

APPENDIX

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Terrestrial and Aquatic Ecology Technical Report

Part 1 of 7

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

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ACRONYMS AND ABBREVIATIONS

Acronyms	Description
ADR	Accepted development requirement
AEP	Annual exceedance probability
ALA	Atlas of Living Australia
ARTC	Australian Rail Track Corporation Limited
AUSRIVAS	Australian River Assessment System
BC	BioCondition assessments
Biosecurity Act	Biosecurity Act 2014 (Qld)
BPA	Biodiversity planning assessment
CE	Critically Endangered
CEMP	Construction Environmental Management Plan
Ch	Chainage
CpW	Change in peak water levels (< or > 0.20 m)
CTIA	Change in time of Inundation (>12 hours)
CTIB	Change in time of Inundation (> 24 hours)
CTI0	Change in time of Inundation (0.5 to 12 hours)
DAF	Department of Agriculture and Fisheries
DAWE	Department of Agriculture, Water and the Environment (Cth)
dB	Decibels
dB(A)	Decibels weighted to the hearing range of humans
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cth)
DDMRB	Darling Downs Moreton Rabbit Board
DEHP	Department of Environment and Heritage Protection (former)
DESI	Department of Environment, Science and Innovation (Qld)
DTMR	Department of Transport and Main Roads (Qld)
E	Endangered
EH	Essential habitat
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EO Act	Environmental Offsets Act 2014 (Qld)
EOO	Extent of occurrence
EP Act	Environmental Protection Act 1994 (Qld)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
EPP	Environmental Protection Policy
ERA	Environmentally relevant activity

Acronyms	Description
ESCP	Erosion and Sediment Control Plan
ETV	Erosive threshold velocity
EVNT	Endangered, Vulnerable and Near threatened
FFJV	Future Freight Joint Venture
FHA	Fish habitat area
Fisheries Act	Fisheries Act 1994 (Qld)
GDE	Groundwater dependent ecosystem
GDE Atlas	Groundwater Dependent Ecosystem Atlas
GIS	Geographic information system
GRC	Goondiwindi Regional Council
GSTI	Government supported transport infrastructure
H	High priority
ha	hectare
HES	High ecological significance
HEV	High ecological value
HVR	High value regrowth
Hz	Hertz
ID	Identification
Inland Rail	Melbourne to Brisbane Inland Rail Program
kHz	Kilohertz
km	kilometre
LC	Least Concern
LGA	local government area
m	metre
MER	monitoring, evaluation and reporting
Mi	Migratory
MDC	Material Distribution Centre
MLES	Matters of Local Environmental Significance
mm	millimetre
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
MW	mega watts
NC Act	<i>Nature Conservation Act 1992 (Qld)</i>
nm	nanometres
NSW	New South Wales

Acronyms	Description
NT	Near threatened
Planning Act	<i>Planning Act 2016 (Qld)</i>
PMF	Probable Maximum Flood
Project	Border to Gowrie Project
QA	Quaternary assessments
QEOP	Queensland Environmental Offsets Policy
QLD	Queensland
QR	Queensland Rail
RE	Regional Ecosystem
SDPWO Act	<i>State Development and Public Works Organisation Act 1971 (Qld)</i>
SEQ	South East Queensland
SEVT	Semi-evergreen vine thicket
SLC	Special least concern
sp.	Species
SPP	State Planning Policy 2017
spp.	Multiple species
SRI	Significant Residual Impact
T	Tree (canopy) stratum
TEC	Threatened ecological community
ToR	Terms of reference
TRC	Toowoomba Regional Council
UniSC	University of the Sunshine Coast
UniSQ	University of Southern Queensland
V	Vulnerable
VM Act	<i>Vegetation Management Act 1999 (Qld)</i>
W	Wetting/inundation
WD	Was wet
Water Act	<i>Water Act 2000 (Qld)</i>
WoNS	Weeds of National Significance

GLOSSARY

Term	Explanation
Adverse impact	Adverse impacts are defined as those impacts that result in an unwanted and unanticipated result of taking a particular action. In an environmental context, an adverse impact means any change in the physical or biological conditions of the natural environment that results in a detrimental effect upon flora, fauna, air, water, minerals or other natural characteristic of the area.
Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: - Genetic diversity – the variety of genes (or units of heredity) in any population - Species diversity – the variety of species - Ecosystem diversity – the variety of communities or ecosystems.
Biodiversity Planning Assessments (Qld) (BPA)	BPA's have been prepared for each of Queensland's bioregions based on the methodology outlined in the Biodiversity Assessment and Mapping Methodology (Department of Environment and Heritage Protection (DEHP), 2014). The BPA's draw upon the DEHP (former) 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. There are three biodiversity significance levels to which an area can be assigned: - State significance – areas assessed as being significant for biodiversity at the bioregional or State scales - Regional significance – areas assessed as being significant for biodiversity at the sub-bioregional scale - Local significance and or other values – local values that are of significance at the local government scale All remnant vegetation will qualify into one of the above three categories.
Biodiversity status	For biodiversity planning purposes and in relation to Environmentally Sensitive Areas (ESAs) the Department of Environment and Science (DES) classifies an RE as 'Endangered' if: - Less than 10% of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss, or 10 to 30% of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 ha; or it is a uncommon RE subject to a threatening process. For biodiversity planning purposes and in relation to ESAs, DES classifies an RE as 'Of Concern' if: 10 to 30% of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss For biodiversity planning purposes and in relation to ESAs an RE is listed as 'Least Concern' at present if: - The degradation criteria listed above for 'Endangered' or 'Of Concern' REs are not met.
Bioregion	A bioregion as defined in An Interim Biographic Regionalisation of Australia (Thackway and Cresswell, 1995). The bioregion subject to this report is the Brigalow Belt bioregion.
<i>Biosecurity Act 2014</i> (Qld) (Biosecurity Act)	The Biosecurity Act lists declared plants and animals that have, or could have, serious economic, environmental or social impacts and are targeted for control. There are legal obligations associated with the control supply, sale, keeping and transport of declared species. Where these exotic pests and weeds are encountered, landholders have an obligation under the Biosecurity Act to control the declared weeds and pest animals, in

Term	Explanation
	accordance with relevant guidelines and local government area (LGA) pest management plans. There are seven categories for restricted matter defined in the Biosecurity Act: • Categories 1 and 2 are restricted matters that have specific urgent reporting requirements. • Categories 3, 4, 5, 6 and 7 relate to restricted matter that is in a person's possession, under their control and is also about not feeding restricted matter. Several restriction categories apply to some restricted matter. In such cases, you would need to follow the requirements of all restriction categories for these restricted matter listings.
Brownfield	A site with existing rail infrastructure.
Connectivity areas	Connectivity areas are areas of remnant vegetation (regional ecosystem located in a category B area on the regulated vegetation management map) outside urban areas containing prescribed regional ecosystems that are required for ecosystem functioning.
Conservation significant	A collective term used with reference to species that are listed as 'Critically Endangered', 'Endangered', 'Vulnerable' or 'Near Threatened' under the provisions of the NC Act and migratory species listed under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC Act) (NC Act conservation significance and EPBC Act conservation significance for more details).
Critical priority	Rating associated with the Back on Track species prioritisation framework. Constitutes the highest total score/priority.
Critically Endangered	Designated as 'Critically Endangered' under the EPBC Act. Refer to definition of EPBC Act conservation status for meaning of 'Critically Endangered' under the Act.
Cumulative impact assessment area	The cumulative impact assessment area encompasses the Project and extends 50 km beyond the temporary Project footprint.
Cumulative impact Project footprint	The cumulative impact Project footprint encompasses the Projects that are identified within Table 9-2 of this technical report.
Cumulative impacts	The impacts that result from the incremental impact of an activity when it is added to past, present, and reasonably foreseeable future activities. Cumulative impacts arise when several developments that may have insignificant effects but when taken together have a significant effect.
Direct impacts	Impacts that result from a direct interaction between integral Project activities and the Environmental Value (e.g. land clearing resulting in vegetation and habitat loss).
Ecological community	An assemblage of species occupying a particular area.
Ecological receptor	A receptor is an individual or grouping of features, areas and/or structures that may be affected by direct or indirect changes to the environment.
Endangered	Designated as 'Endangered' under the EPBC Act, NC Act, <i>Vegetation Management Act 1999</i> (Qld) (VM Act). Refer to definitions of EPBC Act conservation status, NC Act conservation status, VM Act and <i>Environmental Protection Act 1994</i> (Qld) (EP Act) conservation status for meaning of 'Endangered' under each Act. 'Endangered' refers to a species of community that: • Is not 'Critically Endangered' • Is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Term	Explanation
Environmentally Sensitive Area	- As defined under the <i>Environmental Protection Regulation 2019</i>, a Category A Environmentally Sensitive Area is any of the following: - National Parks - Conservation Parks - Forest Reserves - Wet Tropics World Heritage Area - Great Barrier Reef Marine Park Area - Marine Parks other than General Use Zones. - A Category B Environmentally Sensitive Area includes the following: - World Heritage Areas - Queensland Heritage Register Places - Ramsar Sites - Cultural Heritage Registered Areas and DLAs other than the area known as Stanbroke Pastoral Development Holding - Special Forestry Areas - Fish Habitat Areas (FHA) - Coordinated Conservation Areas - Endangered Regional Ecosystems (remnant and mature regrowth (biodiversity status)) - Marine Parks other than General Use Zones - Marine Plants. - A Category C Environmentally Sensitive Area includes any of the following: - Essential Habitat (EH) - Referable Wetlands - Declared Catchment Areas - Nature Refuges - Resources Reserves - State forests - Timber Reserves - Of Concern REs (remnant and mature regrowth (biodiversity status)).
Essential habitat (EH)	Essential habitat, for protected wildlife, is a category A area, a category B area or category C area shown on the regulated vegetation management map— - that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or - in which the protected wildlife, at any stage of its life cycle, is located.
Greenfield	A site that has not been developed or does not contain any rail infrastructure.
Habitat	An area or areas permanently, periodically or occasionally occupied by a species, population or ecological community, including any and all biotic and abiotic features of the area or areas occupied.
High constraint area	The Environmental Value is at risk from the Project activity. The activity will only be allowed with a specific set of stringent mitigation measures.
High Value Regrowth (HVR)	Described as Category C regulated vegetation under the <i>Vegetation Management Act 1999</i>. In accordance with the VM Act, High value regrowth vegetation means vegetation located— - on freehold land, indigenous land, or land subject of a lease issued under the Land Act 1994 for agriculture or grazing purposes or an occupation licence under that Act; and - in an area that has not been cleared (other than for relevant clearing activities) for at least 15 years, if the area is— - an endangered regional ecosystem; or - an of concern regional ecosystem; or

Term	Explanation
	iii. a least concern regional ecosystem.
Impact assessment area	This Project footprint plus a nominal 1 km buffer area. Where multiple options were identified, a 1 km buffer was maintained from the edge of each option, resulting in areas that are wider in some locations.
Indirect impacts	Impacts that are not a direct result of project activities but occur away from the original impact area via a complex pathway (e.g. soil disturbance during construction promoting weed and/or pest invasion that reduces habitat quality). Indirect impacts include the following: • Downstream or downwind impacts, including impact on wetlands or ocean reefs from sediment, fertilisers or chemical which are washed or discharged into river systems • Upstream impacts including impacts associated with the extraction of raw materials and other inputs which are used to undertake the action • Facilitated impacts which result from further actions (including actions by third parties) which are made possible or facilitated by the action.
K-selected species	Those species with low fecundity and longer lifespans.
Koala habitat in South East Queensland	An offset may be required for significant residual impacts on habitat for the koala in the South East Queensland planning area – as identified in the South East Queensland Regional Plan. This includes habitat that is: • an area of essential habitat as identified on the essential habitat map, as defined under the Vegetation Management Act 1999; or • an area that is not mapped as habitat, but which contains, or is known to contain koalas.
Matters of national environmental significance (MNES)	The nine MNES protected under the EPBC Act are: • World heritage properties • National heritage places • Wetlands of International Importance (listed under the Ramsar Convention) • Listed threatened species and ecological communities • Migratory species protected under international agreements • Commonwealth marine areas • The Great Barrier Reef Marine Park • Nuclear actions (including uranium mines) • A water resource, in relation to coal seam gas development and large coal mining development.
Matters of state environmental significance (MSES)	The MSES protected under the NC Act are: • An animal that is critically endangered wildlife, endangered wildlife or vulnerable wildlife • A plant that is critically endangered wildlife, endangered wildlife or vulnerable wildlife • National parks, private protected areas and marine parks • Fish habitat areas and marine plants • Important wetlands and waterways • Regulated vegetation that may include: – Category B areas, – Essential habitat, – Prescribed regional ecosystems, – 'endangered' and 'of concern' regional ecosystems, and – riparian vegetation.
Microchiropteran bats	This report uses the term Microchiropteran bats to refer to small mostly insectivorous bats that use echolocation to navigate and find food, in the suborder <i>Microchiroptera</i> .
Migratory	Species listed as Migratory under the EPBC Act. Refer to definitions of EPBC Act conservation status, for meaning of migratory under the Act.
Matters of state environmental	As defined by DES, MSES Wildlife habitat is vegetation in which a species that is listed under the NC Act as 'Endangered', 'Vulnerable' or 'Near

Term	Explanation
significance (MSES) wildlife habitat mapping (Queensland Government 2019)	Threatened' has been known to occur. MSES wildlife habitat is identified on the approved DES RE mapping.
Naturalness and ecological condition	The apparent naturalness or health/condition of an ecological community, as assessed against the following criteria: • Disturbance — described in terms of its cause (natural or human), its degree or severity, its extent and distribution within the community • Weed content — description of species abundance, horizontal and vertical distribution of each species • Ecological viability — measure of a community's ability to survive in the longer term • Ecological health — measure of regeneration, size, structure and number of dead or dying plants within a community • Ecological relationships — the sequential relationship of one community to another, including diurnal systems.
NC Act conservation status	Under the NC Act, protected species are assigned a conservation status of 'Extinct in the wild', 'Endangered', 'Vulnerable', 'Near Threatened', or 'Least Concern'. Definitions of these terms under the NC Act are as follows: 'Extinct in the wild' • There have been thorough searches conducted for the wildlife, and • It has not been seen in the wild over a period that is appropriate for the lifecycle or form of the wildlife 'Endangered' • There have not been thorough searches conducted for the wildlife and the wildlife has not been seen in the wild over a period that is appropriate for the lifecycle or form of the wildlife, or • The habitat or distribution of the wildlife has been reduced to an extent that the wildlife may be in danger of extinction, or • The population size of the wildlife has declined, or is likely to decline, to an extent that the wildlife may be in danger of extinction, or • The survival of the wildlife in the wild is unlikely if a threatening process continues 'Vulnerable' • Its population is decreasing because of threatening processes, or • Its population has been seriously depleted, and its protection is not secured, or • Its population, while abundant, is at risk because of threatening processes, or • Its population is low or localised or depends on limited habitat that is at risk because of threatening processes 'Near Threatened' • The population size or distribution of the wildlife is small and may become smaller, or • The population size of the wildlife has declined, or is likely to decline, at a rate higher than the usual rate for population changes for the wildlife, or • The survival of the wildlife in the wild is affected to an extent that the wildlife is in danger of becoming 'Vulnerable' 'Least Concern' • The wildlife is common or abundant and is likely to survive in the wild • Native wildlife may be prescribed as 'Least Concern' wildlife even if: • The wildlife is the subject of a threatening process, or • The population size or distribution of the wildlife has declined, or • there is insufficient information about the wildlife to conclude whether the wildlife is common or abundant or likely to survive in the wild.
Near Threatened	Designated as 'Near Threatened' under the NC Act. Refer to definition of NC Act conservation status for meaning of 'Near Threatened' under the NC Act.

Term	Explanation
	Capitalisation of the term 'Near Threatened' in this report refers to those species listed as such under the NC Act.
Negative impact	An impact that is considered to result in an unfavourable or adverse change to the receptor.
Non-remnant vegetation	Vegetation that is not mapped as remnant vegetation by DES and/or which fails to meet DESs criteria for remnant vegetation (see definition of remnant vegetation, below). This includes regrowth, heavily thinned or logged vegetation and significantly disturbed vegetation that fails to meet the structural and/or floristic characteristics of remnant vegetation. It also includes urban and cropping land. Non-remnant vegetation may retain significant biodiversity values (Neldner <i>et al.</i> 2012).
Of Concern	Designated as 'Of Concern' under the VM Act or 'Of Concern' under the EPBC Act. 'Of Concern' refers to a community in which 10% to 30% of pre-clearing extent of remnant vegetation exists in the bioregion, or more than 30% of pre-clearing extent remains and the remnant vegetation is less than 10,000 ha.
Precautionary principle	The precautionary principle stipulates that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Prescribed regional ecosystem	A regional ecosystem, other than a regional ecosystem mentioned in the VM Act located in a category B area on the regulated vegetation management map, to the extent the ecosystem contains remnant vegetation.
Project cumulative impact area	The Inland Rail Program cumulative impact area encompasses the Inland Rail disturbance footprint and extends 50 km beyond the Project footprint boundary.
Project footprint	The Project footprint is the area subject to direct disturbance (both temporary and permanent) associated with the Project.
Protected areas	The classes of protected areas to which the <i>Nature Conservation Act 1992</i> (NC Act) applies are: • national parks (scientific); • national parks; • national parks (Aboriginal land); • national parks (Torres Strait Islander land); • national parks (Cape York Peninsula Aboriginal land); • conservation parks; • resources reserves; • special wildlife reserves; • nature refuges; and • coordinated conservation areas.
Protected matters	Under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act), protected matters are nationally significant (protected) animals, plants, habitats or places. The EPBC Act covers 9 protected matters: • world heritage areas; • national heritage places; • wetlands of international importance (listed under the Ramsar Convention); • listed threatened species and ecological communities; • listed migratory species (protected under international agreements); • Commonwealth marine areas; • Great Barrier Reef Marine Park; • nuclear actions (including uranium mines); and • water resources (that relate to coal seam gas development and large coal mining development).

Term	Explanation
	The term protected matters is not defined in the NC Act. For the purposes of this EIS, protected matters include those matters assessed under the Queensland Environmental Offsets Policy Significant Residual Impact Guideline for the NC Act, <i>Environmental Protection Act 1994</i> (EP Act), and <i>Marine Parks Act 2004</i>. Matters relevant to the Project include: • regulated vegetation; • connectivity areas; • wetlands and watercourses; • protected wildlife habitat; • Koala habitat in South East Queensland; and • protected areas; and • waterway providing for fish passage.
Protected wildlife habitat	Protected wildlife habitat includes the following MSES prescribed in the Environmental Offsets Regulation 2014: • an area of essential habitat on the essential habitat map for an animal or plant that is endangered or vulnerable wildlife; • an area that is shown as a high risk area on the flora survey trigger map and that contains plants that are endangered or vulnerable wildlife; • an area that is not shown as a high risk area on the flora survey trigger map, to the extent the area contains plants that are endangered or vulnerable wildlife; or • an area of habitat (e.g., foraging, roosting, nesting or breeding habitat) for an animal that is endangered, vulnerable or a special least concern animal.
R-selected species	Those species with high fecundity and shorter lifespans.
Red-boarded	Rail term: A line with a stop board attached to the rail preventing traffic entering the section.
Region	A bioregion as defined in An Interim Biographic Regionalisation of Australia (Thackway and Cresswell 1995). The region subject to this report is the Brigalow Belt South bioregion.
Regional Ecosystem (RE)	A vegetation community, within a bioregion, that is consistently associated with a particular combination of geology, landform and soil (Young <i>et al.</i> 1999). REs may be classified under schedules 1 to 3 of the Vegetation Management Regulation as 'Endangered', 'Of Concern' or 'Least Concern'. Refer to VM Act conservation status for meaning of 'Endangered', 'Of Concern' and 'Least Concern' under the Act. These terms in reference to REs in this report refers to the RE status under the Act.
Regrowth vegetation	As defined under the VM Act, regrowth vegetation means vegetation that is not remnant vegetation.
Regulated vegetation	Regulated vegetation is a 'prescribed regional ecosystem' that: • is an endangered or of concern regional ecosystem, as defined under the <i>Vegetation Management Act 1999</i>; or • intersects with an area shown on the vegetation management wetlands map, as defined under the <i>Vegetation Management Act 1999</i>, to remove doubt this refers to that component of a regional ecosystem that lies within a mapped wetland; or • is located within the defined distance from the defining banks of a watercourse identified on the vegetation management watercourse map, as defined under the <i>Vegetation Management Act 1999</i>.
Remnant vegetation	Remnant woody vegetation is defined as vegetation where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy (Neldner <i>et al.</i> 2012).
Significant impact	In accordance with the EPBC Act, a significant impact is an impact which is important, notable, or of consequence, having regard to its context or

Term	Explanation
	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.
Spatial extent	Impacts are considered with respect to the biologically meaningful spatial extents of local, regional, State, and national/international.
Study area	This includes a nominal 1 km buffer area either side of the centreline, wider in some areas where multiple design options required an increase investigation area. Where temporary disturbance exceeds the nominal 1 km buffer from the centreline, a 100m buffer was placed around these footprints to account for potential indirect impacts.
Threatened	A collective term used with reference to species that are listed as 'Critically Endangered', 'Endangered' or 'Vulnerable' under the provisions of the EPBC Act (EPBC Act conservation significance for more details). Under the NC Act (Qld) a threatened species is any plant or animal species that is at risk of extinction and is allocated a conservation class of either extinct in the wild, endangered or 'Vulnerable'.
VM Act conservation status	Under the VM Act, REs may be classified as either 'Endangered', 'Of Concern' or 'Least Concern'. Definitions of these terms under the Act are provided below Endangered - Less than 10% of pre-clearing extent of remnant vegetation (see following definition) exists in the bioregion, or 10% to 30% of pre-clearing extent remains and the remnant vegetation is less than 10,000 ha Of Concern 10% to 30% of pre-clearing extent of remnant vegetation exists in the bioregion, or more than 30% of pre-clearing extent remains and the remnant vegetation is less than 10,000 ha Least Concern - More than 30% of pre-clearing extent of remnant vegetation exists in the bioregion, and it is greater than 10,000 ha. In addition, for biodiversity planning purposes, the DES also classifies a RE as "No concern at present" if the degradation criteria listed above for 'Endangered' or 'Of Concern' REs are not met.
Vulnerable	Designated as 'Vulnerable' under the EPBC Act and/or NC Act. Refer to definitions of EPBC Act conservation status and NC Act conservation status for meaning of 'Vulnerable' under these Acts.
Watercourse	As per the Water Act, is a river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flows.
Watercourse of high ecological value	Watercourse in a high ecological value waters as identified under the Environmental Protection (Water) Policy 2009, schedule 2.
Waterway for fish passage	Any part of a waterway that provides for passage of fish (other than that part of a waterway within an urban area).
Weeds of National Environmental Significance (WoNS)	The State Government is responsible for the legislation and administration of WoNS in Queensland and landholders are responsible for managing WoNS. The Australian Weeds Strategy provides a framework for establishing consistency between all stakeholders and identifies priorities for national weed management with the aim of minimizing the environmental, social and economic impacts of weeds. A National Management Group has been established for each of the WoNS to manage the implementation of the respective National Strategic Plans.

Term	Explanation
Wetland	• Areas shown on the Map of Referable Wetlands which is a document approved by the chief executive on 4 November 2011 and published by the department, as amended from time to time by the chief executive under section 144D of the Environmental Protection Regulation 2008 (Qld); and • Wetlands as defined under the Queensland Wetlands Program as areas of permanent or periodic/intermittent inundation, with water that is static or flowing fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed 6 m, and possess one or more of the following attributes: – At least periodically, the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their lifecycle; or – The substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers; or – The substratum is not soil and is saturated with water or covered by water at some time.
Wetland of high ecological significance	Otherwise known as a high conservation value wetland, is a wetland that meets the definition of a wetland (above) and that is shown as a wetland of high ecological significance (HES) or high conservation value wetland on the <i>Map of Referable Wetlands</i> .
Wetland of high ecological value	Wetland in a high ecological value waters as identified under the Environmental Protection (Water) Policy 2009, schedule 2.

EXECUTIVE SUMMARY

This Terrestrial and Aquatic Ecology Report supports the revised draft Environmental Impact Statement (EIS) for the construction and operation of the NSW/QLD Border to Gowrie Project (the Project), a section of the larger Inland Rail Program. This document addresses Sections 11.94 to 11.106 of the Terms of Reference for an Environmental Impact Statement: Inland Rail – Border to Gowrie project. In order to avoid repetition, Matters of National Environmental Significance (MNES) that have been identified as controlling provisions (i.e. *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) threatened species and communities) have been provided in revised draft EIS Appendix O: Matters of National Environmental Significance, and have been excluded from this document. The revised draft EIS Appendix O is a separate 'stand-alone' document and addresses Sections 11.1 to 11.35 of the Terms of Reference (ToR).

Australian Rail Track Corporation Limited (ARTC) proposes to construct and operate the Project, which consists of a total of 217.48 kilometres (km) of single-track railway with five crossing loops and will be constructed to accommodate 1,800 metres (m) long double stack freight trains. The Project will utilise a combination of 68.00 km of existing open access rail corridor (brownfield) and 149.48 km of new rail corridor (greenfield) to prioritise areas of existing pre-clearing and disturbance.

The Study area for the terrestrial and aquatic ecology assessment includes the Project footprint and an additional 1 km buffer. The assessment of potential impacts has focused on the Project footprint, which totals 3,382.17 hectares (ha) and includes all areas where works are proposed (both temporary and permanent), but it also considers indirect impacts outside of the Project footprint where relevant.

The Study area is located within the Brigalow Belt South bioregion and has a long history of human disturbance from agricultural practices and resource development. At a regional level, most remaining areas of vegetation are now fragmented, occurring on the rockier hilly areas of ranges, as part of state protected lands (State forests), as roadside vegetation, or as relatively small, isolated remnants.

The methodology for this assessment included:

- a desktop assessment where databases, previous studies and existing literature was reviewed;
- an assessment of the likelihood of occurrence of MNES and Matters of State Environmental Significant (MSES) species;
- field surveys for which suitable locations were informed by pre-survey predictive habitat mapping and preliminary surveys;
- an update to the likelihood of occurrence of MNES and MSES species based on the field survey findings;
- habitat mapping based on ground-truthed data and expert consultation; and
- an assessment of significant residual impacts, offset quantification and cumulative impacts.

Desktop assessments identified that the Project footprint contains 31 threatened flora species and 45 threatened fauna species known, likely or with the potential to occur in the Project footprint. Threatened species are those listed under the EPBC Act and/or the *Nature Conservation Act 1992* (NC Act). It was also identified that 25 regional ecosystems (RE), including two 'Endangered', seven 'Of Concern', and 16 'Least Concern' REs (*Vegetation Management Act 1999* (VM Act) status) are mapped within the Project footprint.

Following field surveys, 11 threatened flora, six special least concern (SLC) flora, 13 threatened fauna and four SLC fauna were considered known to occur in the Project footprint. A further six threatened fauna and four SLC fauna species were considered likely to occur, and 11 threatened flora and 11 threatened fauna species were considered as having the potential to occur. The SLC fauna species includes two migratory bird species that are considered to be known to occur within the Project footprint and four migratory bird species that are likely to occur. Ground-truthing surveys resulted in a total of 32 REs identified within the Project footprint, with 25 REs contributing to remnant, mature regrowth and immature regrowth areas. This includes four 'Endangered', eight 'Of Concern', and 13 'Least Concern' REs (VM Act status). The remaining seven REs were non-remnant areas only and were based on State Pre-Clearing Mapping.

Field surveys also assessed borrow pit sites and the site for Whetstone Material Distribution Centre (Whetstone MDC), surveyed aquatic ecosystems and waterways, and habitat types including regulated vegetation. Surveys of the proposed borrow pit sites established that MNES or MSES are absent from the sites.

Aquatic surveys using the AusRivAS method identified that the waterways surveyed range from Band A (reference condition) to Band B (significantly impaired).

A total of eight broad habitat types were identified in the Study area during surveys:

- Natural grassland;
- Non-remnant disturbed pasture, cropping areas and other land uses;
- Remnant dry sclerophyll eucalypt woodlands;
- Mature *Acacia harpophylla*-*Casuarina cristata* open forest;
- Regrowth eucalypt communities;
- Wetlands;
- Watercourses; and
- Groundwater dependent ecosystems.

Ground-truthing surveys determined the Project footprint (3,382.17 ha) to comprise of 16.9% or 570.75 ha of remnant vegetation; 0.5% or 16.48 ha of mature regrowth vegetation; 8.0% or 270.92 ha of immature regrowth vegetation; and 74.6% or 2,524.02 ha of non-remnant.

As defined by Schedule 2 of the *Environmental Offsets Regulation 2014*, the following MSES were identified within the Project footprint:

- Regulated vegetation:
 - Two Category B (remnant) 'endangered' REs, totalling 49.39 ha;
 - Seven Category B (remnant) 'of concern' REs, totalling 85.06 ha;

- Six Category B (remnant) REs that lie within a mapped wetland (5.52 ha), and are within 50 m of a wetland (11.71 ha);
- 19 Category B (remnant) REs within a defined distance from a watercourse, totalling 11.31 ha; and
- 113.19 ha of mapped essential habitat for 13 threatened species;
- 475.33 ha of Category B (remnant) vegetation important for connectivity; and
- 100 waterways providing for fish passage.

The Project intersects both Goondiwindi and Toowoomba Local Government Areas who have their own Planning Scheme Environmental Overlays and associated Overlay Codes. Whilst the Project footprint intersects areas mapped as Matters of Local Environmental Significance (MLES) under the Toowoomba Regional Council Planning Scheme, the Project is exempt from assessment against the Environmental Significance Code and MLES of the Planning Schemes as it is Government supported transport infrastructure.

Without appropriate management and controls, the pre-construction, construction, commissioning, and operation phases of the Project have the potential to impact on ecological values, both terrestrial and aquatic, via the following mechanisms:

- Habitat loss through clearing;
- Fauna species injury or mortality;
- Reduction in biological viability of soil;
- Introduction and spread of weed, pathogens and pest species;
- Habitat fragmentation;
 - Loss of biodiversity corridors;
 - Barrier effects;
 - Edge effects;
- Noise and vibration;
- Air quality and dust;
- Lighting;
- Waste management;
- Altered hydrology and flooding;
- Erosion and sedimentation;
- Changes to groundwater resources;
- Contamination;
- Clearing of riparian vegetation;
- Modification of aquatic habitat; and
- Altered hydrology.

The nature of each unmitigated impact during each phase of the Project was considered in relation to identified ecological values, and the anticipated scale and duration of disturbance. This was utilised to identify mitigation measures and the scale at which they should be implemented.

The mitigation measures for the Project were developed using the four principles of ecologically sustainable development:

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

The revised reference design includes utilising existing cleared areas, reducing proposed laydowns and ancillary areas to minimise impacts to ecological values, and implementation of measures to address specific impacts identified above.

Additional mitigation measures to be implemented post-approval include:

- Refinement of the revised reference design and Project footprint during detailed design to reduce ecological impacts;
- Mitigations to meet fauna connectivity performance criteria and design outcomes including identification of fauna crossing structures and other connectivity components such as fencing and furniture, required to achieve successful fauna connectivity outcomes based on identified priority connectivity zones for target species informed by least cost paths, biodiversity and riparian corridors and other habitat linkages;
- A connectivity implementation plan demonstrating how connectivity function will be integrated in the Project's design progression for compatibility with the flooding mitigation approach (as detailed in revised draft EIS Chapter 14: Flooding and Geomorphology) and allowing for detail such as fauna furniture and noise and lighting baffles, typically associated with later stage detailed design and which may be needed for successful connectivity outcomes, are considered at the appropriate stage in the design progression for successful design integration;
- Bridge crossings at watercourses have been designed to support fauna movement by the incorporation of a minimum width of 3 m and height of 1.5 m clearance at bridge and abutments to ensure fauna passage is maintained through riparian zones along the bed and banks of watercourses;
- Bridge piers in the McIntyre River have been appropriately sized and located to avoid potential impacts to the Murray cod including avoidance of the low flow zone and not resulting in any changed velocity conditions;
- The incorporation of fauna connectivity principles in the on-going design of waterway and watercourse crossings to ensure the establishment of appropriately sized clearance zones at priority connectivity zones such as riparian zones beneath bridge crossings, which have been identified for the site;
- Provision of fauna fencing including exclusion fencing, funnel fencing and fauna escape mechanisms such as jump outs and escape poles;
- Implementation of appropriately designed fauna crossing structures, including multi-use and dedicated fauna culverts, four bridges spanning 6 km of the Condamine River floodplain, and 17 glider poles, as detailed in the Fauna Connectivity Strategy (Appendix P: Fauna Connectivity Strategy); and

- Ongoing monitoring for all mitigation measures to assess the effectiveness of the measures with contingency (under an adaptive management framework) to change/improve management strategies where deleterious impacts to the identified ecological values are observed, or not minimised.
- The development, finalisation and implementation of the following management plans:
 - Draft Koala Management Plan (revised draft EIS Appendix M: Draft Koala Management Plan) to establish best-practice mitigation and management measures to be implemented during design, construction and operation of the Project that reduce the risk of Koala injury and/or mortality, minimise losses to Koala foraging, breeding and dispersal habitat, and maintain connectivity between areas of important Koala habitat. The KMP defines key aspects of a Koala monitoring plan for all Project phases and provides a framework for adaptive management, including schedules and triggers for audits, management plan review and reporting.
 - Draft Fauna Management Plan (revised draft EIS Appendix N: Draft Fauna Management Plan) to outline the fauna monitoring, mitigation and management measures to be implemented to avoid or minimise the impact of Project activities on listed threatened fauna species, and comply with all relevant Commonwealth and State legislation, regulations, conditions of approval and permit requirements during all stages of the Project.
 - Wildlife Connectivity Plan in accordance with the Fauna Connectivity Strategy (revised draft EIS Appendix P) to maintain ecological connectivity and dispersal function through the landscape and minimise the risk of fauna injury and mortality as a result of the Project. This will include fauna connectivity monitoring programs, and fauna crossing structure maintenance programs.
 - Construction Environmental Management Plan (CEMP) in accordance with the Australian Government's Environmental Management Plan guidelines (DCCEEW, 2024) to detail how the performance, commitments and mitigations measures for the Project will be implemented and achieved during all stages of construction, including the following relevant sub-plans:
 - Biodiversity Management Plan, which will outline the management strategies, actions and controls to be implemented to avoid or minimise potential impacts of the Project during construction;
 - Biosecurity Management Plan, which will outline biosecurity risks associated with the construction of the Project and the processes that are to be used to manage those risks;
 - Rehabilitation and Landscaping Management Plan, which will be based on the Inland Rail Landscape and Rehabilitation Strategy, Inland Rail Landscape and Rehabilitation Framework and location-specific reinstatement commitments, it will detail the actions needed to rehabilitate the areas within the temporary Project footprint that are for use during construction phase only. This Plan will be developed in consultation with local councils and affected communities, including Traditional Owners; and

- Soil Management Plan, which provides procedures and protocols for the management of potential impacts on land resources during construction. The Soil Management Plan will include soil conservation measures and erosion and sediment controls with specific reference to identified habitat for threatened flora (where they are found to occur).
- Operational Environmental Management Plan (OEMP) in accordance with relevant guidelines to detail how the performance outcomes, commitments and mitigation measures for the Project will be implemented and achieved during operation, including the following programs and sub-plans:
 - Biosecurity Management Plan which will outline biosecurity risks associated with the operation of the Project and the processes that are to be used to manage those risks; and
 - Biodiversity Management Plan, which will outline the management strategies, actions and controls to be implemented to minimise potential impacts of the Project during operation.

Following the application of the post-approval mitigation measures to the revised reference design, an impact assessment was conducted as per the *Queensland Environmental Offsets Policy: Significant Residual Impact Guideline* (DEHP, 2014b). For species listed under both the EPBC Act and the NC Act, where species specific habitat had been considered in the impact assessment documented in Appendix O and can be demonstrated to be the same or substantially the same, they were omitted from the significant impact assessment. This assessment determined that the Project is unlikely to result in a significant residual impact to wetlands and watercourses, 17 species of threatened fauna, koala habitat in South-East Queensland, protected areas, and waterways providing for fish passage. It was determined that the Project is likely to result in a significant residual impact to the following Prescribed environmental matters under the *Environmental Offsets Act 2014*:

- Regulated vegetation:
 - Prescribed REs that are Endangered or Of Concern;
 - Clearing in the portion of a regional ecosystem that lies within a mapped wetland;
 - Clearing in a regional ecosystem that is within the defined distance of a watercourse;
 - Essential habitat for the pale imperial hairstreak (*Jalmenus eubulus*) is mapped within the Project footprint, however, this species remains unlikely to occur within the Project footprint due to inconsistencies between the ground-truthed RE and State-based mapping. However, because Essential habitat, as a Regulated vegetation Prescribed Matter, has been mapped within the Project footprint, this species has been considered to require an offset;
- Connectivity areas:
- Protected wildlife habitat - threatened flora species:
 - *Cyperus clarus*;
 - *Picris barbarorum*;
- Protected wildlife habitat - threatened fauna species:

- Diamond firetail (*Stagonopleura guttata*);
- Glossy black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*); and
- Southern whiteface (*Aphelocephala leucopsis*).

The primary cause of these impacts is loss of habitat as a result of clearing for the Project. The Project will be refined during the detailed design phase, and it is expected that the final design will result in a reduction in the total impact area. Additionally, design solutions to mitigate barrier effects will be incorporated into the detailed design, as appropriate (e.g. fauna fencing and fauna passageways which will facilitate the movement of wildlife across the alignment).

Potential predicted cumulative impacts of projects within 50 km of the Project footprint were considered. A total of 19 projects were included in the area of influence (AOI), as only projects and areas that are within Queensland were considered as MSES are bound by State borders. Operational projects have been included in the assessment of ecological cumulative impacts due to the potential for such developments to continue to have an ongoing impact on ecological values and processes. Unmitigated, the cumulative impacts resulting from existing and proposed developments within the cumulative impact area of influence (AOI) include some that can be considered irreversible and permanent. Without targeted mitigation measures, the potential cumulative impacts upon MSES within AOI area have been assessed to be low to moderate significance.

The significance of the predicted cumulative impact as a result of the Project and other similar projects has been found to be medium for:

- Reduction in biological viability of soil to support growth due to soil compaction;
- Habitat loss from vegetation clearing/removal;
- Edge effects;
- Habitat fragmentation;
- Barrier effects; and
- Reduction in connectivity of biodiversity corridors.

The Project will result in significant impacts on MSES, even after the implementation of mitigation measures, including rehabilitation. Therefore, environmental offsets will be required for the Project. Each of the ecological values that have been identified as likely to have a significant residual impact or a medium cumulative impact are included in ARTC's Environmental Offset Delivery Strategy – which is contained in revised draft EIS Appendix Q: Environmental Offset Delivery Strategy. The Environmental Offset Delivery Strategy is based on the significant impacts of the Project on ecological values identified in this assessment, and details offsets to address these significant impacts. Property specific Offset Area Management Plans will be developed and finalised in consultation with relevant Australian Government and State regulatory agencies prior to construction.

1. INTRODUCTION

1.1 PROJECT OVERVIEW

The Australian Rail Track Corporation (ARTC) proposes to construct and operate the New South Wales (NSW)/Queensland (QLD) Border to Gowrie Project (the Project), a section of the larger Inland Rail Program. The Project consists of 217.48 km of single-track railway with five crossing loops. The Project will be constructed to accommodate 1,800 metre (m) long double-stack freight trains, and as such each crossing loop will be 2,200 m long. The Project will utilise a combination of existing and new rail corridors.

Vegetation clearing associated with the proposal, as assessed by the Environmental Impact Statement (EIS), is limited to that contained within the Project footprint.

The Project revised reference design responds to key environmental and social constraints and has been developed in line with engineering standards to produce a feasible rail design that will achieve the performance specifications for Inland Rail and the Project.

1.2 SCOPE AND PURPOSE

1.2.1 THIS REPORT

The purpose of this assessment is to support the revised draft EIS. This report specifically addresses sections 11.94 to 11.101 (flora and fauna) and sections 11.102 to 11.106 (biosecurity) of the Project's Terms of Reference (ToR).

The flora and fauna sections have the following objective:

"Matters of environmental significance are identified and appropriately safeguarded to support healthy and resilient ecosystems and ensure the sustainable, long-term conservation of biodiversity and the social, economic, cultural and environmental benefits it provides."

The biosecurity sections have the following objectives:

"The construction and operation of the Project should aim to ensure:

(a) the spread of weeds and pest animals is avoided or minimised

(b) existing weeds and pests are controlled

(c) comply with relevant provisions of the Biosecurity Act 2014 (Qld)."

This assessment describes the existing environment based on various desktop and field studies. It summarises the methods and results for all ecological investigations conducted for the Project and the associated reports are provided in Appendix A Additional Ecological Investigations.

The Project footprint and broader Study area are presented in Figure 1-1 and described in Section 1.2.2.

Potential impacts to ecological values resulting from construction and operation of the Project are discussed in Section 5. Mitigation measures, discussed in Section 5.3.8, have been developed to avoid, or if avoidance is not possible, minimise ecological impacts.

Impact assessments on Matters of State Environmental Significance (MSES) listed under Schedule 2 of the Environmental Offsets Regulation 2014 (Offset Regulation) have been documented in Section 7.2. This full range of values, including but not restricted to MSES, are collectively referred to as 'ecological values'. This includes *Nature Conservation Act 1992* (NC Act) listed species that are not also listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The requirement for environmental offsets is addressed in Section 8.

In accordance with the ToR, impacts on Matters of National Environmental Significance (MNES) have been assessed and documented separately in revised draft EIS Appendix O: Matters of National Environmental Significance Report. The relevant controlling provision is threatened species and ecological communities. For matters that are dual listed, an assessment of whether the same or substantially the same matter has been considered has been conducted in Table 7-1.

To address conservation listing changes that have occurred throughout the duration of the preparation of the revised draft EIS, species that have been listed under the EPBC Act since the Project was determined a controlled action and are dually listed as conservation significant under the NC Act, have been assessed as MSES in this assessment.

The ToR also required assessment of Matters of Local Environmental Significance (MLES) and other natural environmental values, and they are addressed within this assessment.

This assessment has been prepared in accordance with the information requests issued by:

- The Office of the Coordinator-General (OCG) in January 2022 and September 2023; and
- The Department of Climate Change, Energy, Environment and Water (DCCEEW) in July 2023.

1.2.2 STUDY AREA

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

The assessment of potential impacts has focused on the Project footprint (Figure 1-1), but indirect impacts in the Study area are also considered.

The Project footprint (3,382.17 ha) is the land required to accommodate all temporary and permanent components of the Project, as described in the Chapter 5: Project Description being:

- Temporary disturbance footprint (3,382.17 ha) – the area required to accommodate construction activities and facilities of a temporary nature to support the Project. The temporary footprint is generally wider than the permanent footprint to allow for the construction of Project elements including fencing, drainage features including erosion and sediment control measures, temporary stockpiling of soil and cleared vegetation, and to allow necessary construction access and turnaround provisions. Temporary project facilities include laydowns, site office areas, non-resident workforce accommodation, a material distribution centre (MDC), concrete batch plants and borrow pits.

- Permanent disturbance footprint (2,544.86 ha) - the area required to accommodate permanent infrastructure associated with the project including rail, road and other miscellaneous infrastructure. Rail infrastructure includes rail tracks, crossing loops, turnouts, earthworks, bridges, drainage, level crossings, grade separations, rail maintenance access roads, signalling and fencing. Road related works resulting from the Project encompasses new and upgraded roads, realignments and diversions, intersection improvements and closures.

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

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



Legend

- Chainage (km)
- [- -] Study Area
- [] LGA
- [] Temporary Disturbance Footprint
- [] Permanent Disturbance Footprint
- Watercourse
- [] National Park
- [] State Forest



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 2 4 6km

1:200,000

F1.1 (1) - Location of the Project and the Study Area

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

- Chainage (km)
- Study Area
- LGA
- Temporary Disturbance Footprint
- Permanent Disturbance Footprint
- Watercourse
- Conservation park
- National Park
- State Forest



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 2 4 6km

1:200,000

F1.1 (2) - Location of the Project and the Study Area

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

ERM



Legend

- Chainage (km)
- [- -] Study Area
- Temporary Disturbance Footprint
- Permanent Disturbance Footprint
- Watercourse
- Conservation park
- National Park
- State Forest

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

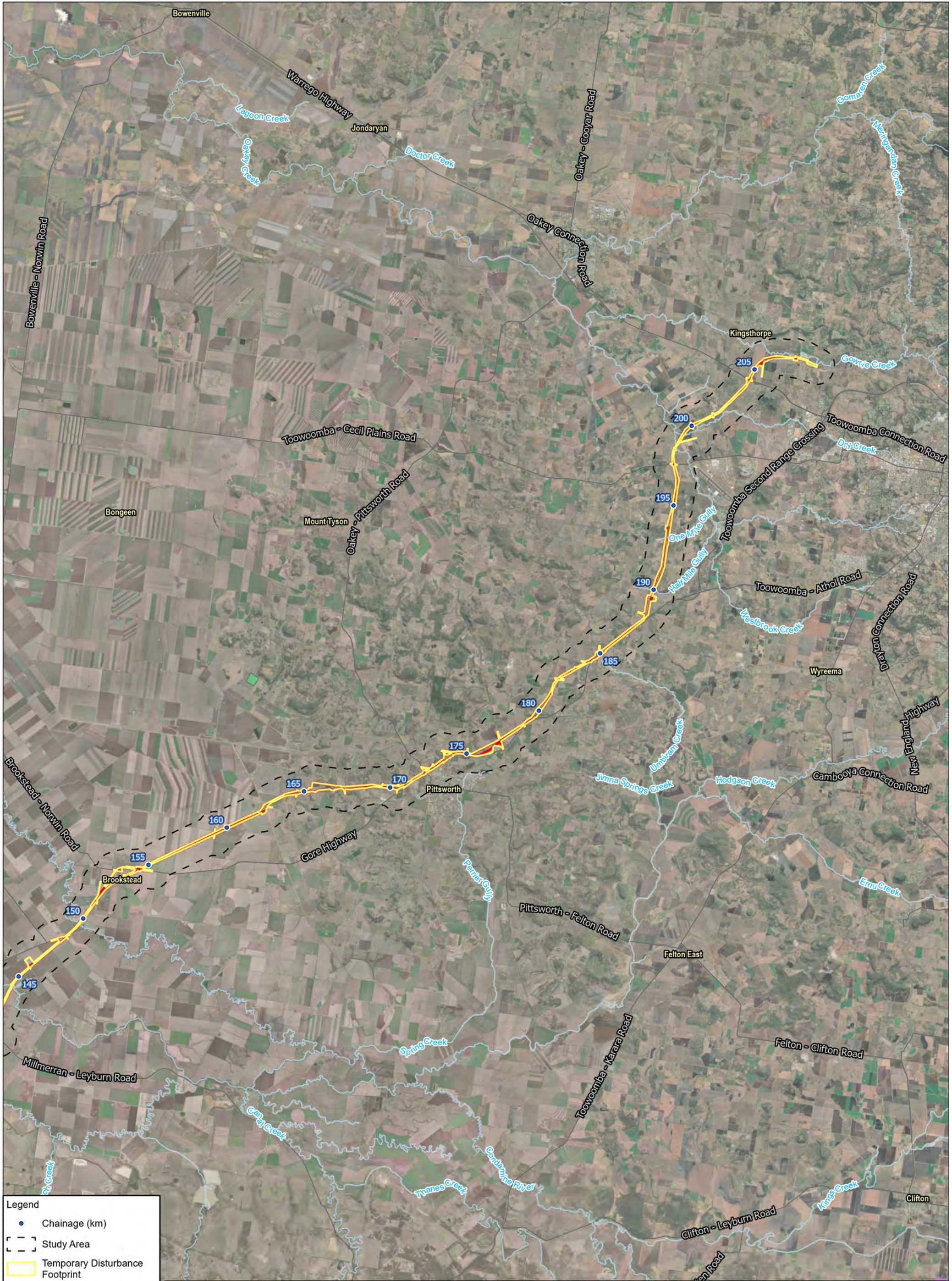
0 2 4 6km

1:200,000

F1.1 (3) - Location of the Project and the Study Area

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

- Chainage (km)
- [- -] Study Area
- Temporary Disturbance Footprint
- Permanent Disturbance Footprint
- Watercourse
- Conservation park
- State Forest



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 2 4 6km

1:200,000

F1.1 (4) - Location of the Project and the Study Area

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

ERM

1.3 PROJECT INFORMATION

1.3.1 PROJECT LOCATION

The Project starts at the NSW/QLD border approximately 18 km to the south-east of Goondiwindi, near Kurumbul. The Project ends in the Gowrie area, approximately 500 m east of Leeson's Road.

The Project provides a link between the adjacent Inland Rail projects of:

- North Star to NSW/QLD border (NS2B) to the south at the Macintyre River; and
- Gowrie to Helidon (G2H) project in the north, which connects into QR's West Moreton Line.

Further information about the location and description of the Project is detailed in Chapter 5: Project Description.

1.3.2 REGIONAL CONTEXT

The Project is located within the Brigalow Belt South bioregion. From west to east, the Project is located within the Commoroon 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 from agricultural practices and resource development. At a regional level, most remaining areas of vegetation are now fragmented, occurring on the rockier hilly areas of ranges, as part of State protected lands (State forests), as roadside vegetation (Plate 1-1 and Plate 1-2), or as relatively small, isolated remnants.

Within the Study area, most lands are highly modified having been cleared for pasture, agricultural purposes (Plate 1-6) and for rural and urban residential settlements. Areas of planned future development on the western outskirts of Toowoomba include the Wellcamp Business Park, Witmack Industry Park, and Charlton Logistics Park, which will be subject to future infrastructure and industrial development.

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

Despite the disturbances within the Study area, the Biodiversity Planning Assessment (BPA) mapping for Brigalow Belt (Queensland Government, 2016; DES, 2018c) identifies regional and State corridors of vegetation that is significant for the connectivity and movement of flora and fauna. Both riparian and terrestrial State ecological corridors have been mapped across the Project footprint.



