland Department of Agriculture and Fisheries (DAF) policy and factsheets on waterways and waterway barrier works (refer Appendix 1).	Sections 10.10.1 and Section 10.10.2 Appendix K: Aquatic Ecology Technical Report Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy

Flora and fauna Terms of Reference requirements		EIS section
11.98	Describe how the achievement of the objectives would be monitored and audited, and how corrective actions would be managed.	Section 10.10.2 Chapter 22: Outline Environmental Management Plan
11.99	Where a significant residual impact will occur on a prescribed environmental matter as outlined in the Environmental Offsets Regulation 2014, the offset proposal (s) must be consistent with the requirements of Queensland's EO Act and the latest version of the Queensland Environmental Offsets Policy (refer Appendix 1).	Section 10.13.2 and Section 10.13.3 Appendix J: Terrestrial Ecology Technical Report Appendix N: Draft Offset Strategy
11.100	Assess the need and suitability and provide objective commitments to the provision of fauna passage between habitat fragmented by the rail corridor, of suitable design and location for affected species and their habitat.	Section 10.10.1 and Section 10.10.2 Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy
11.101	Demonstrate that actions of the Project avoid and minimise impacts of clearing of vegetation regulated through the VM Act/Planning Act and how any clearing maintains connectivity of the remaining mapped category B area in the landscape. Provide details on the exemptions/assessment pathway for any clearing of vegetation regulated through the VM Act/Planning Act.	Section 10.9.5, Section 10.9.8, Section 10.10.1 and Section 10.10.2 Chapter 3: Legislation and Project Approvals Process Appendix J: Terrestrial Ecology Technical Report Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy
Biosecurity		
Existing environment		
11.102	Provide information on the current distribution of animal pests and weeds on the proposed alignment.	Section 10.5.3.4 and Section 10.5.4.3
11.103	Surveys of animal pests and weeds should be undertaken in those areas identified during the desktop assessment as containing listed flora, fauna or ecological communities of national or state environmental significance (MNES or MSES defined by the EPBC and NC Acts respectively).	Section 10.5.3.4, Section 10.5.4.3 and Section 10.10.2
Impact assessment		
11.104	Describe the impact the Project's construction and operation will have on the spread of pest animals, weed species and disease along the proposed alignment and into adjoining properties.	Section 10.9.4
Mitigation measures		
11.105	Propose detailed measures to control and limit the spread of pests, weeds and disease surrounding the proposed alignment and adjacent areas. Detail any relevant local government area Biosecurity Plans. This includes restricted matters listed in the Biosecurity Act 2014 and Biosecurity Regulation 2016 and designated pests under the Public Health Act 2005.	Section 10.10.2 Chapter 22: Outline Environmental Management Plan
11.106	All proposed measures must be in accordance with any relevant biosecurity surveillance or prevention program authorised under the Biosecurity Act and any requirements of the VM Act/Planning Act. Mitigation measures should be developed in consultation with the relevant Queensland and New South Wales government agencies and local governments (e.g. baiting programs) to ensure cross border impacts are minimised.	Section 10.10.2 Chapter 22: Outline Environmental Management Plan

10.3 Policies, standards and guidelines

The policies, standards and guidelines relevant to this ecological assessment are presented in Table 10.2.

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

TABLE 10.2 POLICIES, STANDARDS AND GUIDELINES RELEVANT TO THIS ASSESSMENT

Policy, standard or guideline (jurisdiction/applicable matter)	Relevance to the Project
Commonwealth	
Environment Protection and Biodiversity Conservation Act (Cth) *Environmental Offsets Policy* (2012) (EPBC Act Offsets Policy) (Actions subject to the EPBC Act)	The EPBC Act Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012b) 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 have been developed by the Australian Government Department of the Environment and Energy (DotEE). 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 (DSEWPaC, 2012b). The Project will implement a range of mitigation measures to avoid and minimise significant residual impacts on the MNES. Offsets will be provided in accordance with the policy include direct offsets and other compensatory methods (indirect offsets). It is likely that a combination of methods will be applicable to the Project, based on the extent of the significant residual impacts on MNES. ARTC's *Environmental Offset Delivery Strategy—Qld* (Strategy) informs the development of offsets delivery components including an Environmental Offset Delivery Plan and Offset Area Management Plans. The provision of biodiversity offsets for the Project is discussed in Section 10.13.

Policy, standard or guideline (jurisdiction/applicable matter)	Relevance to the Project
Matters of National Environmental Significance: *Significant impact guidelines 1.1—Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (MNES)	The purpose of the guideline is to assist any person who proposes to take an action to decide whether or not they should submit a referral to the DotEE for a decision by the Australian Government Minister for the Environment on whether assessment and approval is required under the EPBC Act. These 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. Assessment of MNES against the guidelines has facilitated the determination of a significant residual impact to MNES. This is discussed further in Section 10.12.1.
Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DotE, 2015c) (MNES)	The purpose of the guideline is to assist any person who proposes to take an action to decide whether or not they should submit a referral to the Department of Agriculture, Water and the Environment (DAWE) for a decision by the Australian Government Environment Minister on whether assessment and approval is required under the EPBC Act in relation to the 14 migratory birds. These guidelines outline a 'self-assessment' process, including detailed criteria to assist persons in deciding whether referral may be required. Important terms and phrases are explained. Assessment of MNES (non-threatened migratory species) against the guidelines has facilitated the determination of a significant residual impact to migratory birds relevant to this guideline. This is discussed further in Section 10.12.2.
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 and 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. Species recovery plans for the following MNES relevant to this Project have been considered as part of this assessment: ▸ Brush-tailed rock-wallaby (*Petrogale penicillata*) ▸ Spotted-tail quoll (*Dasyurus maculatus maculatus*) ▸ Large-eared pied bat (*Chalinolobus dwyeri*) ▸ Black-breasted button-quail (*Turnix melanogaster*) ▸ Red goshawk (*Erythrotriorchis radiatus*) ▸ Regent honeyeater (*Anthochaera phrygia*) ▸ Swift parrot (*Lathamus discolor*) ▸ Murray cod (*Maccullochella peelii*). Draft recovery plans exist for the following species: ▸ Australasian bittern (*Botaurus poiciloptilus*) ▸ Australian painted snipe (*Rostratula australis*) ▸ Grey-headed flying-fox (*Pteropus poliocephalus*). These recovery plans were used to guide the predictive habitat mapping for each relevant species impact assessment in relation to the *MNES Significant impact guidelines 1.1—Environmental Protection and Biodiversity Conservation Act 1999* (Cth) and *Biodiversity Conservation Act 1999* (Cth), and the development of mitigations measures (refer Appendix L: Matters of National Environmental Significance Technical Report) and Sections 10.4.4, 10.9, 10.10.2, 10.12.1 and 10.12.2.

Policy, standard or guideline (jurisdiction/applicable matter)	Relevance to the Project
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. Threat abatement plans relevant to MNES associated with the Project include: ▸ Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* ▸ Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (*Rhinella marina*) ▸ Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) ▸ Threats identified in the Threat Abatement Plan for competition and land degradation by rabbits ▸ Threat Abatement Plan for predation by feral cats ▸ Threat Abatement Plan for predation by the European red fox ▸ Threat abatement plan to reduce the impacts of tramp ants on biodiversity in Australia and its territories These threat abatement plans were used to guide species impact assessment in relation to the *Matters of National Environmental Significance: Significant impact guidelines 1.1–Environmental Protection and Biodiversity Conservation Act 1999* (Cth), and the development of mitigations measures (refer Appendix L: Matters of National Environmental Significance Technical Report) and Sections 10.9, 10.10.2, 10.12.1 and 10.12.2.
State	
Regional plans (Qld)—*Darling Downs Regional Plan* (Department of State Development, Infrastructure and Planning (DSDIP), 2013b) (Queensland. Specifically, activities that are regulated through the Planning Act)	Regional plans are State planning instruments made under the Planning Act. Regional plans seek to provide strategic direction to achieve regional outcomes that align with the State planning and development interests. The Project is located within the Darling Downs Regional Plan area. The Darling Downs Regional Plan provides the regional framework for local government to manage growth, planning directions, economic competitiveness and high-quality living. The regional plan identifies the need to plan strategically for the protection and enhancement of biodiversity values and landscape function and processes.
State Planning Policy 2017 (SPP) (Department of Infrastructure, Local Government and Planning (DILGP), 2017c)	The SPP is a key component of the Queensland land use planning system, which articulates the Queensland Government's 17 State interests in land use planning and development. The SPP is a statutory instrument and requires that the State interests be integrated into local government planning schemes. Some State interests in the SPP include assessment benchmarks that apply to certain types of development where a local government planning scheme does not appropriately integrate the relevant State interest. The SPP is applicable to the Project across various aspects, including terrestrial and aquatic ecology, which is represented by the *State interest guideline—Biodiversity* (DSDIP, 2014). The biodiversity State interest requires development to be located in areas to avoid significant impacts to MNES, avoid and minimise impacts to matters of state environmental significance (MSES) and matters of local environmental significance (MLES), maintain or enhance ecological processes and connectivity by avoiding fragmentation, and conserve and enhance koala habitat extent and condition.
Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP (Water and Wetland Biodiversity)) (Queensland Government, 2019b)	The quality of Queensland waters is protected under the EPP (Water and Wetland Biodiversity), which is subordinate legislation to the *Environmental Protection Act 1994* (Qld) (EP Act). Environmental values and water quality objectives are being progressively determined for areas of Queensland under the EPP (Water and Wetland Biodiversity). Healthy Waters Management Plans were published for the impact assessment area in 2019, specifying environmental values and water quality objectives for several water quality zones.

Policy, standard or guideline (jurisdiction/applicable matter)	Relevance to the Project
Policy and guidelines for fish habitat conservation and management 2013 (NSW Government, 2013)	This document focuses on promoting compliance with legislation relating to fish habitat conservation and management. It aims to assist local and State government authorities, proponents of developments and their advisers, and individuals or non-government organisations concerned with the planning and management of aquatic resources. It can be used to inform land use and natural resource management planning, development planning and assessment processes. It is also a valuable tool to improve awareness and understanding of the importance of fish habitats and how impacts can be mitigated or managed. This document is applicable to aquatic and riparian ecological values associated with the Macintyre River, at the southern limit of the Project.
Queensland Department of Agriculture and Fisheries policy and factsheets on waterways and waterway barrier works	Free movement along waterways and onto floodplains is an essential requirement for the survival and productivity of many species of Queensland fish. Loss of access to habitat as a result of barriers to fish passage has caused a decline in distribution of native fish populations, including species of commercial, recreational and traditional importance (barramundi, mullet and Australian bass). In Australia, declines of inland species such as Murray cod, freshwater catfish and silver perch are thought to be largely due to the impacts of barriers to fish movement. These policies and documents provide information related to legislative requirements and compliance strategies for works within waterways as defined under the *Fisheries Act 1994* (Qld) (Fisheries Act). These documents apply to waterways across Queensland.
Queensland Environmental Offsets Policy Significant Residual Impact Guideline (MSES Guidelines) (Department of Environment and Heritage Protection (DEHP), 2014)	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 *Nature Conservation Act 1992* (Qld) (NC Act), *Marine Parks Act 2004* (Qld) or EP Act. The Project involves activities prescribed in the *Environmental Offsets Regulation 2014*. As such, assessment against the MSES Guidelines is required to determine if a significant residual impact on an MSES occurs. This assessment is documented in Section 10.12.3.
Queensland Environmental Offsets Policy (Qld) (QEOP)	The QEOP (DES, 2020) 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 achieve a conservation outcome that achieves an equivalent environmental outcome ▸ Offsets must provide environmental 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 environmental values at risk or additional management actions to improve environmental values. Where legal security is required, offsets must be legally secured for the duration of the impact on the prescribed environmental matter. The Project will deliver environmental offsets consistent with the QEOP. ARTC's *Environmental Offset Delivery Strategy—Qld* (Strategy) will inform the development of offset delivery components including an Environmental Offset Delivery Plan and Offset Area Management Plans. The provision of biodiversity offsets for the Project is discussed in Section 10.13.

Policy, standard or guideline (jurisdiction/applicable matter)	Relevance to the Project
Back on Track species prioritisation framework (Priority Back on Track)	Priority Back on Track is an initiative of the DES, based on the method of Marsh et al. (2007), that ranks species (regardless of their NC Act or EPBC Act classification) as 'critical', 'high', 'medium', or 'low' priority for the State and for the National Resource Management (NRM) region. There is also a data deficient category according to three sets of criteria: probability of extinction, consequences of extinction and potential for successful recovery. Although it is not legislated, Priority Back on Track provides a framework for biodiversity assessment and species prioritisation when determining ecological values. Priority Back on Track species have been identified for each of the 14 NRM regions across Queensland. The Project is located across the Condamine and Border Rivers Maranoa-Balonne NRM regions. A total of 36 Priority Back on Track species (12 flora species and 24 fauna species) are known to occur within the Condamine NRM region through the prioritisation framework. The Border Rivers Maranoa-Balonne NRM region identifies 42 Priority Back on Track species, including 20 flora and 22 fauna species.
Biodiversity Planning Assessments (BPAs) (Queensland)	BPAs for each of Queensland's bioregions have been prepared based on the methodology outlined in the *Biodiversity Assessment and Mapping Methodology* (BAMM) (Department of Environment and Heritage Protection (DEHP), 2014b). The BPAs draw on the 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: 1. State significance—areas assessed as being significant for biodiversity at the bioregional or State scales 2. Regional significance—areas assessed as being significant for biodiversity at the sub-bioregional scale 3. 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. The Project is located within the Brigalow Belt BPA area. The *Biodiversity Planning Assessment for the Brigalow Belt Bioregion: Expert Panel Report v2.1* (DES, 2018d) outlines the BPAs conducted within the impact assessment area.
Nature Conservation (Koala) Conservation Plan 2017 (Koala Plan) (Queensland Government, 2017b)	The Koala Plan 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 within District A as identified in the Koala Plan. Clearing works in koala habitats within District A require 'sequential clearing' and the presence of koala spotters.

10.4 Methodology

10.4.1 Impact assessment area

For the purpose of this chapter, the impact assessment area is based on a 1 km buffer of the Project footprint, increasing in buffer extent where multiple design options were identified and explored during development of the reference design. The impact assessment area and Project footprint are shown in Figure 10.1.

10.4.2 Sensitive environmental receptors

Sensitive environmental receptors for this ecological assessment are those defined as 'prescribed environmental matters' in Part 2, Section 5 of the *Environmental Offsets Regulation 2014*. A sensitive environmental receptor is a feature, area or structure that may be affected by direct or indirect changes to the environment. Sensitive environmental receptors include:

- Protected areas (e.g. national parks, nature refuges, coordinated conservation areas, conservation parks and resource reserves)
- EPBC Act listed Threatened Ecological Communities (TECs)
- EPBC Act listed threatened species and their associated habitat
- EPBC Act listed migratory species and their associated habitat
- NC Act listed threatened and near-threatened species and their associated habitat
- NC Act listed 'least concern' and 'special least concern' (SLC) species and their associated habitat
- Regional ecosystems (Res) high-value regrowth and wildlife habitat
- Priority Back on Track flora and fauna species
- Significant wetlands (i.e. international, national and State)
- State-significant ecological constraints (i.e. Biodiversity Planning Assessment).

Impact assessment associated with this chapter specifically focuses on sensitive environmental receptors, which were identified through reviewing existing literature and previous studies relevant to the impact assessment area. The validity of historical records was confirmed through field investigations and geospatial modelling, where applicable.

In instances where conservation-significant species (i.e. species listed as threatened, near-threatened, migratory and SLC) did not have potential habitats within the impact assessment area, these species were not subject to impact assessment. They were not considered to be sensitive environmental receptors for the purpose of the impact assessment process as the risk of impacts to these sensitive environmental receptors was considered low.

Further detail related to the identification of sensitive environmental receptors is provided within Appendix J: Terrestrial Ecology Technical Report, Appendix K: Aquatic Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report.

10.4.3 Review of existing literature and previous studies

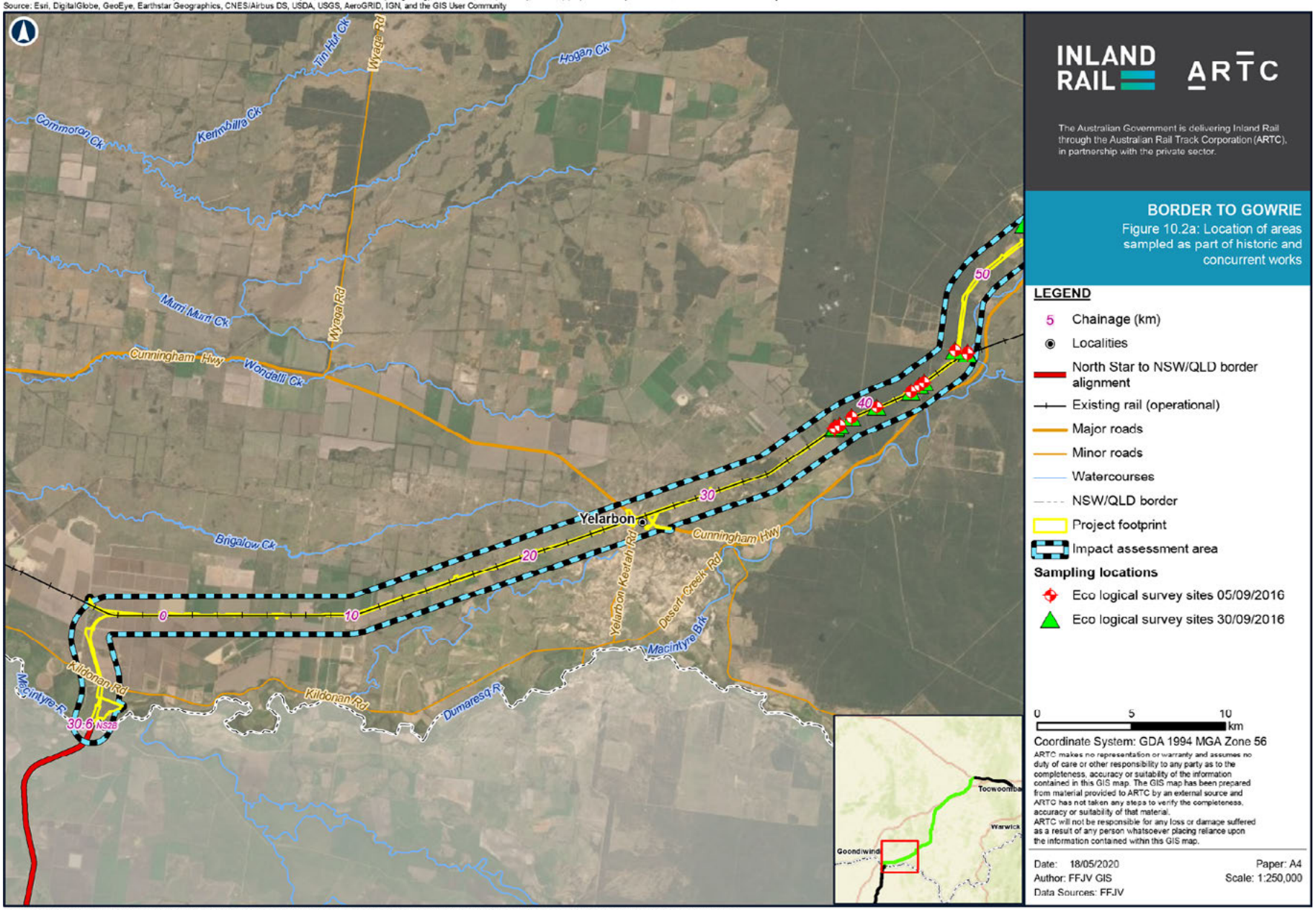
10.4.3.1 Overview

Previous assessments and reports of relevance to the region were identified, to enable an analysis of existing ecological field data associated with the impact assessment area. Previous dedicated ecological assessments and reports of relevance to the Project, including survey timing and survey activities, are listed in Table 10.3.

TABLE 10.3 PREVIOUS DEDICATED ECOLOGICAL ASSESSMENTS AND REPORTS ASSOCIATED WITH THE PROJECT

Document/investigation title	Timing of supporting surveys	Summary of significant findings related to sensitive significant environmental sensitive environmental receptors used to supplement results of the current study
Land/Multiple lots/Queensland/Inland Rail Border to Gowrie Project, QLD (EPBC referral 2018/8165) (ARTC, 2018b)	26–29 April 2016 12–15 September 2016 25–28 October 2016	Provides initial details on how the Project is likely to impact on MNES. This includes identification of the potential presence of threatened species. Identified the likely presence of the following migratory species: ▸ Confirmation of brigalow (*Acacia harpophylla* dominant and codominant) TEC ▸ Confirmation of semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions TEC ▸ South-eastern long-eared bat (*Nyctophilus corbeni*) considered potentially present based on call and location (Canning Creek)
Aurecon investigations undertaken as part of the Toowoomba Bypass (Toowoomba Second Range Crossing) Project	October 2015–June 2018	Identified the presence of the following sensitive environmental receptors to the east of the Project footprint: ▸ Collared delma (*Delma torquata*) ▸ *Thesium australe* (Austral toadflax) ▸ *Picris evae* (Hawkweed) ▸ *Rhaponticum australe* (Austral cornflower) ▸ *Picris barbarorum* (Tall hawkweed) ▸ *Digitaria porrecta* (Finger panic)
Initial Advice Statement: Inland Rail–Border to Gowrie (ARTC, 2018a)	Nil	Provides initial details on how the Project is likely to impact on MNES. This includes identification of the potential presence of threatened species and TECs.

The survey location of previous ecological investigations in relation to the Project footprint are shown in Figure 10.2. Some locations surveyed through previous ecological investigations have also been subject to targeted surveys associated with this assessment (refer Figure 10.3), thereby providing multiple datasets for the same areas.


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Wyaga Rd
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Kembilla Ck
Murri Murri Ck
Wyaga Rd
Cunningham Hwy
Wondalli Ck
Yelarbon
Brigalow Ck
Cunningham Hwy
Yelarbon Keetah Rd
Desert Creek Rd
Macintyre Brk
Kildonan Rd
Macintyre R
Kildonan Rd
Dumaresq R
30:6
NSW
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30
40
50
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BORDER TO GOWRIE
Figure 10.2a: Location of areas sampled as part of historic and concurrent works
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Sampling locations
Eco logical survey sites 05/09/2016
Eco logical survey sites 30/09/2016
Toowoomba
Warwick
Goondiwindi
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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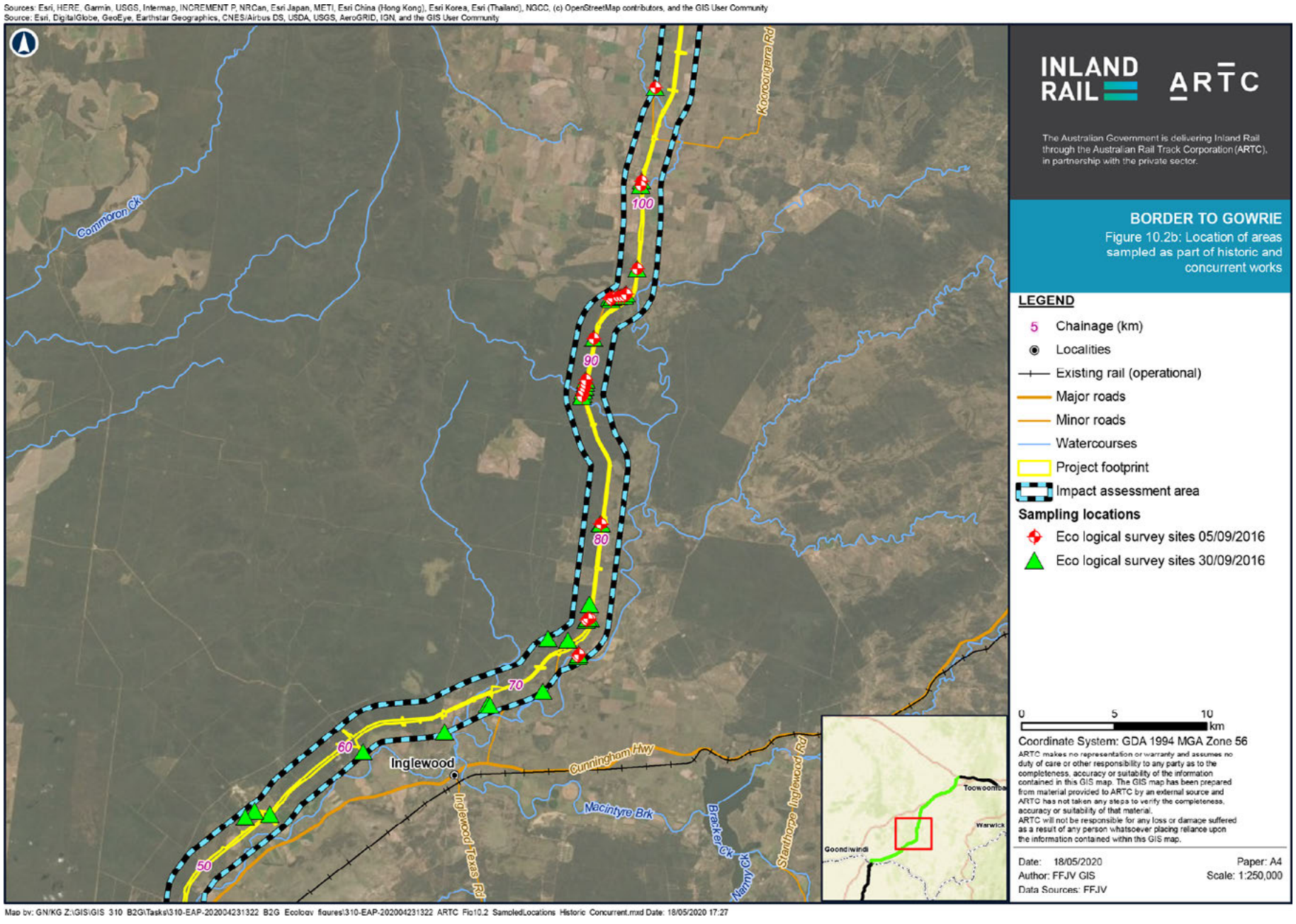
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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Koorongarra Rd
Commoron Ck
100
90
80
70
60
50
Inglewood
Cunningham Hwy
Nacintyre Brk
Inglewood Texas Rd
Brarker Ck
Nanny Ck
Stanthorpe Inglewood Rd
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.2b: Location of areas sampled as part of historic and concurrent works
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Sampling locations
Eco logical survey sites 05/09/2016
Eco logical survey sites 30/09/2016
0 5 10
km
Coordinate System: GDA 1994 MGA Zone 56
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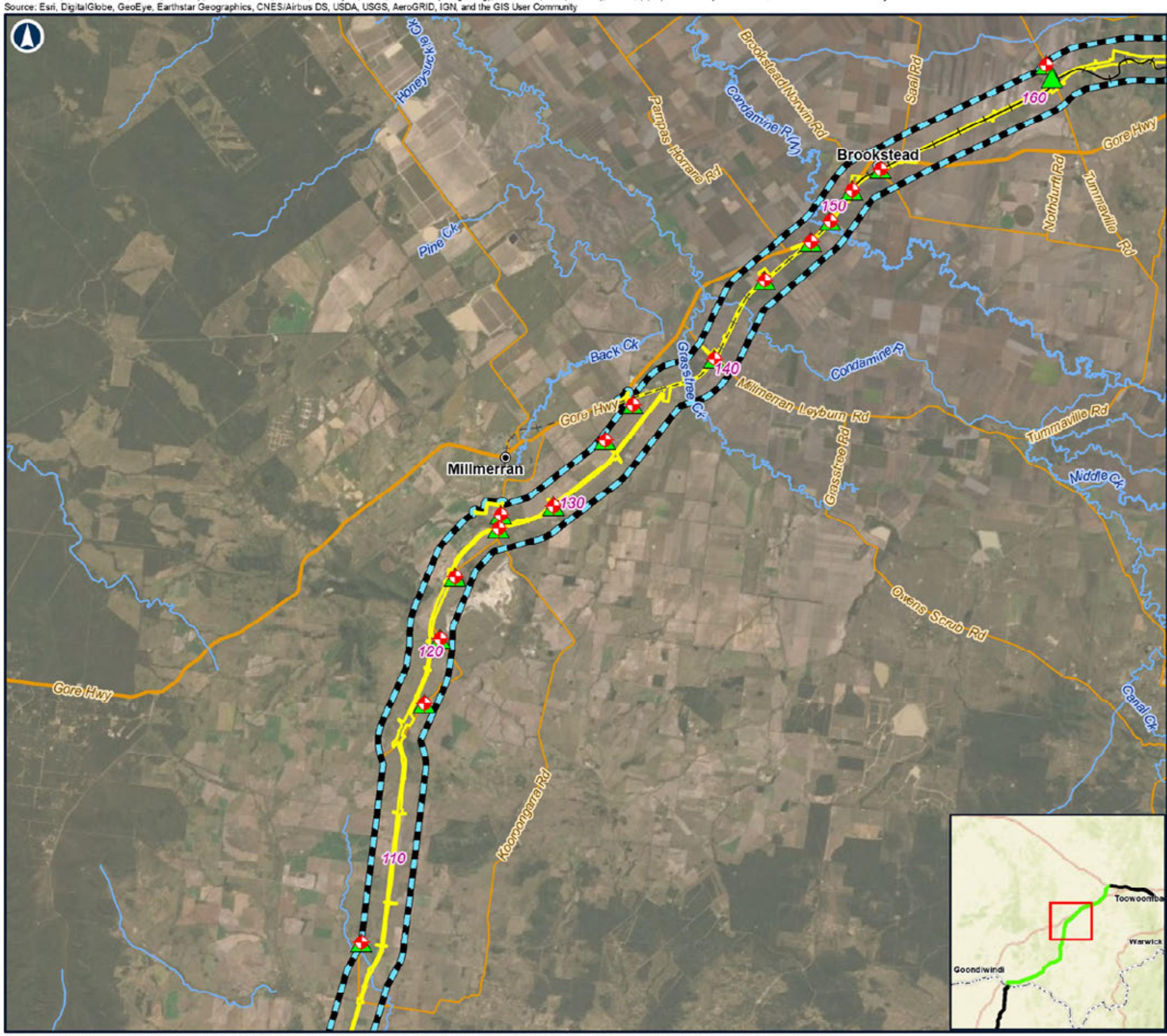

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BORDER TO GOWRIE

Figure 10.2c: Location of areas sampled as part of historic and concurrent works

LEGEND

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Project footprint
- Impact assessment area

Sampling locations

- Eco logical survey sites 05/09/2016
- Eco logical survey sites 30/09/2016

0 5 10 km

Coordinate System: GDA 1994 MGA Zone 56

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Author: FFJV GIS Scale: 1:250,000
Data Sources: FFJV

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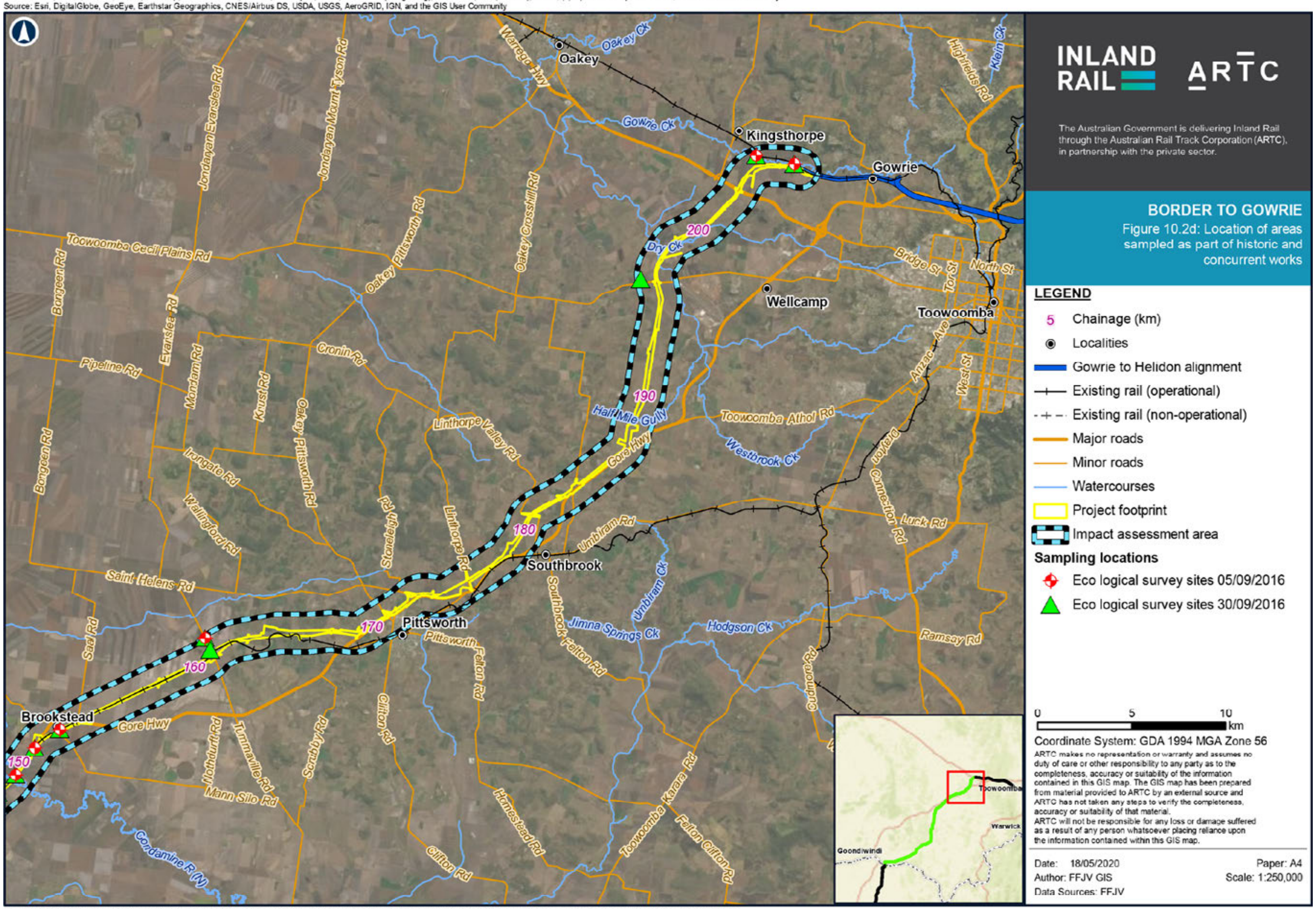

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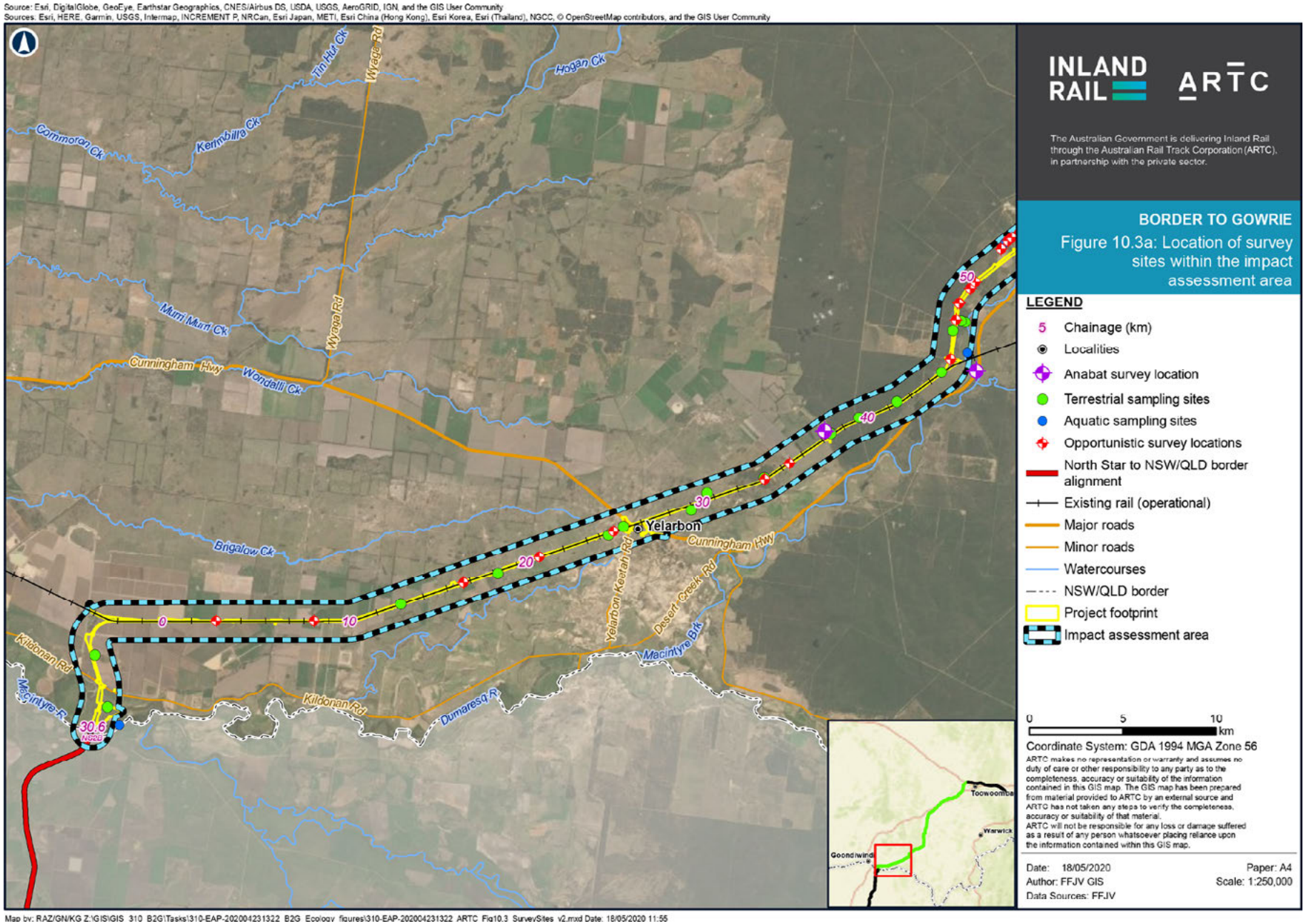
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Commoron Ck
Kembilla Ck
Murri Murri Ck
Wyaga Rd
Cunningham Hwy
Wondalli Ck
Yelarbon
Bingalow Ck
Cunningham Hwy
Yelarbon Keetah Rd
Desert Creek Rd
Macintyre Brk
Kildonan Rd
McIntyre R
Kildonan Rd
Dumaresq R
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INLAND RAIL
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BORDER TO GOWRIE
Figure 10.3a: Location of survey sites within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Anabat survey location
Terrestrial sampling sites
Aquatic sampling sites
Opportunistic survey locations
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Toowoomba
Warwick
Goondiwindi
0 5 10 km
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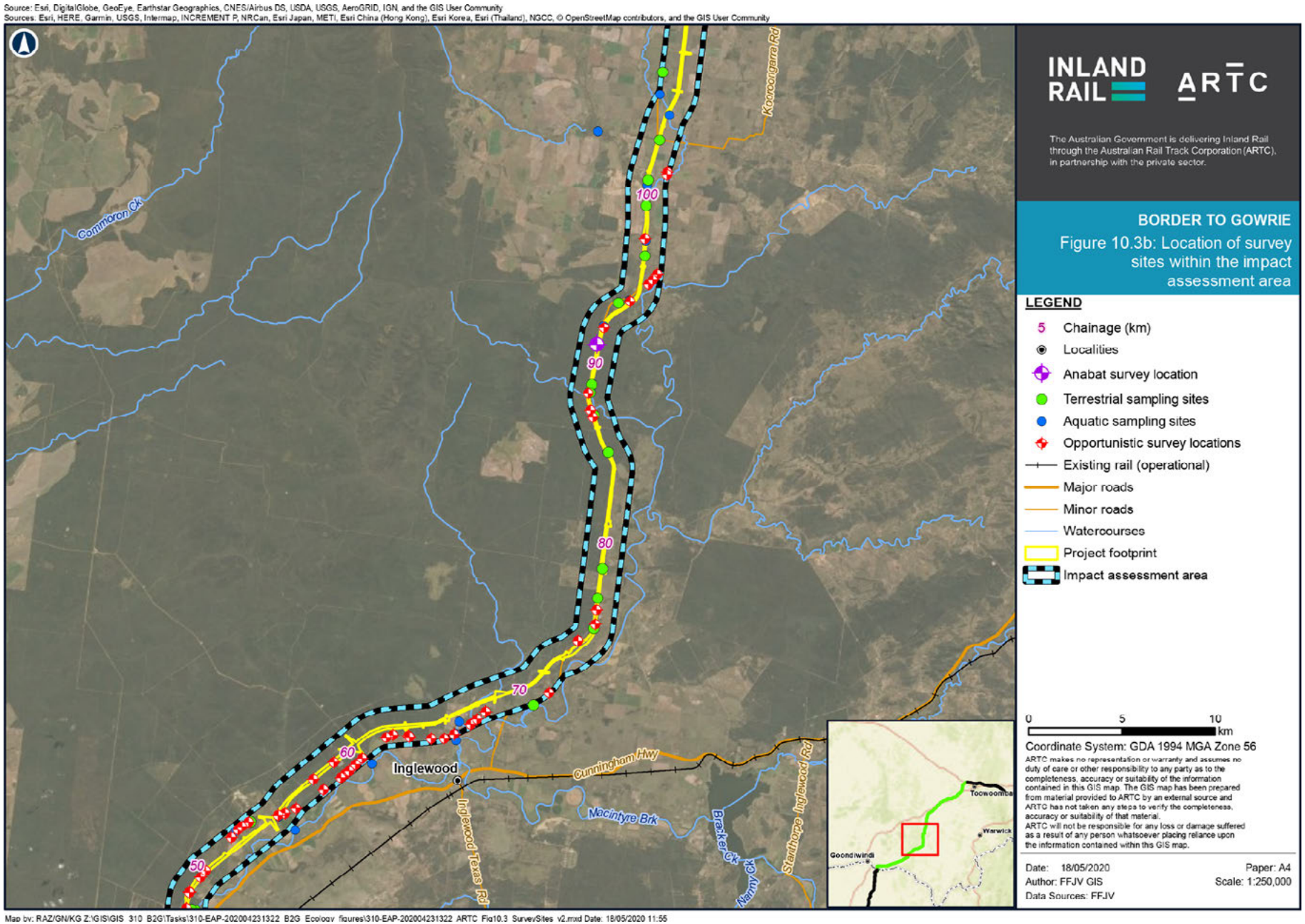
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Commoron Ck
Karoongarra Rd
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Inglewood
Cunningham Hwy
Nacintyre Brk
Inglewood Texas Rd
Brakker Ck
Nanny Ck
Stanthorpe Inglewood Rd
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
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BORDER TO GOWRIE
Figure 10.3b: Location of survey sites within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Anabat survey location
Terrestrial sampling sites
Aquatic sampling sites
Opportunistic survey locations
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
0 5 10 km
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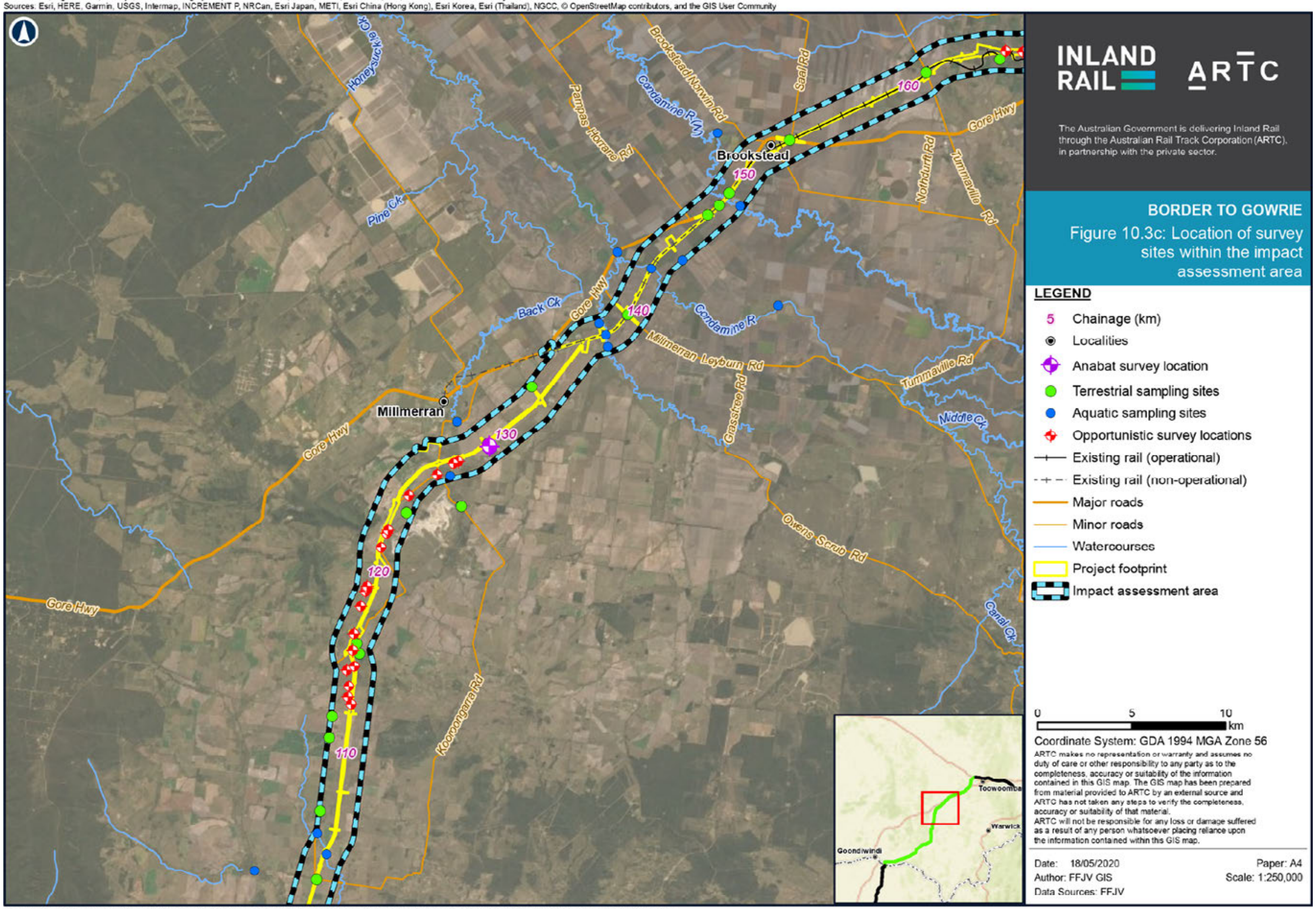

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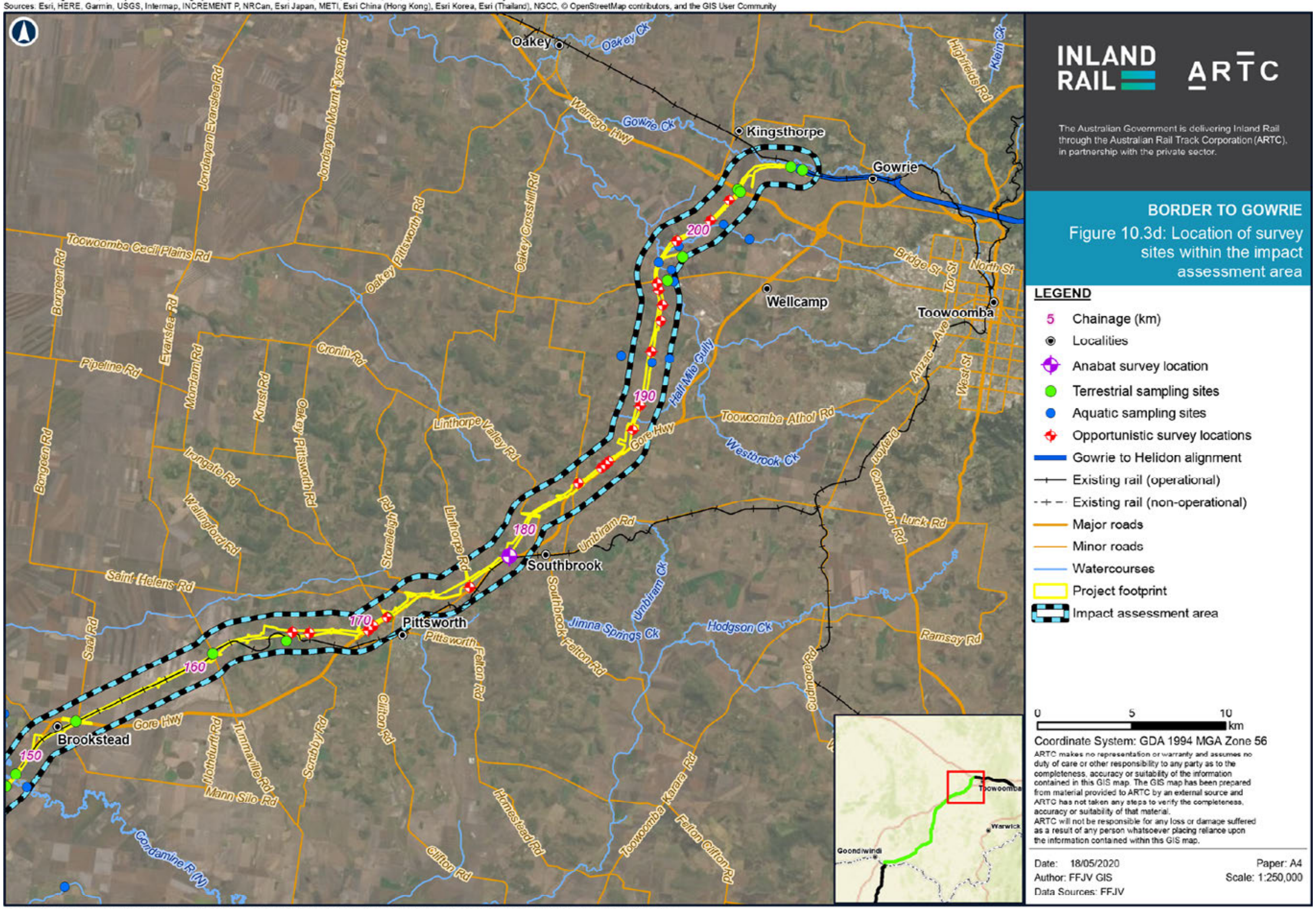

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The findings of each of the studies as outlined in Table 10.3, were incorporated into this assessment, where applicable, and were used to inform the terrestrial and aquatic ecological impact assessment in relation to sensitive environmental receptors associated with the Project. Further information related to historic surveys and the location of survey sites is provided in Appendix J: Terrestrial Ecology Technical Report, Appendix K: Aquatic Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report.

10.4.3.2 Data sources

Prior to field investigations, a desktop analysis of publicly available datasets was undertaken to identify sensitive environmental receptors potentially occurring within the impact assessment area. Details of the relevant database sources, search dates, search area parameters and type of information considered for the desktop study are summarised in Table 10.4.

TABLE 10.4 SUMMARY OF DATA SOURCES ACCESSED FOR THE ASSESSMENT

Database/data source name	Database search date	Database search areas	Data type
Atlas of Living Australia (ALA)	11/05/2020	Impact assessment area	Records of flora and vertebrate fauna, including conservation-significant species listed under the EPBC Act and/or NC Act (i.e. MNES and MSES)
Birds Australia	29/03/2019	Impact assessment area	Records of avian fauna, including threatened and migratory species listed under the EPBC Act
Biodiversity Planning Assessment (BPA) mapping (Queensland Government 21/2/2018)	14/05/2020	Impact assessment 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 modelling to identify core habitat areas).
Back on Track species prioritisation framework	11/05/2020	Condamine and the Border Rivers Maranoa–Balonne National Resource Management (NRM) regions	The Priority Back on Track species are categorised as 'critical', 'high', 'medium', or 'low' priority for the State and for the NRM regions. There is also a data deficient category according to three sets of criteria: probability of extinction, consequences of extinction and potential for successful recovery. Data is presented as a list of species.
EPBC Act Protected Matters Search Tool (PMST) (Australian Government)	26/02/2020	Impact assessment area	MNES listed under the EPBC Act, incorporating World Heritage properties, national heritage places or wetlands of international importance
MSES Wildlife Habitat Mapping (Queensland Government, 2019e)	26/02/2020	Impact assessment area	Essential habitat under the *Vegetation Management Act 1999* (Qld) (VM Act) for a conservation significant species listed under the EPBC Act and/or the NC Act (i.e. MNES and MSES)
Regulated Vegetation Management Map (State of Queensland, 2018)	26/02/2020	Impact assessment area	Mapping of REs and High Value Regrowth (HVR) that provide habitat for TECs and conservation-significant species under the EPBC Act and/or NC Act
Register of Critical Habitat (Australian Government)	26/02/2020	Australian extent	Critical habitat listed under the EPBC Act
Map of Referable Wetlands (State of Queensland, 2018)	26/02/2020	Queens	Includes State-significant, referable wetlands, important wetlands in the Great Barrier Reef catchments and wetland REs
Wildlife Online database (Queensland Government)	26/02/2020	Impact assessment area	Records of flora and vertebrate fauna, including conservation-significant species listed under the EPBC Act and/or NC Act

Database/data source name	Database search date	Database search areas	Data type
Queensland waterways for waterway barrier works (Department of Agriculture and Fisheries (DAF), 2020)	26/02/2020	Impact assessment area	Waterways where proposed waterway barrier works require assessment and approval under the Fisheries Act
Watercourse Identification Mapping (Queensland Government, 2018)	26/02/2020	Impact assessment area	Known extent of watercourses and drainage features that are managed under the Water Act
Fish Habitat Areas (State of Queensland, 2018)	26/02/2020	Impact assessment area	Boundaries of gazetted, declared fish habitat areas
Queensland Springs Database (State of Queensland, 2018)	26/02/2020	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)
Matters of State Environmental Significance (Queensland Government)	26/02/2020	Impact assessment area	Location of MSES, including: ▸ Protected areas ▸ Marine parks ▸ Management A and Management B declared fish habitat areas ▸ Threatened and SLC wildlife listed under the NC Act ▸ Regulated vegetation under the VM Act ▸ Wetlands in a wetland protection area or wetlands of high ecological significance ▸ Wetlands and watercourses in high ecological value waters ▸ Legally secured offset areas
Aquatic Biodiversity Assessment Mapping Method (AquaBAMM)/Aquatic Conservation Assessments (ACA)	22/07/2018	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

10.4.4 Predictive habitat modelling and mapping

Following review of publicly available databases and previous ecological field data/investigations, predictive habitat modelling was developed for conservation-significant flora and fauna species (i.e. threatened, near-threatened, migratory and SLC species) that had been identified as possibly occurring within the impact assessment area. Where available assumptions used to develop the models were derived from species recovery plans, Commonwealth-approved conservation advice and relevant scientific studies. The predictive habitat modelling approach was used to identify and map areas that were considered to have potential to provide habitat for conservation significant species (i.e. flora, fauna) and applies the precautionary principle (i.e. where doubt exists, habitat is included rather than excluded in addition to the inclusion of some areas of habitat that are not considered essential to the survival of the species) so as not to underestimate potential habitat for threatened species.

The adopted predictive habitat modelling approach used a range of existing publicly available Geographical Information System (GIS) datasets to create a specific habitat layer for each of the species identified as potentially occurring within the impact assessment area.

The predictive habitat modelling identified habitats for MNES species and categorised as 'potential habitat', 'important habitat' or 'habitat critical to the survival of the species'. These habitat categories are defined in Section 10.4.4.1. For species listed only under the provisions of the NC Act (i.e. MSES species), the predictive habitat modelling identified habitat as 'general habitat', 'essential habitat' or 'core habitat'. These habitat categories are defined in Section 10.4.4.2. These habitat definitions align with the significant impact assessment criteria under the EPBC Act and the NC Act, respectively.

Further information related to the specific assumptions used to model habitat for each individual species is provided in Appendix J: Terrestrial Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report.

10.4.4.1 Habitat categories for matters for national environmental significance

Potential habitat

Potential habitat consists of areas or locations used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as 'important habitat' or 'habitat critical to the survival of the species' (i.e. records of the species are considered anomalies as general microhabitat features are not considered to be present from a desktop perspective). 'Potential habitat' also includes suitable habitat that is available to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen-backed records and where it does not completely address the relevant criteria to be mapped as Habitat critical to the survival of the species. 'Potential habitat' may include areas of sub-optimal habitat for species. Impacts to Potential habitat (where no *Habitat critical to the survival of the species* occurs) are generally not considered to contribute toward significant residual impacts to an MNES.

Important habitat

In line with DAWE's guidelines, areas of 'important habitat' are regarded as a surrogate for important populations of Brigalow Belt reptiles, which are known to occur within the impact assessment area. The following species are classified as Brigalow Belt reptiles and, where relevant, 'important habitat' for these species has been mapped and defined in Section 5 of the *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (DSEWPaC, 2011d) as:

- Dunmall's snake (*Furina dunmalli*)
- Collared delma (*Delma torquata*)
- Five-clawed worm-skink (*Anomalopus mackayi*).

In addition, 'important habitat' has been identified for migratory species under the *Draft Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DotE, 2015c), where applicable.

In addition to the species identified above, the 'important habitat' category has been used to capture 'priority habitat' areas for the swift parrot (*Lathamus discolor*) as identified in the *National Recovery Plan for the Swift Parrot Lathamus discolor* (Saunders and Tzaros, 2011). Impacts to 'important habitat' are considered to contribute towards significant residual impacts to an MNES.

Habitat critical to the survival of the species

In line with DAWE's guidelines/recovery plans, as outlined in Table 10.2, 'habitat critical to the survival of the species' represents habitat with the greatest value for particular MNES species. This habitat category identifies areas that align with habitat critical to the survival of a listed threatened species, as identified in an approved recovery plan for the relevant MNES species. In instances where there are no recovery plans for a specific species, and in line with the precautionary principle in line with EPBC Act guidelines, the presence of a specimen-backed record (i.e. derived from field investigations or previous database records with low location error information and from within the last 30 years) is considered to align with this category where breeding and foraging habitat is potentially present. For these species, elevation of habitat to this level adequately accounts for the significance of such areas, regardless of the absence of a recovery plan. Impacts to 'habitat critical to the survival of the species' are considered to contribute towards significant residual impacts to an MNES.

10.4.4.2 Habitat categories for matters for State environmental significance

General habitat

'General habitat' consists of areas or locations used by transient individuals, or where species may have been recorded but where there is insufficient information to assess the area as 'essential'/'core' habitat (i.e. records of the species are considered anomalies, as general microhabitat features are not considered to be present from a desktop perspective). 'General habitat' also includes habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen-backed records. 'General habitat' may include areas of sub-optimal habitat for a species.

Essential habitat

'Essential habitat' consists of areas containing resources that are considered essential for the maintenance of populations of the species (e.g. potential habitat for breeding, roosting, foraging, shelter) or areas that have been confirmed as containing suitable habitat as identified by a specimen-backed record or indirect evidence of the species (i.e. scat, trace, track, fur/feather, distinctive vocalisation or other site-based evidence). 'Essential habitat' has been defined from known location-specific records (i.e. low location error information and from within the last 30 years) with a 1 km buffer, or site-based observation of the species during site investigations. In addition, if the 1 km buffer from the known record intersects an area identified as 'general habitat', the 'general habitat' rating has been elevated to 'essential habitat'.

Core habitat

'Core habitat' consists of habitat in which the species is known, and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Where 'essential habitat' intersects with areas identified as important within the relevant bioregion-specific BPA, these areas have been elevated to the 'core habitat' category.

10.4.5 Field methodology

10.4.5.1 Terrestrial ecology

Following development of the predictive habitat model, terrestrial ecology surveys were undertaken to validate modelled habitat and desktop-based mapping and to identify baseline conditions to inform the reference design of the Project. At each terrestrial sampling location, a vegetation survey, a fauna habitat assessment, active searches for cryptic fauna and opportunistic observations were undertaken as a minimum.

Terrestrial ecology surveys were undertaken over two separate, consecutive day periods in autumn and spring 2018, from 16 April 2018 to 22 April 2018 and from 4 September 2018 to 10 September 2018 (total duration of 14 days).

In addition to dedicated terrestrial ecology surveys, opportunistic site investigations were completed as a component of pre-clearance work for geotechnical investigations. Surveys undertaken at opportunistic survey locations were undertaken in accordance with the methodology prescribed in the *Flora Survey Guidelines—Protected Plants* (DES, 2019e).

Field-based terrestrial surveys conducted to inform the EIS approximated an area of 427 ha (i.e. 138 ha associated with targeted surveys and 289 ha associated with opportunistic investigations). This represents approximately 1 per cent of the impact assessment area and approximately 13.33 per cent of the disturbance footprint.

A representative sampling approach was employed as part of the methodology for the targeted terrestrial ecology surveys. Sampling sites were selected that were specifically identified as containing features of interest. Specifically, the following features were used to target areas:

- Areas containing a representative example of a distinct vegetation community (i.e. areas contained within mapped remnant vegetation, regrowth vegetation, and non-remnant vegetation areas)
- Areas containing landscape features that were considered likely to support conservation-significant species when viewed from aerial photography (i.e. gilgai areas, wetlands and escarpments)
- Areas known or predicted to support conservation-significant species
- Areas identified as containing or potentially containing EPBC Act listed TECs
- Waterways that may be impacted by the Project
- Areas that have not been subject to previous ecological investigations.

At each location, a census of all flora, fauna, vegetation communities and habitat features (e.g. presences of hollows, leaf litter, surface rocks, soil banks, water and wetlands, and the availability of foraging resources such as flowers and fruit) was undertaken. Surveys were undertaken with due consideration of the following:

- Australian Government published guidelines for threatened species, where applicable (refer: **environment.gov.au/epbc/policy-statements**)
- *Methodology for surveying and mapping of regional ecosystems and vegetation communities in Queensland* (Neldner et al., 2012)
- *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2018)
- *Flora Survey Guidelines—Protected Plants* (DES, 2019e).

Detailed onsite surveys for threatened fauna have not necessarily been carried out as per the relevant Australian Government survey guidelines for each species. For example, there are no Australian Government guidelines regarding threatened flora and surveys for protected flora have been carried out following State guidelines (e.g. DES, 2019e). Nevertheless, a range of various ecological survey methods have been carried out over a number of years and seasons. In combination with the conservative predictive habitat modelling developed for the Project, these survey methods are considered appropriate for detecting the potential presence of MNES and MSES along a 216.2 km Project alignment. More importantly, the surveys have provided information regarding assessment of the habitat values occurring along the Project alignment and its ability to potentially support MNES and MSES species.

Areas sampled as part of the targeted terrestrial ecology surveys are shown in Figure 10.3. Where field analysis identified sensitive environmental receptors or deviations from the predictive habitat modelling, this information was used to refine the relevant species-specific habitat model to increase the accuracy and precision of the data, for use in subsequent impact assessment analysis.

Further details related to the field assessment methodologies is provided in Appendix J: Terrestrial Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report.

10.4.5.2 Aquatic ecology

A schedule of field activities was developed to identify MNES, MSES and MLES associated with the aquatic environment. The focus of aquatic ecology assessments was to assess a representative number of sites along the Project alignment, with emphasis on aquatic habitat values at risk of disturbance.

Aquatic ecology surveys were undertaken in combination with surface water sampling, which occurred over the following five survey periods:

- 11 to 20 June 2018 (surface water and aquatic habitat assessment, including opportunistic fish survey)
- 26 November to 3 December 2018 (surface water and aquatic ecology survey, including aquatic habitat assessment, macroinvertebrate and fish sampling)
- 11 to 19 February 2019 (surface water only)
- 29 April to 2 May 2019 (surface water only)
- 15 to 19 May 2019 (surface water and aquatic ecology survey, including macroinvertebrate and fish sampling. Aquatic habitat assessments were not undertaken).

The two aquatic ecology surveys, including macroinvertebrate and fish sampling, were scheduled to be consistent with the *Queensland Australian River Assessment System (AusRivAS) Sampling and Processing Manual* (Department of Natural Resources and Mines (DNRM), 2001), which specifies that the preferred timing of surveys is May to July (referred to as the 'late wet') and October to December (referred to as the 'early wet'). Rainfall patterns across the Darling Downs are aligned with this survey timing, with highest rainfall generally occurring in the region between the months of October and March (Bureau of Meteorology (BoM), 2018a). A delay between sampling and large rainfall events of at least four weeks is desirable, to allow macroinvertebrate communities to develop sufficiently, following the disturbance associated with flood events (DNRM, 2001).

A total of 34 sample sites were identified for the survey. These 34 sites consisted of 12 sites where aquatic ecology and surface water quality assessments were conducted and 22 sites where surface water quality assessments were conducted (refer Figure 10.3).