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



PLATE 1-2 EXAMPLE OF MATURE TREES RETAINED WITHIN A ROAD RESERVE, SURROUNDED BY ANTHROPOGENIC DISTURBANCE SOUTH OF TOOWOOMBA

Source: FFJV (2018)

The Project footprint includes areas of agricultural land and State forest. The Project footprint has been subject to historical disturbance/clearing and approximately one third of its length is co-located with existing rail corridors (brownfield). The remaining greenfield portions of the Project footprint extends largely through areas subject to agricultural land uses (Plate 1-3, Plate 1-4, Plate 1-5, and Plate 1-6). Outside of the State forests in the Inglewood area, the remaining patches of vegetation within the Project footprint are highly fragmented.



PLATE 1-3 PORTION OF THE PROJECT FOOTPRINT ON THE CONDAMINE FLOODPLAIN



PLATE 1-4 PROJECT FOOTPRINT NORTH OF THE CONDAMINE FLOODPLAIN



PLATE 1-5 CABBAGE TREE CREEK ON THE CONDAMINE FLOODPLAIN, SHOWING THE NARROW BAND OF MATURE VEGETATION



PLATE 1-6 FERTILE SOILS OF THE CONDAMINE FLOODPLAIN ARE USED FOR CROPPING

Source: FFJV (2019)

In the southern extent of the Project footprint, between the NSW/QLD border and Inglewood, the landscape is dominated by dryland cropping, irrigated agriculture and intensive animal production on the fertile soils and floodplains associated with the Macintyre River, Dumaresq River, and Macintyre Brook. North of Inglewood, the Project passes through the undulating and densely forested landscapes of Whetstone and Bringalily State forests. The Project then traverses the gently undulating agricultural areas near Millmerran before crossing the Condamine River floodplain (Plate 1-5, and Plate 1-6). 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.

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

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

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

There are a five State forests in the vicinity of the Study area not directly affected by the Project. These are:

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

The Irongate Conservation Park (29 ha) protected under the NC Act, is located 6.5 km from the Project footprint, outside of the Study area. Additionally, there is one council reserve, the

Mount Basalt Environmental Park, located 5 km from the Project footprint, outside of the Study area.

These areas are dominated by eucalypt woodlands on sandy plains or shallow soils in areas of higher elevation. They support a high diversity of terrestrial fauna species (DES 2018a).

The Project footprint traverses two catchment areas, the Condamine, and Border Rivers. The Condamine River catchment is one of the largest catchments in the Murray Darling Basin (Murray-Darling Basin Authority, 2018). The main rivers of the catchment, the Condamine and the Maranoa, rise in elevated country and join to become the Balonne River. However, two thirds of the catchment is flat floodplain country (the Lower Balonne Floodplain), with a complex system of rivers and creeks joining and breaking away from the Balonne River. The catchment's extensive floodplains provide habitat for a diverse range of plants and endangered plant communities (Murray-Darling Basin Authority, 2018). The region is significant for its agricultural diversity, with a wide range of winter and summer crops produced on the Darling Downs, and very large cotton production areas in the west (Murray-Darling Basin Authority, 2018).

The Border Rivers catchment is made up of a group of rivers in a region straddling the NSW/QLD border. The rivers of the catchment rise on the western slopes of the Great Dividing Range and run westward, gradually merging with one another to become the Barwon River on the floodplains upstream of Mungindi (Murray-Darling Basin Authority, 2018). The catchment consists of approximately 450 km of rivers. The landscape of the Border Rivers catchment is diverse, containing tablelands and slopes and semi-arid plains (Murray-Darling Basin Authority, 2018). The region is significant for its agricultural diversity, with a wide range of winter and summer crops produced on the Darling Downs, and very large cotton production areas in the west (Murray-Darling Basin Authority, 2018).

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

The Project is located within the Goondiwindi and Toowoomba local government areas (LGA) in the Brigalow-belt bioregion.

1.3.3 PROJECT DESIGN

The Project consists of the key permanent and temporary features listed in Table 1-1. Key features of the Project are also shown in revised draft EIS Appendix B1: Design Drawings.

Further detail regarding key features of the Project is provided in Chapter 5: Project Description, including the works that form part of the Project activities.

TABLE 1-1 KEY FEATURES OF THE PROJECT

Aspect	Description
Permanent features	
New track	- Approximately 217.48 km of new single-track railway, consisting of: 7.0 km of standard gauge rail (1,435 millimetres (mm)), and 210.48 km of dual gauge rail (standard (1,435 mm) and narrow (1,067 mm) gauge).

Aspect	Description
	Railway infrastructure and the corridor will be constructed for 1,800 m long trains.
Rail corridor	- Establishment of approximately 149.48 km of new rail corridor (greenfield) and use of approximately 68.00 km of existing open access rail corridor (brownfield), - The rail corridor width will vary along the length of the alignment. The width is a minimum of 30 m, and is dependent on various elements in the corridor including: - embankment height or cutting depth, - crossing loop and/or maintenance siding, - structures (e.g. bridges, viaducts, concrete boxes, pipes etc.), - drainage and scour protection lengths, - railway maintenance access roads, - level crossings, and - Queensland Rail connections. - Brownfield corridor refers to locations where the Project has coincided with existing rail corridors to prioritise areas of existing pre-clearing and disturbance. This does not mean that the railway is located wholly within the existing rail corridor. Corridor widening and/or curve easing may be required to meet the requirements of the ARTC Basis of Design, resulting in some works outside the extent of the existing rail corridors.
Crossing loops and turnouts	- Crossing loops are places on a single-line track where trains in opposing directions can pass each other. Five crossing loops will be constructed as part of the Project, 2,200 m in length for each loop. - The proposed locations for the crossing loops are: - Yelarbon—Ch 16.3 km to Ch 18.5 km, - Inglewood—Ch 50.2 km to Ch 52.4 km, - Kooroongarra—Ch 89.2 km to Ch 91.4 km, - Yandilla—Ch 132.2 km to Ch 134.4 km, and - Broxburn—Ch 176.1 km to Ch 178.4 km. - Turnouts allow the train to be guided from one section of track to another. Turnouts that connect in to crossing loops and QR's existing South Western Line, Millmerran Branch Line and sidings have been incorporated into the revised reference design.
Earthworks	- Excavations in the existing ground profile will be made where the final design level is lower than the surrounding land, these are known as cuttings. There are 23 locations where the cuts are greater than 7 m in depth along the alignment to maintain the required track elevations. The total cut estimated for the Project is 11,368,000 m³. - Embankments and benching. - Structural fill and capping are required at the top of the formation to provide a solid foundation on which the railway ballast, sleepers and track can be placed.
Bridges	- Bridges to accommodate topographical variation, crossings of waterways or other infrastructure. - The Project involves the construction of 37 new bridge structures. These include: 14 rail-over-road bridges, 18 rail-over-watercourse bridges, and 5 road-over-rail bridges.
Drainage infrastructure	Cross-drainage will be provided by bridges, reinforced concrete pipe culverts and reinforced concrete box culverts. The Project includes 1,193 reinforced concrete box culverts, 2,134 reinforced concrete pipe culverts and a series of viaducts / bridge structures spanning approximately 11 km.

Aspect	Description
	- Scour protection measures will be installed around culvert entrances and exits, on disturbed stream banks and on land bound by a watercourse to prevent erosion and sedimentation. - Longitudinal or track drainage is proposed at specific locations along the Project alignment where the gradient is steep enough to divert surface runoff to the nearest bridge or culvert location. The following two types of track drainage are proposed: - Embankment drains – longitudinal drains that run parallel to the railway and are located within the permanent footprint, at the foot of the railway embankment. - Catch drains – longitudinal drains that run parallel to the railway and are located within the permanent footprint, on the up-slope side of cuttings. - The Yelarbon levee will be augmented to mitigate flood impacts associated with the Inland Rail project and, at a minimum, maintain the current flood immunity offered by the levee.
Road-rail interfaces	- Road-rail interfaces are points at which the rail alignment intersects a public road. Road manager interfaces treatments include: - Department of Transport and Main Roads (TMR) – 9 - Goondiwindi Regional Council (GRC) – 16 - Toowoomba Regional Council (TRC) – 25
Road network changes	To facilitate the Project, changes to the local road network are required to safely accommodate the railway and maintain local and regional connectivity. The road network changes have been developed in consultation with DTMR and local council road managers and will be undertaken in accordance with relevant DTMR and local council design standards. The road network changes consist of road realignments or diversions, consolidations, and upgrades
Rail maintenance access roads	Rail maintenance access roads are required to facilitate maintenance for critical infrastructure (e.g. turnouts), to enable construction in a safe manner and to provide access for emergency recovery during operation of the railway. Formation level access has been proposed for all turnout locations and, where reasonably practical, for the full extent of crossing loops.
Utilities and services	All utility owners have been consulted by ARTC during the revised reference design process to establish potential interface impacts and to identify initial design solutions. Permanent connections will be required during the operational stage.
Fencing	- To prevent public access to the Project's rail corridor, fencing will be provided for the majority of the rail corridor. Fencing will act to protect adjoining lands from trespass and to prevent livestock and wildlife from gaining access to the railway. Fencing is to extend between the corridor and private lots or property adjoining the railway. Specific fencing considerations will be discussed with relevant landowners as part of the detailed design process. - Fauna exclusion fencing will be installed to prevent wildlife access to the railway and guide wildlife towards fauna crossing structures. - The Project intersects the wild dog check fence at three locations, and will be realigned in two of these locations in consultation with GRC and Department of Agriculture and Fisheries (DAF): - From Springborg Road to Whetstone (Ch 37.7 km to Ch 43.5 km) the rail corridor runs parallel to the existing wild dog check fence and is impacted by the necessary corridor widening works of the existing QR South Western Line.

Aspect	Description
	○ Direct severance from McDougalls Road and Cremascos Road (Ch 50.2 km to Ch 51.2 km) requiring a realignment along the rail corridor boundary fence. ○ Direct severance from Cremascos Road heading north-east (Ch 54.6 km to Ch 56.0 km) requiring a realignment along the rail corridor boundary fence. • The Project intersects the DDMRB rabbit-proof fence when traversing through the locality of Clontarf, at approximately Ch 120.2 km. The rabbit proof fence will need to be reinstated and ARTC have undertaken consultation with the DDMRB to determine fencing requirements at this location.
Fish passage	• The Fisheries Act and the Planning Act require that works within waterways that are considered waterway barriers, must be conducted in a manner to provide for adequate fish passage.
Signalling and communications	• The Project will be operated initially using Centralised Train Control with the infrastructure installed upgradable to accommodate future deployment of the Advanced Train Management System (ATMS).
Construction features (temporary)	
Land	• Temporary access tracks will be used to access construction sites. Where possible, access tracks will be retained to serve as rail maintenance access roads during the operation of the Project. • Land requirements for construction will include temporary workspaces, site offices and laydown facilities. Five site offices will be co-located with laydown areas. These requirements are encompassed within the nominated Project footprint. • Seventy-eight laydown areas to support construction activities, including site offices, material and equipment storage, and to facilitate bridge construction, will be located within the temporary footprint (avoiding 1% annual exceedance probability (AEP) floodplains, where possible, and areas of native vegetation). • Two facilities are required during construction for the dual activities of precast concrete structure storage (laydown) and on-site concrete batching.
Quarries and borrow pits	• Seven quarries and seven borrow pits at six locations (dual pits on one location) have been identified as potentially suitable for use during construction activities. ○ Established quarries are expected to be the primary source for ballast and capping and other high-quality aggregates for the Project. ○ Borrow pits are to supply fill for the Project construction.
Non-resident accommodation facilities	• Construction, use and decommissioning of temporary non-resident workforce accommodation facilities to support the construction workforce associated with the Project. Two camp locations have been identified, at Yelarbon and Inglewood.
Utilities and services	• Temporary connections will be required during the construction stage. Utilities and services such as water, sewerage, electricity and telecommunications will need to be supplied to laydown areas, the non-resident workforce accommodation sites and compounds for use in site offices and amenities as required. • Where these utilities are already located close to construction sites, the Contractor will engage with utility providers, with the objective of connecting to mains power, water, communications and sewerage. • Where connection to existing infrastructure networks is not possible or practicable, temporary portable alternatives will be adopted.

Aspect	Description
Whetstone Material Distribution Centre	- A temporary material distribution centre will be located in Whetstone approximately 18 km south-west of Inglewood and 59 km east of Goondiwindi, with a total area of 69.3 ha. The facility is required to support construction of the Project. This will require a temporary change in land use from rural/agricultural to rail operations, work site, material storage and laydown areas. - The facility will include a narrow-gauge turnout to support construction activities as well as to accept and redistribute material via the QR South Western line.

1.3.4 PROJECT SCHEDULE

Table 1-2 shows the Project's anticipated timing of stages. The commencement of Year 0 is marked by the receipt of the Coordinator-General's evaluation report and EPBC Act controlled action determination, and Year 1 marks the commencement of physical works in the Pre-Construction Activities and Early Works stage.

Indicative construction dates have been adopted to enable the Project to demonstrate conservative assessment of potential impacts and mitigation measures.

TABLE 1-2 ANTICIPATED TIMING OF THE PROJECT STAGES AND ACTIVITIES

Duration (quarterly years)	Year 0				Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Detailed design																								
Project Approvals and Corridor Acquisition																								
Pre-construction Activities and Early Works																								
Construction works																								
Commissioning																								
Operations																								

2. REGULATORY ENVIRONMENT

This section provides the statutory context for which the ecological assessment has been undertaken (Table 2-1). The revised draft EIS Chapter 3: Legislation and Project Approvals Process identifies relevant legislation and the approvals required for the Project.

TABLE 2-1 ENVIRONMENTAL LEGISLATION, POLICIES, STANDARDS AND GUIDELINES RELEVANT TO THE PROJECT

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
Commonwealth			
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth)	Australia and its Territories. Specifically, projects that involve or have the potential to impact upon nationally and internationally important flora, fauna, ecological communities, and heritage places – defined under the Act as MNES.	The EPBC Act is the Australian Government's central piece of environmental legislation and provides the legal basis for the management and protection of nationally and internationally important flora, fauna, ecological communities, and heritage places. Under Section 45 of the EPBC Act, the Australian Government and Queensland Government have implemented a bilateral agreement relating to environmental assessment. This agreement allows the Australian Government Minister for the Environment and DCCEE to rely on specified environmental impact assessment processes of Queensland in assessing actions under the EPBC Act. The bilateral agreement specifically aims to achieve the following objectives: • Protect the environment in accordance with the requirements of the EPBC Act, • Promote the conservation and sustainable use of natural resources, and • Ensure an efficient, timely and effective process for environmental assessment and approval of actions.	ARTC submitted an EPBC Act referral to the DCCEE in February 2018 (EPBC 2018/8165). The Minister for the Environment determined the Project a 'controlled action' on 9 April 2018. The controlling provisions for the controlled action are: • Listed threatened species and communities. No Project works that are part of the referred action, will commence prior to the Minister's decision on the EPBC Act controlled action. The EPBC Act controlled action will be assessed under the bilateral agreement with the Queensland Government.
<i>EPBC Act Environmental Offsets Policy 2012</i> (Cth) (EPBC Act Offsets Policy)	Actions subject to the EPBC Act	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. The Australian Government defines offsets as measures that compensate for the significant	Of relevance to this report, the <i>Environmental Offset Policy</i> V1.15 (Qld 2023) states: <i>To avoid duplication of offset conditions between jurisdictions, state and local governments can only impose an offset condition in relation to a prescribed activity if the same or substantially the same impact and the same or substantially the same matter has not been subject to</i>

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		impacts of an action on the environment (Australian Government, 2012).	<i>assessment under". A Commonwealth Act. It also states; "This includes if the Commonwealth could have imposed an offset condition but did not do so". For matters that are dual listed, an assessment of whether the same or substantially the same matter has been considered has been conducted in Table 7-1.</i>
State			
Biodiversity Planning Assessments (BPAs)	-	BPAs for each of Queensland's bioregions have been prepared based on the methodology outlined in the Biodiversity Assessment and Mapping Methodology (DEHP 2014a). The BPAs draw upon the DEHP certified RE mapping, database information, and expert panel reports and incorporate information about threatened ecosystems and/or species, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, as well as buffers to wetlands or other types of important areas for ecological processes. The BPA assigns areas to one of three biodiversity significance levels, including: • State significance — areas assessed as being significant for biodiversity at the bioregional or State scales, • Regional significance — areas assessed as being significant for biodiversity at the sub-bioregional scale, and • 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.	The Project is located within the Brigalow Belt BPA area, (DES, 2018c). The following report outlines the BPAs conducted within the Study area: • Biodiversity Planning Assessment for the Brigalow Belt Bioregion: Expert Panel Report v2.1 (2018).

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		Although it is not legislated, the BPA provides a framework for biodiversity assessment when determining ecological values. In addition to terrestrial BPAs, aquatic BPAs utilises and assesses the conservation and ecological value of wetland systems based on a series of national and international criteria, including naturalness (aquatic and catchment), diversity and richness, threatened species/ecosystems, priority species/ecosystem, special features, connectivity, and representativeness to provide aquatic conservation assessments for SEQ (DEHP, 2015).	
<i>Biosecurity Act 2014</i> (Qld) (Biosecurity Act)	Queensland	The Biosecurity Act seeks to provide a framework for an effective biosecurity system for Queensland that helps to manage and minimise State biosecurity risks, as well as facilitate the response to biosecurity issues and events in a timely and effective way, to align with national and international obligations. The Act introduces the general biosecurity obligation upon all persons to take all reasonable and practical measures to prevent or minimise biosecurity risks. The Biosecurity Act defines Prohibited Matter and Restricted Matter in which specific actions are required to limit the spread and impact of this matter by reducing, controlling, or containing it, depending on the category. The Biosecurity Act identifies requirements for invasive animal barrier fencing including authority for building and maintaining the wild dog check fence, rabbit fence and agreements that are required in order to make an opening in the barrier fences.	The Project will involve interaction with restricted matters and prohibited matters (potentially including pests, diseases or contaminants) and will therefore require compliance with the Biosecurity Act. The Project interacts with the wild dog check fence for the purposes of construction, therefore approvals under the Biosecurity Act will be required.

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
<i>Environmental Offsets Act 2014 (Qld) (EO Act)</i>	Queensland	The EO Act and associated <i>Environmental Offsets Regulation 2014 (Qld) (EO reg)</i> seeks to 'counterbalance the significant residual impacts of particular activities on prescribed environmental matters through the use of environmental offsets'. Introduced on 1 July 2014, the Act is administered by DESI. Under the EO Act, an environmental offset is defined as 'an activity undertaken to counterbalance a significant residual impact of a prescribed activity on a prescribed environmental matter'. The Act defines the type of activities for which offsets may be imposed (i.e. 'prescribed activities') where these activities are determined to result in a 'Significant residual impact' (SRI). MSES are defined in Schedule 2 of the EO reg.	The Project will deliver environmental offsets consistent with the EO Act and associated Regulation. The MSES relevant to the Project are defined in Section 4.9, with the significant residual impact to these MSES requiring an offset provided in Section 7 and 8. ARTC has developed an Environmental Offset Delivery Strategy (revised draft EIS Appendix Q: Environmental Offset Delivery Strategy) addressing the MSES SRIs identified.
<i>Environmental Protection Act 1994 (Qld) (EP Act)</i>	Queensland	The objective of the EP Act is to protect Queensland's environment by promoting ecologically sustainable development. The EP Act has been designed to achieve its objective by setting out a program for the identification and protection of environmental values and through a range of regulatory tools. The EP Act outlines a 'general environmental duty', which specifies that persons must not carry out an activity that causes, or is likely to cause, environmental harm, unless the person takes all reasonable and practical measures to prevent or minimise the harm. The quality of Queensland waters is protected under the Environmental Protection (<i>Water and Wetland Biodiversity</i>) Policy 2019 (<i>EPP Water and Wetland Biodiversity</i>), which is a subordinate instrument to the EP Act.	The identification of any prescribed Environmentally relevant activity (ERA) that will require an environmental approval has been identified in revised draft EIS Chapter 3: Legislation and Project Approvals Process. Confirmation of these ERAs will be undertaken as part of the post-EIS approvals process. The EP Act also lists obligations and duties to prevent environmental harm, nuisances, and contamination. The two primary duties that apply to everyone in Queensland are: General environmental duty – which means a person must not carry out any activity that causes or is likely to cause environmental harm, unless all reasonable and practicable measures to prevent or minimise the harm have been taken by that person (Section 319(1) of the EP Act). Environmental harm is

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
			defined in Section 14 of the EP Act as "any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an ecological value and includes environmental nuisance"; and Duty to notify of environmental harm – to inform the administering authority and landowner or occupier when an incident has occurred that may have caused or threatens serious or material environmental harm that is not authorised. Mitigation strategies (Section 5.3.8) and an Environmental Offset Delivery Strategy (revised draft EIS Appendix Q: Environmental Offset Delivery Strategy) has been prepared to ensure compliance with relevant offsets policies and guidelines to mitigate potential environmental harm.
<i>Fisheries Act 1994</i> (Qld) (Fisheries Act)	Queensland	The Fisheries Act provides for the management, use, development and protection of fish habitats and resources, together with the management of aquaculture activities. The Act covers both marine and freshwater and natural and artificial waterbodies. Administered by the Department of Agriculture and Fisheries (DAF), the Fisheries Act applies to, but not limited to: - Works in a declared fish habitat area (FHA), and - Waterway barrier works resulting in the construction of instream structures inhibiting the free movement of fish along waterways.	The Project transverses mapped waterways for waterway barrier works and therefore will likely trigger the requirement to obtain a Development Permit for Operational Works that is constructing or raising waterway barrier works (State Development Assessment Provisions (SDAP) State Code 18 – Constructing or raising waterway barrier works in fish habitats), unless an exemption applies, or where works can be shown to comply with the accepted development requirements. The Project does not require: - The removal, destruction or damage of marine plants, - Works involving aquaculture, and

Waterway Barrier Works:

A waterway includes a river, creek, stream, watercourse, or inlet of the sea as defined in the Schedule under the Fisheries Act and mapped according to the spatial data layer, Queensland waterways for waterway barrier works.

Waterways providing for fish passage are MSES.

A waterway barrier is defined under the Fisheries Act as a dam, weir, or other barrier across a waterway if the barrier limits fish stock access and movement along a waterway.

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

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

Works that occur within these waterways will be defined as waterway barrier works, unless

- Work that is completely or partly within a declared FHA.

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

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		the works comply with the Accepted development requirements for operational work that is constructing or raising waterway barrier works (1 October 2018).	
<i>Nature Conservation Act 1992 (Qld) (NC Act)</i>	Queensland	The NC Act provides for the conservation of nature through protection of all native plants, birds, reptiles, mammals and amphibians in Queensland (along with a limited range of invertebrates and freshwater fish). The NC Act is based on principles aimed at conserving biological diversity, ecologically sustainable use of wildlife, ecologically sustainable development and international criteria developed by the International Union for the Conservation of Nature (IUCN) for establishing and managing protected areas. • Relevant regulations of the NC Act includes: Nature Conservation (Animals) Regulation 2020, which prohibits the taking or destruction, without authorisation, of protected animals and lists all fauna species that are considered to be extinct in the wild, endangered, vulnerable, near threatened, least concern and special least concern wildlife (Glossary and Abbreviations for definitions of these terms). Also listed is international wildlife and prohibited wildlife. • Nature Conservation (Plants) Regulation 2020, which prohibits the taking or destruction, without authorisation, of protected plants and lists all flora species that are considered to be extinct in the wild, endangered, vulnerable, near threatened, least concern and special least concern wildlife (Glossary and	The following permits and Species Management Program may be required for the Project: • Wildlife Movement Permits (Sections 88 and 97 of the NC Act) – for wildlife protected under the NC Act, and those found in certain areas covered by conservation plans created and implemented under the NC Act • Clearing Permit (Protected Plants) (Section 89 of the NC Act) – for the clearing of vegetation contained within high-risk areas identified on the DESI flora survey trigger map, or where protected plants have been identified in a Project survey within a proposed clearing area • Rehabilitation Permit (spotter catcher endorsement) (Part 14 of the <i>Nature Conservation (Animals) Regulation 2020</i>) • Damage Mitigation Permit (removal and relocation) ((Part 10 of the <i>Nature Conservation (Animals) Regulation 2020</i>) • Species Management Program must be submitted to the DESI for approval for tampering with protected animal breeding places (Section 335 of the <i>Nature Conservation (Animals) Regulation 2020</i>).

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		Abbreviations for definitions of these terms). Also listed is international wildlife and prohibited wildlife. The NC Act also includes provisions for protected areas such as national parks, nature refuges, and world heritage management areas.	
Nature Conservation (Koala) Conservation Plan 2017	Queensland	The Nature Conservation (Koala) Conservation Plan 2017 requires any clearing in certain areas to be undertaken sequentially, and in the presence of a suitably qualified Koala spotter. The Nature Conservation (Koala) Conservation Plan 2017 also prescribes three mapped Koala districts (A, B and C) and includes requirements relating to the release of rehabilitation, sick or injured Koalas.	The Project will require clearing mostly within Koala district C, with a small portion within Koala district A which is defined as SEQ under the Planning Regulation 2020. Clearing works in Koala habitat within district A require 'sequential clearing' and the presence of Koala spotters. A Draft Koala Management Plan has been prepared for the Project which provides management strategies to reduce impact to the Koala (revised draft EIS Appendix M: Draft Koala Management Plan).
<i>Planning Act 2016</i> (Qld) (Planning Act)	Queensland	The purpose of the Planning Act is to provide an efficient, effective, transparent, integrated, coordinated and accountable system of land use planning, development assessment and dispute resolution to facilitate the achievement of ecological sustainability. Together with a development assessment system, Chapter 1 of the Planning Act establishes a hierarchy of planning instruments which comprises: • State planning policies (including temporary policies), • Regional plans, • Planning schemes, • Temporary local planning instruments, and	The Project may trigger the requirement to obtain approval for aspects of development that are assessable under Schedule 10 of the <i>Planning Regulation 2017</i>, such as for the modification of the Yelarbon levee which may have potential impacts on aquatic ecological values (Schedule 10 of the <i>Water Regulation 2016</i>) and integrated through other legislation as part of the Development Assessment Rules process following completion of the EIS process.

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		- Planning scheme policies. Schedule 6 of the Planning Regulation identifies developments that cannot be made assessable under a local government planning scheme, including government supported infrastructure. Government supported transport infrastructure (GSTI) means infrastructure for transport that is— - funded, wholly or partly, by the State or Commonwealth; or - provided by a person, other than under a development approval or infrastructure agreement, on terms that— (a) are agreed to by the State or Commonwealth; and (b) are intended to support the commercial viability of the infrastructure.	
Queensland Environmental Offsets Policy (Qld) (QEOP)	Queensland	The QEOP (DES, 2024d) 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 Act covers both marine and freshwater and natural and artificial waterbodies. 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,	The Project will implement avoidance and mitigation measures to minimise the significant impacts on MSES. Implementing mitigation measures including offsets will be consistent across the Inland Rail Program. Offsets provided for under the policy include direct offsets, and other compensatory methods (or indirect offsets). Where a significant residual impact to MSES has been identified, the Project will compensate for it in accordance with the QEOP. ARTC's Environmental Offset Delivery Strategy – B2G is contained in revised draft EIS Appendix Q: Environmental Offset Delivery Strategy of the revised draft EIS. This Strategy informs the development of offset delivery components for B2G including specific management intent to drive matter

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		- Offsets must achieve a conservation outcome that achieves an equivalent environmental outcome, - Offsets must provide ecological values as similar as possible to those being lost, - Offset provision must minimise the time-lag between the impact and delivery of the offset, and - Offsets must provide additional protection to ecological values at risk, or additional management actions to improve ecological values. To avoid duplication of offset conditions between jurisdictions, state and local governments can only impose an offset condition in relation to a prescribed activity if the same or substantially the same impact and the same or substantially the same matter has not been subject to assessment under one of the following Commonwealth Acts: - the EPBC Act, to the extent the assessment relates to an activity that has been declared a 'controlled action' by the Commonwealth Minister; - the Great Barrier Reef Marine Park 1975; or - another Commonwealth Act prescribed by regulation – there are currently no listings. This includes if the Commonwealth could have imposed an offset condition but did not do so. - Where legal security is required, offsets must be legally secured for the duration of the	specific conservation outcomes across each relevant offset property presented in the Strategy. It is proposed that property specific Offset Area Management Plans (OAMPs) will be developed and submitted for approval. Property specific Offset Area Management Plans will be developed and finalised in consultation with relevant Australian Government and State regulatory agencies prior to construction.

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		impact on the prescribed environmental matter.	
Significant Residual Impact Guideline for matters of state environmental significance and prescribed activities assessable under the <i>Nature Conservation Act 1992</i> (DEHP, 2014b) (SRI Guidelines)	Queensland	The purpose of this guideline is to assist in deciding whether or not a prescribed activity will or is likely to have a significant residual impact on a MSES. This guideline applies to any activity prescribed in the Environmental Offsets Regulation 2014 that requires an approval in relation to MSES, under any of the following: • <i>Nature Conservation Act 1992</i> • <i>Marine Parks Act 2004</i>, or • <i>Environment Protection Act 1994</i>.	
<i>Vegetation Management Act 1999</i> (Qld) (VM Act)	Queensland. Specifically, activities that are regulated through the Planning Act	The VM Act regulates the conservation and management of vegetation communities and clearing of vegetation identified as "Regulated vegetation" identified as Category A, B, C and R. The VM Act provides a framework for identification, description, and mapping of remnant Regional Ecosystems (RE) certified by DESI as 'Endangered', 'Of Concern' or 'Least Concern' (Glossary for definitions of these terms). It also provides a framework for the identification, description, and mapping of High Value Regrowth (HVR) vegetation as 'Endangered', 'Of Concern' or 'Least Concern'.	The clearing of vegetation regulated under the VM Act (e.g. Category B and C regulated vegetation) is considered to be eligible for exemption under Schedule 21 of the Planning Regulation (i.e. GSTI) and does not require a development approval. This includes clearing for early works and pre-construction activities, including the establishment of laydown areas and access roads as described in revised draft EIS Chapter 5: Project Description and revised draft EIS Chapter 3: Legislation and Project Approvals Process.
<i>Water Act 2000</i> (Qld) (Water Act)	Queensland	The Water Act provides for the sustainable management of non-tidal waters and other resources, together with the establishment and operation of water authorities, and for other purposes. The Queensland Government maintains Watercourse Identification Mapping, which identifies defined watercourses under the	The Project involves works within defined mapped watercourses and as such the provisions of the Water Act may apply. Other unmapped drainage features or watercourses will be required to be verified during the detailed design phase to determine their status under the Water Act. Further the Project involves the removal of

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		Water Act, as well as drainage features (not regulated under the Water Act). Through the Planning Act, certain water related development under the Water Act is assessable. In addition to the approvals triggered under Planning Act, the Water Act regulates the undertaking of works that involve the excavating or placing fill in a watercourse, lake or spring. Under the Water Act, a proponent must obtain a Riverine Protection Permit in order to lawfully undertake these works unless the works can be undertaken in accordance with Riverine Protection Permit Exemption Requirements (DNRME, 2018). The Water Plan (Condamine and Balonne) 2019 made under the Water Act documents the plan for the water within the Project. The purpose of this plan is to: a) Define the availability of water to which the plan applies; and b) Provide a framework for sustainably managing water to which the plan applies; and c) Identify priorities and mechanisms for dealing with the future water requirements in the plan area; and d) Provide framework for managing water allocations; and e) Provide a framework for reversing, where practicable, the degradation of natural ecosystems caused by the taking of, or interference with, water to which this plan applies.	vegetation, excavation or placing fill in a watercourse, lake or spring. ARTC is an approved entity for the purpose of the Department of Resources Riverine Protection Permit exemption requirements, and works can be undertaken providing that they meet the guidelines of the exemption. However, activities falling outside this exemption may trigger requirements for approval. Watercourse diversions required by Project activities will require approval under a diversion for resource activities under works that take or interfere with watercourse, lake or spring (for interference with overland flow). The applicability of the Water Plan will be to minimise adverse environmental impacts relating to water to which the plan applies, caused by the Project in the plan area.
Terrestrial ecology – EIS information guideline	Queensland	This guideline advises proponents about the information requirements in relation to	Used as a guide to prepare the revised draft EIS Appendix L Terrestrial and Aquatic Ecology Report, revised draft EIS Appendix

Legislation/policy/plan	Legislative jurisdiction	Intent	Applicability
		terrestrial ecology when preparing an environmental impact statement (EIS).	O Matters of National Environmental Significance Report and Chapter 11 Flora and Fauna.
Aquatic ecology – EIS information guideline	Queensland	This guideline advises proponents about the information requirements in relation to aquatic ecology when preparing an EIS.	Used as a guide to prepare the revised draft EIS Appendix L Terrestrial and Aquatic Ecology Report, revised draft EIS Appendix O Matters of National Environmental Significance Report and Chapter 11 Flora and Fauna.
Various field survey guidelines	Queensland	Flora and fauna guidelines utilised during field surveys conducted for the Project to ensure suitable methods and survey effort were conducted. These various guidelines are prepared by the Department of Environment, Science and Innovation (DESI) or associated authors and are consistent with those referenced in the Projects ToR.	Utilised during field surveys, where applicable (Section 3.3).
Local			
Goondiwindi Regional Planning Scheme 2018.	Local	The Goondiwindi Region Planning Scheme was adopted by Goondiwindi Regional Council (GRC) in March 2018 and is the primary planning document for land located within the Goondiwindi LGA. The Goondiwindi Region Planning Scheme was prepared in accordance with the repealed <i>Sustainable Planning Act 2009</i> (Qld) and was amended for alignment with the Planning Act. The Goondiwindi Region Planning Scheme sets the intention for future development in the planning scheme area over a 20-year period. The Goondiwindi Regional Planning Scheme includes codes relating to environmental and ecological significance and biodiversity overlays.	Whilst the Project footprint intersects areas mapped as Matters of Local Environmental Significance (MLES) under the GRC Planning Scheme, the Project is exempt from assessment against the Environmental Significance Code and MLES of the Planning Schemes as it is GSTI.

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

3. METHODS

3.1 OVERVIEW

The methodology for this ecological assessment includes a compilation of data from the numerous investigations that have been undertaken for the Project between 2016 to 2023.

This assessment has been prepared in accordance with the *Terrestrial ecology – EIS information guideline* (DES, 2022a, Version 1.02) and *Aquatic ecology – EIS information guideline* (DES, 2022b, Version 1.02).

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

The updated desktop assessment (Section 3.2) in this report includes the following information available from the draft EIS (released in 2021):

- Field surveys conducted and discussed in the draft EIS and appendices, treated as preliminary field studies (Section 3.2.2); and
- Knowledge gaps (Section 3.3).

The results of the updated desktop assessment and gap assessment were then used to design a comprehensive field program for within the Project footprint which informed the field surveys.

Whilst field-based assessments assessed species listing and status at the time of survey, this assessment report uses the most up to date species listing and status.

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

- Desktop assessment (Section 3.2);
- Field surveys (Section 3.3);
- Habitat mapping (Section 3.4);
- Impact assessment (Section 3.5); and
- Cumulative impacts assessment (Section 0).

3.1.1 FAUNA AND FLORA NOMENCLATURE

The sources of nomenclature for fauna are:

- Ingram, McDonald, and Nattrass (2002) for frogs;
- Wilson and Swan (2010) for reptiles;
- Pizzey and Knight (2012) for birds;
- Menkhorst and Knight (2011) for mammals;

- Duncan et al. Action Plan for Australian Bats (1999) for microbats; and
- Pusey, Kennard, and Arthington (2004) for freshwater fish.

The source of nomenclature for flora is the Census of the Queensland Flora (Queensland Government, 2023a). The botanical names comply with the rules of the current International Code of Botanical Nomenclature (McNeill *et al.*, 2006) and the International Code of Nomenclature for Cultivated Plants (Bricknell *et al.*, 2004). Author abbreviations follow Brummitt and Powell (1992).

3.2 DESKTOP ASSESSMENT

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

Survey methods were based on this information and prepared in accordance with relevant Commonwealth and State survey guidelines, including the *Terrestrial ecology—EIS information guideline* (DES, 2022a).

The objectives of the desktop assessment were to:

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

3.2.1 DATABASE REVIEW

A database review was initially undertaken in 2017 prior to preliminary field investigations. Searches were re-run in 2019, 2022 and 2024 to enable any relevant updates, or additional species observations to be incorporated into the assessment. Details of the relevant database sources, the most recent search dates and purpose of the data are summarised in Table 3-1.

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

TABLE 3-1 SUMMARY OF DATABASE SEARCHES

Database/data source name	Database search date	Database search areas	Data type
Atlas of Living Australia (ALA)	12/2023 and 01/2024	Study area	Records of flora and fauna, including threatened and Special Least Concern (SLC) species listed under the NC Act (i.e. MSES).
Birds Australia	29/03/2019	Study area	Records of avian fauna, including threatened species listed under the NC Act.
BPA's and Aquatic Conservation Assessments mapping (Queensland Government)	11/04/2022 and 05/06/2024	Study area	State, regional and locally significant biodiversity matters mapping. This mapping has been used to indicate the location of bioregional corridors (i.e. in the State, regional and local context).
EPBC Act Protected Matters Search Tool (Australian Government)	24/03/2022 and 08/11/2024	Study area	Provides a "predictive" account of threatened species that are listed under the NC Act that potentially occur within a specific area.
Protected Plants Flora Survey Trigger Map (Queensland)	30/06/2022 and 05/06/2024	Study area	Records and habitat for NC Act threatened flora and areas where provisions of the NC Act apply to the clearing of protected plants. Determined the extent of the survey area occurring within a high-risk area for protected plants.
National Flying-fox monitoring viewer and DESI Flying Fox Monitoring Program	06/11/2024	Study area	Show the location of flying-fox roosts in Australia (recorded by DESI in Queensland) and includes monitoring data of continuously and periodically (seasonally or irregularly) used roosts. The exact location of roosts may vary within a small, localised area.
Wildlife Online modelled potential habitat (Queensland government)	07/04/2022 and 05/06/2024	Study area	Modelled potential habitat of state listed conservation significant flora and vertebrate fauna. Models taken from records of fauna species occurrence compiled for the purpose of Biodiversity Assessment by DESI (EPA, 2002) and specimen backed flora records compiled from the Queensland Herbarium's Herbers database.
Wetland Maps report	07/04/2022 and 05/06/2024	Study area	Report based on mapping of water bodies and wetland REs across Queensland.
Pre-clearing RE Mapping	11/04/2022	Study area	Pre-clearing REs by Broad Vegetation Group, and wetland and riparian associated vegetation communities.
WildNet Records	07/04/2022 and 01/2024	Study area	Records of species listed as threatened or Special Least Concern species under the NC Acts.
Regulated Vegetation Management Map and Vegetation	22/11/2023	Study area	Mapping of Remnant and HVR REs including categories of mapped vegetation (e.g., Category B, C, R, and REs intersecting with

Database/data source name	Database search date	Database search areas	Data type
Management Supporting Map			watercourses and wetlands) to determine clearing requirements. Determined the likely type and extent of vegetation communities within the Study area.
Register of critical habitat (Australian Government)	30/06/2022	Australian extent	Critical habitat listed under the EPBC Act, for those species dually listed under the NC Act.
Wetland Info database	30/06/2022	Study area	Interactive maps, species records, case studies and legislation associated with Queensland wetlands.
Queensland waterways for waterway barrier works	05/06/2024	Study area	Identify waterways defined by the Fisheries Act and determine whether the site of proposed waterway barrier works requires approval under the Planning Act.
Watercourse Identification Mapping	05/06/2024	Study area	Mapped extent of watercourses and drainage features that are managed under the Water Act.
FHA (Fish habitat area)	30/06/2022	Study area	Boundaries of gazetted, declared FHA.
Queensland Springs Database	30/06/2022	Regional extent	The dataset provides a comprehensive catalogue of permanently saturated springs that have fixed locations and any associated surface expression groundwater dependent ecosystems (GDEs).
Matters of State Environmental Significance (Queensland Government)	7/04/2022 and 05/06/2024	Study area	Location of MSES, including: • Protected areas, • Special wildlife reserves, • Estates, • Nature refuges, • Marine parks, • Management A and Management B declared FHA, • Habitat for threatened and Special Least Concern wildlife listed under the NC Act, • Regulated vegetation under the VM Act, • 100 m from wetland, • Category R Great Barrier Reef (GBR) riverine, • Category B endangered or of concern, • Essential habitat (EH), • Intersecting a watercourse, • Wetlands in a wetland protection area or wetlands of high ecological significance (HES), • Wetlands and watercourses in high ecological value (HEV) waters as defined in the Environmental Protection (Water) Policy 2009, Schedule 2, • Strategic environmental areas, and • Legally secured offset areas.

Database/data source name	Database search date	Database search areas	Data type
Aquatic Biodiversity Assessment Mapping Method/Aquatic Conservation Assessments (ACA)	26/02/2020 and 05/06/2024	Study area	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), and • Landscape connectivity. A summary score (Aquascore) is produced and classified into one of five rankings: • Very High, • High, • Medium, • Low, and • Very Low.
Goondiwindi Regional Planning Scheme – environmental overlays and codes relating to biodiversity and ecological significance	2024	Study area	The Goondiwindi Regional Planning Scheme has been checked for environmental and ecological significance and biodiversity overlays. No MLES matters within or near the Project footprint were identified. The planning scheme is not applicable as the Project is GSTI.
Toowoomba Regional Planning Scheme – environmental overlays and codes relating to biodiversity and ecological significance	2024	Study area	The Toowoomba Regional Planning Scheme has been checked for environmental and ecological significance and biodiversity overlays. The Project footprint intersects MLES, that are also mapped as MSES. However, the planning scheme is not applicable as the Project is GSTI.

Table note:

ALA and WildNet Records database searches in 01/2024 were used to inform updates to the Threatened species profiles in Appendix G Species Profiles.

3.2.2 PRE-SURVEY PREDICTIVE HABITAT MAPPING

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

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

After development of predictive habitat mapping, detailed field surveys were undertaken (Section 3.3.2). This ground-truthed habitat mapping now supersedes the predictive habitat mapping within the Project footprint.

Predictive habitat mapping within the Study area and a larger buffer of 50 km (excluding the Project footprint) was used to inform the assessment of cumulative impacts. A distance of 50 km from the Project was selected as many of the ecological values of relevance to the

Project do not extend beyond this area, and if they do occur, any cumulative impacts associated with the Project are not considered to be relevant beyond this extent.

3.2.3 LIKELIHOOD OF OCCURRENCE ASSESSMENT

An initial likelihood of occurrence of MNES and MSES listed species within the Project footprint was undertaken using the results of the desktop assessment and preliminary field surveys as described in Section 3.3.1 and Table 3-4

During the desktop assessment, the likelihood of occurrence was based on historic datasets, consideration of a species distribution range, the presence, condition and function of habitat in the Project footprint and preliminary field surveys. Each species in the likelihood of occurrence was assigned to one of the categories in Table 3-2, being known, likely, potential or unlikely to occur.

TABLE 3-2 LIKELIHOOD OF OCCURRENCE CRITERIA

	Preferred habitat exists⁴	General habitat exists⁵	Habitat does not exist⁶
Recent ¹ records within the Project footprint ²	Known	Known	Known
Recent records in the Locality ³	Likely	Potential	Unlikely
No records within the Locality, but the Project footprint is within the distribution ⁷	Potential	Unlikely	Unlikely
No records in the Locality, and the Project footprint is outside of the distribution	Unlikely	Unlikely	Unlikely

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

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

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

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

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

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

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

If the likelihood of occurrence was uncertain, for example where the habitat preferences of the species are not well known or because the species is highly cryptic, a precautionary approach was taken, and the species was considered to have potential to occur within the Project footprint. The results of the desktop and likelihood of occurrence assessments were used to identify gaps in the knowledge of the identified ecological values, especially in areas where reliable field data was not available. Field surveys were designed to address these gaps.

Following the field surveys (detailed in Section 3.3), the likelihood of occurrence assessment was re-visited to incorporate field verified habitat assessments and flora and fauna records using the same criteria utilised above.

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

The results of the most recent likelihood of occurrence assessment for threatened flora and fauna species is presented in Appendix B Likelihood of Occurrence.

3.3 FIELD SURVEYS

3.3.1 PRELIMINARY FIELD SURVEY METHODS

The preliminary field surveys undertaken for the Project are summarised in Table 3-3 and their methods are discussed in the following sections. The findings of each of the surveys were used to supplement knowledge gaps identified from database searches.

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

TABLE 3-3 PRELIMINARY FIELD SURVEYS FOR THE PROJECT

Document/investigation title	Consultant/year	Timing of investigations	Summary of methods, significant findings and notes
Border to Gowrie summary of ecological constraints to inform the initial advice statement	Eco Logical Australia (2016)	26 to 29 April 2016	Survey of alignment and corridor options. Included identification of REs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment at three sites.
		12 to 15 September 2016	Survey of further corridor options. Included identification of REs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment at two sites.
		25 to 28 October 2016	Survey of further corridor options. Included identification of REs, TECs, opportunistic searches for flora species and fauna habitat assessments.
Terrestrial ecology report for the EIS	Future Freight Joint Venture (FFJV) (2018a)	16 to 23 April 2018 1 and 4 to 10 September 2018 17 to 19 April 2018	• Active searches for cryptic species • Opportunistic fauna observations • Census of flora species • Habitat assessment
Pre-clearance and Protected Plant surveys associated with geotechnical investigations	FFJV (2018b)	April 2018 November 2018	• Protected plant surveys (meander surveys – minimum 30 minutes) throughout alignment • Habitat surveys • Confirmation of vegetation communities
	FFJV (2019)	April 2019	• Protected plant surveys (meander surveys – minimum 30 minutes) throughout alignment • Habitat surveys • Confirmation of vegetation communities
Inland Rail (Border to Gowrie) Aquatic Ecology Report	Eco Logical Australia (2020)	June and November 2018 May 2019	Aquatic ecology surveys (34 sites) including targeted fish surveys (12 sites)

3.3.1.1 INITIAL ADVICE STATEMENT ECOLOGY SURVEYS – 2016

Terrestrial ecological field surveys were undertaken by Eco Logical Australia in 2016 to inform the initial advice statement for the Project. These surveys included a total of 134 sites across the preliminary alignment over three surveys (totalling 12 days). It is noted that the Project footprint has changed since that time; however, survey findings are still relevant to inform the presence of MSES and MNES within the region.

The methodologies included identification of REs, TECs, opportunistic searches for flora species, fauna habitat assessments and Anabat deployment to identify ecological constraints and inform revisions to the Project footprint.

3.3.1.2 TERRESTRIAL ECOLOGY SURVEYS – 2018

Following initial surveys undertaken in 2016, the Project footprint was revised and further terrestrial ecological surveys were undertaken (FFJV, 2018). Following desktop assessment, sites were selected for targeted ecological surveys which were specifically identified as containing features of interest. The 44 survey locations included:

- 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;
- Waterways which will be potentially impacted by the Project; and
- Areas that have not been subject to previous ecological investigations.

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. In instances where wetland indicators were present (e.g. macrophytes, topography consistent with wetlands or areas mapped as a wetland), an assessment of the potential of the area to be a wetland was undertaken, recording site-based attributes as required. Detailed methodologies are provided below.

Flora survey methods

At each targeted terrestrial survey site, a list of all flora species encountered was recorded and documented. In addition, opportunistic observations across the Study area were used to supplement site specific datasets. Significant flora species that were not previously encountered, or species that were unidentifiable in the field (when sampling occurred), were collected and lodged at the Queensland Herbarium for formal identification (Appendix C Herbarium Verification).

The following approach to Regional Ecosystem verification was applied:

- Within a representative of each different vegetation community, as determined from aerial imagery, an intensive survey occurred, which included an assessment of the relative

species density and diversity within the emergent I, canopy (T1, T2, T3), shrub (S1, S2, S3) and ground (G) strata layers when they were present. Methodologies used were consistent with the tertiary level as described by Neldner et al. (2017) (Version 4) (now Neldner et al., 2022). Survey transects approximated 100 m in length and 20 m in width; and

- Verification of the remaining map units of the same type was undertaken at the quaternary level as described by Neldner et al. (2017) – version 4; (now Neldner *et al.*, 2022).

All species of flora incidentally observed were identified to the species level where possible (Appendix D Completed Vegetation Assessment Proformas).

Fauna habitat assessments

Terrestrial fauna surveys and habitat assessments by FFJV were conducted using the following methods as described in relevant survey guidelines:

- A general habitat assessment and record of all fauna encountered (i.e. observed/heard) was undertaken at every vegetation assessment survey site during different seasons (Eyre et al 2018);
- Localised validation of the likelihood of occurrence was undertaken, where possible; and
- Use of specific techniques to identify possible presence of conservation significant species (e.g. identification of scats, specific scratch marks and diggings).

At each vegetation assessment location an assessment of fauna habitat features, and a record of all fauna species encountered was undertaken (a total of 41 sites). Fauna habitat features recorded included, but was not limited to:

- Level of disturbance relating to fire, grazing, clearing and erosion;
- List of conservation significant fauna species that are likely to utilise the area based on available habitat types (based on database search results);
- Presence and abundance of tree hollows, fallen logs (>10 cm diameter), coarse woody debris (<10 cm diameter) and trees with decorticated bark;
- Percentage of groundcover containing leaf litter, bare ground, grasses, soil cracks, surface rocks, non-native flora species (e.g. weeds);
- Presence of soil banks (e.g. river beds/road cuttings), Wetlands/drainage features; and
- Abundance of flowers and fruit.

All species of fauna incidentally observed were identified to the species level where possible (Appendix E Completed Fauna Assessment Proformas for site fauna habitat assessment datasheets).

Targeted fauna survey methods

Where areas were identified as containing habitat considered likely to support threatened species (i.e. both within vegetation assessment areas and at opportunistic locations), specific techniques recommended in DCCEE and DESI guidelines were employed to increase the likelihood of detecting these species. Location selection was optimised to maximise fauna detection by selecting sites along drainage lines and fauna pathways within bushland. Remote sensing techniques were used to ensure maximum chances of detecting threatened species. Sampling methods included:

- Anabat devices (targeting Microchiropteran bats) were deployed at 5 sites (overnight) for a total survey effort of seven detector nights.
- Standardised surveys for birds at all assessment sites comprising recording birds by observation or calls for 20 minutes over a 2-hectare (ha) survey area. These used the Birds Australia census technique described by Loyn (1986).
- Active searches for koala (*Phascolarctos cinereus*), their pellets and tree scratches were undertaken at all assessment sites where food trees were present.
- Active searches for reptiles at all assessment sites. This involved 20 minutes of searching by two people over 1 ha within suitable microhabitats (beneath rocks and fallen logs and amongst leaf litter and woody debris).
- Spotlighting and night driving for amphibians, reptiles, birds, and mammals – outside of formalised survey locations.
- Infra-red remote motion-sensing cameras (overnight) at watering points and/or at baited feeding stations (mammals and birds) – 9 sites.

Other species encountered during these works were recorded, along with opportunistic observations (all fauna species).

3.3.1.3 PRE-CLEARANCE AND PROTECTED PLANT SURVEYS – 2018 AND 2019

Protected Plant and pre-clearance surveys were undertaken by FFJV at sites within and adjacent to the Project footprint associated with vegetation clearing for geotechnical works (largely boreholes and access tracks) in 2018 and 2019. Surveys were carried out at 91 locations.

Protected Plants

Protected plant surveys were undertaken in accordance with the Queensland Protected Plants survey guidelines (DES, 2020) regardless of whether the location was mapped as a high-risk area on the Queensland Government Protected Plants flora survey trigger map. At each site, the random meander survey method was implemented for a minimum of 30 minutes, or until no new flora species were identified. As per the guidelines, surveys were carried out within the targeted clearing area as well as an additional 100 m buffer area.

Pre-clearance habitat surveys

The pre-clearance surveys were carried out to further inform the ecological assessment and to identify approvals requirements under Queensland legislation for vegetation clearing for the geotechnical works in 2018 and 2019.

The surveys included the following methods:

- Searches for potential breeding habitat for threatened species such as:
 - Recording of all burrows/dens, logs, rocks, caves, and suitable leaf litter that may contain breeding habitat for threatened species;
 - Recording of hollow bearing trees noting hollow attributes such as size, angle, height in the tree and orientation it was facing; and
 - Recording of bird nests and potential for active nesting.
- Habitat suitability assessments for threatened species with key habitat types recorded.

- Incidental fauna observations.

3.3.1.4 AQUATIC FIELD SURVEYS – 2018, 2019 AND 2021

Aquatic ecology surveys were carried out on three discrete survey events in June 2018, November 2018 and May 2019 across 13 sites, varying from major rivers to intermittent streams (Eco Logical Australia, 2020). Surface water sampling was conducted at these 13 sites and an additional 21 sites (34 sites in total). Field survey methods were conducted in accordance with the Australian River Assessment System (AUSRIVAS) protocols and included aquatic habitat assessment, surface water quality assessment (physico-chemical, nutrients, chlorophyll, and dissolved metals), macroinvertebrate sampling, macro-crustacean surveys, and freshwater turtle surveys and targeted fish surveys. Not all components were sampled at each site on each occasion. Each of these methods is described in detail in the following sections.

Another rapid visual aquatic field survey was undertaken on 4 November to 5 November 2021, to address potential impacts related to proposed non-resident workforce accommodation areas for the Project.

Additionally, waterway barrier works were assessed by collecting on ground physical and hydrological attributes aimed at determining if a particular feature is a defined waterway that provides for fish passage.

Macro-crustaceans were collected as by-catch during fish and macroinvertebrate surveys. All captured macro-crustaceans were identified to species level and returned to the water following identification. Information on habitat suitability for freshwater turtles and incidental observations during field surveys were collected to inform the likelihood of occurrence of various turtle species.

Aquatic habitat assessments

AUSRIVAS habitat assessment was completed at each site (Eco Logical Australia, 2020). A detailed list of the habitat variables recorded is provided in Appendix A Additional Ecological Investigations. The habitat value was assessed to predict the nature of faunal assemblages utilising the watercourse including threatened aquatic species. General site observations and photographs were also recorded.

Surface water quality

Surface water quality sampling was conducted at aquatic habitat assessment sites (where water was present at the time of survey) in accordance with the DES Monitoring and Sampling Manual (DES, 2018b). Four discrete water sampling events were carried out: winter (June 2018), spring/summer (November 2018 and February 2019), and an autumn assessment (April 2019). Watercourse flow, and at times the presence of water, was limited. Noting the highly seasonal flow regimes of the watercourses, timing of the assessments was chosen to capture dry or wet season samples.

In-situ water quality field data was collected during each survey event in addition to samples collected for laboratory analysis. Land access at the times also restricted sampling. The results of the water quality sampling assessments are provided in detail in revised draft EIS Appendix S: Surface Water Quality Technical Report.

Macroinvertebrate sampling

Macroinvertebrate sampling was undertaken in November 2018 and May 2019, with samples collected in accordance with the AUSRIVAS method (Parsons *et al.*, 2002). Due to dry conditions, sampling was limited to two sites in November 2018, and five sites in May 2019. Samples were later identified to AusRivAS taxonomic level in the laboratory under stereomicroscope.

Targeted fish surveys

In June 2018, a targeted fish survey was undertaken, in accordance with the *Survey Guidelines for Australia's Threatened Fish* (DSEWPC, 2011c), involving the deployment of baited box traps and dip-netting, targeting small fish at sites containing water (Eco Logical Australia, 2020). At the 34 sites sampled, 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®.

In December 2018 and May 2019, a range of additional survey techniques were applied to assess fish assemblages at aquatic ecology sites that were suitable. Methods were selected from the *Survey Guidelines for Australia's Threatened Fish* (DSEWPAC, 2011c) and included backpack electrofishing (where water depth was <0.5 m), seine netting (2 to 5 mm mesh) and use of fyke nets. Where fyke nets were used, two nets were deployed overnight (one 3 mm stretched mesh and one 4 mm stretched mesh). Nets were dual wing in design, with each wing 4 m in length with a 0.6 m drop. 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 which may foul nets.

3.3.2 REVISED DRAFT EIS FIELD SURVEYS

Following the preliminary field surveys, a field survey program was designed within the Project footprint to assess and validate the ecological values. Survey methods were based on the results of database assessments and preliminary surveys. Detailed methodologies for these investigations are provided in the respective reports in Appendix A Additional Ecological Investigations and summarised in the following sections. The timing of these surveys is presented in Table 3-4.

Field surveys were generally undertaken in accordance with the following survey guidelines and procedures where applicable:

- Commonwealth published guidelines for threatened species where applicable (environment.gov.au/epbc/policy-statements);
- *Methodology for survey and mapping of REs and vegetation communities in Queensland* (Neldner *et al.*, 2019; Neldner *et al.*, 2020);
- *Terrestrial vertebrate fauna survey guidelines for Queensland* (Eyre *et al.*, 2018; Eyre *et al.*, 2022a);
- Queensland species-specific targeted species survey guidelines (i.e., for common death adder, grey snake, yakka skink, glossy black-cockatoo, and painted honeyeater; Queensland Herbarium, 2012-2014);

- *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (DSEWPC, 2011a; surveys were conducted prior to the update to this document in 2024 (DCCEEW, 2023e));
- *Guide to greater glider habitat in Queensland* (Eyre *et al.*, 2022b);
- *Flora Survey Guidelines - Protected Plants*, NC Act (DES, 2020);
- *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland – version 2.2* (Eyre *et al.*, 2015); and
- *Guide to Determining Terrestrial Habitat Quality – version 1.2* (DEHP, 2017).

Aquatic surveys conducted by Hydrobiology were undertaken using modern eDNA methods that are more efficient and effective than current aquatic fauna survey guidelines. An assessment of the adequacy of surveys undertaken against relevant survey guidelines is provided in Appendix F Survey Adequacy.

3.3.2.1 LOCATIONS AND TIMING

Terrestrial seasonal sampling (i.e., spring (mid-September to mid-December) and autumn or post-wet (late February to April)) is recommended for the Brigalow Belt South bioregion (Eyre *et al.*, 2018). Field surveys were undertaken within both periods (Table 3-4).

The field surveys undertaken were primarily concentrated within the Project footprint however targeted field surveys were also undertaken in areas adjoining the Project footprint to determine the extent of potential indirect impacts. Field survey locations (Figure 3-1) considered the revised reference design, and locations of previous survey sites, aiming to undertake comprehensive field surveys within the Project footprint. Field survey sites were positioned in areas within the Project footprint which had not been previously subject to adequate surveys as part of the preliminary field surveys, ensuring inclusion of:

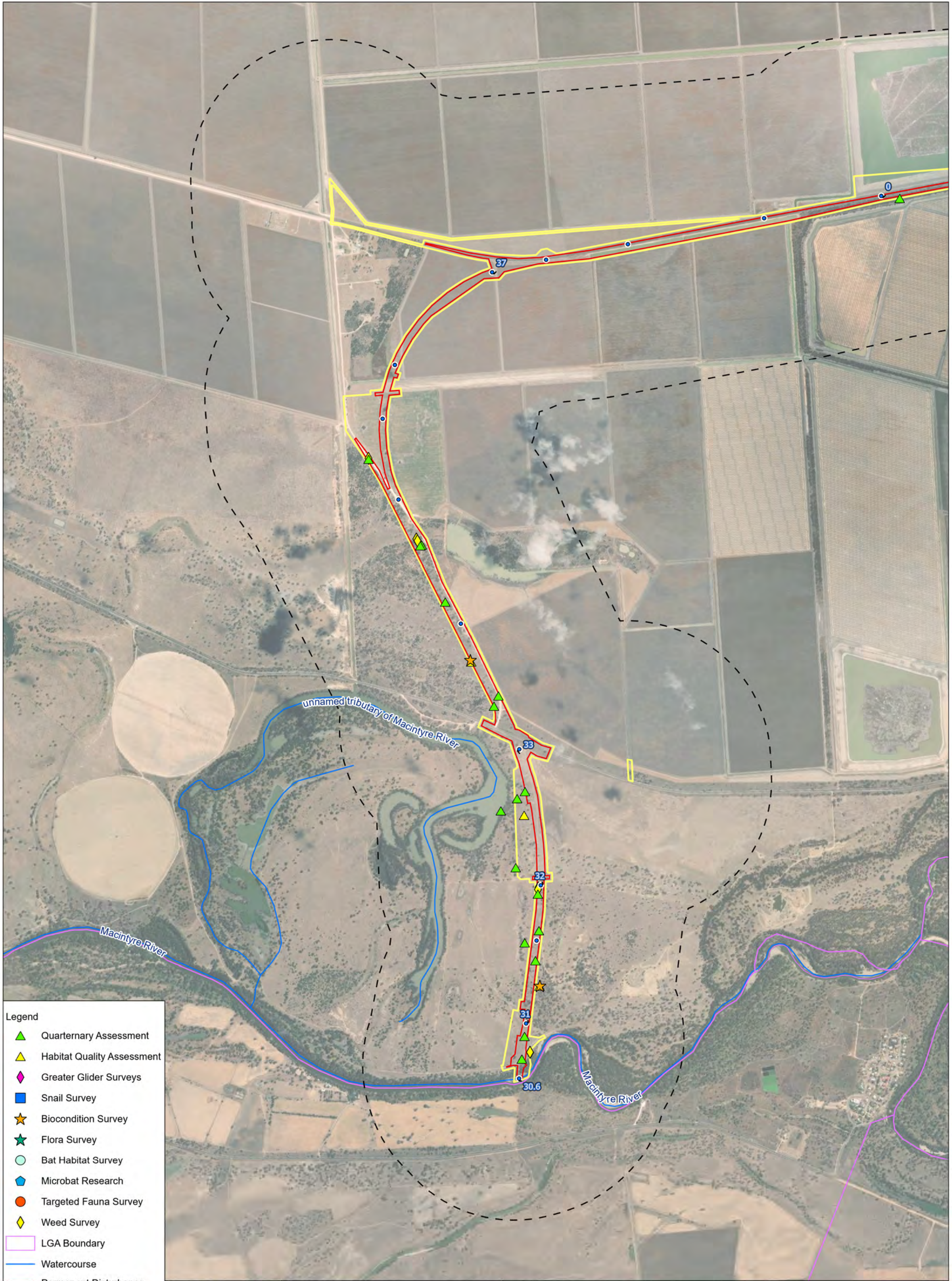
- Representative examples of each distinct vegetation community (RE) and, where appropriate, accounting for remnant regrowth and non-remnant areas;
- Landscape features that were considered likely to support threatened species based on known habitat preferences; and
- Areas known or predicted to support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

TABLE 3-4 TIMING OF FIELD INVESTIGATIONS

Study/investigation	Consultant/year	Timing of investigations	Season	Methodologies and notes
Terrestrial Ecological Assessment Report	Cardno (2021)	19 October to 13 November 2020 15 February to 27 March 2021 26 February to 13 March 2021	Spring, summer, autumn	- Verified presence of REs within the Project footprint - BioCondition assessments - Targeted threatened flora and fauna surveys - Incidental recording of animal breeding places
Supplementary Terrestrial Ecological Assessment Report	Ausecology (2023)	30 August to 3 September 2021 6 to 11 September, 27 to 29 September 2021 5 to 7 October, 25 to 28 October 2021 2 to 5 November, 11 November, 23 November 2021 6 December, 9 to 11 December, 14 December, 30 December 2021 15 to 17 March 2022	Winter, spring, summer and autumn	- Verified presence of REs within the Project footprint - BioCondition assessments - Detailed habitat assessments - Incidental recordings of threatened species - Incidental recording of animal breeding places
Fauna survey report: Targeted survey for Brigalow Woodland Snail <i>Adclarkia cameroni</i> , Queensland	Boobook Consulting (2022)	November 2022	Summer	Targeted survey within selected parts of the Project footprint for Brigalow Woodland Snail (<i>Adclarkia cameroni</i>)
Whetstone Material Distribution Centre Ecology Assessment	Umwelt (2022)	20 September 2022	Spring	- Quaternary assessments - Opportunistic threatened flora searches - Fauna habitat assessments - Active searches, bird surveys and opportunistic fauna sightings
eDNA Aquatic Survey	Hydrobiology (2023)	20 to 25 November 2022	Summer	eDNA sampling of waterways within the Study area

Study/investigation	Consultant/year	Timing of investigations	Season	Methodologies and notes
Microbat Surveys and Research Inland Rail: N2N and B2G	BAAM (Williams, 2023)	24 February to 10 March 2023 16 March to 6 April 2023	Summer, autumn	- Targeted microbat surveys and tracking research within two forested segments of Project footprint - Two threatened microbat species south-eastern long-eared bat (<i>Nyctophilus corbeni</i>) and large-eared pied bat (<i>Chalinolobus dwyeri</i>)
ARTC Inland Rail Border to Gowrie (B2G) Ecology Partnership	UniSQ (2024)	Various January 2023 to 30 June 2024	Winter, spring, summer and autumn	- Ecological fauna surveys, monitoring and research targeting threatened fauna including koalas (<i>Phascolarctos cinereus</i>) and reptiles (yakka skink, Dunmall's snake, collared delma, five-clawed worm-skink and Condamine earless dragon) - Dietary analysis of koalas (<i>Phascolarctos cinereus</i>) - Habitat assessments - Genetic assessments - Threat assessment of wild dogs to koalas
ARTC Inland Rail Border to Gowrie (B2G) Threatened Species Flora Studies	UniSC (2024)	Various July 2023 to June 2024	Winter, spring, summer, autumn	- Document populations sizes, demographic attributes, and locations of populations of <i>Eucalyptus virens</i>, <i>Xerothamnella herbacea</i>, <i>Lepidium monophlooides</i>, and <i>Thesium australe</i>, <i>Westringia parvifolia</i> and <i>Acacia lauta</i> - Test propagation approaches for <i>Eucalyptus virens</i>, <i>Westringia parvifolia</i> and <i>Acacia lauta</i> - Genetic assessments

Study/investigation	Consultant/year	Timing of investigations	Season	Methodologies and notes
B2G Borrow Pit Ecological Surveys	Ausecology (2024a)	5 – 6 September 2023	Spring	- General vegetation assessment at proposed borrow pit sites (inclusive of access tracks) - Incidental recordings pf threatened flora and fauna
B2G Supplementary Ecology Survey Report Memo	ERM (2024a)	December 2023	Summer	Targeted survey within selected parts of the Project footprint for greater glider (<i>Petauroides volans</i>)
White Box TEC Assessment	Ausecology (2024b)	14 – 15 March 2024	Autumn	Verification of box-gum (white box) TEC outside of the Project footprint.
Telstra/Nextgen cable realignment, Gowrie Junction Protected Plant Survey Report	EMM (2024)	18 – 19 December 2023 22 February 2024	Summer	- Targeted threatened flora survey as prescribed by the NC Act - Verified presence of RE within Project footprint
Koala Genetics Study Project: Inland Rail Program	ERM (2024b)	- June 2022 - July 2023	Winter	- Targeted surveys utilising detection dogs within previously identified hotspot areas to identify koala scats for collection. - Targeted vegetation and habitat assessments.



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



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F3.1(1) - Field Survey Locations

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**

ARTC

ERM



Legend

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



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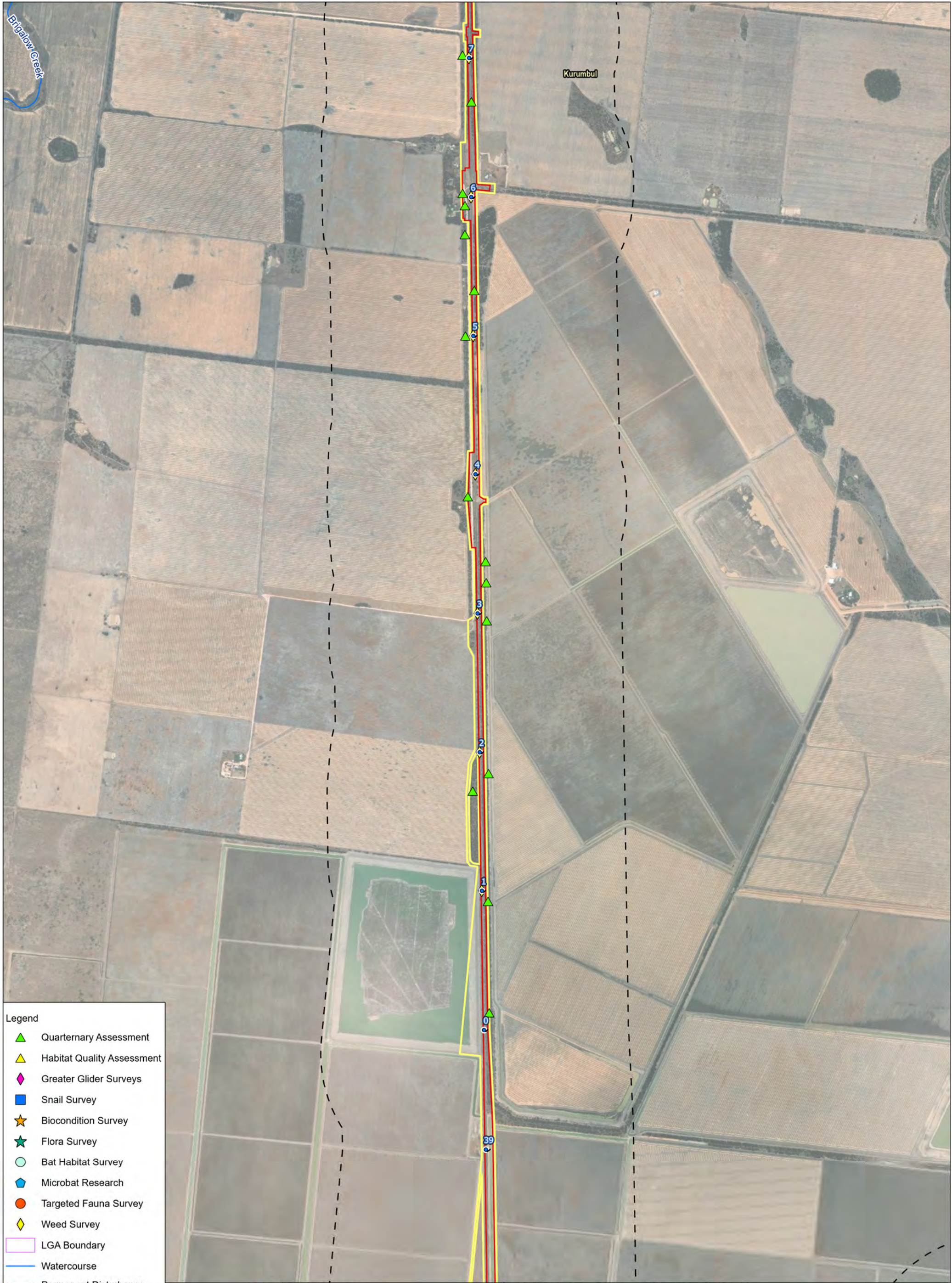
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F3.1(2) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



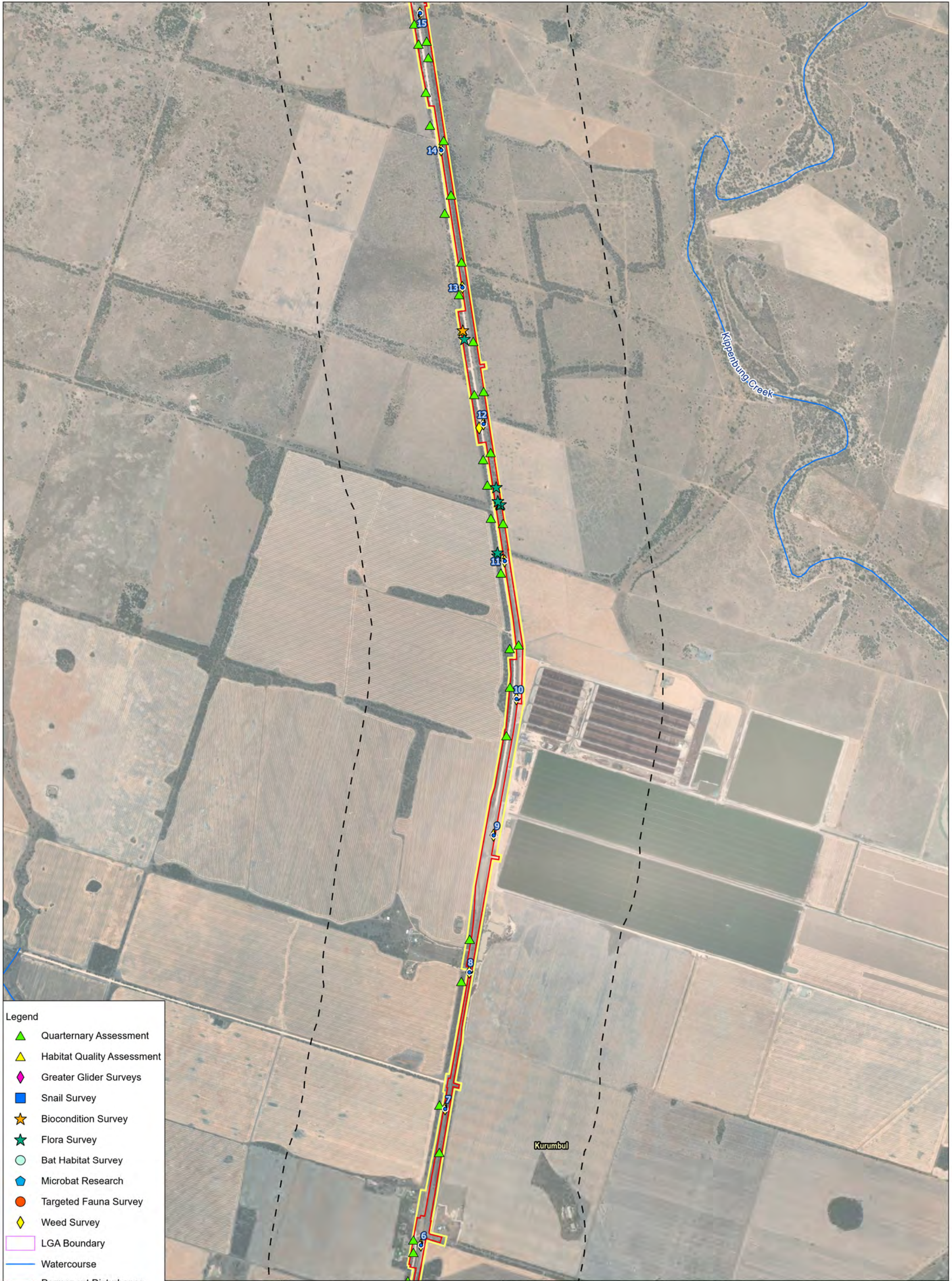
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 - Habitat Quality Assessment
 - Greater Glider Surveys
 - Snail Survey
 - Biocondition Survey
 - Flora Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - Weed Survey
 - LGA Boundary
 - Watercourse
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Study Area
 - Chainage (km)

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F3.1(3) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



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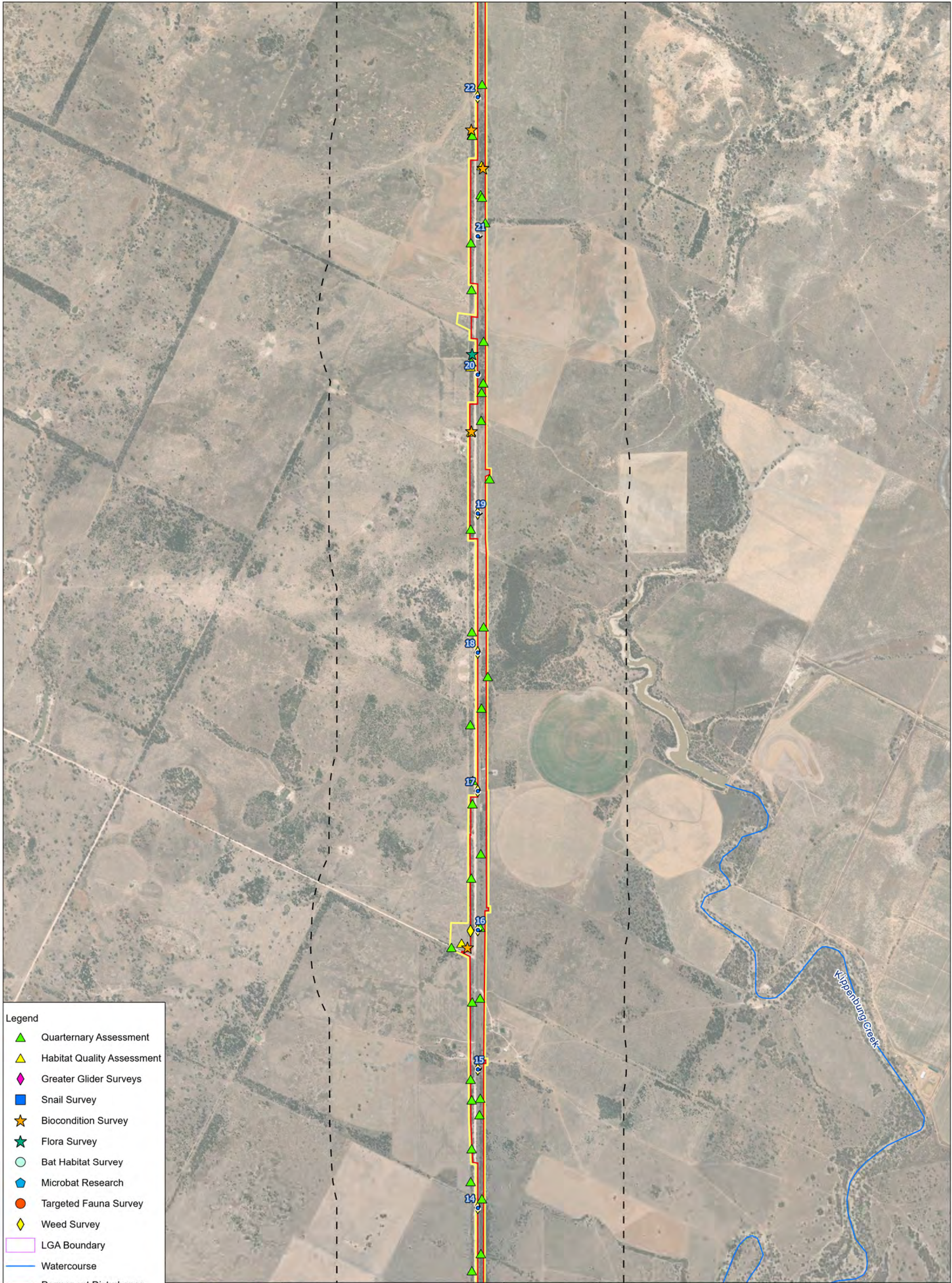
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F3.1(4) - Field Survey Locations

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**

ARTC



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



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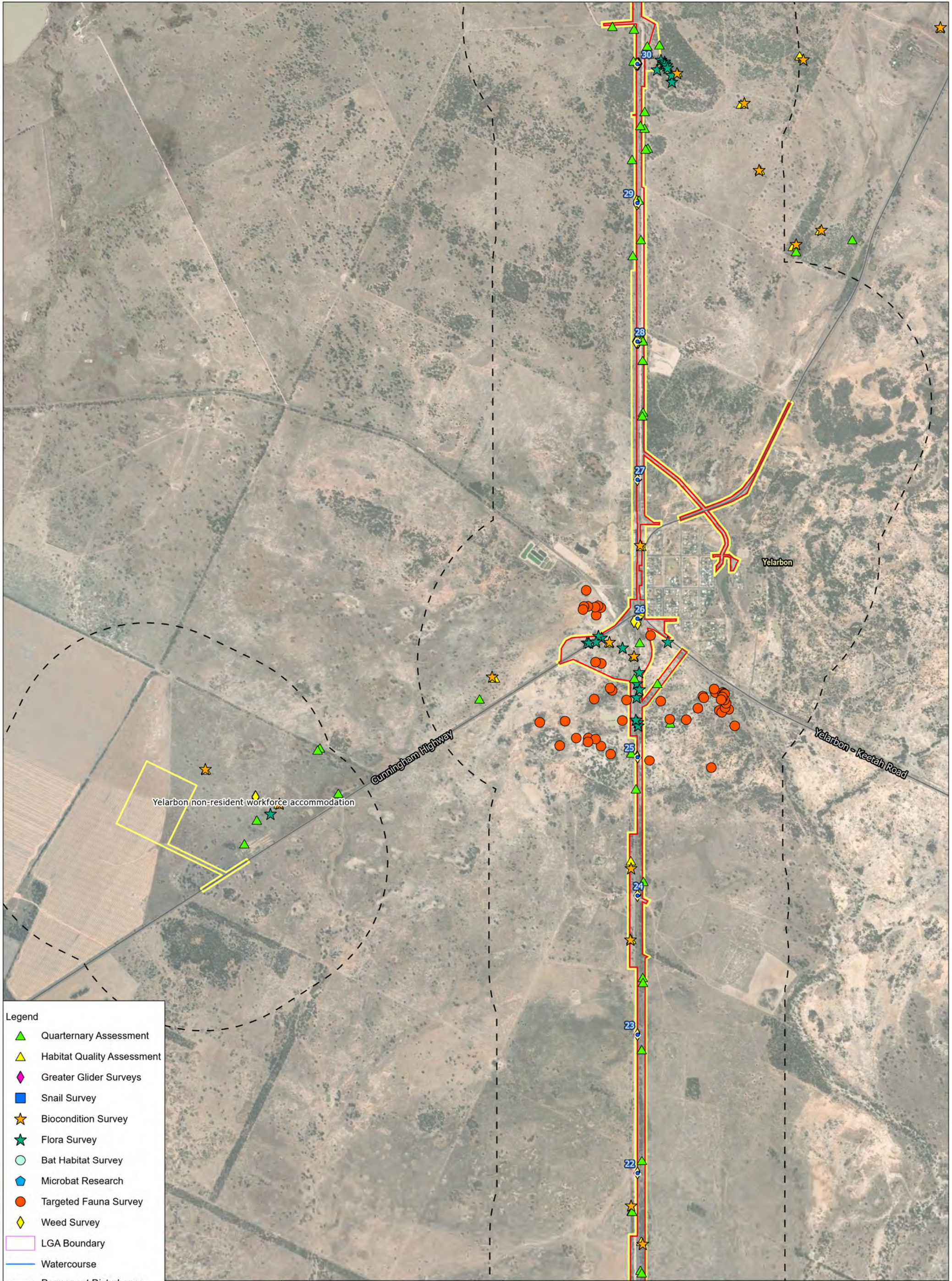
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F3.1(5) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

ERM



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



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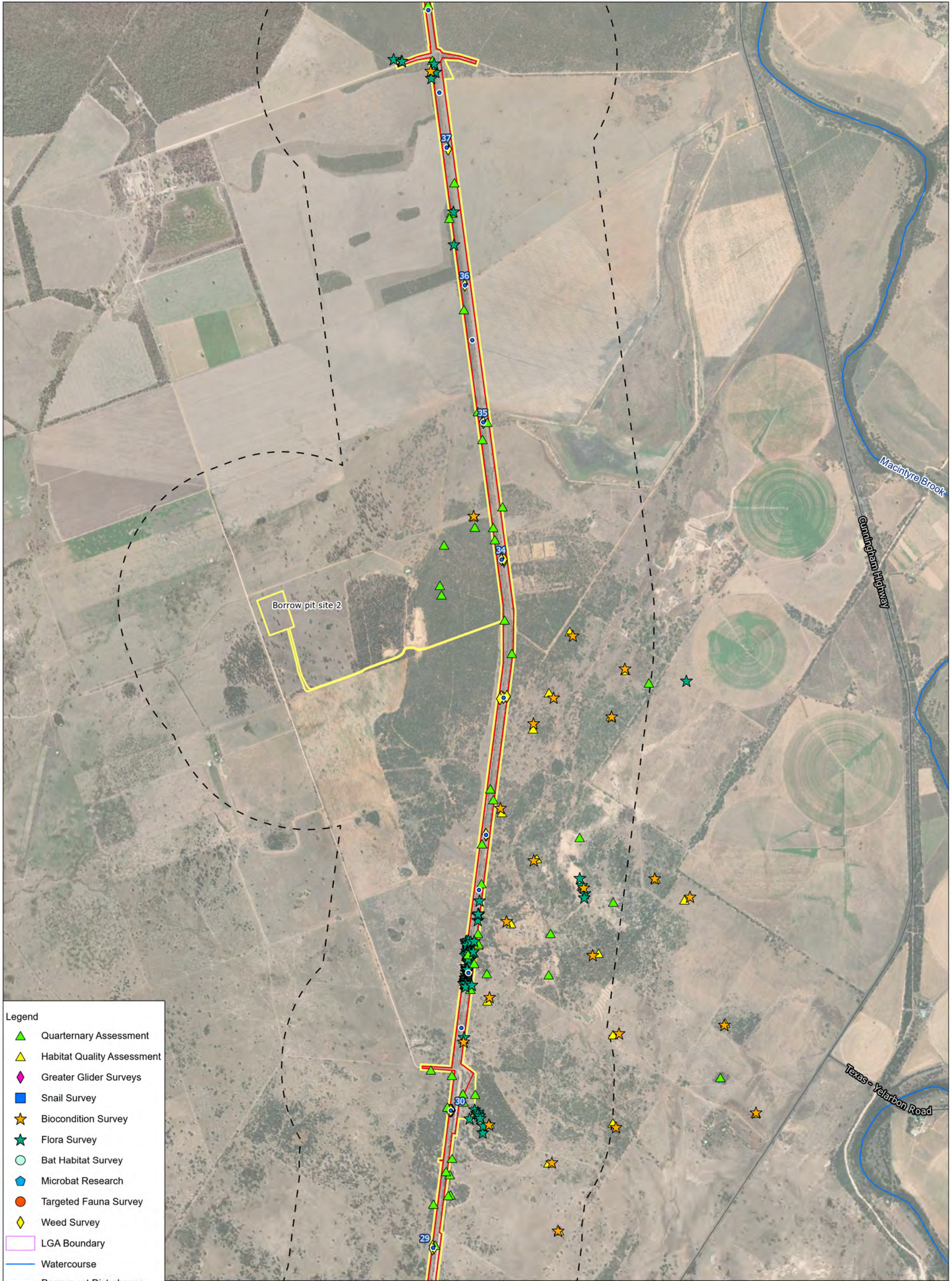
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F3.1(6) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

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



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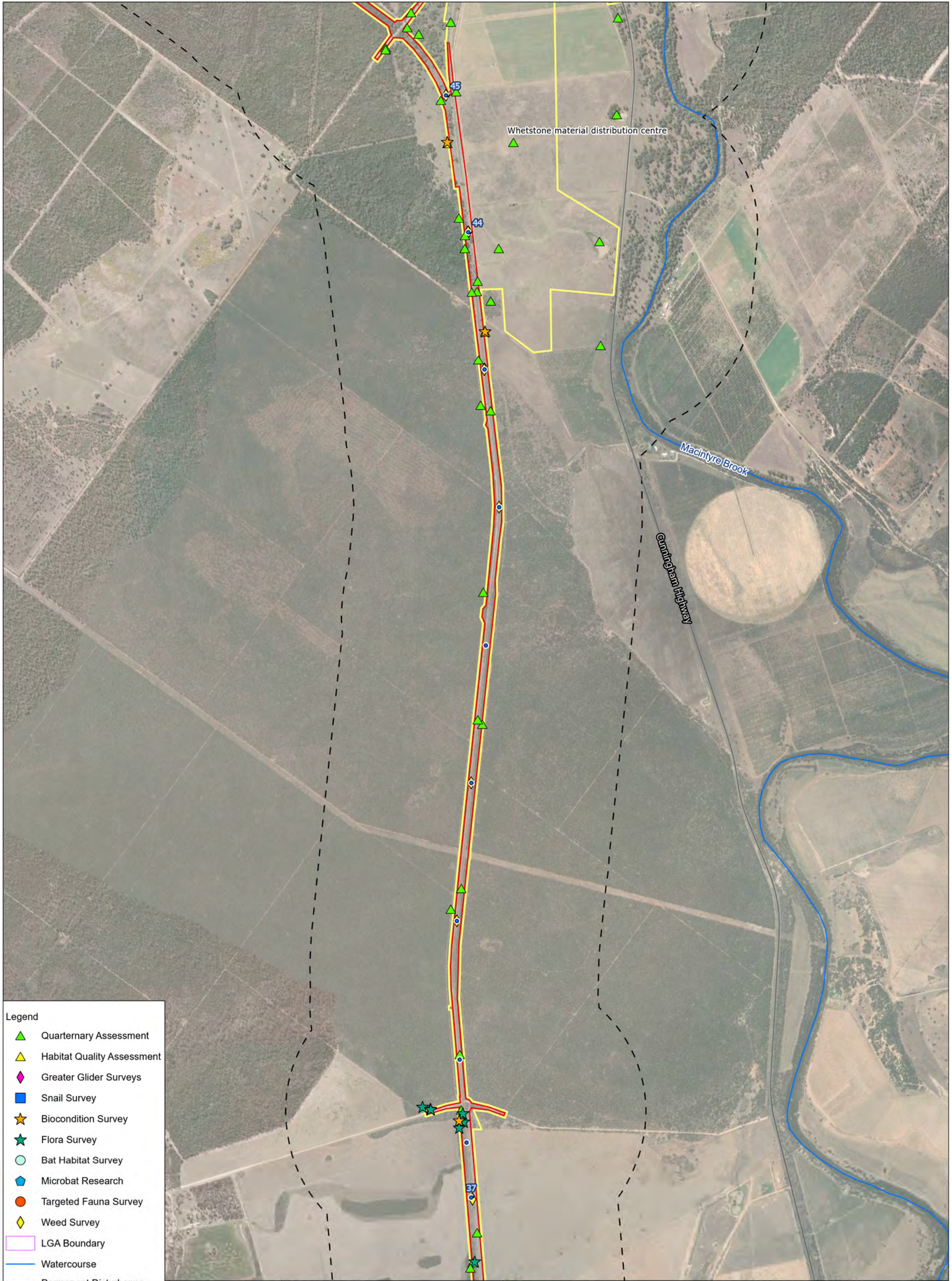
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F3.1(7) - Field Survey Locations

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**

ARTC

ERM



Legend

▲

Quarternary Assessment

▲

Habitat Quality Assessment

◆

Greater Glider Surveys

■

Snail Survey

★

Biocondition Survey

★

Flora Survey

●

Bat Habitat Survey

●

Microbat Research

●

Targeted Fauna Survey

◆

Weed Survey

—

LGA Boundary

—

Watercourse

—

Permanent Disturbance Footprint

—

Temporary Disturbance Footprint

—

Study Area

●

Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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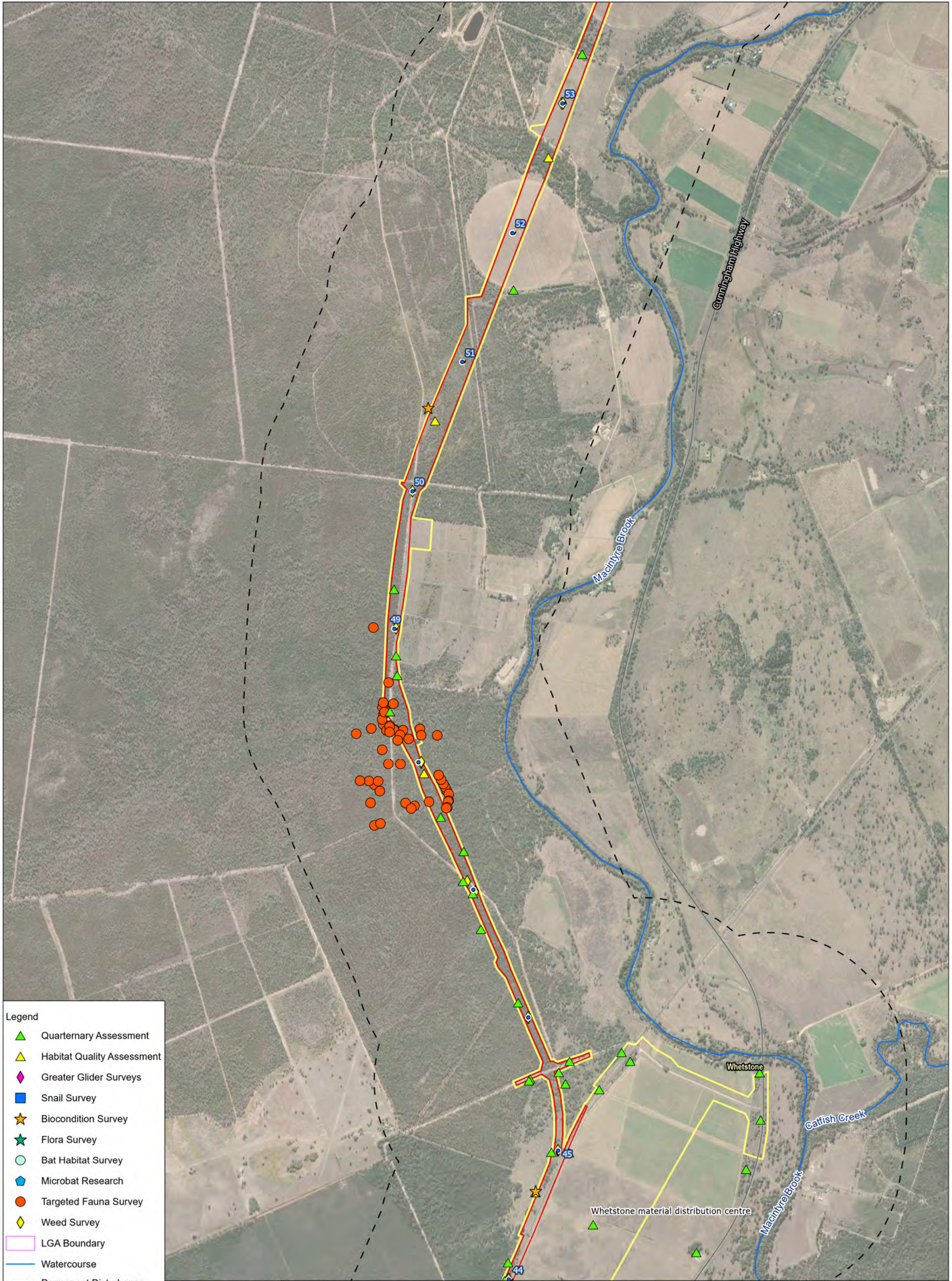
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F3.1(8) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report

ARTC

ERM



Legend

- Quaternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)

Coordinate System:
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Date: 17/10/2024

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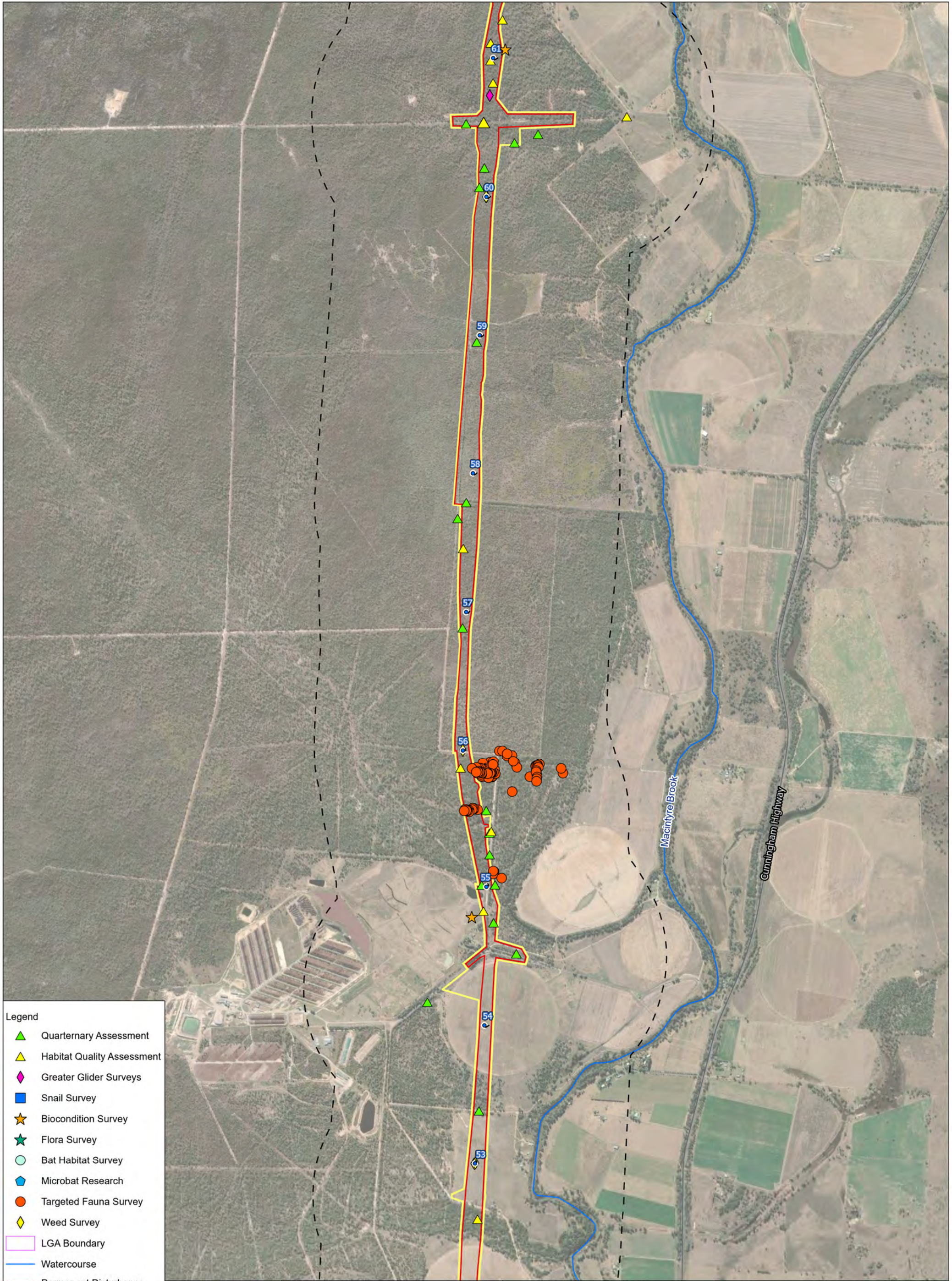
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F3.1(9) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