Aquatic habitats were assessed at each aquatic ecology site in accordance with the AusRivAS physical habitat assessment protocol (Parsons et al., 2002). The information collected was used to inform an assessment of the suitability of aquatic habitats for key species of interest, such as the Murray cod, silver perch and Bell's turtle. To rank physical habitat according to overall condition (e.g. excellent, good, fair or poor), nine physical features were assessed:

- Bottom substrate/available cover
- Embeddedness
- Velocity/depth category
- Channel alteration
- Bottom scouring and deposition
- Pool/riffle, run/bend ratio
- Bank stability
- Bank vegetative stability
- Streamside cover.

General site observations and photographs of aquatic habitats were also recorded.

The numerical outputs of this assessment were used to inform the overall rating. The greater the numerical score, the greater the ecological integrity of the system.

Macroinvertebrate sampling was undertaken in November 2018 and May 2019. Macroinvertebrate samples were collected in accordance with the *Queensland AusRivAS Sampling and Processing Manual* (DNRM, 2001).

Freshwater macroinvertebrate sampling was undertaken to gain an improved understanding of the aquatic values, watercourse health and trophic interactions occurring at each site. Samples were collected from aquatic ecology survey sites that exhibited wetted habitat at the time of assessment.

Sampling was overseen by an AusRivAS accredited ecologist following AusRivAS protocols for Queensland streams (DNRM, 2001). Samples were identified to AusRivAS taxonomic level in the laboratory under stereomicroscope. AusRivAS taxonomic identification was primarily to 'family' level, with the exception of lower phyla. Taxonomic richness of macroinvertebrates was calculated from the number of taxa present in each sample, providing an indication of community diversity at the site, with richness typically increasing with ecological condition.

For the June 2018 field trip, a limited fish survey was implemented, involving the deployment of baited box traps and dip-netting, targeting small fish at sites containing water. At each site, up to seven baited box traps were deployed for approximately one hour, followed by dip-netting watercourse edge habitats for a period of approximately 10 minutes with an Environet®.

For subsequent field trips, in December 2018 and May 2019, the scope of works was expanded, and a range of additional survey techniques were applied to assess suitable fish assemblages at aquatic ecology sites. Targeted fish survey methods were selected from the *Survey guidelines for Australia's threatened fish: Guidelines for detecting fish listed as threatened under the EPBC Act* (DSEWPaC, 2011b) and included backpack electrofishing (where water depth was <0.5 m), seine netting (2 to 5 mm mesh) and use of fyke nets. The survey methods were adapted to suit the local conditions of the watercourse, with the primary considerations being the depth of water and presence of woody debris that may foul nets.

Fish were identified to species level, with the number of each species captured, and size range for each species recorded. After processing, native fish were returned to the water and pest species were euthanised by lethal dose of AQUI-S solution, followed by pithing or exsanguination to confirm death, in accordance with Animal Ethics Committee approval.

Further details related to the field assessment methodologies is provided in Appendix K: Aquatic Ecology Technical Report.

10.4.6 Impact assessment

For the purpose of impact assessment, terrestrial and aquatic ecology, sensitive environmental receptors were assessed both quantitatively and qualitatively. A significant impact depends on the level of sensitivity of a sensitive environmental receptor, the quality of the impacted environment and the magnitude of the potential impacts. Determination of the sensitivity, or vulnerability, of the sensitive environmental receptor and the magnitude of the potential impacts facilitate the assessment of the significance of potential ecological impacts.

Magnitude of impact for each sensitive environmental receptor was classified as follows:

- **Negligible**: less than 1 per cent of the habitat within the impact assessment area disturbed
- **Low**: between 1–2 per cent of the habitat within the impact assessment area disturbed
- **Moderate**: between 2–13 per cent of the habitat within the impact assessment area disturbed
- **High**: between 13–50 per cent of the habitat within the impact assessment area disturbed
- **Major**: greater than 50 per cent of the habitat within the impact assessment area disturbed.

The magnitude of potential ecological impacts for the Project are quantified and categorised in Section 10.11.1.

The use of predictive habitat models facilitated the quantification of potential ecological impacts of the Project, without the implementation of mitigation measures. Reassessment of impacts accounting for the implementation of mitigation measures allowed for instances to be identified where potentially significant residual impacts to sensitive environmental receptors may occur.

Where potentially significant residual impacts were identified, these sensitive environmental receptors were subject to significant impact assessment using the relevant significant impact guidelines to inform potential offset requirements.

For MNES, the significant impact criteria are outlined in the following guidelines:

- *Significant impact guidelines 1.1—Matters of National Environmental Significance* (DotE, 2013b)
- *EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)* (DotE, 2014)
- *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (DotE, 2015c).

The significant residual impact assessment for MNES is documented in Section 10.12.1 for threatened species and communities and in Section 10.12.2 for non-threatened migratory species.

For MSES, the significant impact criteria is outlined in the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (DEHP, 2014a). The significant residual impact assessment for MSES is documented in Section 10.12.3.

For further details, refer Appendix J: Terrestrial Ecology Technical Report, Appendix K: Aquatic Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical report.

10.4.7 Precautionary principle

The assessment methodology incorporates the precautionary principle, which 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.

Ecological assessments have responded to this requirement 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 potential area of disturbance

- Lack of full scientific certainty has not been used as a reason for postponing measures to prevent environmental damage. For example, threatened species that could potentially occur, but were not observed within the impact assessment area during field surveys, are still assumed present (rather than absent). Measures to avoid and/or mitigate impacts on threatened species are proposed, on the basis that these threatened species could be present within the impact assessment area.
- The detail design will be developed 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 reduced to as low as reasonably practicable and that significant residual impacts are offset.
- During development of the Project, the alignment has been refined to avoid sensitive vegetation, areas with known threatened flora and fauna communities, and key habitat areas.

Impacts on biological diversity and ecological integrity have been avoided to the greatest extent possible. For example, surveys were conducted to verify the presence of threatened species and ecological communities within the impact assessment area. The results were used to inform the development of the reference design and location of opportunities for fauna crossings, fauna exclusion fencing, and landscaping, revegetation and rehabilitation works.

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

- A crossing structure hierarchy was adopted during design development. Preference was given to bridges over culverts as, on the whole, bridges result in less severe impacts to fauna passage.
- Fauna crossing opportunities for species such as Koala, Condamine earless dragon and Greater glider have been co-located with waterway crossing structures to maintain habitat connectivity across the rail corridor. Where possible, these align with regional, state and locally significant fauna movement corridors or areas of important fauna habitat.
- Consideration was given to achieving compliance with the DAF *Accepted development requirements for operational work that is constructing or raising waterway barrier works* when designing bridges and culverts across mapped QLD Waterways for waterway barriers works (DAF, 2018e).
- A Rehabilitation and Landscaping Management Sub-plan will be developed to guide the approach to rehabilitating disturbed areas. Rehabilitation will occur progressively throughout the construction phase.
- Other plans that will be developed to minimise potential impacts on biodiversity during the construction phase include a Biodiversity Management Sub-plan, Biosecurity Management Sub-plan and a Soil Management Sub-plan as components of the CEMP.

Where impacts cannot be avoided (e.g. clearing of remnant vegetation or habitat for a threatened species), mitigation and management measures will be implemented. Where required, biodiversity offsets will be secured. ARTC's Environmental Offset Delivery Strategy – Qld (Appendix N: Draft Offset Strategy) for the Project has been prepared in consultation with the QLD and Australian Governments and will inform the delivery of offsets in relation to significant residual impact upon environmental matters.

10.5 Existing environment

10.5.1 Regional and local context

The impact assessment area is located within the Brigalow Belt South bioregion. From west to east, the Project is located within the Commoron Creek Floodout subregion (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 areas (State forests), as roadside vegetation, or as relatively small isolated remnants (refer Photograph 10.1 and Photograph 10.2).

PHOTOGRAPH 10.1 EXAMPLE OF MATURE TREES RETAINED WITHIN A ROAD RESERVE, SURROUNDED BY ANTHROPOGENIC DISTURBANCE WITHIN THE MILLMERRAN REGION

Source: FFJV, 2018

PHOTOGRAPH 10.2 EXAMPLE OF MATURE TREES RETAINED WITHIN A ROAD RESERVE, SURROUNDED BY ANTHROPOGENIC DISTURBANCE SOUTH OF TOOWOOMBA

Source: FFJV, 2018

The impact assessment area commences at the NSW/QLD border, the median line of the Macintyre River, approximately 18 km to the south-east of Goondiwindi, near Kurumbul. The impact assessment area then extends for approximately 216 km in a north–northeast direction, where it finishes between Leeson Road and Draper Road, on the south–eastern outskirts of Kingsthorpe (north of Toowoomba).

The impact assessment area includes extensive areas of agricultural land and State forest. Project footprint has been subject to historical disturbance/clearing and one third of its length is located within brownfield (areas already subject to development). The remaining greenfield portions of the Project footprint extend largely through areas subject to agricultural land uses (refer Photograph 10.3, Photograph 10.4, Photograph 10.5 and Photograph 10.6) and are highly fragmented in nature.

PHOTOGRAPH 10.3 PORTION OF THE PROJECT FOOTPRINT ON THE CONDAMINE FLOODPLAIN

Source: FFJV, 2019

PHOTOGRAPH 10.4 PROJECT FOOTPRINT NORTH OF THE CONDAMINE FLOODPLAIN

Source: FFJV, 2019

In the southern extent of the impact assessment area, 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 extensive Condamine River floodplain (refer Photograph 10.5 and Photograph 10.6). 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.

Within the impact assessment area, the majority of lands are highly modified, having been cleared for pasture, agricultural production (refer Photograph 10.6) and for rural, urban residential settlements. Toowoomba Wellcamp Airport and Charlton will be subject to future infrastructure and industrial development. Agricultural activities are particularly prominent within the low-lying fertile floodplains associated with the Dumaresq River, Macintyre River, Macintyre Brook and Condamine River, which are renowned for their fertile soils and productive agricultural landscapes. Tracts of remnant vegetation are also 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 forest reserves.

PHOTOGRAPH 10.5 CABBAGE TREE CREEK ON THE CONDAMINE RIVER FLOODPLAIN, SHOWING THE NARROW BAND OF MATURE VEGETATION

Source: FFJV, 2019

PHOTOGRAPH 10.6 FERTILE SOILS OF THE CONDAMINE FLOODPLAIN ARE USED EXTENSIVELY FOR CROPPING

Source: FFJV, 2019

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

- Bringalily State Forest (35,695 ha)
- Whetstone State Forest (41,282 ha).

These areas are dominated by eucalypt woodlands on sandy plains or shallow soils in areas of higher elevation. They are noted for a high diversity of terrestrial fauna including threatened species such as Dunmall's snake (*Furina dunmalli*), greater glider (*Petauroides volans*) and spotted-tail quoll (*Dasyurus maculatus maculatus*) (DES, 2018a).

There are a further five State Forests within the vicinity of the impact assessment area and are not intersected by the Project:

- 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.

One conservation park, the Irongate Conservation Park (29 ha), and the Mount Basalt Environmental Park are also located in the impact assessment area.

The impact assessment area 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, 2018b). The main rivers of the catchment, the Condamine and the Maranoa, rise in elevated country in Queensland; however, two-thirds of the catchment is flat floodplain country 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, 2018b). The 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, 2018b).

The Border Rivers catchment is one of the northern-most catchments in the Murray Darling Basin (Murray–Darling Basin Authority, 2018a). It 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, 2018a). 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, 2018a).

There are no World Heritage areas, National Heritage areas, Ramsar Wetlands, Australian Government marine areas or Great Barrier Reef Marine Park areas located within or near the impact assessment area; therefore, these MNES are not discussed further in this document.

10.5.2 Environmental values of Whetstone and Bringalily State forests

Bringalily State Forest covers an area of approximately 35,695 ha and is located to the north of Inglewood. Bringalily State Forest is located approximately 350 km to the west of Brisbane. Approximately 101.73 ha of Bringalily State Forest is contained within the Project impact area. Whetstone State Forest covers an area of approximately 41,282 ha and is located to the west of Inglewood and Bringalily State Forest, and to the north of Yelarbon. Approximately 22.99 ha of Whetstone State Forest is contained within the Project impact area.

Bringalily State Forest and Whetstone State Forest contain open eucalypt woodlands on either shallow soil (in areas of higher elevation) or sandy plains dominate in areas of higher elevation. Diversity of terrestrial vertebrate taxa is very high with approximately 350 species recorded within the area. Among the threatened taxa known are Dunmall's snake (*Furina dunmalli*), Major Mitchell's cockatoo (*Lophochroa leadbeateri*), Regent honeyeater (*Anthochaera phrygia*), Painted honeyeater (*Grantiella picta*), Spotted-tailed quoll (*Dasyurus maculatus*) and Greater glider (*Petauroides volans*). State-listed Priority taxa, under the BPA, include both endemics such as Brigalow scaly foot (*Paradelma orientalis*), and declining taxa, e.g. Brown tree-creeper (*Climacteris picumnus*), Speckled warbler (*Chthonicola sagittate*) and hooded robin (*Melanodryas cucullata*). Bringalily State Forest also forms part of the Herries Range Terrestrial Corridor, which provides an east-west linkage between the major eastern escarpment corridor in the New England Tableland bioregion through to the Wondul Range National Park (DES, 2019f). Potential impacts to environmental values contained within Whetstone and Bringalily State forests are described in Section 10.5.6)

10.5.3 Flora and ecological communities

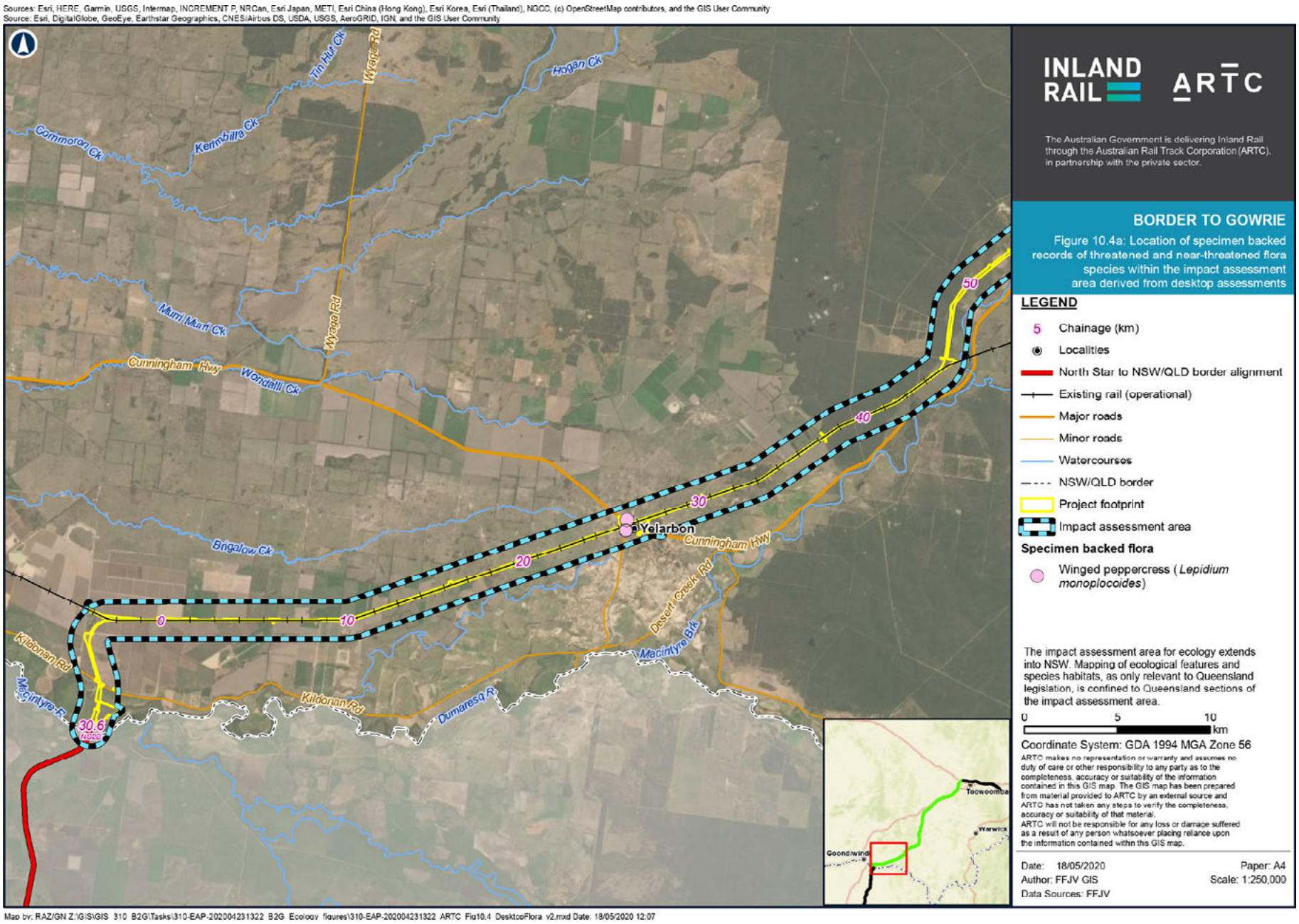
A total of 34 threatened or near-threatened flora species, as listed under the EPBC Act and/or the NC Act, are predicted to occur within the impact assessment area. The location of threatened or near-threatened flora species was derived from specimen-backed records (e.g. Herbarium specimen data (Herbrecs) and Atlas of Living Australia) within the impact assessment area and is provided in Figure 10.4.

A total of 404 terrestrial plant species were identified within the impact assessment area during field surveys, including 283 (70 per cent) native species and 121 non-native species (30 per cent).

Non-native species were typically more abundant and diverse in areas of high anthropogenic disturbance when compared to those characterised by an intact canopy of native species, such as those identified as remnant vegetation/intact bushland; however, encroachment of non-native species, particularly those spread by birds (e.g. *Lantana camara* and *Lantana montevidensis*) was evident in relatively undisturbed areas. These species, in particular, have the potential to outcompete, replace and exclude native flora species within such environments.

The majority of aquatic flora species encountered during the field surveys were common emergent species such as aquatic (or semi-aquatic) grasses, sedges and rushes. Fourteen species of aquatic flora were detected from these surveys. 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 impact assessment area is available in Appendix J: Terrestrial Ecology Technical Report and Appendix K: Aquatic Ecology Technical Report.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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Tim Hut Ck
Wyaga Rd
Hogan Ck
Commoron Ck
Kembrilla Ck
Murri Murri Ck
Wyaga Rd
Cunningham Hwy
Wondalli Ck
Bingalow Ck
Yelarbon
Cunningham Hwy
Desert Creek Rd
Macintyre Brk
Kildonan Rd
Macintyre R
Kildonan Rd
Dumaresq R
30.6
NSW
0
10
20
30
40
50
Toowoomba
Warwick
Goondiwindi
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BORDER TO GOWRIE
Figure 10.4a: Location of specimen backed records of threatened and near-threatened flora species within the impact assessment area derived from desktop assessments
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Specimen backed flora
Winged peppercress (Lepidium monoplocoides)
The impact assessment area for ecology extends into NSW. Mapping of ecological features and species habitats, as only relevant to Queensland legislation, is confined to Queensland sections of the impact assessment area.
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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Author: FFJV GIS
Scale: 1:250,000
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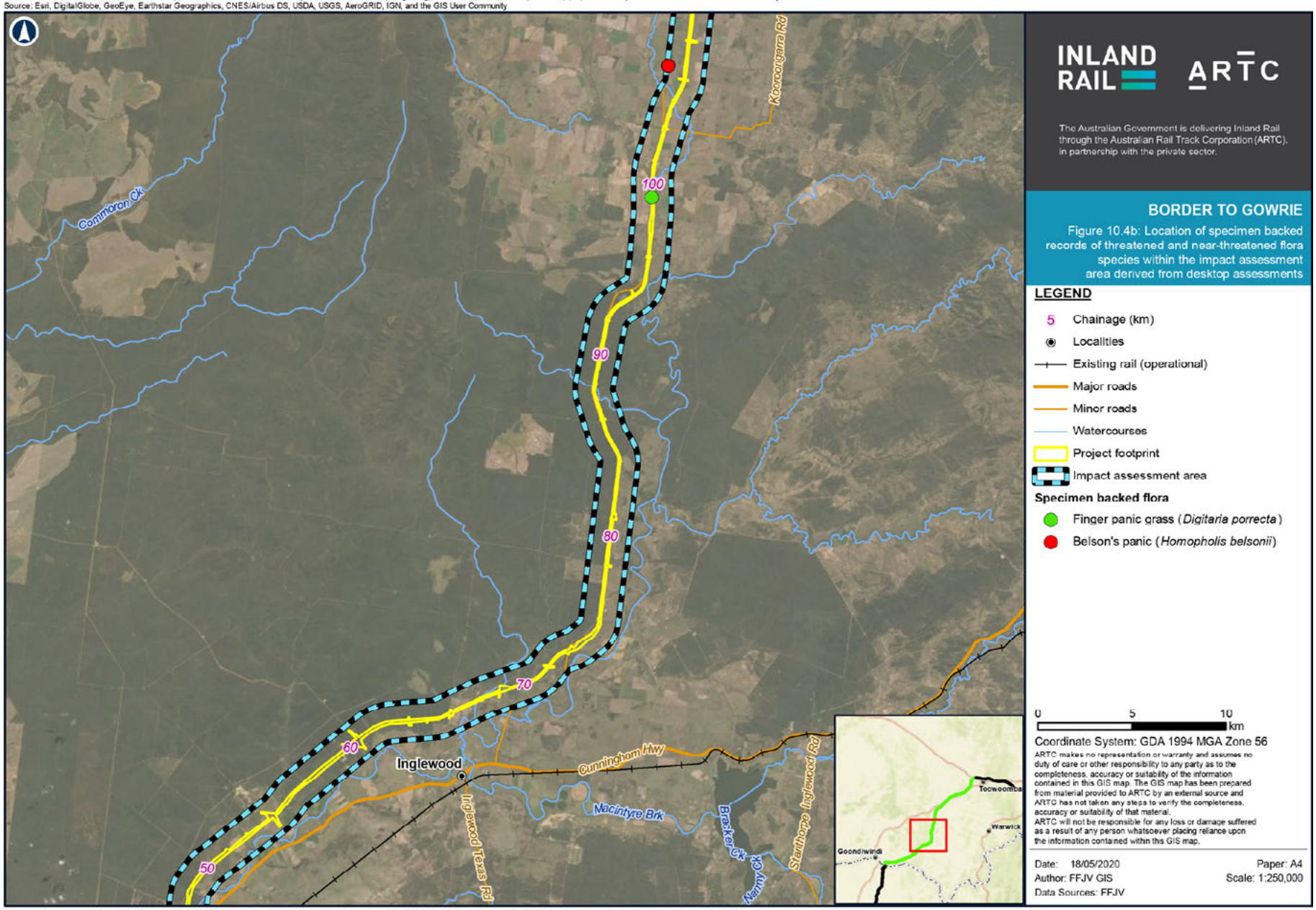
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Commoron Ck
Koorongarra Rd
100
90
80
70
60
50
Inglewood
Cunningham Hwy
Inglewood Texas Rd
Macintyre Brk
Brakers Ck
Nemy Ck
Stanthorpe Inglewood Rd
Toowoomba
Warwick
Goondiwindi
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Figure 10.4b: Location of specimen backed records of threatened and near-threatened flora species within the impact assessment area derived from desktop assessments
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Specimen backed flora
Finger panic grass (Digitaria porrecta)
Belson's panic (Homopholis belsonii)
0 5 10
km
Coordinate System: GDA 1994 MGA Zone 56
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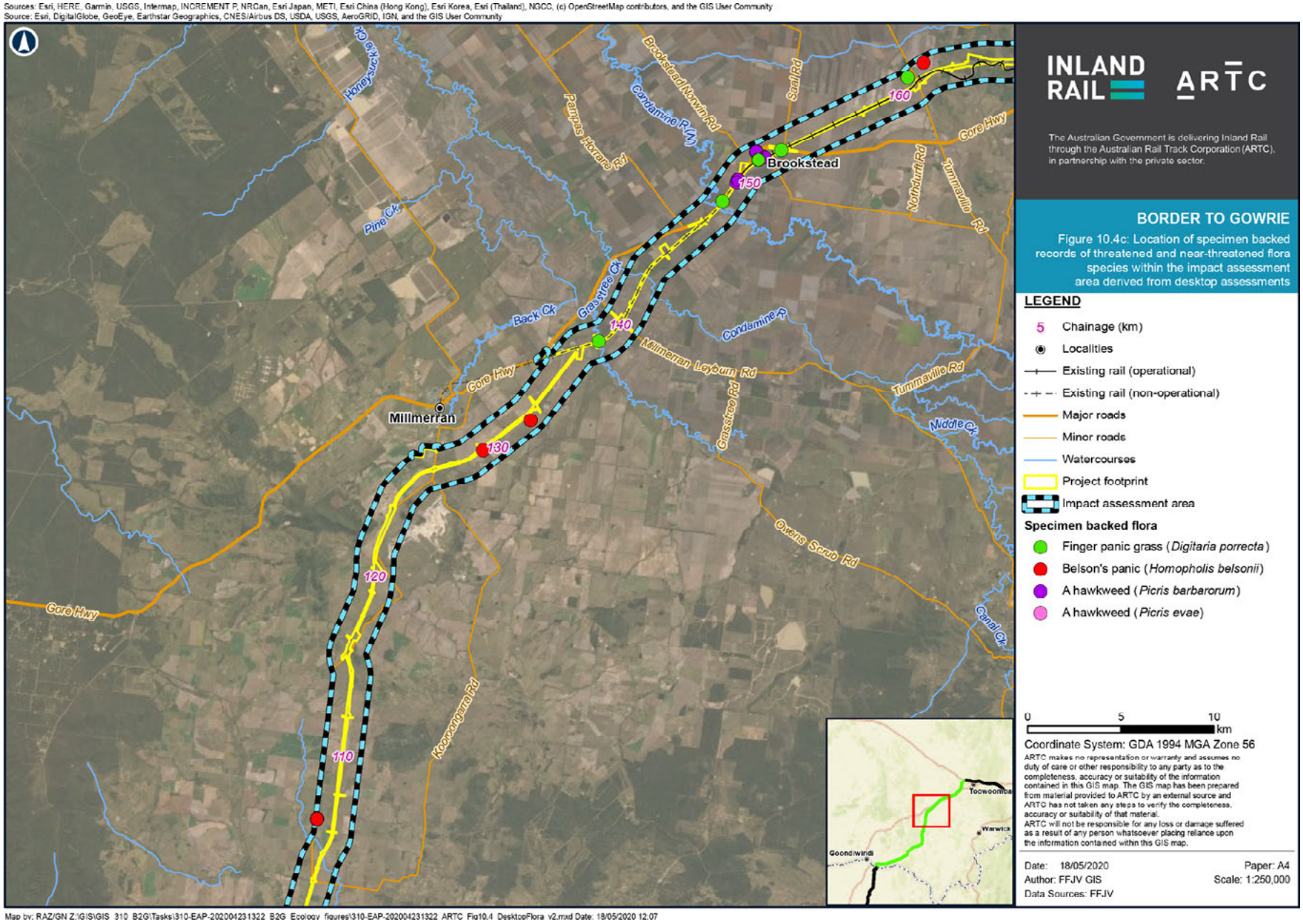
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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Figure 10.4c: Location of specimen backed records of threatened and near-threatened flora species within the impact assessment area derived from desktop assessments
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Existing rail (non-operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Specimen backed flora
Finger panic grass (Digitaria porrecta)
Belson's panic (Homopholis belsonii)
A hawkweed (Picris barbarorum)
A hawkweed (Picris evae)
Brookstead
Millmerran
Goondiwindi
Toowoomba
Warwick
Gore Hwy
Honeysuckle Ck
Brookstead Norwin Rd
Condamine R (N)
Saall Rd
Pampas Horrane Rd
Pine Ck
Northburn Rd
Tummaville Rd
Back Ck
Grassfree Ck
Condamine R
Millmerran Leyburn Rd
Middle Ck
Owens Scrub Rd
Canal Ck
Koopongarra Rd
160
150
140
130
120
110
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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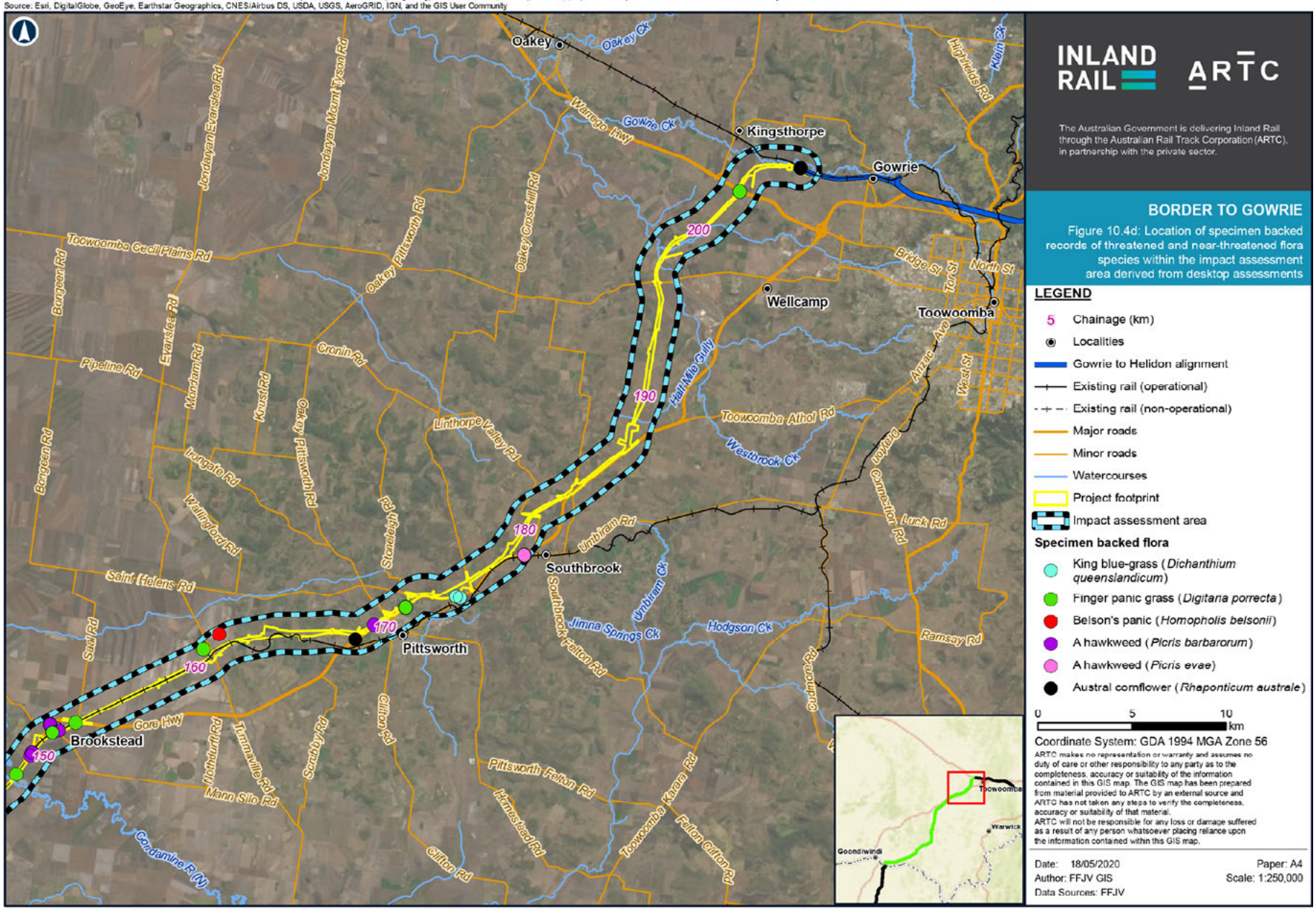
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Oakey
Kingsthorpe
Gowrie
Wellcamp
Toowoomba
Southbrook
Pittsworth
Brookstead
200
190
180
170
150
150
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BORDER TO GOWRIE
Figure 10.4d: Location of specimen backed records of threatened and near-threatened flora species within the impact assessment area derived from desktop assessments
LEGEND
Chainage (km)
Localities
Gowrie to Helidon alignment
Existing rail (operational)
Existing rail (non-operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Specimen backed flora
King blue-grass (Dichanthium queenslandicum)
Finger panic grass (Digitaria porrecta)
Belson's panic (Homopholis belsonii)
A hawkweed (Picris barbarorum)
A hawkweed (Picris evae)
Austral cornflower (Rhaponticum australe)
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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10.5.3.1 Conservation significant flora

Multiple specimens of three threatened flora species listed under the provisions of the NC Act and/or EPBC Act, were recorded within the impact assessment area (refer Table 10.5). These species consisted of *Homopholis belsonii* (Belson's panic) (refer Photograph 10.7 and Photograph 10.8), *Digitaria porrecta* (finger panic) (refer Photograph 10.9) and *Picris barbarorum* (tall hawkweed) (refer Photograph 10.10). The location of these species within the impact assessment area is provided in Figure 10.5.

In addition, eight SLC flora species were observed as relatively common throughout the impact assessment area (refer Table 10.5).

TABLE 10.5 CONSERVATION SIGNIFICANT AND SPECIAL LEAST CONCERN FLORA SPECIES OBSERVED WITHIN THE IMPACT ASSESSMENT AREA

Family	Species name	Common name	NC Act status	EPBC Act status
Acanthaceae	*Brunoniella australis*	Blue trumpet	SLC	-
Amaryllidaceae	*Crinum arenarium*	Crinum lily	SLC	-
Asteraceae	*Picris barbarorum*	Tall hawkweed	V	-
Campanulaceae	*Wahlenbergia communis*	Tufted bluebell	SLC	-
Campanulaceae	*Wahlenbergia gracilis*	Sprawling bluebell	SLC	-
Campanulaceae	*Wahlenbergia stricta*	Bluebell	SLC	-
Orchidaceae	*Caladenia carnea*	Pink fingers	SLC	-
Orchidaceae	*Cymbidium canaliculatum*	Black orchid	SLC	-
Poaceae	*Digitaria porrecta*	Finger panic	NT	-
Poaceae	*Homopholis belsonii*	Belson's panic	V	V
Xanthorrhoeaceae	*Xanthorrhoea johnsonii*	Grass tree	SLC	-

Table notes:
- = Species not listed E = Endangered NT = Near threatened SLC = Special least concern V = Vulnerable

Field investigations also confirmed the presence of habitat, including:

- *Acacia lauta* (Tara wattle)—woodlands in the Whetstone State Forest area
- *Androcalva procumbens*—woodlands in the Whetstone State Forest area
- *Dichanthium queenslandicum* (King blue-grass)—black clay soils on the Condamine River floodplain
- *Eucalyptus virens* (Shiny-leaved ironbark)—woodlands in the Whetstone State Forest area
- *Picris evae* (Hawkweed)—dark clay soils in the Millmerran area and north of Bringalily State Forest
- *Rhaponticum austral* (Austral cornflower)—dark clay soils in the Millmerran area, north of Bringalily State Forest and west of Toowoomba
- *Xerothamnella herbacea*—largely associated with brigalow habitat in the south of the impact assessment area (to the south of Millmerran)
- Belson's panic (*Homopholis belsonii*)—potential habitat available in disturbed areas (e.g. road reserves) where they coincide with the occurrence of brigalow and poplar box trees, particularly south of the Condamine River floodplain
- *Digitaria porrecta* (Finger panic)—potential habitat available in disturbed areas (e.g. road reserves where they coincide with basalt derived soils (e.g. black soils), particularly within the Condamine River floodplain and Toowoomba areas
- *Picris barbarorum* (Tall hawkweed)—potential habitat available in disturbed areas (e.g. road reserves) where they coincide with basalt derived soils (e.g. black soils), particularly within the Condamine Rive floodplain and Toowoomba areas.

The availability of habitat types and their relevance to conservation significant flora is discussed further in Section 10.5.8.

This information was used, in addition to that contained within relevant recovery plans and conservation listing advice, to inform the predictive habitat modelling and mapping for each of the threatened flora species (refer Appendix J: Terrestrial Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report).

PHOTOGRAPH 10.7 BELSON'S PANIC RECORDED DURING PROJECT SURVEYS—MILLMERRAN AREA

Source: FFJV, 2018

PHOTOGRAPH 10.8 ROAD RESERVE HABITAT OF BELSON'S PANIC—MILLMERRAN AREA

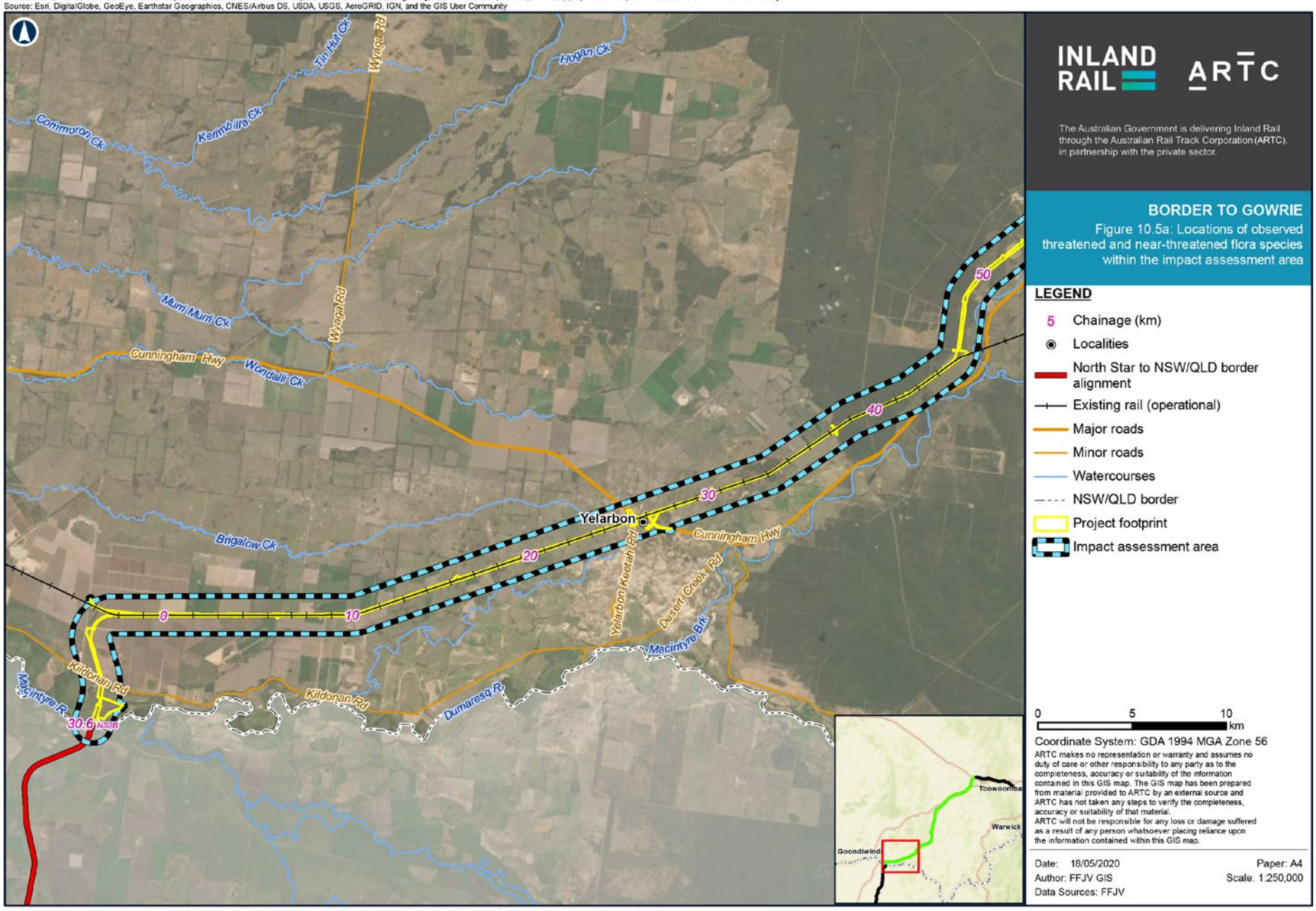
Source: FFJV, 2018

PHOTOGRAPH 10.9 FINGER PANIC GROWING IN HIGHLY DISTURBED AREAS WITHIN THE GOWRIE AREA

Source: FFJV, 2018

PHOTOGRAPH 10.10 TALL HAWKWEED GROWING WITHIN A ROAD RESERVE, SOUTH OF TOOWOOMBA

Source: FFJV, 2018


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Tin Hut Ck
Wyaga Rd
Hogan Ck
Commoron Ck
Kembilla Ck
Mum Murri Ck
Wyaga Rd
Cunningham Hwy
Wondalli Ck
Yelarbon
Brigalow Ck
Yelarbon Keetah Rd
Desert Creek Rd
Cunningham Hwy
Macintyre Brk
Kildonan Rd
Macintyre R
Kildonan Rd
Dumaresq R
30:6 NS2B
0
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20
30
40
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BORDER TO GOWRIE
Figure 10.5a: Locations of observed threatened and near-threatened flora species within the impact assessment area
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Toowoomba
Warwick
Goondiwindi
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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Data Sources: FFJV
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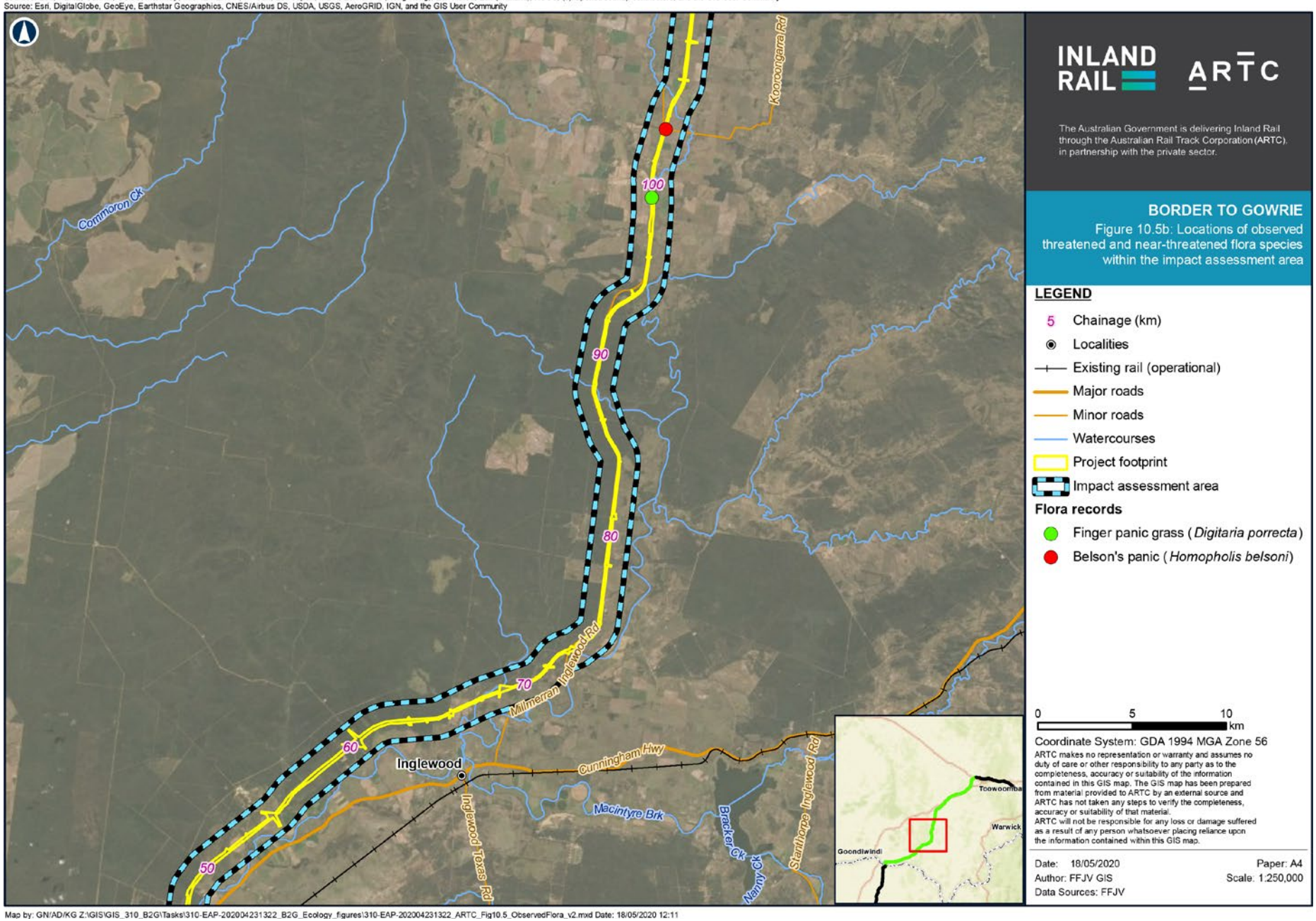
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Commoron Ck
Kooroongarra Rd
100
90
80
70
60
50
Millmerran Inglewood Rd
Inglewood
Cunningham Hwy
Macintyre Brk
Bracker Ck
Nanny Ck
Stanthorpe Inglewood Rd
Inglewood Texas Rd
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
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BORDER TO GOWRIE
Figure 10.5b: Locations of observed threatened and near-threatened flora species within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Flora records
Finger panic grass (Digitaria porrecta)
Belson's panic (Homopholis belsoni)
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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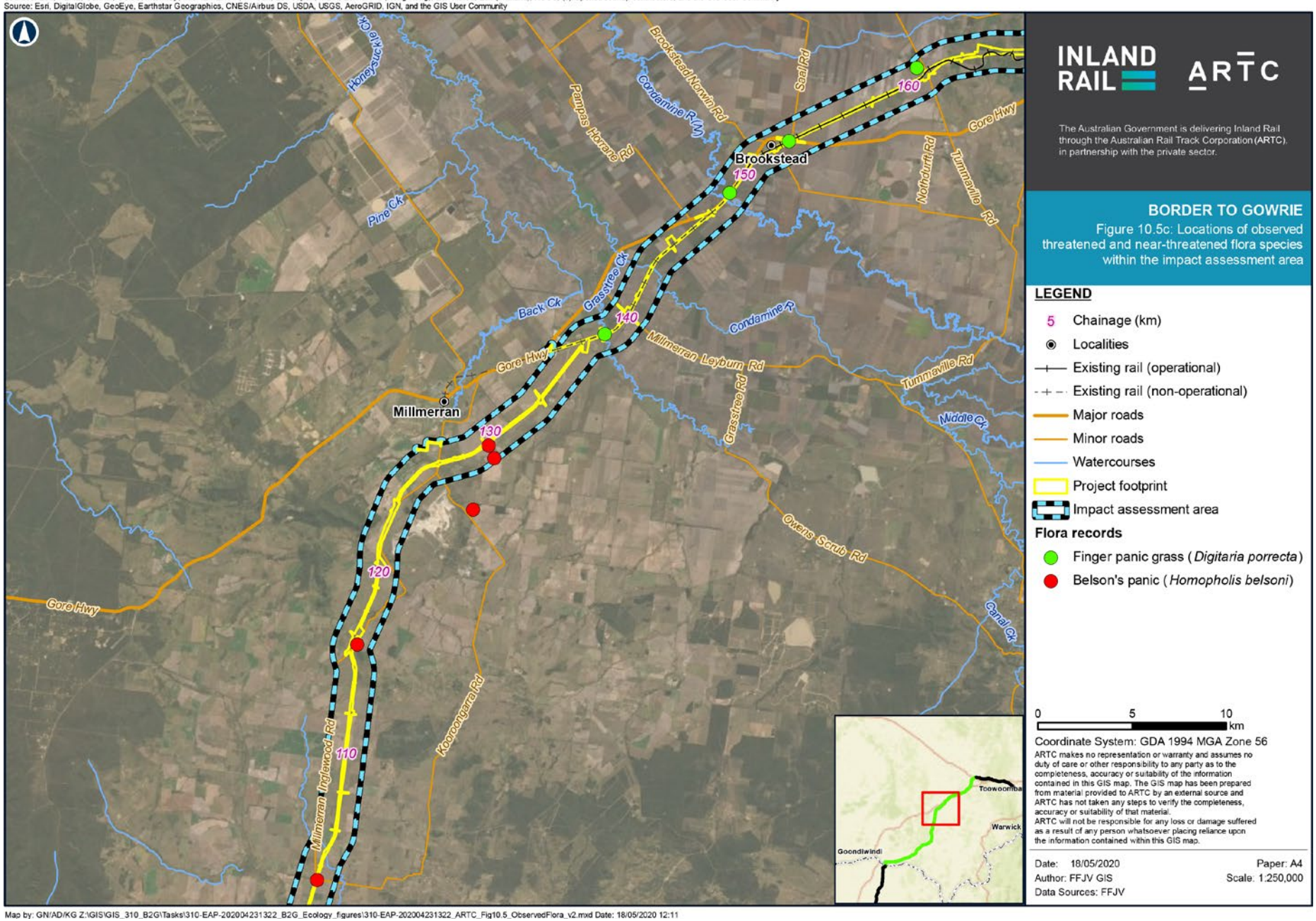
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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BORDER TO GOWRIE
Figure 10.5c: Locations of observed threatened and near-threatened flora species within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Existing rail (non-operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Flora records
Finger panic grass (Digitaria porrecta)
Belson's panic (Homopholis belsoni)
Brookstead
Millmerran
Gore Hwy
Pine Ck
Back Ck
Grasstree Ck
Condamine R
Millmerran Leyburn Rd
Tummaville Rd
Middle Ck
Owens Scrub Rd
Canal Ck
Kooroongarra Rd
Millmerran Inglewood Rd
Brookstead Norwin Rd
Condamine RMD
Pampas Horrane Rd
Saal Rd
Nothdurft Rd
Honeysuckle Ck
Grasstree Rd
160
150
140
130
120
110
Toowoomba
Warwick
Goondiwindi
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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Author: FFJV GIS
Scale: 1:250,000
Data Sources: FFJV
Map by: GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.5_ObservedFlora_v2.mxd Date: 18/05/2020 12:11

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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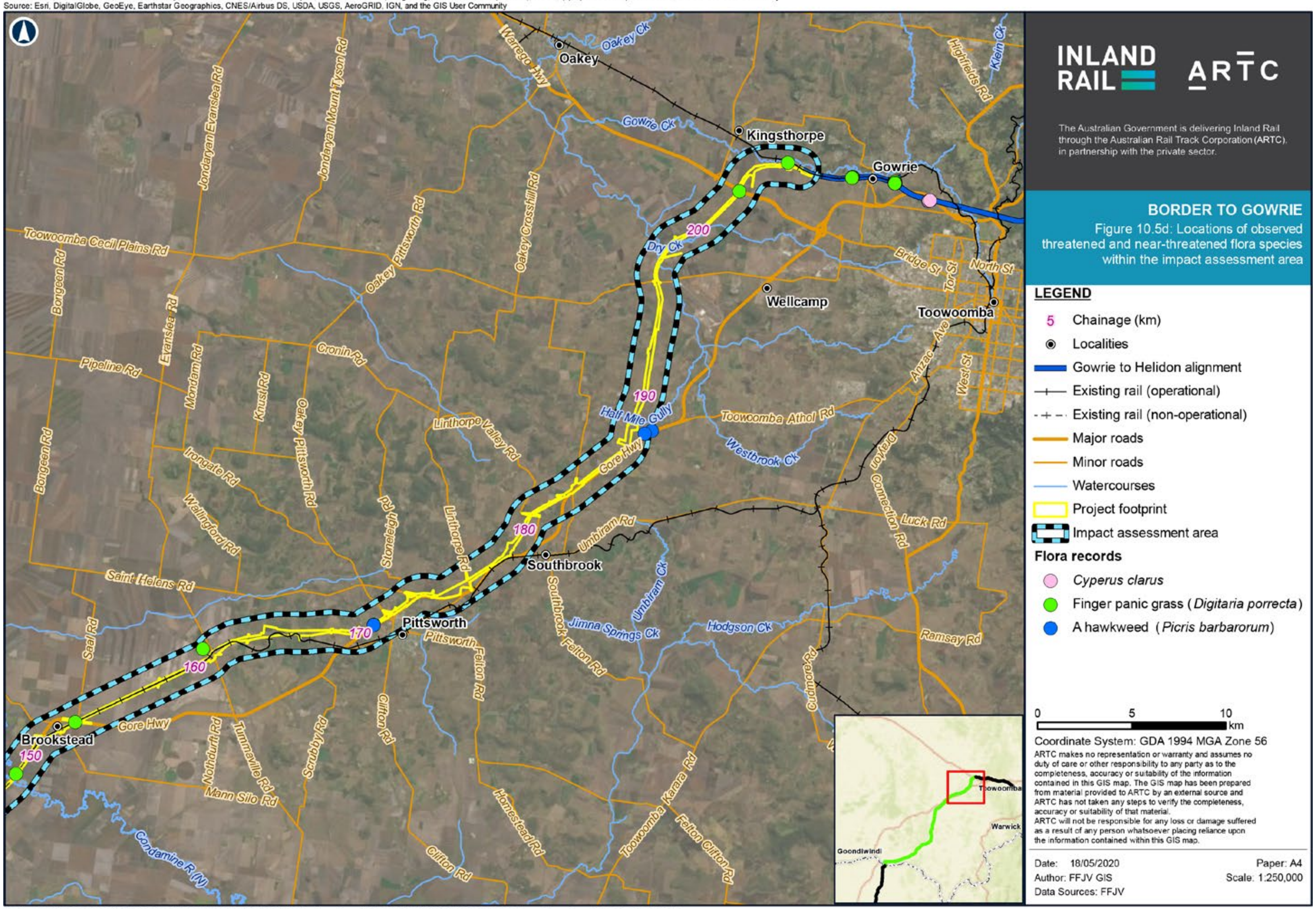

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10.5.3.2 Vegetation communities

Vegetation regulated under the VM Act is categorised into five separate categories as follows:

- **Category A**: vegetation that is subject to compliance notices, offsets and voluntary declarations
- **Category B**: remnant vegetation shown on RE or remnant map as an 'endangered' RE, an 'of concern' RE or a 'least concern' RE
- **Category C**: high-value regrowth vegetation
- **Category R**: regrowth watercourse area
- **Category X**: vegetation that is generally exempt from requirements under vegetation management laws.

In addition to the five categories presented above, vegetation associated with categories A, B, C and R have been assigned a specific three-digit RE code.

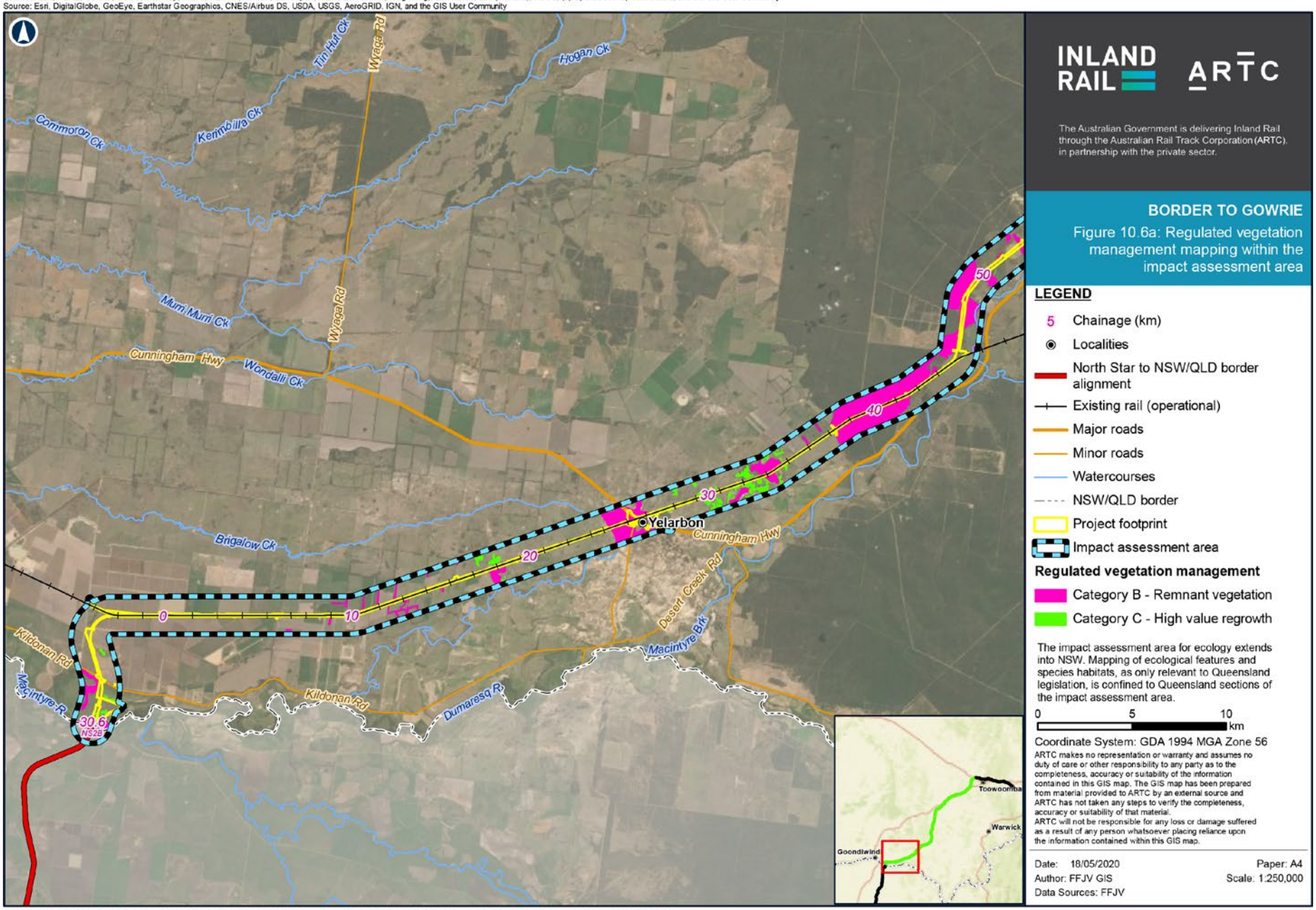
REs are vegetation communities that are consistently associated with a particular combination of geology, landform and soil in a bioregion. REs are shown on the vegetation management supporting map. Each RE has been assigned a vegetation management status based on its current remnant extent—that is, how much of it remains in a bioregion. The three vegetation management codes are as follows:

- **Endangered status**: the area of remnant vegetation is less than 10 per cent of the pre-clearing extent of the RE, or the area of remnant vegetation is 10 to 30 per cent of the pre-clearing extent of the RE, and less than 10,000 hectares remains
- **Of concern status**: the area of remnant vegetation is 10 to 30 per cent of the pre-clearing extent of the RE, or the area of remnant vegetation is more than 30 per cent of the pre-clearing extent of the RE, and less than 10,000 hectares remains
- **Least concern status**: the area of remnant vegetation is more than 30 per cent of the pre-clearing extent of the RE and more than 10,000 ha remains.

Desktop analysis indicates that the impact assessment area contains category B (remnant vegetation) and C (high value regrowth) regulated vegetation as indicated on the regulated vegetation map (State of Queensland, 2018). This vegetation is listed as 'endangered', 'of concern' or 'least concern' REs (23 in total). The impact assessment area does not contain vegetation mapped as category R (refer Table 10.6 and Figure 10.6).