ERM



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
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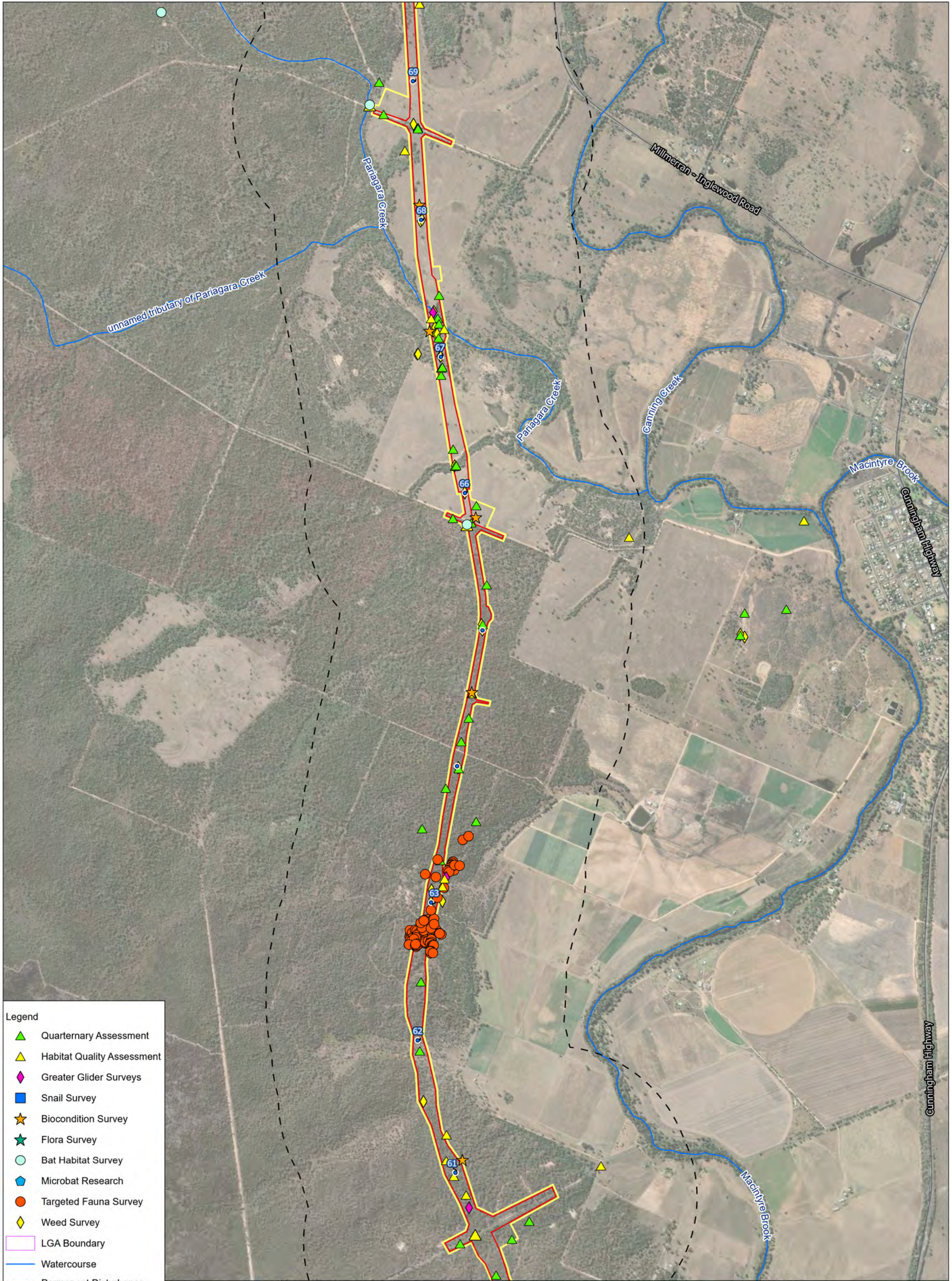
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F3.1(10) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



- Legend
- Quarternary Assessment
 - Habitat Quality Assessment
 - Greater Glider Surveys
 - Snail Survey
 - Biocondition Survey
 - Flora Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - Weed Survey
 - LGA Boundary
 - Watercourse
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Study Area
 - Chainage (km)

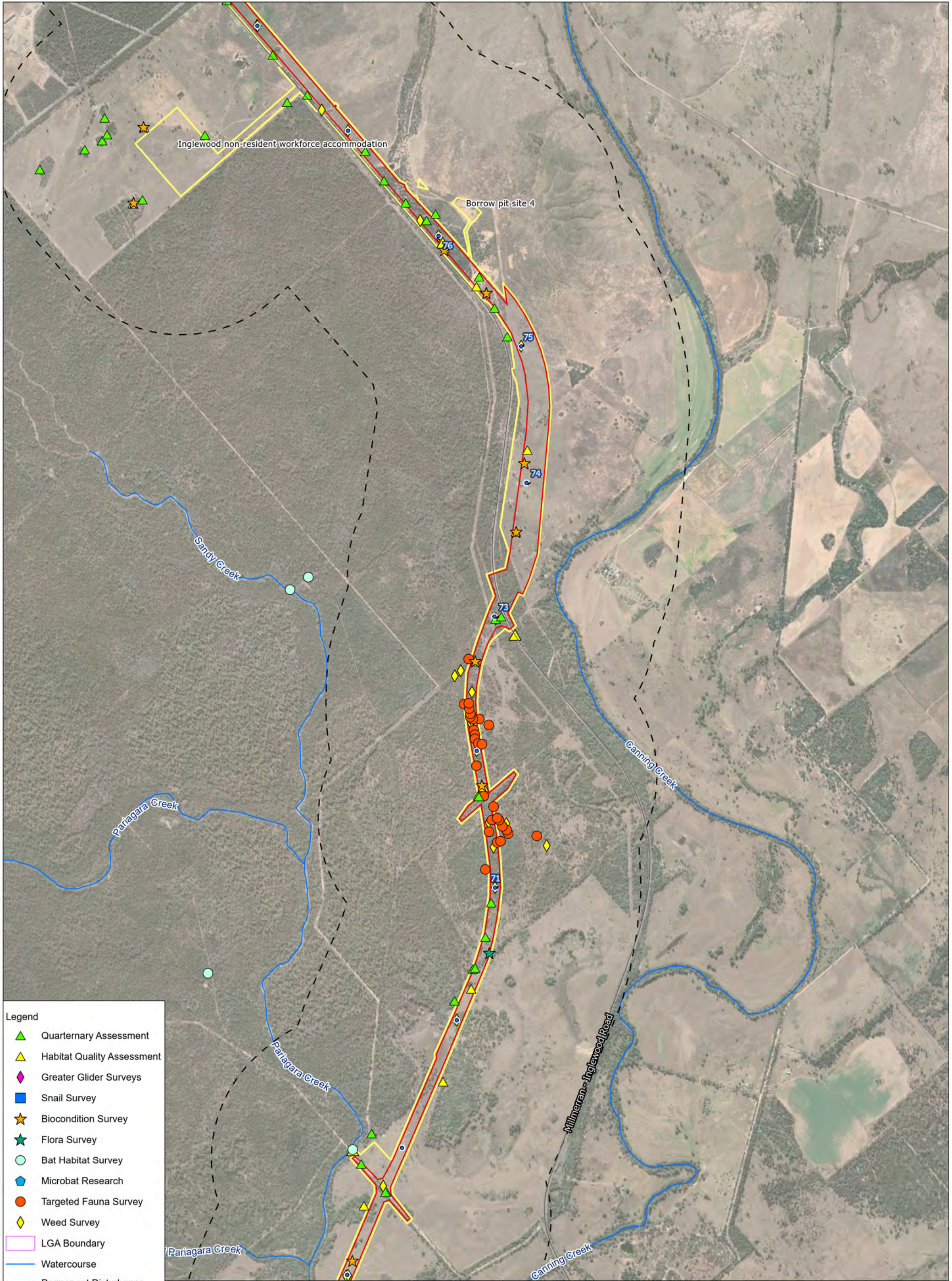


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F3.1(11) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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



Coordinate System:
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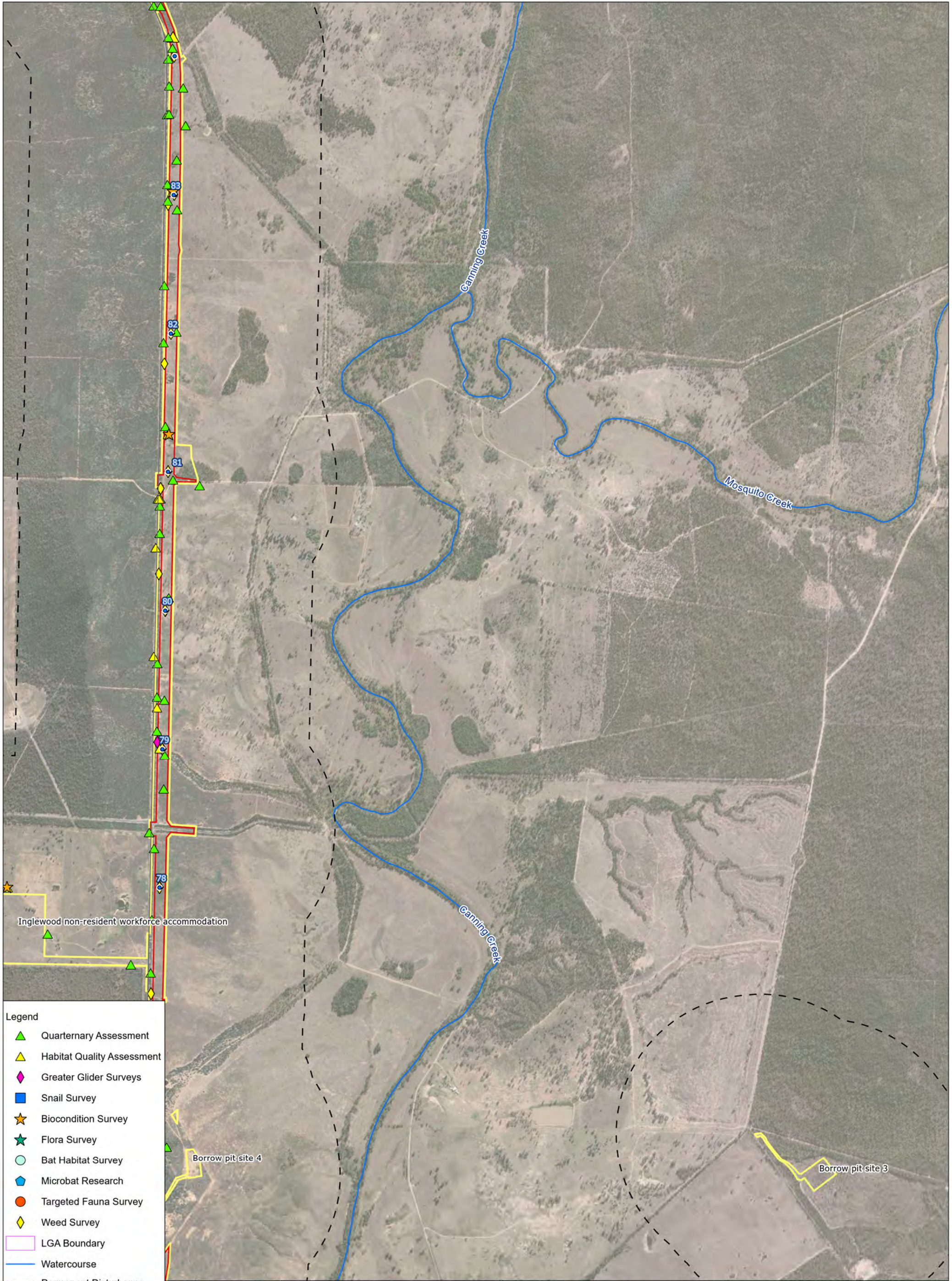
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F3.1(12) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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



Coordinate System:
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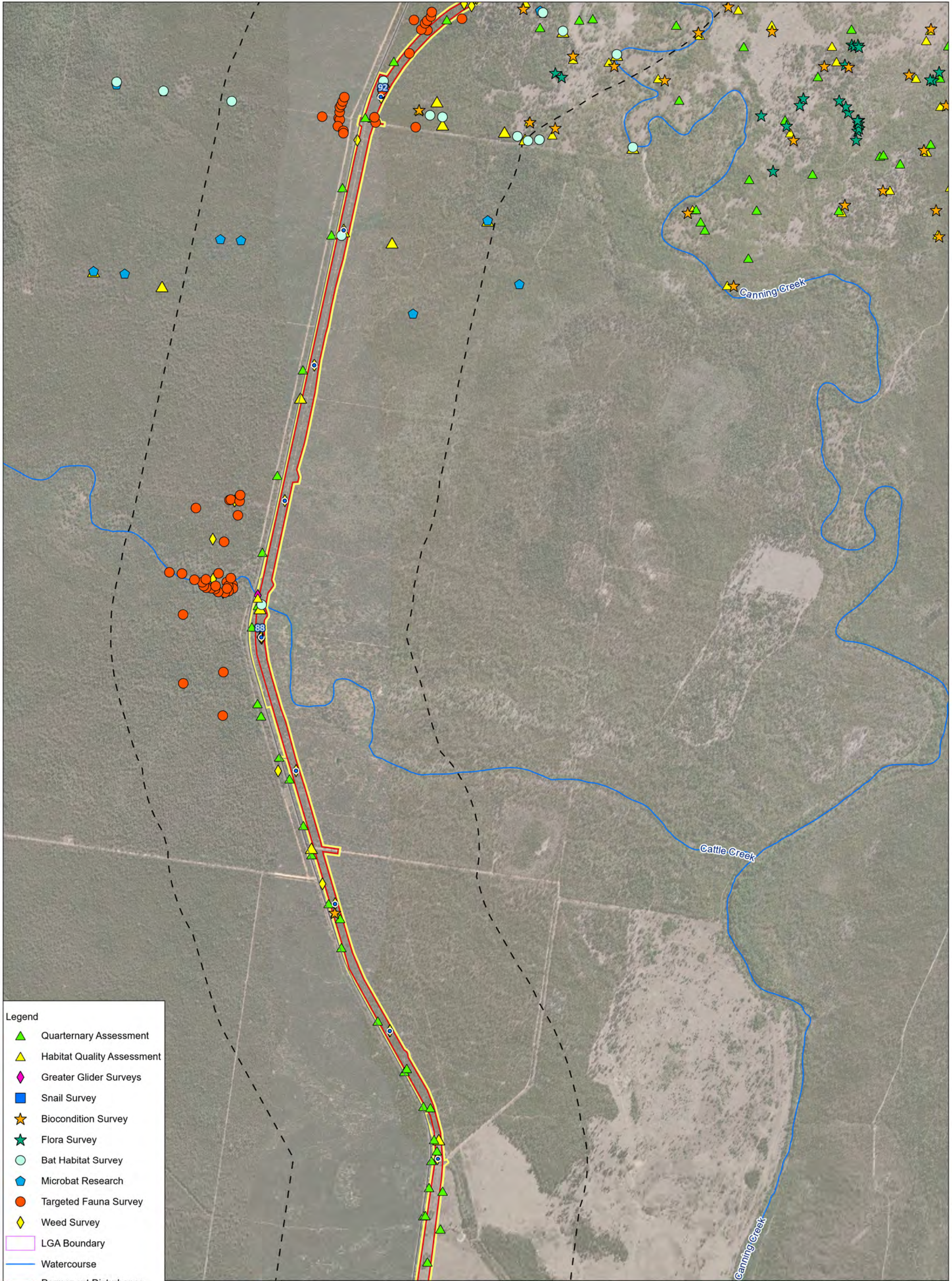
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F3.1(13) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report

ARTC



Legend

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



Coordinate System:
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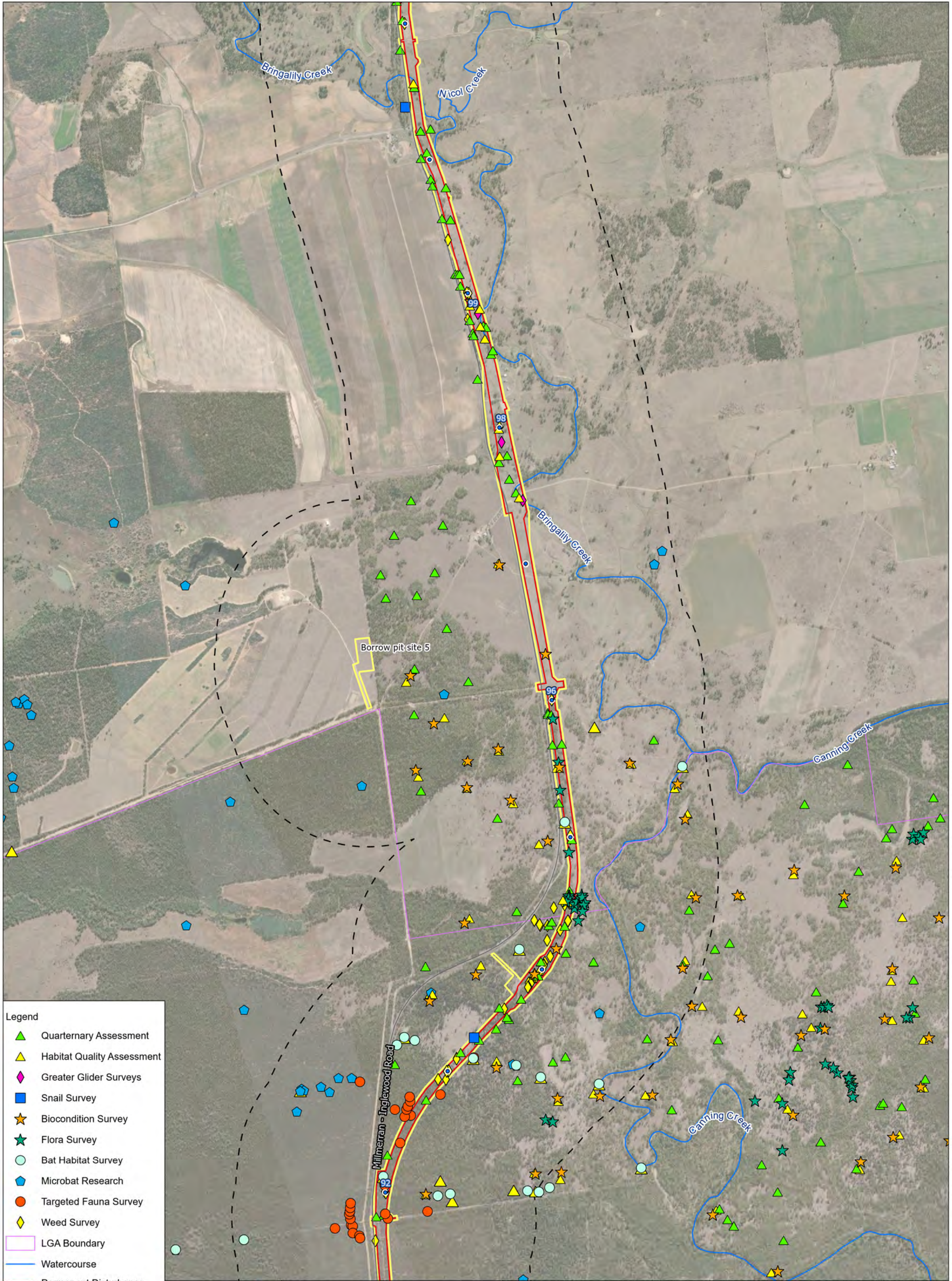
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F3.1(14) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report

ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
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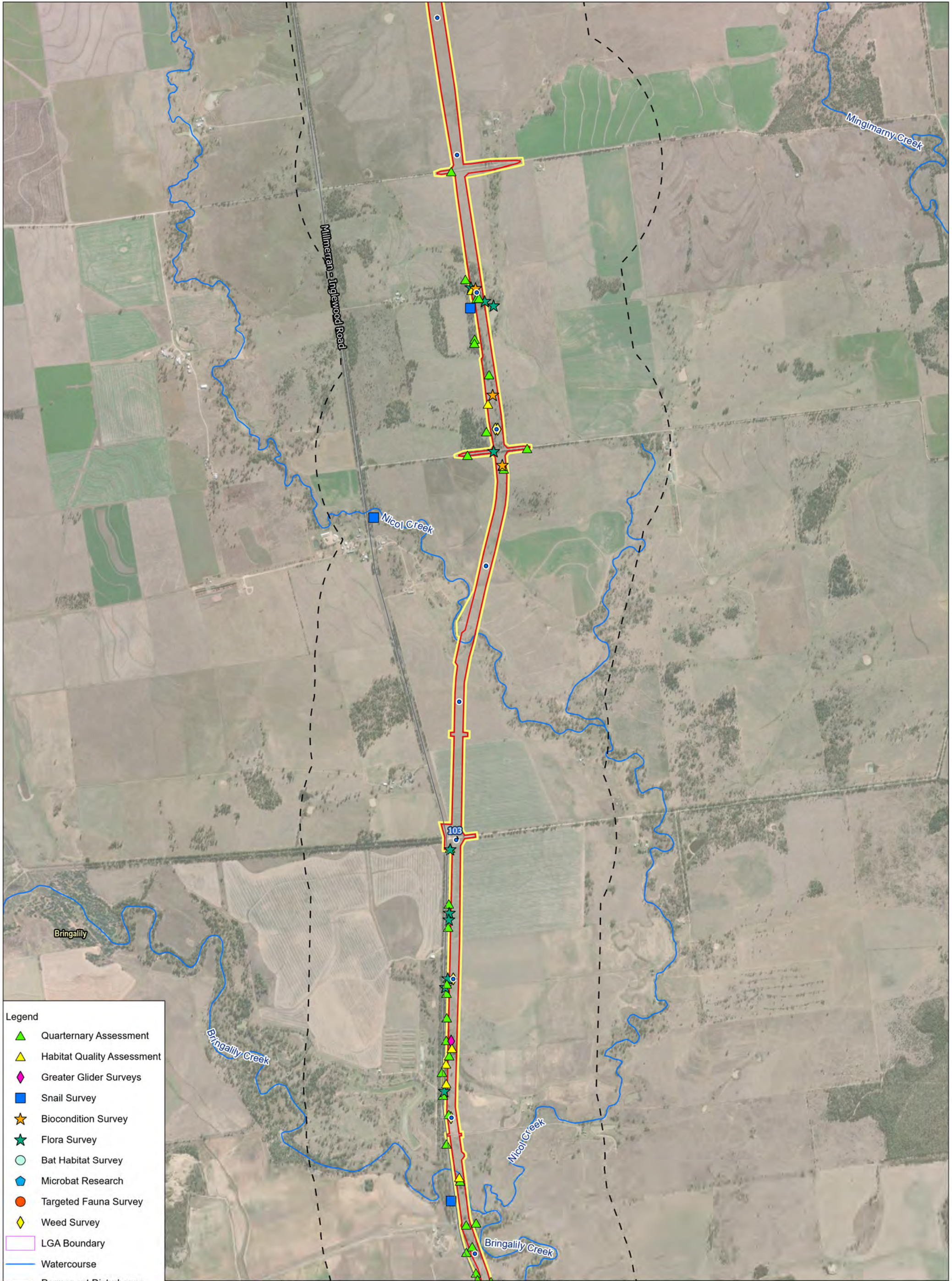
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F3.1(15) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)

Coordinate System:
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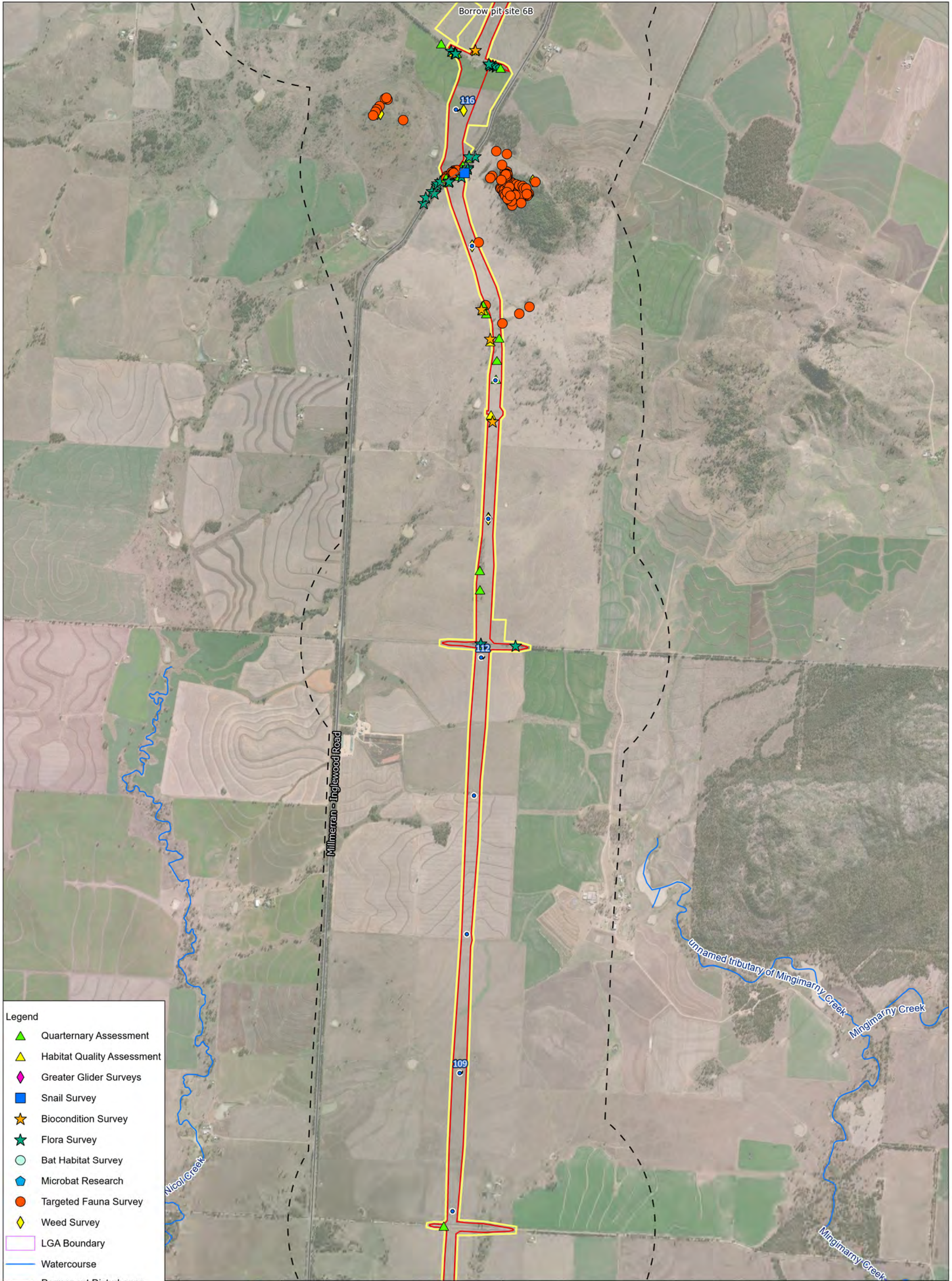
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F3.1(16) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
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Date: 17/10/2024

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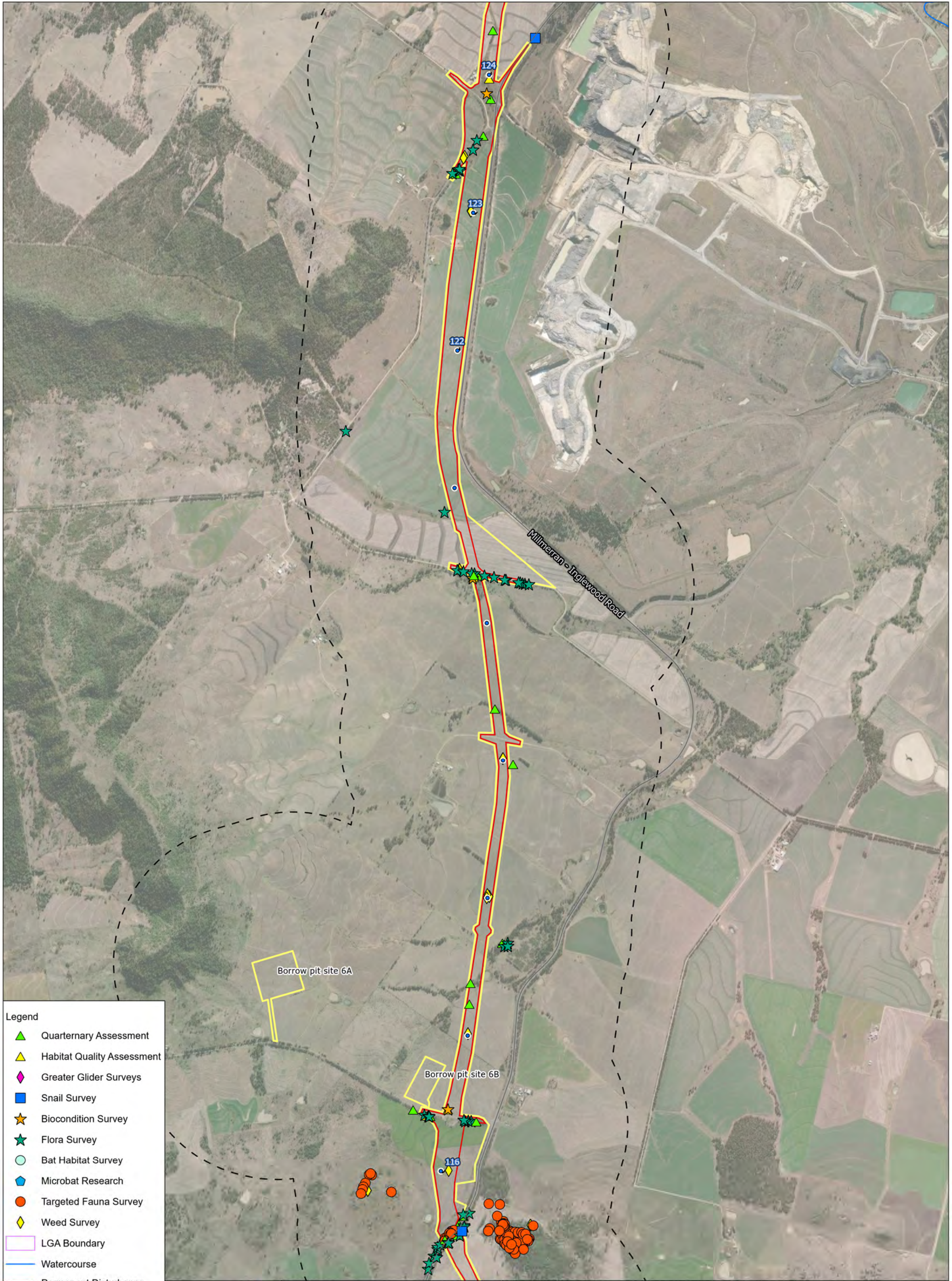
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F3.1(17) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report

ARTC

 **ERM**



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
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Date: 17/10/2024

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F3.1(18) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report

ARTC



- Legend
- ▲ Quarternary Assessment
 - ▲ Habitat Quality Assessment
 - ◆ Greater Glider Surveys
 - Snail Survey
 - ★ Biocondition Survey
 - ★ Flora Survey
 - Bat Habitat Survey
 - Microbat Research
 - Targeted Fauna Survey
 - ◆ Weed Survey
 - LGA Boundary
 - Watercourse
 - ▭ Permanent Disturbance Footprint
 - ▭ Temporary Disturbance Footprint
 - [- - -] Study Area
 - Chainage (km)

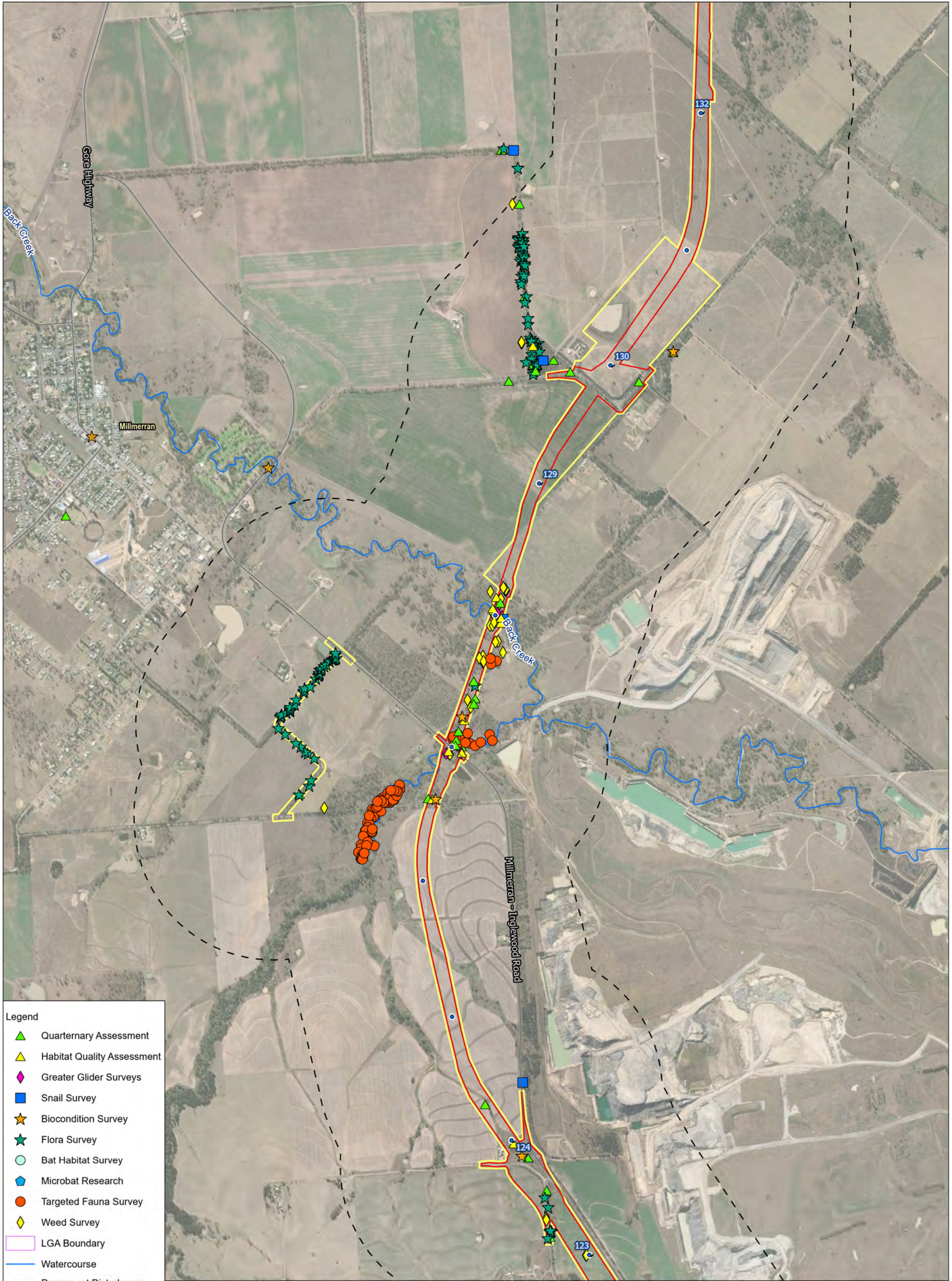


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F3.1(19) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
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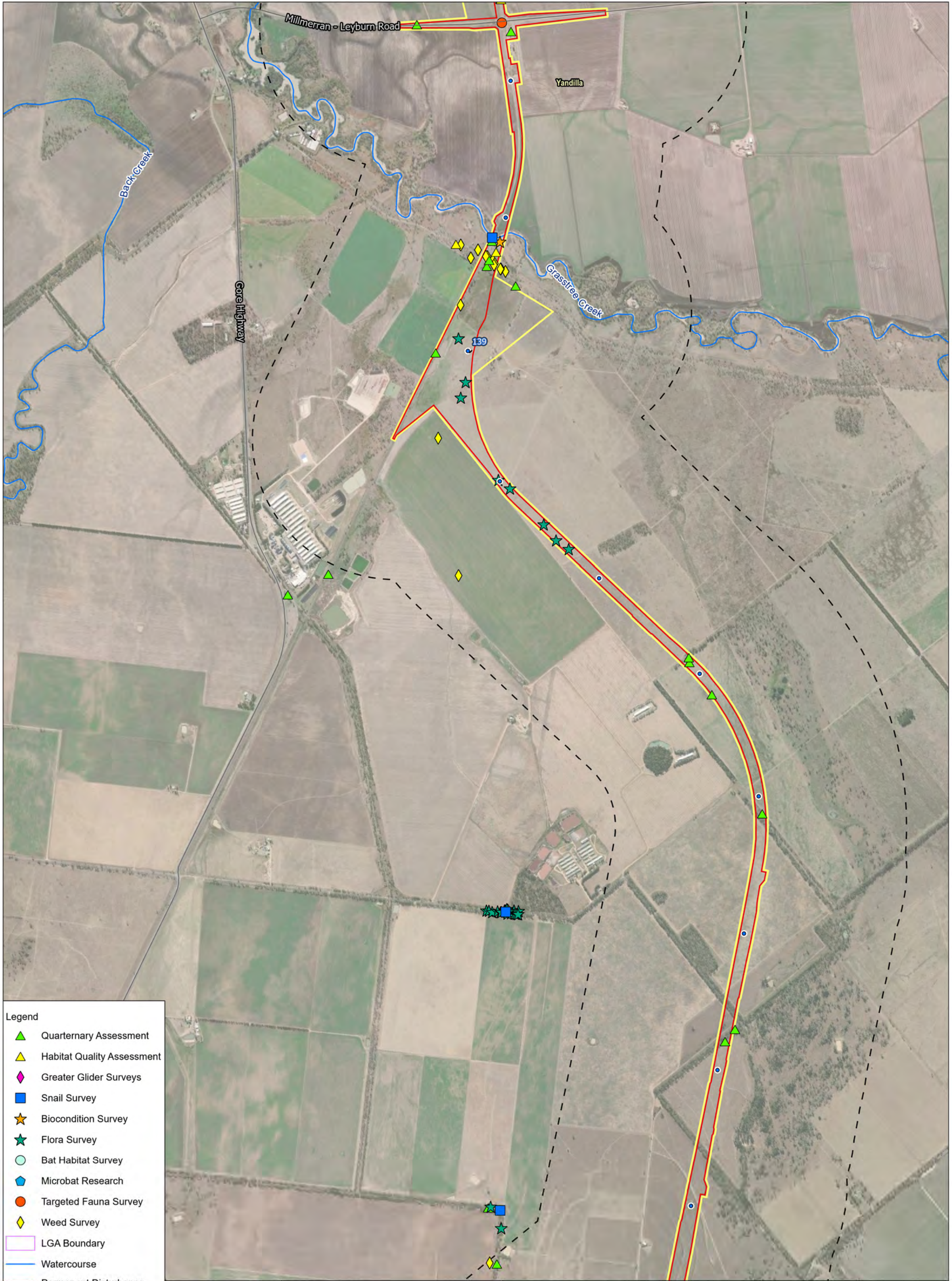
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F3.1(20) - Field Survey Locations

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**

ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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F3.1(21) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report

ARTC

ERM



Legend

- ▲ Quarternary Assessment
- ▲ Habitat Quality Assessment
- ◆ Greater Glider Surveys
- Snail Survey
- ★ Biocondition Survey
- ★ Flora Survey
- Bat Habitat Survey
- ⬠ Microbat Research
- Targeted Fauna Survey
- ◆ Weed Survey
- LGA Boundary
- Watercourse
- ▬ Permanent Disturbance Footprint
- ▬ Temporary Disturbance Footprint
- ⌈ Study Area
- Chainage (km)



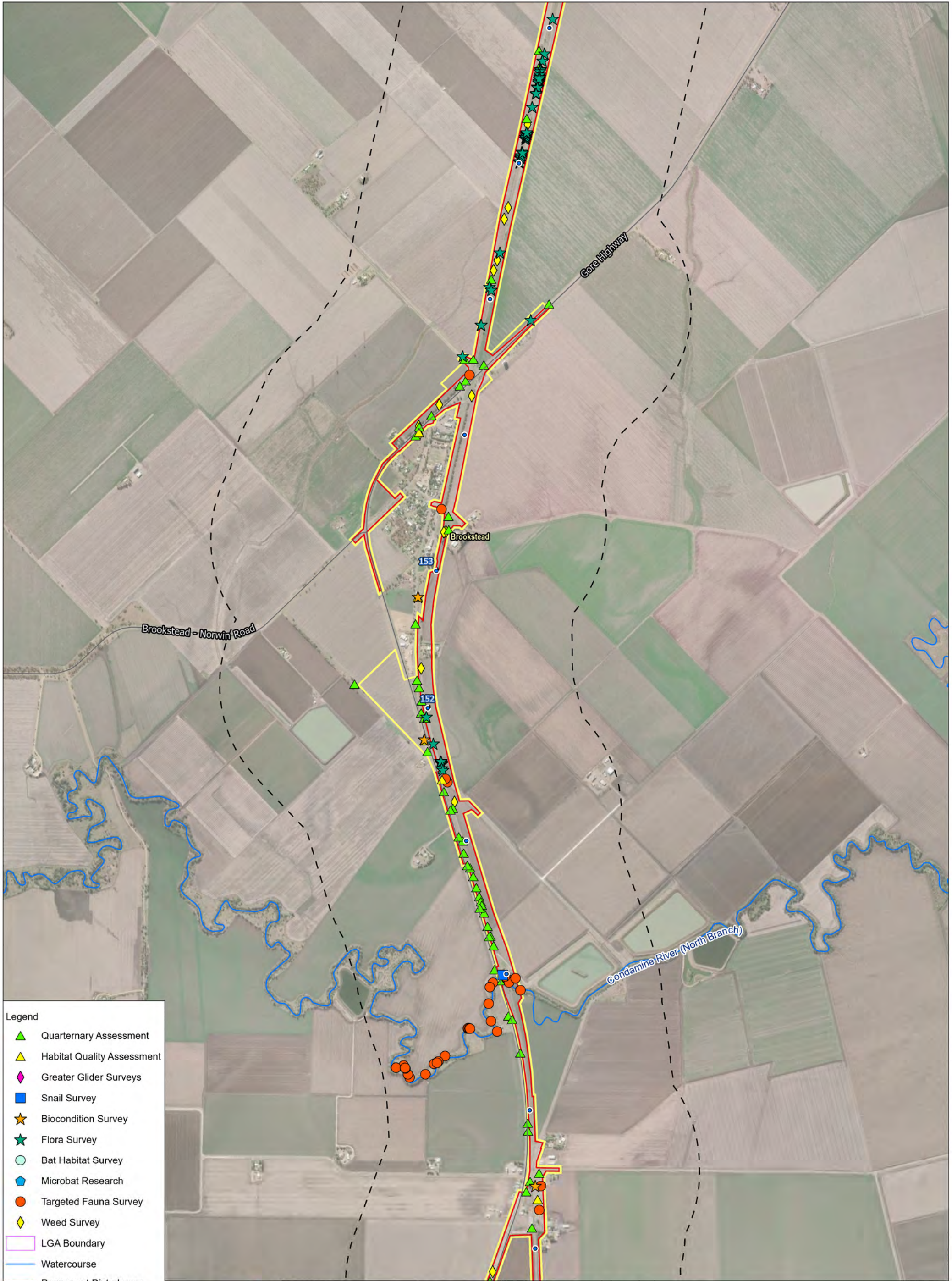
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F3.1(22) - Field Survey Locations

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**
ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)

Coordinate System:
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Date: 17/10/2024

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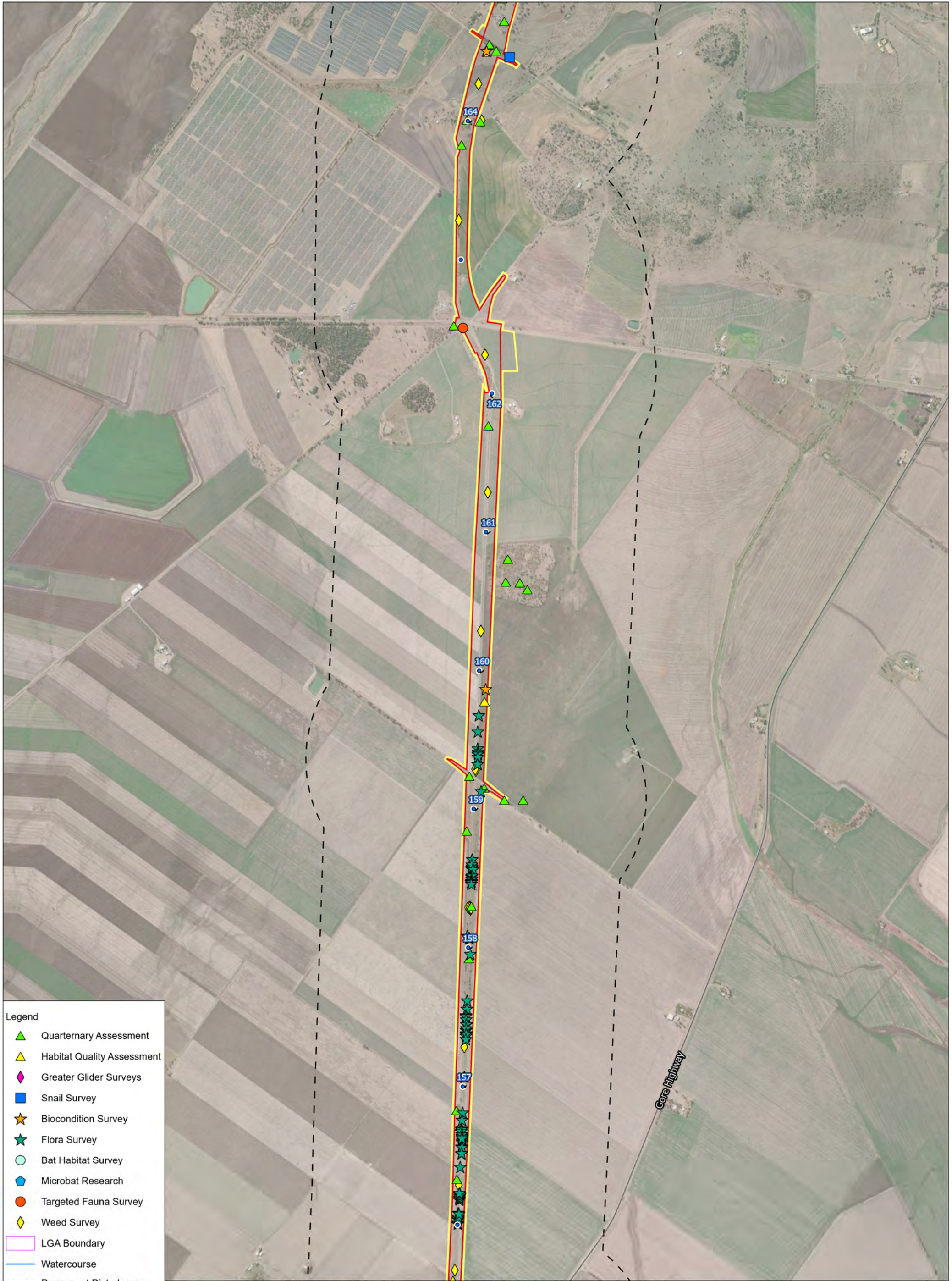
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F3.1(23) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report

ARTC



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
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Date: 17/10/2024

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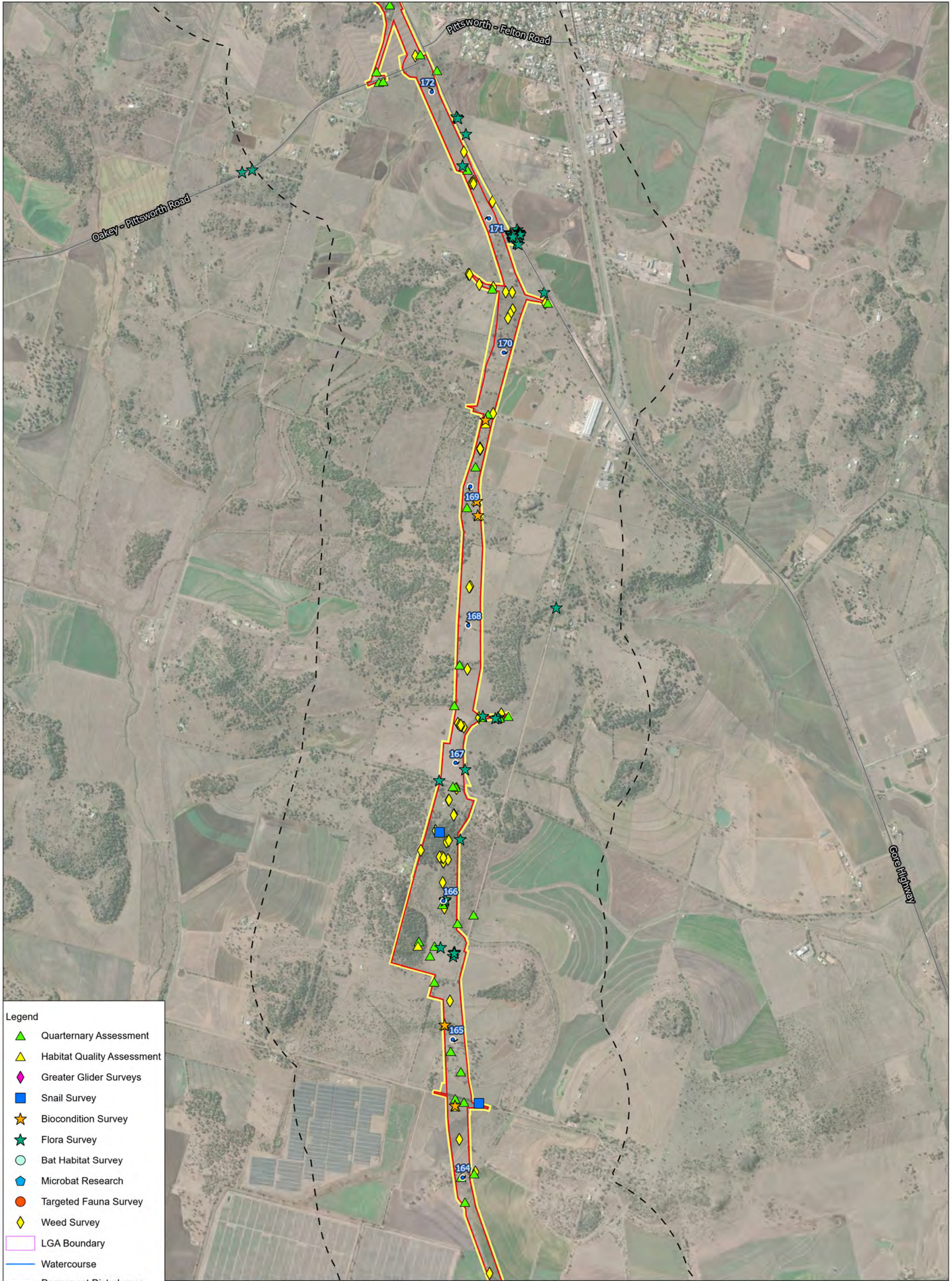
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F3.1(24) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



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

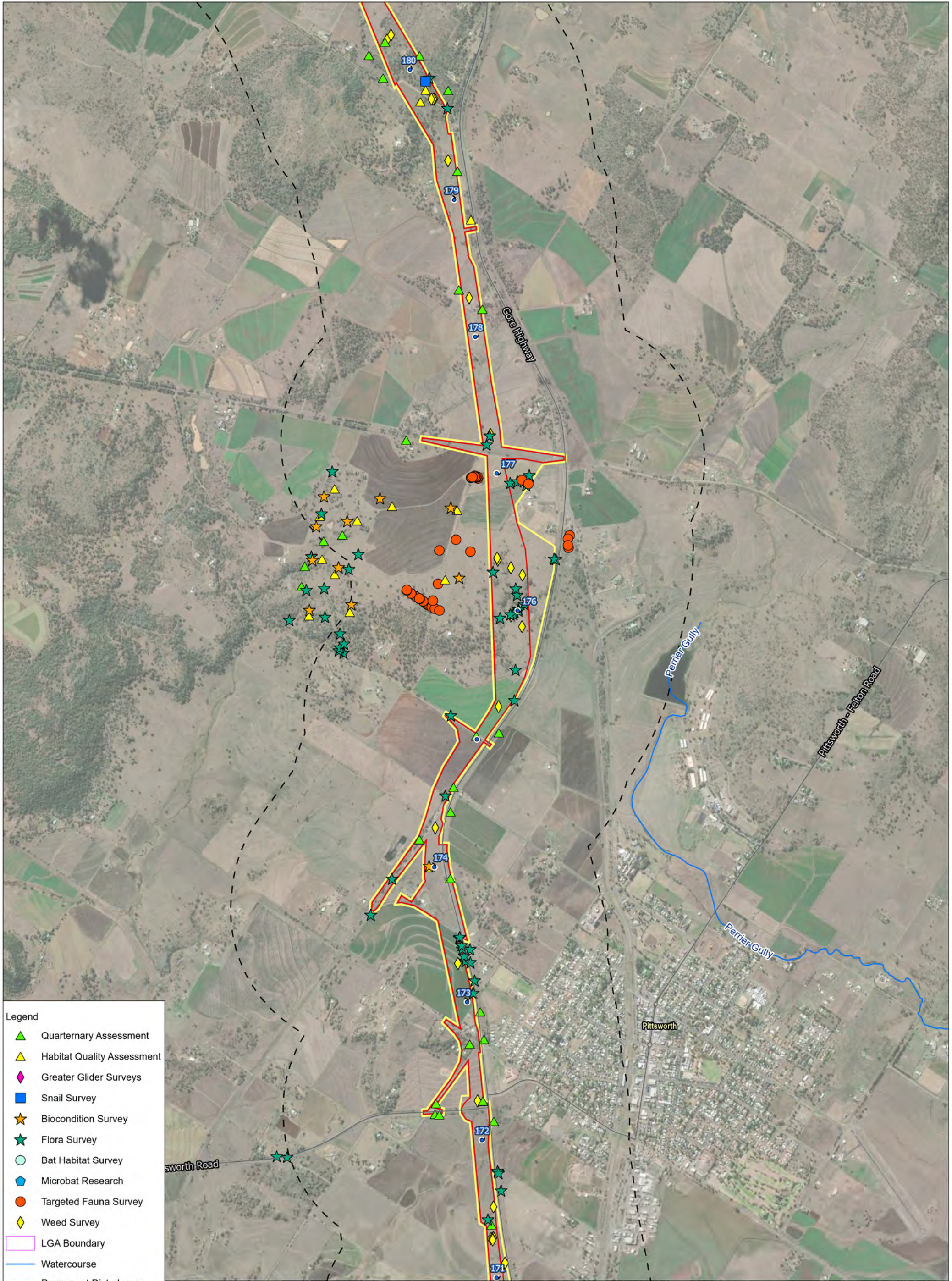


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F3.1(25) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



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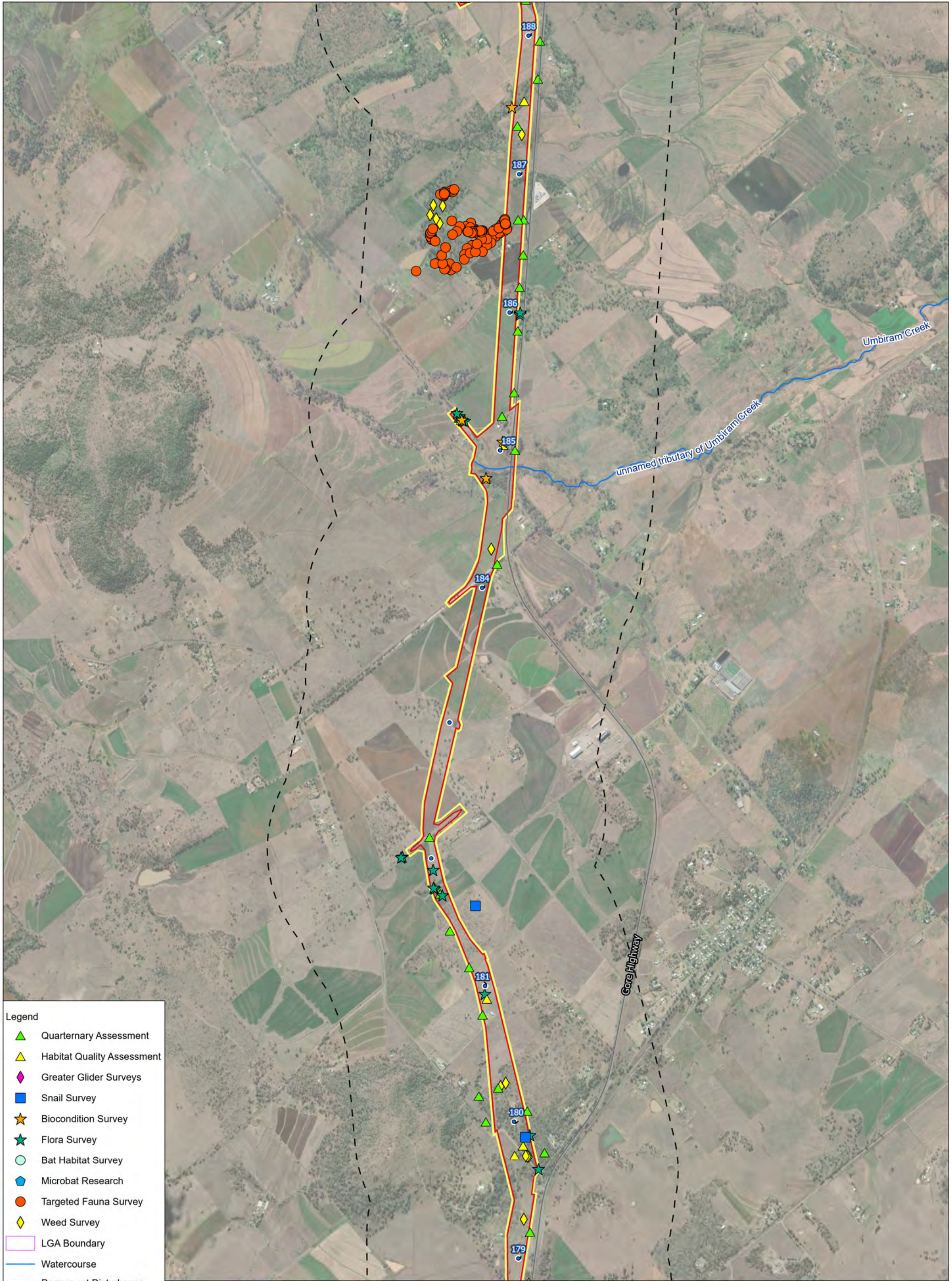
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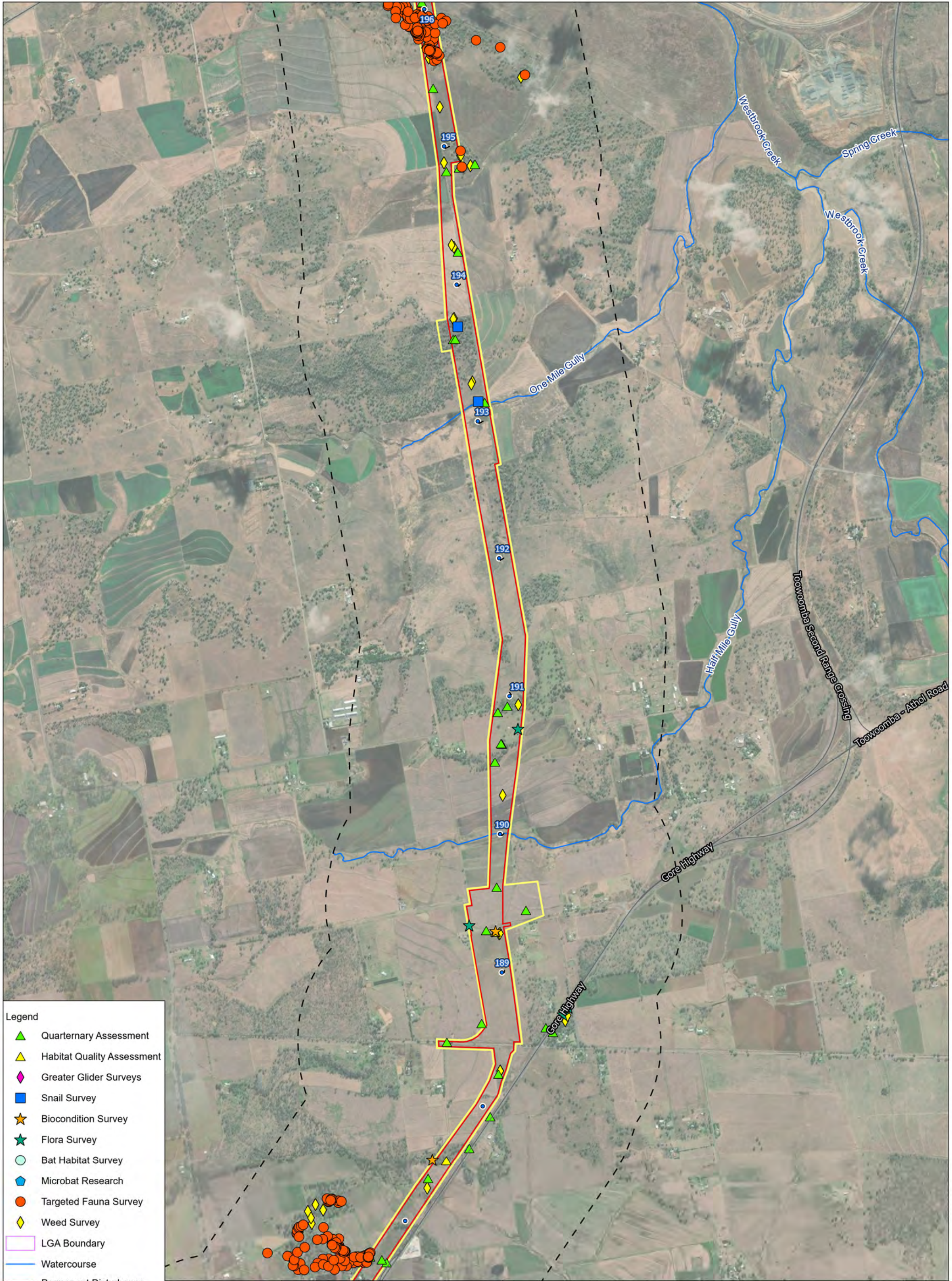
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F3.1(26) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)

Coordinate System:
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Date: 17/10/2024

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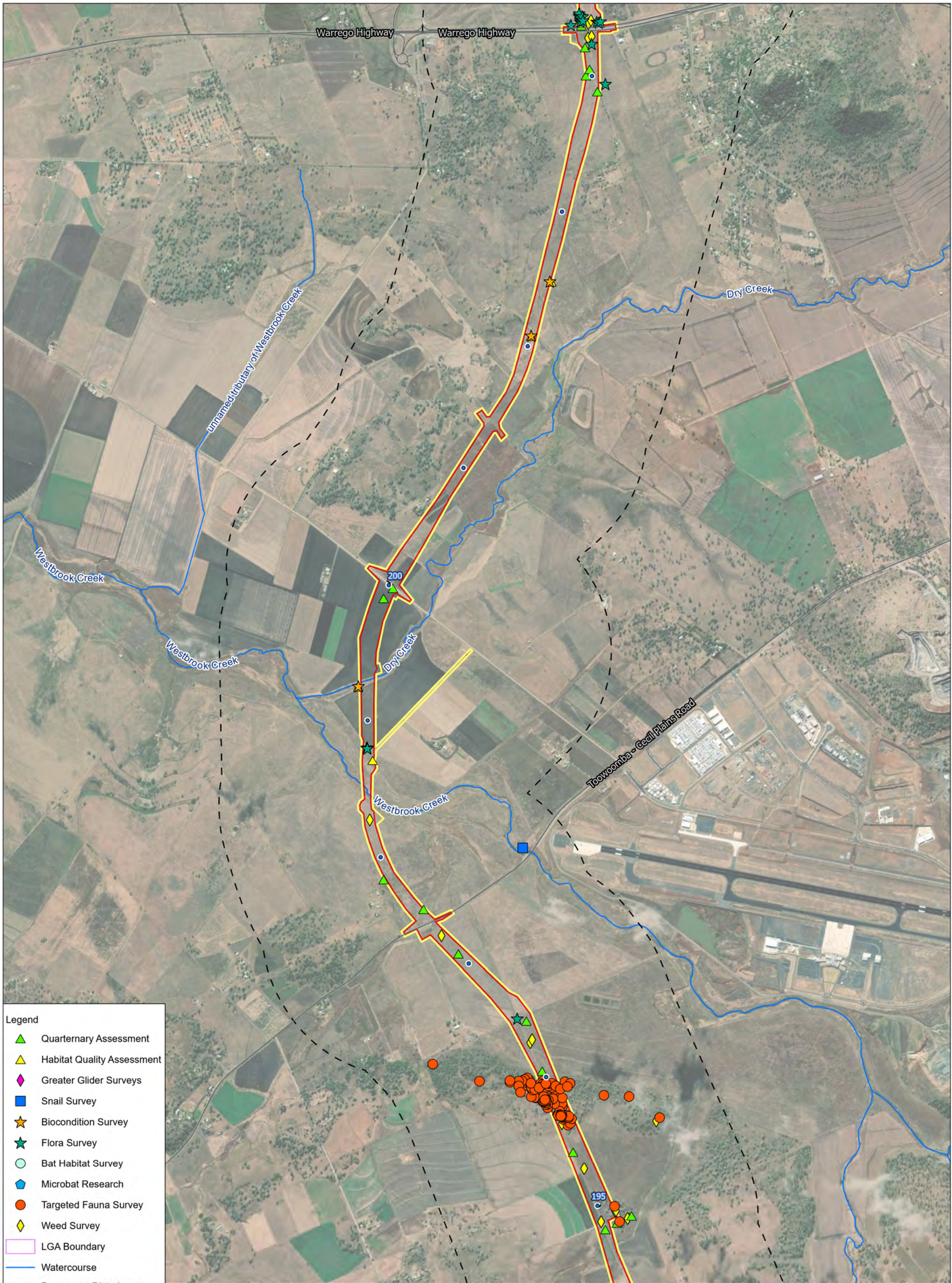
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F3.1(28) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

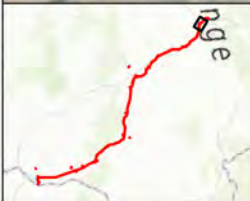
ARTC

ERM



Legend

- Quarternary Assessment
- Habitat Quality Assessment
- Greater Glider Surveys
- Snail Survey
- Biocondition Survey
- Flora Survey
- Bat Habitat Survey
- Microbat Research
- Targeted Fauna Survey
- Weed Survey
- LGA Boundary
- Watercourse
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Study Area
- Chainage (km)



Coordinate System:
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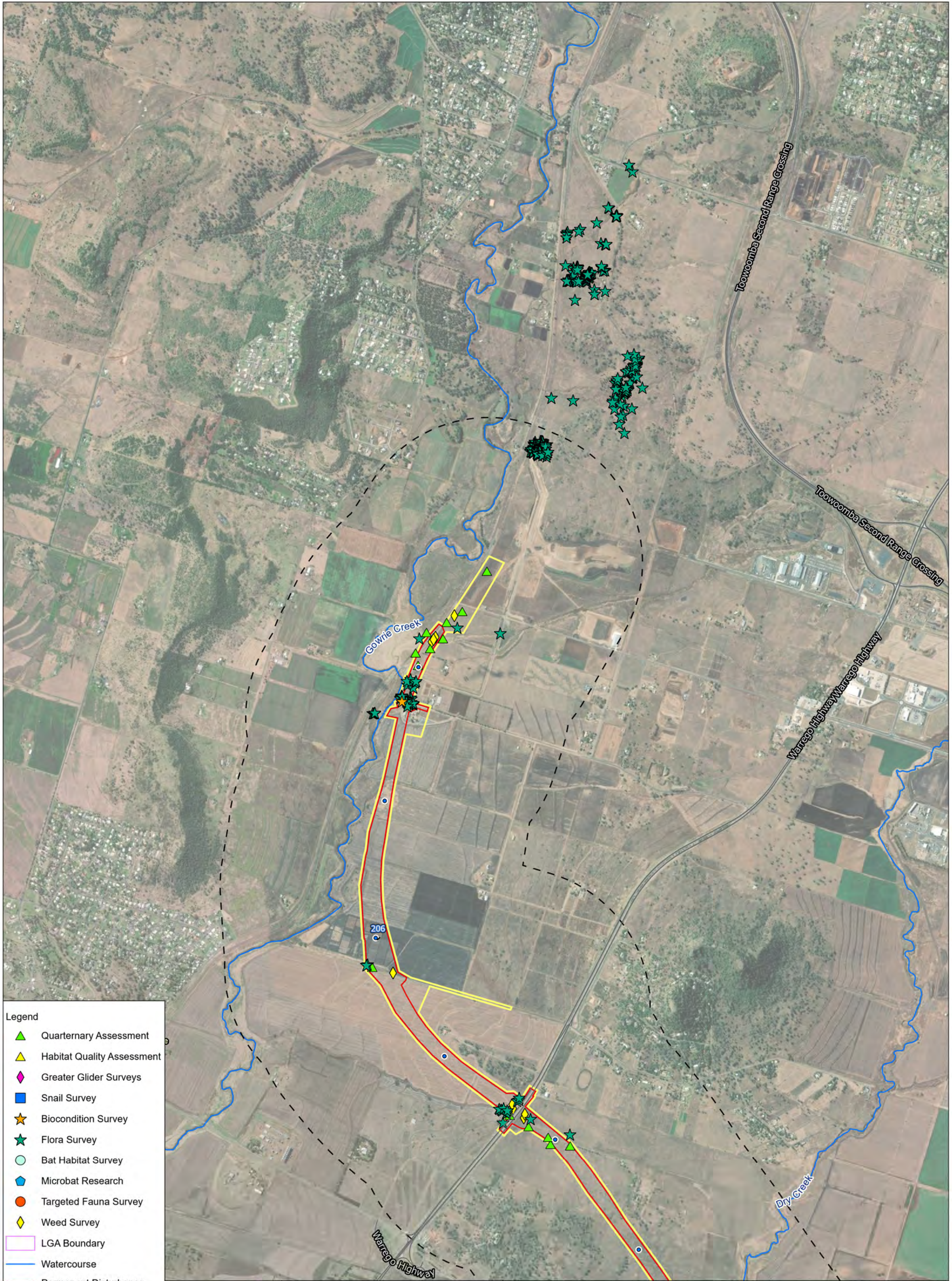
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F3.1(29) - Field Survey Locations

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



3.3.2.2 FLORA FIELD SURVEYS

Targeted threatened flora surveys and ground-truthing of vegetation and habitat were conducted by Cardno (2021), Ausecology (2022), EMM (2024) and UniSC (2024, ongoing) within the Project footprint to address knowledge gaps from the desktop assessment and preliminary field surveys. Reporting and methodologies associated with each of these surveys are summarised in following sections and provided in detail within Appendix A Additional Ecological Investigations.

Regional Ecosystem validation

Regional ecosystem validation was conducted by Cardno (2021) and Ausecology (2023). Quaternary assessments were conducted as per the *Methodology for Surveying and Mapping Regional Ecosystems and Vegetation Communities in Queensland Version 5.1* (Neldner et al., 2020). At each quaternary point, RE classification was confirmed using the definitions of remnant, regrowth, and non-remnant vegetation, as defined under the VM Act and using the relevant BioCondition benchmark. RE validation was undertaken to inform habitat mapping.

BioCondition assessment

BioCondition assessments were undertaken by Cardno (2021) and Ausecology (2023) in accordance with the *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland – version 2.2*. (Eyre et al., 2015) to assess vegetation quality and assign BioCondition Scores. Following collection of field data, further analysis was conducted to calculate landscape attributes to be assessed in conjunction with site-based attributes to determine the overall BioCondition Score for each site and habitat quality scores as required and defined within revised draft EIS Appendix Q: Environmental Offset Delivery Strategy.

Threatened ecological communities

The EPBC Act definition of each potentially occurring TEC was examined and, following ground-truthing of REs, any RE likely to be associated with one (or more) TECs were further assessed against the descriptions, key diagnostic characteristics, condition categories and thresholds as detailed in the respective approved conservation advice documents and provided in further detail in the methods of the technical reports (Appendix A).

TEC assessments were undertaken by Cardno (2021) and Ausecology (2023). Areas adjacent to the TEC impact areas were assessed for viability post impact.

A further survey for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC was conducted by ERM in summer 2023 in an isolated patch within the Project footprint. Previous surveys had been unable to confirm the extent of the patch. Further detail on this survey has been provided in the technical memo in Appendix A. Ausecology undertook TEC assessments in 2023 to verify the SEVT community boundary to inform the updated TEC extent.

Additional TEC surveys were undertaken by Ausecology in March 2024. This area is contiguous with the box-gum grassy woodland TEC within the Project footprint.

Targeted flora surveys

Flora surveys conducted by Cardno (2021) targeted habitat for several threatened flora species which were searched for and mapped within the Project footprint and a wider (100 m) buffer within areas mapped as 'high risk' by the NC Act Protected Flora Survey Trigger Map at the time of surveys. The survey effort for threatened flora species focused on habitat considered suitable for the target species identified by the desktop assessment (Section 4.3.1). The detailed targeted flora survey methodology employed by Cardno (2021) is provided in Appendix A Additional Ecological Investigations, including a summary of the survey effort for threatened flora species known or likely to occur in Appendix A: Field Action Plan of the Cardno report (Appendix A Additional Ecological Investigations).

Ausecology (2021-2022) also recorded incidental observations of threatened flora while undertaking field surveys within the Project footprint. For areas subject to detailed flora surveys these were conducted in accordance with the *Flora Survey Guidelines – Protected Plants* (DES, 2020). Survey methodology followed that of a meander survey, with properties traversed on foot. During traversal, ecologists maintained approximately 10-25 m spacing between search lines, walking at a pace where species remained detectable. Any potential threatened species that could not be identified in the field were collected and submitted to the Queensland Herbarium for formal identification (Appendix C Herbarium Verification).

EMM (2024) conducted two protected flora surveys on 18-19 December 2023 and 22 February 2024, in accordance with the *Flora Survey Guidelines – Protected Plants* (DES, 2020). The area surveyed overlapped with a small section of the Project footprint at its northern extent. Within the Project footprint, EMM recorded three threatened plant species under the EPBC Act.

UniSC is undertaking ongoing targeted flora surveys within the Study area, however the final report issue of these surveys is expected in November 2024. These surveys targeted winged peppercreep (*Lepidium monoplacoides*), small-flowered westringia (*Westringia parvifolia*), Tara wattle (*Acacia lauta*), shiny-leaved ironbark (*Eucalyptus virens*), Austral toadflax (*Thesium australe*) and *Xerothamnella herbacea*.

Weed surveys

General abundance and the location of weeds listed under the Biosecurity Act were recorded within the Project footprint. An average density cover for each weed species observed was recorded every 1 km throughout the Project footprint. Averages were based on criteria listed in the Spatial Pest Attributes Standard (Calvert, 2012) where:

- densities were calculated from a percentage of groundcover for grasses and herbs, vines, aquatic weeds and cacti; and
- densities were calculated from the number of woody stems/10 m² for woody vegetation.

3.3.2.3 FAUNA FIELD ASSESSMENT

Fauna surveys were completed within the Project footprint. Methodologies associated with each of the surveys is summarised in following sections and provided in detail within Appendix A Additional Ecological Investigations and results presented in Section 4.

Fauna habitat assessments

Habitat assessments were completed by Auecology (2022) and were generally co-located with BioCondition assessment sites. Additional habitat assessments were undertaken opportunistically within the Project footprint to capture habitat features and/or provide a comprehensive sample of the condition of an assessment unit and the supporting habitat.

Habitat assessments were undertaken in accordance with *Guide to determining terrestrial habitat quality – version 1.2* (DEHP, 2017) and included the collection of habitat-associated data required for undertaking the habitat quality assessment methodology, including identification of notable habitat features that were representative of the general area, such as:

- soil type;
- presence of watercourses/wetlands;
- groundcover features; and
- presence and abundance of key habitat features including hollow-bearing trees and stags, fallen logs/woody debris, and mistletoes.

Targeted fauna survey methods

Targeted threatened fauna surveys were undertaken by Cardno (2021), Boobook Consulting (2022), Hydrobiology (2023), BAAM (Williams, 2023), ERM (2024a) and UniSQ (ongoing) to ground-truth the Project footprint and target threatened fauna species. Methodologies employed as part of these targeted fauna surveys followed the guidelines of relevance and are summarised in the following sections, provided in Appendix A Additional Ecological Investigations and summarised in Table 3-5.

Cardno surveys

Cardno established 12 targeted terrestrial fauna survey sites, each of which was surveyed over five days and four nights during each of two seasonal surveys (spring, October and November 2020, and post-wet, March 2021). Methods employed at all fauna survey sites included a mix of fauna survey techniques as per species-specific survey guidelines, with survey methods including:

- call playback;
- spotlighting;
- stag watching;
- dawn/dusk surveys;
- habitat assessments;
- indirect detection;
- active diurnal searches;
- camera traps;
- hair tube traps;
- pitfall traps;
- Elliott traps;
- cage traps;

- artificial burrows;
- bat detectors (Anabat or Songmeter);
- harp traps;
- funnel traps; and
- pest animal assessments.

A further ten 'additional sites' were surveyed within the Project footprint, each of which was surveyed over a single day over the duration of the survey periods. The methodologies employed at the 'additional sites' were limited to 'passive' surveys consisting of habitat assessments and opportunistic observations only (i.e. did not involve trapping of fauna).

Following the initial observations regarding the availability and location of suitable habitat for Condamine earless dragon (*Tympanocryptis condaminensis*), additional survey effort targeting this species was undertaken by Cardno during the post-wet survey period (March 2021). Based on a desktop assessment of the suitability of habitat for this species, two sites were identified for the placement of species-specific traps in the form of small artificial arthropod burrows in accordance with the methods by Osborne (2018). A total of 28 traps were installed per site and checked twice daily with walking visual transects also undertaken in the surrounding habitat.

Elsewhere along the alignment, fauna, and habitat observations (including wildlife corridors and habitat features) were recorded opportunistically.

Brigalow woodland snail surveys (Boobook)

Targeted surveys for the brigalow woodland snail (*Adclarkia cameroni*) were completed by Boobook Consulting in 2022. The field survey was conducted over a five-day period in August 2022 and included survey of 20 sites between Wellcamp (near Toowoomba) and Canning Creek (between Millmerran and Inglewood). The methodology included targeted snail searches using active searching (rolling logs and other ground debris, checking the inside of hollow logs, overturning rocks/rock piles, lifting fallen bark piles, and raking through leaf litter and piles of fallen bark and flood debris). The undersides and hollows of logs were checked for aestivating live snails, while the top few centimetres of soil beneath logs was raked to detect whole shells or fragments of dead snails.

Greater glider surveys (ERM)

Following new habitat assessment methodology published in Eyre et al. (2022b), the key guidance on describing greater glider (southern and central) habitat in relation to assessments under the EPBC Act, ERM conducted spotlighting and habitat assessment surveys in areas previously assessed by Ausecology as potential greater glider (southern and central) habitat. ERM conducted spotlighting and habitat assessment surveys in areas previously assessed by Ausecology as potential greater glider (southern and central) habitat. Targeted greater glider surveys were completed over a four-day period in December 2023 and spanned 13 sites between Millmerran and Inglewood. The methodology included vegetation assessments to determine if suitable habitat was present and nocturnal spotlighting transects in each site. Detailed methodology of this survey is described in Appendix A Additional Ecological Investigations.

Aquatic ecology surveys (Hydrobiology)

Hydrobiology (2023) undertook an eDNA survey to build on the survey effort for aquatic species already undertaken (Table 3-5). A total of 10 sites were assessed, based on the location of preliminary aquatic field survey locations and expert knowledge. At each site, eDNA samples were collected and a habitat assessment was completed concurrently using AUSRIVAS. Further details on the eDNA survey are available in Appendix A Additional Ecological Investigations.

Bat surveys (BAAM)

Targeted threatened bat surveys were conducted by BAAM in March-April 2023 to assess the presence of south-eastern long-eared bat and large-eared pied bat. These surveys involved numerous survey methods, including harp trapping, bat call identification, radio-tracking and habitat assessments to inform the impact assessments and habitat mapping within the Project footprint.

Koala, reptile and wild dog surveys (UniSQ)

University of Southern Queensland is conducting ongoing koala, reptile and wild dog surveys within a broad area including the Project footprint to assess species movement, habitat utilisation, dietary preferences, risks and the impacts on threatened species and mitigation requirements. The primary objectives of these ongoing surveys included assessing koala diet and movement patterns; assessing risks posed by wild dogs; assessing wild dog management strategies, assessing capture success and reptile habitat preferences; assessing the relationship between land use practices and reptile presence/absence; and assessing reptile genomes for associations with artificial habitat designs.

3.3.3 SUMMARY OF SURVEY EFFORT

A summary of the preliminary field survey effort (for the draft EIS released in 2021) and survey effort undertaken by Cardno (2021), Ausecology (2022), Boobook Consulting (2022), Hydrobiology (2023) and ERM (2024a) is presented in Table 3-5.

Incidental sightings of threatened fauna were also recorded during all field surveys of the Project footprint. However, this effort has not been quantified. Surveys have taken place across multiple years and within all seasons.

Refer to Appendix F Survey Adequacy for an in-depth assessment of the survey requirements and field survey effort for all threatened flora and fauna under the EPBC Act and NC Act.

TABLE 3-5 SUMMARY OF TARGETED FAUNA SURVEY EFFORT

Survey method	Target species/ Fauna group	Preliminary field surveys	Revised draft EIS field surveys	Total survey effort
Call Playback	Birds	-	12 sites x 5 hours x 2 survey periods	120 hours
	Mammals	-	12 sites x 1 hour x 2 survey periods	24 hours
Spotlighting	Mammals	-	37 x 200 m transects	37 x 200 m transects

Survey method	Target species/ Fauna group	Preliminary field surveys	Revised draft EIS field surveys	Total survey effort
	Greater glider (southern and central)	-	13 x 200 m transects in previously mapped greater glider habitat	13 x 200 m transects
	Reptiles	-	12 sites x 6 hours x 2 survey periods	144 hours
Stag watching	Mammals	-	12 sites x 80 minutes x 2 survey periods	32 hours
Greater glider (southern and central) habitat assessments	Greater glider (southern and central)	-	30 habitat assessments across 13 sites (~1 assessment per 100 m of previously mapped greater glider (southern and central) habitat)	30 habitat assessments
Koala Rapid Assessment Method	Koala	-	35 sites	-
Dawn survey	Birds and butterflies	-	12 sites x 4 hours x 2 survey periods	96 hours
Dusk survey	Birds and butterflies	-	12 sites x 4 hours x 2 survey periods	96 hours
	Bats (fly out)	-	12 sites x 4 hours x 2 survey periods	96 hours
General bird surveys	Birds	44 sites x 20 minutes	20 sites x 20 minutes	21.2 hours
	Reptiles	44 sites x 20 minutes x 2 people	-	29.3 hours
Area searches (scats, tracks etc.)/ incidental flushing	All fauna groups	-	12 sites x 8 hours x 2 survey periods	96 hours
Active diurnal searches (for individuals and habitat)	Mammals	-	37 x 100 m transects	37 x 100m transects
	Reptiles	-	12 sites x 3 hours x 2 survey periods 10 additional opportunistic sites and transects	72 hours
	Birds	-	12 sites x 4 hours x 2 survey periods	96 hours
	Land snails	-	20 sites x 2 hours	40 hours
Camera traps	All fauna groups	-	12 sites x 20 traps x 4 nights x 2 survey periods	969 trap nights
	Predators	-	100 traps (2 km apart) x 10 months	~ 30,000 trap nights

Survey method	Target species/ Fauna group	Preliminary field surveys	Revised draft EIS field surveys	Total survey effort
Hair tube traps	Mammals	-	12 sites x 20 traps x 4 nights x 2 survey periods	1920 trap nights
Pitfall traps	Reptiles	-	12 sites x 6 pitfalls x 4 nights x 2 survey periods	576 trap nights
Elliott traps (Type A)	Mammals	-	12 sites x 20 traps x 4 nights x 2 survey periods	1920 trap nights
Cage traps and Elliott traps (Type B)	Mammals	-	12 sites x 10 traps x 4 nights x 2 survey periods	960 trap nights
Artificial burrows	Condamine earless dragon	-	2 sites x 58 traps x 6 nights x 2 survey periods	696 trap nights
Bat detectors (unattended)	Microbats	7 trap nights 12 trap nights	12 sites x 1 Anabat / Songmeter x 4 nights x 2 survey periods	115 trap nights
Bat detectors (attended)	Microbats	-	12 sites x 4 hours x 2 survey periods	96 hours
Harp traps	Microbats	-	12 sites x 2 survey periods	96 trap nights
Funnel traps	Reptiles	-	12 sites x 2 traps (one on either end of pitfall drift fence) x 4 nights x 2 survey periods	192 trap nights
Aquatic habitat assessments	Aquatic species including platypus	20 sites	-	20 sites
Macroinvertebrate sampling	Aquatic macroinvertebrates	7 sites	-	7 sites
Fish surveys	Aquatic species including platypus	6 sites	-	6 sites
eDNA-Hydrobiology	Aquatic MNES and platypus	-	3 samples x 10 sites	30 eDNA samples
GPS collaring	Koala	-	43 individuals captured and collared for up to 431 days; 12 retained for continual tracking	25,610 GPS points – monitoring ongoing
	Wild dogs and foxes	-	3 wild dogs and 4 foxes captured and collared for 401 days; 2 dogs and 1 fox retained for continual tracking	3,018 GPS points – monitoring ongoing
Reptile trapping grids	Reptiles	-	20 sites surveyed monthly	208 site surveys

Survey method	Target species/ Fauna group	Preliminary field surveys	Revised draft EIS field surveys	Total survey effort
			• 4 sites x 12 survey periods • 4 sites x 11 survey periods • 8 sites x 10 survey periods • 4 sites x 9 survey periods	
Reptile rock piles	Reptiles	-	5 paired sites x 5 survey periods	25 site surveys

3.3.4 WHETSTONE MDC AND BORROW PIT SURVEYS

3.3.4.1 WHETSTONE MATERIAL DISTRIBUTION CENTRE ENVIRONMENTAL ASSESSMENT

Umwelt (2022) conducted an Environmental Assessment within the MDC development footprint, comprising 212.62 ha. Investigations focused on MSES and MNES. Prior to field investigations, Umwelt completed desktop analysis of publicly available environmental databases and historic field surveys. Investigations were undertaken on 20 September 2022 and included quaternary assessments, fauna habitat assessments and active searches, diurnal bird surveys and opportunistic flora and fauna sightings.

Further information is available in Appendix A: Whetstone Material Distribution Centre Environmental Assessment.

3.3.4.2 BORROW PIT ECOLOGICAL SURVEYS

Field surveys were conducted for seven borrow pits at six sites on 5-6 September 2023 (Ausecology, 2024a). These surveys included ground-truthing Regional Ecosystems, BioCondition assessments, targeted flora surveys and incidental fauna surveys. The detailed survey methodology is provided in Appendix A: Additional Ecological Investigations.

3.4 HABITAT MAPPING

Post-field analysis of ground-truthed data was undertaken to produce detailed habitat mapping within the Project footprint for threatened flora and fauna species identified as known or likely to occur within the Project footprint. Habitat mapping was also developed for all MNES species with the potential to occur within the Project footprint and specific MSES species with the potential to occur as requested by the Coordinator General.

For threatened flora species known to occur within the Project footprint, habitat mapping was developed using records from field surveys and online databases. Where flora species were recorded during field surveys, habitat was mapped using methods outlined in *Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method* (DPIE, 2020) with regard to defining an area of suitable habitat. Individuals identified by point locations were buffered by a 30 m radius, with overlapping boundaries combined to form complete polygons. For all other flora records, habitat was mapped in accordance with

the *Method for mapping matters of state environmental significance* (DESI, 2024a) where all flora records were compiled, vetted and buffered by a 1 km radius, to map areas of suitable habitat.

Habitat definitions were written to support habitat mapping for all other relevant threatened species. Habitat suitability and function was assessed by suitably qualified ecologists in accordance with published information concerning the known supporting habitat characteristics for each species together with relevant approved Conservation Advices, Recovery Plans, SPRAT profiles, DESI species profiles and other literature where available. This analysis identified the functional types of habitats (breeding, foraging, roosting, nesting or denning, dispersal) that occur for fauna species (where applicable) and therefore the aspect of the species' functional ecology that would be impacted by the Project. Habitat definitions were then reviewed by species experts (as detailed in Section 3.4.1) and refined where advised. These habitat descriptions and mapping rules are presented in the Threatened species profiles in Appendix G Species Profiles.

Numerous targeted field surveys (as per Section 3.3) were conducted within the Project footprint and used to identify areas of species habitat. Final habitat definitions were mapped by Ausecology and reviewed by Ausecology, ERM, ARTC and/or species experts until all consultants were satisfied with the final mapping.

3.4.1 EXPERT CONSULTATION

ERM consulted with species experts on habitat definitions, including habitat mapping rules. Based upon feedback received, ERM updated these accordingly. Additionally, these species experts reviewed the survey adequacy table for the species relevant to their expertise. Experts consulted were:

- Bats – Dr Elizabeth Williams, Biodiversity Assessment and Management (BAAM);
- Brigalow woodland snail – Craig Eddie, Boobook Consulting;
- Gliders – Dr Teresa Eyre, Queensland Herbarium and Biodiversity Science, Department of Environment, Science and Innovation;
- Murray cod – Andrew Berghuis, Aquatic Biopassage Services;
- Reptiles – Dr Jon-Paul Emery, University of Southern Queensland;
- Spotted-tailed quoll – Dr Scott Burnett;
- Koala – Dr David Dique, ERM; and
- Squatter pigeon – Ned Bowden, ERM.

Updated habitat definitions were mapped by Ausecology. Mapping rules and mapped habitats were reviewed and adjusted by Ausecology, ERM, ARTC and/or species experts until all consultants were satisfied with the final mapping.

3.5 IMPACT ASSESSMENT METHODOLOGY

3.5.1 NOISE IMPACT ASSESSMENT

Assessments were undertaken for construction and operation separately, allowing for the different characteristics of noise and vibration such as duration and frequency, noting short term impacts associated with construction and the limited passes per day during operations,

such that even if disturbance occurs highly mobile species can likely move in and out of impacted habitat, or will habituate Noise impact assessment methods involved:

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

3.5.2 ALTERED HYDROLOGY AND FLOODING IMPACT ASSESSMENT

Impacts on MSES associated with flooding were assessed using the following approach, with each step further detailed in the below sections and Figure 3-2:

1. Risk assessment: Risk assessment of listed threatened species known and likely to occur, to determine those protected matters that are subject to a negligible, low, medium or high risk of changes to hydrology. See Section 5.2.10.1 for details.
2. Habitat mapping outside of the Project footprint: For those protected matters with a low to high rating in the risk assessment, habitat mapping has been prepared outside of the footprint within 5 km of the centre of the rail line. See Section 5.2.10.2 for details.
3. Assessment of susceptibility: The 1% annual exceedance probability (AEP) (1 in 100-year flood) scenario was overlaid on the habitat mapping and used to identify those protected matters that are susceptible to changes in flooding, requiring detailed quantification of impacts. See Section 5.2.10.3 for details.
4. Quantification of flooding impacts: Detailed quantification of changes in inundation area, duration, depth, and velocity as modelled under three scenarios, 20% AEP (1 in 5-year flood), 10% AEP (1 in 10-year flood), and 5% AEP (1 in 20-year flood) for relevant at-risk protected matters (as determined by steps 1 and 3 above). See Section 5.2.10.4 for details.
5. Impact assessment: Impact assessment of the outcomes of the quantification and determination of significant residual impacts. See Section 5.2.10.5 for details.

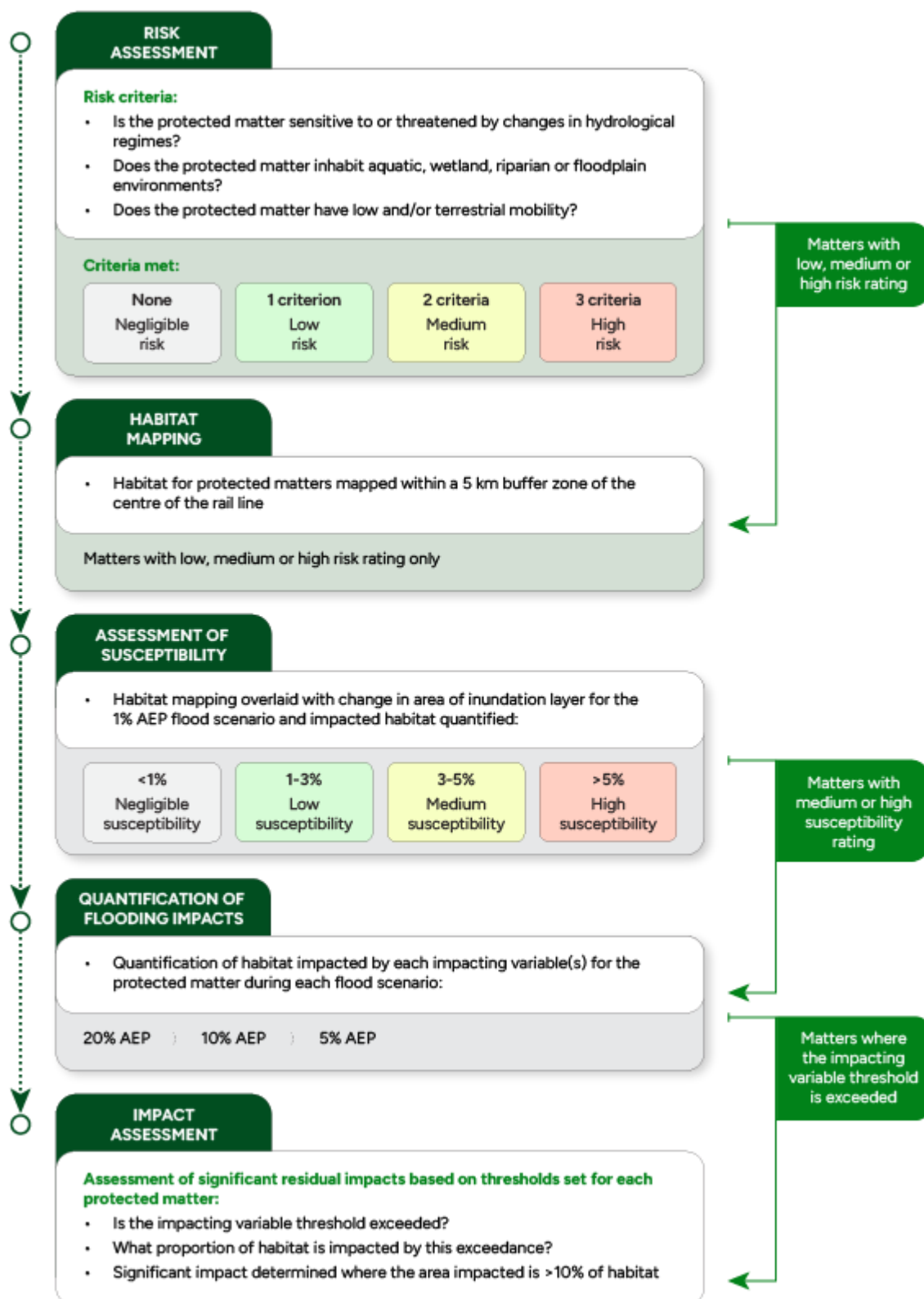


FIGURE 3-2 FLOW CHART OF FLOODING IMPACT ASSESSMENT

3.5.3 TERRESTRIAL ASSESSMENT

The terrestrial assessment of the Project used a significance-based impact assessment framework to identify and assess Project related impacts in relation to ecological values which was informed by the information collected for the Project. Detailed field surveys have been undertaken from 2021 through to 2024 (Appendix A Additional Ecological Investigations). This material has been used to assess the potential impacts from direct disturbance within the Project footprint (Section 7.1). Potential indirect disturbance to ecological values within the Study area but outside of the Project footprint has been informed by desktop mapping, and the preliminary field surveys (Section 5.1).

For impact assessment, terrestrial ecology components have been assessed both quantitatively (e.g. quantity measurements for direct impacts) and qualitatively (e.g. via categorisation for indirect impacts).

Threatened and SLC (restricted to fauna, as per the guidelines; DEHP, 2014b) matters listed under the NC Act and considered likely or known to occur within the Project footprint, were assessed as applicable to the Project. A number of species that have the potential to occur within the Project footprint were also assessed for significant residual impacts at the request of the Office of the Coordinator General.

3.5.4 AQUATIC ASSESSMENT

The aquatic assessment employed a qualitative assessment, based on the sensitivity of environmental receptors. This method has been targeted to areas where an impact will occur, to assess the sensitivity or vulnerability of the ecological values and the magnitude of the impact. Sensitivity criteria, magnitude criteria and a significance matrix were established to facilitate the assessment of Project impacts before and after the implementation of mitigation measures, to minimise the duration, intensity or extent of impacts are provided in Sections 5 and 5.3.8.

The aquatic conservation assessment using AquaBAMM¹ 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 (DEHP, 2015). The aquatic conservation assessment provides an overall conservation value (AquaScore) ranging from very low to very high, for each spatial unit (e.g., wetland), which is based on eight separate criteria. Each criterion value is formed through a mathematical combination of measures and indicators.

3.5.5 SIGNIFICANT RESIDUAL IMPACT ASSESSMENT

A significant residual impact (SRI) assessment has been undertaken in accordance with the criteria provided in the Significant Residual Impact Guidelines (DEHP, 2014b) for relevant MSES within the Project footprint

¹ AquaBAMM is a decision support tool that utilises existing information and expert input to assess conservation value of aquatic ecosystems. It uses a robust and easily accessible analysis of ecological or conservation values associated with a catchment that is useful for catchment, sub-catchment and regional planning. It is applicable in freshwater riverine, freshwater non-riverine (lacustrine and palustrine) and estuarine wetlands.

Detailed significant impact assessments were undertaken for MSES against criteria set out in the Significant Residual Impact Guidelines (DEHP, 2014b), specific to each prescribed environmental matter, i.e. regulated vegetation, connectivity areas, protected wildlife habitat, and waterways providing for fish passage.

The assessment of significant impacts associated with the Project is based on:

- Ground-truthed extent of suitable habitat for threatened species (Appendix G Species Profiles, and Sections 4.3 (threatened flora) and 4.4 (threatened fauna));
- Potential habitat mapping outside of the Project footprint for produced for assessment of impacts relating to changes in hydrology and flooding (Section 5.2.10 and Appendix G Species Profiles);
- The revised reference design and incorporated mitigation measures (Section 1.3.3 and Section 6.2);
- Information on potential impacts of Project during construction and operation (Section 5.2 and Section 5.3); and
- Proposed post-approval mitigation measures (Section 6.3, Table 6-1, Table 6-2Table 6-1 and Table 6-3).

Only relevant information from these sections is reiterated in the SIA tables to support conclusions made.

For MSES that are also considered MNES, a Significant Impact Assessment was undertaken in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE, 2013) (see Section 6.4 and revised draft EIS Appendix O: Matters of National Environmental Significance Report). It was considered that the areas included in this assessment were the same or substantially the same as what would be assessed under an MSES SRI, therefore they have not been assessed in this report (refer to Table 7-1).

3.5.6 CUMULATIVE IMPACT ASSESSMENT

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

The following sections outline the selected projects and the method applied in the Cumulative Impact Assessment (CIA).

3.5.6.1 APPROACH

The approach used to identify and assess potential cumulative impacts of this Project was:

- A review of the potential impacts identified within this assessment. The environment at the time of the ToR is the baseline, prior impacts from past land use have not been considered.
- A preliminary list of projects for consideration in the CIA was collated with estimated timelines to demonstrate the temporal relationship between projects. The assessable projects are relevant at the time of receiving the request for additional information from the Office of the Coordinator-General. These comprise projects that meet either one or more of the selection criteria summarised in Section 3.5.6.2.

- Identification and mapping of the assessable projects and area of influence (AOI) of each specific matter being considered to determine the spatial overlaps. Predictive habitat mapping was used to estimate habitat within the AOI.
- Where there is a potential overlap in impacts (either spatially or temporally), a CIA has been undertaken to determine the nature of the cumulative impact. This includes:
 - Where possible, the assessment method has been quantitative in nature; however, qualitative assessment has also been undertaken for some specific matters.
 - The probability, duration and magnitude/intensity of the impacts have been considered, as well as the sensitivity of the receiving environmental conditions.
- An assessment matrix method (see Section 3.5.6.3) has been used to determine the significance of cumulative impacts with respect to beneficial or detrimental effects.
- Where cumulative impacts were deemed to be of 'medium' or 'high' significance, additional mitigation measures were proposed, beyond those already proposed.

3.5.6.2 PROJECT SELECTION CRITERIA

Projects identified as assessable, and therefore included in the CIA, meet either one or more of the following criteria:

- 'State significant' or 'strategic' projects (i.e. coordinated projects under the *State Development and Public Works Organisation Act 1971* (QLD) (SDPWO Act) that are in the public domain as being planned, constructed or operated at the time of the assessment.
- Additional projects that have been deemed to be of local significance, as occurring through consultation with community groups and stakeholders including:
 - Projects subject to approval under the *Planning Act 2016* (QLD) and listed in the GRC and TRC development application databases;
 - Economic Development Queensland (EDQ) development projects, including development within Priority Development Areas (PDA) and State Development Areas (SDA);
 - Infrastructure designations;
 - Projects within the public register of environmental authorities;
 - Department of Transport and Main Roads (DTMR) infrastructure projects;
 - Private infrastructure facilities; and
 - Development in accordance with the *Regional Planning Interests Act 2014* (QLD).
- Other Inland Rail projects adjacent to the Project.