TABLE 10.6 EXTENT OF CATEGORY B, C, R AREAS OF REGULATED VEGETATION WITHIN THE IMPACT ASSESSMENT AREA AND PROJECT FOOTPRINT

	Extent (ha)	
Regulated vegetation category	**Impact assessment area**	**Project footprint**
Category A—Constrained remnant vegetation	0.00	0.00
Category B—Remnant vegetation	8,254.08	563.25
Category C—High value regrowth	797.00	34.64
Category R—Regrowth watercourse	0	0


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Tin Hut Ck
Wyaga Rd
Hogan Ck
Commoron Ck
Kembille Ck
Mum Murri Ck
Wyaga Rd
Cunningham Hwy
Wondalli Ck
Brigalow Ck
Yelarbon
Cunningham Hwy
Desert Creek Rd
Macintyre Brk
Kildonan Rd
Macintyre R
Kildonan Rd
Dumaresq R
30.6
NS2B
0
10
20
30
40
50
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.6a: Regulated vegetation management mapping within the impact assessment area
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Regulated vegetation management
Category B - Remnant vegetation
Category C - High value regrowth
The impact assessment area for ecology extends into NSW. Mapping of ecological features and species habitats, as only relevant to Queensland legislation, is confined to Queensland sections of the impact assessment area.
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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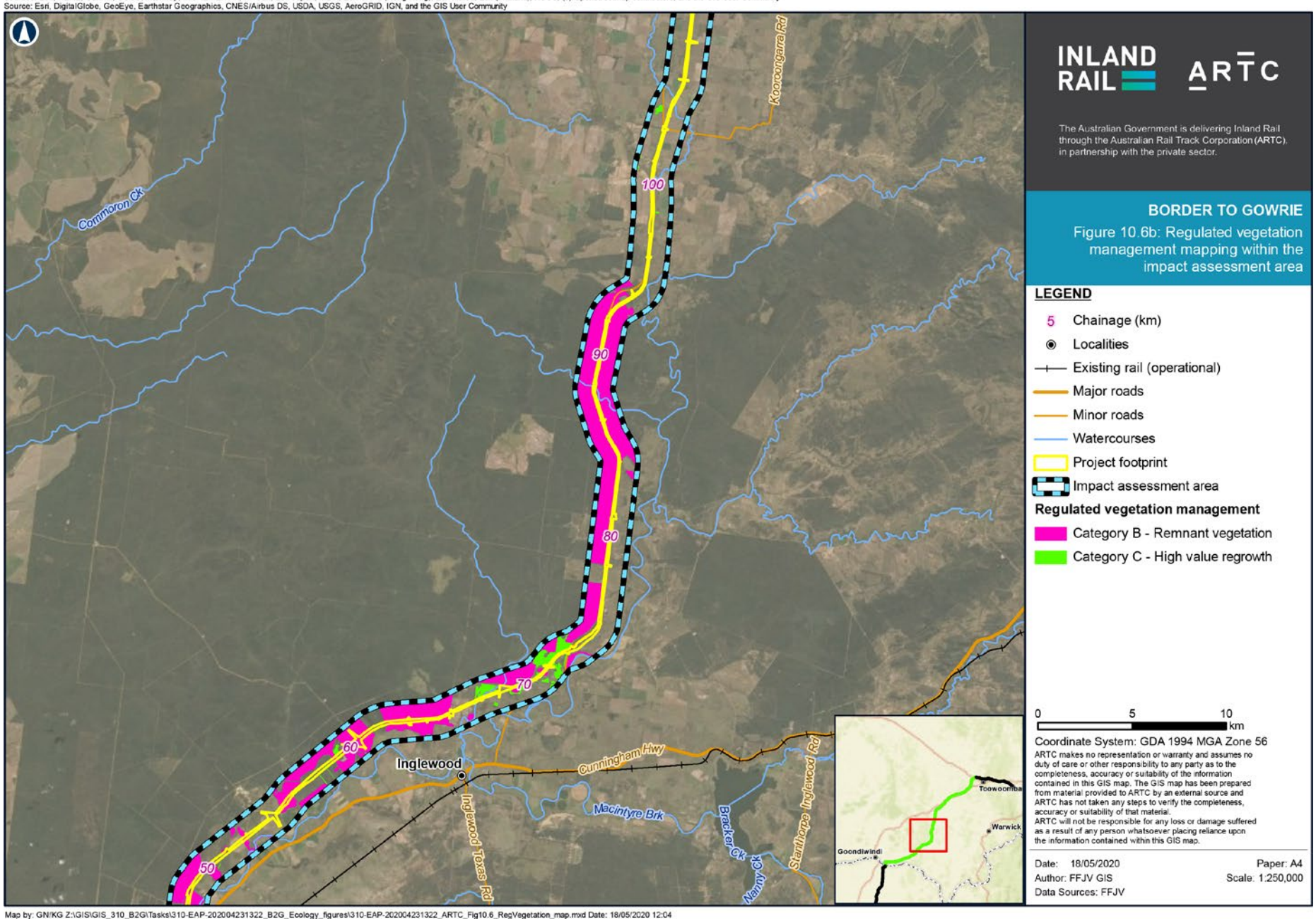
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Commoron Ck
Koorongarra Rd
100
90
80
70
60
50
Inglewood
Cunningham Hwy
Macintyre Brk
Bracker Ck
Nanny Ck
Stanthorpe Inglewood Rd
Inglewood Texas Rd
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.6b: Regulated vegetation management mapping within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Regulated vegetation management
Category B - Remnant vegetation
Category C - High value regrowth
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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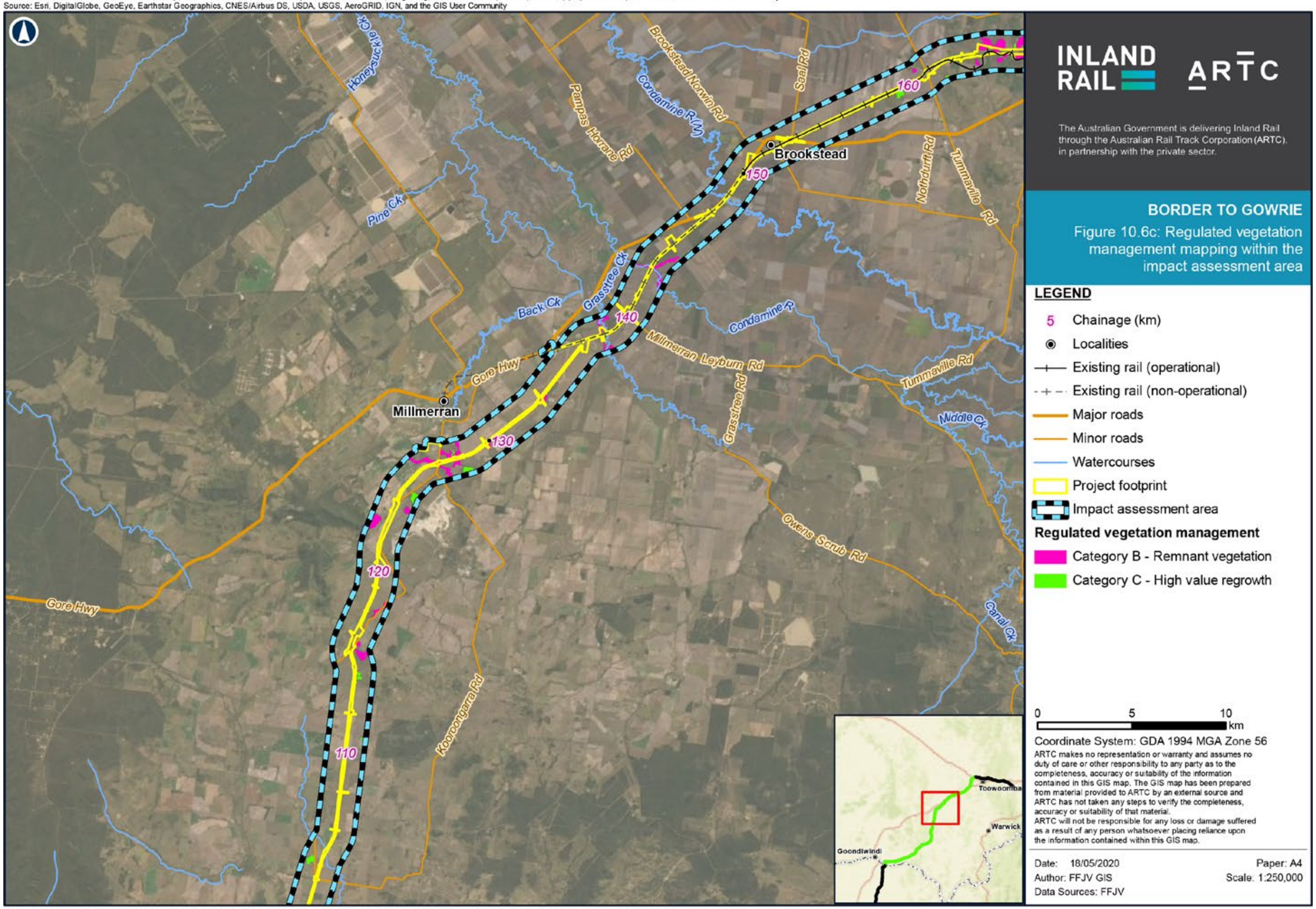
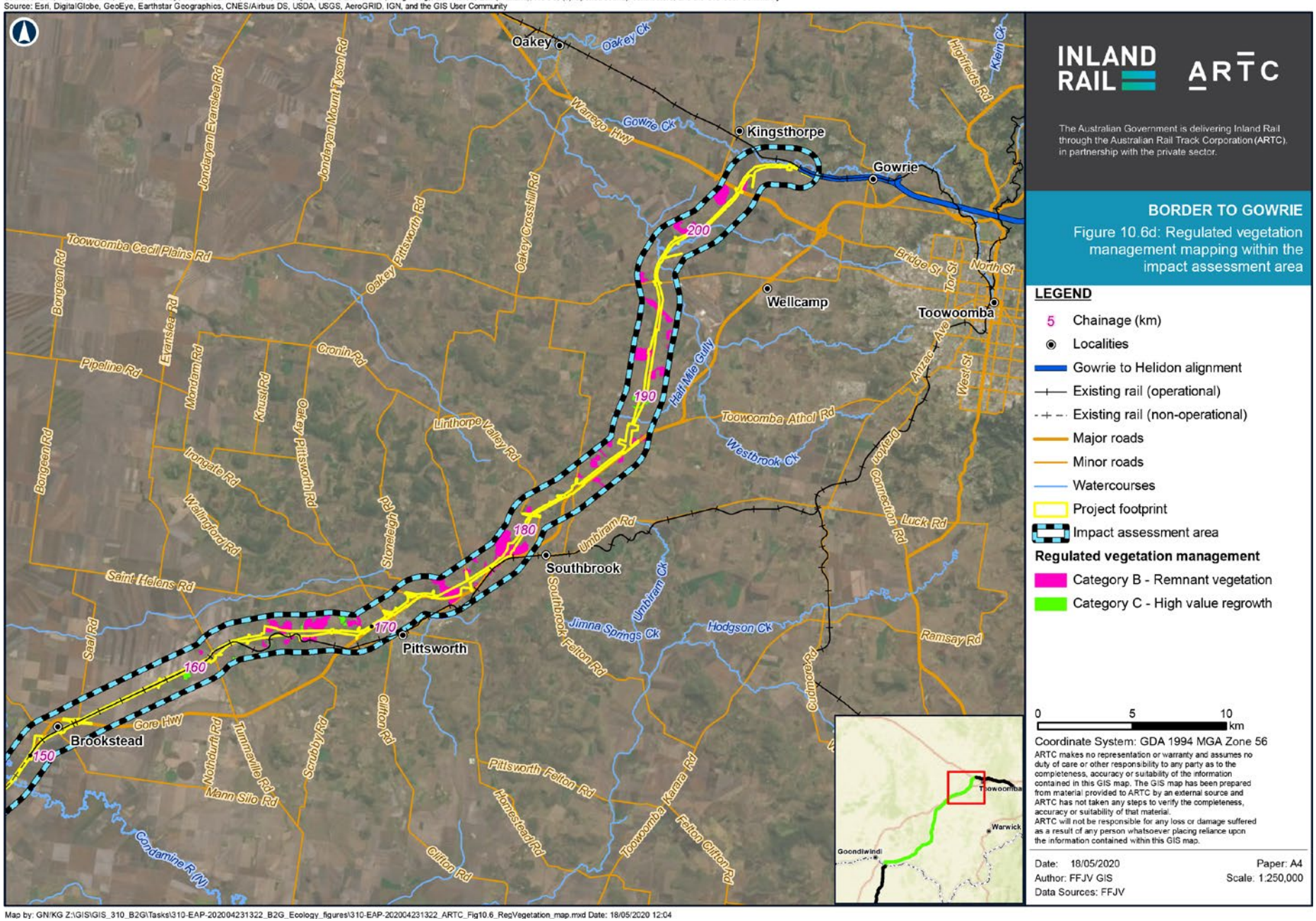
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.6_RegVegetation_map.mxd Date: 18/05/2020 12:04


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Oakey
Kingsthorpe
Gowrie
Wellcamp
Toowoomba
Southbrook
Pittsworth
Brookstead
Oakey Ck
Gowrie Ck
Warrego Hwy
Highfields Rd
Klein Ck
Jondaryan Evanslea Rd
Jondaryan Mount Tyson Rd
Toowoomba Cecil Plains Rd
Bongeen Rd
Evanslea Rd
Oakey Pittsworth Rd
Oakey Crosshill Rd
Bridge St
Tor St
North St
Pipeline Rd
Mondam Rd
Knust Rd
Cronin Rd
Half Mile Gully
Anzac Ave
West St
Toowoomba Athol Rd
Linthorpe Valley Rd
Westbrook Ck
Drayton Connection Rd
Irongate Rd
Wallangford Rd
Stonelee Rd
Umbiram Rd
Luck Rd
Saint Helens Rd
Umbiram Ck
Southbrook Felton Rd
Jimna Springs Ck
Hodgson Ck
Ramsay Rd
Seal Rd
Gore Hwy
Northcott Rd
Tummaville Rd
Scrubby Rd
Clifton Rd
Cudmore Rd
Mann Silo Rd
Pittsworth Felton Rd
Homestead Rd
Toowoomba Karara Rd
Felton Clifton Rd
Condamine R (N)
200
190
180
170
160
150
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.6d: Regulated vegetation management mapping within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Gowrie to Helidon alignment
Existing rail (operational)
Existing rail (non-operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Regulated vegetation management
Category B - Remnant vegetation
Category C - High value regrowth
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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Data Sources: FFJV
Map by: GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.6_RegVegetation_map.mxd Date: 18/05/2020 12:04

Regulated vegetation identified as an MSES includes those mapped as categories B, C, R areas of 'endangered' RE or 'of concern' RE, and category A, B, C, R areas intersecting a watercourse or wetland when they meet the following criteria:

- Category A, B, C and R areas that are located within a defined distance from the defining banks of a relevant watercourse identified on the vegetation management watercourse and drainage feature map
- Category A, B, C and R areas that are located within 100 m from the defining bank of a wetland identified on the vegetation management wetlands map.

Categories B and C regulated vegetation intersecting a watercourse/wetland occur within the impact assessment area. Category R regulated vegetation intersecting a watercourse/wetland does not occur within the impact assessment area. The extent of regulated vegetation intersecting watercourses and wetlands is summarised in Table 10.7.

TABLE 10.7 THE EXTENT OF REGULATED VEGETATION LOCATED A DEFINED DISTANCE FROM A WATERCOURSE OR WETLAND WITHIN THE IMPACT ASSESSMENT AREA AND PROJECT FOOTPRINT

	Extent (ha)	
Regulated vegetation category	**Impact assessment area**	**Project footprint**
Category A—Constrained remnant vegetation	0.00	0.00
Category B—Remnant vegetation	733.23	43.88
Category C—High value regrowth	35.66	2.87
Category R—Remnant vegetation	0.00	0.00

A list of the REs (category B and C regulated vegetation) and their extent within the impact assessment area is provided in Table 10.8. A summary of the extent of category B and C areas of regulated vegetation that are 'endangered' or 'of concern' REs within the impact assessment area is provided in Table 10.8. For further information related to regulated vegetation, refer Appendix J: Terrestrial Ecology Technical Report.

TABLE 10.8 DESCRIPTIONS OF MAPPED REGIONAL ECOSYSTEMS (CATEGORY B AND C REGULATED VEGETATION) WITHIN THE IMPACT ASSESSMENT AREA

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.3.2	Of concern	Of concern	Poplar box (*Eucalyptus populnea*) woodland to open woodland. Silver-leaved ironbark (*E. melanophloia*) may be present and locally dominant. There is sometimes a distinct low tree layer dominated by species including wilga (*Geijera parviflora*), false sandalwood (*Eremophila mitchellii*), cooba (*Acacia salicina*), weeping myall (*A. pendula*), Lysiphyllum (*Lysiphyllum* spp.), Brewster's cassia (*Cassia brewsterii*), white cypress–pine (*Callitris glaucophylla*) and Wallowa (*Acacia excelsa*). The ground layer is grassy, dominated by a range of species depending on soil and management conditions. Species include red-leg grass (*Bothriochloa decipiens*), curley windmill grass (*Enteropogon acicularis*), purple wiregrass (*Aristida ramosa*) and rye beetle-grass (*Tripogon loliiformis*). Occurs on Cainozoic alluvial plains with variable soil types including texture contrast, deep uniform clays, massive earths and sometimes cracking clays. This RE is analogous to an EPBC Act listed Poplar Box Grassy Woodland on Alluvial Plains TEC. Refer to Appendix L: Matters of National Environmental Significance Technical Report for further information.	641.81	39.72
11.3.4	Of concern	Of concern	Forest red gum (*Eucalyptus tereticornis*) woodland to open forest. Other tree species that may be present and locally dominant include river red gum (*E. camaldulensis*), Moreton Bay ash (*Corymbia tessellaris*), coolabah (*Eucalyptus coolabah*), grey bloodwood (*Corymbia clarksoniana*), poplar box (*E. populnea*) or Brown's box (*E. brownii*), silver-leaved ironbark (*E. melanophloia*), white gum (*E. platyphylla*) or rough-barked apple (*Angophora floribunda*). Narrow-leaved ironbark (*E. crebra*) and swamp box (*Lophostemon suaveolens*) may be locally dominant (subregion 14). A shrub layer is usually absent, and a tall grassy ground layer is often prominent and may include any of Australian bluestem (*Bothriochloa bladhii* subsp. *Bladhii*), wiregrass (*Aristida* spp.), black speargrass (*Heteropogon contortus*), bluegrass (*Dichanthium* spp.) and kangaroo grass (*Themeda triandra*). Heavily grazed areas tend to have shorter or annual grasses including button grass (*Dactyloctenium radulans*) or red grass (*Bothriochloa* spp.). Occurs on Cainozoic alluvial plains and terraces. Occurs on a variety of soils, including deep cracking clays, medium to fine textured soils, and deep texture-contrast soils.	335.40	14.24
11.3.14	Least concern	No concern at present	Rough-barked apple (*Angophora floribunda*), rusty gum (*A. leiocarpa*), forest red gum (*Eucalyptus tereticornis*) and red gum (*E. chloroclada)* woodland with a mid-layer dominated by white cypress pine (*Callitris glaucophylla*) and sometimes bulloak (*Allocasuarina luehmannii*). A low shrub layer dominated by species including xylomelum (*Xylomelum cunninghamianum*), oleander wattle (*Acacia neriifolia*), black cypress pine (*Callitris endlicheri*), crowded-leaf wattle (*A. conferta*), dogwood (*Jacksonia scoparia*), tantoon (*Leptospermum polygalifolium*), blunt beard-heath (*Leucopogon muticus*) and thyme-leaf honey-myrtle (*Melaleuca thymifolia*) is often present. Occurs on Cainozoic alluvial plains with sandy soils.	241.52	14.49

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.3.18	Least concern	No concern at present	Poplar box (*Eucalyptus populnea*) and/or silver-leaved ironbark (*E. melanophloia*) dominate the woodland canopy. Other canopy tree species that may be present include white cypress-pine (*Callitris glaucophylla*), narrow-leaved ironbark (*E. crebra*) (can be locally dominant), red gum (*E. chloroclada*) and smooth-barked apple (*Angophora costata*). A low tree layer dominated by bulloak (*Allocasuarina luehmannii*), white cypress-pine (*Callitris glaucophylla*), wilga (*Geijera parviflora*) and/or false sandalwood (*Eremophila mitchellii*), and sometimes bitterbark (*Alstonia constricta*) is often present. The ground cover is usually open-to-sparse and dominated by perennial grasses including red leg grass (*Bothriochloa decipiens*), curley windmill grass (*Enteropogon acicularis*), purple plume grass (*Triraphis mollis*), purple lovegrass (*Eragrostis lacunaria*) and wiregrass (*Aristida* spp.). Occurs on levees, higher alluvial plains and terraces associated with drainage lines. The soils are mainly deep, uniform red sands, or deep, texture contrast soils with a sandy, thick surface horizon overlying neutral, blocky to massive subsoils. Small areas occur on red massive earths and alluvial soils.	254.58	13.95
11.3.21	Endangered	Endangered	Grassland dominated by silky blue grass (*Dichanthium sericeum*) and/or a Mitchell grass (including *Astrebla* spp., *A. lappacea*, *A. elymoides* and *A. squarrosa*). A wide range of other grass and forb species are usually present and may be dominant depending on seasonal conditions and management regimes. Frequently occurring species include the grasses, white speargrass (*Aristida leptopoda*), feathertop wiregrass (*A. latifolia*), Australian bluestem (*Bothriochloa bladhii subsp. Bladhii*), common native couch (*Brachyachne convergens*), black speargrass (*Heteropogon contortus*), native millet (*Panicum decompositum*), cup grass (*Eriochloa* spp.), rat's tail couch (*Sporobolus mitchellii*) and coolibah grass (*Thellungia advena*) and the forbs, native rosella (*Abelmoschus ficulneus*), Corchorus (*Corchorus trilocularis*), scurvy weed (*Commelina ensifolia*), Euphorbia (*Euphorbia coghlanii*), cow vine (*Ipomoea lonchophylla*), sensitive plant (*Neptunia gracilis*), Phyllanthus (*Phyllanthus maderaspatensis*), hairy sida (*Sida trichopoda*) and camel bush (*Trichodesma zeylanicum* var. *latisepalum*). Scattered trees and shrubs may occur including coolabah (*E. coolabah*), poplar box (*E. populnea*), forest red gum (*E. tereticornis*) or wattle (*Acacia* spp.). Occurs on Cainozoic alluvial plains that are near level (slope <1 per cent), i.e. on flats associated with rivers and creeks, including back-plains, terraces, low levees and back-swamps. Associated soils are usually cracking clays that lack gilgai, are often self-mulching, usually deep, and range in colour from dark grey–brown to grey or black. This RE is analogous to an EPBC Act listed natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland TEC. Refer to Appendix L: Matters of National Environmental Significance Technical Report for further information.	0.95	0.00

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.3.25	Least concern	No concern at present	River red gum (*E. camaldulensis*) or forest red gum (*E. tereticornis*) open forest to woodland. Other tree species including river sheoak (*Casuarina cunninghamiana*), coolabah (*E. coolabah*), black tea-tree (*M. bracteata*), weeping bottlebrush (*M. viminalis*), cabbage palm (*Livistona* spp.) (in north), bottlebrush (*Melaleuca* spp.) and rough-barked apple (*A. floribunda*) are commonly present and may be locally dominant. An open-to-sparse, tall shrub layer is frequently present, dominated by species including cooba (*A. salicina*), river cooba (*A. stenophylla*) or *Lysiphyllum carronii*. Low shrubs are present, but rarely form a conspicuous layer. The ground layer is open-to-sparse and dominated by perennial grasses, sedges or forbs, including cogon grass (*Imperata cylindrica*), Australian bluestem (*Bothriochloa bladhii*), desert bluegrass (*B. ewartiana*), ribbon grass (*Chrysopogon fallax*), sedge (*Cyperus dactylotes*), variable flatsedge (*C. difformis*), giant flat sedge (*C. exaltatus*), slender flat sedge (*C. gracilis*), rice flat sedge (*C. iria*), curly flat sedge (*C. rigidellus*), sedge (*C. victoriensis*), silky blue grass (*Dichanthium sericeum*), Leptochloa (*Leptochloa digitate*), mat rush (*Lomandra longifolia*) or panic grass (*Panicum* spp.). Occurs on fringing levees and banks of major rivers and drainage lines of alluvial plains throughout the region. Soils are very deep, alluvial, grey and brown cracking clays with or without some texture contrast. These are usually moderately deep to deep, soft or firm, acid, neutral or alkaline brown sands, loams or black cracking or non-cracking clays, and may be sodic at depth.	359.45	17.70
11.3.27b	Least concern	Of concern	Vegetation ranges from open water +/- aquatics and emergent plants, including curly pondweed (*Potamogeton crispus*), redwater milfoil (*Myriophyllum verrucosum*), green algae (*Chara* spp.), nitella (*Nitella* spp.), blue lily (*Nymphaea violacea*), swamp lily (*Ottelia ovalifolia*), robust marshwort (*Nymphoides indica*), wavy marshwort (*N. crenata*), floating pondweed (*Potamogeton tricarinatus*), variable flatsedge (*C. difformis*), *eelgrass* (*Vallisneria caulescens*) and water thyme (*Hydrilla verticillata*). Often with fringing woodland, commonly river red gum (*E. camaldulensis*) or coolabah (*E. coolabah*), but also a wide range of other species, including poplar gum (*Eucalyptus platyphylla*), forest red gum (*E. tereticornis*), bottlebrush (*Melaleuca* spp.), soapbush wattle (*A. holosericea*) or other wattles (*Acacia* spp.). Occurs on billabongs and lacustrine wetlands.	59.51	0.97

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.4.3	Endangered	Endangered	Open forest dominated by brigalow (*A. harpophylla*) and/or belah (*Casuarina cristata*). Brigalow (10–16 m high) predominates, forming a fairly continuous canopy with varying densities of belah (14–18 m high) forming part of the canopy or emerging above it. Belah may be dominant or form pure stands, particularly in the south of the bioregion (subregions 33, 36). Eucalypts including mountain coolibah (*E. orgadophila*), poplar box (*E. populnea*), grey box (*E. microcarpa*), grey box (*E. woollsiana*), Dawson gum (*E. cambageana*) and *E. thozetiana* (on shallower soils and upper slopes) may be scattered through the canopy or emerge up to 22 m high through the canopy. Queensland bottle tree (*Brachychiton rupestris*) may also be present in places. An open-to-dense tall shrub layer is present and is dominated by false sandalwood (*Eremophila mitchellii*) and/or wilga (*Geijera parviflora*). Low shrubs are often present, occasionally forming a distinct layer dominated by species including currant bush (*Carissa ovata*) and scrub boonaree (*Alectryon diversifolius*). Tree/shrub height may range from 3–8 m. Black tea-tree (*M. bracteate*) may be present in low-lying areas. The ground layer is sparse-to-open and composed of grasses and forbs. Occurs on Cainozoic clay plains with cracking clay soils, which are often with a weak gilgai microrelief. The plains may be flat to gently undulating. Soils are often cracking clay that are usually deep to very deep, often self-mulching, and sometimes with surface stone. Texture contrast soils and other clays may also be present in places. This RE is analogous to an EPBC Act listed brigalow (*Acacia harpophylla* dominant and co dominant) ecological community TEC. Refer to Appendix L: Matters of National Environmental Significance Technical Report for further information.	336.65	62.42
11.5.1	Least concern	No concern at present	Narrow-leaved red ironbark (*Eucalyptus crebra*) and/or poplar box (*E. populnea*) +/- smooth-barked apple (*Angophora leiocarpa*) +/- narrow-leaved box (*E. woollsiana*) (in south of bioregion) dominate the woodland (to open woodland) canopy. A low tree layer dominated by bulloak (*Allocasuarina luehmannii*) +/- feather honey-myrtle (*Melaleuca decora*) +/- white cypress pine (*Callitris glaucophylla*) +/- black cypress pine (*C. endlicheri*) is usually present. In some areas, bulloak low woodland is the dominant layer. The ground cover is usually sparse and dominated by perennial grasses. Occurs on flat to gently undulating plains formed from weathered sandstones. Duplex soils with sandy surfaces.	1,673.20	95.68
11.5.1a	Least concern	No concern at present	Poplar box (*Eucalyptus populnea*) woodland with bulloak (*Allocasuarina luehmannii*) low tree layer.	155.18	0.47
11.5.4	Least concern	No concern at present	Red gum (*Eucalyptus chloroclada*), white cypress pine (*Callitris glaucophylla*), smooth-bark apple (*Angophora leiocarpa*), +/- rough-bark apple (*A. floribunda*) +/- narrow leaved ironbark (*E. crebra*) woodland with a low tree layer dominated by species including bulloak (*Allocasuarina luehmannii*), woolly oak (*A. inophloia*) and black cypress pine (*C. endlicheri*). Localised areas are dominated by *E. rhombica*. Occurs on Cainozoic plains with deep sandy soils.	1,780.61	107.21

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.5.14	Of concern	Of concern	Hummock grass (*Triodia* spp.) grassland with scattered low trees and shrubs. Porcupine grass (*Triodia scariosa*) grassland with scattered trees and shrubs or patches of shrubland to low open woodland of bulloak (*Allocasuarina luehmannii*) with paperbark (*Melaleuca densispicata*), false sandalwood (*Eremophila mitchellii*), northern sandalwood (*Santalum lanceolatum*) +/- emergent narrow-leaved box (*E. woollsiana*), and occasional poplar box (*E. populnea*). River red gum (*E. camaldulensis*) occurs along the drainage lines. Scattered short grasses and forbs including slender chloris (*Chloris divaricata*), windmill grass (*C. truncata*), and three-spined bassia (*Sclerolaena tricuspis*) and roly-poly (*Salsola australis*) also occur. Occurs on Cainozoic sandplains with highly alkaline soils.	373.20	49.71
11.5.20	Least concern	No concern at present	Gum-topped box (*Eucalyptus moluccana*), grey box (*E. microcarpa*) or grey box *(E. woollsiana*) woodland to open forest. Species including bulloak (*Allocasuarina luehmannii*) and white cypress pine (*Callitris glaucophylla*) often form a low woodland layer. Occurs on flat to gently undulating plains formed from Cainozoic/Quaternary sediments. Soils are mainly texture contrast with sandy surfaces.	1,020.32	25.66
11.7.4	Least concern	No concern at present	Mixed eucalypt woodland on Cainozoic lateritic duricrusts. Species can include narrow-leaved red ironbark (*Eucalyptus crebra*), gum-topped ironbark (*E. decorticans*), brown bloodwood (*Corymbia trachyphloia*), narrow-leaved white mahogany (*E. tenuipes*), yellowjacket (*C. watsoniana*) and white cypress pine (*Callitris glaucophylla*). There is usually a distinct low-tree to tall-shrub layer comprising species including brown hazelwood (*Lysicarpus angustifolius*) or wattles (*Acacia* spp.) Occurs on low hills and ranges with shallow soils.	101.86	11.90
11.7.5	Least concern	No concern at present	Shrubland +/- emergent eucalypts. Characteristic genera include star flowers (*Calytrix* spp.), hakea (*Hakea* spp.), kunzea (*Kunzea* spp.), heath myrtle (*Micromyrtus* spp.), wattles (*Acacia* spp.), paperbarks (*Melaleuca* spp.) and (in the ground layer) hummock grass (*Triodia* spp.). Often scattered or fringing emergent tree species are present, including Queensland peppermint (*Eucalyptus exserta*), yetman ironbark (*E. panda*), plunkett mallee (*E. curtisii*), brown bloodwood (*Corymbia trachyphloia*) and Blake's wattle (*Acacia blakei*). Occurs on shallow soils often associated with natural scalds on Cainozoic lateritic duricrusts and sometimes lithosols derived from quartzose sandstone.	44.76	2.12

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.7.7	Least concern	No concern at present	Blue-leaved ironbark (*Eucalyptus fibrosa* subsp. *nubile*) predominates and forms a distinct but discontinuous open forest to woodland canopy (22–25 m high). Narrow-leaved red ironbark (*E. crebra*) often co-dominates or is locally dominant, particularly on lower slopes. Also includes areas with lemon-scented gum (*Corymbia citriodora*) as a codominant. Other frequently occurring sub-dominant tree species include brown bloodwood (*Corymbia trachyphloia*), inland white mahogany (*E. apothalassica*), red ironbark (*E. sideroxylon*), lancewood (*Acacia shirleyi*) and white cypress-pine (*Callitris glaucophylla*). There is usually a low woodland mid layer dominated by *Acacia* spp. or sometimes bulloak (*Allocasuarina luehmannii*) and black cypress pine (*Callitris endlicheri*). Scattered tall shrubs may occur, but rarely form a prominent layer. There is usually a moderately dense, low shrub layer developed with a variable floristic composition. The ground layer is open-to-moderately dense and dominated by grasses. Occurs on low hills and ranges formed from deeply weathered sediments. Soils are usually shallow (< 30cm deep) uniform sands with stone or rocks covering much of the ground surface.	306.76	25.20
11.8.2a	Least concern	No concern at present	Forest red gum (*Eucalyptus tereticornis*) and yellow box (*E. melliodora*) woodland occurring on low hills. Occurs on low hills (subregion 31 and 32) formed from basalt. The soils are generally shallow (< 60 cm deep), brown to grey–brown, gradational, clay-loams and clays. Basalt stones and boulders can occur on the surface.	38.79	0.00
11.8.3	Of concern	Of concern	Semi-evergreen vine thicket that may have emergent brigalow (*Acacia harpophylla*), belah (*Casuarina cristata*) and eucalypts (*Eucalyptus* spp.). Occurs on Cainozoic igneous rocks. Generally restricted to steeper, rocky hillsides. This RE is analogous to an EPBC Act listed semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions TEC**.** Refer to Appendix L: Matters of National Environmental Significance Technical Report for further information.	38.36	0.00
11.8.4	Least concern	No concern at present	Silver-leaved ironbark (*Eucalyptus melanophloia*) and/or narrow-leaved red ironbark (*E. crebra*) +/- mountain coolibah (*E. orgadophila*) +/- red bloodwood (*Corymbia erythrophloia*) grassy open woodland. Cycad palm (*Macrozamia moorei*) is a conspicuous element of the mid layer in the Central Highlands. Localised patches of lemon-scented gum (*C. citriodora*) occur on volcanic plugs, including Minerva Hills. Generally occurs on slopes of mountains and hills formed from Cainozoic igneous rocks, usually with shallow stony soils and extensive outcropping.	325.94	49.72

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.8.5	Least concern	No concern at present	Mountain coolibah (*Eucalyptus orgadophila*) grassy open woodland. Mountain coolibah predominates and forms a distinct but discontinuous canopy, sometimes with other sub-dominant species including red bloodwood (*Corymbia erythrophloia*), silver-leaved ironbark (*E. melanophloia*) and occasionally narrow-leaved red ironbark (*E. crebra*). Shrubs are usually scarce and scattered, although a well-defined shrubby layer does develop in some areas. On the lower slopes at better sites, softwood scrub species may form tall and low shrub layers under the canopy of mountain coolibah. The ground layer is moderately dense to dense and dominated by species that include the grasses, wire grass (*Aristida Lazaridis*), purple wire grass (*A. ramose*), desert bluegrass (*Bothriochloa ewartiana*), silky blue grass (*Dichanthium sericeum*), ribbon grass (*Chrysopogon fallax*), black speargrass (*Heteropogon contortus*), slender nineawn (*Enneapogon gracilis*), kangaroo grass (*Themeda triandra*) and small burrgrass (*Tragus australianus*), and the herbs, blue trumpet (*Brunoniella australis*), tropical speedwell (*Evolvulus alsinoides*), galactia (*Galactia tenuiflora*) and birdsville indigo (*Indigofera linnaei*). Occurs on undulating plains, rises and low hills or, sometimes, flat tablelands on top of mountains, formed from basalt. Soils are generally shallow to moderately shallow, often rocky or stony clays.	684.29	60.49
11.8.11	Of concern	Of concern	Grassland dominated by silky blue-grass (*Dichanthium sericeum*), wire grass (*Aristida* spp.), Mitchell grass (*Astrebla* spp.) and rigid panic (*Panicum decompositum*) with or without trees, including mountain coolibah (*Eucalyptus orgadophila*), silver-leaved ironbark (*E. melanophloia*), red bloodwood (*Corymbia erythrophloia*) and cooba (*Acacia salicina*), (height 11 +/- 3 m); however, dominance and cover may vary with seasonal and other environmental conditions. Frequently occurring and sometimes locally dominant species include the grasses, wire grass (*Aristida zazaridis*), purple wire-grass (*A. ramosa*), desert bluegrass (*Bothriochloa ewartiana*), silky blue grass, ribbon grass (*Chrysopogon fallax*), black speargrass (*Heteropogon contortus*), slender ninawn (*Enneapogon gracilis),* kangaroo grass (*Themeda triandra*) and small burrgrass (*Tragus australianus*), and the herbs, blue trumpet (*Brunoniella australis*), tropical speedwell (*Evolvulus alsinoides*), Galactia (*Galactia tenuiflora*) and birdsville indigo (*Indigofera linnaei*). Isolated emergent trees (tree height 12 +/ -4 m - species including mountain coolibah (*Eucalyptus orgadophila*), silver-leaved ironbark (*E. melanophloia*) and red bloodwood (*Corymbia erythrophloia*) or small areas of open woodland may also be present. Occurs on Cainozoic igneous rocks, particularly fresh basalt, and is generally associated with undulating to gently undulating rises. It usually occurs on the crests and middle and upper slopes (slopes 2–6 per cent), although also present on lower slopes and flat areas (slopes 0–2 per cent). Associated soils are moderately shallow to deep cracking clay soils, dark brown to reddish brown in colour, often self-mulching, and with gravel, stone or linear gilgai sometimes present. Surface stone 10–15 cm diameter is present in the south-western remnants.	8.56	0.00

Regional ecosystems (REs)	Management status		Description (REDD Version 11)	Extent (Category A and B regulated vegetation) (ha)	
	VM Act	BD status		Within impact assessment area	Project footprint
11.9.5	Endangered	Endangered	Open forest dominated by brigalow (*Acacia harpophylla*) and/or belah (*Casuarina cristata*) (10–20 m) or brigalow with a semi-evergreen vine thicket understorey. Open forest dominated by belah is more common in southern parts of the bioregion. A prominent low tree or tall shrub layer dominated by species including wilga (*Geijera parviflora*) and false sandalwood (*Eremophila mitchellii*), and often with semi-evergreen vine thicket species present. The latter include scrub leopardwood (*Flindersia dissosperma*), Queensland bottletree (*Brachychiton rupestris*), scrub poison tree (*Excoecaria dallachyana*), bonewood (*Macropteranthes leichhardtii*) and soft acalypha (*Acalypha eremorum*) in eastern areas, and species including currant bush (*Carissa ovata*), emu apple (*Owenia acidula*), silver croton (*Croton insularis*), stiff denhamia (*Denhamia oleaster*) and velvet mock olive (*Notelaea microcarpa*) in south-western areas. Black tea-tree (*Melaleuca bracteate*) may be present along watercourses. Occurs on fine-grained sediments. The topography includes gently undulating plains, valley floors and undulating footslopes, and rarely on low hills. The soils are generally deep texture-contrast and cracking clays. The cracking clays are usually black or grey to brown or reddish-brown in colour, often self-mulching and sometimes with gilgai microrelief in flatter areas. Some texture contrast soils are shallow to only moderately deep. This RE is analogous to the brigalow (*Acacia harpophylla dominant and co dominant*) ecological community. Refer to Appendix L: Matters of National Environmental Significance Technical Report for further information.	85.54	0.91
11.9.7	Of Concern	Of Concern	Poplar box (*Eucalyptus populnea*) predominates, forming a distinct but discontinuous canopy (10–20 m tall). Occasionally silver-leaved ironbark (*E. melanophloia*) is present in the canopy. Lower trees are absent or infrequent. An open-to-dense, tall shrub layer is always present, with false sandalwood (*Eremophila mitchellii*) often dominant. A patchy low shrub layer of varying density may be formed, where the tall shrub layer is more than 6 m tall. The ground layer is dominated by perennial grasses and varies from sparse to dense, depending on the shrub and tree density. Red leg grass (*Bothriochloa decipiens*), curly windmill grass (*Enteropogon acicularis*), purple wire grass (*Aristida ramosa*) and jericho wiregrass (*Aristida jerichoensis*) are the most common dominants in the east with wire grass (*Aristida calycina* var. *praealta*), jericho wiregrass, lovegrass (*Eragrostis* spp.) and comb chloris (*Chloris pectinate*) dominant further west. Forbs are seasonally abundant. Occurs on the lower and middle slopes of gently undulating lowlands and plains formed from Cainozoic to Proterozoic consolidated, fine-grained sediments. Associated soils are predominantly deep loamy red earths with sparse superficial ferruginous gravel, or deep texture contrast soils with thin sandy or loamy surfaces over strongly alkaline subsoils.	181.07	5.33
Non-remnant	-	-	*Not applicable*	34,509.48	2,605.89

Table notes:
BD = Biodiversity ha = hectare mm/yr = millimetres per year

10.5.3.3 Threatened ecological communities

A total of eight TECs identified under the provisions of the EPBC Act are predicted to occur within the impact assessment area. Identified TECs consist of the following:

- Lowland rainforest of subtropical Australia—Critically Endangered
- Brigalow (*Acacia harpophylla* dominant and co-dominant)—Endangered
- Coolibah—black box woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions—Endangered
- Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland—Critically Endangered
- Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions—Endangered
- Weeping myall woodlands—Endangered
- White box–yellow box–Blakely's red gum grassy woodland and derived native grassland—Endangered
- Poplar box grassy woodland on alluvial plains—Endangered.

Based on review of the RE mapping and previous surveys, there are five TECs likely to occur within the impact assessment area:

- Brigalow (*Acacia harpophylla* dominant and codominant) ecological community
- Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland
- Weeping myall woodlands
- White box–yellow box–Blakely's red gum grassy woodland and derived native grassland
- Poplar box grassy woodland on alluvial plains.

Profiles related to each of the TECs identified above, mapping produced by DAWE, relevant threat abatement/recovery plans and threatening processes are provided in Appendix L: Matters of National Environmental Significance Technical Report.

The current State RE mapping indicates the presence of these communities within the following areas relevant to the Project:

- Brigalow remnants occur largely as fragments between Yelarbon and Millmerran. For the most part, these occur as linear fragments associated with fence lines and road reserves. The Project footprint intersects part of a large tract of mixed woodland potentially comprising brigalow woodland associated with Bringalily State Forest (north of Inglewood).
- Patches of Weeping myall woodlands potentially occurs between the southern extent of the Project and Pittsworth, although are more prevalent in the Inglewood area. The Project footprint intersects a large tract of mixed woodlands potentially comprising Weeping myall woodland associated with Whetstone State Forest (south-west of Inglewood).
- A small area of white box–yellow box–Blakely's red gum grassy woodland occurs within the edge of the impact assessment area to the south of Millmerran (to date, this TEC has not been observed within the Project footprint)
- A small patch of potential natural grassland TEC occurs within the impact assessment area between Millmerran and Pittsworth (to date, this TEC has not been observed within the Project footprint)
- Poplar box woodland overlaps substantially with REs that are analogous to Weeping myall woodlands (RE 11.3.2) (refer Table 10.9). As such, the Project footprint intersects a large tract of mixed woodlands potentially comprising poplar box woodlands associated with Whetstone State Forest.

These communities may provide habitats for a number of threatened flora and fauna species. The amount of each community occurring within the impact assessment area, based on vegetation community mapping at a desktop level, is detailed in Table 10.9. The DES vegetation (RE) mapping incorporates a number of mixed polygons, thereby including more than one vegetation community as potentially present. The desktop mapping has included the estimated percentage of each community within these mapped polygons. As such, incorporation of this data may not reflect the actual extent of the TECs on the ground.

It is also noted the current DES vegetation (RE) mapping may be inaccurate and therefore may not identify the true extent of potential TECs within the Project footprint. Condition thresholds, as outlined in the approved community-specific EPBC Act, conservation advice may be relatively small (e.g. 0.5 ha for the Brigalow and Natural Grasslands TECs) and may not reflect the community growth status (i.e. remnant or regrowth) of the State-based mapping. As such, incorporation of the State-based mapping will likely not reflect the actual extent of the TECs on the ground.

TABLE 10.9 THREATENED ECOLOGICAL COMMUNITIES IDENTIFIED WITHIN THE IMPACT ASSESSMENT AREA BASED ON DESKTOP MAPPING

Threatened ecological community name	EPBC Act status[1]	Extent (ha)	
		MNES impact assessment area	Project footprint[2]
Lowland rainforest of subtropical Australia	CE	0.00	0.00
Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	422.18	62.89
Coolibah—black box woodlands of the Darling Riverine Plains and the Brigalow Belt South	E	0.00	0.00
Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	CE	0.95	0.00
Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions	E	0.00	0.00
Weeping myall woodlands	E	641.81	39.72
White box–yellow box–Blakely's red gum grassy woodland and derived native grassland	E	38.79	0.00
Poplar box grassy woodland on alluvial plains	E	641.81	39.72

Table note:
1. CE = Critically Endangered, E = Endangered
2. Subject to confirmation through detailed ecological surveys of the Project footprint

A single endangered TEC identified in the desktop study (brigalow (*Acacia harpophylla* dominant and co-dominant), was observed during field surveys and confirmed as occurring approximately 20 km north of Inglewood within the impact assessment area (refer Photograph 10.11), as well as other locations further south–west in proximity to Yelarbon (refer Photograph 10.12).

Queensland RE mapping indicates that heterogeneous polygons, including remnant RE 11.3.2 (analogous to the Weeping myall woodlands and Poplar box woodlands TECs) occur within the impact assessment area and Project footprint. The occurrence of these communities could not be confirmed due to a lack of property access at the time of Project surveys. The location and extent of mapped TECs within the impact assessment area is presented in Section 10.10.1 and Table 10.9.

Detailed ecological surveys of the Project footprint will be undertaken to identify the accuracy of the vegetation mapping and the extent to which TECs actually occur within the vicinity of the Project footprint.

PHOTOGRAPH 10.11 BRIGALOW TEC IDENTIFIED WITHIN THE IMPACT ASSESSMENT AREA NORTH OF INGLEWOOD

Source: FFJV, 2018

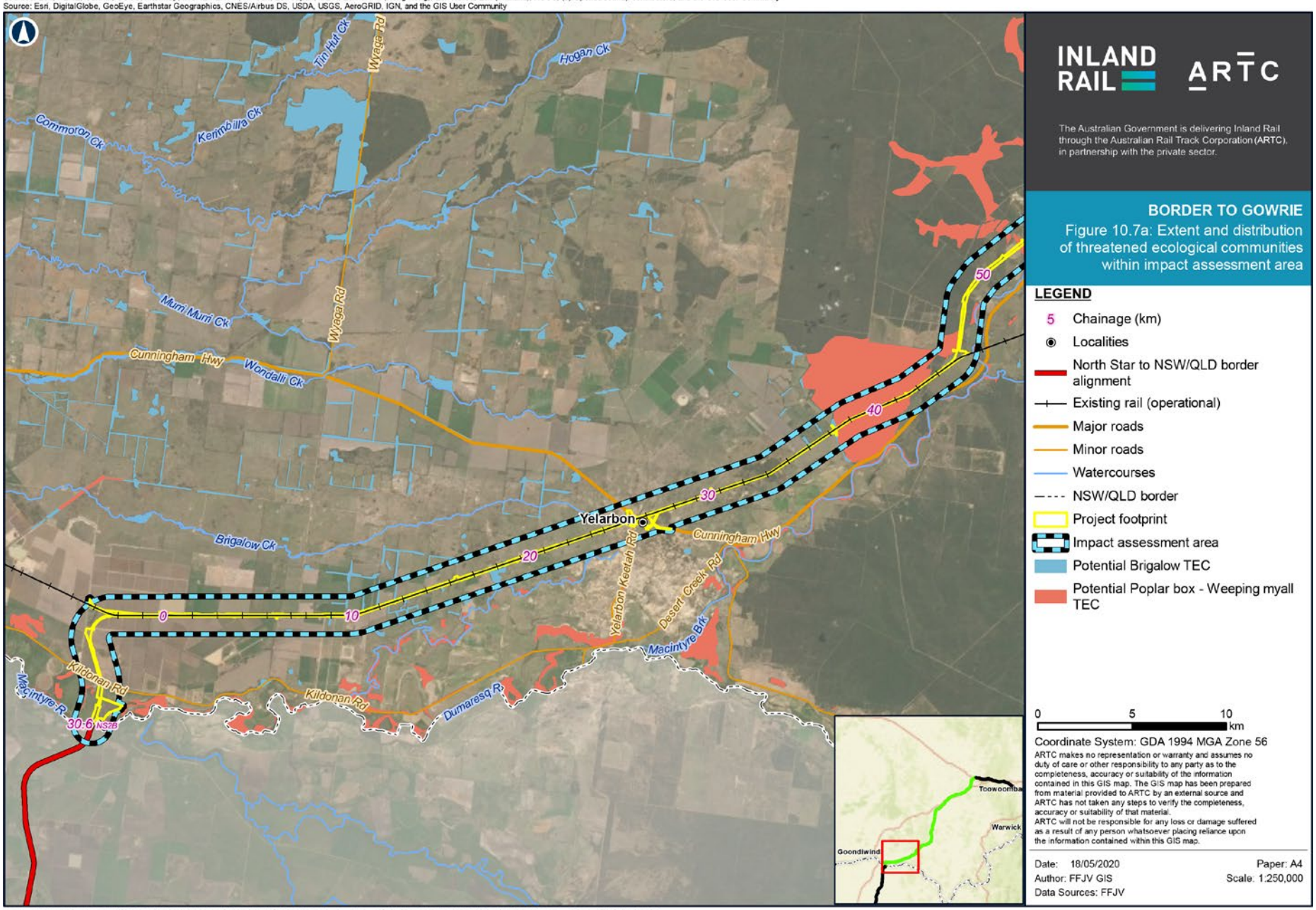
PHOTOGRAPH 10.12 BRIGALOW TEC IDENTIFIED WITHIN THE IMPACT ASSESSMENT AREA IN PROXIMITY TO YELARBON

Source: FFJV, 2018

10.5.3.4 Weeds species

In total, 121 non-native terrestrial flora species were identified during the field surveys (refer Appendix J: Terrestrial Ecology Technical Report). Of these species, 17 'category three restricted matter' flora species as listed under the *Biosecurity Act 2014* (Qld) were observed growing within the impact assessment area. One of these species, *Senecio madagascariensis* (fireweed) was not identified from the desktop assessment.

The 17 restricted matter flora species (i.e. noxious weeds) observed in the impact assessment area are listed in Table 10.10. Each of these species occurs in greatest densities in areas of previous disturbance, particularly along fence lines.


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Tim Hut Ck
Wyaga Rd
Hogan Ck
Commoron Ck
Kerimbilla Ck
Murri Murri Ck
Cunningham Hwy
Wondalli Ck
Yelarbon
Brigalow Ck
Yelarbon Keetah Rd
Desert Creek Rd
Macintyre Brk
Kildonan Rd
Macintyre R
Dumaresq R
NSW
QLD
0
10
20
30
40
50
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.7a: Extent and distribution of threatened ecological communities within impact assessment area
LEGEND
Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Potential Brigalow TEC
Potential Poplar box - Weeping myall TEC
0
5
10
km
Coordinate System: GDA 1994 MGA Zone 56
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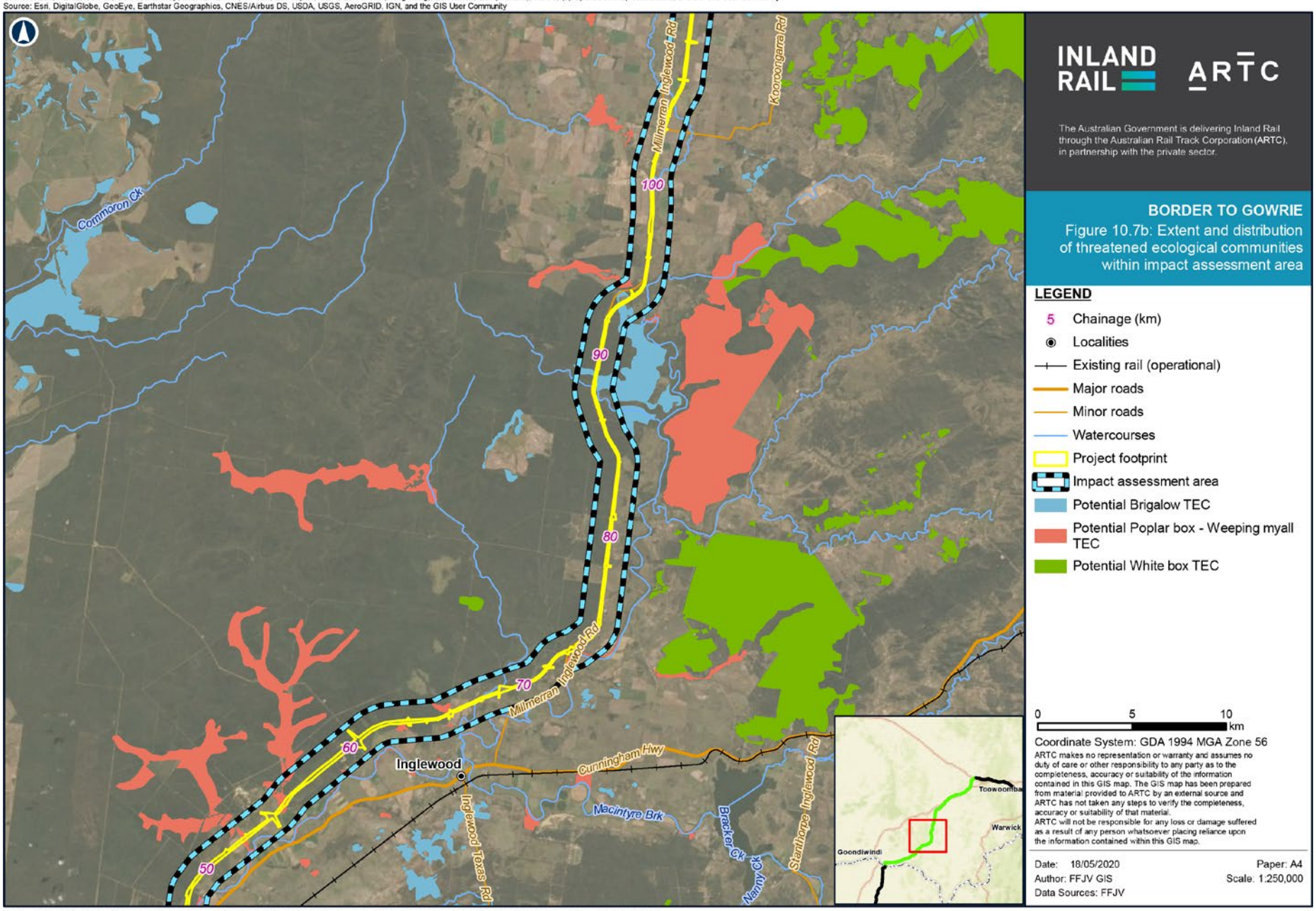
Author: FFJV GIS
Scale: 1:250,000
Data Sources: FFJV
Map by: RAZ/GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.7_TEC_v2.mxd Date: 18/05/2020 17:34


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Commoron Ck
Millmerran Inglewood Rd
Kooroongarra Rd
100
90
80
70
60
50
Inglewood
Cunningham Hwy
Macintyre Brk
Inglewood Texas Rd
Bracker Ck
Nanny Ck
Stanthorpe Inglewood Rd
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.7b: Extent and distribution of threatened ecological communities within impact assessment area
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Potential Brigalow TEC
Potential Poplar box - Weeping myall TEC
Potential White box TEC
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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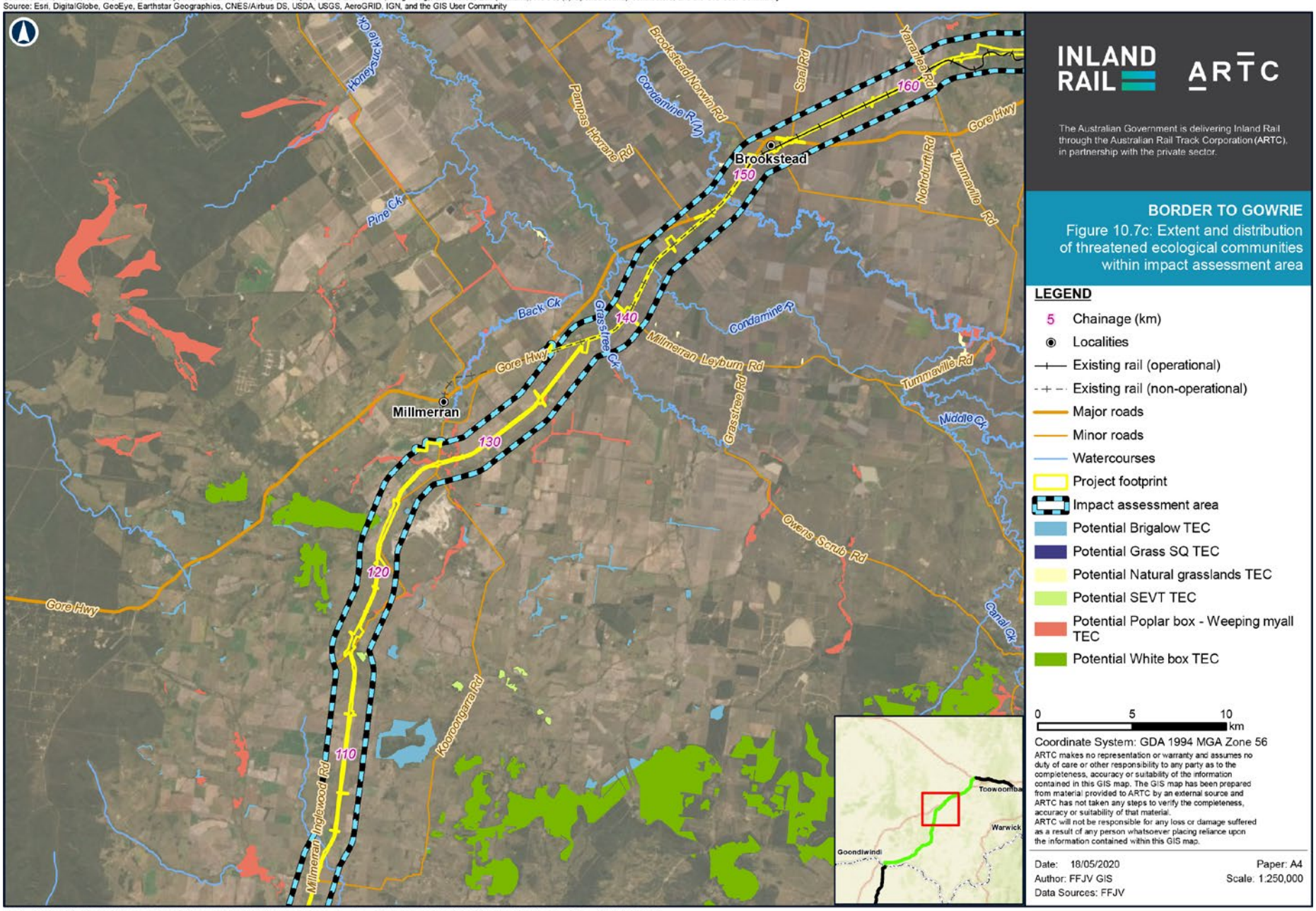
Date: 18/05/2020
Paper: A4
Author: FFJV GIS
Scale: 1:250,000
Data Sources: FFJV
Map by: RAZ/GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.7_TEC_v2.mxd Date: 18/05/2020 17:34


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Brookstead
Millmerran
Gore Hwy
Pine Ck
Back Ck
Grasstree Ck
Condamine R
Millmerran Leyburn Rd
Tummaville Rd
Middle Ck
Owens Scrub Rd
Canal Ck
Koorcongeral Rd
Millmerran Inglewood Rd
Brookstead Norwin Rd
Pompais Horrane Rd
Saall Rd
Yarranlea Rd
Nothdurft Rd
Honeysuckle Ck
160
150
140
130
120
110
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.7c: Extent and distribution of threatened ecological communities within impact assessment area
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Existing rail (non-operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Potential Brigalow TEC
Potential Grass SQ TEC
Potential Natural grasslands TEC
Potential SEVT TEC
Potential Poplar box - Weeping myall TEC
Potential White box TEC
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
ARTC makes no representation or warranty and assumes no duty of care or other responsibility to any party as to the completeness, accuracy or suitability of the information contained in this GIS map. The GIS map has been prepared from material provided to ARTC by an external source and ARTC has not taken any steps to verify the completeness, accuracy or suitability of that material.
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Date: 18/05/2020
Author: FFJV GIS
Data Sources: FFJV
Paper: A4
Scale: 1:250,000
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Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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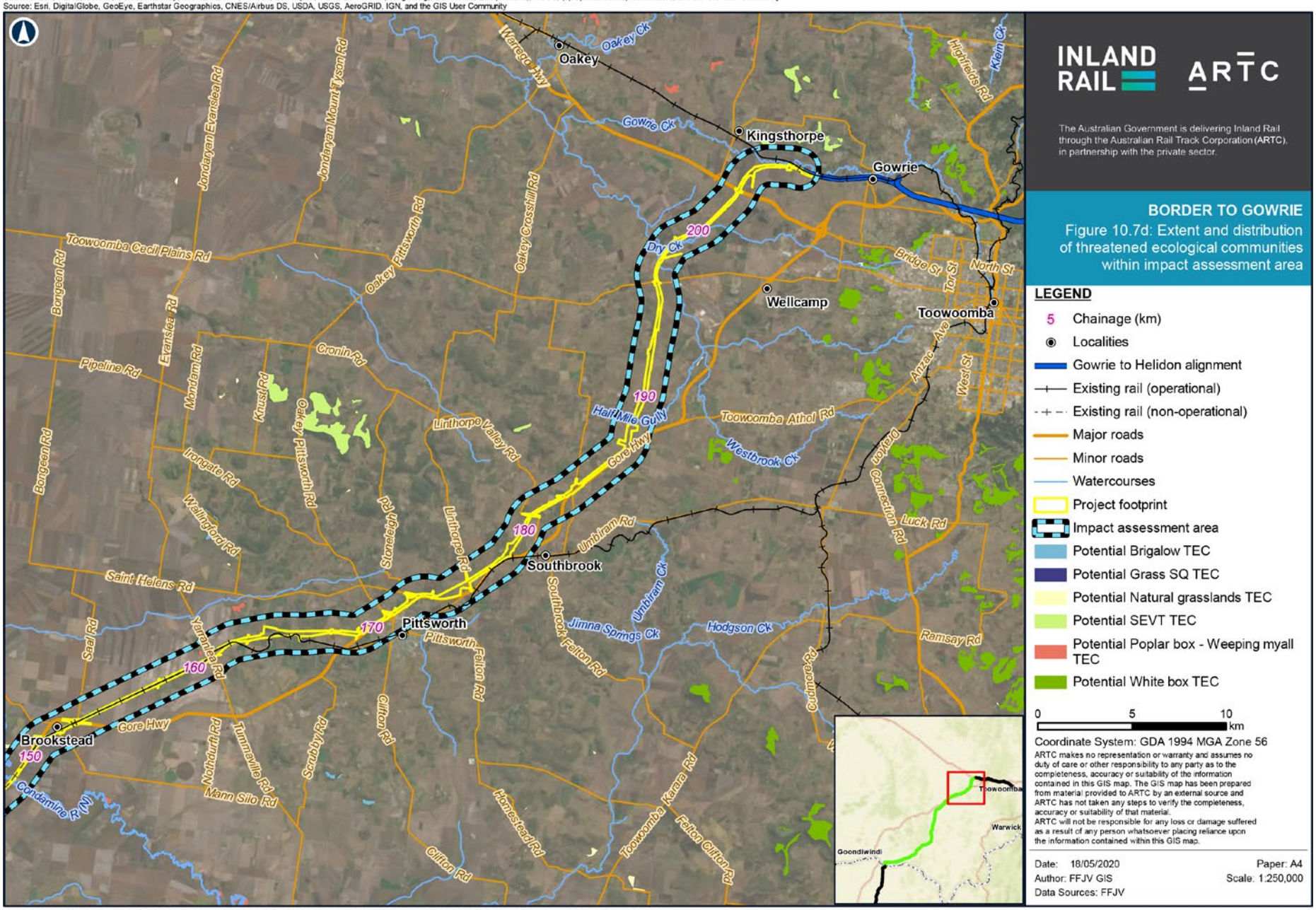

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BORDER TO GOWRIE

Figure 10.7d: Extent and distribution of threatened ecological communities within impact assessment area

LEGEND

- 5 Chainage (km)
- Localities
- Gowrie to Helidon alignment
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Project footprint
- Impact assessment area
- Potential Brigalow TEC
- Potential Grass SQ TEC
- Potential Natural grasslands TEC
- Potential SEVT TEC
- Potential Poplar box - Weeping myall TEC
- Potential White box TEC

0 5 10 km

Coordinate System: GDA 1994 MGA Zone 56

Date: 18/05/2020 Paper: A4
Author: FFJV GIS Scale: 1:250,000
Data Sources: FFJV

Map by: RAZ/GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.7_TEC_v2.mxd Date: 18/05/2020 17:34

TABLE 10.10 RESTRICTED MATTERS (NOXIOUS WEEDS) IDENTIFIED WITHIN THE IMPACT ASSESSMENT AREA

Family name	Species name	Common name	Weeds of national significance	Schedule 2 of the Biosecurity Act[1]	Relative abundance within impact assessment area
Asparagaceae	*Asparagus africanus*	Ornamental asparagus	No	Category 3	Widespread and common. Highest densities south of Inglewood
Asparagaceae	*Asparagus plumosus*	Feathered asparagus fern	Yes	Category 3	Widespread and common
Bignoniaceae	*Dolichandra unguis-cati*	Cat's claw creeper	Yes	Category 3	Widespread and common
Verbenaceae	*Lantana camara*	Lantana	Yes	Category 3	Widespread and common
Poaceae	*Sporobolus spp.*	Giants rats tail grass	No	Category 3	Widespread and common
Asteraceae	*Ambrosia artemisiifolia*	Annual ragweed	No	Category 3	Widespread and common. Highest densities south of Inglewood
Asteraceae	*Tamarix aphylla*	Athel pine	No	Category 3	Widespread and common. Highest densities south of Inglewood
Cactaceae	*Opuntia aurantiaca*	Tiger pear	Yes	Category 3	Widespread and common. Highest densities south of Inglewood
Cactaceae	*Harrisia martinii*	Harrisia cactus	No	Category 3	Widespread and common. Highest densities south of Inglewood
Cactaceae	*Opuntia stricta*	Prickly pear	Yes	Category 3	Widespread and common. Highest densities south of Inglewood
Cactaceae	*Opuntia tomentosa*	Velvety tree pear	Yes	Category 3	Widespread and common. Highest densities south of Inglewood
Crassulaceae	*Bryophyllum delagoense*	Mother-of-millions	Yes	Category 3	Widespread and common. Highest densities south of Inglewood
Oleaceae	*Ligustrum lucidum*	Broad-leaf privet	No	Category 3	Common near Toowoomba
Solanaceae	*Lycium ferocissimum*	African boxthorn	Yes	Category 3	Widespread and common
Ulmaceae	*Celtis sinensis*	Chinese celtis	No	Category 3	Widespread and common
Basellaceae	*Anredera cordifolia*	Madeira vine	Yes	Category 3	Widespread and common
Asteraceae	*Senecio madagascariensis*	Fireweed	Yes	Category 3	Widespread and common

Table note:

1. Category 3 = includes noxious fish, weeds and pest animals. People must not distribute this restricted matter. This means it must not be given as a gift, sold, traded or released into the environment unless the distribution or disposal is authorised in a regulation or under permit.

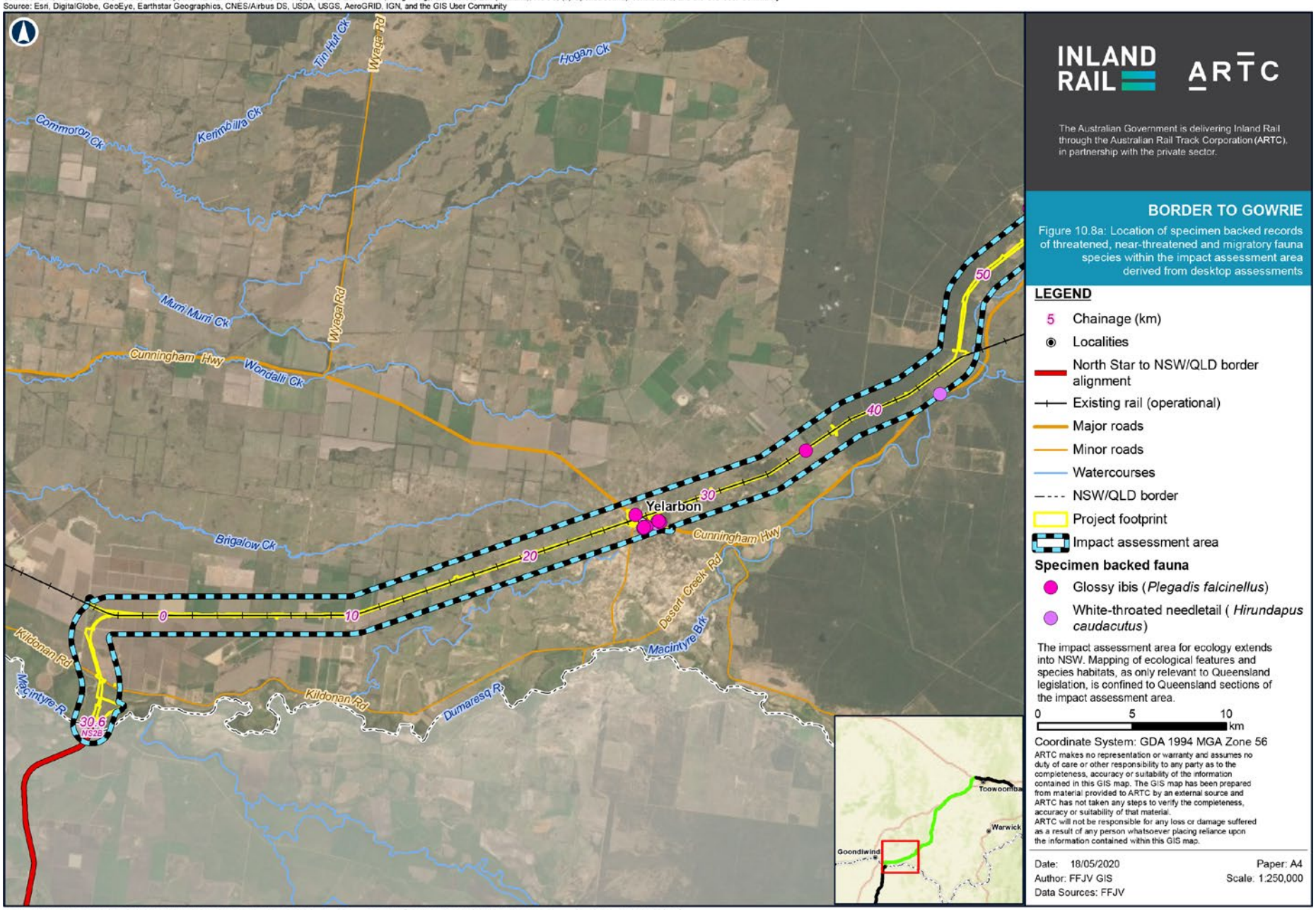
10.5.4 Fauna

A total of 36 threatened or near-threatened fauna species identified under the EPBC Act and/or NC Act are predicted, based on predictive habitat mapping, to occur within the impact assessment area. In addition, 15 non-threatened migratory species as listed under the EPBC Act and two SLC mammals (i.e. short-beaked echidna and platypus) are also predicted to occur within the impact assessment area. The location of specimen-backed records for threatened, near-threatened and migratory fauna species, derived from database sources (e.g. Birds Australia, WildNet and Atlas of Living Australia) that are known from the impact assessment area is provided in Figure 10.8a–d.