This assessment focuses on the cumulative impacts to MSES, and considers only projects and areas within Queensland as MSES are bound by State borders. Assessment of cumulative impacts for MNES is provided in revised draft EIS Appendix O: Matters of National Environmental Significance Report.

3.5.6.3 ASSESSMENT MATRIX

Following the identification of each potential cumulative impact, relevance factor scores of Low, Medium, and High have been determined in consideration of the impacts, in accordance with the assessment matrix in Table 3-6.

The significance of the impact has been determined by using professional judgement to select the most appropriate relevance factor for each aspect in Table 3-6 and summing the relevance factors. The sum of the relevance factors determines the impact significance and consequence which are summarised in Table 3-7. For example, if a Project impact on an ecological value such as changed flood regimes was considered to have a probability of impact of 2, duration of impact of 3, magnitude /intensity of impact of 1 and a sensitivity of receiving environment of 1 the significance of impact would be $(2+3+1+1 = 7) = \text{Medium}$.

TABLE 3-6 ASSESSMENT MATRIX

Aspect	Relevance factor		
	Low	Medium	High
Probability of impact	1	2	3
Duration of impact	1	2	3
Magnitude/intensity of impact	1	2	3
Sensitivity of receiving environment	1	2	3

TABLE 3-7 IMPACT SIGNIFICANCE

Impact significance	Sum of relevant factors	Consequence
Low	1 to 6	Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.
Medium	7 to 9	Mitigation measures likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
High	10 to 12	Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

4. RESULTS

This section contains the results of the desktop assessments and field surveys conducted within the Project footprint in Sections 4.1 to 4.8. Further details relating specifically to MLES and MSES are described in Section X and Y. Further details relating to MNES are described in revised draft EIS Appendix O: Matters of National Environmental Significance.

4.1 REGIONAL ECOSYSTEMS

4.1.1 DESKTOP ASSESSMENT RESULTS

A total of 25 REs, including two 'Endangered', seven 'Of Concern', and 16 'Least Concern' REs (VM Act status) are mapped within the Project footprint (RE mapping version 13.0). The Project footprint consists of a total of 0.07 ha of Category A vegetation, 475.37 ha of Category B (remnant) vegetation, 26.35 ha of Category C (HVR) vegetation, and 2,880.37 ha of Category X (non-remnant) vegetation. The small area of Category A vegetation was investigated through publicly available databases and reports, and it was determined that this area is not a trigger for MSES. During field surveys, this area was identified as RE 11.4.3 and brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community (TEC). State mapped REs are shown on Figure 4-1.

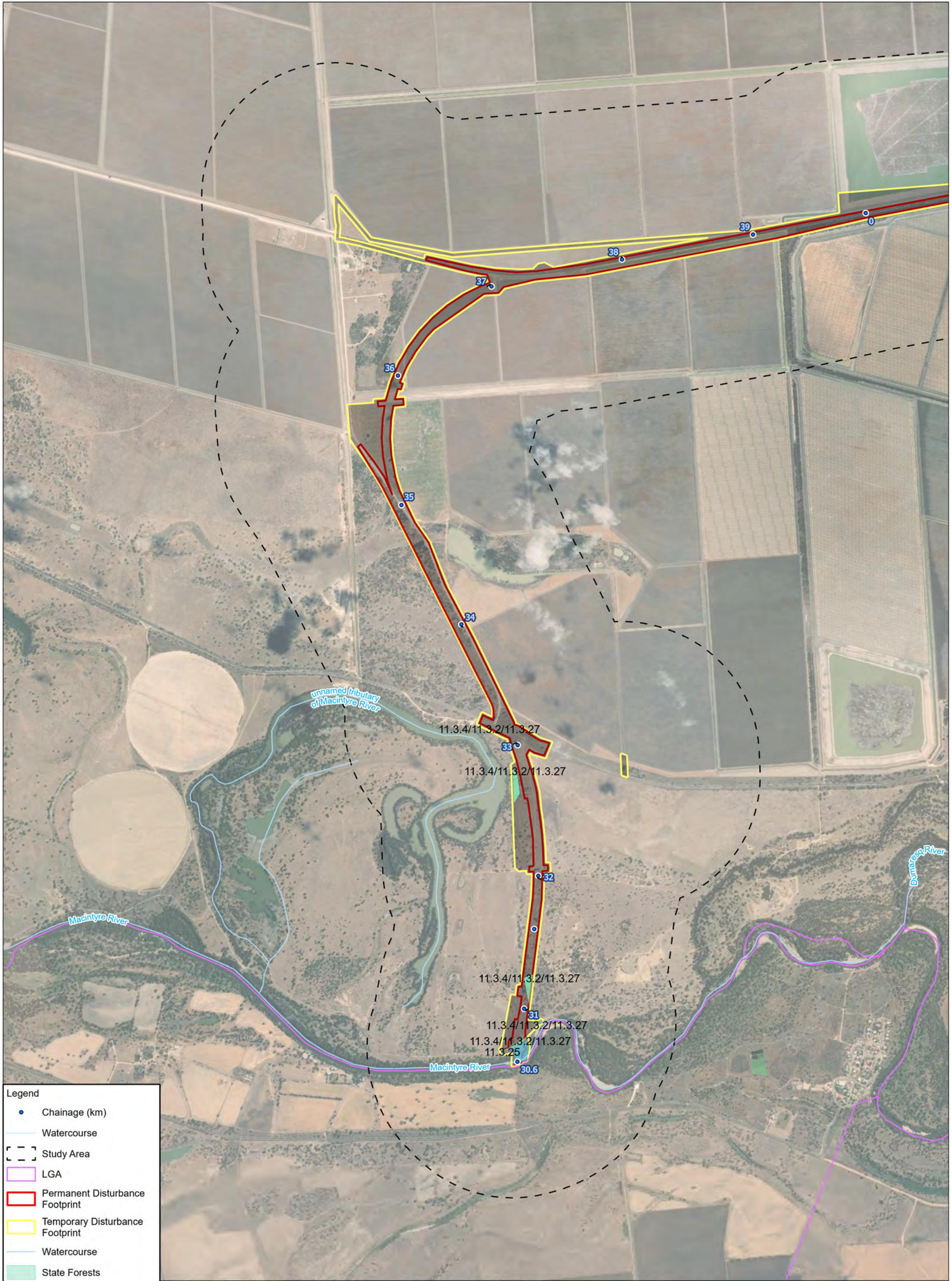
4.1.2 FIELD SURVEY RESULTS

The ground-truthed mapping frequently differed from the State RE mapping, regarding description, VM Act status, extent, and condition (e.g. remnant, non-remnant, regrowth). Ground-truthing resulted in a total of 32 REs identified within the Project footprint, with 25 REs contributing to remnant, mature regrowth and immature regrowth areas (Figure 4-2). This includes four 'Endangered', eight 'Of Concern', and 13 'Least Concern' REs (VM Act status). The remaining seven REs were non-remnant areas only and were based on State Pre-Clearing Mapping.

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

Of the 3,382.17 ha of the Project footprint, the majority (74.6%) of the area is comprised of non-remnant areas, with the remainder consisting of either remnant vegetation (16.9%), HVR vegetation (0.5%) or immature regrowth vegetation (8.0%). For detailed field descriptions of the REs, refer to Appendix A Additional Ecological Investigations.

Ground-truthed REs are shown on Figure 4-2 and a summary is provided in Table 4-1.



Legend

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

State Mapped Regional Ecosystem

- 11.3.25
- 11.3.4
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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Drawing Size: A3

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F4.1(1) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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F4.1(2) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Regional Ecosystem
- 11.4.3
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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F4.1(3) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- 11.4.3
- Non-remnant

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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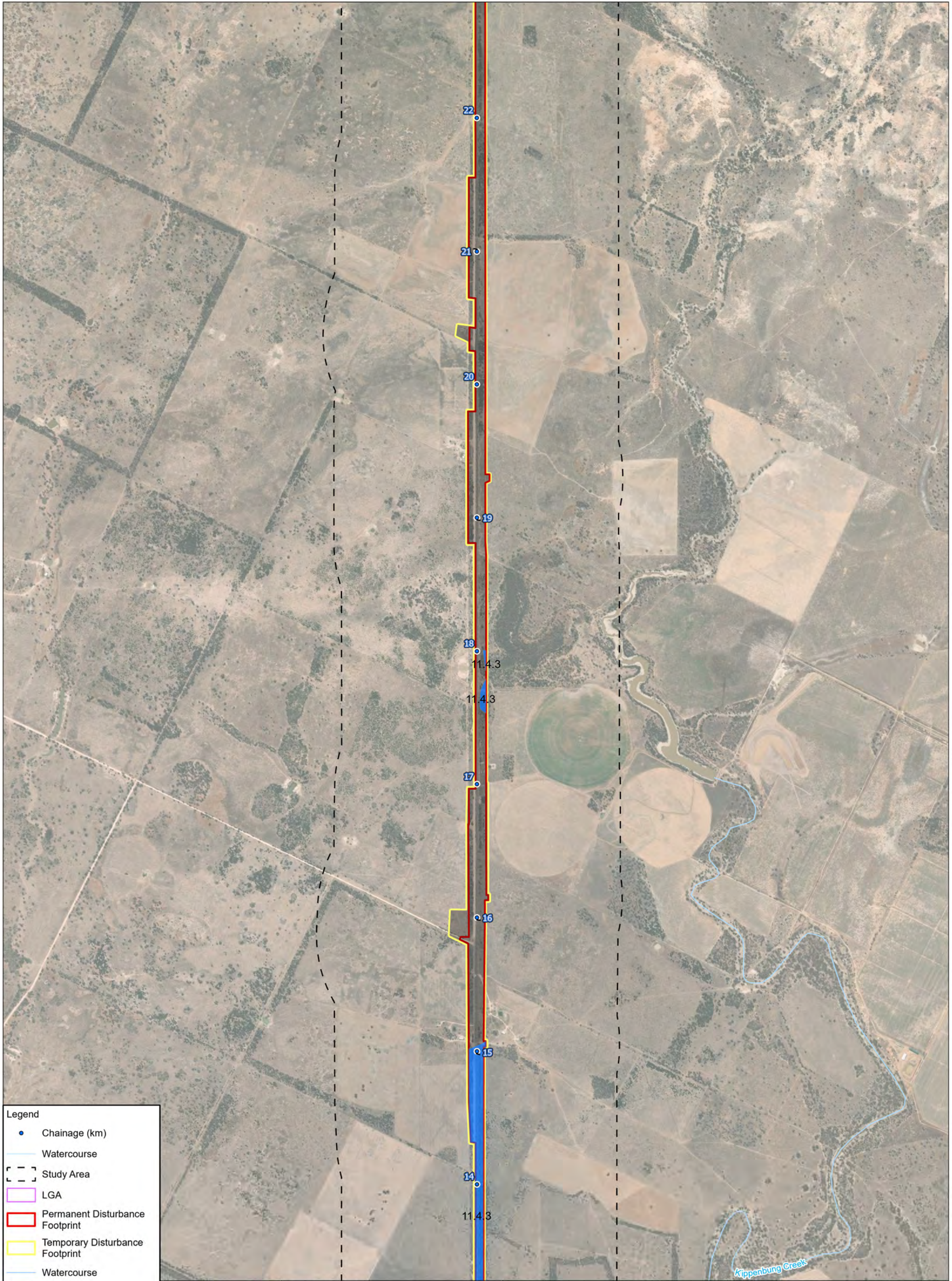
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F4.1(4) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- 11.4.3
- Non-remnant

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 200 400 600m

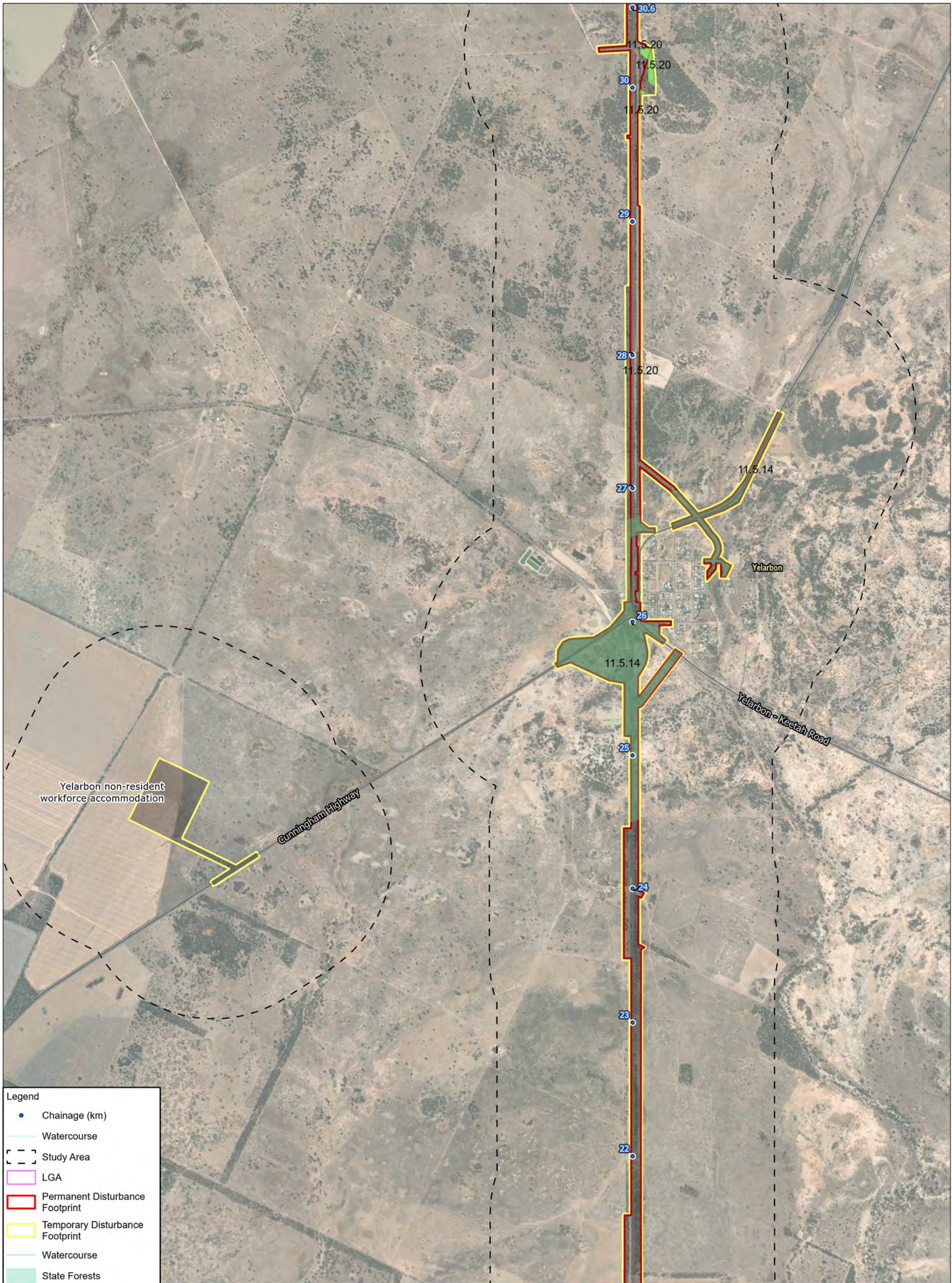
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F4.1(5) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

State Mapped Regional Ecosystem

- 11.5.14
- 11.5.20
- Non-remnant



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Date: 17/10/2024
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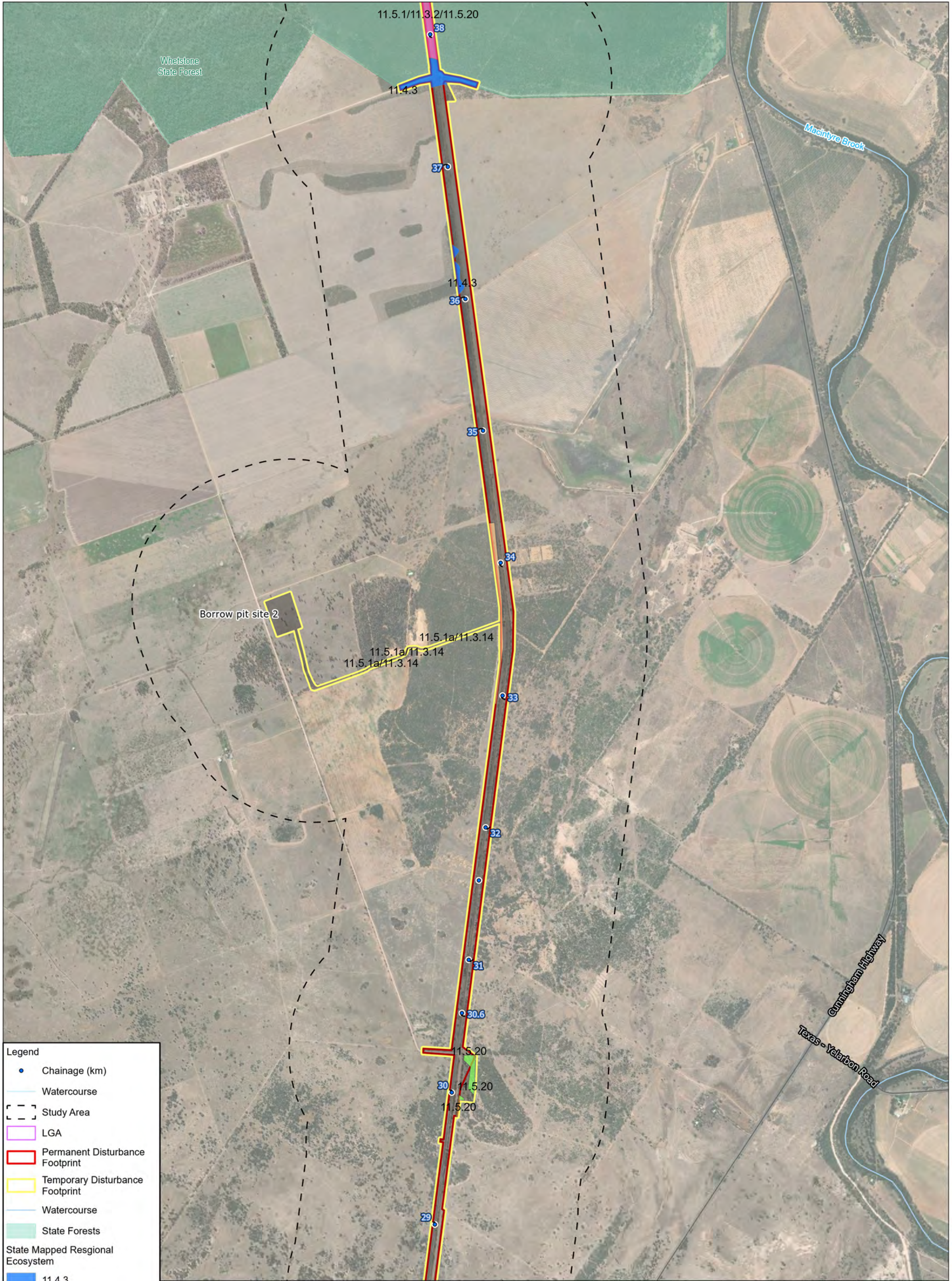


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F4.1(6) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Regional Ecosystem
- 11.4.3
- 11.5.1
- 11.5.1a
- 11.5.20
- Non-remnant



Coordinate System:
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Date: 17/10/2024

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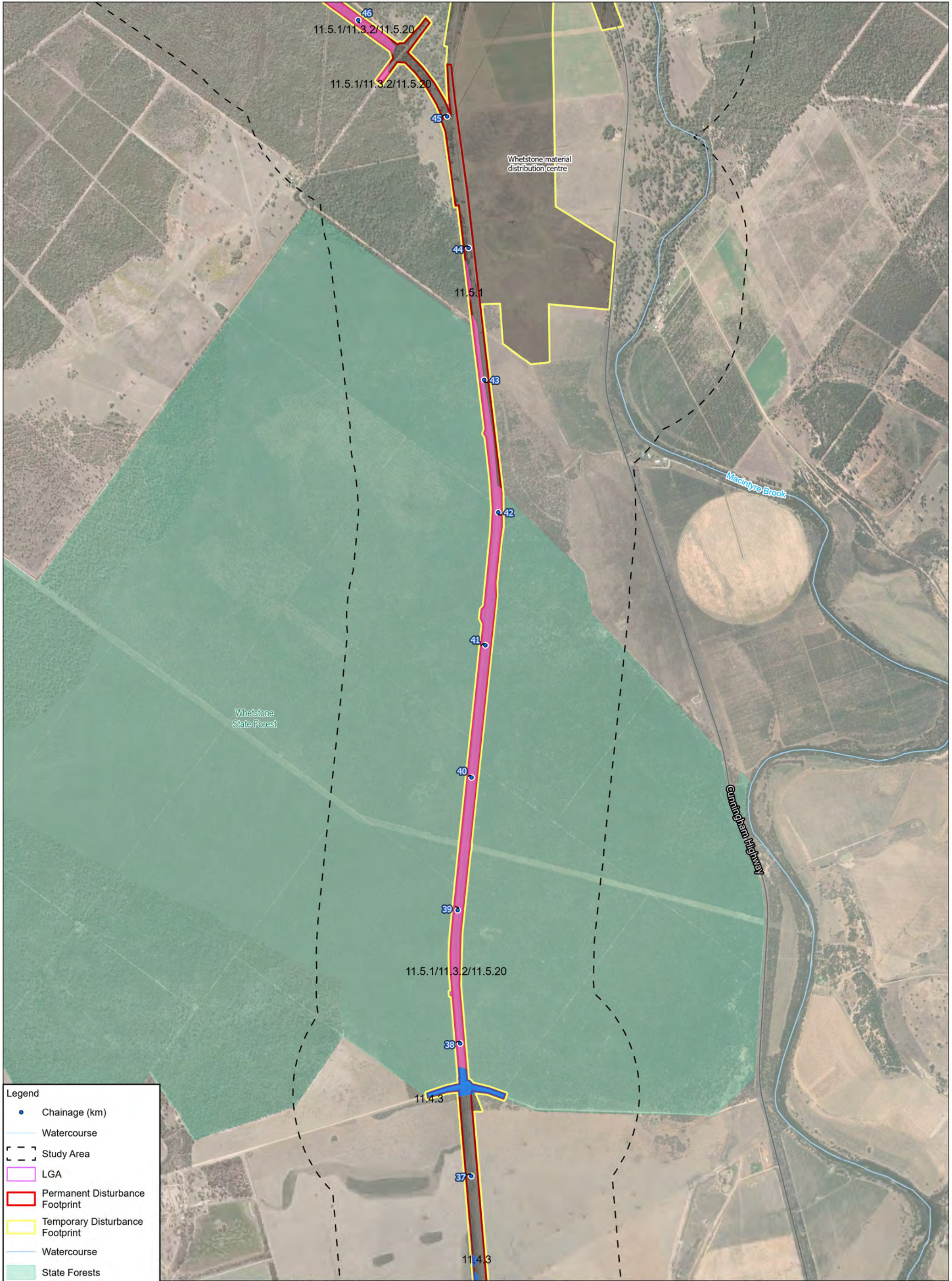
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F4.1(7) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

State Mapped Resgional Ecosystem

- 11.4.3
- 11.5.1
- Non-remnant

Coordinate System:
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Date: 17/10/2024

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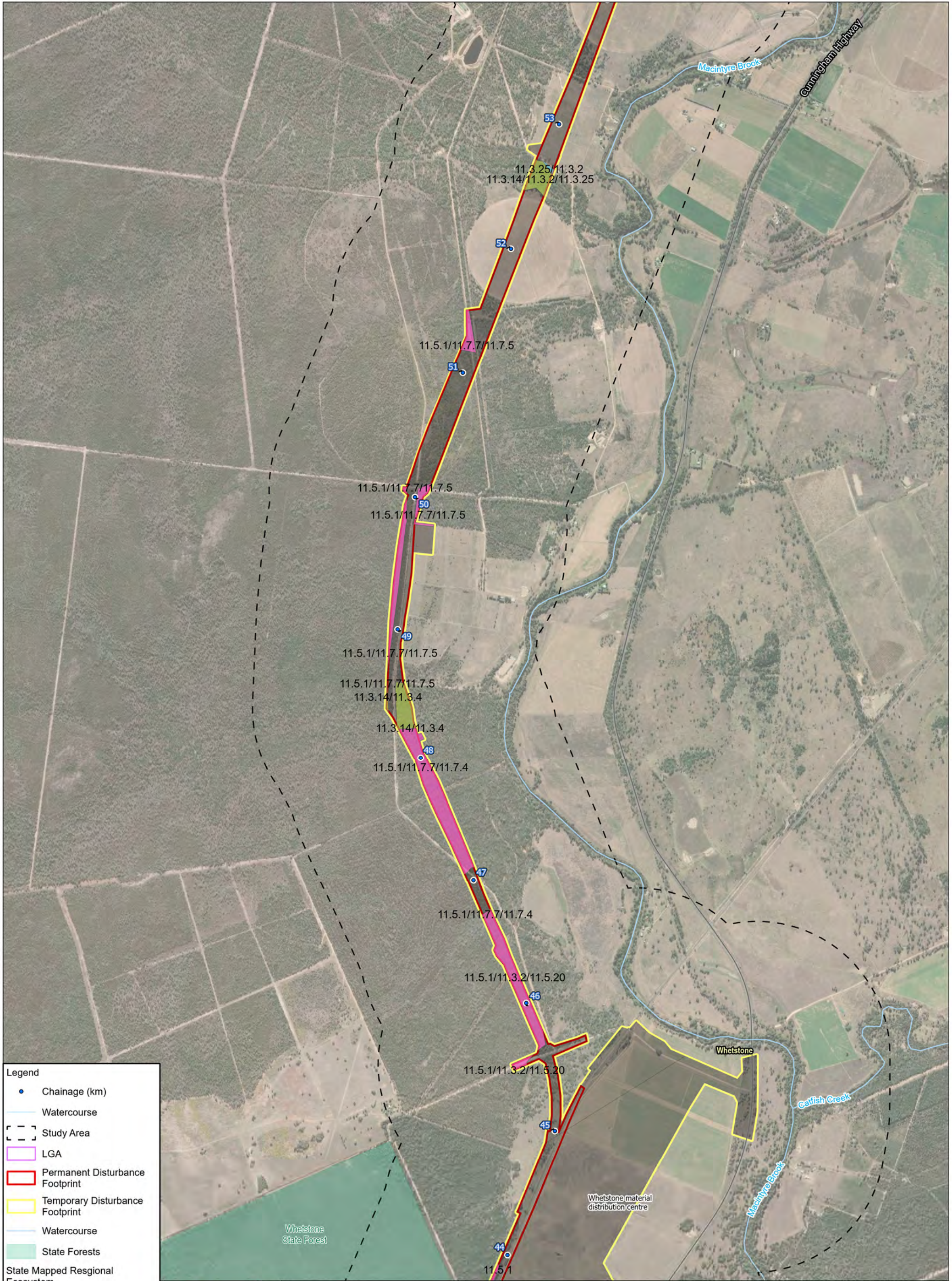
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F4.1(8) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

11.3.14
11.3.25
11.5.1
Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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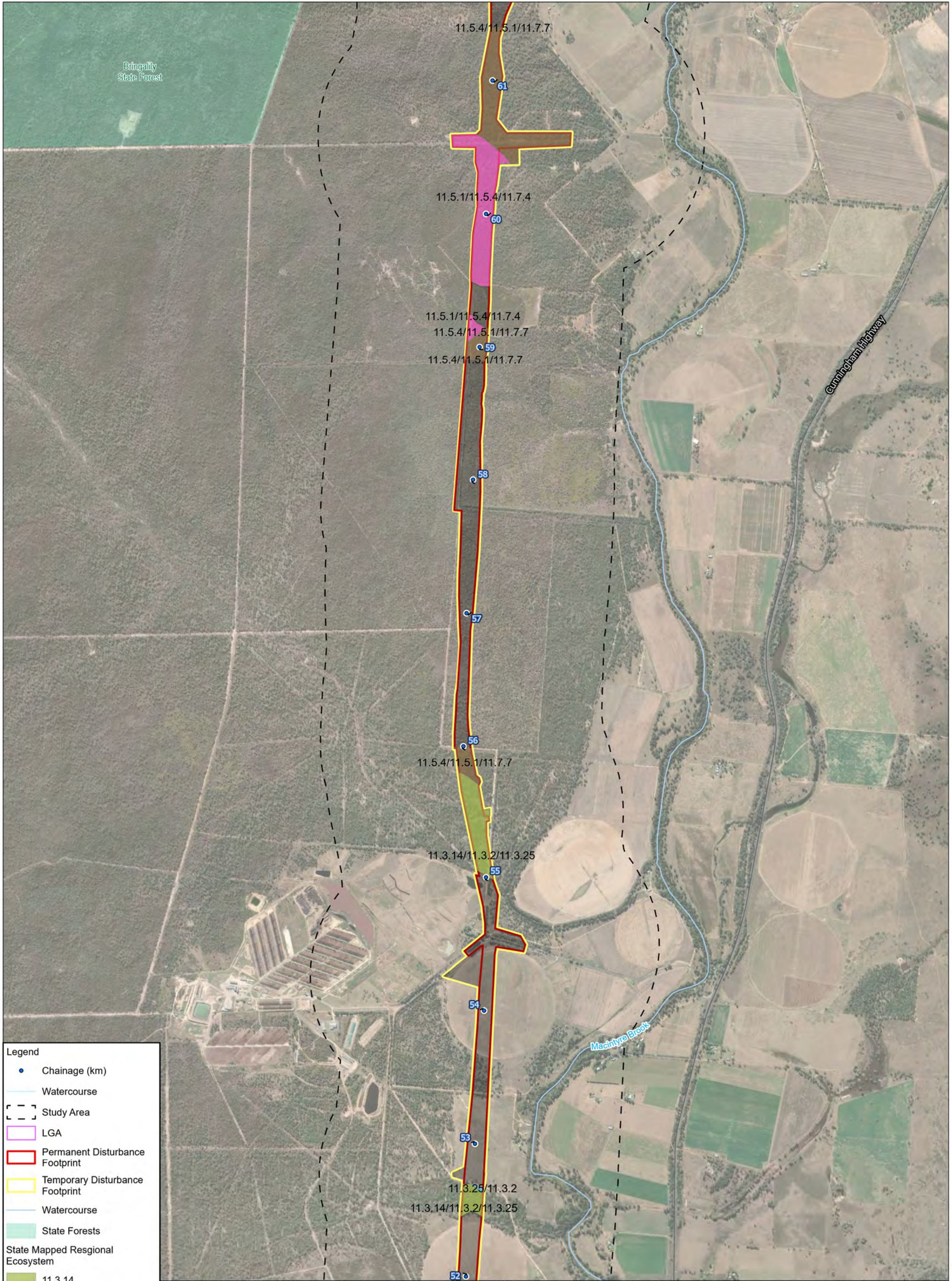
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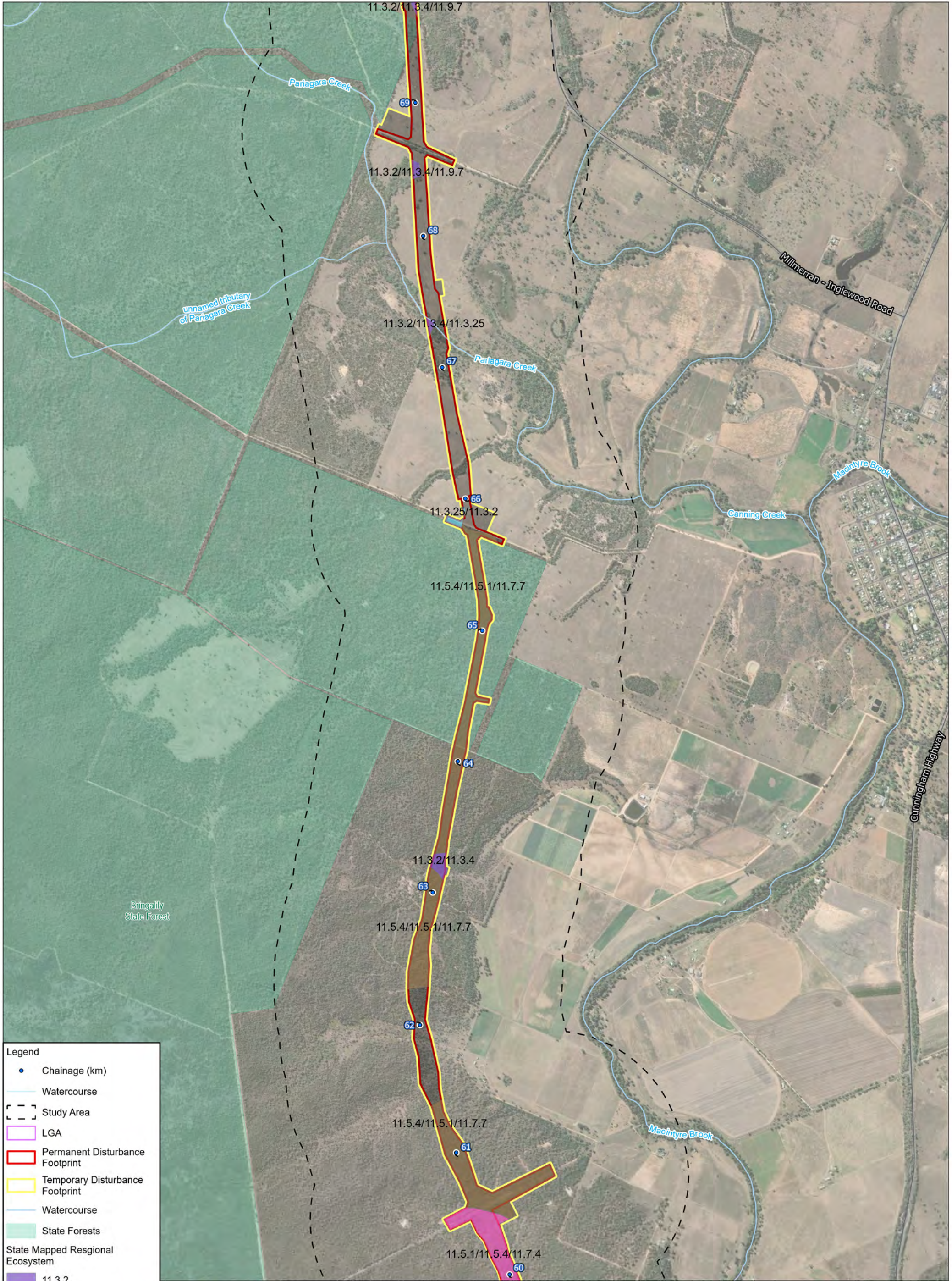
F4.1(9) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

ERM





Legend

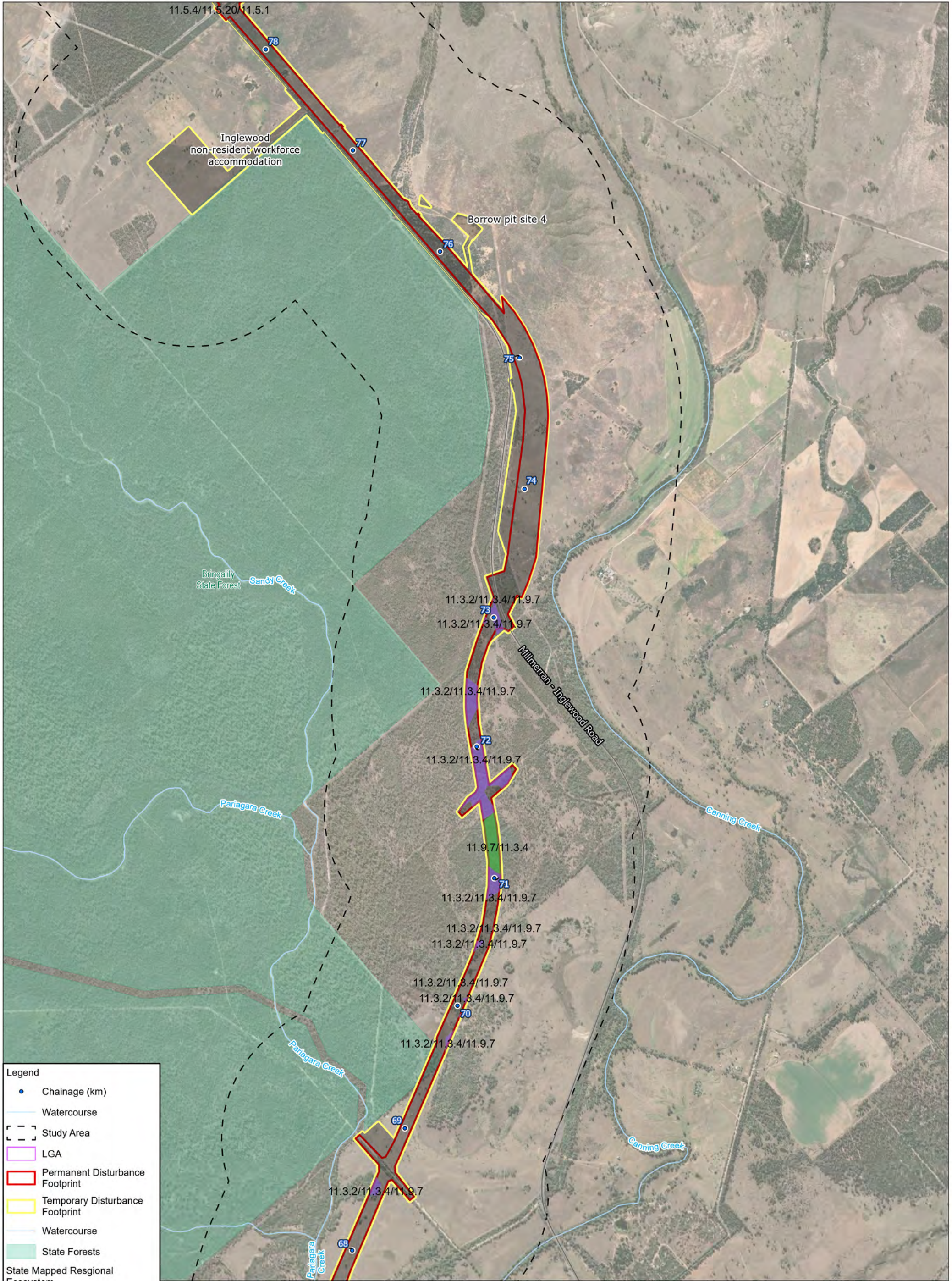
- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- 11.3.2
- 11.3.25
- 11.5.1
- 11.5.4
- Non-remnant



Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
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F4.1(11) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

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

State Mapped Regional Ecosystem

- 11.3.2
- 11.5.4
- 11.9.7
- Non-remnant



Coordinate System:
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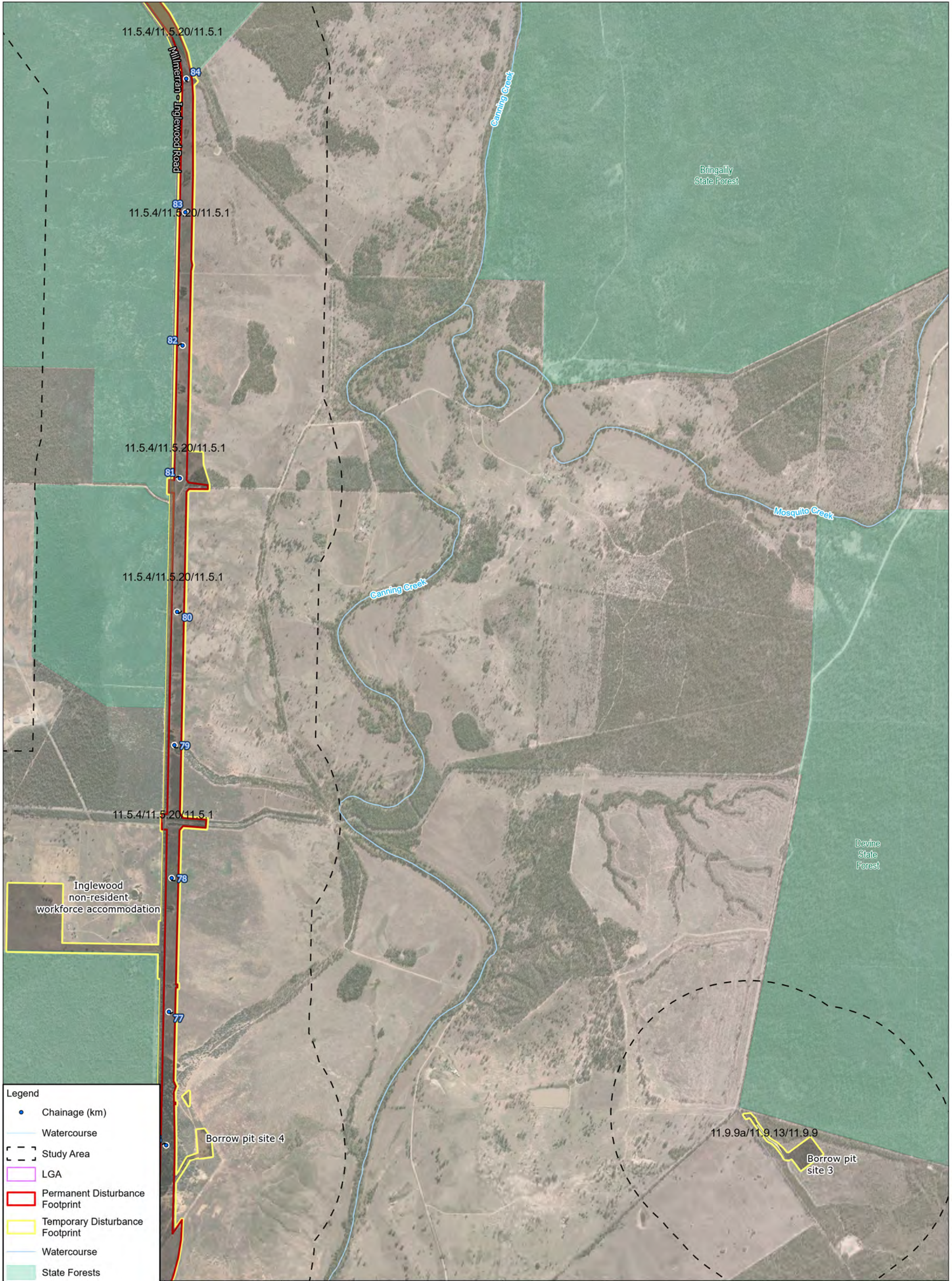
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F4.1(12) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

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

State Mapped Regional Ecosystem

- 11.5.4
- 11.9.9a
- Non-remnant



Coordinate System:
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Date: 17/10/2024

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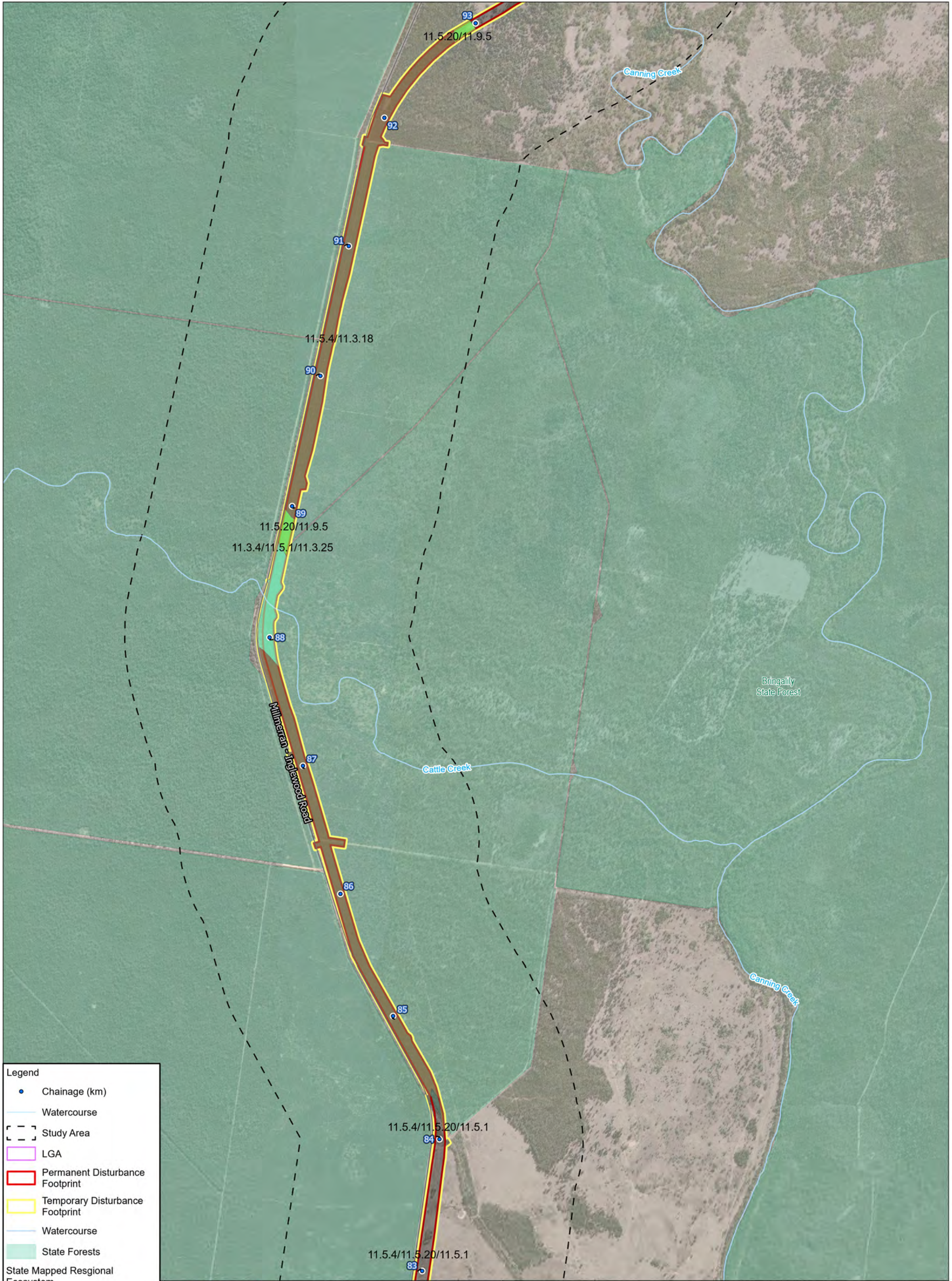
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F4.1(13) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

11.3.4
11.5.20
11.5.4
Non-remnant



Coordinate System:
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Date: 17/10/2024

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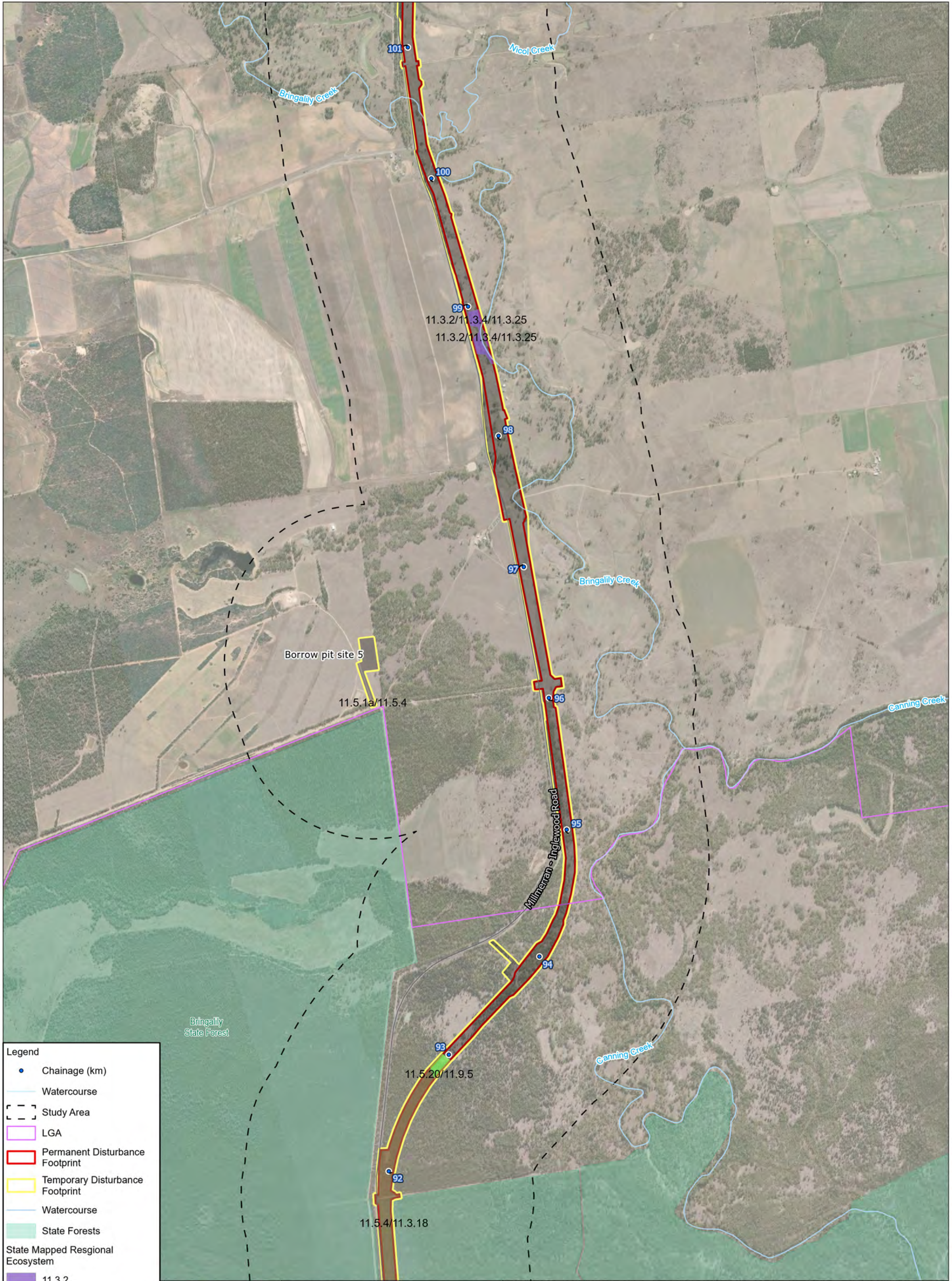
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F4.1(14) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