Field surveys identified a total of 130 terrestrial fauna species, including 119 (91.5 per cent) native species and 11 (8.5 per cent) non-native species, 9 of which were restricted matters (refer Table 10.11). Recorded species consisted of 91 (70 per cent) birds, 26 (20 per cent) mammals, 10 (8 per cent) reptiles, and 3 (2 per cent) amphibians (refer Appendix J: Terrestrial Ecology Technical Report). Given the fragmented nature of bushland areas within the impact assessment area, their vagile nature and ability to persist in fragmented landscapes it is to be expected that birds would constitute the largest percentage of observed species; however, their dominance of the recorded species is also likely to 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 that included 12 native and three non-native species (i.e. introduced fish).

A comprehensive list of fauna species recorded within the impact assessment area is available in Appendix J: Terrestrial Ecology Technical Report, Appendix K: Aquatic Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report.


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Tin Hut Ck
Wyaga Rd
Hogan Ck
Commoron Ck
Kerrimbilla Ck
Murri Murri Ck
Wyaga Rd
Cunningham Hwy
Wondalli Ck
Yelarbon
Brigalow Ck
Cunningham Hwy
Desert Creek Rd
Macintyre Brk
Kildonan Rd
Macintyre R
Kildonan Rd
Dumaresq R
0
10
20
30
40
50
30.6
NS2B
Toowoomba
Warwick
Goondiwindi
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BORDER TO GOWRIE
Figure 10.8a: Location of specimen backed records of threatened, near-threatened and migratory fauna species within the impact assessment area derived from desktop assessments
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Specimen backed fauna
Glossy ibis (Plegadis falcinellus)
White-throated needletail (Hirundapus caudacutus)
The impact assessment area for ecology extends into NSW. Mapping of ecological features and species habitats, as only relevant to Queensland legislation, is confined to Queensland sections of the impact assessment area.
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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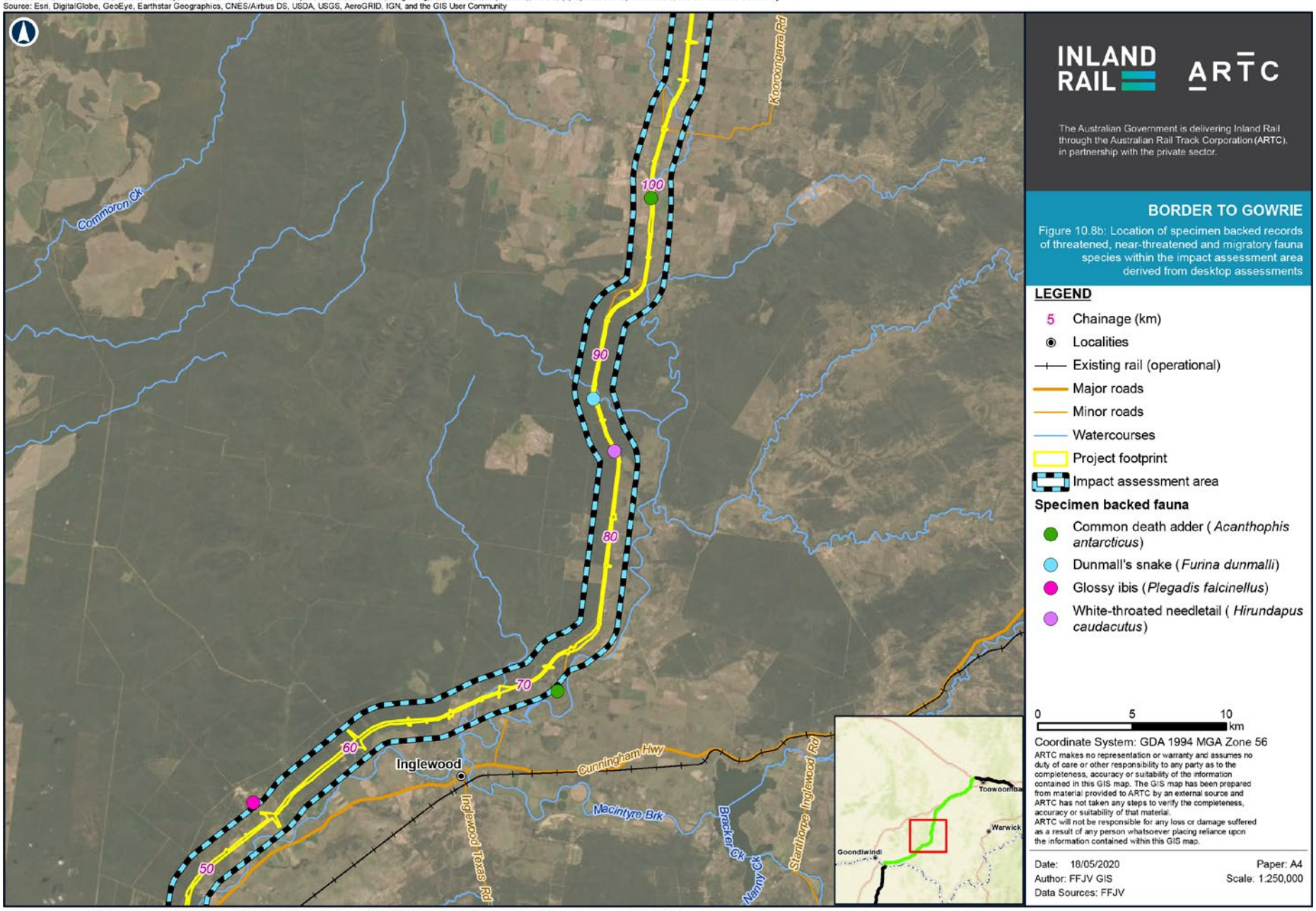
Scale: 1:250,000
Data Sources: FFJV
Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.8_DesktopFauna_v2.mxd Date: 18/05/2020 17:36


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Commoron Ck
Kooroongarra Rd
100
90
80
70
60
50
Inglewood
Cunningham Hwy
Macintyre Brk
Inglewood Texas Rd
Bracker Ck
Nanny Ck
Stanthorpe Inglewood Rd
Toowoomba
Warwick
Goondiwindi
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BORDER TO GOWRIE
Figure 10.8b: Location of specimen backed records of threatened, near-threatened and migratory fauna species within the impact assessment area derived from desktop assessments
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Specimen backed fauna
Common death adder (Acanthophis antarcticus)
Dunmall's snake (Furina dunmalli)
Glossy ibis (Plegadis falcinellus)
White-throated needletail (Hirundapus caudacutus)
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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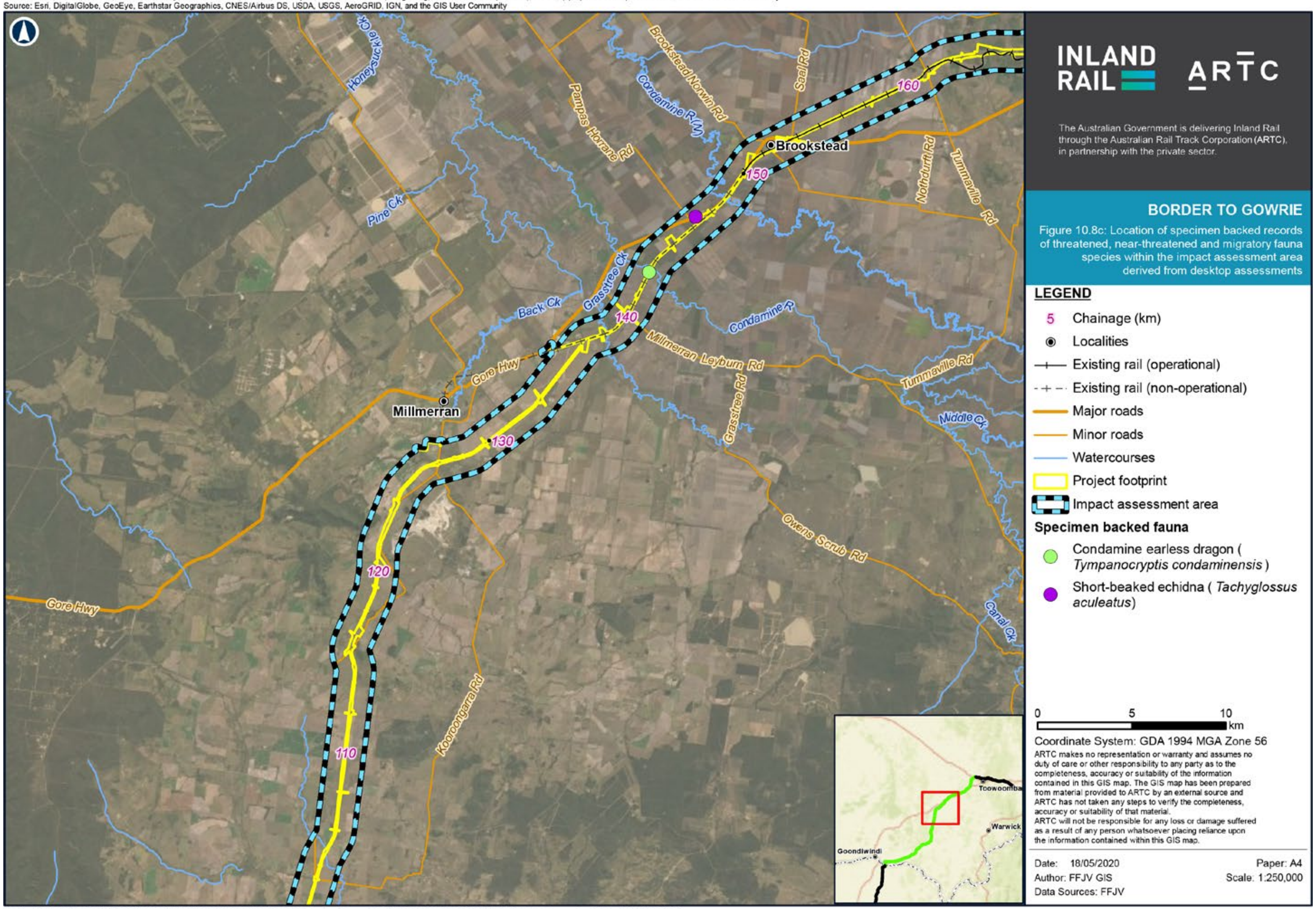
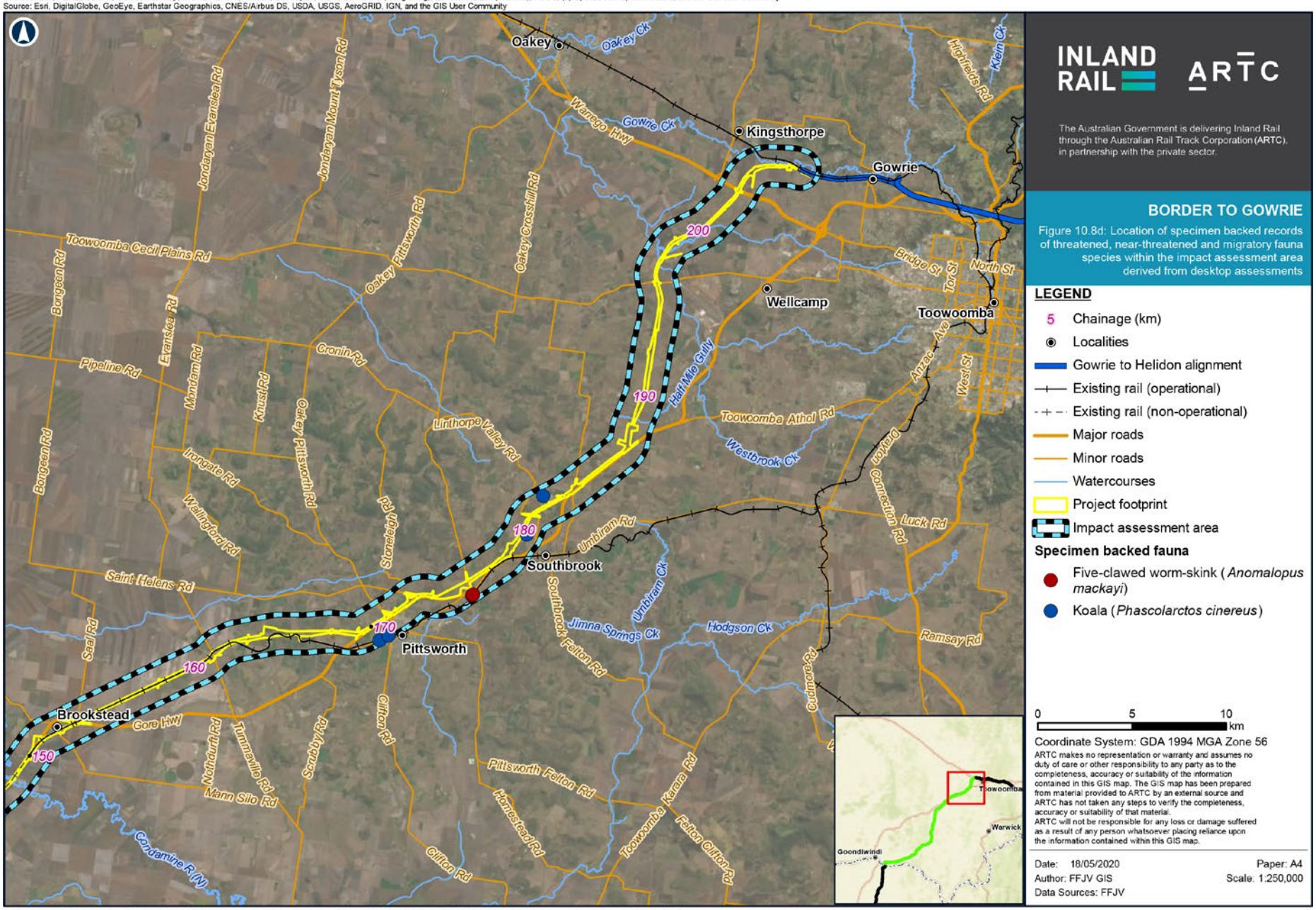
Paper: A4
Author: FFJV GIS
Scale: 1:250,000
Data Sources: FFJV
Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.8_DesktopFauna_v2.mxd Date: 18/05/2020 17:36

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.8_DesktopFauna_v2.mxd Date: 18/05/2020 17:36

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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BORDER TO GOWRIE

Figure 10.8d: Location of specimen backed records of threatened, near-threatened and migratory fauna species within the impact assessment area derived from desktop assessments

LEGEND

- 5 Chainage (km)
- Localities
- Gowrie to Helidon alignment
- Existing rail (operational)
- Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses
- Project footprint
- Impact assessment area

Specimen backed fauna

- Five-clawed worm-skink (*Anomalopus mackayi*)
- Koala (*Phascolarctos cinereus*)

0 5 10 km

Coordinate System: GDA 1994 MGA Zone 56

Date: 18/05/2020 Paper: A4
Author: FFJV GIS Scale: 1:250,000
Data Sources: FFJV

Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.8_DesktopFauna_v2.mxd Date: 18/05/2020 17:36

10.5.4.1 Conservation significant species

Three threatened fauna species were recorded within the impact assessment area during field surveys. In addition, a fourth species may also potentially occur within the impact assessment area. These species consisted of the following:

- Grey-headed flying fox (*Pteropus poliocephalus*) was observed at a camp located on Macintyre Brook next to the township of Inglewood. This is a known flying-fox camp, which contained approximately 200–300 individuals at the time of survey.
- Condamine earless dragon (*Tympanocryptis condaminensis*) was identified in an existing rail reserve located between Millmerran and Brookstead (refer Photograph 10.13). Potential grassland on cracking clay habitat suitable for the species was identified throughout the area (refer Photograph 10.14).
- Murray cod (*Maccullochella peelii*) was recorded in the Macintyre River and Macintyre Brook during targeted surveys in 2019. Suitable habitat for the species was also identified in the Condamine River (refer Photograph 10.15).
- Microchiropteran call detection (i.e. Anabat) recorded a long-eared bat species from the genus *Nyctophilus* in proximity to the impact assessment area, near Whetstone State Forest. The species was also recorded as potentially occurring in the Canning Creek area (Bringalily State Forest) from the results of previous surveys for the Project (Eco Logical Australia, 2016). An identification to a species level is not possible for this genus on call detection alone; the adoption of the conservative approach and presence of suitable habitat within the local landscape (large tracts of woodlands with a relatively dense lower tree storey) lead to the assumption of presence for the south-eastern long-eared bat (*Nyctophilus corbeni*).

The locations of threatened fauna records are displayed in Figure 10.9.

PHOTOGRAPH 10.13 MODIFIED HABITAT IN WHICH CONDAMINE EARLESS DRAGON WAS OBSERVED WITHIN PROJECT FOOTPRINT

Source: FFJV, 2018

PHOTOGRAPH 10.14 GRASSLAND HABITAT SUITABLE FOR CONDAMINE EARLESS DRAGON WITHIN PROJECT FOOTPRINT

Source: FFJV, 2018

PHOTOGRAPH 10.15 CAPTURED MURRAY COD AND ASSOCIATED HABITAT WITHIN THE MACINTYRE RIVER (TOP) AND MACINTYRE BROOK (BOTTOM) WITHIN THE IMPACT ASSESSMENT AREA

Source: Eco Logical Australia, 2019

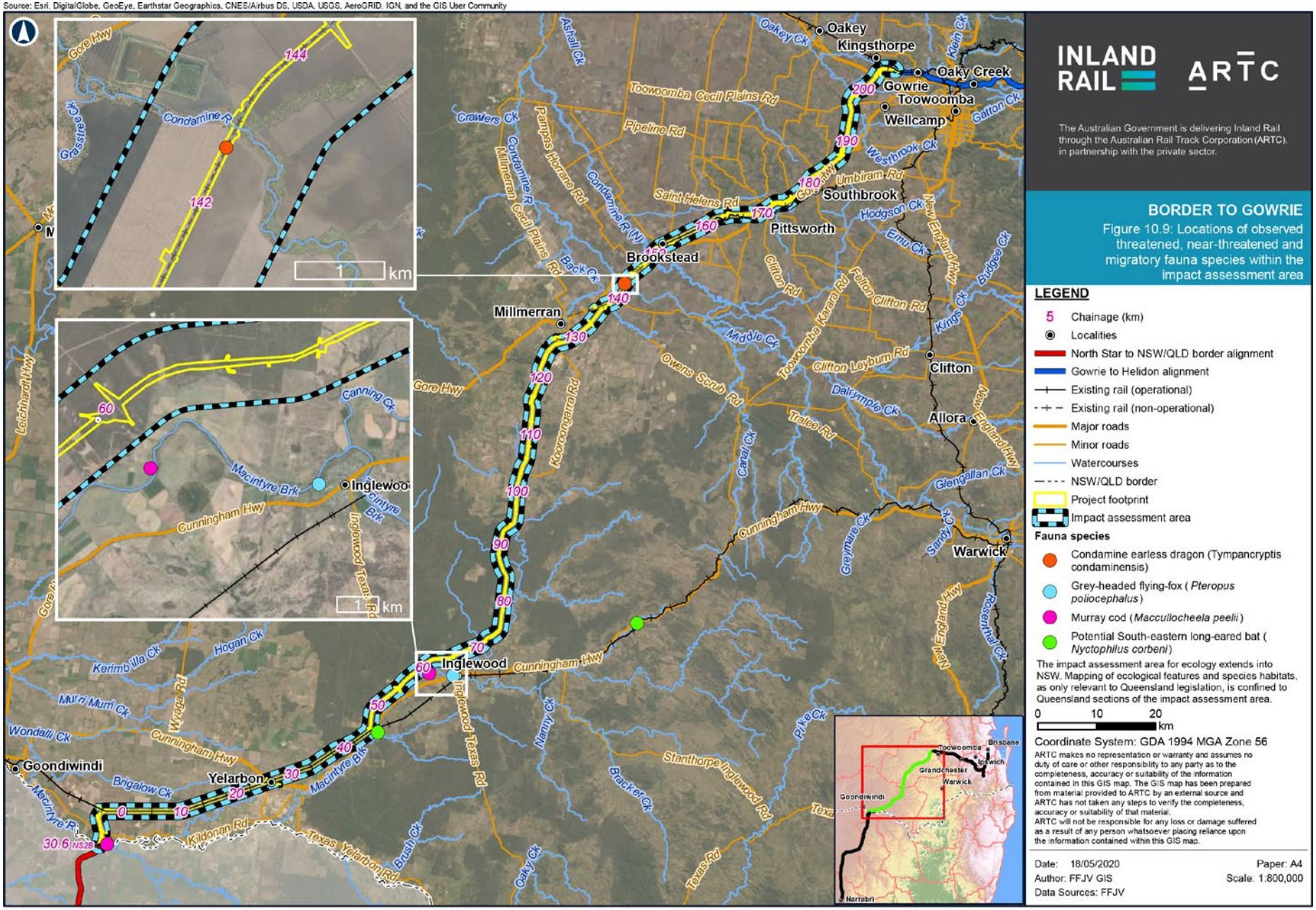
Field investigations also confirmed the presence of suitable fauna habitat (foraging and breeding), including the following:

- Confirmed habitat (primarily in areas containing eucalypt open forest/woodland communities) for the following species:
  - Regent honeyeater (*Anthocharea phrygia*)—box–ironbark woodlands
  - Squatter pigeon (*Geophaps scripta scripta*)—grassy woodlands on sandy soils in the Inglewood area
  - Painted honeyeater (*Grantiella picta*)—eucalypt/acacia woodlands
  - Large-eared pied bat (*Chalinolobus dwyeri*)—eucalypt woodlands in the Canning Creek area (in the vicinity of Wondul Range) and Gowrie Mountain
  - Yakka skink (*Egernia rugosa*)—eucalypt woodlands associated with the woodlands in State forests north of Inglewood
  - Five-clawed worm-skink (*Anomalopus mackayi*)—open woodlands and grasslands on cracking clays to the south of Millmerran and north-west of Toowoomba
  - Dunmall's snake (*Furina dunmalli*)—largely associated with the woodlands in State forests north of Inglewood
  - Koala (*Phascolarctos cinereus*)—eucalypt woodlands throughout, although preferentially in riparian habitat along drainage lines
  - Suitable habitat for forest/woodland migratory species such as the oriental cuckoo (*Cuculus optatus*), satin flycatcher (*Myiagra cyanoleuca*), rufous fantail (*Rhipidura rufifrons*), black-faced monarch (*Monarcha melanopsis*) and spectacled monarch (*Symposiachrus trivirgatus*) in the form of riparian forests and woodlands
  - Suitable habitat for wetland/wader migratory species such as in the form or wetlands and farm dams and ephemeral wetland areas
  - Glossy-black cockatoo (*Calyptorhynchus lathami*)—potential habitat where suitable food resources were available (i.e. *Allocasuarina torulosa, Allocasuarina littoralis*) within larger tracks of remnant vegetation and State forests
  - Echidna (*Tachyglossus aculeatus*)—occurrence of forests, woodlands and grasslands with areas suitable for breeding burrows
  - Platypus (*Ornithorinchus anatinus*)—larger drainage lines with permanent water and pools (e.g. Macintyre River).

The availability of habitat types and their relevance to threatened fauna is discussed further in Section 10.5.8. This information was used, in addition to that contained within relevant recovery plans and conservation listing advice, to inform the predictive habitat modelling for each of the threatened, migratory and SLC fauna species (refer Appendix J: Terrestrial Ecology Technical Report and Appendix L: Matters of National Environmental Significant Technical Report).

It is noted that while all areas of the Project footprint were not accessible due to land access issues, information derived from historic and concurrent surveys (refer Figure 10.2) was used to inform the predictive mapping for MNES fauna species where applicable.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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10.5.4.2 Aquatic fauna species

Aquatic macroinvertebrates

Macroinvertebrate sampling was undertaken in November 2018 and May 2019. Macroinvertebrate samples were collected in accordance with the *Queensland AusRivAS Sampling and Processing Manual* (DNRM, 2001). Freshwater macroinvertebrate sampling was undertaken to gain an improved understanding of the aquatic values, watercourse health and trophic interactions occurring at each site. Samples were collected from aquatic ecology survey sites that exhibited wetted habitat at the time of assessment. Due to dry conditions, this was limited to Site 2 (Macintyre River) and Site 16 (Bringalily Creek) in November 2018, and Site 2 (Macintyre River), Sites 6R and 7 (Macintyre Brook), Site 18 Bringalily Creek and Site 42 (Dry Creek) in May 2019.

A total of 26 taxa were identified from 523 aquatic macroinvertebrates collected from two sites in November 2018. Taxa richness was slightly more diverse in the samples collected from Bringalily Creek (Site 16; 19 taxa) than in the samples collected from the Macintyre River (Site 2; 18 taxa). Taxa richness was greater in the edge habitat at each site than in the bed habitat, likely owing to the greater habitat complexity and food sources.

A total of 54 taxa were identified from 1,785 aquatic macroinvertebrates collected from five sites in May 2019. Taxa richness was most diverse in the Macintyre River (Site 2; 34 taxa), with slightly lower diversity at sites 18 (30 taxa), 42 (29 taxa), 6R (28 taxa) and 7 (27 taxa). This is likely a reflection of the lower (yet sustained) flow producing greater habitat complexity at Site 2, including varying depths, velocities and substrate sizes.

The most taxa-rich orders were *Hemiptera* (aquatic bugs), *Coleoptera* (beetles) and *Diptera* (true flies) in both the November 2018 and May 2019 sampling rounds.

Aquatic macro-crustaceans

Macro-crustaceans seen with the naked eye were collected using fish sampling techniques. Specimens were collected and retained for identification. All macro-crustaceans collected using fishing apparatus were returned to the water following identification. In total, three macro-crustacean families: *Palaemonidae* (freshwater prawns), *Atyidae* (freshwater shrimp) and *Parastacidae* (yabbies), were encountered within the impact assessment area. Individuals from the family *Palaemonidae* were identified as *Macrobrachium australiense*. Individuals from the family *Atyidae* were identified as *Paratya australiense*. Individuals from the family *Parastacidae* were identified as *Cherax destructor*. Further details on macro-crustaceans are discussed within Appendix H: Aquatic Ecology Technical Report.

Fish

Field surveys confirmed the presence of several native and pest fish species across the impact assessment area and yielded the following results:

- No fish captured in bait traps during the June 2018 survey, predominantly due to dry conditions and limitations of the sampling method
- A total of 202 fish representing nine species were caught across the two sites in November 2018 with sufficient water for investigation
- A total of 1,865 fish representing 12 species were caught across the five sites in May 2019 with sufficient water for investigation.

The presence and abundance of fish species at many sites is likely to have been limited by the dry conditions during the approximate 12-month survey period. A greater diversity and abundance of fish across watercourses of the impact assessment area is therefore assumed for the purposes of impact assessment.

The Murray cod was confirmed to be present in the Macintyre River and Macintyre Brook (refer Section 10.5.4.1), and is assumed to be present in other large watercourses of the impact assessment area, including the Condamine River and larger tributaries based on microhabitat features and predictive habitat mapping (refer Appendix K: Aquatic Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report). Many of the fish species found or assumed to be present in watercourses of the impact assessment area undertake migration, including bony bream, Murray river rainbowfish, Australian smelt and Murray cod.

The silver perch was not identified within the impact assessment area and it is not expected that this species will occur (refer Appendix K: Aquatic Ecology Technical Report).

10.5.4.3 Invasive animals

Database searches identified nine category 3 restricted matter invasive animal species under the *Biosecurity Act 2014* (Qld) within the impact assessment area; one of which was not identified during the desktop assessment but was observed in the field. These restricted matter fauna species are listed in Table 10.11.

TABLE 10.11 RESTRICTED MATTER FAUNA SPECIES IDENTIFIED WITHIN THE IMPACT ASSESSMENT AREA

Family name	Species name	Common name	Schedule 2 of the *Biosecurity Act 2014 (Qld)**	Relative abundance
Felidae	*Felis catus*	Cat	Category 3	Widespread
Leporidae	*Lepus europaeus*	Hare	Category 3	Widespread
Leporidae	*Oryctolagus cuniculus*	Rabbit	Category 3	Widespread
Canidae	*Canis lupus dingo*	Dingo	Category 3	Widespread
Canidae	*Canis lupus familiaris*	Dog	Category 3	Widespread
Canidae	*Vulpes vulpes*	European fox	Category 3	Widespread
Suidae	*Sus scrofa*	Feral pig	Category 3	Widespread
Poeciliidae	*Gambusia holbrooki*	Mosquitofish	Category 3, 5, 6	Widespread
Cyprinidae	*Cyprinus carpio*	European carp	Category 3, 5, 6	Widespread

Table notes:

* *Biosecurity Act 2014* (Qld), DAF Queensland Government; Biosecurity category 3: A person must not distribute the invasive species either by sale or gift, release it into the environment; Biosecurity category 5: A person must not keep the invasive species; Biosecurity category 6: Includes certain invasive animals such as foxes, rabbits, wild dogs, feral deer and noxious fish such as carp, gambusia and tilapia. You must not feed this category of restricted matter.

The wild dog check fence is located north of the existing rail corridor at Yelarbon, running adjacent to the Project footprint from Ch 27.5 km to Ch 44 km. The Project alignment intersects the wild dog check fence at four locations between Yelarbon and Millmerran within the Goondiwindi LGA, at Ch 50.0 km, Ch 51.0 km, Ch 54.5 km and Ch 56.0 km. The Goondiwindi Regional Council (GRC) is responsible for the ongoing maintenance of approximately 283 km of the wild dog check fence.

In addition, the Project alignment intersects the 555-km long Darling Downs–Moreton Rabbit Board (DDMRB) rabbit-proof fence when traversing through the locality of Clontarf, at Ch 120.2 km. Management and maintenance of the fence is provided 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 barrier fence. The management of impacts associated with severance of biosecurity fencing is addressed in Chapter 7: Land Use and Tenure.

10.5.5 Wildlife and koala mapping and Biodiversity Planning Assessment mapping

10.5.5.1 Matters of State environmental significance wildlife and essential habitat mapping

Habitat for threatened flora and fauna (including some SLC animals) as listed under the NC Act and the Nature Conservation (Animals) Regulation 2020 (the Animals Regulation) are defined as MSES under the SPP. This includes areas listed as 'essential habitat' for threatened species as mapped under the VM Act.

Mapped MSES wildlife habitat and essential habitat mapping occurring within the Project footprint is shown in Figure 10.10 and quantified in Table 10.12.

TABLE 10.12 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WILDLIFE HABITAT PRESENT WITHIN THE IMPACT ASSESSMENT AREA

	Extent (ha)	
Identified wildlife habitat	Impact assessment area	Project footprint
MNES wildlife mapping	1,125.67	121.83
Essential habitat	1,299.96	117.31

10.5.5.2 Nature (Koala) Conservation Plan 2017 mapping

The impact assessment area is wholly contained within koala district A which is defined as SEQ under the *Planning Regulation 2017*, as defined by the *Nature Conservation (Koala) Conservation Plan 2017* (Queensland Government, 2017b), which categorises areas into four distinct categories (i.e. Koala Priority Areas, Koala Habitat Areas, Koala Habitat Restoration Areas, Locally Refined Koala Habitat Areas). The extent of these areas is shown in Figure 10.11 and defined in Table 10.13.

TABLE 10.13 THE EXTENT OF KOALA MAPPING WITHIN THE IMPACT ASSESSMENT AREA

	Extent (ha)	
Habitat category	**Impact assessment area**	**Project footprint**
Koala Priority Areas	0.00	0.00
Koala Habitat Areas	81.73	7.44
Koala Habitat Restoration Area—Koala Priority Area	0.00	0.00
Koala Habitat Restoration Areas	0.00	0.00
Locally Refined Koala Habitat Areas	0.00	0.00

10.5.5.3 Biodiversity Planning Assessment mapping

The BPA classifies areas according to their significance based on the presence of 'endangered', 'vulnerable' and 'near threatened' (EVNT) taxa. It excludes highly mobile fauna taxa (refer Appendix J: Terrestrial Ecology Technical Report for further information). The impact assessment area includes areas of State and regional habitat values for EVNT taxa. The extent of this habitat within the impact assessment area is provided in Table 10.14 and shown in Figure 10.12.

TABLE 10.14 THE EXTENT OF BIODIVERSITY PLANNING ASSESSMENT HABITAT VALUES WITHIN THE IMPACT ASSESSMENT AREA

	Extent (ha)	
Habitat values	**Impact assessment area**	**Project footprint**
Local or other values	111.32	5.19
Regional	1,245.98	95.23
State	6,567.49	419.82
State habitat for EVNT taxa	414.42	48.96

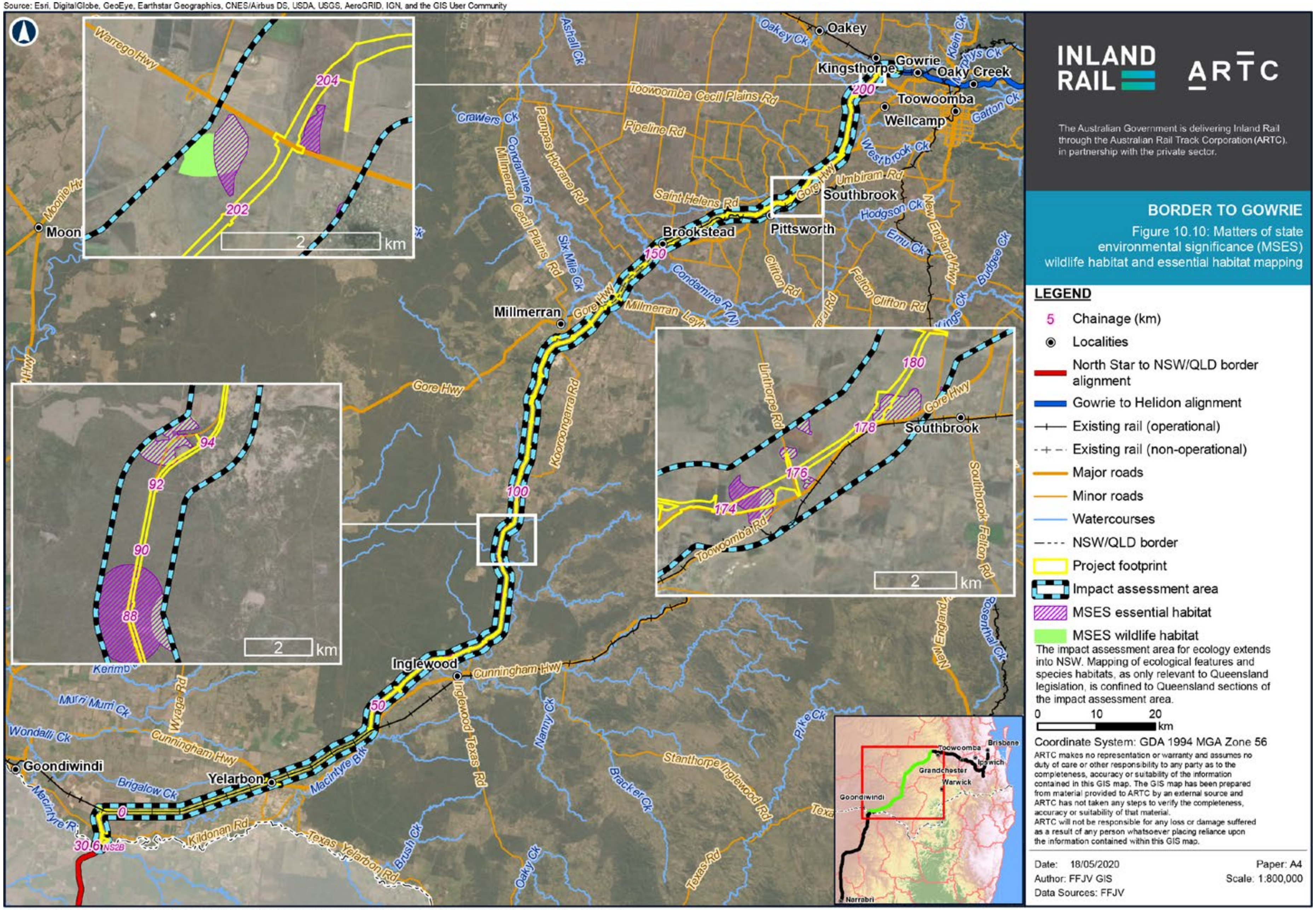
Areas identified as corridors under the BPA qualify either because they are existing vegetated corridors important for contiguity including regrowth or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and stepping stones.

The impact assessment area is traversed by terrestrial and riparian ecological corridors. The location of these corridors is provided in Figure 10.12 and quantified in Table 10.15.

TABLE 10.15 THE EXTENT OF BIODIVERSITY PLANNING ASSESSMENT TERRESTRIAL AND RIPARIAN ECOLOGICAL CORRIDORS WITHIN THE IMPACT ASSESSMENT AREA

	Extent (ha)	
Corridor type	**Impact assessment area**	**Project footprint**
Regional riparian	694.24	41.15
Regional riparian/terrestrial	2.07	0.00
Regional terrestrial	2,267.09	235.37
State riparian	936.46	37.42
State riparian/terrestrial	84.31	3.27
State terrestrial	3,314.80	161.39

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.10_MSES.mxd Date: 18/05/2020 11:32

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

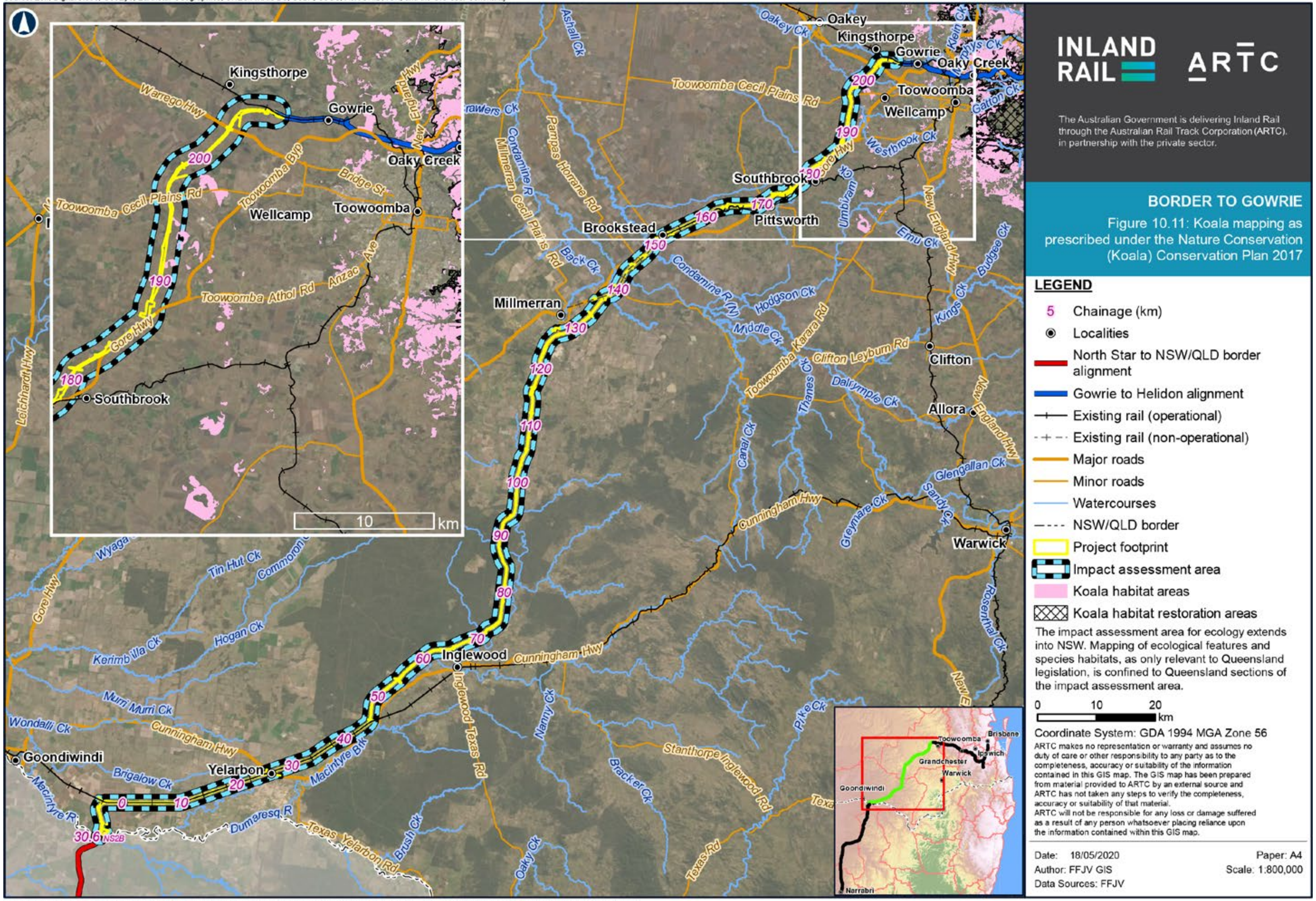
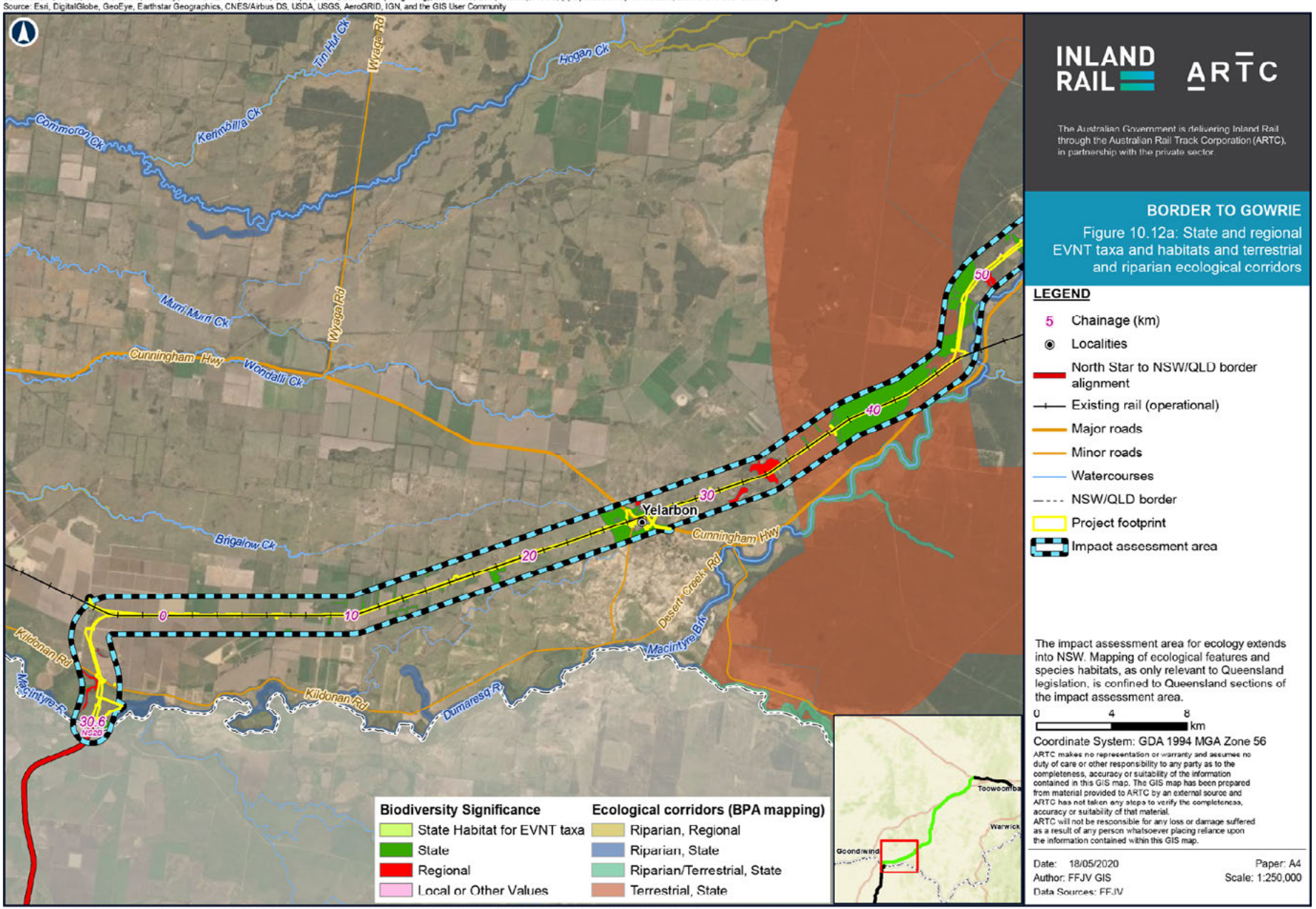


Figure 10.11: Koala mapping as prescribed under the Nature Conservation (Koala) Conservation Plan 2017

Map by: GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.11_KoalaMap.mxd Date: 18/05/2020 11:45


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Tin Hut Ck
Wyaga Rd
Hogan Ck
Commoron Ck
Kembilla Ck
Murri Murri Ck
Wyaga Rd
Cunningham Hwy
Wondalli Ck
Yelarbon
Brigalow Ck
Cunningham Hwy
Desert Creek Rd
Macintyre Brk
Kildonan Rd
Macintyre R
Kildonan Rd
Dumaresq R
0
10
20
30
40
50
30.6
NEW
Biodiversity Significance
State Habitat for EVNT taxa
State
Regional
Local or Other Values
Ecological corridors (BPA mapping)
Riparian, Regional
Riparian, State
Riparian/Terrestrial, State
Terrestrial, State
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.12a: State and regional EVNT taxa and habitats and terrestrial and riparian ecological corridors
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
The impact assessment area for ecology extends into NSW. Mapping of ecological features and species habitats, as only relevant to Queensland legislation, is confined to Queensland sections of the impact assessment area.
0 4 8
km
Coordinate System: GDA 1994 MGA Zone 56
ARTC makes no representation or warranty and assumes no duty of care or other responsibility to any party as to the completeness, accuracy or suitability of the information contained in this GIS map. The GIS map has been prepared from material provided to ARTC by an external source and ARTC has not taken any steps to verify the completeness, accuracy or suitability of that material.
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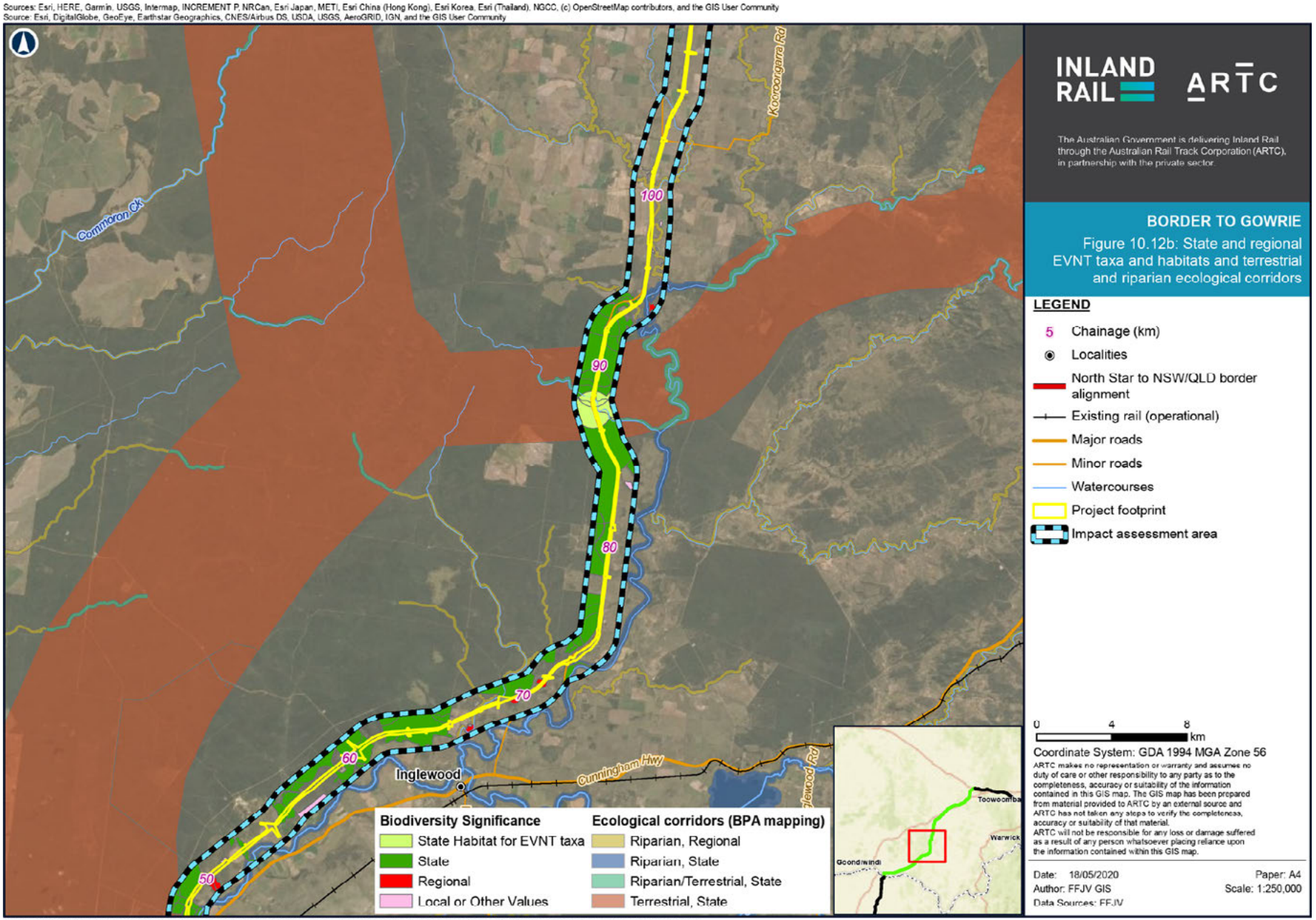
Date: 18/05/2020
Author: FFJV GIS
Data Sources: FFJV
Paper: A4
Scale: 1:250,000
Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.12_HabitatsEcoCorridors.mxd Date: 18/05/2020 17:38


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Commoron Ck
Kooroongarra Rd
Inglewood
Cunningham Hwy
100
90
80
70
60
50
Biodiversity Significance
State Habitat for EVNT taxa
State
Regional
Local or Other Values
Ecological corridors (BPA mapping)
Riparian, Regional
Riparian, State
Riparian/Terrestrial, State
Terrestrial, State
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
BORDER TO GOWRIE
Figure 10.12b: State and regional EVNT taxa and habitats and terrestrial and riparian ecological corridors
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
0 4 8 km
Coordinate System: GDA 1994 MGA Zone 56
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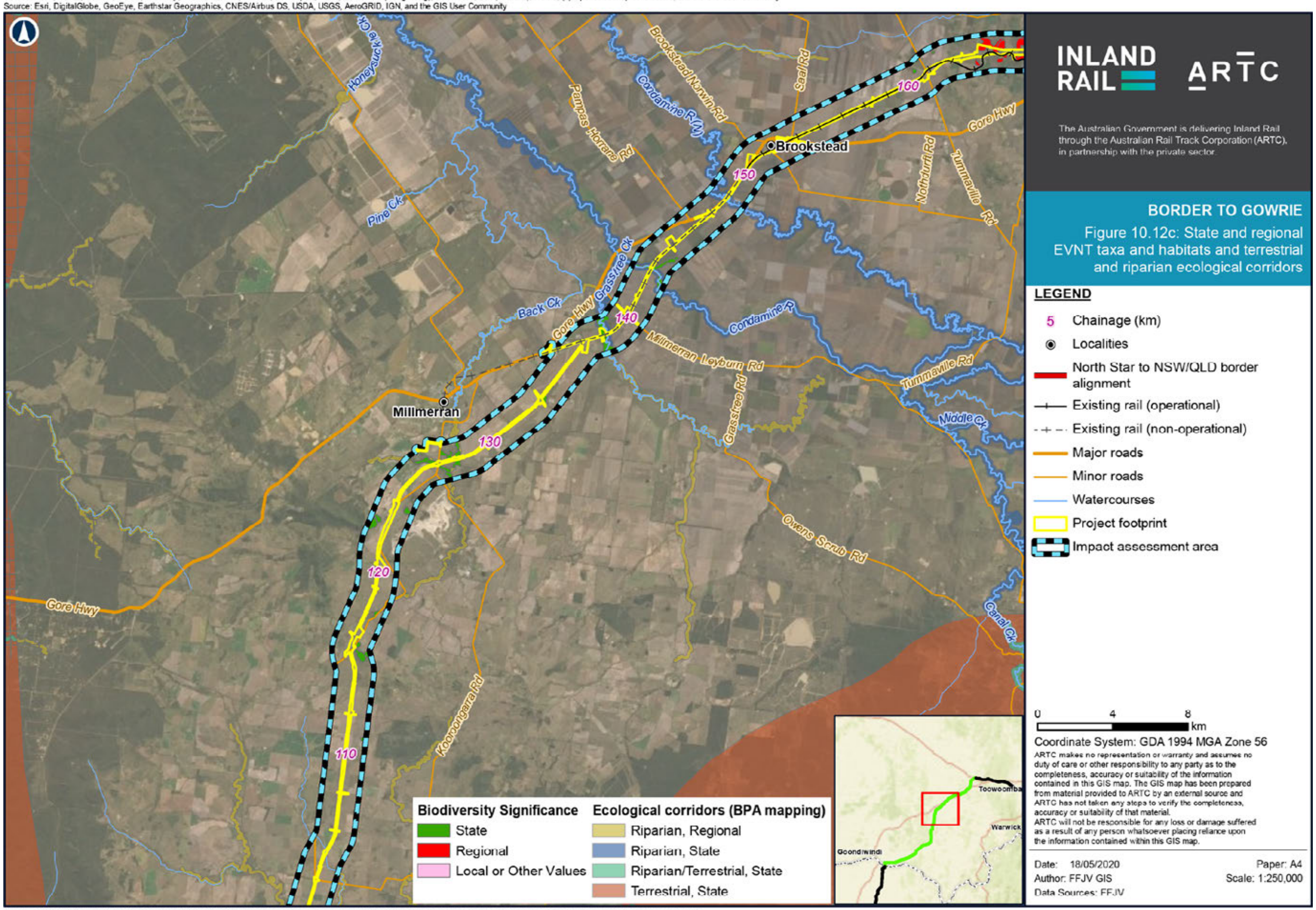
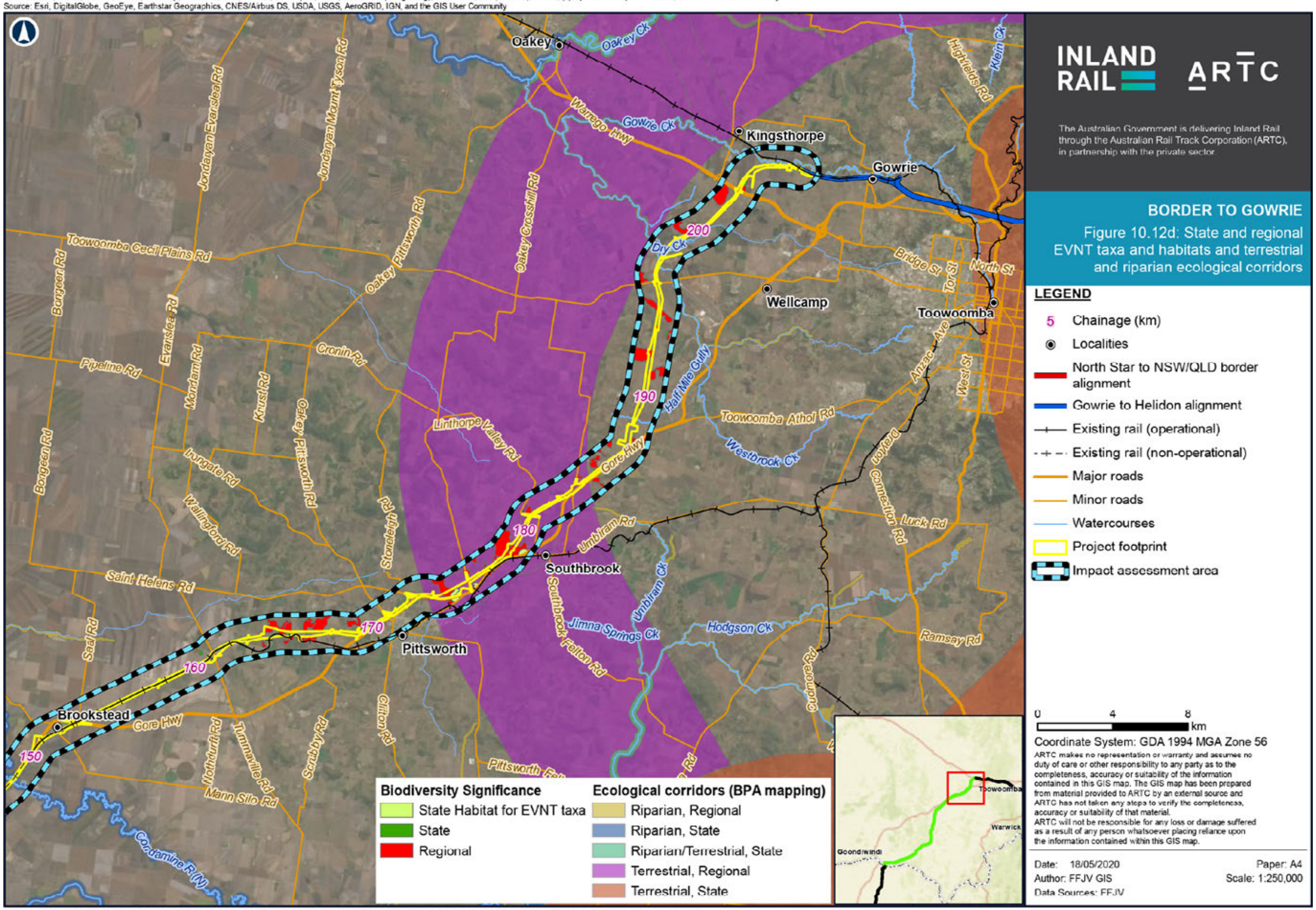
Date: 18/05/2020
Author: FFJV GIS
Data Sources: FFJV
Paper: A4
Scale: 1:250,000
Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.12_HabitatsEcoCorridors.mxd Date: 18/05/2020 17:38

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.12_HabitatsEcoCorridors.mxd Date: 18/05/2020 17:38

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: RAZ/GN/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.12_HabitatsEcoCorridors.mxd Date: 18/05/2020 17:38

10.5.6 Protected areas (Bringalily and Whetstone State forests)

Two protected areas (as defined under the *Forestry Act 1959* (Qld)) exist within the impact assessment area. These areas, including the extent contained within the impact assessment area, are presented in Table 10.16. Protected areas constitute a MSES, as they are listed under Schedule 2 of the *Environmental Offsets Regulation 2014.*

TABLE 10.16 PROTECTED AREAS IDENTIFIED AS OCCURRING WITHIN THE IMPACT ASSESSMENT AREA

Protected area	Extent contained within the impact assessment area (ha)	Extent contained within the Project footprint (ha)
Bringalily State Forest	2,761.74	101.73
Whetstone State Forest	990.77	22.99

Ecological values contained within Bringalily and Whetstone State forests

GIS analysis of habitat modelling (refer Section 10.4.4) and publicly available datasets (refer Section 10.4.3) indicates that potential impacts to a number of different MNES and MSES are likely to occur. The quantum of these features contained within each State forest is presented in Table 10.17, Table 10.18 and Table 10.19.

TABLE 10.17: COMMONWEALTH VALUES, LISTED UNDER THE EPBC ACT CONTAINED WITHIN BRINGALILY AND WHETSTONE STATE FORESTS

Species name	Common name	NC Act Status	EPBC Act status	Total combined habitat types (Bringalily State Forest) (ha)	Total combined habitat types (Whetstone State Forest) (ha)
Threatened Ecological Communities (TECs)					
Brigalow (*Acacia harpophylla* dominant and codominant)		-	E	2.25	2.55
Weeping myall woodlands		-	E	0.04	20.43
Poplar box grassy woodland on alluvial plains		-	E	0.04	20.43
Threatened Flora					
Acacia lauta	Tara wattle	V	V	98.86	2.43
Arthraxon hispidus	Hairy-joint grass	V	V	0.60	0.00
Cadellia pentastylis	Ooline	V	V	2.25	0.00
Eucalyptus virens	Shiny-leaved ironbark	V	V	96.62	2.43
Homopholis belsonii	Belson's panic	V	V	34.00	2.43
Lepidium monoplocoides	Winged peppercress	LC	E	96.62	2.43
Lepidium peregrinum	Wandering pepper-cress	LC	E	9.46	0.00
Macrozamia machinii	*Macrozamia*	V	V	56.67	0.00
Prostanthera sp. Dunmore	Dunmore prostanthera	V	V	17.99	0.00
Rhaponticum australe	Austral cornflower	V	V	9.43	0.00
Thesium australe	Austral toadflax	V	V	9.43	0.00
Tylophora lineari	Slender tylophora	E	E	87.23	0.00
Xerothamnella herbacea	*Xerothamnella*	E	E	2.25	2.55
Westringia parvifolia	*Westringia*	V	V	0.00	0.00
Threatened Fauna					
Anthochaera phrygia	Regent honeyeater	E	CE	17.99	0.00
Botaurus poiciloptilus	Australasian bittern	LC	E	2.19	0.00
Erythrotriorchis radiatus	Red goshawk	E	V	0.14	0.00

Species name	Common name	NC Act Status	EPBC Act status	Total combined habitat types (Bringalily State Forest) (ha)	Total combined habitat types (Whetstone State Forest) (ha)
Geophaps scripta scripta	Squatter pigeon—southern subspecies	V	V	9.48	2.43
Grantiella picta	Painted honeyeater	V	V	9.48	0.00
Lathamus discolor	Swift parrot	E	CE	12.29	2.43
Rostratula australis	Australian painted snipe	E	E	2.19	0.00
Falco hypoleucos	Grey falcon	V	V	11.66	0.00
Chalinolobus dwyeri	Large-eared pied bat	V	V	11.70	0.00
Dasyurus maculatus	Spotted-tailed quoll	V	E	9.81	0.00
Nyctophilus corbeni	South-eastern long-eared bat	V	V	98.92	22.99
Petauroides volans	Greater glider	V	V	17.99	0.00
Phascolarctos cinereus	Koala	V	V	98.92	2.43
Anomalopus mackayi	Five-clawed worm-skink	E	V	9.48	2.43
Delma torquata	Collared delma	V	V	63.55	2.43
Egernia rugosa	Yakka skink	V	V	98.92	2.43
Furina dunmalli	Dunmall's snake	V	V	98.29	0.00
Tympanocryptis condaminensis	Condamine earless dragon	E	E	11.72	0.00
Migratory Fauna					
Actitis hypoleucos	Common sandpiper	SL	M	2.96	0.00
Apus pacificus	Fork-tailed swift	SL	M	101.73	22.99
Calidris acuminata	Sharp-tailed sandpiper	SL	M	2.96	0.00
Calidris melanotos	Pectoral sandpiper	SL	M	2.96	0.00
Calidris ruficollis	Red-necked stint	SL	M	2.96	0.00
Cuculus optatus	Oriental cuckoo	SL	M	5.77	0.00
Gallinago hardwickii	Latham's snipe	SL	M	2.96	0.00
Monarcha melanopsis	Black-faced monarch	SL	M	5.77	0.00
Motacilla flava	Yellow wagtail	SL	M	2.96	0.00
Myiagra cyanoleuca	Satin flycatcher	SL	M	5.77	0.00
Pandion haliaetus	Osprey	SL	M	2.19	0.00
Plegadis falcinellus	Glossy ibis	SL	M	2.96	0.00
Rhipidura rufifrons	Rufous fantail	SL	M	5.77	0.00
Symposiachrus trivirgatus	Spectacled monarch	SL	M	5.77	0.00
Tringa nebularia	Common greenshank	SL	M	2.96	0.00

TABLE 10.18: STATE FLORA AND FAUNA VALUES, LISTED UNDER THE NC ACT VALUES CONTAINED WITHIN BRIGALILY AND WHETSTONE STATE FORESTS

Species name	Common name	NC Act status	Total combined habitat (Bringalily State Forest) (ha)	Total combined habitat (Whetstone State Forest) (ha)
Digitaria porrecta	Finger panic	NT	1.12	0.00
Picris barbarorum	Tall hawkweed	V	96.65	2.43
Acanthophis antarcticus	Common death adder	V	98.92	22.99
Calyptorhynchus lathami lathami	Glossy black-cockatoo	V	98.87	22.99
Lophochroa leadbeateri	Major Mitchell's cockatoo	V	98.92	22.99
Ornithorhynchus anatinus	Platypus	SLC	7.93	0.00
Tachyglossus aculeatus	Echidna	SLC	99.93	22.99

TABLE 10.19: STATE-BASED ENVIRONMENTAL FEATURES CONTAINED WITHIN BRIGALILY AND WHETSTONE STATE FORESTS

Sensitive environmental receptor	Bringalily State Forest (ha)	Whetstone State Forest (ha)
Endangered remnant vegetation (REs) (Category B)	2.25	2.55
Of concern remnant vegetation (REs) (Category B)	9.47	20.43
Least concern remnant vegetation (REs) (Category B)	87.20	0.00
MSES wildlife habitat	30.41	0.00
Essential habitat	47.04	0.00
BPA habitat values for EVNT taxa (State)	21.58	0.00
BPA State riparian corridors	3.20	0.00
BPA State terrestrial corridors	53.37	22.99

10.5.7 Predicted habitat for conservation significant species

Predicted habitat mapping for threatened, near-threatened, migratory species and SLC indicates that potential habitat for 22 flora and 43 fauna (26 threatened, 15 migratory and 2 SLC) species occurs within the impact assessment area (refer Table 10.20, Table 10.21 and Table 10.22). Areas of habitat for these species are provided in Table 10.20, Table 10.21 and Table 10.22 and mapped areas of habitat are provided in Appendix J: Terrestrial Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report.

TABLE 10.20: PREDICTED HABITAT FOR THREATENED (EPBC ACT) FLORA AND FAUNA SPECIES WITHIN THE IMPACT ASSESSMENT AREA

			Predicted habitat within the impact assessment area (ha)[2] (43,560.56 ha)				Predicted habitat within the Project footprint (ha)[2] (3,203.78 ha)[3]			
Common name	**Species name**	**EPBC Act status**	**Potential habitat**	**Important habitat**	**Habitat critical to the survival of the species[4]**	**Total habitat[5]**	**Potential habitat**	**Important habitat**	**Habitat critical to the survival of the species[4]**	**Total habitat[5]**
Flora (threatened)										
Tara wattle	*Acacia lauta*	V	5,510.32	N/A	0.00	**5,510.32**	295.85	N/A	0.00	**295.85**
Hairy-joint grass	*Arthraxon hispidus*	V	832.26	N/A	0.00	**832.26**	33.09	N/A	0.00	**33.09**
Bertya	*Bertya opponens*	V	223.78	N/A	0.00	**223.78**	10.6	N/A	0.00	**10.60**
Ooline	*Cadellia pentastylis*	V	317.48	N/A	0.00	**317.48**	4.56	N/A	0.00	**4.56**
Stream clematis	*Clematis fawcettii*	V	0.00	N/A	0.00	**0.00**	0.00	N/A	0.00	**0.00**
King blue-grass	*Dichanthium queenslandicum*	E	989.56	N/A	23.77	**1,013.33**	116.65	N/A	5.29	**121.94**
Bluegrass	*Dichanthium setosum*	V	693.78	N/A	0.00	**693.78**	60.49	N/A	0.00	**60.49**
Shiny-leaved ironbark	*Eucalyptus virens*	V	5,110.00	N/A	0.00	**5,110.00**	292.55	N/A	0.00	**292.55**
Belson's panic	*Homopholis belsonii*	V	4,495.94	N/A	13.87	**4,509.81**	287.69	N/A	3.19	**290.88**
Winged peppercress	*Lepidium monoplocoides*	E	5,893.63	N/A	244.39	**6,138.02**	329.61	N/A	40.91	**370.52**
Wandering pepper-cress	*Lepidium peregrinum*	E	813.32	N/A	0.00	**813.32**	50.39	N/A	0.00	**50.39**
Coolmunda leucopogon	*Leucopogon sp. Coolmunda (D. Halford Q 1635)*	E	653.20	N/A	0.00	**653.20**	48.20	N/A	0.00	**48.20**
Macrozamia	*Macrozamia machinii*	V	1,495.06	N/A	0.00	**1,495.06**	77.72	N/A	0.00	**77.72**
Hawkweed	*Picris evae*	V	5,254.41	N/A	168.08	**5,422.49**	575.31	N/A	18.68	**593.99**
Dunmore prostanthera	*Prostanthera (sp. Dunmore)*	V	1,230.40	N/A	0.00	**1,230.40**	105.84	N/A	0.00	**105.84**
Austral cornflower	*Rhaponticum australe*	V	2,307.63	N/A	64.26	**2,371.89**	220.24	N/A	2.29	**222.53**
Brush sophora	*Sophora fraseri*	V	80.53	N/A	0.00	**80.53**	0.00	N/A	0.00	**0.00**
Austral toadflax	*Thesium australe*	V	2,196.20	N/A	0.00	**2,196.20**	202.59	N/A	0.00	**202.59**
Slender tylophora	*Tylophora linearis*	E	3,683.47	N/A	0.00	**3,683.47**	229.42	N/A	0.00	**229.42**
Small-flowered westringia	*Westringia parvifolia*	V	0.00	N/A	0.00	**0.00**	0.00	N/A	0.00	**0.00**
Xerothamnella	*Xerothamnella herbacea*	E	616.40	N/A	0.00	**616.40**	66.97	N/A	0.00	**66.97**

Common name	Species name	EPBC Act status	Predicted habitat within the impact assessment area (ha)[2] (43,560.56 ha)				Predicted habitat within the Project footprint (ha)[2] (3,203.78 ha)[3]			
			Potential habitat	Important habitat	Habitat critical to the survival of the species[4]	Total habitat[5]	Potential habitat	Important habitat	Habitat critical to the survival of the species[4]	Total habitat[5]
Fauna (threatened)										
Birds[1]										
Regent honeyeater	*Anthochaera phrygia*	CE	2,100.72	N/A	0.00	**2,100.72**	157.39	N/A	0.00	**157.39**
Australasian bittern	*Botaurus poiciloptilus*	E	924.20	N/A	0.00	**924.20**	44.98	N/A	0.00	**44.98**
Curlew sandpiper	*Calidris ferruginea*	CE, M	167.46	N/A	0.00	**167.46**	13.80	N/A	0.00	**13.80**
Red goshawk	*Erythrotriorchis radiatus*	V	4,181.54	N/A	2,122.60	**6,304.14**	224.63	N/A	114.71	**339.34**
Grey falcon	*Falco hypoleucos*	V	13,359.20	N/A	0.00	**13,359.20**	838.71	N/A	0.00	**838.71**
Squatter pigeon (southern subspecies)	*Geophaps scripta scripta*	V	6,277.49	N/A	0.00	**6,277.49**	339.34	N/A	0.00	**339.34**
Painted honeyeater	*Grantiella picta*	V	7,236.05	N/A	0.00	**7,236.05**	432.99	N/A	0.00	**432.99**
White-throated needletail	*Hirundapus caudacutus*	V, M	34,509.5	9,051.08	0.00	**43,560.58**	2,605.9	597.89	0.00	**3,203.8**
Swift parrot	*Lathamus discolor*	CE	220.2	0.00	4,339.41	**4,559.61**	20.12	0.00	243.54	**263.66**
Australian painted snipe	*Rostratula australis*	E	0.00	N/A	924.20	**924.20**	0.00	N/A	44.98	**44.98**
Black-breasted button-quail	*Turnix melanogaster*	V	0.00	N/A	36.41	**36.41**	0.00	N/A	0.00	**0.00**
Fish										
Murray cod	*Maccullochella peelii*	V	186.58	N/A	162.32	**348.90**	7.76	N/A	5.06	**12.82**
Mammals										
Large-eared pied bat	*Chalinolobus dwyeri*	V	1,065.35	N/A	0.00	**1,065.35**	54.95	N/A	0.00	**54.95**
Spotted-tailed quoll	*Dasyurus maculatus maculatus*	E	937.05	N/A	568.12	**1,505.17**	65.93	N/A	15.49	**81.42**
South-eastern long-eared bat	*Nyctophilus corbeni*	V	6,364.49	N/A	0.00	**6,364.49**	344.10	N/A	0.00	**344.10**
Greater glider	*Petauroides volans*	V	2,680.33	N/A	0.00	**2,680.33**	198.42	N/A	0.00	**198.42**
Brush-tailed rock-wallaby	*Petrogale penicillata*	V	0.00	N/A	0.00	**0.00**	0.00	N/A	0.00	**0.00**
Koala	*Phascolarctos cinereus*	V	179.95	N/A	7,911.46	**8,091.41**	11.91	N/A	481.15	**493.06**

Common name	Species name	EPBC Act status	Predicted habitat within the impact assessment area (ha)[2] (43,560.56 ha)				Predicted habitat within the Project footprint (ha)[2] (3,203.78 ha)[3]			
			Potential habitat	Important habitat	Habitat critical to the survival of the species[4]	Total habitat[5]	Potential habitat	Important habitat	Habitat critical to the survival of the species[4]	Total habitat[5]
Grey-headed flying-fox	*Pteropus poliocephalus*	V	964.73	N/A	79.72	**1,044.45**	110.38	N/A	0.10	**110.48**
Reptiles										
Five-clawed worm-skink	*Anomalopus mackayi*	V	2,679.55	194.35	0.00	**2,873.90**	161.58	16.68	0.00	**178.26**
Collared delma	*Delma torquata*	V	0.00	4,700.10	0.00	**4,700.10**	0.00	295.76	0.00	**295.76**
Yakka skink	*Egernia rugosa*	V	7,071.21	N/A	0.00	**7,071.21**	364.47	N/A	0.00	**364.47**
Dunmall's snake	*Furina dunmalli*	V	0.00	5,633.89	0.00	**5,633.89**	0.00	298.85	0.00	**298.85**
Condamine earless dragon	*Tympanocryptis condaminensis*	E	3,037.01	N/A	227.66	**3,264.67**	227.66	N/A	17.93	**245.59**
Invertebrates										
Brigalow woodland snail	*Adclarkia cameroni*	E	1,313.25	N/A	0.00	**1,313.25**	131.46	N/A	0.00	**131.46**

Table notes:

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

1. For aerial species, all 'air-space' above the Project footprint may be considered habitat; however, these areas will not be impacted by the Project. Therefore, aerial species have not been subject to impact assessment.
2. No value (i.e. 0) represents areas where habitat modelling has indicated that no predicted habitat occurs. For species where no habitat is present within the impact assessment area, impact assessment has not been conducted; however, the habitat requirements and ecology of these species has been considered through the modelling process (refer Appendix A of Appendix L: Matters of National Environmental Significance Technical Report). This mapping will be verified through detailed ecological surveys of the Project footprint in parallel to the development of the detail design.
3. This area includes 716.5 ha which is existing, cleared and maintained rail corridor.
4. Only 'Potential habitat' has been identified in instances where there are no species records within the impact assessment area or the Project footprint, and when habitat conditions are not consistent with the definition of 'Habitat critical to the survival of the species', as presented in the *Matters of National Environmental Significance: Significant impact guidelines 1.1–Environmental Protection and Biodiversity Conservation Act 1999* (refer Section 10.3). In all instances, where Habitat critical to the survival of the species has not been identified, there is no indication that these species are present within the impact assessment area. Detailed ecological surveys of the Project footprint will be undertaken in parallel to the development of the detail design. These surveys will be in accordance with the relevant survey guidelines for nationally threatened species, as published in accordance with the EPBC Act. Data obtained from these detailed surveys will be used to refine the quantification of ecological impacts and revise the calculation of offset requirements for the Project.
5. Total habitat = sum of 'potential', 'important' and 'habitat critical to the survival of the species'.

TABLE 10.21 PREDICTED HABITAT FOR EPBC ACT LISTED MIGRATORY SPECIES WITHIN THE IMPACT ASSESSMENT AREA

Species name	Common name	NC Act status	EPBC Act status	Predicted habitat within the impact assessment area (ha)[2,3]			Predicted habitat within the Project footprint (ha)[2,3]		
				Total habitat[4]	Potential habitat	Important habitat	Total habitat	Potential habitat[4]	Important habitat
EPBC Act migratory species									
Actitis hypoleucos	Common sandpiper	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62
Apus pacificus[1]	Fork-tailed swift	SL	M	43,560.56	34,509.48	9,051.08	3,203.78	2,605.89	597.89
Calidris acuminata	Sharp-tailed sandpiper	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62
Calidris melanotos	Pectoral sandpiper	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62
Calidris ruficollis	Red-necked stint	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62
Cuculus optatus	Oriental cuckoo	SL	M	444.93	444.93	0.00	24.45	24.45	0.00
Gallinago hardwickii	Latham's snipe	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62
Monarcha melanopsis	Black-faced monarch	SL	M	444.93	444.93	0.00	24.45	24.45	0.00
Motacilla flava	Yellow wagtail	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62
Myiagra cyanoleuca	Satin flycatcher	SL	M	444.93	444.93	0.00	24.45	24.45	0.00
Pandion haliaetus	Osprey	SL	M	924.19	914.83	9.36	44.98	44.98	0.00
Plegadis falcinellus	Glossy ibis	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62
Rhipidura rufifrons	Rufous fantail	SL	M	444.93	444.93	0.00	24.45	24.45	0.00
Symposiachrus trivirgatus	Spectacled monarch	SL	M	444.93	444.93	0.00	24.45	24.45	0.00
Tringa nebularia	Common greenshank	SL	M	2,170.34	924.2	1,246.14	132.60	44.98	87.62

Table notes:

M = Migratory SLC = Special Least Concern

1. Aerial species, all 'air-space' above the Project may be considered habitat. However, these areas will remain unimpacted by the Project. This species has not been subject to impact assessment.
2. No value (i.e. 0) represents areas where habitat modelling has indicated that no predicted habitat has been identified within a particular area. For these species, impact assessment has not occurred although their habitat requirements and ecology has been considered through the modelling process.
3. As defined in Section 10.4.4.1.
4. Total habitat = the sum of 'potential' and 'important' habitat

TABLE 10.22 PREDICTED HABITAT FOR NC ACT THREATENED, NEAR-THREATENED AND SPECIAL LEAST CONCERN FLORA AND FAUNA SPECIES (EXCLUDING MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE) WITHIN THE IMPACT ASSESSMENT AREA

			Predicted habitat within the impact assessment area (ha)[1,2]				Predicted habitat within the Project footprint (ha)[1,2]			
Species name	**Common name**	**NC Act status**	**Total habitat[3]**	**General**	**Essential**	**Core**	**Total habitat[3]**	**General**	**Essential**	**Core**
NC Act conservation significant flora										
Cyperus clarus	-	V	974.12	974.12	0.00	0.00	106.00	106.00	0.00	0.00
Digitaria porrecta	-	NT	3,717.62	3,188.66	528.96	0.00	455.61	373.87	81.74	0.00
Picris barbarorum	Hawkweed	V	7,709.76	7,355.76	354	0.00	567.49	529.35	38.14	0.00
NC Act conservation significant fauna										
Calyptorhynchus lathami lathami	Glossy black-cockatoo (eastern)	V	6,981.85	6,673.18	102.77	205.9	480.86	457.7	14.96	8.2
Lophochroa leadbeateri	Major Mitchell's cockatoo	V	6,432.52	6,432.52	0.00	0.00	387.77	387.77	0.00	0.00
Acanthophis antarcticus	Common death adder	V	8,240.82	8,159.75	33.52	47.55	540.87	540.87	0.00	0.00
NC Act SLC animals										
Ornithorhynchus anatinus	Platypus	SL	2,019.28	2,019.28	0.00	0.00	87.73	87.73	0.00	0.00
Tachyglossus aculeatus	Short-beaked echidna	SL	9,875.51	9,875.51	0.00	0.00	736.72	736.72	0.00	0.00

Table notes:

E = Endangered V = Vulnerable NT = Near threatened SLC = Special Least Concern

1. No value (i.e. 0) represents areas where habitat modelling has indicated that no predicted habitat has been identified within a particular area. For these species, impact assessment has not occurred although their habitat requirements and ecology has been considered through the modelling process.
2. As defined in Section 10.4.4.2.
3. Total habitat = sum of 'general', 'essential' and 'core' habitat

10.5.8 Flora and fauna habitat located within the impact assessment area

A total of 10 broad fauna habitat types have been identified within the impact assessment area. The broad habitat types were delineated by grouping vegetation communities according to their vegetative structure, composition, and geomorphological characteristics. The condition of the various habitat types was derived from aerial photograph interpretation, RE mapping, relevant database searches, field reconnaissance and previous experience within the impact assessment area.

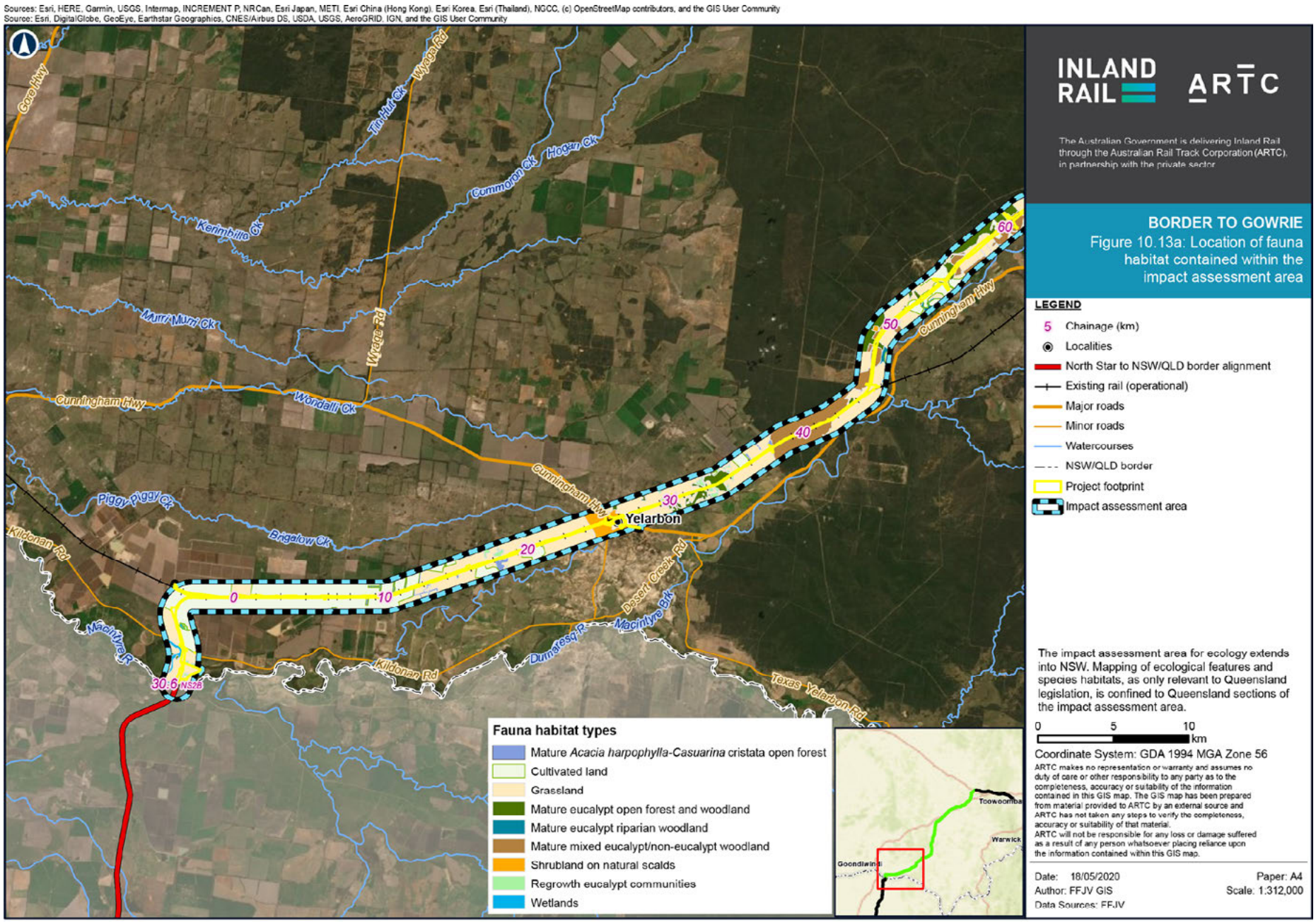
Discrete areas of remnant vegetation were scattered across the impact assessment area but most of the area is characterised by non-remnant vegetation, particularly cleared agricultural areas. These cleared areas provided grassland habitat for fauna species. Grassland was the dominant land cover in the impact assessment area. Other land cover types, in order of decreasing extent, include crops, forest/woodland, urban, and quarry.

Most remnant and non-remnant native vegetation occurred in the Inglewood region and was within protected areas. Extensive but fragmented remnant vegetation also existed in the northern portion of the impact assessment area around Gowrie Mountain. The Condamine River floodplain region was extensively cleared and highly modified for irrigated agriculture. Non-remnant linear vegetation along roadsides and drainage lines, regrowth vegetation and isolated paddock trees, form a variegated landscape mosaic in an otherwise fragmented environment.

Each broad habitat type is discussed in further detail below and shown in Figure 10.13. An analysis of the quantity of fauna habitat contained within the impact assessment area and within the Project footprint is presented in Table 10.23.

TABLE 10.23 EXTENT OF FAUNA AND FAUNA HABITAT LOCATED WITHIN THE IMPACT ASSESSMENT AREA

		Extent (ha)	
Fauna habitat type	**Analogous REs (Category B regulated vegetation)**	**Impact assessment area (including Project footprint)**	**Project footprint**
Grassland	RE 11.3.24, 11.5.14, 11.8.11, non-remnant areas	2,0021.51 (46.04% of impact assessment area)	1,641.53 (51.24% of Project footprint)
Cultivated land	Non-remnant areas	14,414.85 (33.15% of impact assessment area)	962.76 (30.05% of Project footprint)
Mature eucalypt open forest and woodland	RE 11.3.4, 11.3.2, 11.3.14, 11.3.18. 11.8.2, 11.8.2a, 11.9.7,	3,153.98 (7.25% of impact assessment area)	160.42 (5.01% of Project footprint)
Mature eucalypt riparian woodland	RE 12.3.25,	332.29 (0.76% of impact assessment area)	13.2 (0.41% of Project footprint)
Mature mixed eucalypt/non-eucalypt woodland	RE 11.4.10, 11.5.1, 11.5.4, 11.7.4	4,214.6 (9.69% of impact assessment area)	287.96 (8.99% of Project footprint)
Mature *Acacia harpophylla-Casuarina cristata* open forest	RE 11.9.5, 11.4.3	276.48 (0.64% of impact assessment area)	58.18 (1.82% of Project footprint)
Shrubland on natural scalds	RE 11.7.5, 11.5.14	390.53 (0.90% of impact assessment area)	51.31 (1.60% of Project footprint)
Semi-evergreen vine thicket	RE 11.8.3	38.36 (0.09% of impact assessment area)	0.00 (0.00% of Project footprint)
Regrowth eucalypt communities	High value regrowth (Category C)	579.87 (1.33% of impact assessment area)	27.53 (0.86% of Project footprint)
Wetlands	RE 11.3.27b, non-remnant areas	66.49 (0.15% of impact assessment area)	0.88 (0.03% of Project footprint)


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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INLAND RAIL
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BORDER TO GOWRIE
Figure 10.13a: Location of fauna habitat contained within the impact assessment area
LEGEND
5 Chainage (km)
Localities
North Star to NSW/QLD border alignment
Existing rail (operational)
Major roads
Minor roads
Watercourses
NSW/QLD border
Project footprint
Impact assessment area
Fauna habitat types
Mature Acacia harpophylla-Casuarina cristata open forest
Cultivated land
Grassland
Mature eucalypt open forest and woodland
Mature eucalypt riparian woodland
Mature mixed eucalypt/non-eucalypt woodland
Shrubland on natural scalds
Regrowth eucalypt communities
Wetlands
Yelarbon
Goondiwindi
Toowoomba
Warwick
The impact assessment area for ecology extends into NSW. Mapping of ecological features and species habitats, as only relevant to Queensland legislation, is confined to Queensland sections of the impact assessment area.
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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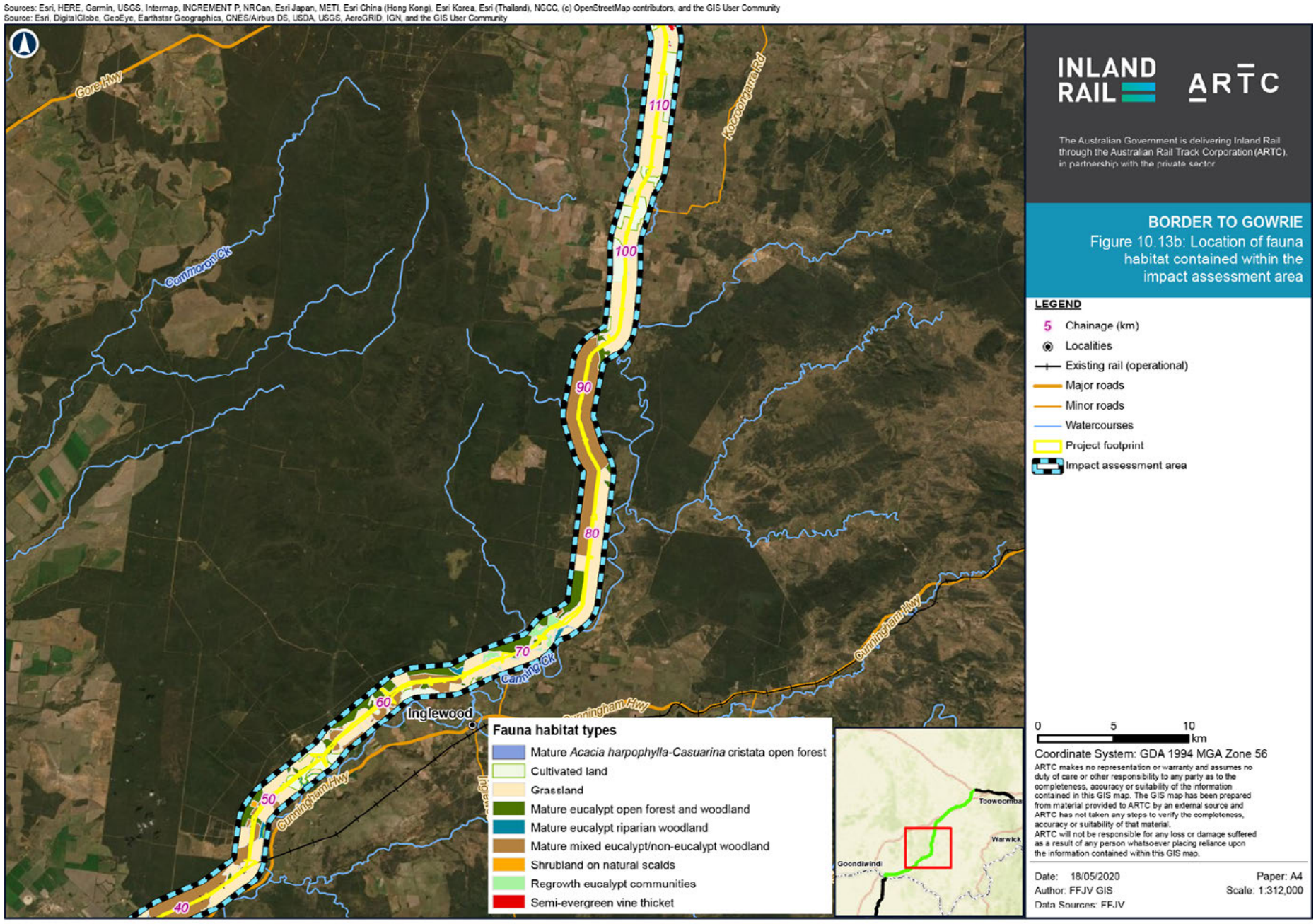
Author: FFJV GIS
Data Sources: FFJV
Paper: A4
Scale: 1:312,000
Map by: RAZ/GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.13_FaunaHabitats_v3.mxd Date: 18/05/2020 12:00


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Gore Hwy
Common Ck
Koreelah Creek Rd
110
100
90
80
70
60
50
40
Caming Ck
Cunningham Hwy
Inglewood
Fauna habitat types
Mature Acacia harpophylla-Casuarina cristata open forest
Cultivated land
Grassland
Mature eucalypt open forest and woodland
Mature eucalypt riparian woodland
Mature mixed eucalypt/non-eucalypt woodland
Shrubland on natural scalds
Regrowth eucalypt communities
Semi-evergreen vine thicket
Toowoomba
Warwick
Goondiwindi
INLAND RAIL
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BORDER TO GOWRIE
Figure 10.13b: Location of fauna habitat contained within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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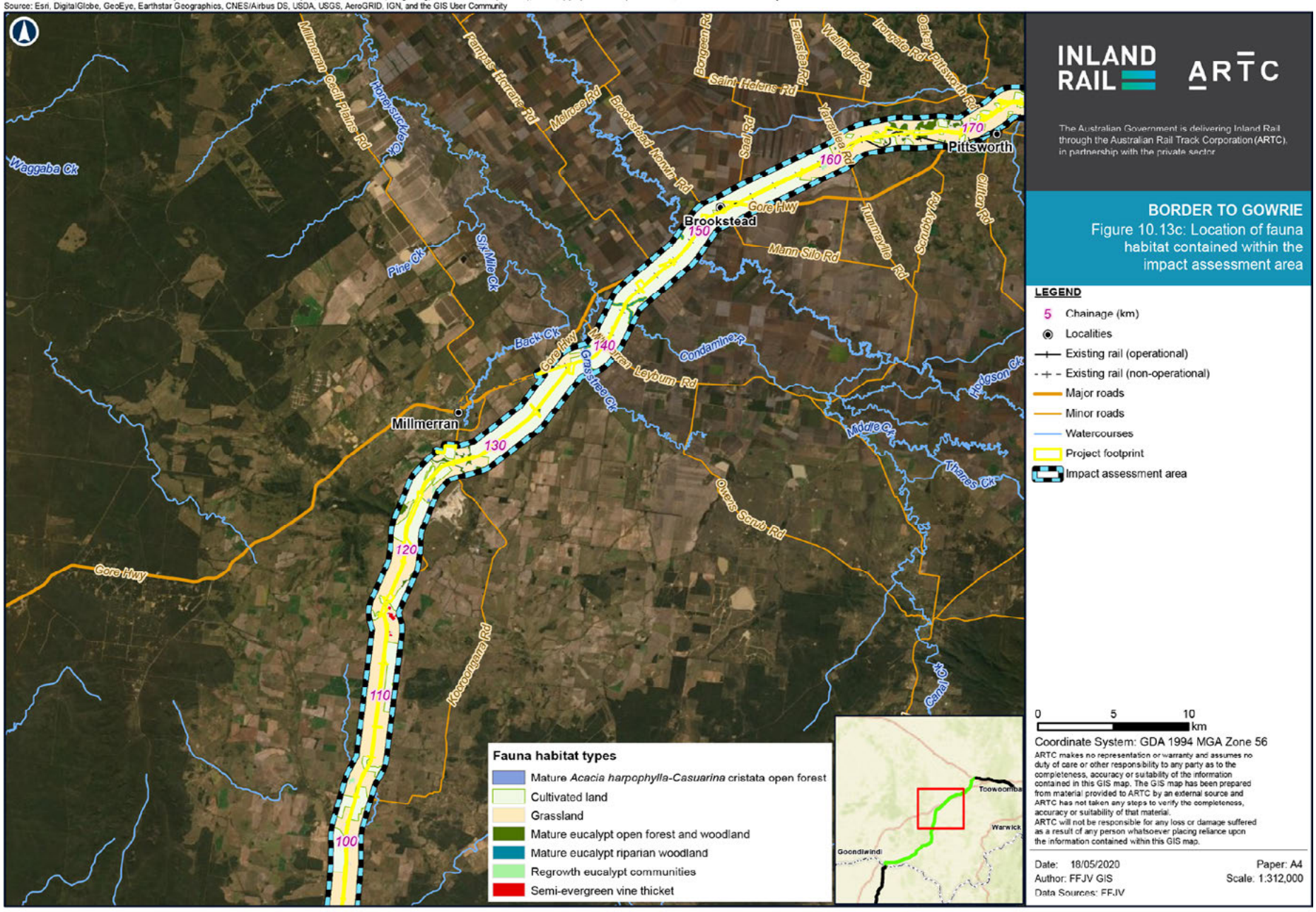
Data Sources: FFJV
Map by: RAZ/GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.13_FaunaHabitats_v3.mxd Date: 18/05/2020 12:00


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
INLAND RAIL
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BORDER TO GOWRIE
Figure 10.13c: Location of fauna habitat contained within the impact assessment area
LEGEND
5 Chainage (km)
Localities
Existing rail (operational)
Existing rail (non-operational)
Major roads
Minor roads
Watercourses
Project footprint
Impact assessment area
Fauna habitat types
Mature Acacia harpophylla-Casuarina cristata open forest
Cultivated land
Grassland
Mature eucalypt open forest and woodland
Mature eucalypt riparian woodland
Regrowth eucalypt communities
Semi-evergreen vine thicket
Millmerran
Brookstead
Pittsworth
Toowoomba
Warwick
Goondiwindi
0 5 10 km
Coordinate System: GDA 1994 MGA Zone 56
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Author: FFJV GIS
Data Sources: FFJV
Paper: A4
Scale: 1:312,000
Map by: RAZ/GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.13_FaunaHabitats_v3.mxd Date: 18/05/2020 12:00

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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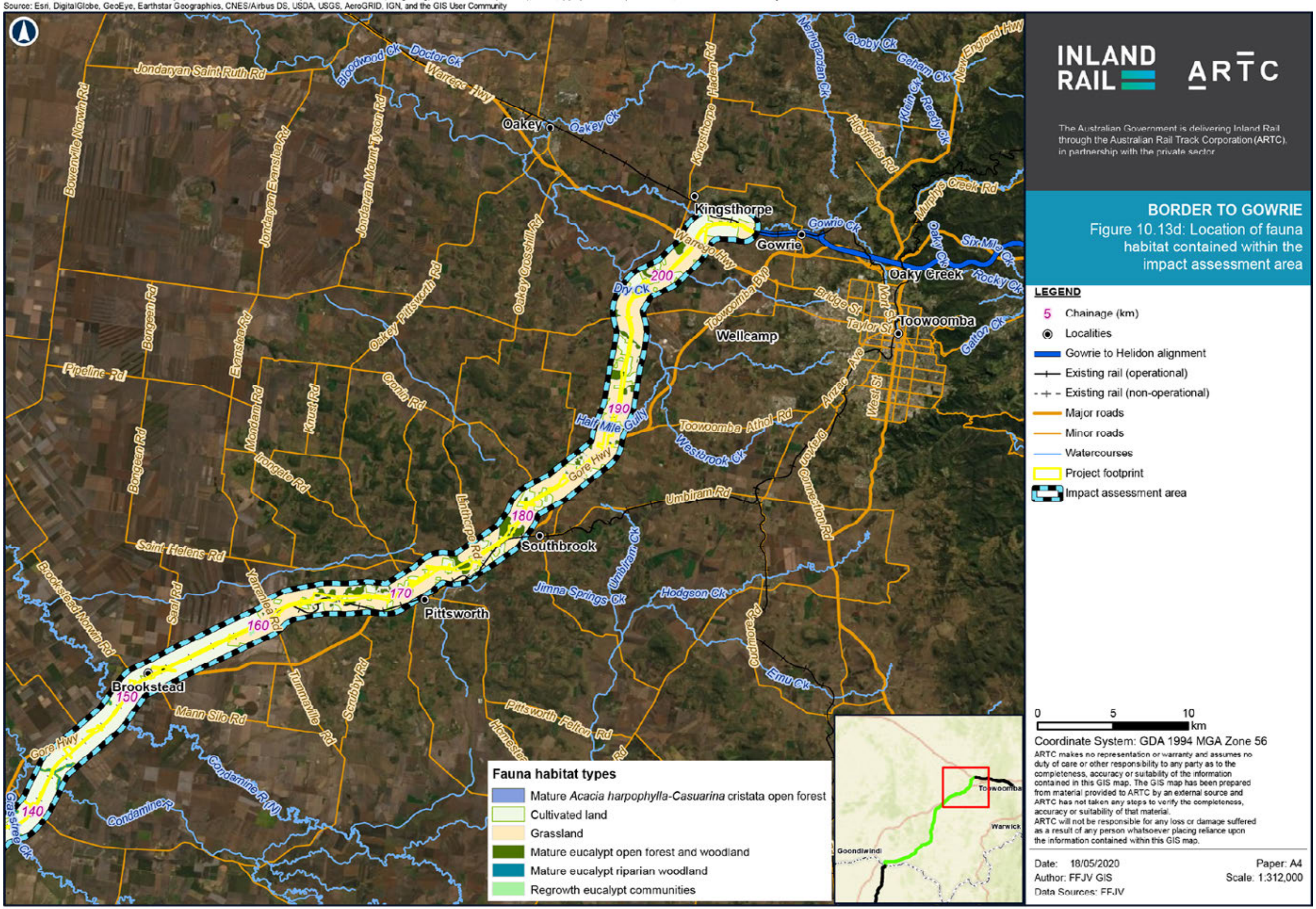

Map by: RAZ/GN/AD/KG Z:\GIS\GIS_310_B2G\Tasks\310-EAP-202004231322_B2G_Ecology_figures\310-EAP-202004231322_ARTC_Fig10.13_FaunaHabitats_v3.mxd Date: 18/05/2020 12:00

10.5.8.1 Grassland

Grassland habitats within the impact assessment area include remnant native grasslands, non-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.

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 *Chloris gayana* (rhodes grass), *Megathyrsus maximus* (green panic), and *Sorghum halepense* (Johnson grass) but native grass species also occur, including *Dichanthium sericeum* (blue grass), *Digitaria* spp, *Panicum* spp. and *Bothriochloa* spp.

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 *Panicum queenslandicum* (Queensland panic), *Dichanthium sericeum* (blue grass), *Digitaria spp., Themeda spp.*, and *Bothriochloa spp.* but exotic pasture grasses sometimes occur, such as *Chloris gayana* (rhodes grass).

Non-native and native-derived grasslands are considered as one fauna habitat type due to similarities in structure and floristics. Grassland is the most extensive fauna habitat within the impact assessment area by far and is typically located on alluvial floodplains and creek flats. These grassland habitats are commonly used for agricultural purposes including livestock grazing and fodder harvesting. Grasslands in road reserves provide the least impacted representation of this habitat (refer Photograph 10.16 and Photograph 10.17).

Grassland within the impact assessment area provides foraging habitats for granivorous bird species, such as finches, parrots and pigeons. Grassland habitats 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, providing fauna habitat and connectivity in otherwise cleared and fragmented landscapes.

In general, the grasslands that dominate the Project footprint provide poor habitat value for MNES fauna species potentially occurring in the area, although grasslands may provide temporary habitat for wetland bird species when flooded. Nevertheless, MNES conservation significant fauna species that may use grassland habitat within the impact assessment area, include Condamine earless dragon (*Tympanocryptis condaminensis*), and five-clawed worm-skink (*Anomalopus mackayi*) where cracking clay soils occur. Grasslands may also provide suitable habitat for MNES flora species such as *Homopholis belsonii* (Belson's panic), *Dichanthium queenslandicum* (king bluegrass) and *Thesium australe* (austral toadflax) (a root parasite with a preference for *Themeda* spp). These areas have a high potential to contain NC Act listed grassland specialist flora such as *Picris barbarorum* (tall hawkweed), *Digitaria porrecta* (finger panic) and *Cyperus clarus* (sedge), particularly when they occur on Basalt-derived soils (i.e. black soils).

PHOTOGRAPH 10.16 EXAMPLE OF NATIVE GRASSLAND IN ROAD RESERVE LOCATED SOUTH OF MILLMERRAN

Source: FFJV, 2018

PHOTOGRAPH 10.17 GRASSLAND COMPOSED OF NATIVE AND NON-NATIVE SPECIES WITHIN ROAD RESERVE SOUTH OF TOOWOOMBA

Source: FFJV, 2018

10.5.8.2 Cultivated land

Cultivated land within the impact assessment area is extensive and includes irrigated and dryland crops, stubble fields and fallow fields. Common crops include winter cereals and irrigated cotton. The availability of soil cracks and other microhabitat refugia is greatly reduced by soil cultivation; however, cultivated field and adjacent areas are known to provide habitat for MNES species such as the Condamine earless dragon (*Tympanocryptis condaminensis*) and Belson's panic (*Homopholis belsonii*). These areas also have a high potential to contain NC Act listed (MSES) grassland specialist flora such as *Picris barbarorum* (tall hawkweed), *Digitaria porrecta* (finger panic) and *Cyperus clarus* (sedge), particularly when they occur on Basalt-derived soils (i.e. black soils).

10.5.8.3 Mature eucalypt open forest and woodland

On sedimentary and igneous rocks

Areas of mature eucalypt open forest and woodland on sedimentary/igneous rocks and within the impact assessment area, include areas dominated by *Eucalyptus orgadophila* (mountain grey gum), *Eucalyptus crebra* (narrow-leaved ironbark), *Eucalyptus tereticornis* (Queensland bluegum), *Eucalyptus populnea* (poplar box), and *Eucalyptus melliodora* (yellow box). Areas of remnant, mature eucalypt open forest and woodland within the impact assessment area are represented by REs 11.9.7, 11.8.4 and 11.8.2. This habitat type was dominant in the elevated areas north–east of Yelarbon associated with the Whetstone State Forest, and north of Inglewood associated with the Bringalily State Forest (refer Photograph 10.18).

The condition and structure of these habitats varies greatly across the impact assessment area, ranging from a simplified structure with sparse shrub and/or ground strata reflective of past land use and current management practices (logging, cattle grazing and vegetation thinning), to a complex vegetation structure with all strata (canopy, mid-storey and understorey) essentially intact. Important microhabitat refugia provided by this habitat type includes tree hollows, hollow logs and termitaria (arboreal and terrestrial).

Canopy species present in this habitat type provide a range of trunk and limb hollows (of a variety of size classes), which potentially provide suitable habitat for *Microchiropteran* bats, gliders, possums, birds (including parrots, cockatoos and owls), arboreal snakes and monitors. Canopy trees and also shrubs provide nectar and pollen resources for a range of fauna species, including birds, bats, arboreal mammals and insects. Standing dead trees (stags) also provide roosting sites, nesting dens and breeding locations for a similar range of species. Where mature eucalypt open forest and woodlands occur as fragmented/isolated patches in largely cleared agricultural landscapes, they are somewhat restricted in their capacity to support woodland and forest species and are more likely to offer habitat value to transitional species and support mammal and bird species typical of disturbed areas; however, these isolated trees may provide important feed resources to vagile species during their flowering periods.

Areas of mature eucalypt open forest and woodland within the impact assessment area may provide suitable habitat for MNES fauna species including the south-eastern long-eared bat (*Nyctophilus corbeni*), spotted-tail quoll (*Dasyurus maculatus maculatus*), koala (*Phascolarctos cinereus*) and grey-headed flying fox (*Pteropus poliocephalus*).

On alluvial plains

Areas of mature eucalypt open forest and woodland on alluvial plains within the impact assessment area include areas dominated by *Eucalyptus tereticornis* (Queensland blue gum), *Eucalyptus populnea* (poplar box) and *Eucalyptus camaldulensis* (river red gum). Areas of remnant eucalypt open forest and woodland (on alluvial plains) within the impact assessment area represented the communities' REs 11.3.4, 11.3.2, 11.3.14, and 11.3.18 and are associated with the floodplains and creek flats within the impact assessment area. This habitat generally exhibits low structural complexity, particularly at lower strata levels (refer Photograph 10.19). Ground cover is typically low due to livestock use, and the understorey very sparse with an open canopy of large *Eucalyptus tereticornis* or *Eucalyptus camaldulensis*; however, mature eucalypt trees on alluvial plains are known to provide important habitat, such as food (nectar) and shelter (hollows), for a range of fauna species including birds, mammals, and reptiles. Conservation significant fauna species that may occur in eucalypt open forest and woodland on alluvial plains within the impact assessment area include koala (*Phascolarctos cinereus*) and south-eastern long-eared bat (*Nyctophilus corbeni*) (where it occurs in the vicinity of large tracts of remnant woodlands). Migratory fauna species that may occur in eucalypt open forest and woodland on alluvial plains within the impact assessment area, and conservation significant species that frequent these areas, may include glossy black-cockatoo (*Calyptorhynchus lathami*), short-beaked echidna (*Tachyglossus aculeatus*), oriental cuckoo (*Cuculus optatus*), satin flycatcher (*Myiagra cyanoleuca*) and the rufous fantail (*Rhipidura rufifrons*).

Furthermore, during the wet season, this habitat type commonly floods temporarily, effectively becoming a wetland habitat (riverine wetland). When flooded, this habitat type is suitable for a range of wetland bird species, including ducks, geese, grebes, snipe, crakes, rails, egrets, and herons. MNES fauna species that may use flooded eucalypt open forest and woodland on alluvial plains include Australian painted snipe (*Rostratula australis*).

The definition of open forest and woodland habitats applied here excludes riparian vegetation along watercourses that have been classified as the habitat type 'mature eucalypt riparian open forest and woodlands'.

PHOTOGRAPH 10.18 MATURE EUCALYPT WOODLAND ON SEDIMENTARY ROCK, LOCATED WITHIN THE INGLEWOOD REGION

Source: FFJV, 2018

PHOTOGRAPH 10.19 ALLUVIAL POPLAR BOX WOODLAND NEAR MILLMERRAN

Source: FFJV, 2018

On sand plains

Mature eucalypt woodland and forest on sand plains within the impact assessment area is represented by RE 11.5.20. This habitat type is described as *Eucalyptus moluccana* (gum-topped box), *E. microcarpa* (grey box) or *E. woollsiana* (grey box) woodland to open forest.

Species including *Allocasuarina luehmannii* (buloke) and *Callitris glaucophylla* (white cypress-pine) often form a low woodland layer. This habitat occurs on flat to gently undulating plains formed from Cainozoic/Quaternary sediments. MNES fauna that may occur in eucalypt forest and woodland on sand plains include the south-eastern long-eared bat (*Nyctophilus corbeni*).

On duricrusts

Mature eucalypt forest and woodland on duricrusts within the impact assessment area is represented by RE 11.7.7. This habitat type is described as open forest to woodland dominated by *Eucalyptus fibrosa* subsp. *nubilis* (broad-leaved red ironbark) forming a distinct but discontinuous open forest to woodland canopy (22–25m high) (refer Photograph 10.20). Broad-leaved red ironbark provides nectar and hollow resources for fauna including birds, arboreal mammals, insects, reptiles and bats.

Eucalyptus crebra (narrow-leaved red ironbark) often co dominates or is locally dominant, particularly on lower slopes. This habitat also includes areas with *Corymbia citriodora* (lemon-scented gum) as a codominant. There is usually a low woodland mid layer dominated by *Acacia* spp. or sometimes *Allocasuarina luehmannii* (buloke) and *Callitris endlicheri* (black cypress-pine). Scattered tall shrubs may occur, but rarely form a prominent layer. There is usually a moderately dense, low shrub layer developed with a variable floristic composition. The ground layer is open-to-moderately dense and dominated by grasses. This habitat occurs on low hills and ranges formed from deeply weathered sediments.

MNES fauna that may occur in eucalypt forest and woodland on duricrusts include south-eastern long-eared bat (*Nyctophilus corbeni*) and large-eared pied bat (*Chalinolobus dwyeri*).

PHOTOGRAPH 10.20 EUCALYPT WOODLAND ON DURICRUST

Source: FFJV, 2018

PHOTOGRAPH 10.21 MATURE EUCALYPT RIPARIAN WOODLAND LOCATED SOUTH OF INGLEWOOD

Source: FFJV, 2018

10.5.8.4 Mature eucalypt riparian woodland

Eucalypt riparian open forest and woodlands within the impact assessment area include open forests and woodlands dominated by *Eucalyptus tereticornis* (forest red gum) or *Eucalyptus camaldulensis* (river red gum), fringing drainage lines with associated species including *Melaleuca* spp. (paperbark) and *Angophora floribunda* (rough-barked apple), and *Casuarina cunninghamiana* (riveroak). An open-to-sparse tall shrub layer is frequently present, dominated by species including *Acacia salicina* (cooba) and *A. stenophylla* (river cooba).

Areas of remnant eucalypt riparian open forest and woodland within the impact assessment area were represented by RE 12.3.25 and occur exclusively along the edge of rivers, creeks and vegetated drainage lines within the impact assessment area (refer Photograph 10.20 and Photograph 10.21). Mature eucalypt riparian open forest and woodlands within the impact assessment area is often structurally complex at all strata levels and potentially supports the highest fauna diversity per hectare.

A range of fauna, including birds, mammals, and reptiles, use this habitat type for foraging, breeding, and dispersal. Available foraging resources include nectar, water, and prey fauna species. Available breeding habitats may include tree hollows and decorticating bark, hollow logs, soil banks and overhangs, and dense vegetation. Riparian woodland is often used for dispersal due to a greater vegetation density and landscape connectivity. The movement corridors provided by this habitat type are important for structural connectivity in otherwise fragmented landscapes.

MNES fauna species that may occur in mature eucalypt riparian open forests and woodland include regent honeyeater (*Anthochaera phrygia)*, swift parrot (*Lathamus discolor*), greater glider (*Petauroides Volans*) and koala (*Phascolarctos cinereus*).

10.5.8.5 Mature mixed eucalypt/non-eucalypt woodland

On clay plains

The mature mixed eucalypt/non-eucalypt woodlands on clay plains within the impact assessment area is represented by RE 11.4.10. This habitat type is dominated by *Eucalyptus populnea* (poplar box) and/or *E. woollsiana* (grey box), *E. moluccana* (gum-topped box), *E. macrocarpa* (grey box) with an understorey of *Acacia harpophylla* (brigalow) or *Casuarina cristata* (belah). Mixed woodland typically occurs on the edges of Cainozoic clay plains—on the lower parts of the plain around its dissecting edges and on natural discharge areas where the clay plains meet higher landforms.

MNES species that may occur within mature mixed eucalypt/non-eucalypt woodland on clay plains include yakka skink (*Egernia rugosa*) and Dunmall's snake (*Furina* dunmalli) due to habitat associations with brigalow.

On sand plains

The mature mixed eucalypt/non-eucalypt woodlands on sand plains within the impact assessment area is represented by REs 11.5.1 and 11.5.4 (refer Photograph 10.22). These habitat types are dominated by eucalypts and bloodwoods in the canopy, with a low tree layer dominated by she-oak and native cypress pine (*Allocasuarina* and *Callitris* spp.) on sandy soils. A sparse ground layer of perennial grasses is usually present.

MNES species that may occur within mature mixed eucalypt/non-eucalypt woodland include south-eastern long-eared bat (*Nyctophilus corbeni*), Dunmall's snake (*Furina dunmalli*) and yakka skink (*Egernia rugosa*).

PHOTOGRAPH 10.22 MIXED MATURE EUCALYPT/BULOKE WOODLAND ON SAND, LOCATED NORTH OF INGLEWOOD

Source: FFJV, 2018

PHOTOGRAPH 10.23 MIXED MATURE EUCALYPT/CALLITRIS WOODLAND DURICRUST, LOCATED SOUTH OF INGLEWOOD

Source: FFJV, 2018

On duricrusts

The mature mixed eucalypt/non-eucalypt woodlands on duricrusts within the impact assessment area is represented by RE 11.7.4. This habitat type occurs on Cainozoic lateritic duricrusts and is dominated by *Eucalyptus crebra* (narrow-leaved red ironbark), *E. decorticans* (gum-topped ironbark), *Corymbia trachyphloia* (brown bloodwood), *E. tenuipes* (narrow-leaved white mahogany), *C. watsoniana* (large-fruited yellowjacket) and *Callitris glaucophylla* (white cypress-pine) (refer Photograph 10.23). There is usually a distinct low-tree to tall-shrub layer comprising species, including *Lysicarpus angustifolius* (brown hazelwood) or *Acacia* spp.

MNES species that may occur within mature mixed eucalypt/non-eucalypt woodland include south-eastern long-eared bat (*Nyctophilus corbeni*).

10.5.8.6 Mature Acacia harpophylla-Casuarina cristata open forest

On sedimentary rocks

Within the impact assessment area this community was represented by RE 11.9.5. This habitat type is dominated by *Acacia harpophylla* (brigalow) and/or *Casuarina cristata* (belah), or brigalow with a semi-evergreen vine thicket understorey (refer Photograph 10.24). A prominent low-tree or tall-shrub layer dominated by species including *Geijera parviflora* (wilga) and *Eremophila mitchellii* (false sandalwood), and often with semi-evergreen vine thicket species, is present. The latter include *Carissa ovata* (currant bush), *Owenia acidula* (emu apple), *Croton insularis* (silver croton), *Denhamia oleaster* (stiff denhamia) and *Notelaea macrocarpa* (velvet mock olive). *Melaleuca bracteata* (Black tea-tree) may be present within the community, along watercourses.

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. Gilgais provide important habitat refugia and water sources for amphibian species.

This habitat type is suitable for MNES species, including Dunmall's snake (*Furina dunmalli*), south-eastern long-eared bat (*Nyctophilus corbeni*), and brigalow woodland snail (*Adclarkia cameroni*) where shelter sites such as logs, rocks, tree hollows, decorticating bark, and root cavities are available. The painted honeyeater (*Grantiella picta*) is associated with this habitat type when *Amyema* spp. mistletoe is abundant.

PHOTOGRAPH 10.24 BRIGALOW/BELAH OPEN FOREST ON SEDIMENTARY ROCK LOCATED TO SOUTH OF MILLMERRAN

Source: FFJV, 2018

PHOTOGRAPH 10.25 BRIGALOW/BELAH OPEN FOREST ON CLAY PLAINS LOCATED WITHIN ROAD RESERVES SOUTH OF YELARBON

Source: FFJV, 2018

On clay plains

This community within the impact assessment area was represented by RE 11.4.3. This habitat type is dominated by *Acacia harpophylla* (brigalow) and/or *Casuarina cristata* (belah). Brigalow (10–16 m high) predominates, forming a fairly continuous canopy with varying densities of belah (14–18 m high), forming part of the canopy or emerging above it (refer Photograph 10.25). *Eucalyptus* spp. including *E. orgadophila* (mountain coolibah), *E. populnea* (poplar box), *E. microcarpa* (grey box), *E. woollsiana* (grey box), *E. cambageana* (Dawson gum) and *E. thozetiana* (on shallower soils and upper slopes) may be scattered through the canopy or occur as emergents up to 22 m high. *Brachychiton rupestris* (Queensland bottle tree) may also be present in places. An open-to-dense, tall shrub layer is present, and is dominated by *Eremophila mitchellii* (false sandalwood) and/or *Geijera parviflora* (wilga). Low shrubs are often present, occasionally forming a distinct layer dominated by species including *Carissa ovata* (currant bush) and *Alectryon diversifolius* (scrub boonaree). Tree/shrub height may range from 3–8 m. *Melaleuca bracteata* (black tea-tree) may be present in low-lying areas. The ground layer is sparse-to-open and composed of grasses and forbs. Occurs on Cainozoic clay plains with cracking clay soils, often with a weak gilgai microrelief (refer Photograph 10.11 and Photograph 10.12).

Mature *Acacia harpophylla-Casuarina cristata* open forest has a relatively high degree of structural connectivity with an intact sub-canopy and shrub layer; however, many patches of brigalow are degraded by livestock grazing and have a simplified structure. This habitat type provides suitable habitat for taxa that prefer greater structural complexity, including insectivorous bats, forest-dependent bird species, and reptiles. The availability of hollows in this habitat type is low but brigalow's loose bark provides important refugia for arboreal geckoes and microbats.

MNES species that may occur include Dunmall's snake (*Furina dunmalli*), south-eastern long-eared bat (*Nyctophilus corbeni*), painted honeyeater (*Grantiella picta*) and brigalow woodland snail (*Adclarkia cameroni*).

10.5.8.7 Shrubland on natural scalds

Shrubland on natural scalds within the impact assessment area is represented by RE 11.7.5 (refer Photograph 10.26). This habitat type is described as a shrubland with or without emergent eucalypts. Characteristic genera include *Calytrix* spp. (star flowers), hakea (*Hakea* spp.), *Kunzea* spp. (kunzea), *Micromyrtus* spp. (heath myrtle), *Acacia* spp. (wattles), *Melaleuca* spp. (bottlebrush) and (in the ground layer) *Triodia* spp. (hummock grass). Often scattered or fringing emergent tree species are present, including *Eucalyptus exserta* (Queensland peppermint), *E. panda* (Yetman ironbark), *E. curtisii* (Plunkett mallee), *Corymbia trachyphloia* (brown bloodwood) and *Acacia blakei* (Blake's wattle). Occurs on shallow soils often associated with natural scalds on Cainozoic lateritic duricrusts and sometimes lithosols derived from quartzose sandstone.

This habitat type is of limited value as fauna habitat; however, the edge of hard pans may be associated with soak, with soft spongy soil and liverworts, mosses and sedges during wet periods providing important habitat for amphibian species.

MNES species that may occur within shrubland on natural scalds include Dunmall's snake (*Furina dunmalli*).

PHOTOGRAPH 10.26 SHRUBLAND ON NATURAL SCALDS LOCATED SOUTH OF INGLEWOOD

Source: FFJV, 2018

PHOTOGRAPH 10.27 REGROWTH COMMUNITY DOMINATED BY EUCALYPTUS AND ACACIA SPECIES, LOCATED WITHIN THE INGLEWOOD REGION

Source: FFJV, 2018

10.5.8.8 Semi-evergreen vine thicket

Semi-evergreen vine thickets within the impact assessment area are represented by RE 11.8.3, which occurs within the impact assessment area but not within the Project footprint. This habitat type is generally restricted to steeper, rocky hillsides on igneous rocks, with emergent *Acacia harpophylla, Casuarina cristata* and *Eucalyptus* spp. Semi-evergreen vine thickets have the greatest structural complexity at all strata levels, providing quality habitat for many species of birds, reptiles and arboreal marsupials. The steep and rocky terrain typical of semi-evergreen vine thickets also provides important habitat refugia for terrestrial marsupials and reptiles.

MNES species that may occur within semi-evergreen vine thickets include spotted-tailed quoll (*Dasyurus maculatus maculatus*), brush-tailed rock wallaby (*Petrogale penicillata*), and black-breasted button quail (*Turnix melaogaster*).

10.5.8.9 Regrowth eucalypt communities

Areas of regrowth vegetation, largely represented by the DNRME High Value Regrowth (HVR) vegetation mapping, are present throughout the impact assessment area. A total of 9.3 ha of HVR is mapped within the impact assessment area (refer Photograph 10.27). The patches of regrowth vegetation within the impact assessment area are generally in poor condition, suffering from extensive weed invasion and disturbance from cattle grazing practices. Areas of regrowth habitat may provide foraging and roosting habitat value for transitional bird species and suitable microhabitats, including cracking clay soils for reptile species.

10.5.8.10 Wetlands

Wetland habitats within the impact assessment area include dams and reservoirs (lacustrine), wetlands associated with the floodplains of major watercourses (riverine), and vegetated swamps (palustrine). Artificially created wetlands (i.e. farm dams), which are abundant across agricultural landscapes, are included as they potentially provide suitable wetland alternatives for vertebrate fauna. Artificial wetlands include typically small farm 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 represent a very minor area within the Project footprint (0.97 ha). Typical aquatic and emergent plants include *Chara* spp., *Nitella* spp., *Myriophyllum verrucosum, Nymphaea violacea, Pyrgillus javanicus, Potamogeton crispus, P. tricarinatus, Ottelia ovalifolia, Vallisneria caulescens* and *Nymphoides indica*. A narrow fringing woodland commonly dominated *by Eucalyptus camaldulensis* or *E. coolabah* may occur. These wetland habitats within the region are highly ephemeral, particularly in the southern and drier sections of the alignment (refer Photograph 10.28).

Wetland habitats within the impact assessment area are considered to provide suitable habitat for a variety of amphibian, reptile and bird species. Larger palustrine wetlands potentially provide important refuge habitat for many bird species and may act as stepping stones during periods of travel.

PHOTOGRAPH 10.28 EPHEMERAL WETLAND AREAS LOCATED AT YELARBON, ASSOCIATED WITH THE YELARBON SCALD

Source: FFJV, 2018

Wetland habitats within the impact assessment area may provide suitable habitat for a variety of fish, amphibian, reptile (including turtles) and bird species. Larger palustrine wetlands potentially provide important refuge habitat for many bird species, including dispersive species. MNES fauna species that may use wetland habitats within the impact assessment area include the Australasian bittern (*Botaurus poiciloptilus)* and Australian painted snipe (*Rostratula australis*), although both of these species are reliant on the presence of dense vegetation, either aquatic (in the case of the bittern) or as nearby cover (for snipe). It is noted that farm dams are less likely to provide these habitat elements and floodplain wetlands are highly ephemeral; curlew sandpiper (*Calidris ferruginea*) may rarely occur on larger dams with shallow muddy areas during migrations to coastal areas further south. In addition to birds, MNES fish have the potential to use wetland areas when connected to larger areas of habitat or during periods of flood.

No springs are identified on the Queensland wetland mapping (DES, 2013) within the impact assessment area.

10.5.9 Wetlands and groundwater dependent ecosystems

Multiple palustrine wetlands and some REs with potential riverine wetland values within the impact assessment area have been identified in the *Map of Queensland wetland environmental values* (DES, n.d.) as high ecological significance (HES) wetlands, as recognised under the EP Regulation (recognised as MSES) (refer Table 10.24); however, none of these mapped wetlands occur within mapped high ecological value (HEV) waters as per the EPP (Water). Similarly, many of the wetlands (palustrine, lacustrine and mosaic) mapped within the impact assessment area are also mapped as wetlands under the VM Act.

TABLE 10.24 HIGH ECOLOGICAL SIGNIFICANCE AND HIGH ECOLOGICAL VALUE WETLANDS IDENTIFIED AS OCCURRING WITHIN THE IMPACT ASSESSMENT AREA

Habitat values	Extent contained within the impact assessment area (ha)	Extent contained within the Project footprint (ha)
HEV wetlands	0.00	0.00
HES wetlands	9.90	0.00

GDEs are ecosystems that rely on groundwater for their continued persistence. Both aquatic and terrestrial GDEs have been identified during the desktop assessment as occurring along the alignment from the NSW/QLD border to Millmerran. Terrestrial GDEs are most dominant and concentrated in this mid-section, while aquatic GDEs are scattered towards the southern end of the Project alignment, near the NSW/QLD border. These terrestrial GDEs are associated with the watercourses of Canning Creek and Macintyre Brook, both of which intercept the rail alignment. The aquatic GDEs are scattered towards the southern end of the Project alignment, near the NSW/QLD border, some of which are associated with the Macintyre Brook. Some aquatic GDEs occur in the Millmerran area and are also associated with Canning Creek.

Further details related to wetlands and GDEs identified within the impact assessment area, are provided in Appendix J: Terrestrial Ecology Technical report, Appendix K: Aquatic Ecology Technical Report and Appendix P: Surface Water Technical Report.

10.5.10 AquaBAMM and physical habitat of aquatic systems

The aquatic conservation assessment using AquaBAMM 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 (Clayton, P.D et al., 2006).

The AquaBAMM scores for each monitoring site are detailed in the Appendix P: Surface Water Technical Report and Appendix K: Aquatic Ecology Technical Report. The details of each monitoring site can be found in those reports. The resulting modelled score (as a categorical, standardised score of overall ecological value) gives an indicative representation of expected wetland ecological value. Modelled scores for each monitoring site are provided in Table 10.25.

TABLE 10.25 SPECIFIC RIVERINE AQUABAMM AQUASCORE FOR ALL WATER QUALITY MONITORING SITES

Aquascore	Monitoring site (refer Figure 10.3)
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

The overall physical habitat assessment scores across the areas sampled were 'fair' to 'good', with no significant difference between the two survey periods (June 2018 and November 2018). Channel flow status rated 'poor' at most sites due to the dry conditions encountered during the time of assessment. Epifaunal substrate/available cover also rated 'poor' at most sites, owing to the dominance of silt/clay substrates and general lack of substrate complexity. This is generally a reflection of the natural clay-rich bed substrates, as opposed to siltation. Bed and bank stability rated 'high' at most sites, owing largely to good vegetative bank protection and reasonably intact riparian zones across the impact assessment area.

Further details related to the aquatic habitat values contained within the impact assessment area are provided in Appendix K: Aquatic Ecology Technical Report.