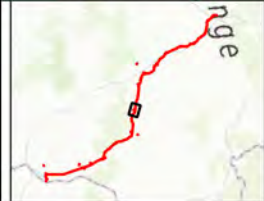


Legend

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

State Mapped Resgional Ecosystem

- 11.3.2
- 11.5.1a
- 11.5.20
- 11.5.4
- Non-remnant



Coordinate System:
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Date: 17/10/2024

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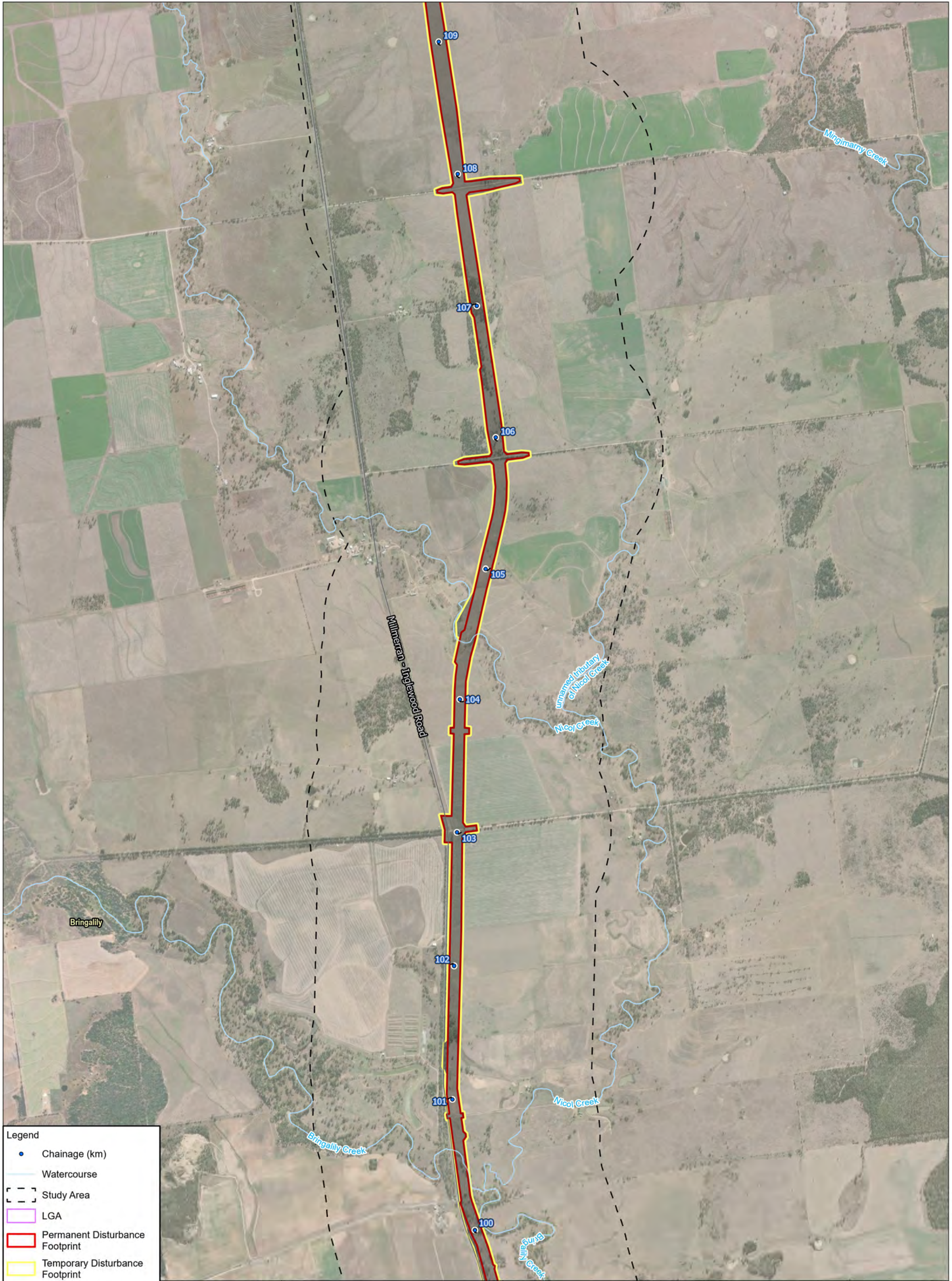
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F4.1(15) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Regional Ecosystem
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.1(16) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

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

State Mapped Resgional Ecosystem

- 11.8.3
- Non-remnant

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.1(17) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- 11.8.3
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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F4.1(18) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- 11.3.2
- Non-remnant



Coordinate System:
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Date: 17/10/2024

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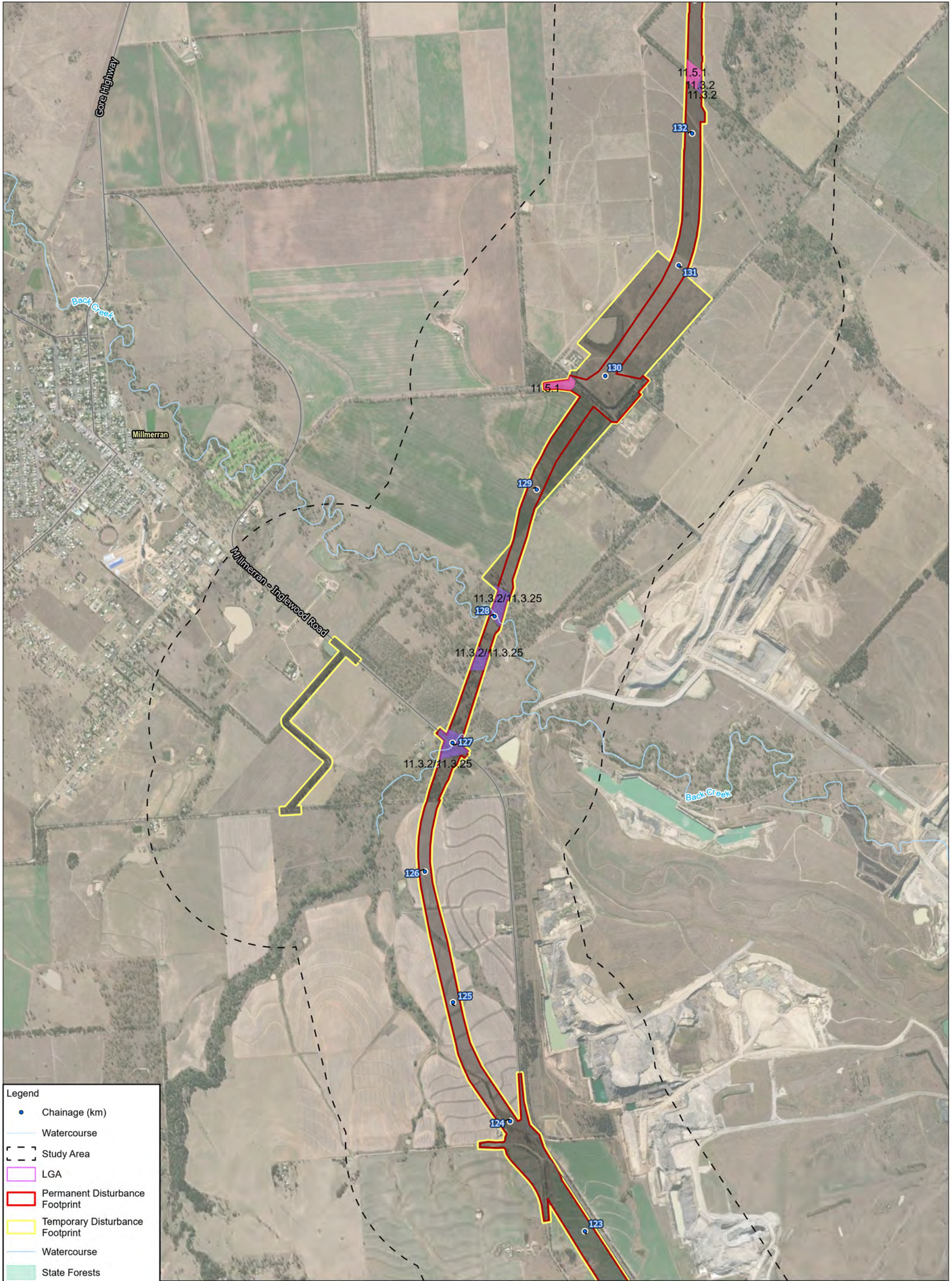
F4.1(19) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

ERM



Legend

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

State Mapped Regional Ecosystem

- 11.3.2
- 11.5.1
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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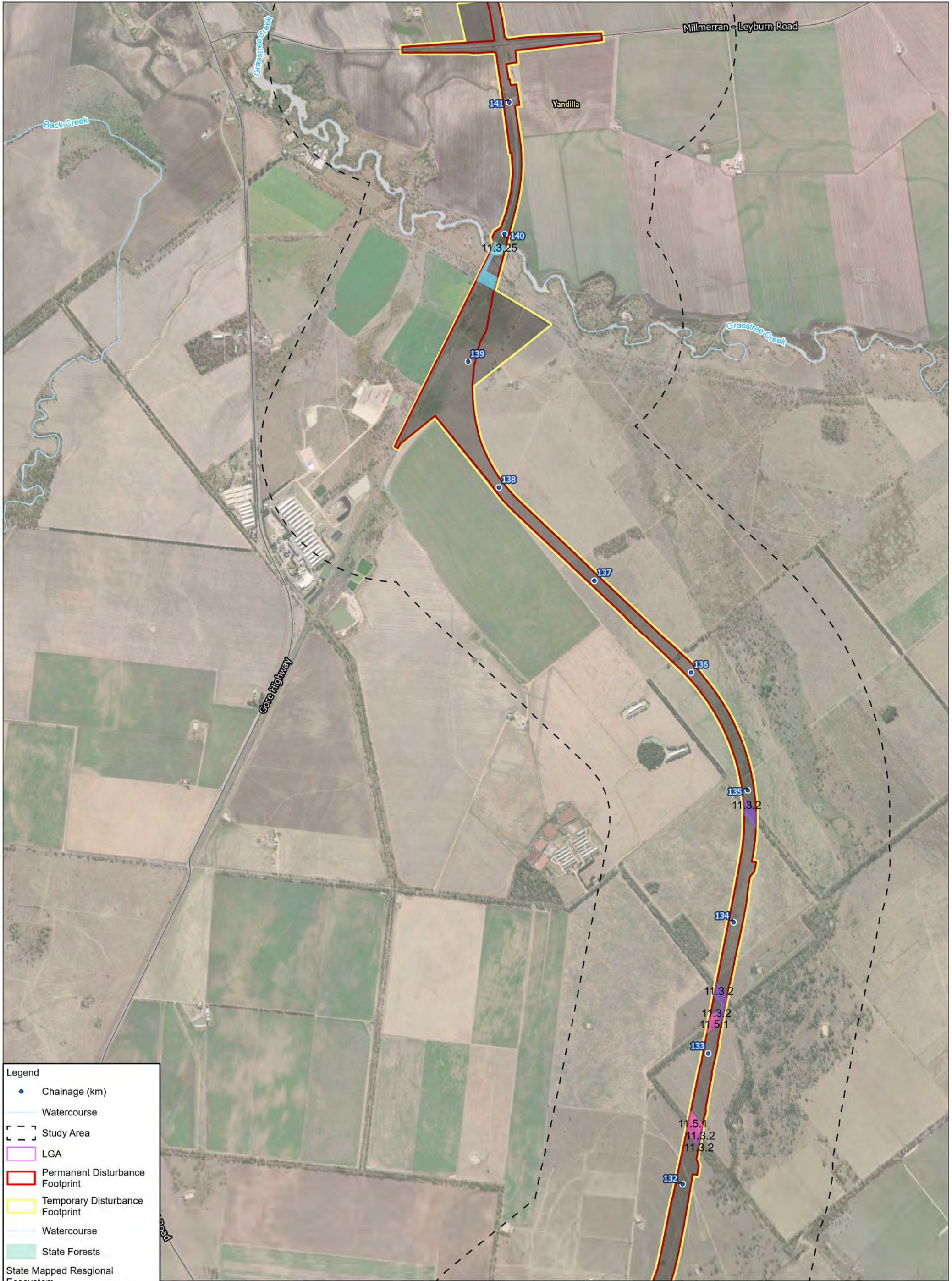
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F4.1(20) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- [] LGA
- [] Permanent Disturbance Footprint
- [] Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Regional Ecosystem
- 11.3.2
- 11.3.25
- 11.5.1
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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F4.1(21) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

ERM



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Regional Ecosystem
- 11.3.25
- Non-remnant



Coordinate System:
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Date: 17/10/2024

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F4.1(22) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

ERM



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Regional Ecosystem
- Non-remnant



Coordinate System:
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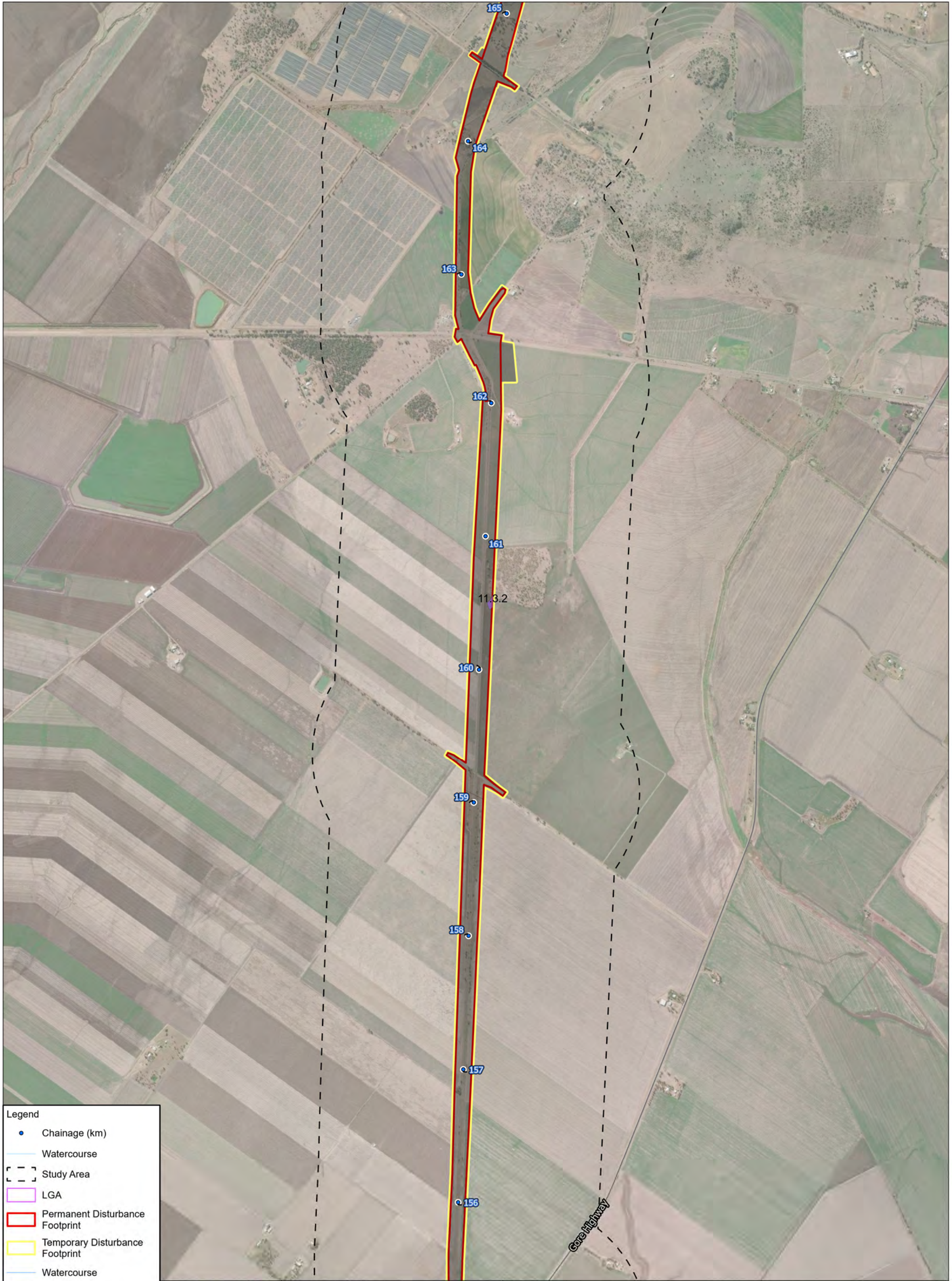
F4.1(23) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Regional Ecosystem
- 11.3.2
- Non-remnant

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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F4.1(24) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- 11.8.5
- Non-remnant

Coordinate System:
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Date: 17/10/2024

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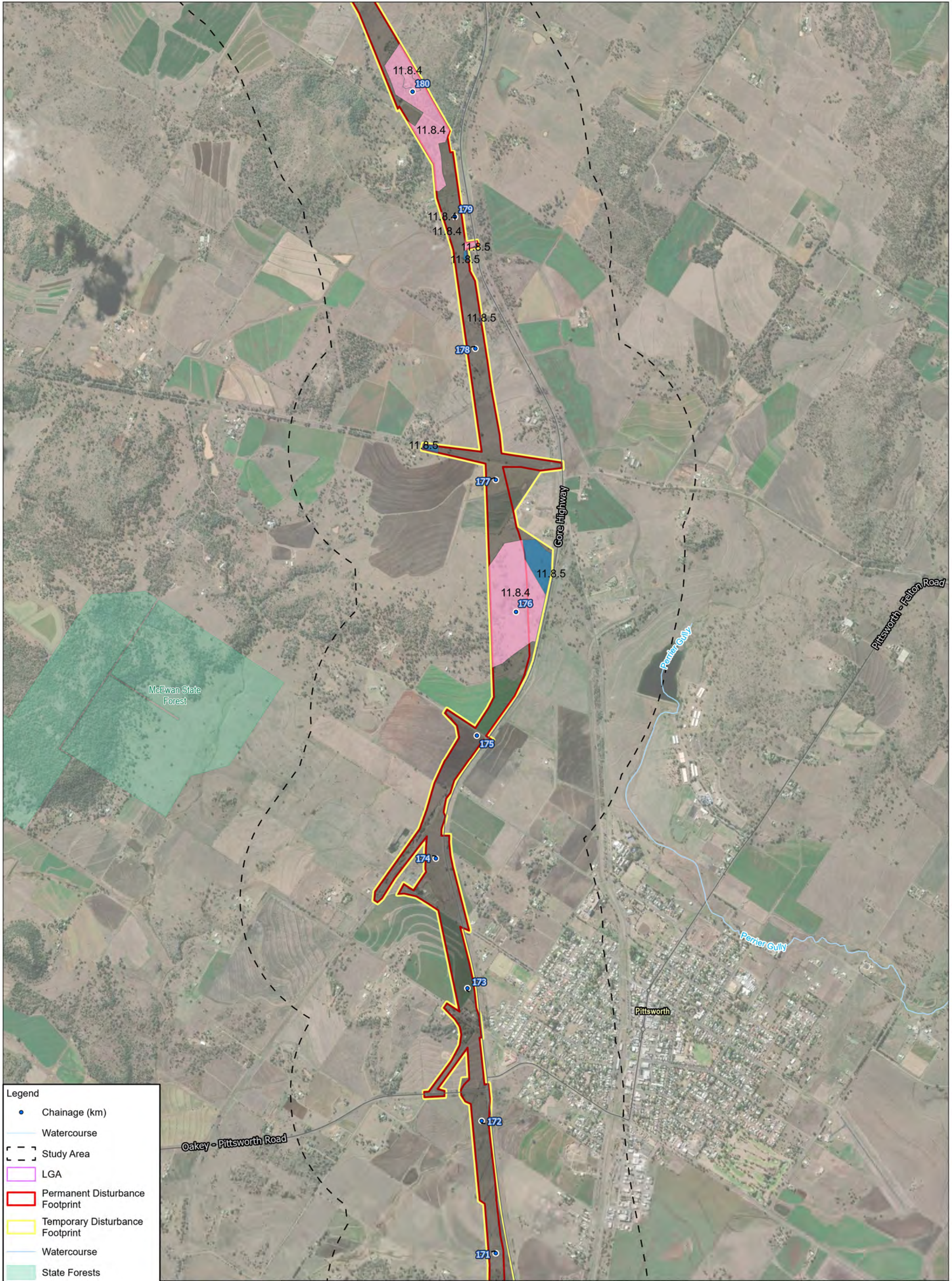
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F4.1(25) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

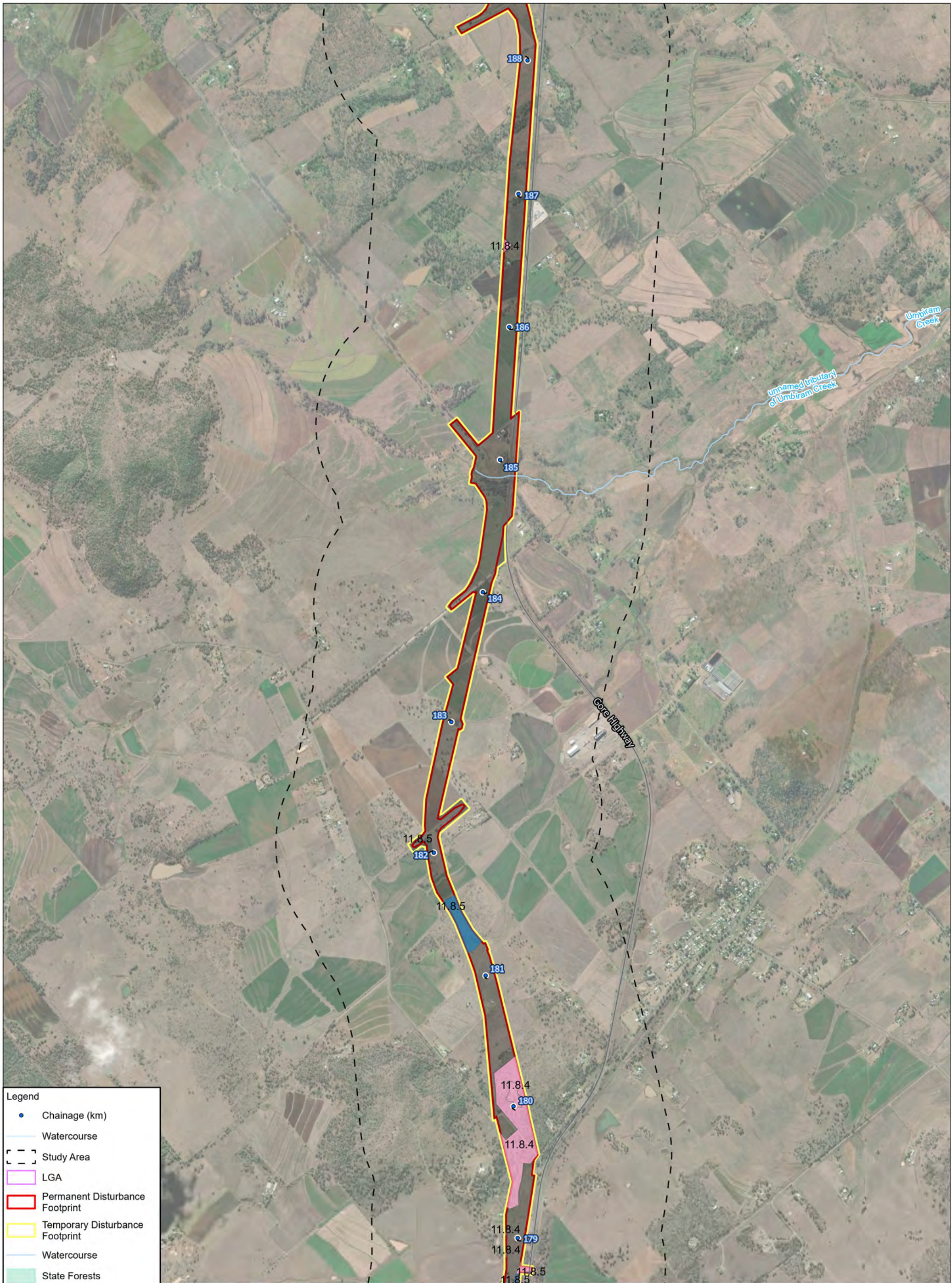
State Mapped Regional Ecosystem

- 11.8.4
- 11.8.5
- Non-remnant

Coordinate System:
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F4.1(26) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

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

State Mapped Regional Ecosystem

- 11.8.4
- 11.8.5
- Non-remnant



Coordinate System:
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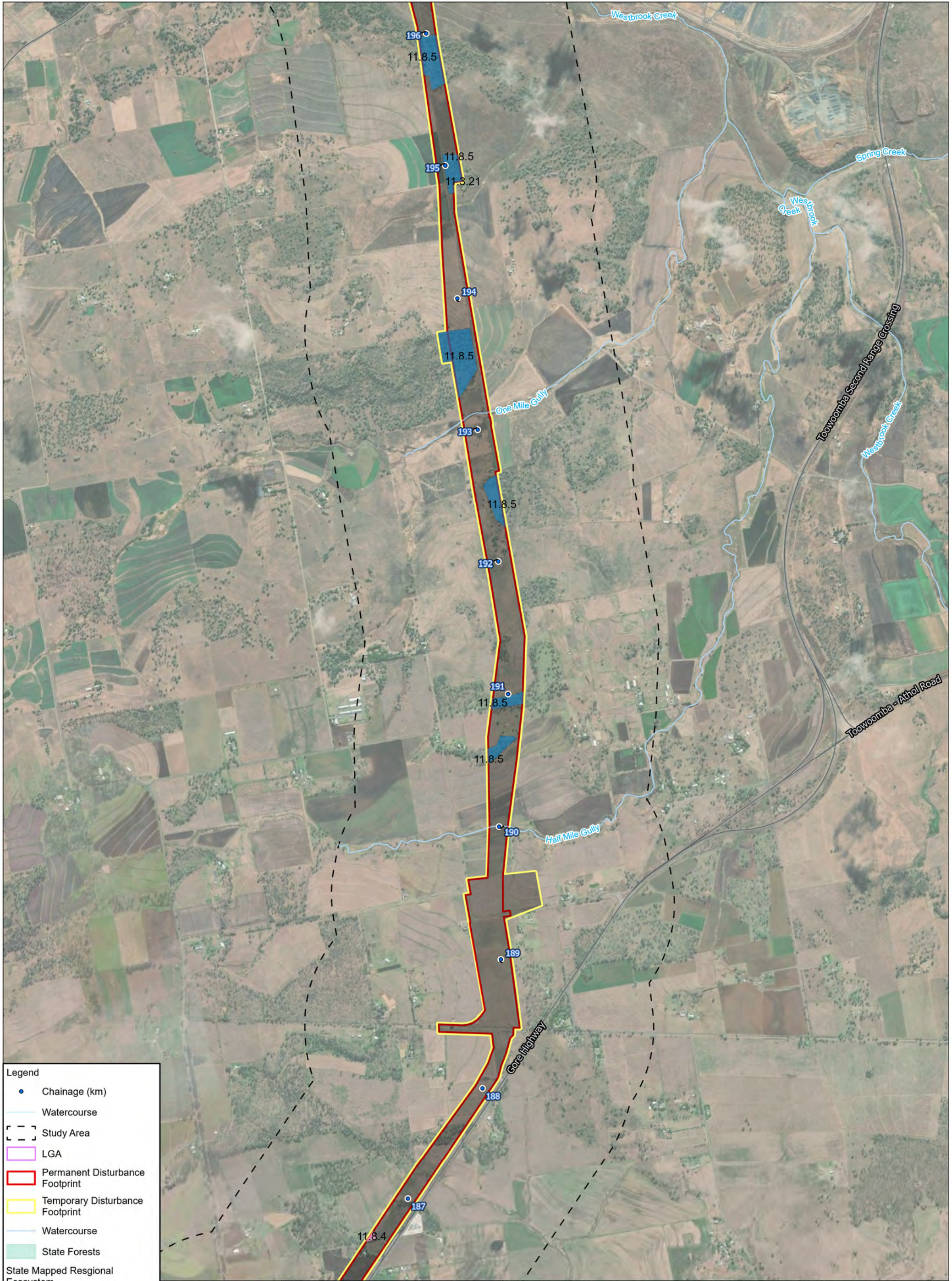


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F4.1(27) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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

State Mapped Regional Ecosystem

- 11.3.21
- 11.8.4
- 11.8.5
- Non-remnant



Coordinate System:
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Date: 17/10/2024

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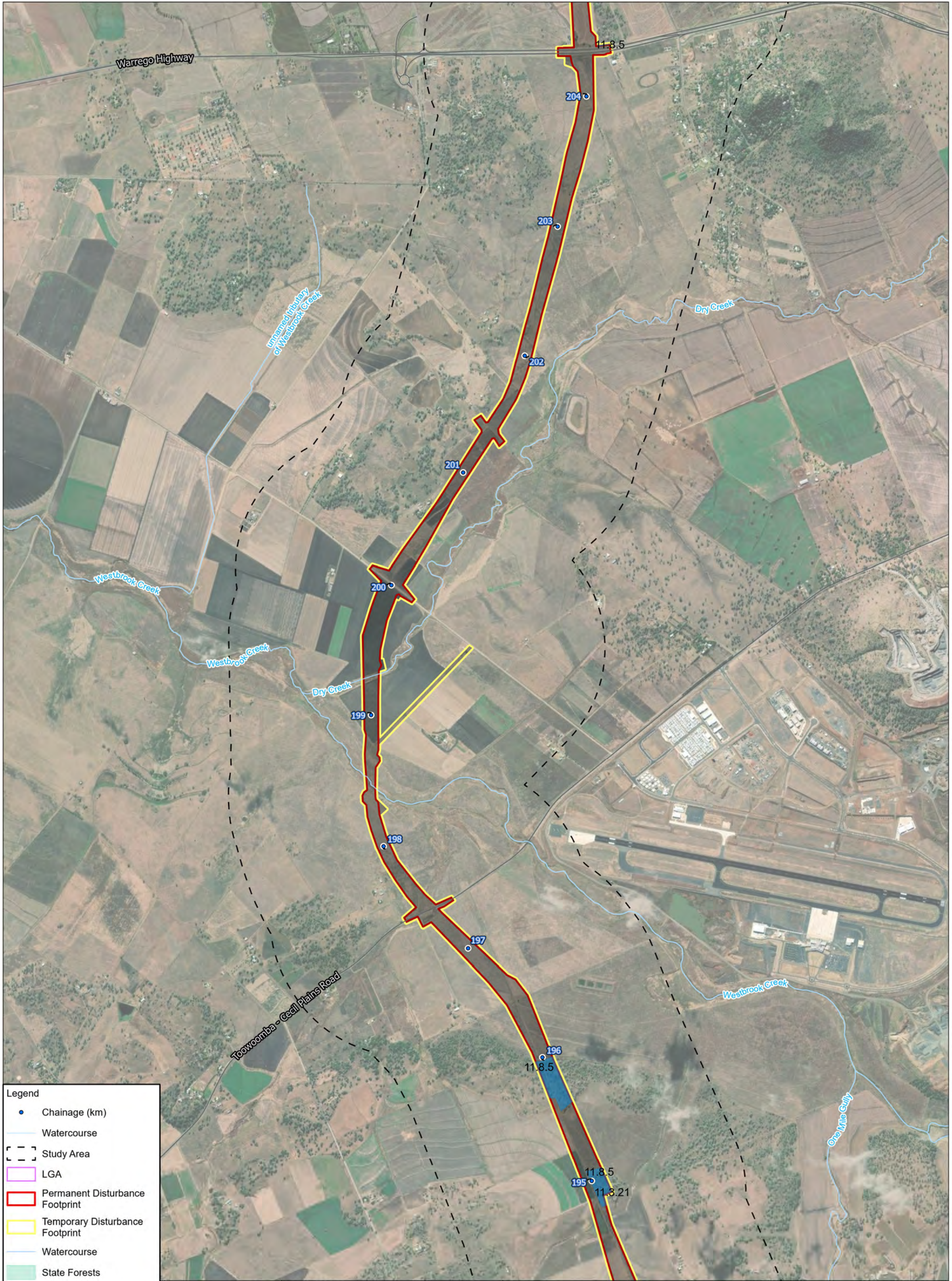
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F4.1(28) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

State Mapped Regional Ecosystem

- 11.3.21
- 11.8.5
- Non-remnant



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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F4.1(29) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- State Mapped Resgional Ecosystem
- 11.8.5
- Non-remnant



Coordinate System:
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Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.1(30) - State Mapped Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

TABLE 4-1 GROUND-TRUTHED REGIONAL ECOSYSTEMS WITHIN THE PROJECT FOOTPRINT

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant ¹		
			Area (ha)	No. of BC	No. of QA	Mature regrowth area (ha)	Immature regrowth area (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	E	1.46	1	1	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	OC	33.09	3	17	1.08	27.31	0	15	459.95	6	34
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	OC	9.53	1	2	0.38	8.39	0	2	162.34	0	-
11.3.14	<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains	LC	22.01	3	5	0.01	6.57	1	3	23.31	-	2
11.3.17	<i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains	OC	4.07	0	1	0.00	0.00	N/A	N/A	0.06	N/A	-
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	LC	0.00	N/A	N/A	0.00	0.00	N/A	N/A	26.53	0	-
11.3.21	<i>Dichanthium sericeum</i> and/or <i>Astrebla</i> spp. grassland on alluvial plains. Cracking clay soils	OC	17.45	6	14	0.00	0.00	N/A	N/A	182.71	5	41

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant ¹		
			Area (ha)	No. of BC	No. of QA	Mature regrowth area (ha)	Immature regrowth area (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.3.24	<i>Themeda avenacea</i> grassland on alluvial plains. Basalt derived soils	E	0.00	N/A	N/A	0.00	0.00	N/A	N/A	3.63	0	-
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	LC	14.39	2	13	0.00	1.83	0	0	79.30	2	2
11.3.27	Freshwater wetlands	LC	0.60	0	0	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.27 b	Vegetation ranges from open water +/- aquatics and emergents. Often with fringing woodland	LC	0.00	N/A	N/A	0.00	0.00	N/A	N/A	3.75	0	1
11.3.27 i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer	LC	7.91	0	0	0.00	0.00	N/A	N/A	0.00	N/A	-
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	E	31.42	4	20	5.32	60.20	1	31	290.00	5	8
11.4.10	<i>Eucalyptus populnea</i> or <i>E. woollsiana</i> , <i>Acacia harpophylla</i> , <i>Casuarina cristata</i> open forest to woodland on margins of Cainozoic clay plains	E	21.57	1	9	0.35	3.61	0	1	15.02	1	1
11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris</i>	LC	115.26	4	30	7.73	21.41	2	4	168.17	1	8

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant ¹		
			Area (ha)	No. of BC	No. of QA	Mature regrowth area (ha)	Immature regrowth area (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
	<i>glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces											
11.5.1a	<i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer	LC	0.24	N/A	N/A	0.09	0.00	N/A	N/A	10.21	0	1
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	LC	109.49	4	17	0.89	55.10	0	4	69.16	3	16
11.5.14	<i>Triodia</i> sp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	OC	31.68	1	4	0.00	4.42	2	4	24.00	1	2
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	LC	10.80	2	4	0.63	10.34	2	6	92.39	2	6
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i>	LC	0.00	N/A	N/A	0.00	0.00	N/A	N/A	0.54	N/A	-

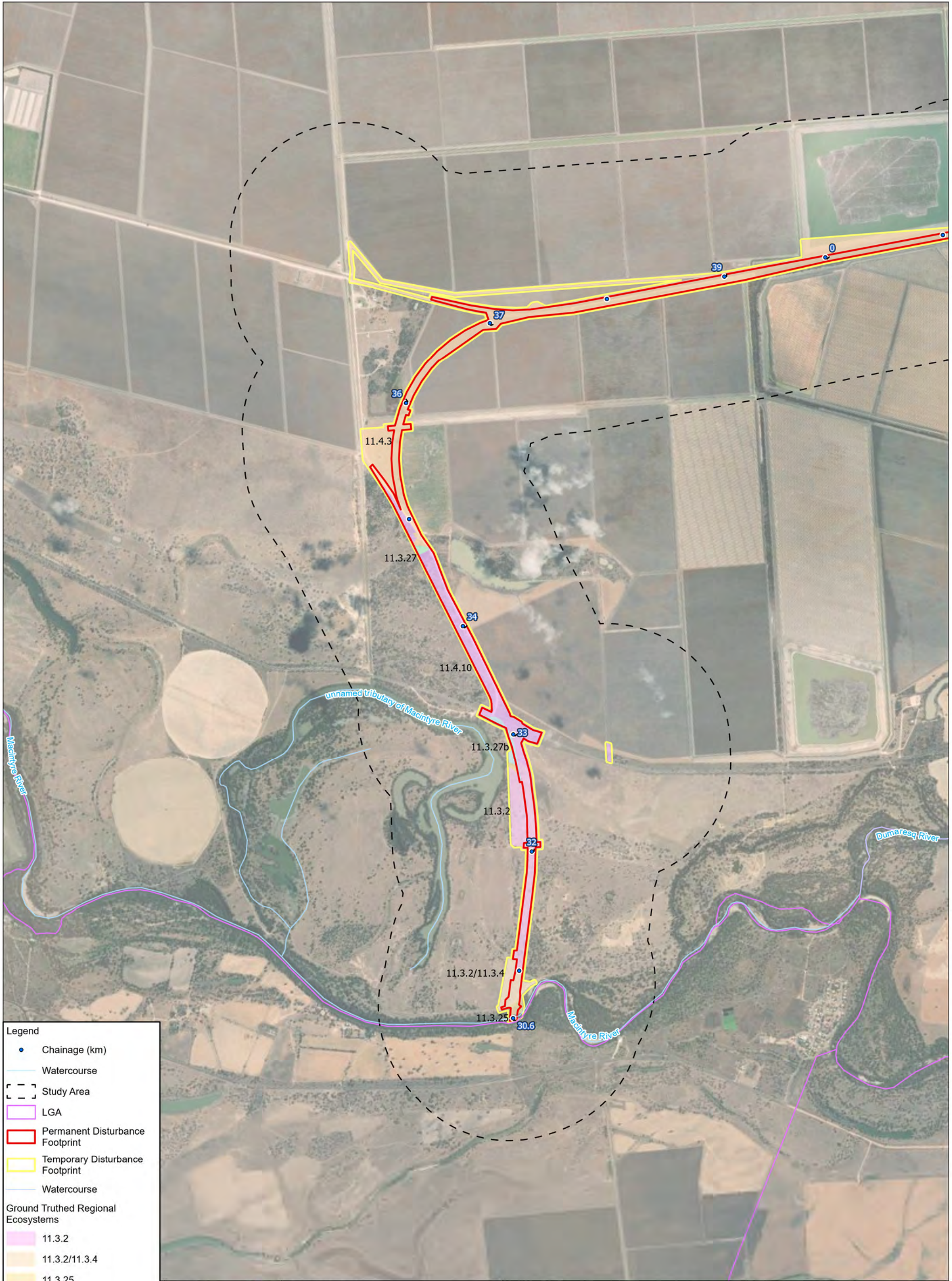
RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant ¹		
			Area (ha)	No. of BC	No. of QA	Mature regrowth area (ha)	Immature regrowth area (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
	woodland on Cainozoic lateritic duricrust											
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	LC	0.00	N/A	N/A	0.00	0.00	N/A	N/A	2.87	N/A	-
11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust	LC	20.38	1	1	0.00	17.65	0	0	8.07	0	-
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks	OC	0.00	N/A	N/A	0.00	0.00	0	0	9.27	1	-
11.8.4	<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks.	LC	21.96	2	3	0.00	6.17	2	2	131.08	0	10
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	LC	66.71	4	10	0.00	24.48	1	8	376.35	4	35
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	OC	24.18	1	4	0.00	0.00	N/A	N/A	93.35	2	4
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	E	2.42	0	3	0.00	23.43	2	20	232.47	5	11
11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i>	OC	0.00	N/A	N/A	0.00	0.00	N/A	N/A	38.35	0	-

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant ¹		
			Area (ha)	No. of BC	No. of QA	Mature regrowth area (ha)	Immature regrowth area (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
	shrubby woodland on fine-grained sedimentary rocks											
11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks	LC	0.09	0	2	0.00	0.00	N/A	N/A	1.75	0	1
11.9.9a	<i>Eucalyptus albens</i> +/- <i>E. crebra</i> +/- <i>E. tereticornis</i> +/- <i>Callitris baileyi</i> woodland. Occurs in southern part of bioregion.	LC	2.49	1	1	0.00	0.00	N/A	N/A	0.00	N/A	-
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks	OC	1.40	0	1	0.00	0.00	N/A	N/A	10.48	0	0
11.9.13	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> open forest on fine grained sedimentary rocks	OC	0.13	0	2	0.00	0.00	N/A	N/A	1.75	0	1
Water	Dam surrounded by cleared land	-	0.00	N/A	N/A	0.00	0.00	N/A	N/A	7.15	N/A	N/A
Total			570.75	41	160	16.48	270.92	13	100	2,524.02	38	182

Table notes:

E = Endangered, OC = Of Concern, LC = Least Concern.

¹ Areas associated with non-remnant are based on State Pre-Clearing Mapping.



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.2
- 11.3.2/11.3.4
- 11.3.25
- 11.3.27
- 11.3.27b
- 11.4.10
- 11.4.3



Coordinate System:
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F4.2(1) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- Ground Truthed Regional Ecosystems
- Non Remnant



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F4.2(2) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

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

Ground Truthed Regional Ecosystems

- 11.4.10
- 11.4.3



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F4.2(3) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- Ground Truthed Regional Ecosystems
- 11.4.3

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F4.2(4) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.4.10
- 11.4.3

Coordinate System:
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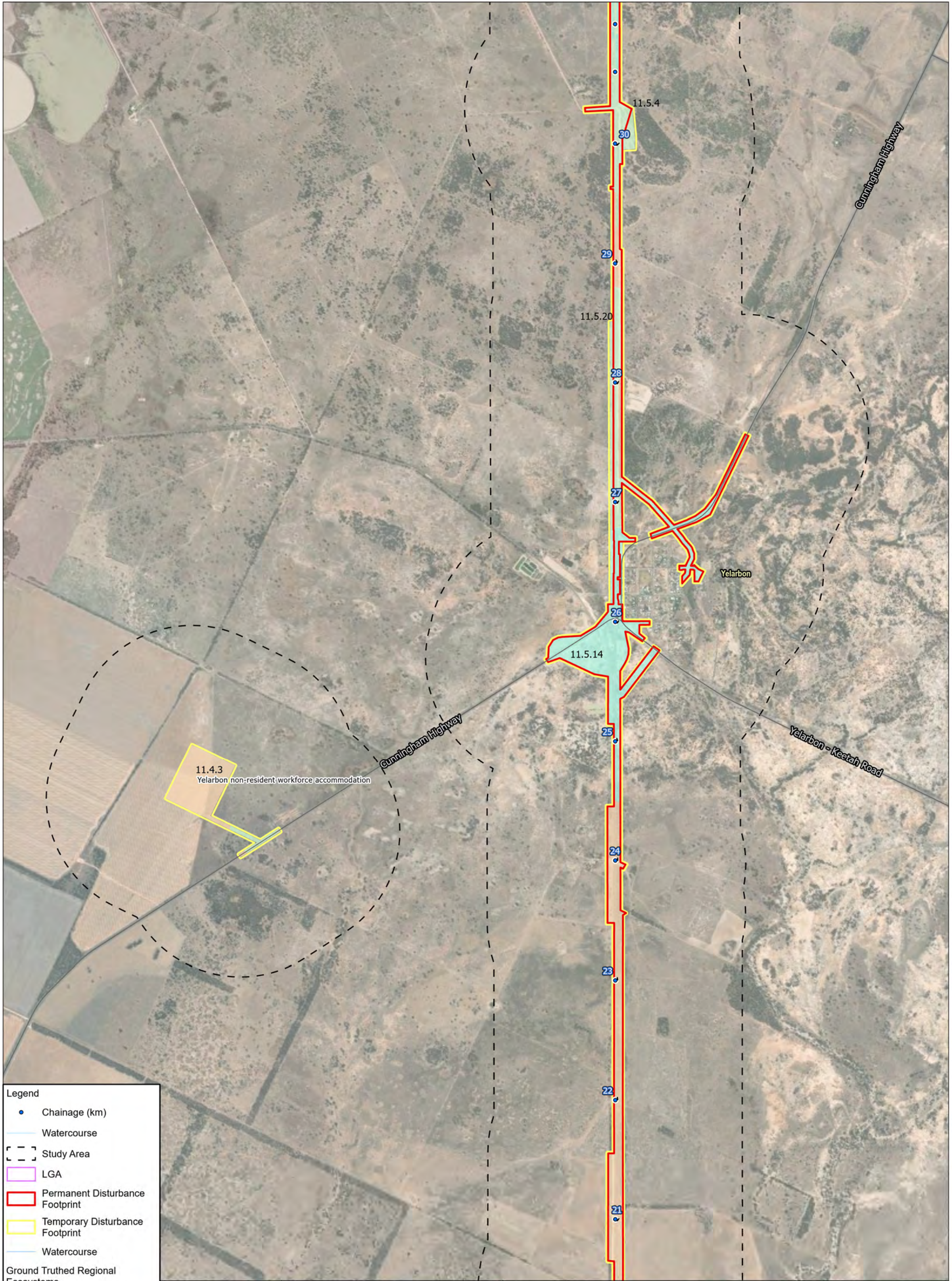
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F4.2(5) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

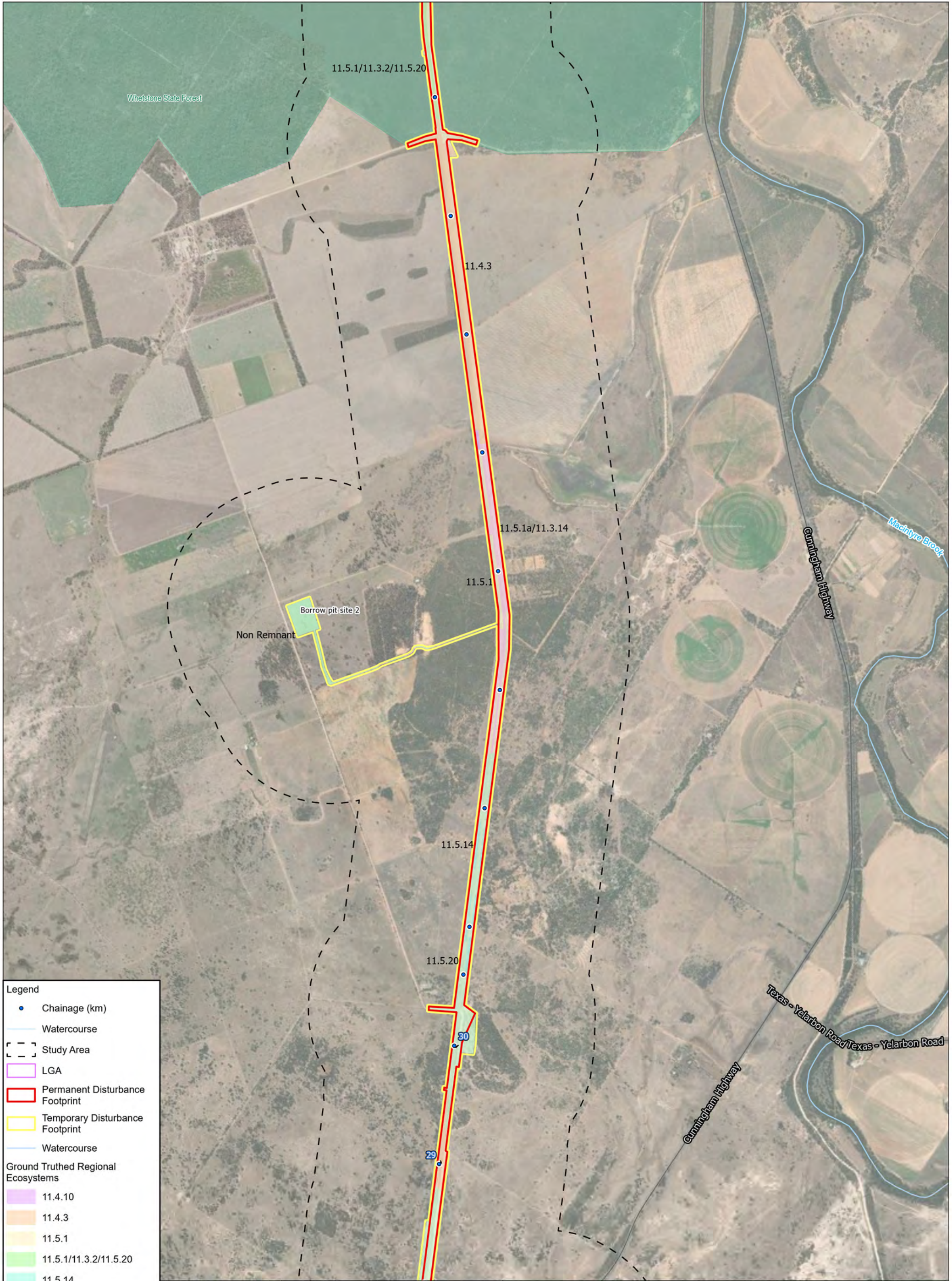
Ground Truthed Regional Ecosystems

- 11.4.3
- 11.5.14
- 11.5.20
- 11.5.4



Coordinate System:
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Legend

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

Ground Truthed Regional Ecosystems

11.4.10
11.4.3
11.5.1
11.5.1/11.3.2/11.5.20
11.5.14
11.5.1a/11.3.14
11.5.20
11.5.4
Non Remnant