10.6 Matters of national environmental significance

10.6.1 Matters identified within the impact assessment area

The following MNES were identified within, or in close proximity to, the impact assessment area:

- Threatened species listed under the EPBC Act and their associated habitat (refer Sections 10.5.5, 10.5.3.1, 10.5.4.1 and 10.5.6)
- Threatened ecological community listed under the EPBC Act (refer Section 10.5.3.3)
- Habitat for non-threatened EPBC Act listed migratory species (refer Section 10.5.6)
- Groundwater-dependent ecosystems (refer Section 10.5.9).

It is acknowledged that water resources will not be subject to impacts associated with coal seam gas development and large coal mining development and, as such, they do not constitute an MNES for the purposes of this EIS. Potential impacts to GDEs are likely to result from potential drawdown as a result of cut-and-fill activities located proximate to the GDE. These impacts are considered to be minor–negligible given the limited extent of their proximity to the Project and are therefore not discussed further in this document.

It is noted that while considered an MNES, EPBC Act listed, non-threatened migratory species are not a controlling provision of the Project but have been included for completeness.

Appendix L: Matters of National Environmental Significance Technical Report provides further details related to MNES.

10.6.2 Matters not within the impact assessment area

The following MNES were not identified within or in close proximity to the impact assessment area:

- World Heritage areas
- National Heritage areas
- Commonwealth marine areas
- Great Barrier Marine Park
- Nuclear actions
- Springs and GDEs (water resources) associated with coal seam gas development and large coal mining development.

10.7 Sensitive environmental receptors

A sensitive environmental receptor is a feature, area or structure that may be affected by direct or indirect changes to the environment. For conservation significant flora and fauna species, predictive habitat mapping has been used to assess the species' potential to occur within the impact assessment area. In instances where species/communities did not have a potential habitat contained within the impact assessment area, these species were not subject to impact assessment and were no longer considered to constitute sensitive environmental receptors, as the risk of impacts to any of these species are considered to be 'low'. The sensitive environmental receptors identified for terrestrial and aquatic ecology within the impact assessment area are:

- Protected areas (refer Section 10.5.6)
- EPBC Act listed TECs and conservation significant species (refer Sections 10.5.3.1, 10.5.3.3 and 10.5.4.1)
- Habitat for EPBC Act listed threatened and migratory species (refer Sections 10.5.3.1 and 10.5.4.1)
- NC Act listed conservation significant species (refer Sections 10.5.3.1 and 10.5.4.1)
- Habitat for NC Act listed conservation significant species (refer Sections 10.5.7 and 10.5.8)
- Regulated vegetation and MSES wildlife habitat/Essential habitat (refer Sections 10.5.3.2 and 10.5.5)
- Least Concern and SLC species (refer Section 10.5.2, Section 10.5.4)
- Priority Back on Track flora and fauna species (refer Section 10.5.2 and Section 10.5.4)
- Significant wetlands (refer Section 10.5.9)
- State significant ecological constraints associated with movement corridors and wildlife habitat (i.e. BPA mapping) (refer Section 10.5.5.3).

10.8 Project activities

Activities proposed as part of the Project have been categorised into three phases—construction, commissioning, and reinstatement and operation. A summary of Project-related activities and the duration of their disturbance is provided in Table 10.26. A full description of Project activities is provided in Chapter 5: Project Description.

TABLE 10.26 SUMMARY OF PROJECT RELATED ACTIVITIES ASSOCIATED WITH CONSTRUCTION, COMMISSIONING AND REINSTATEMENT, OPERATION, AND DECOMMISSIONING PHASE

Phase	Infrastructure activity	Description of activities	Duration of disturbance*
Construction	Site preparation	Vegetation clearing	Permanent
		Topsoil stripping	Medium term/permanent
		Construction of temporary site compounds	Medium term
		Construction of rail access roads	Permanent
		Installation of boreholes and construction water storage	Medium term
		Installation of offices, hardstands, etc	Medium term
		Stockpiling	Medium term
		Artificial impoundment dewatering	Permanent
	Utility diversions	Excavation	Temporary
		Trenching	Short term
		Modification, diversion and realignment of utilities and associated infrastructure	Short term/medium term
	Drainage	Culvert installation	Permanent
	Structures	Construction of bridges over waterways	Medium term
		Road/rail bridge construction	Medium term
	Civil works	Cutting construction	Medium term
		Embankment construction using cut-to-fill from rail alignment and borrow-to-fill from external borrow sources, where required	Medium term
		Construction of temporary haul roads	Medium term
		Drainage controls	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
	Rail construction	Drilling	Temporary
		Ballast installation	Short term
		Sleeper placement	Short term
		Rail placement	Short term
		Installation of train signals and communications infrastructure	Short term
		Demobilising site compounds	Short term
	Signals and communications installation	Removal of temporary fencing	Temporary
Commissioning and reinstatement	Demobilisation/ Decommissioning	Establish permanent fencing	Temporary
		Restoration of disturbed areas, including revegetation where required	Short term
	Spoil mounds	Conversion of haul roads and construction access roads into permanent roads	Medium term
	Fencing	Train services	Permanent
	Restoration	Minor maintenance works	Temporary

Phase	Infrastructure activity	Description of activities	Duration of disturbance*
Commissioning and reinstatement (continued)	Road works	Bridge and culvert inspections	Temporary
		Sleeper replacement	Temporary
		Rail welding	Temporary
		Rail grinding	Temporary
		Ballast dropping	Temporary
		Track tamping	Temporary
		Major periodic maintenance	Temporary
Operation	Train operations	Train movements along the railway	Permanent
	Operational maintenance	Ongoing vehicle movement within the rail corridor	Temporary

Table note:
* Duration of disturbance timeframes:
Temporary—days to months (e.g. 1 to 2 seasons; 3 to 6 months) Short term—Up to 2 years (i.e. 6 to 24 months)
Medium term—from 2 to 10 years
Long term/long lasting—from 11 to 21 years
Permanent—more than 21 years

10.9 Potential impacts

Potential impacts to sensitive environmental receptors may occur during the construction and operation phases of the Project. The potential impacts and susceptible sensitive receptors are summarised in Table 10.27. This section outlines unmitigated potential impacts associated with the Project on sensitive environmental receptors. Mitigation measures for the Project are presented in Sections 10.10.1 and 10.10.2. Application of these mitigation measures is likely to reduce the magnitude and duration of impacts on the sensitive environmental receptors.

TABLE 10.27 SUMMARY OF IMPACT PROCESSES AND SENSITIVE ENVIRONMENTAL RECEPTORS LIKELY TO BE IMPACTED

	Susceptible sensitive environmental receptors		
Habitat values	TECs	Flora	Fauna
Habitat loss and degradation from vegetation clearing/removal	Yes	Yes	Yes
Fauna species injury or mortality	No	No	Yes
Reduction in biological viability of soil to support plant growth due to soil compaction	Yes	Yes	No
Displacement of threatened flora and fauna by invasion of weeds and pest species	Yes	Yes	Yes
Reduction in the connectivity of biodiversity corridors	No	Yes	Yes
Edge effects	Yes	Yes	Yes
Habitat fragmentation	No	Yes	Yes
Barrier effects	No	Yes	Yes
Noise, dust and light impacts	No	Yes	Yes
Increase in litter (waste)	No	No	Yes
Aquatic habitat degradation	No	No	Yes
Erosion and sedimentation	Yes	Yes	Yes
Flooding	Yes	Yes	Yes

Potential impacts identified above are discussed in greater detail in the Section 10.9.1 to 10.9.14.

10.9.1 Habitat loss and degradation from vegetation clearing/removal

The Project footprint encompasses a total of 3,203.78 ha. Under current Queensland Government (DNRME) vegetation mapping, this includes 563.24 ha of remnant vegetation and 34.64 ha of regrowth vegetation. The remaining 2,605.9 ha (81.3 per cent of the Project footprint) consists of clearing for agriculture/cattle grazing.

The removal of vegetation and construction of linear infrastructure resulting in habitat loss is likely to pose the largest risk of adverse impacts for biodiversity arising from the Project. The impact may be direct, in the form of vegetation and habitat removal, or indirect, as fauna and flora diversity may become reduced due to shortages in available habitat resources. Small-scale clearing within largely intact patches of vegetation can cause localised depletion of some species (Kutt et al., 2012) and is particularly relevant to species with small home ranges or reduced ability to disperse (e.g. collared delma). Vegetation clearing and habitat loss are likely to occur during the construction-phase activities. Habitat loss and degradation has the potential to impact on threatened species and communities identified in this assessment.

Aerial foraging bird species (e.g. white-throated needletail and fork-tailed swift) that are not dependent on forested areas may occur across the entire Project footprint. Given the species occurs transiently across a broad swathe of eastern Australia, the impact from the Project is considered negligible at worst and impacts on this species are not considered further.

The Brigalow Belt southern bioregion exists in a highly modified state, and potential vegetation removal associated with the Project is considered to be relatively small when compared to historical broad-scale vegetation clearing that has occurred in the region for agricultural purposes; however, this does not diminish the significance of such loss. Vegetation clearing and habitat loss that cannot be avoided, particularly in high-constraint areas, is likely to result in permanent impacts to threatened biodiversity values.

10.9.2 Fauna species injury or mortality

Physical trauma to fauna is a direct impact that has the potential to reduce local population size and create a 'source/sink' dynamic, although this may not necessarily alter population size (Furrer and Pasinelli, 2016); however, changes in the mortality rate can affect population viability and may be a critical factor in a fragmented landscape where population sizes are fairly small and/or poorly connected. The impact of mortality on population viability is particularly pronounced for longer-lived, slow-breeding species, such as the koala (*Phascolarctos cinereus*) (i.e. k-selected species—species with a long life and low fecundity) and is less pronounced in those that are r-selected (e.g. those species with high fecundity and shorter lifespans) (Oli, 2004).

Physical trauma to fauna is a direct impact that reduces local population numbers. Physical trauma to MNES fauna has the potential to occur during all phases of the Project, with the highest potential likelihood during construction activities that involve vegetation clearing, earthworks, trenching and increased workforce presence (through the movement of vehicles). Species most at risk of injuries and mortality are those that are cryptic, difficult to detect and with poorly developed dispersal mechanisms (e.g. Condamine earless dragon (*Tympanocryptis condaminensis*)); however, larger species with defined territories and movement patterns (e.g. greater glider (*Petauroides volans*), and koala (*Phascolarctos cinereus*)) are less likely to be at risk to direct mortality where appropriate mitigation measures are applied (i.e. pre-clearance surveys and the use of fauna spotters during clearing).

This potential impact will be proportionate to the extent of vegetation and habitat potential for species that are removed and has the potential to impact sensitive environmental receptors, including threatened fauna species listed under the provisions of the EPBC Act.

Some listed diurnal (active during the day) and mobile species, such as listed birds, may move away from areas being disturbed (i.e. vegetation removal) and may not be adversely impacted in terms of direct physical trauma unless fauna are nesting; however, other listed species that are less mobile (i.e. ground-dwelling reptile, mammal and aquatic species) or those that are nocturnal and nest or roost in tree 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.

There is the potential for fauna injury or mortality during all phases of the Project as a result of vehicle collision, particularly when high volumes of vehicle activity occur or during the operational stages of the rail. 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 development of temporary construction tracks, as well as the general use of permanent access tracks and roads across the Project footprint will result in increased vehicle movements that may cause injury or death to fauna by vehicle strike. In addition, once operational, train strike 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 use roads for movement pathways or as foraging habitat.

In addition, entrapment of wildlife in utility diversions (e.g. trenches) or other excavations associated with the Project may also cause physical trauma to fauna. For example, 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 in pits or other excavations during construction of the Project are ground-dwelling species that are capable of moving across modified areas (e.g. Condamine earless dragon (*Tympanocryptis condaminensis*) and arboreal species that descend to the ground to disperse such as koala (*Phascolarctos cinereus*)).

Given the nature of the Project, there is potential for some species, such as the greater glider (*Petauroides volans*), to be struck by trains during periods of dispersal and movement (e.g. while gliding over the alignment). This would only be the case in instances where the alignment is at ground level in predicted habitat (i.e. not in locations of high embankments, bridges or cuttings).

In addition, entrapment of wildlife in utility diversions (e.g. trenches) or other excavations associated with the Project may also cause physical trauma to fauna. For example, 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 in pits or other excavations during construction of the Project are ground-dwelling species that are capable of moving across modified areas in the absence of woodland or forest habitat, such as mammals, amphibians and reptiles.

Aquatic fauna may be injured or killed during construction within waterways, such as the construction of culverts and bridges and associated temporary impoundments required during construction. Species most susceptible to death or injury include smaller and/or sessile species such as freshwater invertebrates. Species such as Murray cod (*Maccullochella peelii*) are less likely to be at risk to direct mortality where appropriate mitigation measures are applied (i.e. pre-clearance relocation activities prior to creating temporary impoundments).

The unmitigated potential occurrence of fauna species injuries or mortalities resulting from the Project can be permanent, where mortality to the species occurs, or temporary, where the species is rehabilitated and re-released.

10.9.3 Reduction in biological viability of soil to support plant growth due to soil compaction

Compaction of soil as a result of the Project activities 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). Changes to soil consistency and structure can affect the productive capacity of the soil for agricultural practices, the suitability of the soils for various land uses, how the soil and landscape will respond to management practices, and the flow paths by which water moves within the soil and landscape (Hicks et al., 1999).

The most direct effect of soil compaction is an increase in the bulk density of soil, which can restrict 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. This influence over water and air movement can impact root penetration, seedling emergence and plant growth (Hicks et al., 1999; Duiker, 2004). Reduction in soil viability may negatively impact the brigalow TEC, the weeping myall woodlands TEC and the poplar box grassy woodland TEC, as well as threatened flora such as Tara wattle (*Acacia lauta*), *Androcalva procumbens*, hairy-joint grass (*Arthraxon hispidus*), *Bertya opponens*, king bluegrass *(Dichanthium queenslandicum),* bluegrass (*Dichanthium setosum*), Belson's panic (*Homopholis belsonii*), winged peppercress (*Lepidium monoplocoides*), wandering pepper-cress (*Lepidium peregrinum*), Coolmunda leucopogon (*Leucopogon* sp. Coolmunda (D. Halford Q 1635)), hawkweed (*Picris evae*), Dunmore prostanthera (*Prostanthera* (sp. Dunmore)), austral cornflower (*Rhaponticum australe*), austral toadflax (*Thesium austral)*, slender tylophora (*Tylophora lineari*), tall hawkweed (*Picris barbarorum*), finger panic (*Digitaria porrecta*) and *Xerothamnella herbacea*. Impacts to soil may also have flow-on effects to sensitive environmental receptors though degradation of their associated habitat.

Soil biota may also be affected by compaction; for example, earthworm numbers and activity can be reduced in compacted soils and compaction may impact on the growth of fungi that are a potential food source for some species. In addition, water infiltration and percolation are slower in compacted soils, thereby inhibiting root growth, leading to the potential reduced uptake of immobile nutrients, such as phosphorus and potassium. Increased nitrogen losses can also be expected due to prolonged periods of saturated conditions in compacted soils.

The unmitigated potential impacts of soil compaction resulting from the Project are generally short term and temporary.

10.9.4 Displacement of threatened flora and fauna by invasion of weeds and pest species

Weed and pest species have the potential to impact on terrestrial and aquatic biodiversity as native species can become displaced through predation and competition. In addition, weeds may result in impact to the brigalow TEC, the weeping myall woodlands TEC and the poplar box grassy woodland TEC through competitive process and displacement by altering nutrient cycling and outcompeting for limited resources.

Pest species can also damage native vegetation that is either an MNES or supports MNES, by grazing and trampling (Adair and Groves, 1998; Clarke et al., 2000; Thorp and Lynch, 2011) or though direction competition/predation (e.g. mosquitofish (*Gambusia holbrooki*) within aquatic ecosystems); therefore, weed and pest species may reduce the extent or quality of available habitat and hence population size for specific MNES. This may have the effect of increasing mortality and reducing the size and viability of population sizes though resource limitation and associated stress.

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of the Project activities) that may have cumulative effects as each Project activity occurs, and as a result of agricultural practices and other resource Project activities, which may act in conjunction to increase the chances of weed and pest proliferation throughout the Project footprint and adjoining areas. Proliferation of weed and pest species has the potential to occur during all phases of the Project, especially during the construction phase; however, the highest likelihood of weed and pest species occurring is from vegetation clearing and soil disturbance from local agricultural land practices.

The effects of proliferation of weed and pest species may not be noticeable immediately or even in the short term, as visible signs may take several months or seasons to impact on sensitive environmental receptors. These potential impacts are likely to be long term and affect all sensitive environmental receptors in the impact assessment area, including affecting the quality and integrity of TECs, remnant vegetation, habitat for conservation significant species, wetlands and waterways.

Non-native species comprised 30 per cent of the flora species recorded in the impact assessment area. Of these, 24 flora species (as well as nine pest fauna species) are considered as 'restricted matters', listed under the provisions of the Biosecurity Act (including six species listed as weeds of national significance). Weeds were prevalent across the entire ecology significant impact area but were most abundant in areas subject to anthropogenic disturbance, such as roadsides and areas subject to cattle grazing. Without appropriate management strategies, the Project activities have the potential to disperse weeds into areas of remnant vegetation where weed species are currently in low densities. In areas that provided highly specific habitat for sensitive environmental receptors (e.g. collared delma (*Delma torquata*)), weed/pest infestations are likely to have the most significant impact and will contribute towards threatening processes; however, pest and weed invasion may benefit some species and some sensitive environmental receptors by supplying an abundant food source that would otherwise be unavailable (e.g. mosquitofish (*Gambusia holbrooki*) as a food source for the Murray cod (*Maccullochella peelii*) and non-native plants as a food source for the brush-tailed rock-wallaby (*Petrogale penicillata*)).

Project activities also have the potential to introduce new weed species into the impact assessment area. The most likely causes of weed dispersal and introduction associated with the Project include earthworks, movement and disturbance of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. Weed dispersal by vehicles along access tracks and roads is a key source of weed invasion (Birdsall et al., 2012). Weed invasion is an indirect impact that may degrade the quality of habitats, potentially resulting in habitat loss.

Soil disturbance during construction may increase the risk of invasion from weed and/or pest species, which can further reduce habitat quality and compromise the integrity of adjacent areas such as the brigalow TEC, the weeping myall woodlands TEC and the poplar box grassy woodland TEC.

Large areas of the impact assessment area have significant weed growth, particularly non-native grasses, which have been introduced as part of historic agricultural land use of the area; therefore, the potential for habitat modification from weed invasion resulting from the Project is highest where Project activities take place in relatively intact areas, such as those identified as containing intact remnant vegetation that currently has low weed diversity and abundance.

Large areas of the impact assessment area have significant weed growth, particularly non-native grasses that have been introduced as part of historic agricultural land use of the area; therefore, the potential for habitat modification from weed invasion resulting from the Project is highest where Project activities take place in relatively intact areas, such as those identified as containing in-tact remnant vegetation that currently has low weed diversity and abundance.

Unmitigated Project activities have the potential to disperse pest (animal) species from the impact assessment area into the surrounding landscape, due to habitat removal, noise disturbance, and human presence during the construction and operation phases of the Project.

Construction of access tracks and rail infrastructure through large patches of intact vegetation may result in the establishment of pest species (particularly predators such as foxes and cats) into areas where they are currently absent or in low numbers; therefore, unmitigated potential impacts of the displacement of native species through the invasion of non-native may be temporary or irreversible.

10.9.5 Reduction in the connectivity of biodiversity corridors

Biodiversity corridors (including those associated with waterways) can be defined as systems of linear habitat that enhance the connectivity of wildlife populations and may help to overcome the main consequences of habitat fragmentation (Wilson and Lindenmayer, 1995). Corridors can assist ecological functioning, at a variety of spatial and temporal scales, from daily foraging movements of individuals, to broad-scale genetic gradients across biogeographical regions. Fragmentation of such corridors have been identified as important threatening processes to MNES such as spotted-tail quoll (*Dasyurus maculatus maculatus*) and koala (*Phascolarctos cinereus*).

State-based mapping for the Brigalow Belt (State of Queensland, 2018) depicts State corridors within the impact assessment area where the alignment intersects vegetation associated with Whetstone and Bringalily State forests. The alignment intersects a regional corridor comprising patchy fragmented vegetation to the north of Pittsworth. The corridor mapping portrays vegetation that is significant for the spread and movement of flora and fauna, including sensitive environmental receptors. Connectivity is generally present only in the south of the impact assessment area, where the majority of native vegetation is situated within State forest and along the higher order watercourses.

Most of the impact assessment area exists in a very fragmented environment but functional connectivity is retained through local linkages of remnant and regrowth vegetation associated with roadside and riparian corridors linking larger patches of vegetation on private land. These linkages are likely to provide landscape permeability for vagile sensitive environmental receptors, such as birds and bats.

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 sections below. An additional potential impact on biodiversity corridors resulting from the Project is the proliferation of weeds and pest species, as mentioned previously. Conservation significant species listed under the provisions of the EPBC Act and NC Act, bioregional corridors and wildlife refugia, are likely to be affected the most as a result of these potential impacts, due to the importance of habitat quality and connectedness for species at a local scale, and the cumulative impacts that may be realised at a regional landscape scale.

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

10.9.6 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. These new environmental conditions along the habitat edges can promote the growth of different vegetation types (including weed species), promote invasion by pest animals 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 from an edge (Forman et al., 2000; Bali, 2005).

Within the impact assessment area, many patches of vegetation are small, irregularly shaped, and fragmented and, as such, 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. In large habitat patches with low edge-to-area ratios (e.g. State forests or remnant vegetation), however, Project activities (vegetation clearing, temporary and permanent) may create edge effects resulting in habitat degradation and a reduction of the habitat available for a range of species.

Edge effects have the potential to impact on the range of flora and fauna species identified as potentially occurring in the impact assessment area, especially on the species with specific micro-habitat requirements that are less tolerant to disturbance (e.g. *Xerothamnella herbacea*, brigalow woodland snail (*Adclarkia cameroni*) and collared delma (*Delma torquata*)). Conversely, some threatened plant species appear to respond positively to edge effects, particularly ground disturbance, and colonise these edge areas reasonably quickly (hairy-joint grass (*Arthraxon hispidus*), king bluegrass (*Dichanthium queenslandicum*), bluegrass (*Dichanthium setosum*), Belson's panic (*Homopholis belsonii*), hawkweed (*Picris evae*), austral cornflower (*Rhaponticum australe*), austral toadflax (*Thesium australe*), tall hawkweed (*Picris barbarorum*), and finger panic (*Digitaria porrecta*)).

It is anticipated that sensitive environmental receptors involving threatened species and wetland and waterway habitat (including habitat for Murray cod (*Maccullochella peelii*)) may be impacted greatest from edge effects, where avoidance of vegetated areas is not practicable; however, given the fragmented nature of the receiving environment, the unmitigated potential impacts of edge effects resulting from the Project are considered to be short term.

10.9.7 Habitat fragmentation

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

The landscape in which the Project is situated is generally highly fragmented, with most vegetation occurring as small fragments due to agricultural practices such as pasture, cropping and horticulture. The Project activities will contribute to further fragmentation along with the associated edge effects and reduction in habitat. This effect will largely impact habitat associated with the large tracts of extant vegetation within the State forests north of Inglewood. Habitat fragmentation has been identified as an important threatening process to sensitive environmental receptors such as spotted-tail quoll (*Dasyurus maculatus maculatus*) 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 to disperse widely across the landscape (e.g. koala (*Phascolarctos cinereus*)).

Linear project activities may, however, result in some small-scale localised fragmentation, which has the potential to be detrimental to the dispersal of relatively sedentary species, such as small mammals, frogs, and reptiles. This can lead to crowding effects and increased competition within habitat patches. Mobile species, such as larger mammals, birds, and bats, may not be affected by this small-scale fragmentation as the landscape in which they currently exist is fragmented and the predicted level of fragmentation would not be enough to restrict their dispersal between habitat patches, providing mitigation measures are in place to facilitate dispersal in these species.

The unmitigated potential impacts of habitat fragmentation resulting from the Project are considered to be long term and irreversible.

10.9.8 Barrier effects

Barrier effects (permanent and/or temporary) occur where particular species are either unable or are 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) or a physical barrier such as a fence, alteration to a waterway, or a culvert that does not provide movement opportunities (particularly important to aquatic species such as the Murray cod (*Maccullochella peelii*)). As noted in the previous section (fragmentation) 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 alignment.

Species most vulnerable to barrier effects include uncommon species, smaller ground-dwelling species and relatively sessile species with smaller home ranges. Sensitive environmental receptors most vulnerable to barrier effects include the Condamine earless dragon (*Tympanocryptis condaminensis*), greater glider (*Petauroides volans*), brush-tailed rock-wallaby (*Petrogale penicillata*) and koala (*Phascolarctos cinereus*).

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. operational and construction access tracks and temporary waterway barrier works, such as the construction of culverts within watercourses, operational rail corridor, construction laydown areas, etc.). Mobile species such as larger mammals, birds and bats may not be affected to the same extent; however, in some instances, the Project infrastructure/works may not present a barrier to populations identified as relevant to the area, given the capacity of the species to disperse widely across the landscape (including heavily disturbed areas) and use Project infrastructure (such as culverts) (e.g. koala (*Phascolarctos cinereus*)).

Human activity and infrastructure are likely to create a barrier, as many species are known to avoid areas of human activity, resulting in indirect habitat loss. 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. Predators and prey may respond differentially to human activity, causing a disruption of community interaction and potentially disrupting ecological processes (Caro, 2005). Human presence and activity is likely to produce avoidance responses in larger mammalian predators that are sensitive to disturbance (i.e. quolls), while species such as macropods (i.e. kangaroos and wallabies) and smaller amphibian and reptile species are more likely to habituate to human presence.

Similarly, barrier effects may be experienced by native animals in the form of increased patrolling and predation by pest animals (e.g. foxes and wild dogs) along barriers, such as a cleared corridor, as prey becomes more exposed and easier to detect and catch.

The unmitigated potential impacts of barrier effects resulting from the Project are, in most cases, considered to be short term and temporary but may, in some cases, be long term and irreversible.

10.9.9 Noise, dust and light impacts

Noise, dust, and light are direct impacts that have the potential to occur as a result of the Project activities during all phases and may also have cumulative effects. Understanding of the impacts of noise on fauna is limited. There are no current State Government or Australian Government policies or guidelines that recommend noise thresholds or limits associated with impacts to fauna. Noise may adversely affect wildlife by interfering with communication, masking the sound of predators and prey, causing stress or avoidance reactions 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 react to new noise initially as a potential threat, but quickly learn that the noise is not associated with a threat (Radle, 2007).

The Project may lead to localised increases of airborne dust levels during construction. Increased dust can result in respiratory issues in fauna, adverse impacts on plant photosynthesis and productivity (Chaston, K. & Doley, D., 2006), changes in soil properties ultimately impacting plant species assemblages (Farmer, 1993), and mortality and/or decrease in aquatic health on aquatic communities from the toxicity of 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 as a result 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).

Artificial lighting may have a range of impacts across different groups of taxa and between species within these groups. Rodents may avoid brightly lit areas at night. Frogs and nocturnal reptiles may congregate at artificial lights to feed on insects attracted to light (Perry et al., 2008). Similarly, many microbat species may congregate at artificial lighting (Rich and Longcore, 2006), although other species may avoid well-lit areas (Threlfall et al., 2013).

The likelihood of potential impacts is anticipated to be greatest where Project activities take place near vegetated areas and known habitat, during construction, decommissioning and rehabilitation phases. Operating rail lines will generate noise and vibration and it is likely that many species will habituate as a result of the regularity of generated noise.

The Project will result in impacts from light spill into adjacent receiving environments (e.g. fauna habitat) due to the operation of plant and equipment throughout the construction phase of the Project and installation of lighting on infrastructure required for the operation of the Project. Impacts associated with light spill may include direct impacts (e.g. increased susceptibility to predation from increased light) or indirect impacts related to altered foraging and habituation in areas exposed to increased lighting. Light impacts associated with construction will be temporary in nature but operational lighting impacts will be long term and very localised (e.g. infrastructure) or transient in nature (i.e. vehicle movement). While light spill may impact negatively on many species, it may positively impact on species such as the large-eared pied bat (*Chalinolobus dwyeri*) and the south-eastern long-eared bat (*Nyctophilus corbeni*) by attracting nocturnally flying insects on which these species feed.

Sensitive environmental receptors affected by these potential impacts include all threatened flora (impact associated with dust) and terrestrial fauna species (impact associated with noise and vibration) and aquatic species (impacts associated with dust, noise and vibration) listed under the provisions of the EPBC Act. The brigalow TEC, weeping myall woodlands TEC and the poplar box grassy woodland TEC may be impacted to a lesser extent and these impacts are likely to be associated with dust alone (i.e. reducing photosynthetic processes following settlement of dust on the leaves of components of the TEC). These types of impacts are likely to be short in duration and localised.

10.9.10 Increase in litter (waste)

The act of littering has the potential to impact the surrounding environment (by causing injury to wildlife), poses threats to human health and is aesthetically displeasing. 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 and, as such, negatively impact species such as the Murray cod (*Maccullochella peelii*). Littered objects may also provide suitable habitat for disease-spreading insects, such as flies and mosquitoes (Healthy Land and Water, 2019).

According to the National Litter Index, across Australia, the most littered items are cigarette butts, and plastic objects are the most littered by volume of material. Cigarette butts and small plastic items are often mistaken for food resources and have been found in the stomachs of juvenile birds. In addition, littering of cigarette butts also poses a bushfire risk (Healthy Land and Water, 2019).

Sensitive environmental receptors affected from this potential impact include all threatened flora (through alterations in recruitment and nutrient cycles) and fauna species (direct consumption, declines in habitat suitability and entanglement). This type of impact has the potential to be long-term in duration due to the varying times of decomposition but it is likely to be localised and manageable.

10.9.11 Aquatic habitat degradation

Activities related to the construction and operation of the Project are likely to impact water quality, thereby degrading habitats for aquatic fauna and flora. Erosion and sedimentation (refer Section 10.9.12), contamination and an increase in litter (refer Section 10.9.10) are all potential mechanisms that will adversely impact aquatic habitat. In addition, direct loss of waterway habitat may occur through activities associated with waterway crossings during construction and operation.

Physical habitat modification due to hydrological regime change may degrade current habitat morphological features, including substrate composition, channel form and bank stability, which may reduce aquatic ecological values. Further loss of ecological services may occur from a removal of riparian vegetation required for both watercourse and drainage feature infrastructure (within construction and operation phases), which may compound physical habitat modification from any changes to hydrological regimes. It is noted that most waterways intersected by the Project are already subject to significant habitat modification due to adjacent land use.

The transport of sediment and eroded material can be washed off areas of exposed soil, stockpile locations, or localised areas in proximity to Project infrastructure (e.g. culverts and bridges) during rainfall events and thus may also affect terrestrial habitats. This in turn may lead to increased sediment loads and turbidity within waterways and potentially increase nutrient loads. In addition to direct impacts to aquatic habitat degradation associated with erosion and sedimentation, flow-on effects from increased sedimentation may impair the functioning of culverts should deposition be too high, exacerbating barrier effects (refer Section 10.9.8).

There is potential for contaminants and pollutants associated with construction and operation of the Project to enter aquatic environments, resulting in the alteration or loss of potential habitat for terrestrial and aquatic species. Concrete, oil and grease, and other chemicals associated with construction and operation, may result in localised run-off into adjacent watercourses and waterbodies following rainfall events.

The disturbance and modification of some riparian zones and works within watercourses/wetlands during the construction phase of the Project, as well as during temporary and permanent diversions of drainage lines/ watercourses, has the potential to reduce the ecological integrity of the watercourse, thereby impacting on structural aspects that support breeding and foraging requirements of aquatic species.

Aquatic habitat degradation is considered a threatening process to the Murray cod (*Maccullochella peelii*) (National Murray Cod Recovery Team, 2010) although this largely occurs at the catchment scale, as a result of land clearing and flow regulation, which influence water quality. Murray cod is restricted to areas of permanent water and is known to complete their lifecycle entirely within freshwater (i.e. potamodromous) habitats. The species is regularly stocked in impounded waters on rivers as well as in dams. The temporary impoundment of watercourses intersected by the Project in which the species may occur (Macintyre River, Macintyre Brook and Condamine River) is not expected to pose a risk to the species. Potential threats are more likely to be realised through impacted water quality (e.g. increased turbidity) at the site localised to construction works, although this is only expected to be temporary in nature.

10.9.12 Erosion and sedimentation

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 as a result of decreasing habitat value.

Erosion and subsequent sedimentation can be damaging to the ecological health of waterways and the surrounding terrestrial environment and may be a proximate cause of environmental degradation. Mobilised course sandy sediment tends to accumulate in areas of slow-flow and may smother bottom-dwelling organisms and their habitats. Deep, permanent river pools, which are valuable habitats for aquatic fauna and refuges for wildlife during summer and drought, may become filled by course 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.

In addition to the secondary impact of erosion and sedimentation on aquatic habitats, the primary impact of erosion on terrestrial habitat has the potential to occur in relation to Project activities. As indicated above, these would be expected 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.

10.9.13 Contamination

An assessment of contaminated land within the impact assessment area was undertaken using a contaminated land risk assessment 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 environmental 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, as their quality is regulated by statutory bodies, as well as being pathways for contaminant migration to other receptors.

The source-pathway-receptor relationship allows an assessment of potential environmental risk to be carried out, based on the nature of the source, the degree of exposure of a receptor to a source, and the sensitivity of the receptor.

Based on the land uses within the impact assessment area, findings of a desktop assessment and field investigations, the potential sources of contamination in the vicinity of the Project alignment are considered to include:

- Agricultural activities: Hydrocarbons (fuel and oil storage and use), pesticides and herbicides, asbestos and lead paint, arsenic (cattle dips) and landfilling
- Quarries: Hydrocarbons (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
- Unknown fill material: Asbestos, metals/metalloids and hydrocarbons.

The source-pathway-receptor linkage for each of the potential sources of contamination within the impact assessment area is presented in Table 10.28.

TABLE 10.28 POTENTIAL EXISTING CONTAMINATED LAND SOURCE, PATHWAY AND RECEPTOR LINKAGES

Potential source	Located within the Project footprint	Contaminants	Potential pathway	Potential receptor
Agricultural land	Yes	Pesticides and herbicides (agricultural storage and use)	Direct contact Dispersion of soil and dust from wind and water Surface water runoff	Human health: Ingestion, inhalation, dermal contact Current and future site users, construction workers, site visitors, surrounding land users. Ecological: Terrestrial—direct contact and consumption (including bioaccumulation) Aquatic ecosystems—direct contact and consumption (including bioaccumulation).
		Hydrocarbons (fuel and oil storage and use) (agricultural storage and use)	Direct contact Dispersion of soil and dust from wind and water Surface water runoff	Human health: Current and future site users, construction workers, site visitors, surrounding land users. Ecological: Potential exposure to surrounding cropping lands. Aquatic ecosystems.

Potential source	Located within the Project footprint	Contaminants	Potential pathway	Potential receptor
Agricultural land (continued)		Asbestos and lead paint (agricultural buildings/ structures)	Direct contact Ingestion Inhalation Dispersion of soil and dust from wind and water Surface water runoff.	Human health: Current and future site users, construction workers, site visitors, surrounding land users.
		Livestock dips or spray races arsenic, DDT, DDE, DDD (agricultural storage and use)	Direct contact Ingestion Dispersion of soil and dust from wind and water Surface water runoff.	Human health: Ingestion, inhalation, dermal contact Current and future site users, construction workers, site visitors, surrounding land users. Ecological: Terrestrial—direct contact and consumption (including bioaccumulation) Aquatic ecosystems—direct contact and consumption (including bioaccumulation).
Housing/sheds/ other	Yes	Hydrocarbons (fuel and oil storage and use), pesticides and herbicides, lead paint and asbestos (agricultural and residential storage and use, commercial enterprise)	Direct contact Ingestion Inhalation Dispersion of soil and dust from wind and water Surface water runoff	Human health: Landowners, current and future site users, construction workers, site visitors, surrounding land users Ecological: Terrestrial—direct contact and consumption Aquatic ecosystems—direct contact and consumption (including bioaccumulation).
Mines **e.g. Lot 8 SP126840**	No	Acid mine drainage, metals/ metalloids (commercial enterprise)	Direct contact Ingestion Inhalation Dispersion of soil and dust from wind and water Surface water runoff	Human health: Landowners, current and future site users, construction workers, site visitors, surrounding land users Ecological: Terrestrial—direct contact and consumption Aquatic ecosystems—direct contact and consumption (including bioaccumulation).
Existing rail corridor	Yes	Metals/metalloids, asbestos, hydrocarbons, pesticides/ herbicides (railway land use)	Direct contact Dispersion of soil and dust from wind and water Surface water runoff	Human health: Ingestion, inhalation, dermal contact Current and future site users, construction workers, site visitors, surrounding land users. Ecological: Terrestrial—direct contact and consumption Aquatic ecosystems—direct contact and consumption (including bioaccumulation).

Potential source	Located within the Project footprint	Contaminants	Potential pathway	Potential receptor
Landfill (municipal) **e.g. Lot 1 RP835800**	No	Hazardous materials, hydrocarbons, metals/metalloids, phenols, polychlorinated biphenyls, phthalates, volatiles and pesticides and herbicides (local Council or commercial enterprise)	Direct contact Dispersion of soil and dust from wind and water Surface water runoff Leaching	Human health: Current and future site users, site workers, site visitors, surrounding land users. Ecological: Terrestrial—direct contact and consumption (including bioaccumulation) Aquatic ecosystems—direct contact and consumption (including bioaccumulation).
Roads	Yes	Metals, hydrocarbons, pesticides/ herbicides (public roads)	Direct contact Dispersion of soil and dust from wind and water Surface water runoff	Human health: Ingestion, inhalation, dermal contact Current and future site users, construction workers, site visitors, surrounding land users. Ecological: Terrestrial—direct contact and consumption Aquatic ecosystems—direct contact and consumption (including bioaccumulation).

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.

The Project footprint and construction methodology will be subject to confirmation through the detail design phase. Following confirmation of these aspects, a further assessment will be required to identify potential contaminated land that is within the Project footprint and will be disturbed by construction activities. Potentially contaminated sites, including existing rail corridor, that will be disturbed will require specific management controls to be developed by a suitably qualified person to outline the process to identify, document and manage contamination in these locations. In some instances, further environmental site investigation may be warranted. Risks to ecological receptors will be considered as a part of further environmental site investigations.

10.9.14 Flooding

The hydrologic 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 12: Surface Water and Hydrology. These predicted changes are not expected to impact habitat for MNES species or TECs in more than a minor and transient manner.

Of the TECs identified within the impact assessment area, Brigalow (*Acacia harpophylla* dominant and co-dominant), Weeping Myall Woodlands and Poplar Box Grassy Woodland on alluvial plains are considered to be the main receptors for changes to hydrological regime. As these TECs occur on floodplains (which are naturally highly variable in flood regime), these were not further considered with regard to potential impacts from flooding changes associated with the Project.

Potential impacts associated with alterations to hydrology are likely to impact species that are less mobile. For example, the Common death adder and other receptors that are unable to mobilise in the face of changing environmental conditions (i.e. flora). Larger species and avian fauna are likely to mobilise away from indirect impacts. While indirect impacts may result in a loss of habitat, this loss is expected to be transient.

Hydrology and flooding issues are not expected to result in a significant residual impact due to the temporary nature of flooding impacts related to the Project. The hydrology variables used for potential impacts involved watercourse catchment change in peak water levels, changes to wetting/drying and change in time of inundation. The modelled catchments included Gowrie Creek; Westbrook Creek, Condamine River (including Grasstree Creek), Back Creek, Nicol Creek, Bringalily Creek, Native Dog Creek, Cattle Creek, Pariagara Creek, Macintyre Brook, Macintyre River.

Hydrology and flooding potential impacts for the susceptible sensitive environmental receptors are typically related to a variation in peak water levels of 0.20 m and a change to dry or wet periods during the extreme flooding events (i.e. 1 in 10,000 AEP or PMF). Variation across impacts for separate sub-catchments (associated with single waterway and defined watercourses) suggests that potential impact is linked to habitat use. Time of inundation is a potential impact for Belson's Panic (*Homopholis belsonii*); however, impacts to this species are typically associated with smaller flood events, which would not be significantly exacerbated by the Project.

Within the smaller flooding scenarios, identified as occurring more commonly, MNES susceptible sensitive receptors that were identified as potentially impacted from changes to wet and dry landscape variation or changes to peak water levels included:

- *Homopholis belsonii* (Belson's panic),
- Five-clawed worm-skink (*Anomalopus mackayi*)
- Spotted-tail quoll (mainland) (*Dasyurus maculatus maculatus*)
- Condamine earless dragon (*Tympanocryptis condaminensis*).

Within the smaller flooding scenarios, identified as occurring more commonly, MSES susceptible sensitive receptors that were identified as potentially impacted from changes to wet and dry landscape variation or changes to peak water levels included:

- Digitaria porrecta (Finger panic)
- Picris barbarorum (Tall hawkweed)
- Common death adder (Acanthophis antarcticus).

The Project impacts on hydrology and flooding are discussed in detail in EIS Appendix Q: Hydrology and Flooding Technical Report.

10.10 Mitigation measures

This section provides discussion of mitigation measures and controls that have been incorporated into the reference design development process, as appropriate and where possible (refer Section 10.10.1), as well as those measures that are proposed to be adopted for future phases of Project delivery (refer Section 10.10.2).

10.10.1 Mitigation through the reference design phase

Development of the reference design has progressed in parallel with the impact assessment process. As a result, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the reference design as appropriate and where possible.

Mitigation measures and controls that have been factored into the reference design for the Project are as follows:

- The Project has been positioned to maximise the use of existing rail corridors and to be co-located with existing road infrastructure, where possible. Co-location with existing linear infrastructure minimises the need to develop natural and rural landscapes that have not previously been subject to disturbance for a similar purpose.
- The Project footprint has been restricted to what is anticipated to be required to construct and operate the works in a safe and efficient manner. Restricting the temporary construction disturbance footprint and the permanent operational disturbance footprint minimises the extent of disturbance required to vegetation and habitats during construction and operation.
- Greenfield components of the Project have been aligned to minimise the extent of impact to remnant vegetation, and the number of watercourses traversed by the Project. Clearing of remnant vegetation will be restricted to the minimum required to enable the safe construction, operation and maintenance of the rail corridor, including minimising the disturbance of sensitive areas such as:
  - Habitat for 'critically endangered', 'endangered' and 'vulnerable' flora and fauna species
  - 'Endangered' and 'of concern' REs and HVR
  - Riparian vegetation
  - Steep slopes
  - Along riverbanks.

- Watercourse crossing structures (including culverts and bridges) have been designed to maintain aquatic fauna passage and minimise the risk of blockages in reference to the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018e)
- The Project has been developed to minimise impacts to watercourses, riparian vegetation and in-stream flora and habitats, by adopting a crossing structure hierarchy where bridges are preferred to culverts to maintain connectivity for species such as fish and platypus, and riparian fauna conduits that are important to fauna species
- Bridges have been designed to minimise impacts to the bed, banks and environmental flows of watercourses in accordance with requirements of the *Fisheries Act 1994* (Qld)
- Bridge and culvert structures have been located and sized to avoid increases in peak water levels, velocities and duration of inundation
- The Project incorporates bridge and culvert structures to maintain existing flow paths and flood flow distributions, such as across the Condamine River floodplain where six bridges have been incorporated into the design, with a combined length of 6 km
- Twenty bridge structures over watercourses are to be constructed to minimise disturbance of aquatic habitats. These bridge structures consist of:
  - Macintyre River Viaduct 1 (Ch 30.5–30.7 km (NS2B))
  - Macintyre River Viaduct 2 (Ch 30.7–31.1 km (NS2B))
  - Macintyre Floodplain #1 Rail Bridge (Ch 31.4–31.6 km (NS2B))
  - Macintyre Floodplain #2 Rail Bridge (Ch 32.2–32.8 km (NS2B))
  - Macintyre Brook Rail Bridge 1 (Ch 52.4–52.7 km)
  - Macintyre Brook Rail Bridge 2 (Ch 55.4–55.6 km)
  - Pariagara Creek Rail Bridge (Ch 67.2–67.5 km)
  - Cattle Creek Rail Bridge (Ch 88.2–88.3 km)
  - Native Dog Creek Rail Bridge (Ch 93.8–94.0 km)
  - Bringalily Creek 1 Rail Bridge (Ch 97.4–97.7 km)
  - Bringalily Creek 3 Rail Bridge (Ch 100.1–100.7 km)
  - Nicol Creek Rail Bridge (Ch 104.3–104.4 km)
  - Back Creek Rail Bridge (Ch 127.9–128.1 km)
  - Grasstree Creek #1 Rail Bridge (Ch 138.6–138.9 km)
  - Grasstree Creek #2 Rail Bridge (Ch 138.9–139.9 km)
  - Condamine River South Branch Rail Bridge (Ch 141.9–142.5 km)
  - Condamine River Main Branch #1 Rail Bridge (Ch 143.1–145.1 km)
  - Condamine River Main Branch #2 Rail Bridge (Ch 145.1–145.7 km)
  - Condamine River North Branch Rail Bridge (Ch 147.8–149.3 km)
  - Westbrook Creek Rail Bridge (Ch 197.1–197.4 km)
  - Dry Creek Rail Bridge (197.9–198.0 km).
- 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
- Fauna crossing opportunities have been co-located with waterway crossing structures to maintain habitat connectivity across the rail corridor. The structures attempt to align with the State significant fauna movement corridor to the north of Inglewood and locations assessed as providing movement opportunities for the greatest number of species. Opportunities to incorporate fauna infrastructure at other potential crossing points (such as large culverts) will be considered during the detail design process (refer Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy).
- Opportunities for the provision of fauna fencing have been identified (refer Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy). These include fencing strategies to guide species such as koala to safe movement opportunities. These opportunities will be refined through the detail design process and incorporated where appropriate.

10.10.2 Proposed mitigation measures

In order to manage and mitigate Project risks, several mitigation measures have been proposed for implementation in future phases of Project delivery. These proposed mitigation measures have been identified to address Project-specific issues and opportunities. Information related to government threat abatement plans and recovery plans has been incorporated into the identified mitigation measures wherever applicable (refer Appendix L: Matters of National Environmental Significance Technical Report for further details). Additional strategies from relevant threat abatement plans and recovery plans will be incorporated, as appropriate, into the Project's Construction Environmental Management Plan (CEMP) and associated sub-plans. A summary of threat abatement plans and recovery plans applicable to the identified MNES is provided in Appendix L: Matters of National Environmental Significance Technical Report.

Mitigation measures proposed for implementation in future phases of Project delivery have been grouped and presented, as follows:

- Table 10.29 identifies overarching mitigation and management measures for all ecological values
- Table 10.30 provides mitigation measures specific to sensitive environmental receptors (flora and fauna) that constitute an MNES
- Table 10.31 provides mitigation measures specific to sensitive environmental receptors (flora and fauna) that constitute an MSES.

The specific management measures for MNES and MSES target habitat types in the first instance, as opposed to individual species; therefore, some MNES and MSES species are grouped together in Table 10.30 and Table 10.31, despite being of different taxonomic classes; for example, Condamine earless dragon, five-clawed worm-skink, Dunmall's snake, squatter pigeon, south-eastern long-eared bat and koala have been grouped together in Table 10.30 as each of these species is known to occupy overlapping habitat within the Project footprint. Species-specific measures have been nominated within these groupings, where relevant.

In each instance in the relevant Project phase, the sensitive environmental receptor that is impacted and the proposed mitigation measures are provided. The measures presented have then been factored into the assessment of residual significance, as documented in Section 10.11.2.

Chapter 22: Draft Outline Environmental Management Plan provides further context and the framework for implementation of these proposed mitigation and management measures.

TABLE 10.29 PROJECT IMPACT MITIGATION MEASURES

Delivery phase	Aspect	Mitigation and management measures
Detail design	Flora and fauna/ biodiversity	A biodiversity management sub-plan will be developed as part of the CEMP and will be comply with any applicable approval conditions. This plan will include appropriate criteria, directives and procedures in relation to: ▸ Methods and sequencing of protected plant surveys, including seasonal timing, in accordance with the requirements of the *Flora Survey Guidelines—Protected Plants* (DES, 2019e). Flora species to be targeted through these surveys include: ▸ MNES: – *Acacia lauta* (Tara wattle) – *Arthraxon hispidus* (Hairy-joint grass) – *Bertya opponens* – *Dichanthium queenslandicum* (king blue-grass) – *Dichanthium setosum* (bluegrass) – *Eucalyptus virens* (shiny-leaved ironbark) – *Homopholis belsonii* (Belson's panic) – *Lepidium monoplocoides* (winged peppercress) – *Lepidium peregrinum* (wandering pepper-cress) – *Leucopogon* sp. Coolmunda (D. Halford Q 1635) (Coolmunda leucopogon) – *Macrozamia machinii* – *Picris evae* (hawkweed) – *Prostanthera* sp. Dunmore (Dunmore prostanthera) – *Rhaponticum australe* (Austral cornflower) – *Thesium australe* (Austral toadflax) – *Tylophora linearis* (slender tylophora) – *Xerothamnella herbacea* – *Westringia parvifolia* ▸ MSES flora: – A sedge (*Cyperus clarus*) – Tall hawkweed (*Picris barbarorum*) – Finger panic (*Digitaria porrecta*)

Delivery phase	Aspect	Mitigation and management measures
Detail design (continued)	Flora and fauna/ biodiversity (continued)	▸ Methods and sequencing of pre-clearance fauna surveys, including terrestrial, aquatic habitats and breeding habitats (including burrows and hollow bearing trees/logs, existing culverts and structures). Fauna species to be targeted through these surveys include: ▸ MNES: – Brigalow woodland snail (*Adclarkia cameroni*) – Five-clawed worm-skink (*Anomalopus mackayi*) – Regent honeyeater (*Anthochaera phrygia*) – Australasian bittern (*Botaurus poiciloptilus*) – Curlew sandpiper (*Calidris ferruginea*) – Large-eared pied bat (*Chalinolobus dwyeri*) – Spotted-tailed quoll (*Dasyurus maculatus maculatus*) – Collared delma (*Delma torquata*) – Yakka skink (*Egernia rugosa*) – Red goshawk (*Erythrotriorchis radiatus*) – Dunmall's snake (*Furina dunmalli*) – Squatter pigeon - southern subspecies (*Geophaps scripta scripta*) – Painted honeyeater (*Grantiella picta*) – Swift parrot (*Lathamus discolor*) – Murray cod (*Maccullochella peelii*) – South-eastern long-eared bat (*Nyctophilus corbeni*) – Greater glider (*Petauroides volans*) – Brush-tailed rock-wallaby (*Petrogale penicillata*) – Koala (*Phascolarctos cinereus*) – Grey-headed flying-fox (*Pteropus poliocephalus*) – Australian painted snipe (*Rostratula australis*) – Black-breasted button-quail (*Turnix melanogaster*) – Condamine earless dragon (*Tympanocryptis condaminensis*) ▸ MSES fauna: – Common death adder (*Acanthophis antarcticus*) – Glossy black-cockatoo (*Calyptorhynchus lathami lathami*) – Major Mitchell's cockatoo (*Lophochroa leadbeateri*)

Delivery phase	Aspect	Mitigation and management measures
Detail design (continued)	Flora and fauna/ biodiversity (continued)	▸ MNES fauna (non-threatened migratory species): – Common sandpiper (*Actitis hypoleucos*) – Fork-tailed swift (*Apus pacificus*) – Sharp-tailed sandpiper (*Calidris acuminata*) – Pectoral sandpiper (*Calidris melanotos*) – Red-necked stint (*Calidris ruficollis*) – Oriental cuckoo (*Cuculus optatus*) – Latham's snipe (*Gallinago hardwickii*) – Black-faced monarch (*Monarcha melanopsis*) – Yellow wagtail (*Motacilla flava*) – Satin flycatcher (*Myiagra cyanoleuca*) – Osprey (*Pandion haliaetus*) – Glossy ibis (*Plegadis falcinellus*) – Rufous fantail (*Rhipidura rufifrons*) – Spectacled monarch (*Symposiachrus trivirgatus*) – Common greenshank (*Tringa nebularia*) ▸ Staging works so that they avoid animal breeding periods as much as possible within areas of habitat (large watercourses) ▸ Staged and sequential clearing protocols ▸ Animal handling protocols, including engagement of an approved fauna handler with a valid damage mitigation permit ▸ Relocation of plants and habitats for threatened species, where possible, and documented evidence of previous relocation exists ▸ Requirements for inspections and corrective actions during construction and rehabilitation activities ▸ Biodiversity/fauna and flora management actions to 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 should the outcomes not achieve the adopted objectives. A Soil Management Sub-plan will be developed and will include the following procedures and protocols relevant to potential impacts to the receiving environment: ▸ Soil/land conservation objectives for the Project to minimise impacts on soil conservation plans and viable productive land, and include: ▸ Appropriate design measures to ensure velocity of flow remains low enough to avoid erosion of contour banks and waterways ▸ Consideration of land slope, land use, soil type, rainfall, trafficability and farm type when designing new contour banks ▸ Stabilisation of banks ▸ Management of problem soils, such as: – Acid sulfate soils (ASS) – Erosive or dispersive soils, such as sodosols, that are expected to be encountered between the Macintyre River and Yelarbon as well as along the fertile lands north of Inglewood to the west of Kooroongarra – Cracking/expansive clays (vertosols) that are expected to be encountered between Kooroongarra and Millmerran and from Yandilla to Gowrie ▸ Saline soils, particularly in high salinity hazard areas such as between Kurumbul and Yelarbon.

Delivery phase	Aspect	Mitigation and management measures
Detail design (continued)	Flora and fauna/ biodiversity (continued)	▸ Minimising exposure of dispersive subsoils through methods such as staging construction disturbance, topsoil replacement or rehabilitation immediately following construction ▸ Appropriate design considerations will be implemented where cracking/expansive clays feature, as well as minimising shrink swell characteristics through methods such as keeping constant soil moisture ▸ Stockpiling and management/segregation of topsoil where it contains native plants seedbank or weed material ▸ Vehicle, machinery and imported fill hygiene protocols and documentation, in accordance with the requirements of the *Biosecurity Act 2014* (Qld) ▸ Specification of the type and location of erosion and sediment controls. The erosion and sediment control measures will be developed by a certified professional in erosion and sediment control and be in accordance with the *Best Practice Erosion and Sediment Control* (International Erosion Control Association, 2008). Details will include: ▸ Locations for specific temporary/permanent erosion and sediment control measures, such as: – Sediment retention basins – Scour protection (included in the reference design) – Sediment fencing – Berms and other surface flow diversions. ▸ Nomination of location-specific erosion controls will include consideration of site conditions, proximity to environmental receptors, adjoining land uses, climatic and seasonal factors, and will be based on an erosion risk assessment ▸ Minimise the area of disturbance during each stage to that required to enable the safe construction, operation and maintenance of the rail corridor ▸ Scheduling of works with consideration to avoiding periods of higher rainfall (summer months) ▸ Establish and specify 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 ▸ Removal and lawful disposal of restricted matters (noxious weeds) ▸ Vehicle, machinery and imported fill hygiene protocols and documentation, in accordance with the requirements of the *Biosecurity Management Sub-plan* ▸ Practical scheduling of construction to minimise land disturbance and exposure of soils. ▸ Where practical, plan to use existing tracks. Design new access tracks (permanent and temporary) with the aim of minimising disturbance of substrate and vegetation. ▸ Detailed ecological surveys of the Project footprint will be undertaken in parallel to the development of the detail design. These surveys will be in accordance with the relevant survey guidelines for nationally threatened species, published in accordance with the EPBC Act. Data obtained from these detailed surveys will be used to refine the quantification of ecological impacts and revise the calculation of offset requirements for the Project.

Delivery phase	Aspect	Mitigation and management measures
Detail design (continued)	Riparian vegetation, aquatic fauna and habitats	▸ The design will continue to be developed to minimise the extent of impacts to waterways, riparian vegetation and in-stream flora and habitats, in accordance with the intent of: ▸ Riverine protection permit exemption requirements (WSS/2013/726). Where the Project is unable to comply with the exemption requirements, a riverine protection permit will be sought for works within a watercourse. ▸ *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018e), e.g. for the dimensions, design and configuration of new culvert crossings. Where the Project is unable to comply with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works*, a development approval for operational work that is constructing or raising waterway barrier works will be sought. ▸ Design modifications during the detail design phase 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.
	Water quality	▸ A Surface Water Management Sub-plan will be developed as a component of the CEMP (refer Chapter 12: Surface Water and Hydrology). The sub-plan will provide a surface water monitoring framework for the Project that establishes: ▸ Additional monitoring and sampling required to establish baseline water quality conditions, as a continuation of data collected during development of the draft EIS. Baseline water quality conditions will preferentially use water quality monitoring sites used within the draft EIS, with consideration of construction activities, seasonality and watercourse sensitivity. These will be monitored, at a minimum monthly, for a period of 12 months prior to commencement of construction, to determine baseline conditions as a reference for monitoring of impact (as per *Queensland Water Quality Guidelines* (QWQG) (DEHP, 2009)). ▸ Watercourse-specific water quality values, based on baseline data, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ), 2018), QWQG and relevant Water Quality Objectives (WQOs) under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* ▸ Frequency and location of surface water sampling during construction of the Project, with consideration for: – Construction activities with potential to impact water quality – Seasonality – Sensitivity of receiving watercourse. ▸ In-situ water quality parameters (pH, electrical conductivity, dissolved oxygen, temperature, oxidation-reduction potential and total dissolved solids) and laboratory analysis required for samples collected at each sampling location ▸ Quality assurance and quality control requirements for surface water sampling and analysis ▸ A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment ▸ Responses to impact threshold exceedances (to be determined after the establishment of baseline water quality conditions) ▸ Data management and reporting requirements

Delivery phase	Aspect	Mitigation and management measures
Detail design (continued)	Fauna movement	▸ Fauna movement opportunities (refer Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy) will be assessed and, where appropriate, developed during detail design, including: ▸▸ Assessment of the compatibility of each approach with the general design principles at each location ▸▸ Consideration of safety requirements for the rail corridor and adjoining properties, e.g. elevated fauna crossing structures may provide insufficient clearance for double-stacked trains ▸▸ Consultation with adjoining landowners to confirm the acceptability of a fauna movement solution and ensure compatibility with their land use operation, e.g. grazing, animal husbandry, etc. ▸ Fauna passage design will be consistent with the intent of the *Fauna Sensitive Road Design Manual* (DTMR, 2000) and, where applicable, will include species-specific requirements.
	Fauna fencing	▸ Fauna fencing opportunities (refer Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy) will be further assessed and, where appropriate, developed during detail design, including: ▸▸ Assessment of the compatibility of each approach with the general fencing principles at each location ▸▸ Consideration of 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 ensure compatibility with their land use operation ▸▸ Consideration for maintenance constraints that a fauna connectivity or fencing opportunity may introduce. ▸ Fauna fencing will be designed in reference to guidelines documented in the *Fauna Sensitive Road Design Manual* (DTMR, 2000). Additional expert guidance in relation to specific design features will be sought during the detail design process. ▸ Priority will be given to fauna fencing in areas identified as State, regional or local fauna movement corridors to channel fauna toward safe movement options (i.e. culverts) to limit vehicle strikes and associated incidents.

Delivery phase	Aspect	Mitigation and management measures
Detail design (continued)	Weeds and pests	▸ A Biosecurity Management Sub-plan will be developed as a component of the CEMP. This plan will include: ▸ Requirements for pre-clearing and operational surveys to determine the risk of weeds or pest animals being present within the Project footprint ▸ Maps of the existing extent, confirmed through surveys, and severity of weed infestation (e.g. restricted matters including mother-of-millions (*Bryophyllum delagoense*), *opuntioid* cacti, African boxthorn (*Lycium ferocissimum*), lippia (*Phyla canescens*) and lantana (*Lantana camara)* 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 ▸ Site hygiene and waste management procedures to deter pest animals ▸ Locations of 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 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. Restrictions may apply 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 ▸ 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, where agreed, will be documented in individual property management agreements. ▸ Further liaison with GRC and DDMRB will be undertaken during detail design to confirm the fencing specifications for the dog check and rabbit exclusion fence, respectively.

Delivery phase	Aspect	Mitigation and management measures
Detail design (continued)	Rehabilitation	▸ A Rehabilitation and Landscaping Management Sub-plan will be developed for the Project, as a component of the CEMP. This sub-plan will be based on the Inland Rail Landscape and Rehabilitation Strategy and location-specific reinstatement commitments. As a minimum it will establish the following: ▸ Location-specific objectives for rehabilitation, reinstatement and/or stabilisation ▸ Within the rail corridor, maintaining operational safety and rail formation stability will be the driving factors ▸ Objectives and timeframes for rehabilitation and/or reinstatement/stabilisation works (including biodiversity, vegetation establishment and erosion and sediment control outcomes to be achieved) ▸ 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 ▸ Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, while minimising the duration of exposure in disturbed areas ▸ Include rehabilitation requirements such as: – Milling and removal of bitumen pavement – Removal of any decommissioned culverts – Tyning 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). ▸ Native flora species endemic to the Darling Downs and Toowoomba regions, or other suitable species appropriate to the landscape context, and nursery/seed stock sources ▸ 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 ▸ Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas.
	Offsets	▸ Restriction of the Project footprint through detail design as far as practical to that required to safely and efficiently construct and operate the Project. In doing so, areas of MNES, MSES and their associated habitat will be avoided, thereby minimising significant adverse residual impacts to MNES. ▸ Significant adverse residual impact to habitat for MNES and MSES will be re-calculated to confirm the Project's offset obligations under Australian Government and State requirements ▸ A Project Offset Plan will be developed to provide for the staged delivery of offsets, where appropriate, ahead of relevant clearing works being undertaken and finalised in consultation with relevant Australian Government and State regulatory agencies (refer Appendix N: Draft Offset Strategy).

Delivery phase	Aspect	Mitigation and management measures
Pre-construction	Flora and fauna/biodiversity	▸ The Biodiversity Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ▸ Scheduling of construction activities to minimise time of works in or adjacent to drainage lines, waterways or watercourses, particularly during periods of flow ▸ 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* (Standards Australia, 2009).
	Rehabilitation	▸ The Rehabilitation and Landscaping Management Sub-plan, as a component of the CEMP, will be implemented (refer above).
	Weeds and pests	▸ Where the Project footprint interacts with the wild dog check fence, between chainages Ch 26.8 km and Ch 56.0 km (approximately), the fence will be reinstated on the northwest side of the rail corridor in accordance with the design solution agreed with GRC through the detail design process ▸ Where the Project crosses the DDMRB fence at chainage 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 detail design process ▸ Undertake pre-construction survey and mapping of weeds within the Project footprint, prior to the commencement of pre-construction and construction activities, in accordance with the Biosecurity Management Sub-plan (refer above).
	Flora	▸ Protected plant surveys, in accordance with the requirements of the *Nature Conservation Act 1992* (Qld), will be undertaken as required in support of pre-construction enabling works. Such works may include additional geotechnical investigations to confirm the viability of borrow pit locations, re-fencing works or the establishment of non-resident workforce accommodation. ▸ Prior to any pre-construction clearing works being undertaken, the clearing extents/site boundary/limit of works will be clearly defined with flagging or marking tape. No-go areas will also be marked. ▸ A qualified Fauna Spotter Catcher will undertake pre-clearance surveys of remnant and regrowth vegetation ▸ The Fauna Spotter Catcher will supervise the subsequent clearing of remnant and regrowth vegetation.
Construction	Flora and fauna/biodiversity	▸ Minimise clearance of remnant vegetation to that necessary for construction. Ensure all necessary permits and approvals are in place prior to the commencement of construction. ▸ Where necessary, clearing activities are to be conducted in accordance with approved performance requirements under the accepted development vegetation management codes ▸ Clearly mark designated revegetation/rehabilitation zones and other no-go areas (including large significant trees) prior to any vegetation clearing. 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. ▸ Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species ▸ A qualified Fauna Spotter Catcher will undertake pre-clearance surveys of vegetation and will supervise the subsequent clearing of vegetation ▸ 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.

Delivery phase	Aspect	Mitigation and management measures
Construction (continued)	Riparian vegetation and aquatic habitats	▸ Refuelling will only occur at designated locations within the Project footprint and sited at suitable separation distances from sensitive receptors, including surface water features and drainage lines. These refuelling locations will be equipped with onsite chemical and hydrocarbon absorbent socks/booms and spill kits. ▸ The Surface Water Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ▸ Works within or adjacent to watercourses will be conducted in accordance with the intent of: ▸ *Riverine protection permit exemption requirements* (WSS/2013/726) (DNRME, 2018a) or conditions of a riverine protection permit issued for the Project ▸ *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018e) or conditions of development approval for operational work that is constructing or raising waterway barrier works. ▸ The salvage and relocation of fish within isolated aquatic environments will be managed in accordance with *Guidelines for fish salvage* (DAF, 2018f) ▸ 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 ▸ Records of all fish recovered, and the location of their release, will be maintained. ▸ 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.
	Flora	▸ Minimise clearance of remnant vegetation to that necessary for construction and safe operation ▸ Clearly mark designated revegetation/rehabilitation zones and other no-go areas (including large significant trees) prior to any vegetation clearing. High-visibility tape, barricade webbing or similar will be used. All contractors are to be briefed on clearing requirements and restrictions (including fines) to prevent over-clearing of these areas. ▸ Where possible, minimise loss of canopy vegetation and works that will lead to the proliferation of weed species will be minimised ▸ Topsoil stockpiles will be a maximum of 2.5 m in height to avoid heat sterilisation of the seed bank ▸ Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species such as Belson's panic, hawkweed, finger panic (*Digitaria porrecta*), austral toadflax and austral cornflower.
	Fauna movement	▸ Fauna movement opportunities will be constructed to reinstate safe fauna passage as soon as possible, in accordance with the fauna movement strategy (refer Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy), which will be finalised and documented in the detail design.
	Fauna fencing	▸ Fauna fencing will be installed where practically possible generally in accordance with the fencing strategy (refer Appendix M: Preliminary Fauna Movement Provision and Fencing Strategy), which will be finalised and documented in the detail design.

Delivery phase	Aspect	Mitigation and management measures
Construction (continued)	Weeds and pests	▸ The Biosecurity Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ▸ The effectiveness of weed hygiene measures will be monitored as a component of the environmental monitoring procedure for the Project ▸ Any vegetated material containing, or with the potential to contain, weed seed material will not be used for onsite mulching or erosion protection ▸ A complaint hotline for the Project will be established and advertised to enable members of the public to notify ARTC of issues, including concerns regarding weeds and pests.
	Erosion and sediment control	▸ Implement the Soil Management Sub-plan, including erosion and sediment controls, as a component of the CEMP (refer above).
	Rehabilitation and landscaping	▸ The Rehabilitation and Landscaping Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ▸ Rehabilitation and landscaping will occur sequentially as work fronts are completed ▸ The rail corridor will be maintained free of woody vegetation.

Operation	Riparian vegetation and aquatic habitats	▸ Maintenance activities within or adjacent to watercourses will be conducted in accordance with the intent of:
		  ▸ *Riverine protection permit exemption requirements* (WSS/2013/726) (DNRME, 2018a) or conditions of a riverine protection permit issued for the Project
		  ▸ *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018e) or conditions of development approval for operational work that is constructing or raising waterway barrier works.

	Weeds and pests	▸ Weed management protocols for the operational rail corridor and other ARTC facilities will be in accordance with the requirements of the *Biosecurity Act 2014* (Qld), ARTC operation and maintenance procedures and policies and the Operation EMP. These protocols will include:
		  ▸ Site hygiene and waste management procedures to deter pest animals
		  ▸ Weed surveillance and treatment during operation and maintenance activities
		  ▸ Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of MNES or MSES habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides
		  ▸ Vehicle, machinery and imported fill hygiene protocols and documentation
		  ▸ Erosion and sediment control risks associated with broad-scale weed removal or treatment
		  ▸ Corrective actions should the outcomes not achieve the adopted objectives.

	Fauna passage	▸ Fauna movement/passage infrastructure and surrounding vegetation will be inspected and maintained during operation to retain the integrity/viability of the fauna movement opportunities.
	Fauna fencing	▸ Fauna movement/passage infrastructure, fencing and surrounding vegetation will be inspected and maintained during operation.

TABLE 10.30 PROPOSED MITIGATION MEASURES SPECIFIC TO MATTERS FOR NATIONAL ENVIRONMENTAL SIGNIFICANCE

Sensitive environmental receptor	Receptor-specific mitigation and management measures (in addition to those specified in Table 10.29)
Construction	
Brigalow (*Acacia harpophylla* dominant and codominant), weeping myall woodlands and poplar box grassy woodlands	▸ Pre-construction surveys will be carried out to confirm to what extent the identified TECs occur within, or adjacent to, the Project footprint. Where TECs are found to occur, condition assessment will be undertaken (using BioCondition assessment) with regular monitoring against initial assessment values. Corrective actions to minimise impacts are to be implemented where Project-associated impacts are identified. ▸ Quantification of the area of TECs removed to enable the Environmental Offsets Delivery Strategy—Queensland to be refined ▸ The Soil Management Sub-plan is to include soil conservation measures and erosion and sediment controls with specific reference/controls to identified TEC areas ▸ The Biosecurity Management Sub-plan will include reference to relevant guidelines to control potential deleterious pathogens, including *Phytophthora cinnamomi* and myrtle rust (*Austropuccinia psidii*), associated with Project activities, both of which may impact eucalypt species. ▸ Design modifications during the detail design phase will seek to maintain inundation regimes within the TEC as close to natural conditions as possible ▸ Annual monitoring of TECs retained within the Project footprint against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified. ▸ Where possible, rehabilitation of disturbed areas, within the Project footprint but outside of the rail corridor, using endemic species.
Dichanthium queenslandicum (King bluegrass), *Lepidium monoplocoides* (winged peppercress), *Xerothamnella herbace*a, *Homopholis belsonii* (Belson's panic), *Picris evae* (hawkweed), *Rhaponticum australe* (Austral cornflower), and *Westringia parvifolia*	▸ Pre-construction protected flora surveys, as per the NC Act, within the Project footprint that target areas identified as potential habitat for the species, as per species habitat mapping (Appendix L: Matters of National Environmental Significance Technical Report). In particular, the following will be targeted: ▸ Suitable habitat in the Yelarbon/Inglewood area for Westringia parvifolia and Xerothamnella herbacea ▸ All other identified threatened flora species occur on the dark clay soils in the northern portion of the Project footprint (north of Bringalily State Forest) ▸ Undertake translocation of specimens where appropriate for a species and where there is documented record of previous translocation trials/schemes ▸ Where a threatened flora species is found to occur within the Project footprint, pre-construction condition assessment of species habitat will be undertaken (using BioCondition assessment) with regular monitoring against initial assessment values. Corrective actions to minimise impacts are to be implemented where Project-associated impacts are identified. ▸ Quantification of the area of threatened flora species removed to enable the Environmental Offsets Delivery Strategy–Queensland to be refined ▸ The Soil Management Sub-plan is to include soil conservation measures and erosion and sediment controls with specific reference to identified habitat for threatened flora (where they are found to occur) ▸ 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 ▸ Annual monitoring of threatened flora species retained within the Project footprint against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified ▸ Where possible rehabilitation of disturbed areas, within the Project footprint but outside of the rail corridor, using endemic species.

Sensitive environmental receptor	Receptor-specific mitigation and management measures (in addition to those specified in Table 10.29)
Lepidium peregrinum (wandering peppercress), *Leucopogon* sp. Coolmunda (Coolmunda leucopogon), *Tylophora linearis* (slender tylophora), *Arthraxon hispidus* (hairy-joint grass), *Bertya opponens*, *Cadellia pentastylis* (Ooline), *Dichanthium setosum* (bluegrass), *Eucalyptus virens* (shiny-leaved ironbark), *Prostanthera* sp. Dunmore (Dunmore prostanthera), *Macrozamia machinii* and *Thesium australe* (Austral toadflax)	▸ Pre-construction protected flora surveys, as per the NC Act, within the Project footprint that target areas identified as potential habitat for the species, as per species habitat mapping (Appendix L: Matters of National Environmental Significance Technical Report). ▸ Undertake translocation of specimens where appropriate for a species and there is documented record of previous translocation trials/schemes ▸ Where a threatened flora species is found to occur within the Project footprint, pre-construction condition assessment of species habitat will be undertaken (using BioCondition assessment) with regular monitoring against initial assessment values. Corrective actions to minimise impacts are to be implemented where Project-associated impacts are identified. ▸ Quantification of the area of threatened flora species removed to enable the *Environmental Offsets Delivery Strategy—Queensland* to be refined ▸ The Soil Management Sub-plan is to include soil conservation measures and erosion and sediment controls with specific reference to identified habitat for threatened flora (where they are found to occur) ▸ 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 ▸ Annual monitoring of threatened flora species retained within the Project footprint against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified. ▸ Where possible, rehabilitation of disturbed areas, within the Project footprint but outside of the rail corridor, using endemic species.
Murray cod	▸ 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 flows in floodplain systems are more likely ▸ Pre-construction surveys of watercourse crossings that are identified as potential habitat if suitable waterholes are present (i.e. Condamine River floodplain channels and Macintyre River) to identify whether the species occurs. Surveys will follow the *Survey guidelines for Australia's threatened fish* (DSEWPaC, 2011b). ▸ 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 (e.g. replacement of large woody debris and ensure no or limited change to instream flows and to allow fish passage) ▸ Implementation of the Biosecurity Management Sub-plan, Soil Management Sub-plan and the Surface Water Management Sub-plan.

Sensitive environmental receptor	Receptor-specific mitigation and management measures (in addition to those specified in Table 10.29)
Wetland migratory species: Common sandpiper (*Actitis hypoleucos*), sharp-tailed sandpiper (*Calidris acuminate*), pectoral sandpiper (*Calidris melanotos*), red-necked stint (*Calidris ruficollis*), Latham's snipe (*Gallinago hardwickii*), yellow wagtail (*Motacilla flava*), osprey (*Pandion haliaetus*), glossy ibis (*Plegadis falcinellus*), common greenshank (*Tringa nebularia*) Wetland birds: Australian painted snipe (*Rostratula australis*), Australasian bittern (*Botaurus poiciloptilus*) and curlew sandpiper (*Calidris ferruginea*)	▸ Pre-construction surveys of wetlands identified as potential habitat of species to identify whether any of these species occurs ▸ Restricted works measures in place should nesting species be detected ▸ Implement measures to ensure pest predator fauna are not attracted to works areas or to using the Project footprint for shelter ▸ Implementation of the Biosecurity Management Sub-plan, Soil Management Sub-plan and the Surface Water Management Sub-plan ▸ Establish and maintain a fauna management and incident register to record sightings and/or incidents involving fauna species during the undertaking of Project activities.

Condamine earless dragon (*Tympanocryptis condaminensis*), five-clawed worm-skink (*Anomalopus mackayi*), Dunmall's snake (*Furina dunmalli*), squatter pigeon (Southern Subspecies) (*Geophaps scripta scripta*), south-eastern long-eared bat (*Nyctophilus corbeni*) and koala[1] (*Phascolarctos cinereus*)	▸ Pre-construction surveys of areas identified as potential habitat of species, as per species habitat mapping (Appendix L: Matters of National Environmental Significance Technical Report), to establish whether individuals occur within the Project footprint. Particular focus on the following:
	  ▸ Suitable habitat on dark clay soils in northern portion of the alignment for Condamine earless dragon (*Tympanocryptis condaminensis*) and five-clawed worm-skink (*Anomalopus mackayi*) (refer *Survey guidelines for Australia's threatened reptiles* (DSEWPaC, 2011a) for survey methods)
	  ▸ Suitable habitat in the Inglewood area for Dunmall's snake (*Furina dunmalli*) (refer *Survey guidelines for Australia's threatened reptiles* (DSEWPaC, 2011a) for survey methods)
	  ▸ Identified potential habitat for south-eastern long-eared bat (*Nyctophilus corbeni*) with focus on areas outside of the State forests north of Inglewood where the species scan be assumed as present (refer *Survey guidelines for Australia's threatened bats* (DEWHA, 2010a) for survey methods)
	  ▸ Identified potential habitat for squatter pigeon (Southern Subspecies) (*Geophaps scripta scripta*) with focus on areas outside of the State forests north of Inglewood where the species scan be assumed as present (refer *Survey guidelines for Australia's threatened birds* (DEWHA, 2010a) for survey methods)
	  ▸ Koala (*Phascolarctos cinereus*) may be assumed as potentially present throughout eucalypt woodlands in the Project footprint.
	▸ Undertake pre-clearance ground surveys for Condamine earless dragon (*Tympanocryptis condaminensis*) and five-clawed worm-skink (*Anomalopus mackayi*) where pre-construction surveys have identified the species as occurring or likely to occur
	▸ Undertake retrieval of tree hollows, where safe to do so, during vegetation clearing, allowing for inspections for roosting south-eastern long-eared bat.
	▸ Implement protocols to allow safe daytime storage of roosting bats and evening release of individuals

Sensitive environmental receptor	Receptor-specific mitigation and management measures (in addition to those specified in Table 10.29)
Condamine earless dragon (*Tympanocryptis condaminensis*), five-clawed worm-skink (*Anomalopus mackayi*), Dunmall's snake (*Furina dunmalli*), squatter pigeon (Southern Subspecies) (*Geophaps scripta scripta*), south-eastern long-eared bat (*Nyctophilus corbeni*) and koala[1] (*Phascolarctos cinereus*) (continued)	▸ Vegetation clearing within the Project footprint in Koala (*Phascolarctos cinereus*) habitat will be carried out in a manner that will minimise stress on potential individuals as much as is practicably possible (e.g. sequential clearing and minimising time of disturbance to animals). Where possible, clearing activities will take place outside the breeding season for koala (October–May). ▸ Restricted works measures in place should koala or squatter pigeon (Southern Subspecies) (*Geophaps scripta scripta*) be observed within Project footprint to allow safe movement away from the works area ▸ Implement measures to allow safe and responsible handling of fauna (where required) and repatriation in pre-identified appropriate habitat outside of the Project footprint ▸ Koalas (*Phascolarctos cinereus*) that are subject to handling will be examined and, if suspected of chlamydia infection, will be taken to a predesignated veterinarian/wildlife care facility for treatment prior to release ▸ Establish and maintain a fauna management and incident register to record sightings and/or incidents involving fauna species during the undertaking of Project activities ▸ The Biosecurity Management Sub-plan will include reference to relevant guidelines to control potential deleterious pathogens, including *Phytophthora cinnamomi* and myrtle rust (*Puccinia psidii*) associated with Project activities; both of which may impact eucalypt species and therefore koala (*Phascolarctos cinereus*). ▸ Fauna crossing structures and fencing are installed in accordance with design specifications ▸ Rehabilitation of temporary construction areas where woodland habitat has been cleared. Revegetation plant species will be obtained from a reliable source that is certified free of pathogens.

Collared delma (*Delma torquata*), yakka skink (*Egernia rugosa*), Spotted-tail quoll (*Dasyurus maculatus maculatus*), greater glider (*Petauroides volans*) and large-eared pied bat (*Chalinolobus dwyeri*) and brigalow woodland snail[1] (*Adclarkia cameroni*)	▸ Pre-construction surveys of areas identified as potential habitat of species, as per species habitat mapping (Appendix L: Matters of National Environmental Significance Technical Report), to establish whether individuals occur within the Project footprint. Surveys will be species specific, following the *Survey guidelines for Australia's threatened mammals* (DSEWPaC, 2011c) and *Survey guidelines for Australia's threatened reptiles* (DSEWPaC, 2011a) and include the following:
	  ▸ Identification of species-specific habitat and habitat features considered suitable for species presence (e.g. cliff faces/boulder piles for large-eared pied bat (*Chalinolobus dwyeri*) and spotted-tail quoll (*Dasyurus maculatus maculatus*) and loose surface rocks for collared delma (*Delma torquata*)
	  ▸ Targeted surveys for brigalow woodland snail (*Adclarkia cameroni*) in identified habitat (Condamine River floodplain riparian woodland). Surveys to be carried out as per expert advice.
	▸ Implement measures to ensure safe retrieval of tree hollows during vegetation clearing and allow safe movement of species (e.g. greater glider (*Petauroides volans*)) away from works area
	▸ Implement measures to ensure retrieval of potential habitat elements (loose surface rock, large fallen timber) during vegetation clearing and placement in adjacent unimpacted habitat
	▸ Implement restricted works measures should larger species (spotted-tail quoll (*Dasyurus maculatus maculatus*)) be observed within the Project footprint to allow safe movement safe away from works area
	▸ Implement measures to allow safe handling of fauna (where required) and repatriation in a suitable habitat away from site
	▸ Establish and maintain a fauna management and incident register to record sightings and/or incidents involving fauna species during the undertaking of Project activities
	▸ 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.

Sensitive environmental receptor	Receptor-specific mitigation and management measures (in addition to those specified in Table 10.29)
Grey-headed flying-fox (*Pteropus poliocephalus*)	▸ Pre-construction surveys of riparian habitat identified as potential roost sites of species. The purpose of surveys will be to identify whether camps occur within or near the Project footprint. It is noted that the species were recorded at a known flying-fox roost site in Inglewood (3 km south of Project) during Project surveys, although this is not known to be a regular roost. No other regular roosts for the species have been previously identified within 10 km of the Project. ▸ Should a roost site be found to occur, management actions will incorporate the mitigation standards detailed in the Australian Government's *Referral guideline for management actions in grey-headed and spectacled flying-fox camps* (DotE, 2015a).

Woodland birds: swift parrot (*Lathamus discolour*), painted honeyeater (*Grantiella picta*), regent honeyeater (*Anthochaera Phrygia*) and red goshawk (*Erythrotriorchis radiatus*), oriental cuckoo (*Cuculus optatus*), black-faced monarch (*Monarcha melanopsis*), satin flycatcher (*Myiagra cyanoleuca*), rufous fantail (*Rhipidura rufifrons*), spectacled monarch (*Symposiachrus trivirgatus*)	▸ Pre-construction surveys of woodlands identified as potential habitat (refer habitat mapping in Appendix L: Matters of National Environmental Significance Technical Report), particularly:
	  ▸ For red goshawk (*Erythrotriorchis radiatus*), to identify whether individuals occur and potentially nest within the Project footprint
	  ▸ For painted honeyeater (*Grantiella picta*) in relevant nesting habitat (brigalow woodlands), to determine whether the species and potential nesting occurs within the Project footprint
	  ▸ For other nest sites within the Project footprint, as per MNES guidelines where suitable nesting habitat (i.e. large emergent trees near water) is identified.
	▸ Should active nest sites for either red goshawk (*Erythrotriorchis radiatus*) or painted honeyeater (*Grantiella picta*) be identified, restricted works measures will be implemented to allow nesting to continue undisturbed.

Operation	
All sensitive receptors	▸ Ongoing weed monitoring within the rail corridor with specific reference to maintaining the pre-construction condition of TEC and habitats that adjoin the rail corridor ▸ Maintenance of erosion and sediment controls within the rail corridor with specific reference to maintaining the pre-construction condition of TECs and habitats that adjoin the rail corridor ▸ Maintenance of the effectiveness of cross-drainage structure (e.g. culverts) to ensure continued connectivity of watercourses and drainage features that are aligned across the rail corridor. ▸ Maintain a fauna management and incident register including observed collisions associated with rail operations ▸ Information on fauna strike will be used to monitor the effectiveness of structures for fauna passage and to inform potential for further measures to be applied to minimise/eliminate the risk of future incidents.

Table note:

The specific management measures for MNES target habitat types in the first instance, as opposed to individual species. Therefore, some MNES species are grouped together despite being of different taxonomic classes.

TABLE 10.31 PROJECT IMPACT MITIGATION MEASURES SPECIFIC TO MATTERS FOR STATE ENVIRONMENTAL SIGNIFICANCE FLORA AND FAUNA SPECIES

Sensitive environmental receptor	Receptor-specific mitigation and management measures (in addition to those specified in Table 10.31)
Construction	
Cyperus clarus, *Digitaria porrecta* (finger panic), *Picris barbarorum* (tall hawkweed)	▸ Pre-construction protected flora surveys, as per the NC Act, within the Project footprint that target areas identified as potential habitat for the species, as per species habitat mapping (refer Appendix J: Terrestrial Ecology Technical Report). Potential suitable habitat for *Cyperus clarus*, finger panic (*Digitaria porrecta*) and tall hawkweed (*Picris barbarorum*) exists between Millmerran and Toowoomba, particularly within road and rail reserves that contain basalt derived soils (i.e. black soils) ▸ Undertake translocation of specimens, where appropriate, for a species where there is documented record of previous translocation trials/schemes ▸ Where a threatened flora species is found to occur within the Project footprint, pre-construction condition assessment of species habitat will be undertaken (using BioCondition assessment) with regular monitoring against initial assessment values. Corrective actions to minimise impacts are to be implemented where Project-associated impacts are identified. ▸ The Soil Management Sub-plan is to include soil conservation measures and erosion and sediment controls, with specific reference to identified habitat for threatened flora (where they are found to occur) ▸ 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 ▸ Annual monitoring of threatened flora species retained within the Project footprint against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified. ▸ Where possible rehabilitation of disturbed areas, within the Project footprint but outside of the rail corridor, using endemic species.
Platypus	▸ 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 flows in floodplain systems are more likely ▸ Pre-construction surveys of watercourse crossings that are identified as potential habitat if suitable waterholes are present (i.e. Condamine River floodplain channels and Macintyre River) to identify whether the species occurs ▸ 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 (e.g. replacement of large woody debris and ensure no or limited change to instream flows and passage) ▸ Implementation of the Biosecurity Management Sub-plan, Soil Management Sub-plan and the Surface Water Management Sub-plan.

Sensitive environmental receptor	Receptor-specific mitigation and management measures (in addition to those specified in Table 10.31)
Common death adder (*Acanthophis antarcticus*) and short-beaked echidna[1] (*Tachyglossus aculeatus*)	▸ Pre-construction surveys of potential habitat of these species to identify whether individuals occur within the Project footprint. Surveys will target those areas identified as potential habitat for the species as per species habitat mapping (Appendix J: Terrestrial Ecology Technical Report) and be carried out as per relevant DES guidelines. Surveys specifically to look for short-beaked echidna (*Tachyglossus aculeatus*) breeding burrows and assess the requirement for a Species Management Program to tamper with animal breeding places, in accordance with the Animals Regulation. ▸ Undertake pre-clearance ground surveys for the common death adder (*Acanthophis antarcticus*) and short-beaked echidna (*Tachyglossus aculeatus*) where pre-construction surveys have identified the species as occurring or likely to occur ▸ Implement measures to allow safe and responsible handling of fauna (where required) and repatriation in pre-identified appropriate habitat outside of the Project footprint ▸ Measures to responsibly handle injured fauna ▸ Measures to control vehicle speed limits onsite to no more than 40 km/hr ▸ Establish and maintain a fauna management and incident register to record sightings and/or incidents involving fauna species during the undertaking of Project activities ▸ Fauna crossing structures and fencing are installed in accordance with design specifications ▸ Rehabilitation of temporary construction areas where habitat has been cleared. Revegetation plant species will be obtained from a reliable source that is certified free of pathogens.
Glossy black-cockatoo (*Calyptorhynchus lathami*), Major Mitchell's cockatoo (*Lophochroa leadbeateri*)	▸ Pre-construction surveys of woodlands within the Project footprint identified as potential habitat (refer habitat mapping in Appendix J: Terrestrial Ecology Technical Report). Surveys for nest sites will be as per DES guidelines where suitable nesting habitat (i.e. large trees containing hollows) is identified. ▸ Should active nest sites for either parrot be identified, restricted works measures will be implemented to allow nesting to continue undisturbed.
Operation	
All sensitive receptors	▸ Ongoing weed monitoring within the rail corridor with specific reference to maintaining the pre-construction condition of TEC and habitats that adjoin the rail corridor ▸ Maintenance of erosion and sediment controls within the rail corridor with specific reference to maintaining the pre-construction condition of TECs and habitats that adjoin the rail corridor ▸ Maintenance of the effectiveness of cross-drainage structures (e.g. culverts) to ensure continued connectivity of watercourses and drainage features that are aligned across the rail corridor ▸ Maintain a fauna management and incident register including observed collisions associated with rail operations ▸ Information on fauna strike will be used to monitor the effectiveness of structures for fauna passage and to inform potential for further measures to be applied to minimise/eliminate the risk of future incidents.

Table note:
The specific management measures for MSES target habitat types in the first instance, as opposed to individual species; therefore, some MSES species are grouped together despite being of different taxonomic classes.

10.10.2.1 Flora and fauna management and monitoring

Mitigation measures have been selected based on the best available information including government guidelines (e.g. DTMR's *Fauna Sensitive Road Design Manual* (DTMR, 2000)) and mitigation measures used on similar projects that have been subject to legislative approval (refer footnotes to Table 10.29). It is acknowledged the effectiveness of these measures may not be subject to rigorous peer-reviewed analysis.

ARTC has reviewed a cross-section of available published literature on effectiveness of mitigation measures used on linear infrastructure. There is significant literature that corroborates ARTC's proposed mitigation measures as being effective:

- Installation and regular maintenance of fauna exclusion fences can help reduce wildlife mortality during construction. Wildlife crossing structures (underpasses and overpasses) have been constructed around the world and are used by many species to safely cross linear infrastructure (Bond and Jones, 2008; VicRoads, 2012; van der Grift, et al., 2015; van der Ree, et al., 2015; Weller 2015)
- Wildlife crossing structures also improve traffic safety and contribute to the conservation of biodiversity by allowing animals to move safely across roads, thereby reducing the risk of collision (Smith et al., 2015)
- Wildlife crossing structures are the most effective approach to mitigate the barrier effect of linear infrastructure on wildlife movement (Taylor and Goldingay, 2010; Smith et al., 2015)
- The combination of exclusion fencing with wildlife passes are complementary, with the ability to avoid animal collisions and maintain infrastructure permeability (VicRoads, 2012; Carlvalho et al., 2017; Ghent, 2018; Barrientos, et al., 2019).
- VicRoads (2012) corroborates the use of bridge underpasses for the effective use of koala crossings
- The most effective stream crossings for fish, when long-span bridges are not an option, are culverts or shorter span bridges that simulate the natural channel (Ottburg and Blank, 2015).
- Use of planting native species to the region was validated by Milton, et al. (2015).

ARTC is committed to implementing ongoing monitoring of the effectiveness of the measures with contingency (under an adaptive management framework) to change/improve management strategies where deleterious impacts to the identified environmental values are observed, or are not minimised, as per the objectives of the proposed measures.

Literature is in agreement that monitoring is a critical component of quantifying effectiveness of a specific mitigation measure (van der Ree, et al., 2008; van der Grift et al., 2015). This is because the success of mitigation measures is heavily reliant on factors such as existing environment, potential habitat, species, climate, design components of the linear infrastructure, and operational frequency of the transport. Due to these factors, it is not feasible to be able to provide a quantification of effectiveness of the Project's mitigation measures (Ghent, 2018).

For example, a comprehensive evaluation of the effectiveness of wildlife crossing structures requires a clear definition of success. Effectiveness is defined as the extent to which the goals of mitigation are reached; however, it is difficult to assess effectiveness without a specific and measurable goal. Therefore, ARTC recommends the SMART approach, that is, goals that are Specific, Measurable, Achievable, Realistic and Time framed (van der Ree, et al., 2008; van der Ree et al., 2015; van der Grift, van der Ree and Jarger, 2015). Van der Ree, et al. (2007) proposed that the overall objective of wildlife crossing structures is to 'increase the permeability of a road corridor'. Criteria that can be used to measure effectiveness include:

- Rates of roadkill
- Habitat connectivity
- Biological requirements are met
- Allowance for dispersal and re-colonisation
- Maintenance of meta-population processes and ecosystem services.

It is also recommended that goals should be set for individual projects that are specific to species, location and the nature of the conflict; for example, a specific goal might be to ensure more than 90 per cent of individuals that approach a crossing structure successfully cross it, or to maintain the risk of extinction of a population to less than 5 per cent over the next 100 years.

As the Project moves into the detail design and construction phases, more focused and comprehensive ecological surveys in accordance with the Commonwealth's survey guidelines will be undertaken under the Project's Flora and Fauna Sub-plan. Targeted surveys will be conducted in parallel to developing the detail design and will identify the actual occurrence/ extent of TECs within and adjacent to the Project footprint and the presence of threatened species and/or habitat suitable to supporting the presence of threatened species. Surveys will be carried out as per diagnostic criteria and condition thresholds outlined in community-specific approved conservation advice (for TECs) and relevant survey guidelines (for threatened fauna). The surveys aim to address any changes to the Project design and footprint, along with informing the design and construction, including specific measures to avoid, mitigate, minimise impacts on a particular species or TECs, along with ongoing monitoring activities.

The surveys will also have the added benefit of addressing some of the recommendations in conservation advices, recovery plans and threat abatement plans, including:

- Identifying extent and quality of TECs
- Identifying extent and quality of habitat for threatened species
- Identifying new populations and knowledge of the species ecology
- Surveys may be designed to monitor known populations for certain species
- The Project is also a mechanism to engage the public about a species.

As part of these surveys, ARTC will look to collaborate and supplement existing studies being undertaken by local councils, environmental groups and government agencies.

During detail design, ARTC will also finalise the location and design of fauna movement structures across Project alignment, targeting key locations. ARTC will work with the relevant stakeholders, including DTMR, local councils, DES and, where applicable, local environmental groups, to finalise the location and design of any crossing structures. This will be especially important in areas of future development or complementary to any ecological corridor strategies within the impact assessment area.

An Environmental Offset Delivery Plan and Offset Area Management Plans will be developed and implemented by ARTC prior to construction, subject to approval under the EPBC Act. The Environmental Offset Delivery Plan will quantify the significant residual impacts of the Project and detail offsets to address these significant residual impacts.

10.11 Impact assessment

This section documents the quantification and assessment of potential impacts to sensitive environmental receptors as a result of the Project. The impact assessment has been undertaken in accordance with the methodology discussed in Section 10.4.6 and in Chapter 4: Assessment Methodology.

10.11.1 Quantified magnitude of potential impacts

Estimation of the potential magnitude of disturbance was undertaken for each of the sensitive environmental receptors identified during the desktop assessment and field surveys. This assessment of impact magnitude was undertaken using predictive habitat modelling, which was supported by field validation and government GIS datasets. In addition, the Project footprint was used to determine the 'unmitigated' disturbance area as a percentage of the extent of the ecological receptors within the broader Project context (i.e. the impact assessment area).

Calculated estimates of potential disturbance magnitudes for each of the sensitive environmental receptors is provided in the following:

- Table 10.32 for EPBC Act controlling provisions of the Project
- Table 10.33 for non-threatened, migratory species listed under the EPBC Act
- Table 10.34 for NC Act threatened, near-threatened and SLC species
- Table 10.35 for other state-based sensitive environmental receptors.

The magnitude of impacts is determined using techniques and tools that facilitate an estimation of the extent, duration and frequency of the impacts as described in Appendix J: Terrestrial Ecology Technical Report, Appendix K: Aquatic Ecology Technical Report and Appendix L: Matters of National Environmental Significance Technical Report. The criteria used to determine magnitude of impacts is presented in Table 10.36.

ARTC are committed to undertaking detailed ecological surveys throughout the Project footprint in parallel to the development of the detail design. The quantification of impacts to MNES will be updated, as necessary, following the conclusion of detailed ecological surveys of the Project footprint. Conclusions from the updated impact assessment will be used to refine the quantification of significant residual impacts and confirm the biodiversity offset requirements for the Project.

TABLE 10.32: ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE TO THREATENED (EPBC ACT) FLORA, FAUNA SPECIES AND ECOLOGICAL COMMUNITIES IDENTIFIED FOR THE PROJECT

				Predicted habitat within the Project footprint (ha)[1, 2, 3, 4]				Percentage (%) disturbance to sensitive environmental receptors within the impact assessment area				
Species name	Common name	NC Act status	EPBC Act status	Potential habitat	Important habitat	Habitat critical to the survival of the species	Total habitat	Potential habitat	Important habitat	Habitat critical to the survival of the species	Total habitat	Magnitude of disturbance area [5,6]
Threatened ecological communities												
Brigalow (*Acacia harpophylla* dominant and codominant)		-	E	-	-	-	**62.89**	-	-	-	**12.48**	Moderate
Natural grassland on basalt and fine-textured alluvial plains on northern NSW and southern QLD		-	E	-	-	-	**0.00**	-	-	-	**0.00**	Absent—not applicable
Weeping myall woodlands		-	E	-	-	-	**81.92**	-	-	-	**5.02**	Moderate
White box–yellow box–Blakely's red gum grassy woodland and derived native grassland		-	E	-	-	-	**0.00**	-	-	-	**0.00**	Absent- not applicable
Poplar box grassy woodland on alluvial plains		-	E	-	-	-	**81.92**	-	-	-	**5.02**	Moderate
Flora (threatened)												
Acacia lauta	Tara wattle	V	V	295.85	0.00	0.00	**295.85**	5.37	0.00	0.00	**5.37**	Moderate
Arthraxon hispidus	Hairy-joint grass	V	V	33.09	0.00	0.00	**33.09**	3.98	0.00	0.00	**3.98**	Moderate
Bertya opponens	*Bertya*	LC	V	10.60	0.00	0.00	**10.60**	4.74	0.00	0.00	**4.74**	Moderate
Cadellia pentastylis	Ooline	V	V	4.56	0.00	0.00	**4.56**	1.44	0.00	0.00	**1.44**	Low
Clematis fawcettii	Stream clematis	V	V	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	Negligible
Dichanthium queenslandicum	King blue-grass	V	E	116.65	0.00	5.29	**121.94**	11.79	0.00	22.25	**12.03**	Moderate
Dichanthium setosum	Bluegrass	LC	V	60.49	0.00	0.00	**60.49**	8.72	0.00	0.00	**8.72**	Moderate
Eucalyptus virens	Shiny-leaved ironbark	V	V	292.55	0.00	0.00	**292.55**	5.73	0.00	0.00	**5.73**	Moderate
Homopholis belsonii	Belson's panic	V	V	287.69	0.00	3.19	**290.88**	6.40	0.00	23.00	**6.45**	Moderate
Lepidium monoplocoides	Winged peppercress	LC	E	329.61	0.00	40.91	**370.52**	5.59	0.00	16.74	**6.04**	Moderate
Lepidium peregrinum	Wandering pepper-cress	LC	E	50.39	0.00	0.00	**50.39**	6.20	0.00	0.00	**6.20**	Moderate
Leucopogon sp. Coolmunda (D. Halford Q 1635)	Coolmunda leucopogon	E	E	48.20	0.00	0.00	**48.20**	7.38	0.00	0.00	**7.38**	Moderate
Macrozamia machinii	*Macrozamia*	V	V	77.72	0.00	0.00	**77.72**	5.20	0.00	0.00	**5.20**	Moderate
Picris evae	Hawkweed	V	V	575.31	0.00	18.68	**593.99**	10.95	0.00	11.11	**10.95**	Moderate

Species name	Common name	NC Act status	EPBC Act status	Predicted habitat within the Project footprint (ha)[1, 2, 3, 4]				Percentage (%) disturbance to sensitive environmental receptors within the impact assessment area				Magnitude of disturbance area [5,6]
				Potential habitat	Important habitat	Habitat critical to the survival of the species	Total habitat	Potential habitat	Important habitat	Habitat critical to the survival of the species	Total habitat	
Prostanthera sp. Dunmore	Dunmore prostanthera	V	V	105.84	0.00	0.00	**105.84**	8.60	0.00	0.00	**8.60**	Moderate
Rhaponticum australe	Austral cornflower	V	V	220.24	0.00	2.29	**222.53**	9.54	0.00	3.56	**9.38**	Moderate
Sophora fraseri	Brush sophora	V	V	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	Negligible
Thesium australe	Austral toadflax	V	V	202.59	0.00	0.00	**202.59**	9.22	0.00	0.00	**9.22**	Moderate
Tylophora lineari	Slender tylophora	E	E	229.42	0.00	0.00	**229.42**	6.23	0.00	0.00	**6.23**	Moderate
Xerothamnella herbacea	*Xerothamnella*	E	E	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	Negligible
Westringia parvifolia	*Westringia*	V	V	66.97	0.00	0.00	**66.97**	10.86	0.00	0.00	**10.86**	Moderate
Fauna (threatened)												
Anthochaera phrygia	Regent honeyeater	E	CE	157.39	0.00	0.00	**157.39**	7.49	0.00	0.00	**7.49**	Moderate
Botaurus poiciloptilus	Australasian bittern	LC	E	44.98	0.00	0.00	**44.98**	4.87	0.00	0.00	**4.87**	Moderate
Calidris ferruginea	Curlew sandpiper	E	CE, M	13.80	0.00	0.00	**13.80**	8.24	0.00	0.00	**8.24**	Moderate
Erythrotriorchis radiatus	Red goshawk	E	V	224.63	0.00	114.71	**339.34**	5.37	0.00	5.40	**5.38**	Moderate
Falco hypoleucos	Grey falcon	V	V	838.71	0.00	0.00	**838.71**	6.28	0.00	0/00	**6,28**	Moderate
Geophaps scripta scripta	Squatter pigeon—southern subspecies	V	V	339.34	0.00	0.00	**339.34**	5.41	0.00	0.00	**5.41**	Moderate
Grantiella picta	Painted honeyeater	V	V	432.99	0.00	0.00	**432.99**	5.91	0.00	0.00	**5.91**	Moderate
Lathamus discolor	Swift parrot	E	CE	20.12	0.00	243.54	**263.66**	9.14	0.00	5.61	**5.78**	Moderate
Rostratula australis	Australian painted snipe	E	E	0.00	0.00	44.98	**44.98**	0.00	0.00	4.87	**4.87**	Moderate
Turnix melanogaster	Black-breasted button-quail	V	V	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	Negligible
Maccullochella peelii	Murray cod	-	V	7.76	0.00	5.06	**12.82**	4.16	0.00	3.12	**3.67**	Moderate
Chalinolobus dwyeri	Large-eared pied bat	V	V	54.95	0.00	0.00	**54.95**	5.16	0.00	0.00	**5.16**	Moderate
Dasyurus maculatus	Spotted-tailed quoll	V	E	65.93	0.00	15.49	**81.42**	7.04	0.00	2.73	**5.41**	Moderate

Species name	Common name	NC Act status	EPBC Act status	Predicted habitat within the Project footprint (ha)[1, 2, 3, 4]				Percentage (%) disturbance to sensitive environmental receptors within the impact assessment area				Magnitude of disturbance area [5,6]
				Potential habitat	Important habitat	Habitat critical to the survival of the species	Total habitat	Potential habitat	Important habitat	Habitat critical to the survival of the species	Total habitat	
Nyctophilus corbeni	South-eastern long-eared bat	V	V	344.10	0.00	0.00	**344.10**	5.41	0.00	0.00	**5.41**	Moderate
Petauroides volans	Greater glider	V	V	198.42	0.00	0.00	**198.42**	7.40	0.00	0.00	**7.40**	Moderate
Petrogale penicillata	Brush-tailed rock-wallaby	V	V	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	Negligible
Phascolarctos cinereus	Koala	V	V	11.91	0.00	481.15	**493.06**	6.62	0.00	6.08	**6.09**	Moderate
Pteropus poliocephalus	Grey-headed flying-fox	LC	V	110.38	0.00	0.10	**110.48**	11.44	0.00	0.13	**10.58**	Moderate
Anomalopus mackayi	Five-clawed worm-skink	E	V	161.58	16.68	0.00	**178.26**	6.03	8.58	0.00	**6.20**	Moderate
Delma torquata	Collared delma	V	V	0.00	295.76	0.00	**295.76**	0.00	6.29	0.00	**6.29**	Moderate
Egernia rugosa	Yakka skink	V	V	364.47	0.00	0.00	**364.47**	5.15	0.00	0.00	**5.15**	Moderate
Furina dunmalli	Dunmall's snake	V	V	0.00	298.85	0.00	298.85	0.00	5.30	0.00	**5.30**	Moderate
Tympanocryptis condaminensis	Condamine earless dragon	E	E	227.66	0.00	17.93	245.59	7.50	0.00	5.11	**7.25**	Moderate
Adclarkia cameroni	Brigalow woodland snail	V	E	131.46	0.00	0.00	**131.46**	10.01	0.00	0.00	**10.01**	Moderate

Table notes:

CE = Critically endangered E = Endangered V = Vulnerable M = Migratory LC = Least concern - = Not listed

1. Area of project footprint: 3,203.78 ha
2. No value (i.e. 0) represents areas where habitat modelling has indicated that no predicted habitat has been identified within a particular area. This mapping will be verified through detailed ecological surveys of the Project footprint in parallel to the development of the detail design. Sensitive environmental receptors that recorded a magnitude of 'not applicable' were not subject to an assessment of impact significance as the sensitive environmental receptor was not subject to impacts.
3. There is potential for each of the sensitive environmental receptor impacts to 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.
4. Refer Table 10.20 for areas of habitat within the impact assessment area
5. Based on total habitat available
6. Refer Table 10.36 for magnitude criteria

TABLE 10.33 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE FOR EPBC ACT LISTED, NON-THREATENED MIGRATORY SPECIES FOR THE PROJECT

Species name	Common name	NC Act status	EPBC Act status	Predicted habitat within the Project footprint (ha)[1,2,3,4]			Percentage (%) disturbance to sensitive environmental receptors within the impact assessment area			Magnitude of disturbance area [5,6]
				Total habitat	Potential habitat	Important habitat	Total habitat	Potential habitat	Important habitat	
EPBC Act migratory species										
Actitis hypoleucos	Common sandpiper	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate
Apus pacificus	Fork-tailed swift	SL	M	**3,203.78**	2,605.89	597.89	**7.35**	7.55	6.61	Moderate
Calidris acuminata	Sharp-tailed sandpiper	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate
Calidris melanotos	Pectoral sandpiper	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate
Calidris ruficollis	Red-necked stint	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate
Cuculus optatus	Oriental cuckoo	SL	M	**24.45**	24.45	0.00	**5.50**	5.50	0.00	Moderate
Gallinago hardwickii	Latham's snipe	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate
Monarcha melanopsis	Black-faced monarch	SL	M	**24.45**	24.45	0.00	**5.50**	5.50	0.00	Moderate
Motacilla flava	Yellow wagtail	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate
Myiagra cyanoleuca	Satin flycatcher	SL	M	**24.45**	24.45	0.00	**5.50**	5.50	0.00	Moderate
Pandion haliaetus	Osprey	SL	M	**44.98**	44.98	0.00	**4.87**	4.92	0.00	Moderate
Plegadis falcinellus	Glossy ibis	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate
Rhipidura rufifrons	Rufous fantail	SL	M	**24.45**	24.45	0.00	**5.50**	5.50	0.00	Moderate
Symposiachrus trivirgatus	Spectacled monarch	SL	M	**24.45**	24.45	0.00	**5.50**	5.50	0.00	Moderate
Tringa nebularia	Common greenshank	SL	M	**132.60**	44.98	87.62	**6.11**	4.87	7.03	Moderate

Table notes:
M = Migratory SLC = Special Least Concern

1. Area of project footprint: 3,203.78 ha
2. No value (i.e. 0) represents areas where habitat modelling has indicated that no predicted habitat has been identified within a particular area. This mapping will be verified through detailed ecological surveys of the Project footprint in parallel to the development of the detail design. Sensitive environmental receptors that recorded a magnitude of 'not applicable' were not subject to an assessment of impact significance as the sensitive environmental receptor was not subject to impacts.
3. There is potential for each of the sensitive environmental receptor impacts to 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.
4. Refer Table 10.20 for areas of habitat within the impact assessment area
5. Based on total habitat available
6. Refer Table 10.36 for magnitude criteria

TABLE 10.34 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE FOR NC ACT CONSERVATION SIGNIFICANT FLORA AND FAUNA SPECIES (EXCLUDING MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE) FOR THE PROJECT

			Predicted habitat within the Project footprint (ha)[1,2,3,4]				Percentage (%) disturbance to sensitive environmental receptors within the impact assessment area				Magnitude of total habitat disturbance area [5,6]
Species name	**Common name**	**NC Act status**	**Total habitat**	**General**	**Essential**	**Core**	**Total habitat**	**General**	**Essential**	**Core**	
NC Act conservation significant flora											
Cyperus clarus	A sedge	V	**106**	106	0.00	0.00	**10.88**	10.88	0.00	0.00	Moderate
Digitaria porrecta	Finger panic	NT	**455.61**	373.87	81.74	0.00	**12.26**	11.72	15.45	0.00	Moderate
Picris barbarorum	Tall hawkweed	V	**567.49**	529.35	38.14	0.00	**7.36**	7.20	10.77	0.00	Moderate
NC Act conservation significant fauna											
Acanthophis antarcticus	Common death adder	V	**540.87**	540.87	0.00	0.00	**6.56**	6.63	0.00	0.00	Moderate
Calyptorhynchus lathami lathami	Glossy black-cockatoo	V	**480.86**	457.7	14.96	8.2	**6.89**	6.86	14.56	3.98	Moderate
Lophochroa leadbeateri	Major Mitchell's cockatoo	V	**387.77**	387.77	0.00	0.00	**6.03**	6.03	0.00	0.00	Moderate
NC Act SLC animals											
Ornithorhynchus anatinus	Platypus	SLC	**87.73**	87.73	0.00	0.00	**4.34**	4.34	0.00	0.00	Moderate
Tachyglossus aculeatus	Echidna	SLC	**736.72**	736.72	0.00	0.00	**7.46**	7.46	0.00	0.00	Moderate

Table notes:

E = Endangered V = Vulnerable NT = Near threatened SLC = Special Least Concern

1. Area of project footprint: 3,203.78 ha
2. No value (i.e. 0) represents areas where habitat modelling has indicated that no predicted habitat has been identified within a particular area. This mapping will be verified through detailed ecological surveys of the Project footprint in parallel to the development of the detail design. Sensitive environmental receptors that recorded a magnitude of 'not applicable' were not subject to an assessment of impact significance as the sensitive environmental receptor was not subject to impacts.
3. There is potential for each of the sensitive environmental receptor impacts to 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.
4. Refer Table 10.20 for areas of habitat within the impact assessment area
5. Based on total habitat available
6. Refer Table 10.36 for magnitude criteria

TABLE 10.35 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE FOR SENSITIVE ENVIRONMENTAL RECEPTORS (EXCLUDING THREATENED AND MIGRATORY SPECIES) IDENTIFIED FOR THE PROJECT

Sensitive environmental receptor	Total coverage of sensitive environmental receptor within the impact assessment area (ha)[3]	Total potential disturbance area within the Project footprint (ha)[1,2,3,4]	Percentage (%) disturbance to sensitive environmental receptors within the impact assessment area	Magnitude of disturbance area [5,6,7]
State significant environmental constraints (MSES)				
Protected areas	3,752.99	124.72	3.32	Moderate
Regulated vegetation (VM Act)				
Endangered remnant vegetation (REs) (Category B)	506.70	62.74	12.38	Moderate
Of concern remnant vegetation (REs) (Category B)	2,583.23	151.50	5.86	Moderate
Least concern remnant vegetation (REs) (Category B)	5,164.15	349.00	6.76	Moderate
High value regrowth vegetation (Category C)	111.98	4.23	3.78	Moderate
MSES wildlife habitat	1,125.67	121.83	10.82	Moderate
Essential habitat	1,299.96	117.31	9.02	Moderate
Nature Conservation (Koala) Conservation Plan 2017 mapping				
Koala Priority Areas	0.00	0.00	0.00	Not present—not applicable
Koala Habitat Areas	81.73	7.44	9.10	Moderate
Koala Habitat Restoration Areas	0.00	0.00	0.00	Not present—not applicable
Locally Refined Koala Habitat Areas	0.00	0.00	0.00	Not present—not applicable
Wetlands				
State significant wetlands (HES)	9.85	0.00	0.00	Not present—not applicable
Least concern flora and fauna* (NC Act) and Priority Back on Track flora and fauna species				
Least concern flora and fauna	115.82	27.76	23.97	High
Priority Back on Track species (not listed under the EPBC Act or NC Act)	115.82	27.76	23.97	High

Sensitive environmental receptor	Total coverage of sensitive environmental receptor within the impact assessment area (ha)[3]	Total potential disturbance area within the Project footprint (ha)[1,2,3,4]	Percentage (%) disturbance to sensitive environmental receptors within the impact assessment area	Magnitude of disturbance area [5,6,7]
Biodiversity Planning Assessment				
BPA habitat values for EVNT taxa (State)	414.42	48.96	11.81	Moderate
BPA habitat values for EVNT taxa (regional)	1,245.98	95.23	7.64	Moderate
Regional terrestrial corridors	2267.09	235.37	10.38	Moderate
State riparian corridors	936.46	37.42	4.00	Moderate
State terrestrial corridors	3314.8	161.39	4.87	Moderate

Table notes:

1. Area of Project footprint: 3,203.78 ha
2. No value (i.e. 0) represents areas where habitat modelling has indicated that no predicted habitat has been identified within a particular area. This mapping will be verified through detailed ecological surveys of the Project footprint in parallel to the development of the detail design. Sensitive environmental receptors that recorded a magnitude of 'not applicable' were not subject to an assessment of impact significance as the sensitive environmental receptor was not subject to impacts.
3. There is potential for each of the sensitive environmental receptor impacts to 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.
4. Refer Table 10.20 for areas of habitat within the impact assessment area
5. Based on total habitat available
6. Refer Table 10.36 for magnitude criteria
7. Sensitive environmental receptors that recorded a magnitude of 'N/A' were not subject to an assessment of impact significance, as the sensitive environmental receptor was not subject to impacts, as determined from predictive habitat mapping.

TABLE 10.36 CRITERIA FOR MAGNITUDE OF DISTURBANCE

Magnitude	Description
Major	An impact that is widespread, permanent and results in substantial irreversible change to the sensitive environmental receptor (e.g. greater than 50 per cent of the habitat within the greater area disturbed).
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the sensitive environmental receptor (e.g. between 13–50 per cent of the habitat within the greater area disturbed).
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the Project is being developed (e.g. between 2–13 per cent of the habitat within the greater area disturbed).
Low	A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls (e.g. between 1–2 per cent of the habitat within the greater area disturbed).
Negligible	An extremely localised impact that is barely discernible and is effectively mitigated through standard environmental management controls (e.g. less than 1 per cent of the habitat within the greater area disturbed).

10.11.2 Initial significance assessment

The impact assessment of the Project on sensitive environmental receptors is provided in Table 10.37 for EPBC Act controlling provisions and Table 10.38 for non-threatened EPBC Act listed migratory species and State-based sensitive environmental receptors. For each sensitive environmental receptor, these tables present both the initial impact significance (i.e. application of mitigation measures already incorporated into the reference design) and the residual significance of impact following the application of Project mitigation measures.

In addition to the mitigation measures presented in Section 10.10.1 and Table 10.29, Table 10.30 and Table 10.31, rehabilitation works may also be an effective mitigation measure to minimise potential impacts over time; however, these strategies are not expected to completely diminish negative impacts associated with Project activities. As such, the potential significant residual impacts are likely to require some level of offset in accordance with legislative requirements. This is further discussed in Section 10.13.

Significance ratings of 'low', 'moderate', 'high' and 'major' may constitute a potential significant residual impact to an MNES or State-based prescribed environmental matters, and were subsequently re-assessed against the MNES significant impact guidelines (for species/communities listed under the EPBC Act, including migratory species) or MSES significant impact guidelines (for prescribed environmental matters) to confirm the initial impact assessment results (refer Sections 10.12.1, 10.12.2 and 10.12.3).

TABLE 10.37 INITIAL ASSESSMENT OF SIGNIFICANCE OF POTENTIAL IMPACTS OF THE PROJECT ON SENSITIVE ENVIRONMENTAL RECEPTORS (EPBC ACT CONTROLLING PROVISIONS)

			Initial impact significance (application of reference design measures presented in Section 10.10.1)		Residual impact significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.30[3]	
Sensitivity[1]	**Phase**	**Potential impacts[2]**	**Magnitude[1]**	**Significance**	**Magnitude**	**Significance**
TECs—Brigalow (*Acacia harpophylla* dominant and codominant), weeping myall woodlands and poplar box grassy woodlands						
High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Dust impacts ▸ Erosion and sedimentation ▸ Contamination ▸ Flooding	Moderate	**High**	Low	**Moderate** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)
	Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Erosion and sedimentation ▸ Flooding	Low	**Moderate**	Negligible	**Low**
	Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Erosion and sedimentation ▸ Flooding	Negligible	**Low**	Negligible	**Low**
Dichanthium queenslandicum* (king bluegrass), *Lepidium monoplocoides* (winged peppercress), *Xerothamnella herbacea*, *Homopholis belsonii* (Belson's panic), *Picris evae* (hawkweed), *Rhaponticum australe* (Austral cornflower), and *Westringia parvifolia						
High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora species from invasion of weed species ▸ Edge effects ▸ Dust impacts ▸ Erosion and sedimentation ▸ Contamination ▸ Flooding	High	Major	Moderate	**High** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)

			Initial impact significance (application of reference design measures presented in Section 10.10.1)		Residual impact significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.30[3]	
Sensitivity[1]	**Phase**	**Potential impacts[2]**	**Magnitude[1]**	**Significance**	**Magnitude**	**Significance**
High	Commissioning and reinstatement	▸ Displacement of flora species from invasion of weed and pest species ▸ Erosion and sedimentation	Negligible	Low	Negligible	Low
	Operation	▸ Erosion and sedimentation ▸ Flooding	Negligible	Low	Negligible	Low
***Lepidium peregrinum* (wandering peppercress), *Leucopogon* sp. Coolmunda (Coolmunda leucopogon), *Tylophora linearis* (slender Tylophora), *Arthraxon hispidus* (hairy-joint grass), *Bertya opponens*, *Cadellia pentastylis* (ooline), *Dichanthium setosum* (bluegrass), *Eucalyptus virens* (Shiny-leaved ironbark), *Prostanthera* sp. Dunmore (Dunmore Prostanthera), *Macrozamia machinii* and *Thesium australe* (Austral Toadflax)**						
High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora species from invasion of weed species ▸ Edge effects ▸ Dust impacts ▸ Erosion and sedimentation ▸ Contamination ▸ Flooding	Moderate	High	Low	**Moderate** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)
	Commissioning and reinstatement	▸ Displacement of flora species from invasion of weed species ▸ Edge effects ▸ Erosion and sedimentation ▸ Flooding	Negligible	Low	Negligible	Low
	Operation	▸ Displacement of flora species from invasion of weed and pest species ▸ Erosion and sedimentation ▸ Flooding	Negligible	Low	Negligible	Low
Murray cod						
High	Construction	▸ Habitat loss from temporary waterway impoundment ▸ Displacement of fauna species from invasion of weed and pest species ▸ Barrier effects ▸ Dust impacts ▸ Aquatic habitat degradation ▸ Erosion and sedimentation ▸ Contamination ▸ Flooding	Moderate	**High**	Low	**Moderate** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)

			Initial impact significance (application of reference design measures presented in Section 10.10.1)		Residual impact significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.30[3]	
Sensitivity[1]	**Phase**	**Potential impacts[2]**	**Magnitude[1]**	**Significance**	**Magnitude**	**Significance**
High	Commissioning and reinstatement	▸ Displacement of fauna species from invasion of weed and pest species ▸ Aquatic habitat degradation ▸ Erosion and sedimentation ▸ Flooding	Low	**Moderate**	Negligible	**Low**
	Operation	▸ Erosion and sedimentation ▸ Flooding	Negligible	**Low**	Negligible	**Low**
Wetland birds: Australian painted snipe (*Rostratula australis*), Australasian bittern (*Botaurus poiciloptilus*) and Curlew sandpiper (*Actitis hypoleucos*)						
High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Edge effects ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation ▸ Erosion and sedimentation ▸ Contamination ▸ Flooding	Moderate	**High**	Low	**Moderate** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)
	Commissioning and reinstatement	▸ Displacement of fauna species from invasion of weed and pest species ▸ Edge effects ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation ▸ Erosion and sedimentation ▸ Flooding	Low	**Moderate**	Negligible	**Low**
	Operation	▸ Displacement of fauna species from invasion of weed and pest species ▸ Light impacts ▸ Erosion and sedimentation ▸ Flooding	Negligible	**Low**	Negligible	**Low**

Sensitivity[1]	Phase	Potential impacts[2]	Initial impact significance (application of reference design measures presented in Section 10.10.1)		Residual impact significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.30[3]	
			Magnitude[1]	Significance	Magnitude	Significance
Condamine earless dragon (*Tympanocryptis condaminensis*), five-clawed worm-skink (*Anomalopus mackayi*), Dunmall's snake (*Furina dunmalli*), squatter pigeon (Southern Subspecies) (*Geophaps scripta scripta*), south-eastern long-eared bat (*Nyctophilus corbeni*) and koala[4] (*Phascolarctos cinereus*)						
High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Reduction in the connectivity of biodiversity corridors ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust and light impacts ▸ Contamination ▸ Flooding	High	**Major**	Moderate	**High** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)
	Commissioning and reinstatement	▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Reduction in the connectivity of biodiversity corridors ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust and light impacts ▸ Flooding	Low	**Moderate**	Negligible	**Low**
	Operation	▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Reduction in the connectivity of biodiversity corridors ▸ Habitat fragmentation ▸ Barrier effects ▸ Light impacts ▸ Flooding	Negligible	**Low**	Negligible	**Low**

Sensitivity[1]	Phase	Potential impacts[2]	Initial impact significance (application of reference design measures presented in Section 10.10.1) Magnitude[1]	Significance	Residual impact significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.30[3] Magnitude	Significance
Collared delma (*Delma torquata*), yakka skink (*Egernia rugosa*), spotted-tail quoll (*Dasyurus maculatus maculatus*), greater glider (*Petauroides volans*), Large-eared pied bat (*Chalinolobus dwyeri*) and brigalow woodland snail[4] (*Adclarkia cameroni*)						
High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Reduction in the connectivity of biodiversity corridors ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust, and light impacts ▸ Contamination ▸ Flooding	Moderate	**High**	Low	**Moderate** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)
	Commissioning and reinstatement	▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Reduction in the connectivity of biodiversity corridors ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust, and light impacts ▸ Flooding	Low	**Moderate**	Negligible	**Low**
	Operation	▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Reduction in the connectivity of biodiversity corridors ▸ Habitat fragmentation ▸ Barrier effects ▸ Light impacts ▸ Flooding	Low	**Moderate**	Negligible	**Low**
Grey-headed flying-fox (*Pteropus poliocephalus*)						
High	Construction	Habitat loss from vegetation clearing/removal Fauna species injury or mortality Noise, dust, and light impacts Aquatic habitat degradation	Moderate	**High**	Low	**Moderate** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)

			Initial impact significance (application of reference design measures presented in Section 10.10.1)		Residual impact significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.30[3]	
Sensitivity[1]	**Phase**	**Potential impacts[2]**	**Magnitude[1]**	**Significance**	**Magnitude**	**Significance**
High	Commissioning and reinstatement	Noise, dust, and light impacts Aquatic habitat degradation	Negligible	**Low**	Negligible	**Low**
	Operation	Light impacts	Negligible	**Low**	Negligible	**Low**
Woodland birds: Swift parrot (*Lathamus discolor*), painted honeyeater (*Grantiella picta*), regent honeyeater (*Anthochaera Phrygia*) and red goshawk (*Erythrotriorchis radiatus*) and grey falcon (*Falco hypoleucos*)						
High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Displacement of fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation	Moderate	**High**	Low	**Moderate** (refer to Section 10.12.1 for assessment against MNES Significant Impact Guidelines)
	Commissioning and reinstatement	▸ Displacement of fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation	Negligible	**Low**	Negligible	**Low**
	Operation	▸ Displacement of fauna species from invasion of weed and pest species ▸ Noise and light impacts	Negligible	**Low**	Negligible	**Low**

Table notes:

1. Refer Table 10.36 for magnitude criteria.
2. Potential impacts to MNES in the above table are based on those presented in Section 10.9.
3. The use of offsets has not been considered as a mitigation measure for the purposes of Project mitigation for the assessment of potential impacts. Refer Section0 relating to the use of offset to compensate Project-related impacts that are not sufficiently reduced in the above table.
4. The specific management measures for MNES target habitat types in the first instance, as opposed to individual species. Therefore, some MNES species are grouped together despite being of different taxonomic classes.

TABLE 10.38 INITIAL ASSESSMENT OF SIGNIFICANCE OF IMPACTS OF THE PROJECT ON IDENTIFIED SENSITIVE ENVIRONMENTAL RECEPTORS

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
Australian Government receptors (EPBC Act listed migratory species)							
Australian Government Significant Ecological Constraint (Species listed as migratory under the EPBC Act): ▸ Osprey (*Pandion haliaetus*) ▸ Fork-tailed swift (*Apus pacificus*) ▸ Oriental cuckoo (*Cuculus optatus*) ▸ Black-faced monarch (*Monarcha melanopsis*) ▸ Rufous fantail (*Rhipidura rufifrons*) ▸ Satin flycatcher (*Myiagra cyanoleuca*) ▸ Spectacled monarch (*Symposiachrus trivirgatus*) ▸ Yellow wagtail (*Motacilla flava*) ▸ Common sandpiper (*Actitis hypoleucos*) ▸ Sharp-tailed sandpiper (*Calidris acuminata*) ▸ Pectoral sandpiper (*Calidris melanotos*) ▸ Red-necked stint (*Calidris ruficollis*) ▸ Latham's snipe (*Gallinago hardwickii*) ▸ Glossy ibis (*Plegadis falcinellus*) ▸ Common greenshank (*Tringa nebularia*)	High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust, and light impacts ▸ Increase in litter (waste) ▸ Aquatic habitat degradation	High	Major	Moderate	High (refer to Section 10.12.2 for assessment against MNES Significant Impact guidelines for migratory species)
		Commissioning and reinstatement	▸ Fauna species injury or mortality ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation	Low	Moderate	Negligible	Low
		Operation	▸ Fauna species injury or mortality ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation	Low	Moderate	Negligible	Low

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
State receptors							
State significant ecological constraint (VM Act): Endangered remnant vegetation (REs) (Category B)	High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Increase in litter (waste)	High	Major	Moderate	High (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Moderate	Negligible	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Moderate	Negligible	Low
State Significant Ecological Constraint (VM Act): Of concern remnant vegetation (REs) (Category B)	Moderate	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Increase in litter (waste)	High	High	Moderate	Moderate (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Low	Negligible	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Low	Negligible	Low

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
State Significant Ecological Constraint (VM Act): Least concern remnant vegetation (REs) (Category B)	Low	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Increase in litter (waste)	Moderate	Low	Low	Negligible
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Moderate	Low	Negligible	Negligible
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species	Moderate	Low	Negligible	Negligible
State significant ecological constraint (VM Act): High value regrowth vegetation (Category C)	Moderate	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Increase in litter (waste) ▸ Aquatic habitat degradation	High	High	Moderate	Moderate (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Moderate	Moderate	Low	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species	Moderate	Moderate	Low	Low

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
State Significant Ecological Constraint (VM Act): ▸ MSES wildlife habitat ▸ Essential habitat	High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Increase in litter (waste)	Moderate	High	Low	Moderate (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Moderate	Negligible	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species;	Low	Moderate	Negligible	Low
Nature Conservation (Koala) Conservation Plan 2017 mapping, including: ▸ Koala Habitat Areas	High	Construction	▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Barrier effects ▸ Noise, dust, and light impacts	Moderate	High	Low	Moderate (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts	Low	Moderate	Negligible	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts	Low	Moderate	Negligible	Low

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
State Significant Ecological Constraint (species listed as threatened under the NC Act): **Flora:** ▸ *Cyperus clarus* (a sedge) ▸ *Digitaria porrecta* (finger panic) ▸ *Picris barbarorum* (tall hawkweed) **Fauna:** ▸ Common death adder (*Acanthophis antarcticus*) ▸ Glossy black-cockatoo (*Calyptorhynchus lathami lathami*) ▸ Major Mitchell's cockatoo (*Lophochroa leadbeateri*)	High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust, and light impacts ▸ Increase in litter (waste) ▸ Aquatic habitat degradation ▸ Contamination ▸ Flooding	High	Major	Moderate	High (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Fauna species injury or mortality ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Flooding	Low	Moderate	Negligible	Low
		Operation	▸ Fauna species injury or mortality ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation ▸ Flooding	Low	Moderate	Negligible	Low
State Significant Ecological Constraint (SLC fauna species): ▸ Echidna (*Tachyglossus aculeatus*) ▸ Platypus (*Ornithorhynchus anatinus*)	Moderate	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Noise, dust, and light impacts ▸ Increase in litter (waste) ▸ Aquatic habitat degradation ▸ Contamination ▸ Flooding	High	High	Moderate	Moderate (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
State Significant Ecological Constraint (SLC fauna species): ▸ Echidna (*Tachyglossus aculeatus*) ▸ Platypus (*Ornithorhynchus anatinus*) (continued)	Moderate	Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Low	Negligible	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts	Low	Low	Negligible	Low
State Significant Ecological Constraint: ▸ Priority Back on Track flora and fauna species (that are not listed under as threatened under the provisions of the EPBC Act or NC Act)	Low	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust, and light impacts ▸ Increase in litter (waste) ▸ Aquatic habitat degradation ▸ Contamination	High	Moderate	Moderate	Low (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Negligible	Negligible	Negligible	Negligible
		Operation	▸ Fauna species injury or mortality ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation	Moderate	Low	Negligible	Negligible

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
State Significant Ecological Constraint: Flora and fauna species not listed under the EPBC Act but listed as 'least concern' under the provisions of the NC Act and flora that is listed as SLC under the provisions of the NC Act	Low	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Fauna species injury or mortality ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Noise, dust, and light impacts ▸ Increase in litter (waste) ▸ Aquatic habitat degradation ▸ Contamination	High	Moderate	Moderate	Low (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines))
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Negligible	Negligible	Negligible	Negligible
		Operation	▸ Fauna species injury or mortality ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Noise, dust, and light impacts ▸ Aquatic habitat degradation	Moderate	Low	Negligible	Negligible
State Significant Ecological Constraint (BPA): ▸ BPA habitat values for EVNT taxa (**State**) ▸ **State** Riparian corridors ▸ **State** Terrestrial corridors	High	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Increase in litter (waste) ▸ Aquatic habitat degradation	High	Major	Moderate	High (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)

Sensitive environmental receptor(s)	Sensitivity[1]	Phase	Potential impacts[2]	Initial significance (application of initial mitigation measures presented in Section 10.10.1)		Residual significance following the application of Project mitigation measures presented in Table 10.29 and Table 10.31[3]	
				Magnitude[1]	Significance	Magnitude	Significance[4]
State Significant Ecological Constraint (BPA): ▸ BPA habitat values for EVNT taxa (**State**) ▸ **State** Riparian corridors ▸ **State** Terrestrial corridors (continued)	High	Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Moderate	Negligible	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Moderate	Negligible	Low
State Significant Ecological Constraint (BPA): ▸ BPA habitat values for EVNT taxa (**regional**) ▸ **Regional** Terrestrial corridors	Moderate	Construction	▸ Habitat loss from vegetation clearing/removal ▸ Reduction in biological viability of soil to support plant growth due to soil compaction ▸ Displacement of flora and fauna species from invasion of weed and pest species ▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Increase in litter (waste)	Moderate	Moderate	Low	Low (refer to Section 10.12.3 for assessment against MSES Significant Impact guidelines)
		Commissioning and reinstatement	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Low	Negligible	Low
		Operation	▸ Displacement of flora and fauna species from invasion of weed and pest species	Low	Low	Negligible	Low

Table notes:

1. Refer Appendix J: Terrestrial Ecology Technical Report for the assessment methodology for 'sensitivity' and 'magnitude' criteria.
2. Potential impacts to terrestrial and aquatic ecology values in the above table are based on those presented in Section 10.9.
3. The use of offsets has not been considered as a mitigation measure for the purposes of project mitigation for the assessment of potential impacts.
4. In instances where the mitigated significance returns a rating of 'high' or above, offsets may be an option to reduce the residual ecological impacts in the long term. Offset for biodiversity values are discussed further in Section 10.13

10.12 Significant residual impact assessment

10.12.1 Significant residual 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–Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (DotE, 2013b) and the EPBC Act *Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)* (DotE, 2014). 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 10.39. Full assessment in accordance with the guidelines is provided in Appendix L: Matters of National Environmental Significance Technical Report.

TABLE 10.39 SUMMARY OF THE SIGNIFICANT IMPACT ASSESSMENT OF EPBC ACT CONTROLLING PROVISIONS FOR THE PROJECT

Scientific name	Common name	NC Act status	EPBC Act status	Summary of significant impact assessment result[1]
TECs				
Brigalow (*Acacia harpophylla* dominant and co-dominant)		-	E	Significant residual impact likely
Natural grassland on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland		-	E	No significant residual impact expected
Weeping myall woodlands		-	E	Significant residual impact possible (TEC presence within Project footprint requires further confirmation)
White box–yellow box–Blakely's red gum grassy woodland and derived native grassland		-	E	No significant residual impact expected
Poplar box grassy woodland on alluvial plains		-	E	Significant residual impact possible (TEC presence within Project footprint requires further confirmation
Flora				
Dichanthium queenslandicum	King blue-grass	V	E	Likely significant residual impact
Lepidium monoplocoides	Winged peppercress	LC	E	Potential significant residual impact
Lepidium peregrinum	Wandering pepper-cress	LC	E	No significant residual impact expected
Leucopogon sp. Coolmunda (D. Halford Q 1635	Coolmunda leaucopogon	E	E	No significant residual impact expected
Tylophora linearis	Slender tylophora	E	E	No significant residual impact expected
Xerothamnella herbacea	Xerothamnella	E	E	Potential significant residual impact
Acacia lauta	Tara wattle	V	V	No significant residual impact expected—no important populations or critical habitat mapped as present
Arthraxon hispidus	Hairy-joint grass	V	V	No significant residual impact expected—no important populations or critical habitat mapped as present
Bertya opponens	*Bertya opponens*	LC	V	No significant residual impact expected—no important populations or critical habitat mapped as present
Cadellia pentastylis	Ooline	E	V	No significant residual impact expected—no important populations or critical habitat mapped as present

Scientific name	Common name	NC Act status	EPBC Act status	Summary of significant impact assessment result[1]
Clematis fawcettii	Stream clematis	V	V	No significant residual impact expected
Dichanthium setosum	Bluegrass	LC	V	No significant residual impact expected—no important populations or critical habitat mapped as present
Eucalyptus virens	Shiny-leaved ironbark	V	V	Potential significant residual impact
Homopholis belsonii	Belson's panic	V	V	Likely significant residual impact
Macrozamia machinii	*Macrozamia*	V	V	Potential significant residual impact
Picris evae	Hawkweed	V	V	Likely significant residual impact
Prostanthera (sp. Dunmore)	Dunmore prostanthera	V	V	No significant residual impact expected—no important populations or critical habitat mapped as present
Rhaponticum australe	Austral cornflower	V	V	Likely significant residual impact
Sophora fraseri	Brush sophora	V	V	No significant residual impact expected
Thesium australe	Austral toadflax	V	V	No significant residual impact expected—no important populations or critical habitat mapped as present
Westringia parvifolia	Westringia	V	V	No significant residual impact expected
Fauna				
Adclarkia cameroni	Brigalow woodland snail	V	E	No significant residual impact expected
Anthochaera phrygia	Regent honeyeater	E	CE	No significant residual impact expected
Botaurus poiciloptilus	Australasian bittern	LC	E	No significant residual impact expected
Calidris ferruginea	Curlew sandpiper	E	CE	No significant residual impact expected
Falco hypoleucos	Grey falcon	V	V	No significant residual impact expected
Lathamus discolor	Swift parrot	E	CE	Likely significant residual impact
Rostratula australis	Australian painted snipe	E	E	No significant residual impact expected
Dasyurus maculatus maculatus	Spotted-tail quoll (mainland)	V	E	Minor potential for significant residual impact
Tympanocryptis condaminensis	Condamine earless dragon	E	E	Likely significant residual impact
Anomalopus mackayi	Five-clawed worm-skink	V	V	Likely significant residual impact
Chalinolobus dwyeri	Large-eared pied bat	V	V	No significant residual impact expected—no important populations mapped as present
Delma torquata	Collared delma	V	V	Minor potential for significant residual impact
Egernia rugosa	Yakka skink	V	V	Minor potential for significant residual impact
Erythrotriorchis radiatus	Red goshawk	V	V	No significant residual impact expected
Furina dunmalli	Dunmall's snake	V	V	Likely significant residual impact
Geophaps scripta scripta	Squatter pigeon–southern subspecies	V	V	Likely significant residual impact
Grantiella picta	Painted honeyeater	V	V	No significant residual impact expected—no important populations mapped as present
Maccullochella peelii	Murray cod	-	V	No significant residual impact expected—no important populations mapped as present
Nyctophilus corbeni	South-eastern Long-eared bat	V	V	Likely significant residual impact

Scientific name	Common name	NC Act status	EPBC Act status	Summary of significant impact assessment result[1]
Petauroides volans	Greater glider	V	V	No significant residual impact expected—no important populations mapped as present
Petrogale penicillata	Brush-tailed rock-wallaby	V	V	No significant residual impact expected—no habitat mapped as present
Phascolarctos cinereus	Koala	V	V	Likely significant residual impact
Pteropus poliocephalus	Grey-headed flying-fox	LC	V	No significant residual impact expected—no important populations mapped as present
Turnix melanogaster	Black-breasted button-quail	V	V	No significant residual impact expected—no habitat mapped as present

Table notes:
CE = Critically endangered, E = Endangered, V = Vulnerable, LC – Least concern, - = Not listed;
1. Conclusions will be updated, as necessary, following the completion of detailed ecological surveys of the Project footprint

10.12.2 Significant residual impact assessment for matters of national environmental significance (non-threatened migratory species species)

This section summarises assessment of the potential for significant residual impacts as a result of the Project on the EPBC Act non-controlling provisions of the Project, specifically non-threatened migratory species. This assessment has been undertaken using the relevant criteria outlined in the *Matters of National Environmental Significance: Significant impact guidelines 1.1* (DotE, 2013b) and the *Draft Referral guidelines for 14 birds listed as migratory species under the* EPBC Act (DotE, 2015c). A summary of the outcomes of this assessment is provide in Table 10.40. Full assessment in accordance with the guidelines is provided in Appendix J: Terrestrial Ecology Technical Report.

TABLE 10.40 SUMMARY OF THE SIGNIFICANT IMPACT ASSESSMENT OF EPBC ACT MIGRATORY SPECIES FOR THE PROJECT

Species name	Common name	NC Act status	EPBC Act status	Summary of significant impact assessment result[1]
Aerial migrants				
Apus pacificus^	Fork-tailed swift	SLC	M	No significant impact likely
Marine migrants				
Actitis hypoleucos	Common sandpiper	SLC	M	No significant impact likely
Calidris acuminata	Sharp-tailed sandpiper	SLC	M	No significant impact likely
Calidris melanotos	Pectoral sandpiper	SLC	M	No significant impact likely
Calidris ruficollis	Red-necked stint	SLC	M	No significant impact likely
Gallinago hardwickii	Latham's snipe	SLC	M	No significant impact likely
Tringa nebularia	Common greenshank	SLC	M	No significant impact likely
Woodland migrants				
Myiagra cyanoleuca	Satin flycatcher	SLC	M	No significant impact likely
Monarcha melanopsis	Black-faced monarch	SLC	M	No significant impact likely
Symposiachrus trivirgatus	Spectacled monarch	SLC	M	No significant impact likely
Rhipidura rufifrons	Rufous fantail	SLC	M	No significant impact likely
Cuculus optatus	Oriental cuckoo	SLC	M	No significant impact likely
Wetland migrants				
Plegadis falcinellus	Glossy ibis	SLC	M	No significant impact likely
Motacilla flava	Yellow wagtail	SLC	M	No significant impact likely
Pandion haliaetus	Osprey	SLC	M	No significant impact likely

Table notes:
M = migratory SLC = Special least concern
1. Conclusions will be updated, as necessary, following the completion of detailed ecological surveys of the Project footprint

10.12.3 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* criteria details when an action is likely to have a 'significant residual impact' to a MSES as defined in the *Environmental Offsets Regulation 2014*.

A summary of the outcomes of this assessment is provide in Table 10.41. Full assessment in accordance with the guidelines is provided in Appendix J: Terrestrial Ecology Technical Report.

TABLE 10.41 SUMMARY OF THE SIGNIFICANT IMPACT ASSESSMENT OF PRESCRIBED ENVIRONMENTAL MATTERS FOR THE PROJECT

Matter	Summary of significant impact assessment result[1]
Regulated vegetation	
'Endangered' or 'of concern' regional ecosystem (RE)	Significant impact anticipated
A prescribed RE (Category B other than grassland) within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature (Appendix 3 of the *Queensland Environmental Offsets Policy*)	Significant impact anticipated
Remnant vegetation intersection with a VM Act wetland	Uncertain (refer Appendix J: Terrestrial Ecology Technical Report for further information)
Essential habitat	Significant impact anticipated
Connectivity areas	
Connectivity areas	Significant impact anticipated
Designated precincts in Strategic Environmental Areas	
Designated precincts in Strategic Environmental Areas	Significant impact not anticipated
Wetlands and watercourses	
A wetland in a wetland protection area, or wetlands of high ecological significance shown on the map of Queensland wetland environmental values A wetland or watercourse in high ecological value waters	Significant impact not anticipated
Protected wildlife habitat	
An area contains plants that are endangered wildlife or vulnerable wildlife	Significant impact anticipated.
A habitat for an animal that is either: a) endangered wildlife b) vulnerable wildlife c) SLC animal (an echidna or a platypus)	Significant impact anticipated
Fish habitat area	
An area declared under the *Fisheries Act 1994* (Qld) to be a fish habitat area	Significant impact not anticipated
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	Uncertain (refer Appendix J: Terrestrial Ecology Technical Report for further information)

Table notes:
1. Conclusions will be updated, as necessary, following the completion of detailed ecological surveys of the Project footprint

10.13 Biodiversity offsets

Impacts to sensitive environmental receptors will be avoided where possible and then minimised and mitigated to the greatest extent practicable (refer Sections 10.10.1 and 10.10.2). 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. The significance of residual impacts, as shown in Section 10.11.2, reflects the effectiveness of the proposed mitigation measures but also allows for the identification of areas where further management measures may be required.

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* (Strategy) has been developed for the Project and is provided as Appendix N: Draft Offset Strategy.

10.13.1 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.'*

A 'significant impact' is defined as, *'an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts'* (DSWEPaC, 2012b).

Residual impact significance is reflective of the potential for some Project activities to have a cumulative, irreversible and/or permanent impact on some terrestrial MNES TEC and species, even after the implementation of all mitigation measures, including rehabilitation. In these cases, the residual impact will require offset should the residual impact be considered significant in accordance with the EPBC Act *Matters of National Environmental Significance Significant Impact Assessment 1.1* (DotE, 2013b).

An offset is likely to be required for MNES that experience a significant residual impact, which may include areas containing 'habitat critical to the survival of a species' or 'important habitat for EPBC Act listed species' as well as any area occupied by an EPBC Act listed TEC.

An assessment of the relevant MNES to the Project has been undertaken in accordance with the MNES significant impact criteria within the MNES Guidelines (refer Section 10.12.1 and Appendix L: Matters of National Environmental Significance Technical Report). Analysis, based on predictive habitat modelling and mapping, indicates that significant residual impacts for the following sensitive environmental values have potential to occur:

- TECs:
  - Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC
  - Weeping Myall Woodlands TEC
  - Poplar Box Grassy Woodland on Alluvial Plains TEC
- Threatened flora:
  - *Dichanthium queenslandicum* (king blue-grass)
  - *Lepidium monoplocoides* (winged peppercress)
  - *Xerothamnella herbacea*
  - *Eucalyptus virens* (Shiny-leaved ironbark)
  - *Homopholis belsonii* (Belson's panic)
  - *Macrozamia machinii*
  - *Picris evae* (Hawkweed)
  - *Rhaponticum australe* (Austral cornflower)
- Threatened fauna:
  - Spotted-tail quoll (mainland) (*Dasyurus maculatus maculatus*)
  - Condamine earless dragon (*Tympanocryptis condaminensis*)
  - Five-clawed worm-skink (*Anomalopus mackayi*)
  - Collared delma (*Delma torquata*)
  - Yakka skink (*Egernia rugosa*)
  - Dunmall's snake (*Furina dunmalli*)
  - Squatter pigeon - southern subspecies (*Geophaps scripta scripta*)
  - South-eastern long-eared bat (*Nyctophilus corbeni*)
  - Swift parrot (*Lathamus discolor*)
  - Koala (*Phascolarctos cinereus*).

This list is reflective of the significant residual impacts that are anticipated based on the assessment conducted to-date. Detailed ecological surveys of the Project footprint will be undertaken in parallel to the development of the detail design. Data obtained from these detailed surveys will be used to refine the quantification of ecological impacts, revise the analysis of significant residual impacts and re-calculate offset requirements for the Project. Additional species may be identified through this process.

An initial quantification of anticipated significant residual impacts to MNES is presented in Table 10.42.

Calculations of these areas is based on the conservative Project footprint, which will be subject to refinement during detail design and input from detailed field surveys.

TABLE 10.42 QUANTIFICATION OF ANTICIPATED SIGNIFICANT RESIDUAL IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Sensitive environmental receptor (MNES)	Identified significant residual impact[1]
Brigalow (Acacia harpophylla dominant and co-dominant) TEC	62.89 ha—potential extent
Weeping Myall Woodlands TEC	39.72 ha—potential extent
Poplar Box Grassy Woodland on Alluvial Plains TEC	39.72 ha—potential extent
Dichanthium queenslandicum (King blue-grass)	5.29 ha
Lepidium monoplocoides (Winged peppercress)	40.91 ha
Homopholis belsonii (Belson's panic)	3.19 ha
Picris evae (Hawkweed)	18.68 ha
Rhaponticum australe (Austral cornflower)	2.29 ha
Condamine earless dragon (*Tympanocryptis condaminensis*)	17.93 ha
Five-clawed worm-skink (*Anomalopus mackayi*)	16.68 ha
Dunmall's snake (*Furina dunmalli*)	298.85 ha
Swift parrot (*Lathamus discolor*)	243.54 ha
Koala (*Phascolarctos cinereus*)	481.05 ha

Table notes:

1. The significant residual impact assessment for MNES will be updated, as necessary, following the completion of detailed ecological surveys of the Project footprint. Conclusions from the updated significant residual impact assessments will be used to refine the quantification of significant residual impacts and confirm the biodiversity offset requirements for the Project.

10.13.2 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 Offsets Act. The *Environmental Offsets Regulation 2014* and associated Queensland Environmental Offsets Policy 2017 (the Offsets Policy), provide guidance regarding those offsets for MSES. The purpose of the Offsets Policy is to provide a decision–support tool to enable administrating agencies the ability to assess offset proposals to ensure that they meet the requirements of the Offsets Act.

Assessment of MSES of relevance to the Project has been undertaken in accordance with the MSES significant impact criteria (refer Section 10.12.3, Appendix J: Terrestrial Ecology Technical Report and Appendix K: Aquatic Ecology Technical Report). Analysis, based on predictive habitat modelling and mapping, indicates that significant residual impacts for the following sensitive environmental receptors have potential to occur:

- 'Endangered' or 'of concern' REs
- Regulated vegetation (Category B (other than grassland) within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature)
- Remnant vegetation intersection with a VM Act wetland
- Essential habitat
- Connectivity areas
- Protected wildlife habitat for the following species:
  - *Cyperus clarus* (a sedge)
  - Digitaria porrecta (finger panic)
  - *Picris barbarorum* (tall hawkweed)
  - Common death adder (*Acanthophis antarcticus*)
  - Glossy black-cockatoo (*Calyptorhynchus lathami lathami*)
  - *Nature Conservation (Koala) Conservation Plan 2017* (Queensland Government, 2017b) mapping (Koala Habitat Areas).

An initial quantification of anticipated significant residual impacts to MSES is presented in Table 10.43.

TABLE 10.43 QUANTIFICATION OF ANTICIPATED SIGNIFICANT RESIDUAL IMPACTS TO MATTERS FOR STATE ENVIRONMENTAL SIGNIFICANCE

Sensitive environmental receptor (MSES)	Identified significant residual Impact[1, 2]
Regulated vegetation	
'Endangered' RE	62.74 ha
'Of concern' RE	151.50 ha
A prescribed RE (Category B other than grassland) within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature	43.88 ha
Essential habitat	117.31 ha
Connectivity areas	
Regional terrestrial corridors	235.37 ha
State riparian corridors	37.42 ha
State terrestrial corridors	161.39 ha
Protected wildlife habitat	
Flora	
Cyperus clarus (a sedge)	106.00 ha—general habitat
Digitaria porrecta (finger panic)	455.61 ha—(373.87 ha general habitat, 81.74 ha essential habitat)
Picris barbarorum (tall hawkweed)	567.49 ha—(529.35 ha general habitat, 38.14 ha essential habitat)
Fauna	
Common death adder (*Acanthophis antarcticus*)	540.87 ha—general habitat
Glossy black-cockatoo (*Calyptorhynchus lathami lathami*)	480.86 ha—(457.70 ha general habitat, 14.96 ha essential habitat, 8.20 ha core habitat)
Nature Conservation (Koala) Conservation Plan 2017 mapping: ▸ Koala Habitat Areas	81.73 ha

Table notes:
1. Red text indicates highly significant areas in relation to recovery plans and listing advice
2. The significant residual impact assessment for MNES will be updated, as necessary, following the completion of detailed ecological surveys of the Project footprint. Conclusions from the updated significant residual impact assessments will be used to refine the quantification of significant residual impacts and confirm the biodiversity offset requirements for the Project.

10.13.3 Provision of offsets

The Project will result in significant residual adverse impact on prescribed environmental matters, even after the implementation of all mitigation measures, including rehabilitation; therefore, it is expected that environmental offsets will be required for the Project. Offsets will need to be provided in accordance with requirements of the EPBC Act, EO Act and relevant policies.

ARTC's *Environmental Offset Delivery Strategy – Qld* (Strategy) (refer Appendix N: Draft Offset Strategy). This strategy informs the development of offset delivery components including an Environmental Offset Delivery Plan and Offset Area Management Plans. An Environmental Offsets Delivery Plan will be developed and implemented by ARTC prior to construction. The Environmental Offset Plan will:

- Quantify the significant residual impact of the Project on MSES and MNES
- 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:
  - Details of milestones to establish the offset
  - Evidence that significant residual impacts can be offset
  - The offset delivery mechanisms comprising one or more of: land-based offsets, direct benefit management plans, offset transfers or offset payments
  - Identification of land required to provide the offset
  - A legally binding mechanism that ensures protection and management of land-based offset areas.

10.14 Commitments

The approach outlined in this report is considered to be adequate to assess the sensitive environmental receptors relevant to the Project. The report describes the particular aspects of the environment relevant to these receptors and addresses the relevant sections of the EIS ToR.

ARTC is committed to implementing ongoing monitoring of the effectiveness of the measures with contingency (under an adaptive management framework) to change/improve management strategies where deleterious impacts to the identified environmental values are observed, or are not minimised, as per the objectives of the proposed mitigation measures.

As the Project moves into the detail design and construction phases, more focused and comprehensive ecological surveys in accordance with the relevant survey guidelines will be undertaken under the Project's Flora and Fauna Sub-plan. Targeted surveys are to commence in parallel with the development of the detail design and will identify the actual occurrence/extent of TECs within and adjacent to the Project footprint and the presence of threatened species and/or habitat suitable to supporting the presence of threatened species. Surveys will be carried out as per diagnostic criteria and condition thresholds outlined in community specific approved conservation advice (for TECs) and relevant survey guidelines (for threatened fauna). The surveys aim to address any changes to the Project design and footprint, along with informing the design and construction, including specific measures to avoid, mitigate, minimise impacts wherever practically possible on a particular species or TECs, along with ongoing monitoring activities.

The surveys will also have the added benefit of addressing some of the recommendations in conservation advices, recovery plans and threat abatement plans, including:

- Identifying extent and quality of TECs
- Identifying extent and quality of habitat for threatened species
- Identifying new populations and knowledge of the species ecology
- Surveys may be designed to monitor known populations for certain species
- The Project is also a mechanism to engage the public about a species.

As part of these surveys, ARTC will look to collaborate and supplement existing studies being undertaken by local councils, environmental groups and government agencies.

During detail design, ARTC will also finalise the location and design of fauna movement structures across the Project alignment, targeting key locations for fauna movement. ARTC will work with the relevant stakeholders including DTMR, local councils, DES and where applicable local environmental groups to finalise the location and design of any crossing structures in consideration of the railway design and operational constraints. This will be especially important in areas of future development or complementary to any ecological corridor strategies within the impact assessment area.

An Environmental Offset Delivery Plan and Offset Area Management Plans will be developed and implemented by ARTC prior to construction subject to approval under the EPBC Act. The Environmental Offset Delivery Plan will quantify the significant residual impacts of the Project and detail offsets to address these significant residual impacts.

ARTC is committed to implementing ongoing monitoring of the effectiveness of the measures with contingency (under an adaptive management framework) to change/improve management strategies where deleterious impacts to the identified environmental values are observed, or are not minimised, as per the objectives of the proposed mitigation measures.

10.15 Cumulative impacts

It is a requirement of the ToR for this Project that the potential for cumulative impacts be considered. Projects with spatial and/or temporal overlap can result in cumulative impacts. Cumulative impacts may:

- Differ from those of an individual project when considered in isolation
- Be positive or negative
- Differ in severity and duration depending on the spatial and temporal overlap of projects occurring in an area.

This section provides a discussion on the potential for cumulative impacts in relation to ecological features. Further details on the potential for cumulative impacts to arise as a result of the Project, in combination with others, is presented in Chapter 21: Cumulative Impacts. Details on the assessment methodology for cumulative impacts is presented in Chapter 4: Assessment Methodology.

Twenty-three (23) projects were initially identified as having potential to contribute to cumulative impacts in combination with the Border to Gowrie project. These projects are either currently operational, expected to undergo future expansion or are currently going through an approval process. A full list of the 23 projects, with a description of each, is presented in Chapter 21: Cumulative Impacts.

The cumulative impacts of multiple projects occurring in the vicinity of the Project will likely include the continued loss of biodiversity in the South East Queensland and Brigalow Belt bioregions. Twenty (20) of the 23 initially identified projects are sufficiently close to the Project (50 km) that potential cumulative impacts to ecological values may occur due to one or more of 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, contamination and bioaccumulation
- Displacement of flora and fauna species from invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light
- Increase in litter (waste)
- Aquatic habitat degradation
- Erosion and sedimentation
- Flooding.

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 sensitive environmental receptors (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. Given that these values incorporate all habitat categories, residual impacts as a result of the Project (Section 10.12) are significantly less than the values presented in Table 10.41.

The projects considered applicable to the ecological cumulative impact assessment are listed in Table 10.44 and shown in Figure 10.14. 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 sensitive receptors and processes. For example, through the degradation of adjoining habitats or disturbance of species through noise, operational emissions, light, weed incursion, etc.

TABLE 10.44 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 north of the Project footprint	A 45 km underground water pipeline to supply up to 5,500 megalitres of treated waste water to the New Acland coal mine.
New Acland Coal Mine Stage 3	35 km northwest of Toowoomba 18 km north of the Project footprint	Expansion of the existing New Acland open-cut coal mine to up to 7.5 Mtpa.
Australia Pacific LNG Project	Walloons gas fields (approximately 20 km west of Millmerran) 13 km west of the Project footprint	Integrated LNG project. The Walloons gas fields, located to the west of the Project, supplies Coal Seam Gas to support the LNG Facility on Curtis Island.
Toowoomba Bypass (formerly the Toowoomba Second Range Crossing)	The 41 km-long bypass route runs 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 the Project footprint	This bypass takes heavy vehicle through-traffic around the north of Toowoomba.
InterLinkSQ	13 km west of Toowoomba Adjacent to south of the Project footprint	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, QLD 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, QLD 1.5 km east of the Project footprint	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, QLD 3 km southeast of the Project footprint (Witmack Industry Park) Charlton, QLD 3 km south of the Project footprint (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, QLD Adjoins the Project footprint 1 km south of Toowoomba-Cecil Plains Road	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.

Projects	Location	Description
Commodore Mine and Millmerran Power Station	Domville, QLD Intersects the Project footprint, located primarily to the east	The Commodore Mine is an open-cut coal mine, which provides coal for the 850 MW 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, QLD 500 m to the south of the Project footprint	Road and sewerage upgrades at the Pittsworth Industrial Precinct to allow for industrial land for industries servicing agriculture and the wider region.
Doug Hall Poultry	Millmerran, QLD Intersects the Project footprint, located primarily to northwest	Poultry farming operation with capacity of approximately 20,000 chickens. Operations include egg grading, a feedmill with output of 1,500 tonnes per week, piggery, cropping and solar farm.
Yarranbrook Feedlot	Whetstone, QLD Intersects the Project footprint, located predominantly to north	Cattle feedlot licenced for 25,000 head.
Sapphire Feedlot	Kildonan, QLD Adjacent to the south of the Project footprint	Cattle feedlot that currently has a 6,000 head capacity, with plans to expand to 8,700 and in the future.
Wyemo Piggery	Glenarbon, QLD 8 km south of the Project footprint	Piggery with approval for 55,000 pig units.
Yarranlea Solar	Yarranlea, QLD Intersects the Project footprint, generally extends equally to north and south	Solar Farm which will have a generation capacity of up to 100 MW once completed.
Goondiwindi Abattoir	Goondiwindi, QLD 13 km north of the Project footprint	A new beef Abattoir located on the outskirts of Goondiwindi with beef processing of up to 72,000 tonnes per year.
North Star to NSW/QLD Border (Inland Rail)	Rail alignment from North Star, NSW to the NSW/QLD border Adjoins the Project footprint to the south	New 37 km rail corridor to connect North Star (NSW) to the QR South Western Line just north of the NSW/QLD border.
Gowrie to Helidon Project (Inland Rail)	Rail alignment from Gowrie to Helidon, Queensland Adjoins the Project footprint to the north	New 26 km dual-gauge track between Gowrie (north–west of Toowoomba) and Helidon (east of Toowoomba), extending through the LGAs 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 to the 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 LGAs 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.

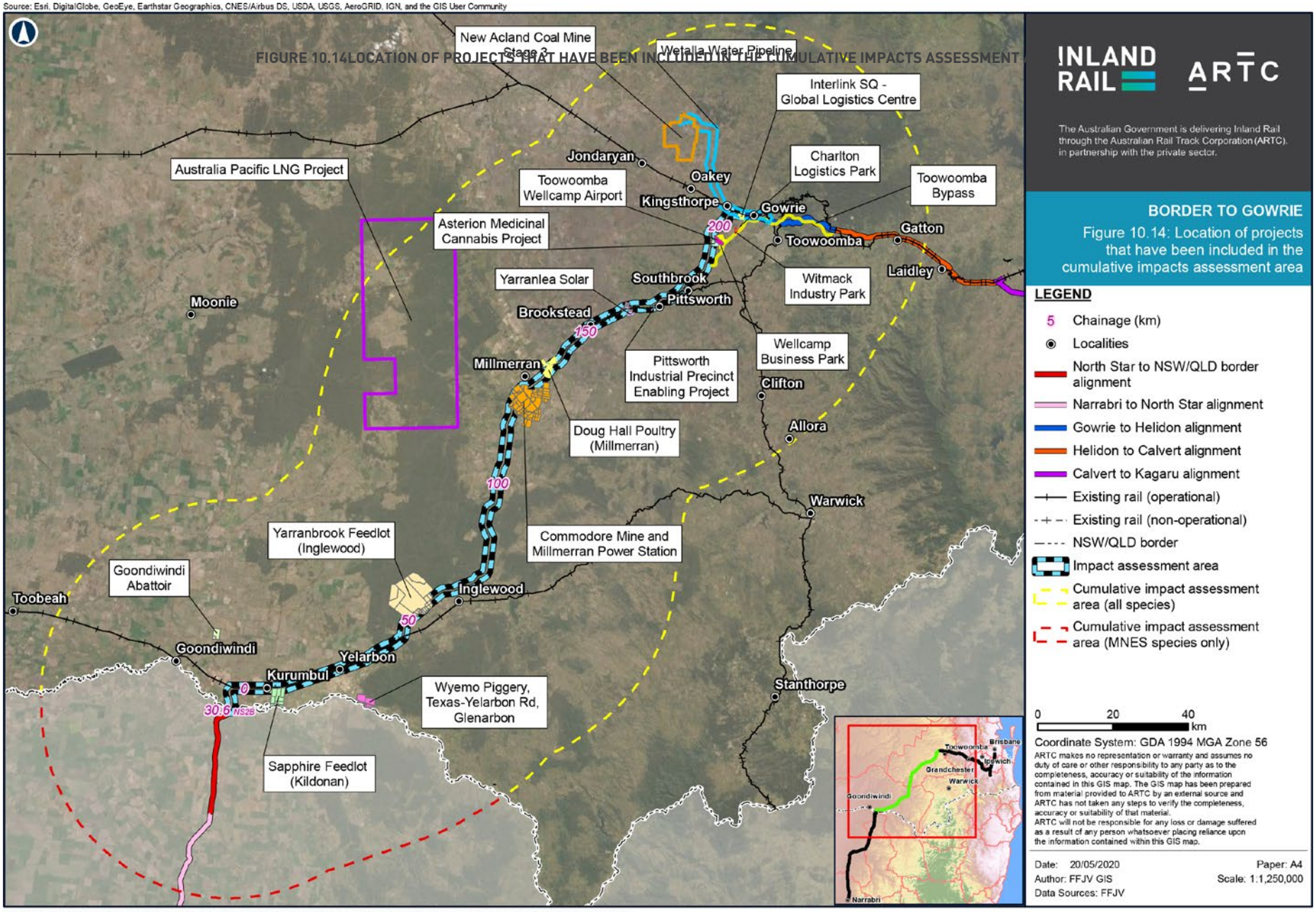

FIGURE 10.14LOCATION OF PROJECTS THAT HAVE BEEN INCLUDED IN THE CUMULATIVE IMPACTS ASSESSMENT

The total impact area of significant sensitive environmental receptors contained within the combined footprint of the 20 projects occurring within the cumulative impact assessment area has been quantified and is provided in Table 10.45. It must be noted that the areas of assessment varied between MSES and MNES. For MNES, assessment included areas contained within NSW as well as Queensland, considering projects within both states; however, for MSES, the cumulative impact assessment only considered projects and areas within Queensland as MSES are bound by State borders. The results of the significance assessment of these cumulative impacts are summarised as follows:

- EPBC Act listed TECs:
  - Weeping Myall Woodlands TEC—Project impact makes a 1.55 per cent contribution to the clearing of approximately 2,558.03 ha (sum of cumulative impact), which constitutes 6.38 per cent of the available habitat within the cumulative impact assessment area
  - Poplar box woodlands TEC—Project impact makes a 1.48 per cent contribution to the clearing of approximately 2,679.39 ha (sum of cumulative impact), which constitutes 5.09 per cent of the available habitat within the cumulative impact assessment area.
- EPBC Act listed threatened flora species habitat:
  - *Bertya opponens*—Project impact makes a 0.21 per cent contribution to the clearing of approximately 5,037.50 ha (sum of cumulative impact), which constitutes 6.80 per cent of the available habitat within the cumulative impact assessment area
  - *Homopholis belsonii* (Belson's panic)—Project impact makes a 3.12 per cent contribution to the clearing of approximately 9,313.44 ha (sum of cumulative impact), which constitutes 8.02 per cent of the available habitat within the cumulative impact assessment area
  - *Lepidium peregrinum* (wandering peppercress) —Project impact makes a 1.62 per cent contribution to the clearing of approximately 3,116.30 ha (sum of cumulative impact), which constitutes 5.40 per cent of the available habitat within the cumulative impact assessment area
  - *Leucopogon* sp. Coolmunda (*Coolmunda leucopogon*) —Project impact makes a 1.34 per cent contribution to the clearing of approximately 3,609.62 ha (sum of cumulative impact), which constitutes 10.52 per cent of the available habitat within the cumulative impact assessment area.
- EPBC Act listed threatened fauna species habitat:
  - Painted honeyeater (*Grantiella picta*)—Project impact makes a 3.19 per cent contribution to the clearing of approximately 13,567.36 ha (sum of cumulative impact), which constitutes 3.27 per cent of the available habitat within the cumulative impact assessment area
  - Swift parrot (*Lathamus discolor*)—Project impact makes a 1.99 per cent contribution to the clearing of approximately 13,243.25 ha (sum of cumulative impact), which constitutes 3.12 per cent of the available habitat within the cumulative impact assessment area
  - South-eastern long-eared bat (*Nyctophilus corbeni*)—Project impact makes a 2.57 per cent contribution to the clearing of approximately 13,409.64 ha (sum of cumulative impact), which constitutes 3.30 per cent of the available habitat within the cumulative impact assessment area
  - Greater glider (*Petauroides volans*)—Project impact makes a 1.89 per cent contribution to the clearing of approximately 10,485.24 ha (sum of cumulative impact), which constitutes 5.55 per cent of the available habitat within the cumulative impact assessment area
  - Five-clawed worm-skink (*Anomalopus mackayi*)—Project impact makes a 4.47 per cent contribution to the clearing of approximately 4,162.35 ha (sum of cumulative impact), which constitutes 4.64 per cent of the available habitat within the cumulative impact assessment area
  - Collared delma (*Delma torquata*)—Project impact makes a 3.46 per cent contribution to the clearing of approximately 8,538.86 ha (sum of cumulative impact), which constitutes 3.12 per cent of the available habitat within the cumulative impact assessment area
  - Yakka skink (*Egernia rugosa*)—Project impact makes a 2.63 per cent contribution to the clearing of approximately 13,856.73 ha (sum of cumulative impact), which constitutes 3.43 per cent of the available habitat within the cumulative impact assessment area
  - Condamine earless dragon (*Tympanocryptis condaminensis*)—Project impact makes a 31.20 per cent contribution to the clearing of approximately 787.21 ha (sum of cumulative impact), which constitutes 3.69 per cent of the available habitat within the cumulative impact assessment area.

- EPBC Act listed, non-threatened migratory species:
  - Common sandpiper (*Actitis hypoleucos*), sharp-tailed sandpiper (*Calidris acuminata*), pectoral sandpiper (*Calidris melanotos*), red-necked stint (*Calidris ruficollis*), yellow wagtail (*Motacilla flava*), glossy ibis (*Plegadis falcinellus*), common greenshank (*Tringa nebularia*)—Project impact makes a 0.17 per cent contribution to the clearing of approximately 77,993.16 ha (sum of cumulative impact), which constitutes 42.9 per cent of the available habitat within the cumulative impact assessment area.
- NC Act listed flora and species habitat:
  - *Digitaria porrecta* (finger panic)—Project impact makes a 9.89 per cent contribution to the clearing of approximately 4,608.69 ha (sum of cumulative impact), which constitutes 7.44 per cent of the available habitat within the cumulative impact assessment area
  - Common death adder (*Acanthophis antarcticus*)—Project impact makes a 3.54 per cent contribution to the clearing of approximately 15,258.00 ha (sum of cumulative impact), which constitutes 2.14 per cent of the available habitat within the cumulative impact assessment area
  - Category B regulated vegetation 'of concern'—Project impact makes a 4.12 per cent contribution to the clearing of approximately 3,681.57 ha (sum of cumulative impact), which constitutes 1.82 per cent of the available habitat within the cumulative impact assessment area
  - MSES Wildlife habitat—Project impact makes an 8.79 per cent contribution to the clearing of approximately 1,385.80 ha (sum of cumulative impact), which constitutes 1.64 per cent of the available habitat within the cumulative impact assessment area.

The quantitative method of assessment that has been applied establishes a percentage of impact to each significant sensitive environmental receptor 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 10.46 (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 cumulative impact assessment area include some that can be may be irreversible and permanent and be of **Low to Moderate Significance**.

The potential contribution of the Project's activities to cumulative ecological impacts will be managed through:

- Refinement of the Project footprint through detail design to limit the extent of disturbance to sensitive environmental receptors to that required to enable safe and efficient construction, operation and maintenance of the Project.
- Pre-construction surveys will be carried out to confirm to what extent the identified MNES and MSES (or their habitat) occur within, or adjacent to, the Project footprint. Where MNES or MSES are found to occur, condition assessment will be undertaken (using BioCondition assessment)
- Annual monitoring of MNES and MSES (or their habitat) retained within the Project footprint against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified.

TABLE 10.45 CUMULATIVE IMPACTS AS CALCULATED WITHIN THE CUMULATIVE IMPACT ASSESSMENT AREA

Sensitive environmental receptor	Occurrence in the cumulative impact assessment area (ha)[1]	Occurrence in the cumulative impact project area (excluding Project footprint)[2]	Occurrence in the footprint of all projects, including the Project	% disturbance in cumulative impact assessment area of all projects, including the Project	% disturbance in cumulative impact assessment area as a result of the Project	Magnitude of disturbance[3]
Australian Government significant ecological constraints						
TECs (EPBC Act)						
Brigalow (*Acacia harpophylla* dominant and co-dominant)	29,809.15	159.77	222.66	0.75	28.24	Low
Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	2,278.37	60.44	60.44	2.65	0.00	Low
Weeping myall woodlands	40,077.38	2,518.31	2,558.03	6.38	1.55	2,558.03
White box-yellow box-Blakely's red gum grassy woodland and derived native grassland	140,376.00	23.80	23.80	0.02	0.00	Low
Poplar box grassy woodland on alluvial plains	52,611.28	2,639.67	2,679.39	5.09	1.48	Low
Threatened flora habitat (EPBC Act)						
Acacia lauta (Tara wattle)	270,012.58	8,995.49	9,294.34	3.44	3.22	Low
Arthraxon hispidus (Hairy-joint grass)	104,535.28	4,112.49	4,145.58	3.96	0.80	Low
Bertya opponens	74,060.99	5,026.90	5,037.50	6.80	0.21	Low
Cadellia pentastylis (Ooline)	9,967.50	241.49	246.05	2.47	1.85	Low
Clematis fawcettii (Stream clematis)	747.67	0.00	0.00	0.00	0.00	None
Dichanthium queenslandicum (King blue-grass)	46,727.72	1,009.51	1,131.44	2.42	10.78	Low
Dichanthium setosum (Bluegrass)	46,819.62	1,009.51	1,070.00	2.29	5.65	Low
Eucalyptus virens (Shiny-leaved ironbark)	248,597.94	8,665.68	8,958.24	3.60	3.273	Low
Homopholis belsonii (Belson's panic)	116,142.08	9,022.55	9,313.44	8.02	3.12	Low
Lepidium monoplocoides (Winged peppercress)	312,467.35	11,745.18	12,115.70	3.88	3.06	Low
Lepidium peregrinum (Wandering pepper-cress()	57,727.63	3,065.91	3,116.30	5.40	1.62	Low
Leucopogon sp. Coolmunda (D. Halford Q 1635) (Coolmunda leucopogon()	34,296.05	3,561.43	3,609.62	10.52	1.34	Low
Macrozamia machinii	104,937.28	3,062.88	3,140.59	2.99	2.47	Low
Picris evae (Hawkweed)	160,083.62	4,726.26	5,320.24	3.32	11.16	Low

Sensitive environmental receptor	Occurrence in the cumulative impact assessment area (ha)[1]	Occurrence in the cumulative impact project area (excluding Project footprint)[2]	Occurrence in the footprint of all projects, including the Project	% disturbance in cumulative impact assessment area of all projects, including the Project	% disturbance in cumulative impact assessment area as a result of the Project	Magnitude of disturbance[3]
Prostanthera sp. Dunmore (Dunmore prostanthera)	100,230.59	3,460.92	3,566.77	3.56	2.97	Low
Rhaponticum australe (Austral cornflower)	70,967.63	2,601.69	2,824.22	3.98	7.88	Low
Sophora fraseri (Brush sophora)	22,960.66	327.93	327.93	1.43	0	Low
Thesium australe (Austral toadflax)	72,373.58	1,869.06	2,071.66	2.86	9.78	Low
Tylophora linearis (Slender tylophora)	220,874.12	5,238.38	5,467.79	2.48	4.20	Low
Xerothamnella herbacea	21,833.42	250.50	317.47	1.45	21.10	Low
Westringia parvifolia	14,556.51	0.00	0.00	0.00	0.00	Absent—not applicable
Threatened fauna habitat (EPBC Act)						
Birds						
Regent honeyeater (*Anthochaera phrygia*)	176,116.89	6,573.48	6,730.87	3.82	2.33	Low
Australasian bittern (*Botaurus poiciloptilus*)	47,137.39	442.96	487.94	1.04	9.22	Low
Curlew sandpiper (*Calidris ferruginea*)	21,214.89	251.52	265.32	1.25	5.20	Low
Red goshawk (*Erythrotriorchis radiatus*)	339,517.32	12,015.86	12,355.20	3.64	2.74	Low
Grey falcon (*Falco hypoleucos*)	645,134.52	13,485.73	14,324.44	2.22	5.86	Low
Squatter pigeon—southern subspecies (*Geophaps scripta scripta*)	307,545.26	10,311.00	10,650.34	3.46	3.19	Low
Painted honeyeater (*Grantiella picta*)	414,530.36	13,134.37	13,567.36	3.27	3.19	Low
Swift parrot (*Lathamus discolor*)	424,007.53	12,979.59	13,243.25	3.12	1.99	Low
Australian painted snipe (*Rostratula australis*)	47,451.51	442.96	487.94	1.03	9.22	Low
Black-breasted button-quail (*Turnix melanogaster*)	43,303.76	164.02	164.02	0.38	0	Low
Fish						
Maccullochella peelii (Murray cod)	20,899.39	101.47	114.29	0.55	11.22	Low
Mammals						
Large-eared pied bat (*Chalinolobus dwyeri*)	103,741.82	3,307.17	3,362.11	3.24	1.63	Low
Spotted-tailed quoll (*Dasyurus maculatus maculatus*)	146,145.71	4,177.76	4,259.19	2.91	1.91	Low

Sensitive environmental receptor	Occurrence in the cumulative impact assessment area (ha)[1]	Occurrence in the cumulative impact project area (excluding Project footprint)[2]	Occurrence in the footprint of all projects, including the Project	% disturbance in cumulative impact assessment area of all projects, including the Project	% disturbance in cumulative impact assessment area as a result of the Project	Magnitude of disturbance[3]
South-eastern long-eared bat (*Nyctophilus corbeni*)	405,983.87	13,065.54	13,409.64	3.30	2.57	405,983.87
Greater glider (*Petauroides volans*)	188,901.99	10,286.82	10,485.24	5.55	1.89	188,901.99
Brush-tailed rock-wallaby (*Petrogale penicillata*)	6,239.60	0.54	0.54	0.01	0	Low
Koala (*Phascolarctos cinereus*)	521,674.94	16,881.67	17,374.73	3.33	2.84	Low
Grey-headed flying-fox (*Pteropus poliocephalus*)	202,963.26	1,820.14	1,930.63	0.95	5.72	Low
Reptiles						
Five-clawed worm-skink (*Anomalopus mackayi*)	89,794.23	3,984.09	4,162.35	4.64	4.47	Low
Collared delma (*Delma torquata*)	273,942.02	8,243.10	8,538.86	3.12	3.46	Low
Yakka skink (*Egernia rugosa*)	414,435.87	13,492.26	13,856.73	3.43	2.63	Low
Dunmall's snake (*Furina dunmalli*)	295,290.03	9,509.38	9,808.23	3.32	3.05	Low
Condamine earless dragon (*Tympanocryptis condaminensis*)	21,307.47	541.62	787.21	3.69	31.20	Low
Invertebrates						
Brigalow woodland snail (*Adclarkia cameroni*)	150,415.22	2,218.55	2,350.01	1.56	5.59	Low
Migratory bird species habitat						
Common sandpiper (*Actitis hypoleucos*)	181,418.10	77,860.56	77,993.16	42.9	0.17	Low
Fork-tailed swift (*Apus pacificus*)	2,874,133.44	814,808.92	818,012.70	28.46	0.39	Low
Sharp-tailed sandpiper (*Calidris acuminata*)	183,807.58	77,437.14	77,569.74	42.20	0.17	Low
Pectoral sandpiper (*Calidris melanotos*)	181,418.10	77,860.56	77,993.16	42.99	0.17	Low
Red-necked stint (*Calidris ruficollis*)	124,397.79	77,702.65	77,835.25	62.57	0.17	Low
Oriental cuckoo (*Cuculus optatus*)	47,909.55	13,310.09	13,334.54	27.83	0.18	Low
Latham's snipe (*Gallinago hardwickii*)	185,580.54	78,005.98	78,138.58	42.10	0.17	Low
Black-faced monarch (*Monarcha melanopsis*)	52,922.99	13,699.97	13,724.42	25.93	0.18	Low
Yellow wagtail (*Motacilla flava*)	181,418.10	77,860.56	77,993.16	42.99	0.17	Low
Satin flycatcher (*Myiagra cyanoleuca*)	55,340.01	13,311.39	13,335.84	24.10	0.18	Low
Osprey (*Pandion haliaetus*)	51,620.01	7,930.23	7,975.21	15.45	0.56	Low

Sensitive environmental receptor	Occurrence in the cumulative impact assessment area (ha)[1]	Occurrence in the cumulative impact project area (excluding Project footprint)[2]	Occurrence in the footprint of all projects, including the Project	% disturbance in cumulative impact assessment area of all projects, including the Project	% disturbance in cumulative impact assessment area as a result of the Project	Magnitude of disturbance[3]
Glossy ibis (*Plegadis falcinellus*)	186,069.48	77,251.00	77,383.60	41.59	0.17	Low
Rufous fantail (*Rhipidura rufifrons*)	57,292.63	13,501.46	13,525.91	23.61	0.18	Low
Spectacled monarch (*Symposiachrus trivirgatus*)	50,033.69	13,346.07	1,3370.52	26.72	0.18	Low
Common greenshank (*Tringa nebularia*)	181,418.10	77,860.56	77,993.16	42.99	0.17	Low
State significant ecological constraints						
Protected nature areas: ▸ 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 ▸ Whilalloo Nature Refuge ▸ Wilga Park Nature Refuge ▸ Xanthorrhoea Nature Refuge	7,946.28	0.00	0.00	0.00	0.00	Low
Protected area estates (*excluding State forests*): ▸ 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 *Note: State forests are not an MSES*	295,306.56	4,450.10	4,610.46	1.56	3.48	Low

Sensitive environmental receptor	Occurrence in the cumulative impact assessment area (ha)[1]	Occurrence in the cumulative impact project area (excluding Project footprint)[2]	Occurrence in the footprint of all projects, including the Project	% disturbance in cumulative impact assessment area of all projects, including the Project	% disturbance in cumulative impact assessment area as a result of the Project	Magnitude of disturbance[3]
Regulated vegetation (VM Act)						
Category B—'Endangered' REs:	46,668.45	201.32	264.06	0.57	23.76	Low
Category B—'Of concern' REs:	202,417.66	3,530.07	3681.57	1.82	4.12	Low
Category B—'Least concern' REs:	465,876.54	11,556.00	11905.00	2.56	2.93	Low
Category C—'High value regrowth' (HVR)	33,835.69	228.87	233.10	0.69	1.81	Low
MSES wildlife habitat	84,262.99	1,263.97	1385.80	1.64	8.79	Low
State significant wetlands (HES Wetlands)	7,476.06	22.02	22.02	0.29	0.00	Low
Threatened flora habitat (NC Act):						
Cyperus clarus (a sedge)	42,108.95	886.54	992.54	2.36	10.68	Low
Digitaria porrecta (finger panic)	61,952.92	4,153.08	4608.69	7.44	9.89	Low
Picris barbarorum (tall hawkweed)	336,729.74	11,856.53	12424.02	3.69	4.57	Low
Threatened fauna habitat (NC Act):						
Common death adder (*Acanthophis antarcticus*)	714,191.76	14,717.13	15258.00	2.14	3.54	Low
Glossy black-cockatoo (*Calyptorhynchus lathami lathami*)	439,933.59	13,484.88	13965.74	3.17	3.44	Low
Major Mitchell's cockatoo (*Lophochroa leadbeateri*)	434,798.66	13,427.68	13815.45	3.18	2.81	Low
'Least concern' flora and fauna, SLC fauna (NC Act) and Priority Back on Track flora and fauna species						
Platypus (*Ornithorhynchus anatinus*)	104,511.33	2,304.67	2392.40	2.29	3.67	Low
Echidna (*Tachyglossus aculeatus*)	841,385.10	16,508.94	17245.66	2.05	4.27	Low
'Least concern' flora and fauna	2,367,317.00	47,908.34	49348.84	2.08	2.92	Low
Priority Back on Track species (not listed under the EPBC Act or NC Act)	2,367,317.00	47,908.34	49348.84	2.08	2.92	Low
Biodiversity Planning Assessment (BPA) areas						
BPA habitat values (local or other)	2,034.26	0.00	1,112.29	1.36	8.56	Low
BPA habitat values (regional)	81,685.73	1,017.06	13,543.18	2.39	0.36	Low
BPA habitat values (State)	566,566.36	13,494.22	1,958.89	1.60	12.02	Low

Sensitive environmental receptor	Occurrence in the cumulative impact assessment area (ha)[1]	Occurrence in the cumulative impact project area (excluding Project footprint)[2]	Occurrence in the footprint of all projects, including the Project	% disturbance in cumulative impact assessment area of all projects, including the Project	% disturbance in cumulative impact assessment area as a result of the Project	Magnitude of disturbance[3]
Corridor (regional terrestrial)	122,194.40	1,723.52	7,429.71	1.79	2.17	Low
Corridor (State riparian)	58,074.21	305.42	1,112.29	1.36	8.56	Low
Corridor (State terrestrial)	415,966.65	7,268.32	13,543.18	2.39	0.36	Low

Table notes:
1. Area = 2,367,317.00 ha
2. Area = 48,648.44 ha
3. Magnitude is calculated based on the proportional disturbance from the Project to each receptor within the cumulative impact assessment 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. For example, the Project's contribution to cumulative impacts to the brigalow TEC is 28.24% of 0.75%, which equates to 0.21%

TABLE 10.46 SIGNIFICANCE ASSESSMENT OF CUMULATIVE IMPACTS WITHIN THE CUMULATIVE IMPACT ASSESSMENT AREA

Sensitive environmental receptor(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 (*Acacia harpophylla* dominant and co-dominant) ▸ Natural grassland on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ▸ Weeping myall woodlands ▸ White box-yellow box-Blakely's red gum grassy woodland and derived native grassland ▸ Poplar box grassy woodland on alluvial plains	▸ Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium
	▸ 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

Sensitive environmental receptor(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
Australian Government significant ecological constraint (species listed under the EPBC Act): **Flora** ▸ *Acacia lauta* (Tara wattle) ▸ *Arthraxon hispidus* (Hairy-joint grass) ▸ *Bertya opponens* ▸ *Cadellia pentastylis* (Ooline) ▸ *Clematis fawcettii* (Stream clematis) ▸ *Dichanthium queenslandicum* (King blue-grass) ▸ *Dichanthium setosum* (Bluegrass) ▸ *Eucalyptus virens* (Shiny-leaved ironbark) ▸ *Homopholis belsonii* (Belson's panic) ▸ *Lepidium monoplocoides* (Winged peppercress) ▸ *Lepidium peregrinum* (Wandering pepper-cress) ▸ *Leucopogon sp.* Coolmunda (D. Halford Q 1635) (Coolmunda Leucopogon) ▸ *Macrozamia machinii* ▸ *Picris evae* (Hawkweed) ▸ *Prostanthera sp. Dunmore* (Dunmore prostanthera) ▸ *Rhaponticum australe* (Austral cornflower) ▸ *Sophora fraseri* (Brush sophora) ▸ *Thesium australe* (Austral toadflax) ▸ *Tylophora linearis* (Slender tylophora) ▸ *Xerothamnella herbacea*	▸ Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium
	▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Reduction in connectivity of biodiversity corridors	2	2	1	3	8	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

Sensitive environmental receptor(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
Fauna							Low
▸ Regent honeyeater (*Anthochaera phrygia*)							
▸ Australasian bittern (*Botaurus poiciloptilus*)							
▸ Curlew sandpiper (*Calidris ferruginea*)							
▸ Red goshawk (*Erythrotriorchis radiatus*)							
▸ Gray falcon (*Falco hypoleucos*)							
▸ Squatter pigeon—southern subspecies (*Geophaps scripta scripta*)							
▸ Painted honeyeater (*Grantiella picta*)							
▸ Swift parrot (*Lathamus discolor*)							
▸ Australian painted snipe (*Rostratula australis*)							
▸ Black-breasted button-quail (*Turnix melanogaster*)							
▸ Murray cod (*Maccullochella peelii*)							
▸ Large-eared pied bat (*Chalinolobus dwyeri*)							
▸ Spotted-tailed quoll (*Dasyurus maculatus maculatus*)							
▸ South-eastern long-eared bat (*Nyctophilus corbeni*)							
▸ Greater glider (*Petauroides volans*)							
▸ Brush-tailed rock-wallaby (*Petrogale penicillata*)							
▸ Koala (*Phascolarctos cinereus*)							
▸ Grey-headed flying-fox (*Pteropus poliocephalus*)							
▸ Five-clawed worm-skink (*Anomalopus mackayi*)							
▸ Collared delma (*Delma torquata*)							
▸ Yakka skink (*Egernia rugosa*)							
▸ Dunmall's snake (*Furina dunmalli*)							
▸ Condamine earless dragon (*Tympanocryptis condaminensis*)							
▸ Brigalow woodland snail (*Adclarkia cameroni*)							

Sensitive environmental receptor(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
Australian Government significant ecological constraint (species listed as migratory under the EPBC Act): **Fauna** ▸ Common sandpiper (*Actitis hypoleucos*) ▸ Fork-tailed swift (*Apus pacificus*) ▸ Sharp-tailed sandpiper (*Calidris acuminata*) ▸ Pectoral sandpiper (*Calidris melanotos*) ▸ Red-necked stint (*Calidris ruficollis*) ▸ Oriental cuckoo (*Cuculus optatus*) ▸ Latham's snipe (*Gallinago hardwickii*) ▸ Black-faced monarch (*Monarcha melanopsis*) ▸ Yellow wagtail (*Motacilla flava*) ▸ Satin flycatcher (*Myiagra cyanoleuca*) ▸ Osprey (*Pandion haliaetus*) ▸ Glossy ibis (*Plegadis falcinellus*) ▸ Rufous fantail (*Rhipidura rufifrons*) ▸ Spectacled monarch (*Symposiachrus trivirgatus*) Common greenshank (*Tringa nebularia*)	▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Reduction in connectivity of biodiversity corridors	2	2	1	3	8	Medium
	▸ Habitat loss from vegetation clearing/removal	2	3	1	3	9	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
MSES							
State significant ecological constraint (VM Act): ▸ Regulated Vegetation—Category B—Endangered remnant vegetation (REs) ▸ Essential habitat ▸ MSES wildlife habitat	▸ Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium
	▸ 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

Sensitive environmental receptor(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 ▸ 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 (VM Act): ▸ Regulated Vegetation—Category B—'Least concern' remnant vegetation (REs)	▸ Habitat loss from vegetation clearing/removal	2	3	1	1	7	Medium
	▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Reduction in connectivity of biodiversity corridors	1	2	1	1	5	Low
	▸ 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

Sensitive environmental receptor(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 C—HVR)	▸ Habitat loss from vegetation clearing/removal	2	3	1	2	6	Low
	▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Reduction in connectivity of biodiversity corridors	1	2	1	2	8	Medium
	▸ 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: ▸ State significant wetlands (HES)	▸ Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium
	▸ 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

Sensitive environmental receptor(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		

State significant ecological constraint (species listed as threatened under the NC Act):
▸ Flora
  ▸ *Cyperus clarus* (a sedge)
  ▸ *Digitaria porrecta* (finger panic)
  ▸ *Picris barbarorum* (tall hawkweed)
▸ Fauna
  ▸ Common death adder (*Acanthophis antarcticus*)
  ▸ Glossy black-cockatoo (*Calyptorhynchus lathami lathami*)
  ▸ Major Mitchell's cockatoo (*Lophochroa leadbeateri*)
	▸ Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium

	▸ 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	Medium
State Significant Ecological Constraint (SLC fauna species): ▸ Platypus (*Ornithorhynchus anatinus*) ▸ Echidna (*Tachyglossus aculeatus*)	▸ Habitat loss from vegetation clearing/removal	2	3	1	2	8	Medium
	▸ 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

Sensitive environmental receptor(s)	Potential cumulative impact	Relevance factor of aspects				Sum of relevance factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
State significant ecological constraint: ▸ Priority Back on Track flora and fauna species (that are not listed under as threatened under the provisions of the EPBC Act or NC Act)	▸ Habitat loss from vegetation clearing/removal	2	3	1	1	7	Medium
	▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Reduction in connectivity of biodiversity corridors	1	2	1	1	5	Low
	▸ 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
State significant ecological constraint: ▸ Flora and fauna species not listed under the EPBC Act but listed as 'least concern' under the provisions of the NC Act and flora that is listed as SLC under the provisions of the NC Act	▸ Habitat loss from vegetation clearing/removal	3	3	1	1	8	Medium
	▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Reduction in connectivity of biodiversity corridors	1	2	1	1	5	Low
	▸ 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

Sensitive environmental receptor(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 (State) ▸ State habitat for EVNT taxa ▸ Corridor (State terrestrial) ▸ Corridor (State riparian)	▸ Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium
	▸ 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
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 ▸ 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

Sensitive environmental receptor(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 (local or other) (MLES)	▸ Habitat loss from vegetation clearing/removal	1	3	1	1	6	Low
	▸ Edge effects ▸ Habitat fragmentation ▸ Barrier effects ▸ Reduction in connectivity of biodiversity corridors	1	2	1	1	5	Low
	▸ 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.

10.16 Conclusions

This chapter has been prepared in accordance with Sections 11.1 to 11.35 and 11.92 to 11.104 of ToR.

The impact assessment 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 impact assessment area that are protected under the VM Act.

Eighty-nine (89) sensitive environmental receptors were identified within the impact assessment area for the purposes of this assessment. These varied from broad-scale sensitive environmental receptors, such as protected areas and bioregional corridors, down to finer species-scale sensitive environmental receptors, including conservation significant and migratory species. These sensitive environmental receptors were grouped into high, moderate and low sensitivity categories based on factors including, conservation status, exposure to threatening processes, resilience and representation in the broader landscape.

The construction and operation of the Project has the potential to impact on sensitive environmental receptors 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
- Displacement of flora and fauna species from invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light
- Increase in litter (waste)
- Aquatic habitat degradation
- Erosion and sedimentation
- Contamination
- Flooding.

The reference design has been developed in parallel with the EIS to avoid the occurrence of impacts to heritage 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 phase of the Project, are summarised in Section 10.10.1.

Where potential impacts to sensitive environmental receptors have not been fully avoided or mitigated through the reference design phase, additional mitigation measures have been nominated for implementation in future phases of the Project. These proposed mitigation and management measures have been detailed in Section 10.10.2.

The impacts to identified sensitive environmental receptors 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 sensitive environmental receptors.

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 (refer Section 10.12).

In accordance with the outcomes of the MNES significant impact guideline potential significant impacts are predicted, based on predictive habitat mapping, for the following threatened EPBC Act threatened species/communities (i.e. Project controlling provisions under the EPBC Act):

- TECs:
  - Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC
  - Weeping myall woodlands TEC
  - Poplar box grassy woodland on alluvial plains TEC
- Threatened flora:
  - *Dichanthium queenslandicum* (king blue-grass)
  - *Lepidium monoplocoides* (winged peppercress)
  - *Xerothamnella herbacea*
  - *Eucalyptus virens* (shiny-leaved ironbark)
  - *Homopholis belsonii* (Belson's panic)
  - *Macrozamia machinii*
  - *Picris evae* (hawkweed)
  - *Rhaponticum australe* (Austral cornflower)
- Threatened fauna:
  - Spotted-tail quoll (mainland) (*Dasyurus maculatus maculatus*)
  - Condamine earless dragon (*Tympanocryptis condaminensis*)
  - Five-clawed worm-skink (*Anomalopus mackayi*)
  - Collared delma (*Delma torquata*)
  - Yakka skink (*Egernia rugosa*)
  - Dunmall's snake (*Furina dunmalli*)
  - Squatter pigeon—southern subspecies (*Geophaps scripta scripta*)
  - South-eastern long-eared bat (*Nyctophilus corbeni*)
  - Swift parrot (Lathamus discolor)
  - Koala (*Phascolarctos cinereus*).

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 predictive habitat mapping, the Project is likely to result in significant residual impacts to following MSES:

- 'Endangered' or 'of concern' REs: 214.24 ha
- Regulated vegetation (Category B (other than grassland) within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature): 43.88 ha
- Essential habitat: 117.31 ha
- Connectivity areas:
  - Regional terrestrial corridors: 235.37 ha
  - State riparian corridors: 37.42 ha
  - State terrestrial corridors :161.39 ha
- Protected wildlife habitat for the following species:
  - Flora:
    - *Cyperus clarus* (A sedge): 974.12 ha
    - *Digitaria porrecta* (finger panic): 3,717.62 ha
    - *Picris barbarorum* (tall hawkweed): 7,709.76 ha
  - Fauna:
    - Common death adder (*Acanthophis antarcticus*): 540.87 ha
    - Glossy black-cockatoo (*Calyptorhynchus lathami lathami*): 480.86 ha
    - *Nature Conservation (Koala) Conservation Plan 2017* mapping (Koala Habitat Areas): 81.73 ha

These potential significant residual impacts are based on the predictive habitat assessment conducted to date. Detailed ecological surveys of the Project footprint will be undertaken in parallel to the development of the detail design. Data obtained from these detailed surveys will be used to refine the quantification of ecological impacts, revise the analysis of significant residual impacts and re-calculate offset requirements for the Project. Additional species or TECs may be identified through this process.

Predicted cumulative impacts were assessed, incorporating the footprints of 20 other projects that are located within the Project cumulative impact area. 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, weeds and pest species, biodiversity corridors, edge effects, habitat fragmentation, barrier effects, noise, dust, and light impacts and litter. Cumulative impacts are most appropriately considered at a biologically relevant spatial scale (e.g. 50 km from the disturbance footprint).

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 adverse impacts, even after the implementation of all mitigation measures, including rehabilitation. As such, the provisions of offsets for the MNES and prescribed matters presented above will be required under the EPBC Act Offsets Policy and delivered consistent with the *Queensland Environmental Offsets Policy 2017*.

Poplar box grassy woodland ARTC's *Environmental Offset Delivery Strategy—Qld* (Strategy) (refer Appendix N: Draft Offset 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 construction commencement.