Coordinate System:
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Date: 17/10/2024

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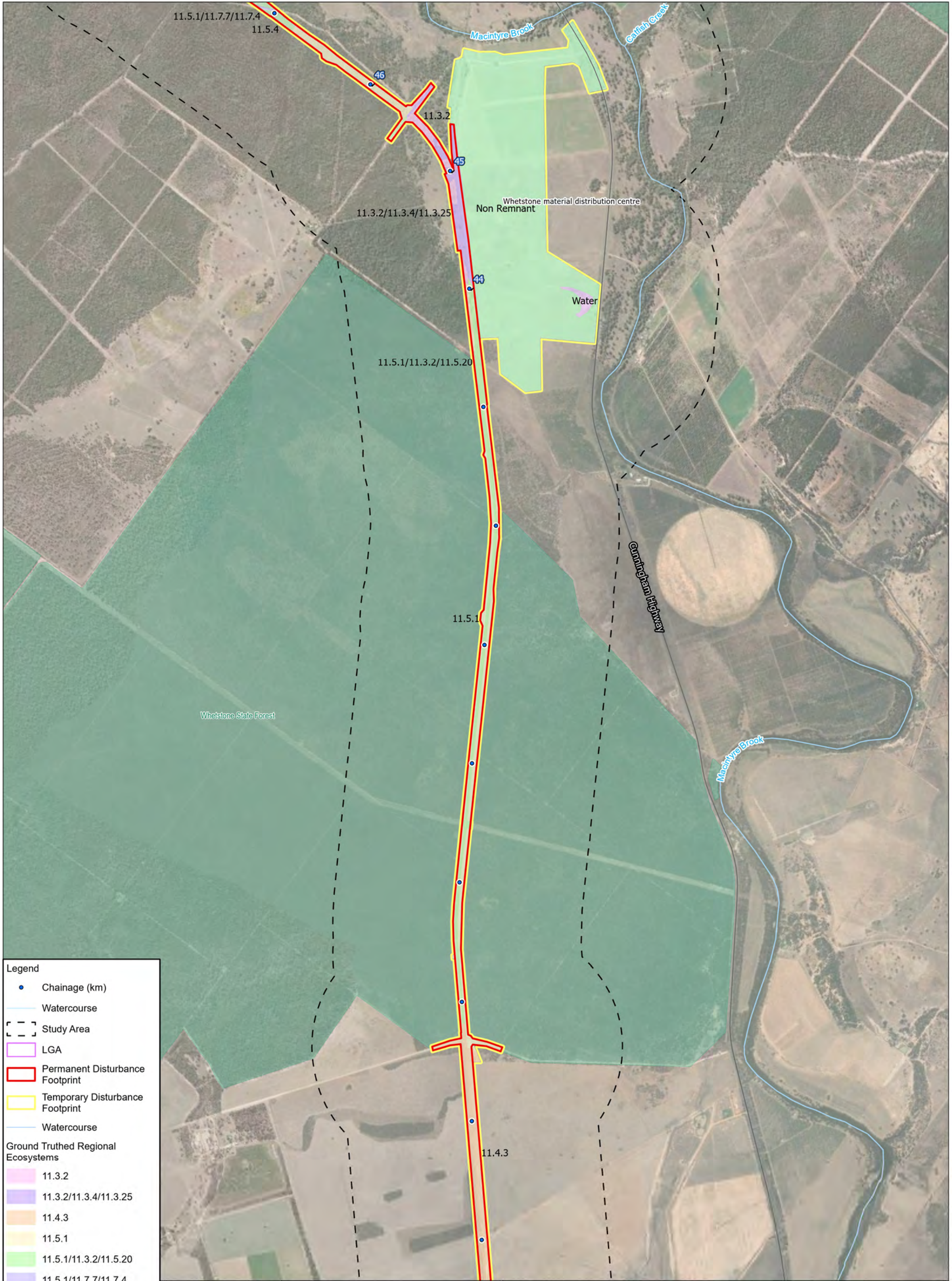
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F4.2(7) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.2
- 11.3.2/11.3.4/11.3.25
- 11.4.3
- 11.5.1
- 11.5.1/11.3.2/11.5.20
- 11.5.1/11.7.7/11.7.4
- 11.5.20
- 11.5.4
- Non Remnant
- Water

Coordinate System:
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Date: 17/10/2024

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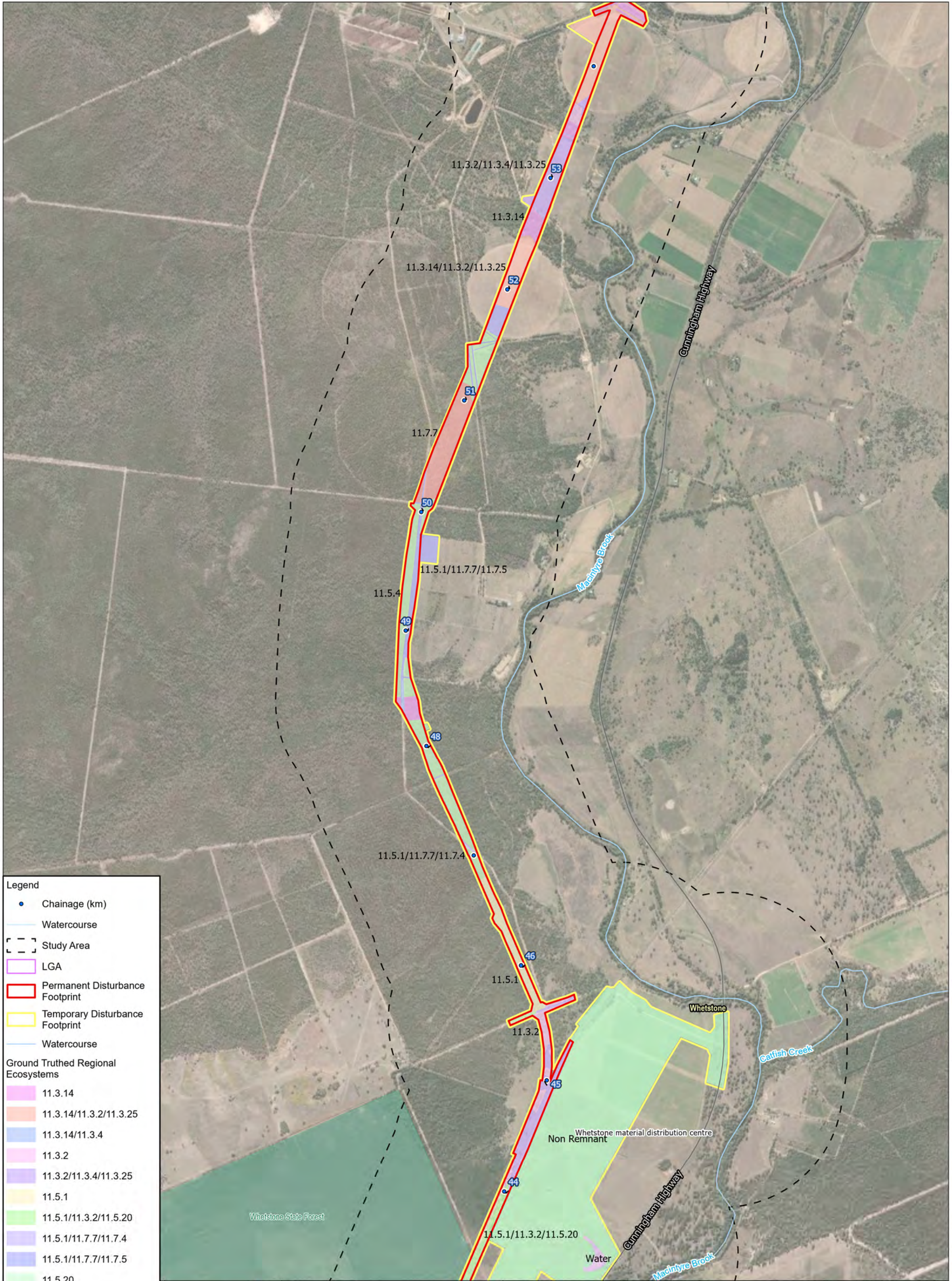
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F4.2(8) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.14
- 11.3.14/11.3.2/11.3.25
- 11.3.14/11.3.4
- 11.3.2
- 11.3.2/11.3.4/11.3.25
- 11.5.1
- 11.5.1/11.3.2/11.5.20
- 11.5.1/11.7.7/11.7.4
- 11.5.1/11.7.7/11.7.5
- 11.5.20
- 11.5.4
- 11.7.7
- Non Remnant
- Water



Coordinate System:
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Date: 17/10/2024

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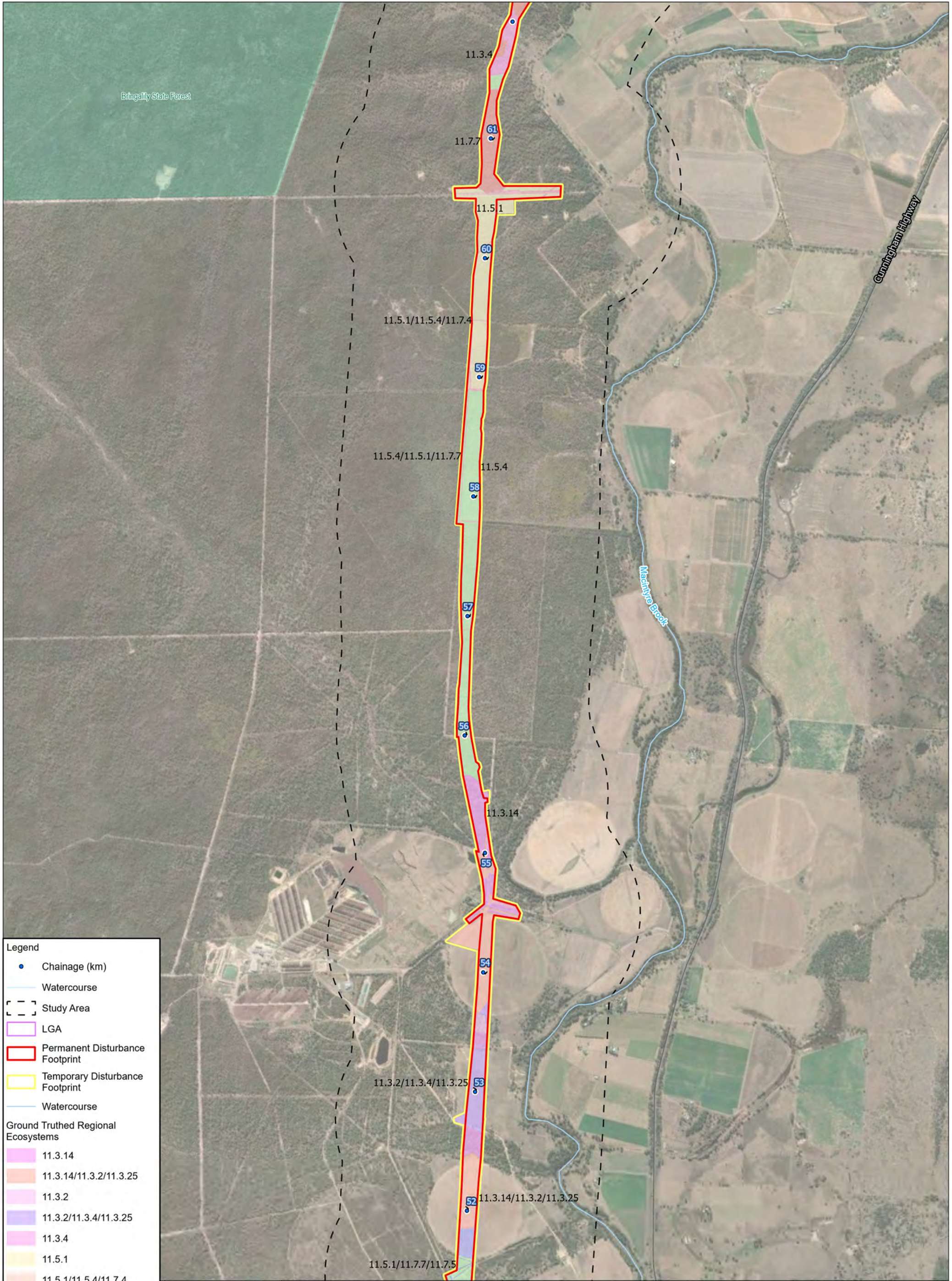
F4.2(9) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

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

Ground Truthed Regional Ecosystems

- 11.3.14
- 11.3.14/11.3.2/11.3.25
- 11.3.2
- 11.3.2/11.3.4/11.3.25
- 11.3.4
- 11.5.1
- 11.5.1/11.5.4/11.7.4
- 11.5.1/11.7.7/11.7.5
- 11.5.4
- 11.5.4/11.5.1/11.7.7
- 11.7.7



Coordinate System:
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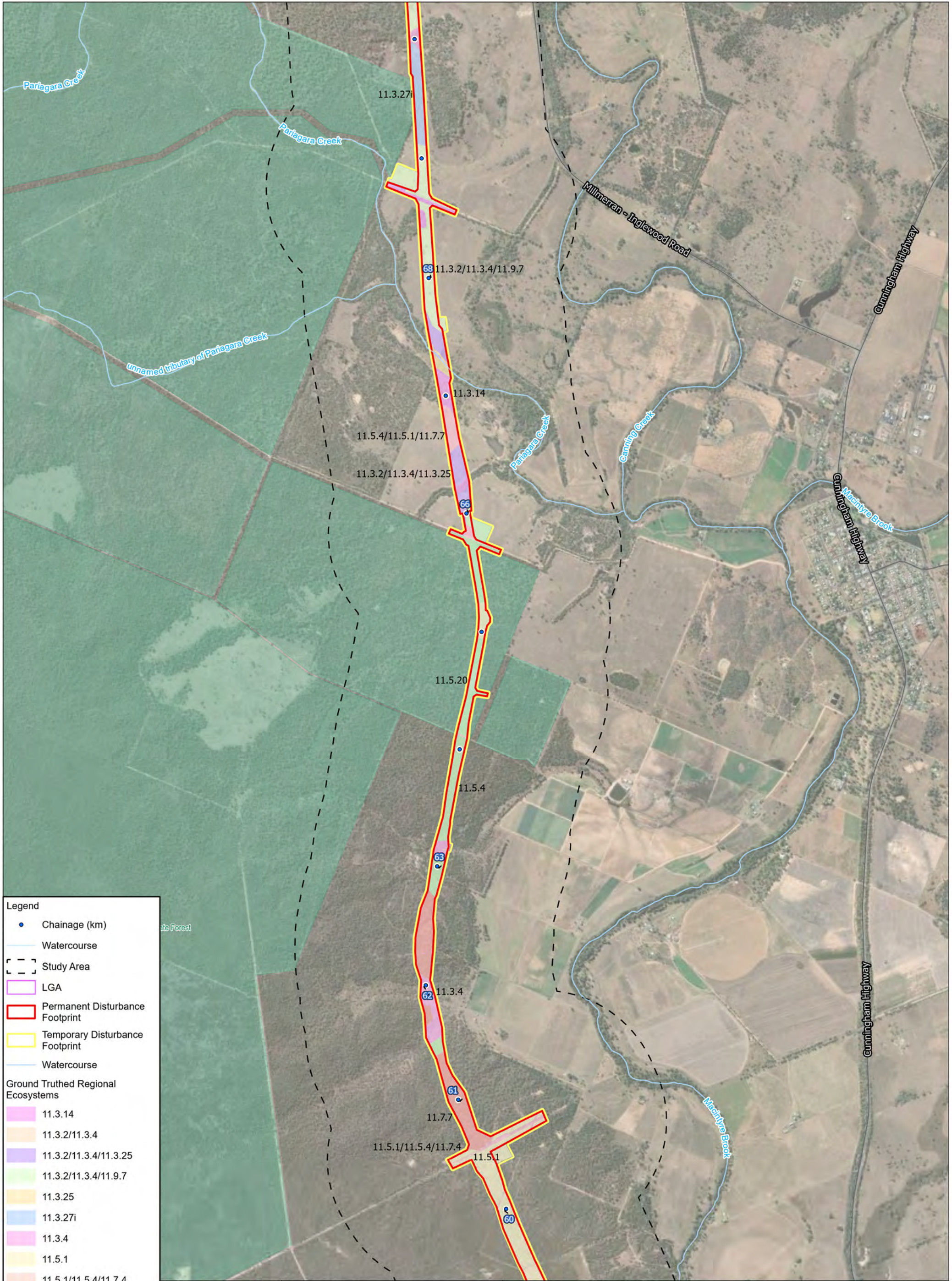
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F4.2(10) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

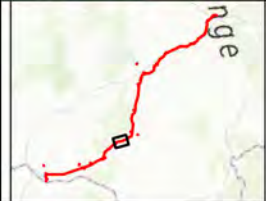


Legend

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

Ground Truthed Regional Ecosystems

11.3.14
11.3.2/11.3.4
11.3.2/11.3.4/11.3.25
11.3.2/11.3.4/11.9.7
11.3.25
11.3.27i
11.3.4
11.5.1
11.5.1/11.5.4/11.7.4
11.5.20
11.5.4
11.5.4/11.5.1/11.7.7
11.7.7



Coordinate System:
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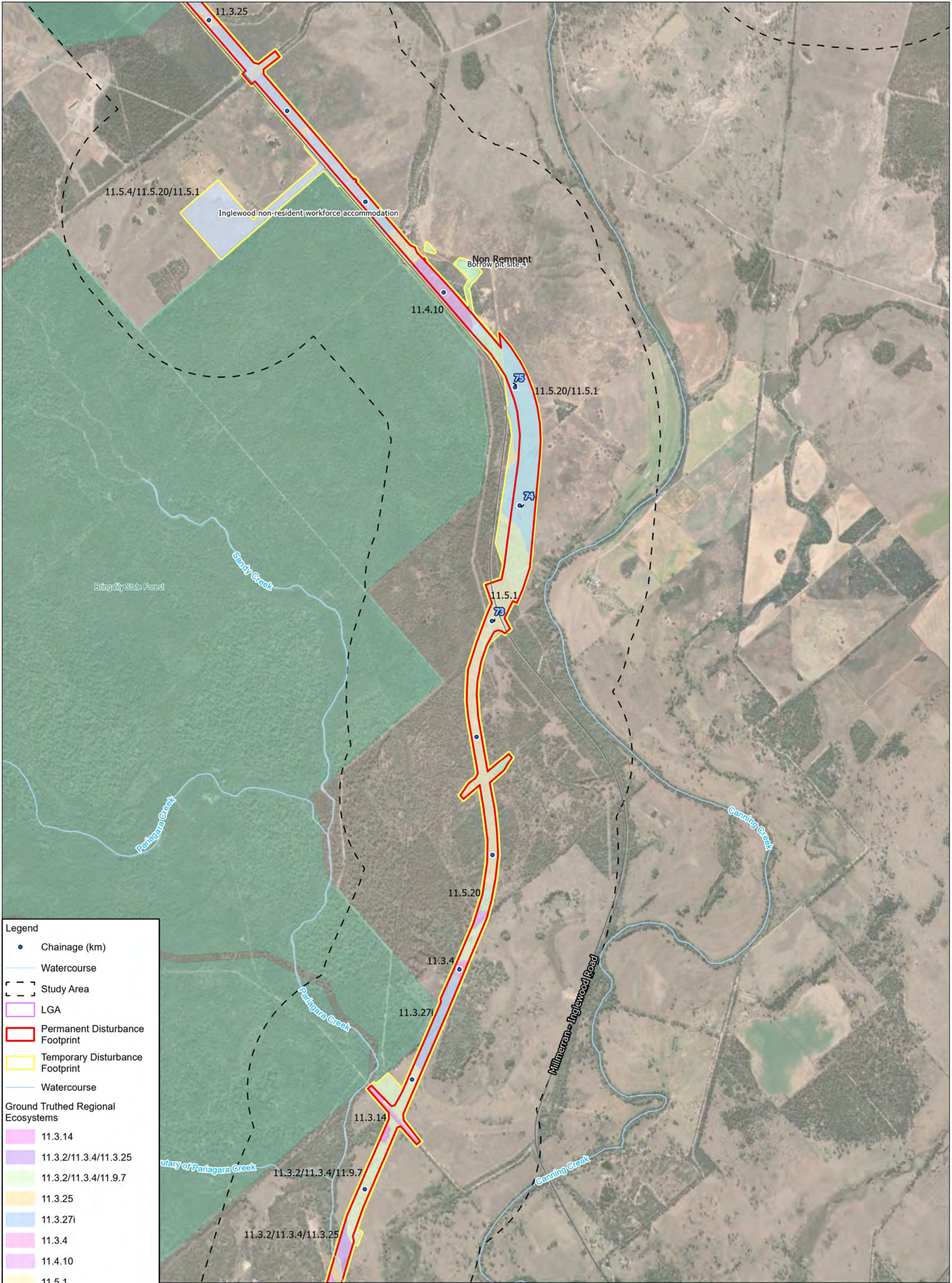
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F4.2(11) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.14
- 11.3.2/11.3.4/11.3.25
- 11.3.2/11.3.4/11.9.7
- 11.3.25
- 11.3.27i
- 11.3.4
- 11.4.10
- 11.5.1
- 11.5.20
- 11.5.20/11.5.1
- 11.5.4/11.5.20/11.5.1
- Non Remnant



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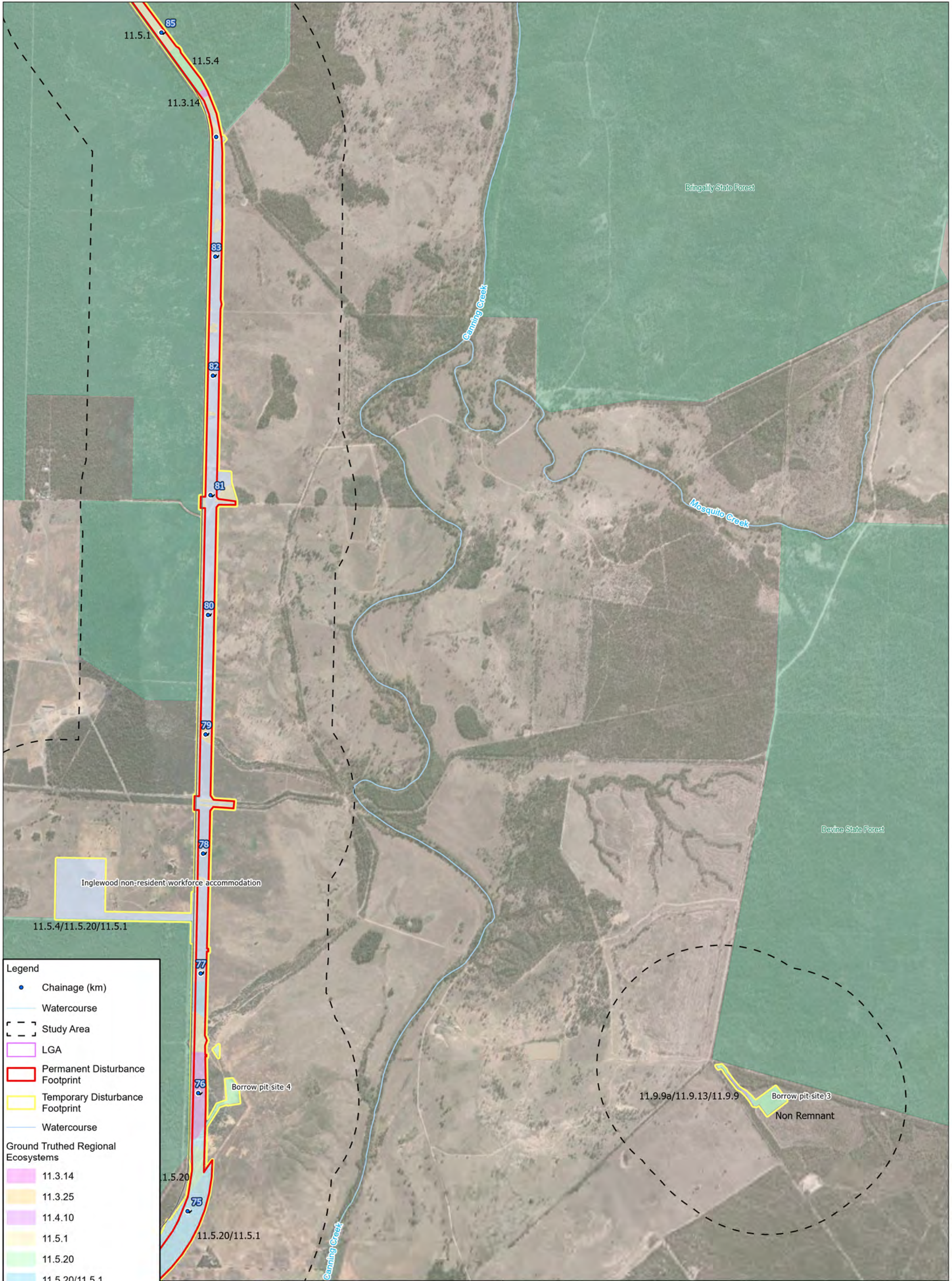
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F4.2(12) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.14
- 11.3.25
- 11.4.10
- 11.5.1
- 11.5.20
- 11.5.20/11.5.1
- 11.5.4
- 11.5.4/11.5.20/11.5.1
- 11.9.9a/11.9.13/11.9.9
- Non Remnant

Coordinate System:
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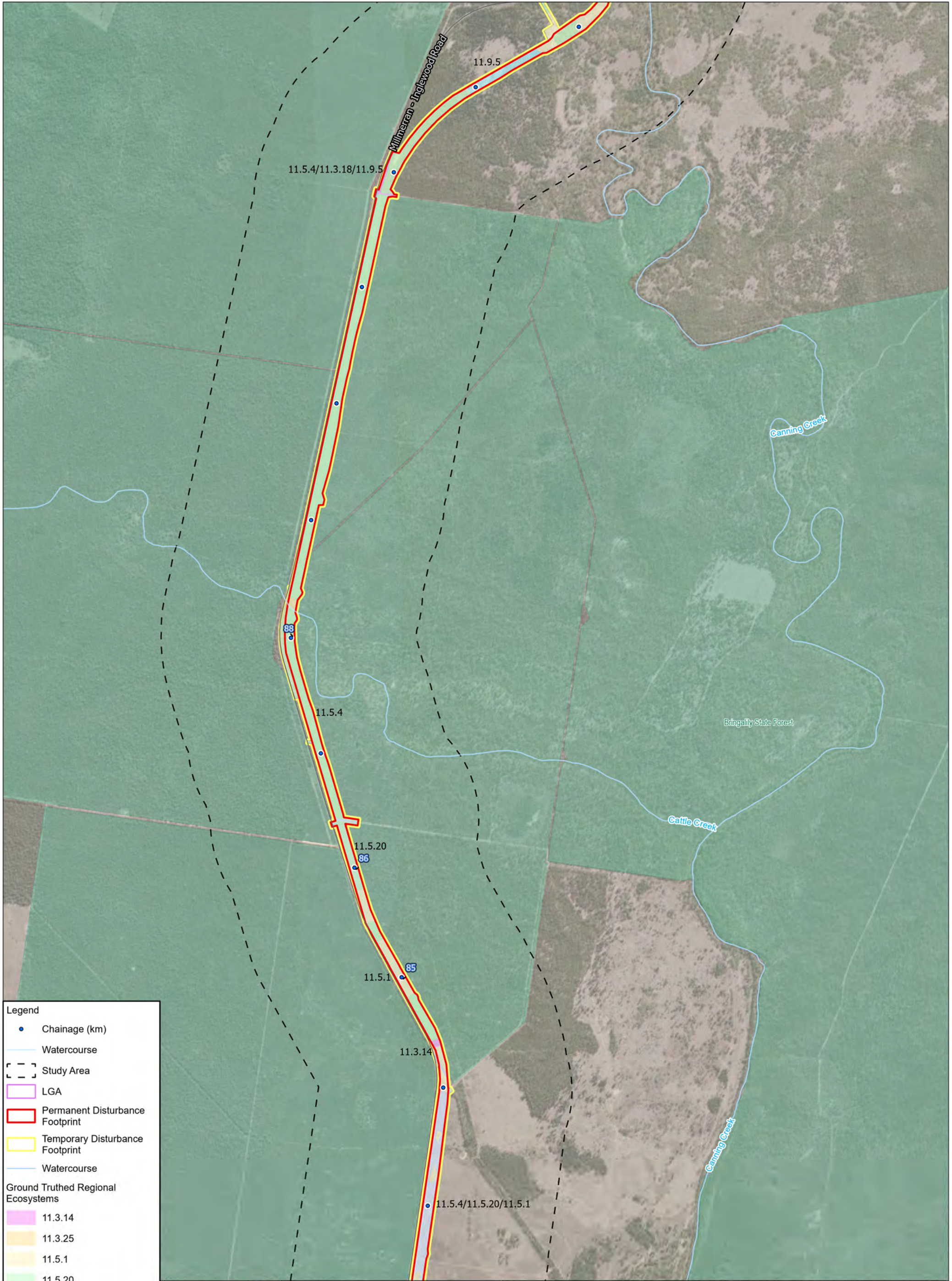
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F4.2(13) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

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

Ground Truthed Regional Ecosystems

11.3.14
11.3.25
11.5.1
11.5.20
11.5.4
11.5.4/11.3.18/11.9.5
11.5.4/11.5.20/11.5.1
11.9.5

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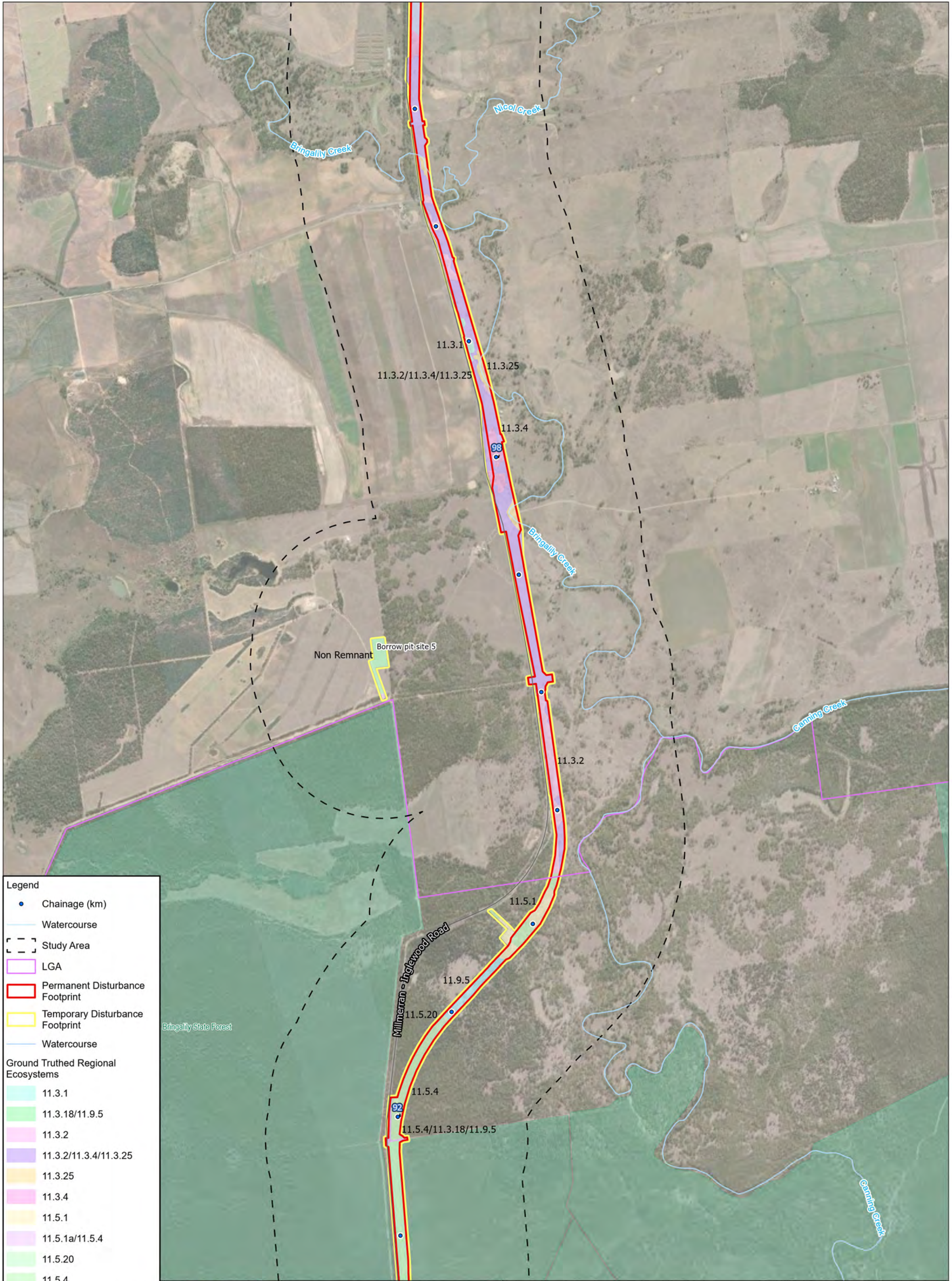
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F4.2(14) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

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Chainage (km)

Watercourse

[- -]

Study Area

LGA

Permanent Disturbance Footprint

Temporary Disturbance Footprint

Watercourse

Ground Truthed Regional Ecosystems

11.3.1

11.3.18/11.9.5

11.3.2

11.3.2/11.3.4/11.3.25

11.3.25

11.3.4

11.5.1

11.5.1a/11.5.4

11.5.20

11.5.4

11.5.4/11.3.18/11.9.5

11.9.5

11.9.5/11.3.18/11.3.4

Non Remnant



Coordinate System:
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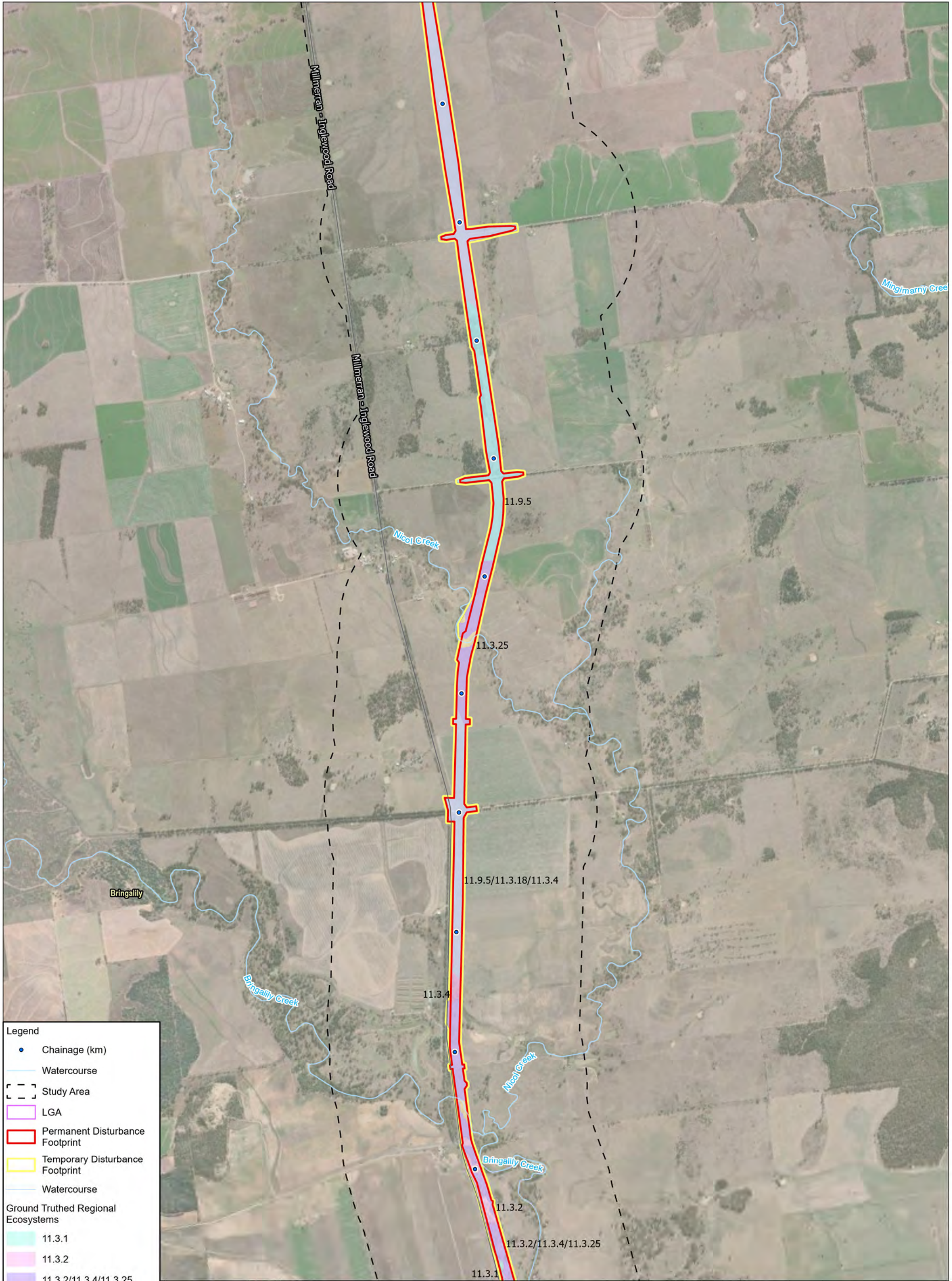
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F4.2(15) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

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Chainage (km)

Watercourse

[-]

Study Area

LGA

Permanent Disturbance Footprint

Temporary Disturbance Footprint

Watercourse

Ground Truthed Regional Ecosystems

11.3.1

11.3.2

11.3.2/11.3.4/11.3.25

11.3.25

11.3.4

11.9.5

11.9.5/11.3.18/11.3.4



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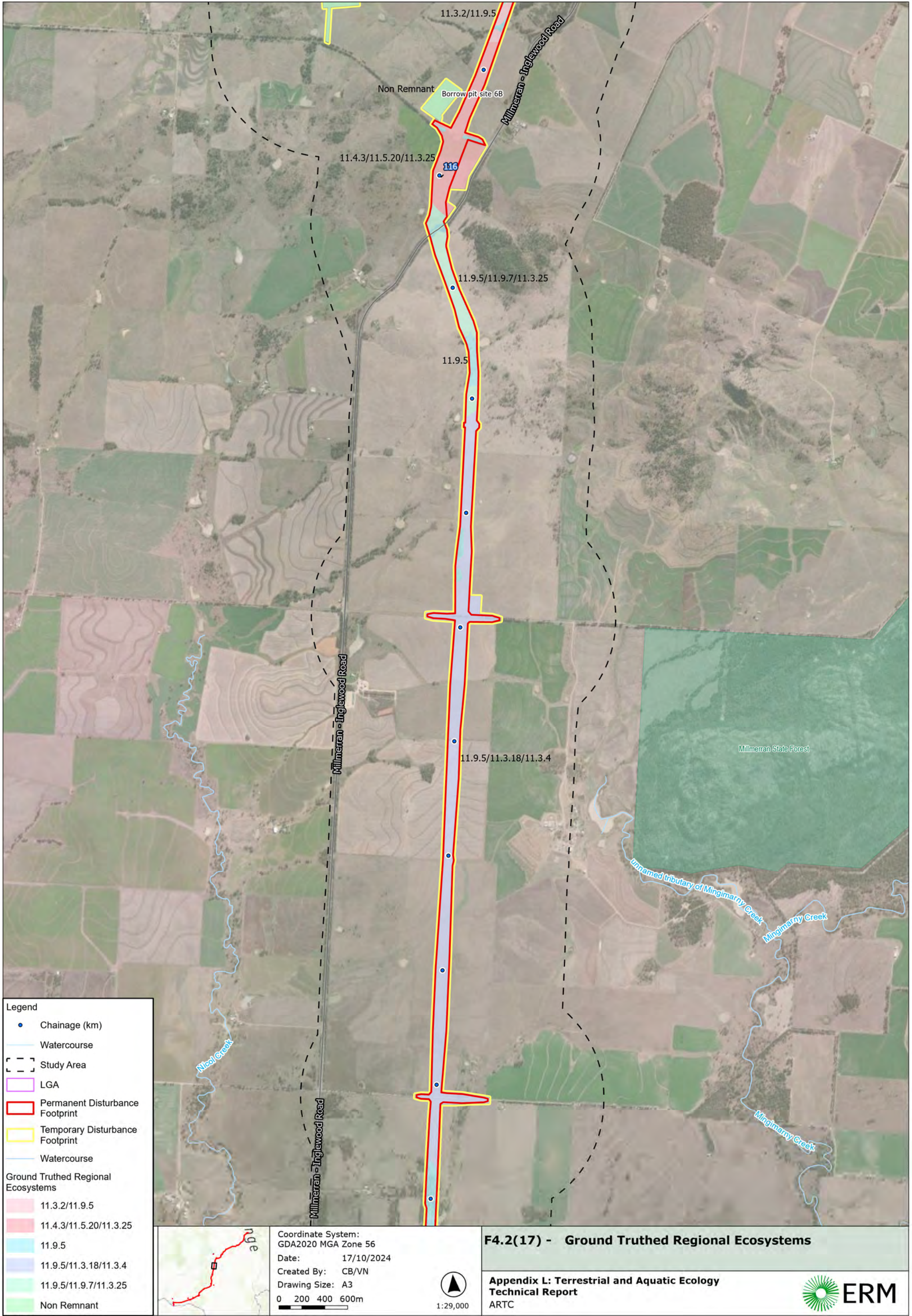


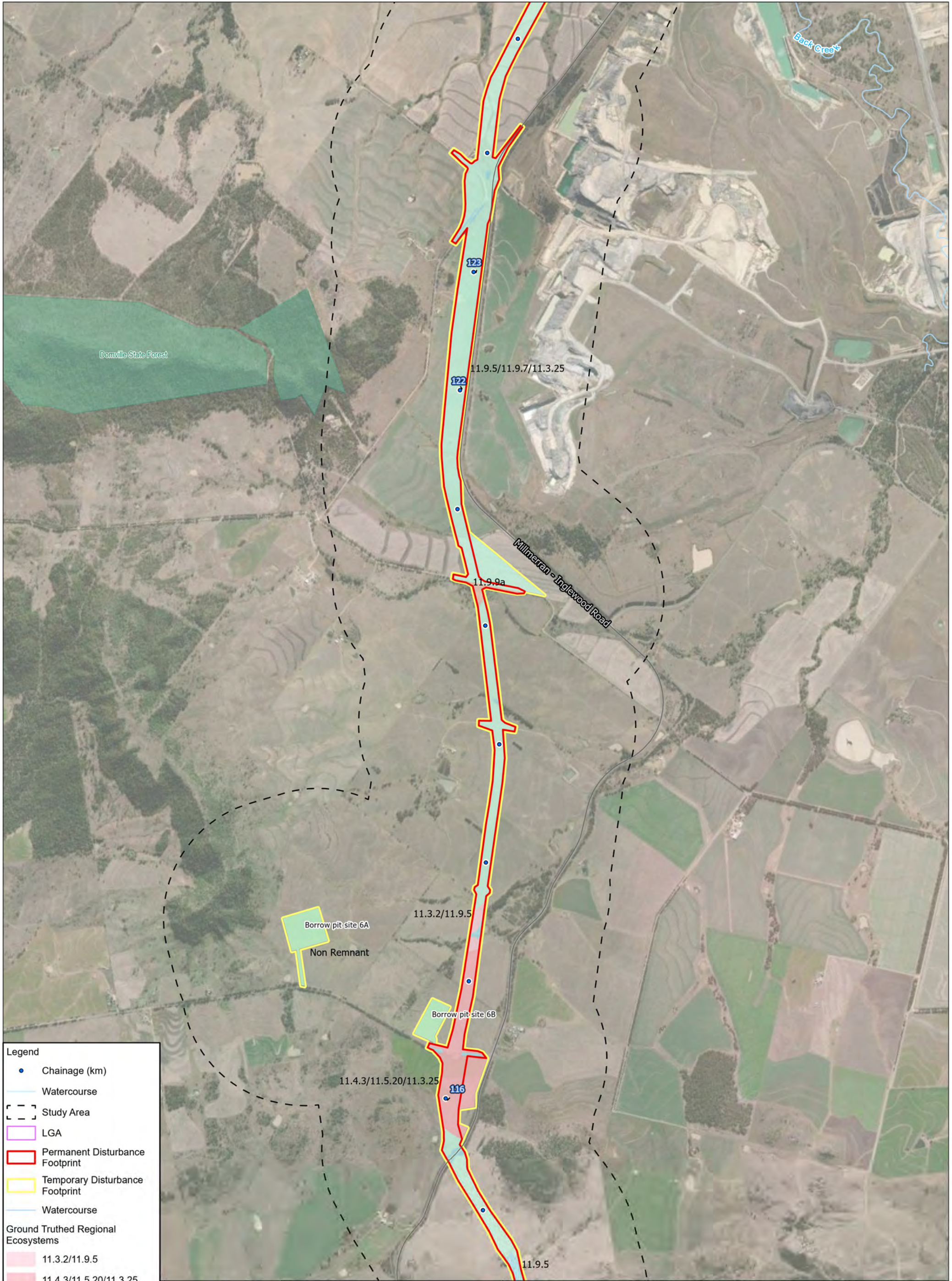
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F4.2(16) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC







Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- [] LGA
- [] Permanent Disturbance Footprint
- [] Temporary Disturbance Footprint
- Watercourse
- Ground Truthed Regional Ecosystems**
- 11.3.2/11.9.5
- 11.4.3/11.5.20/11.3.25
- 11.9.5
- 11.9.5/11.9.7/11.3.25
- 11.9.9a
- Non Remnant



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F4.2(18) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC

Pine Creek

11.3.2/11.3.25

Turallin miscellaneous site facility
11.3.2

Gore Highway

Legend

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

Ground Truthed Regional Ecosystems

- 11.3.2
- 11.3.2/11.3.25

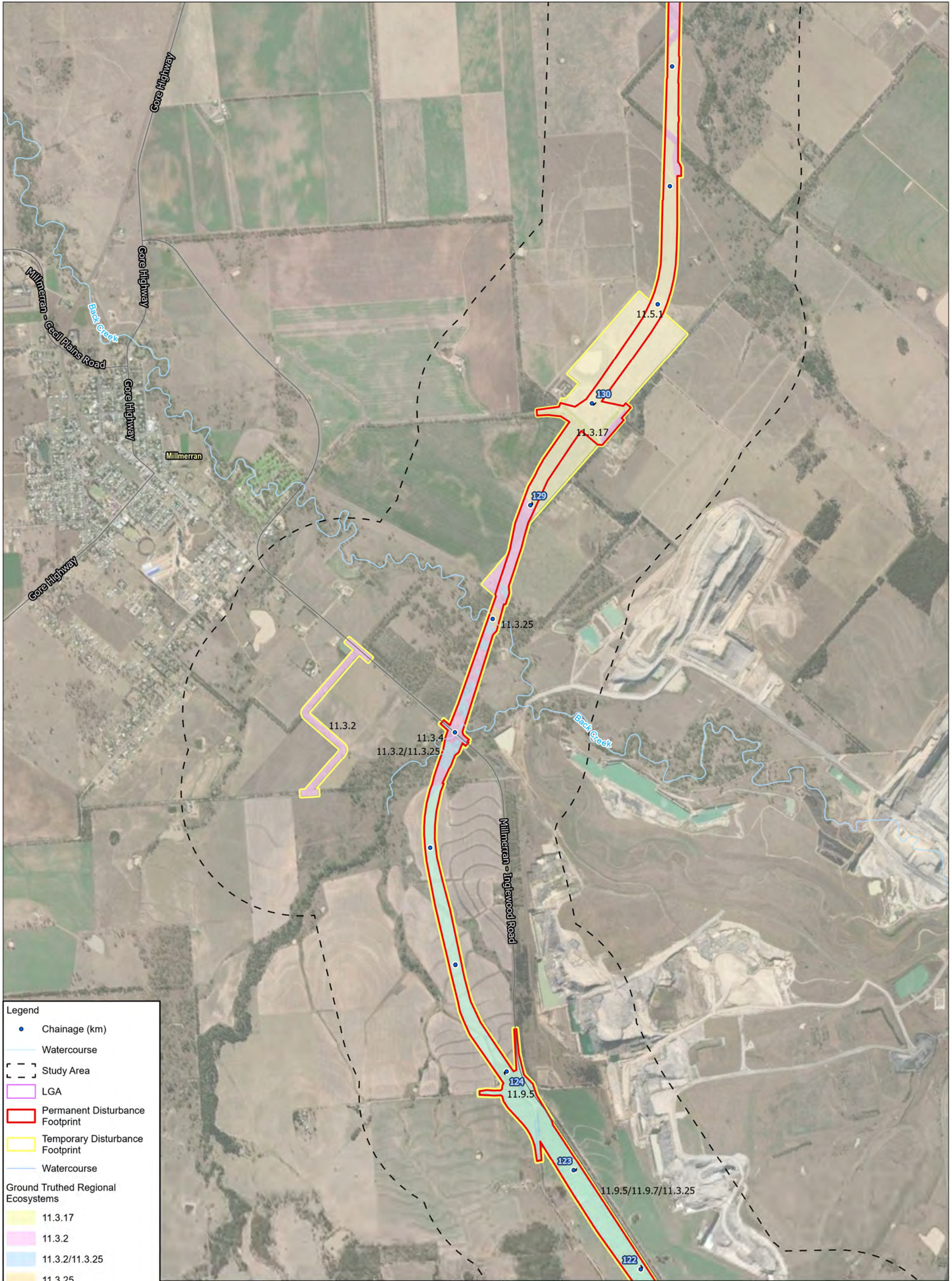
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F4.2(19) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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

Ground Truthed Regional Ecosystems

- 11.3.17
- 11.3.2
- 11.3.2/11.3.25
- 11.3.25
- 11.3.4
- 11.5.1
- 11.9.5
- 11.9.5/11.9.7/11.3.25

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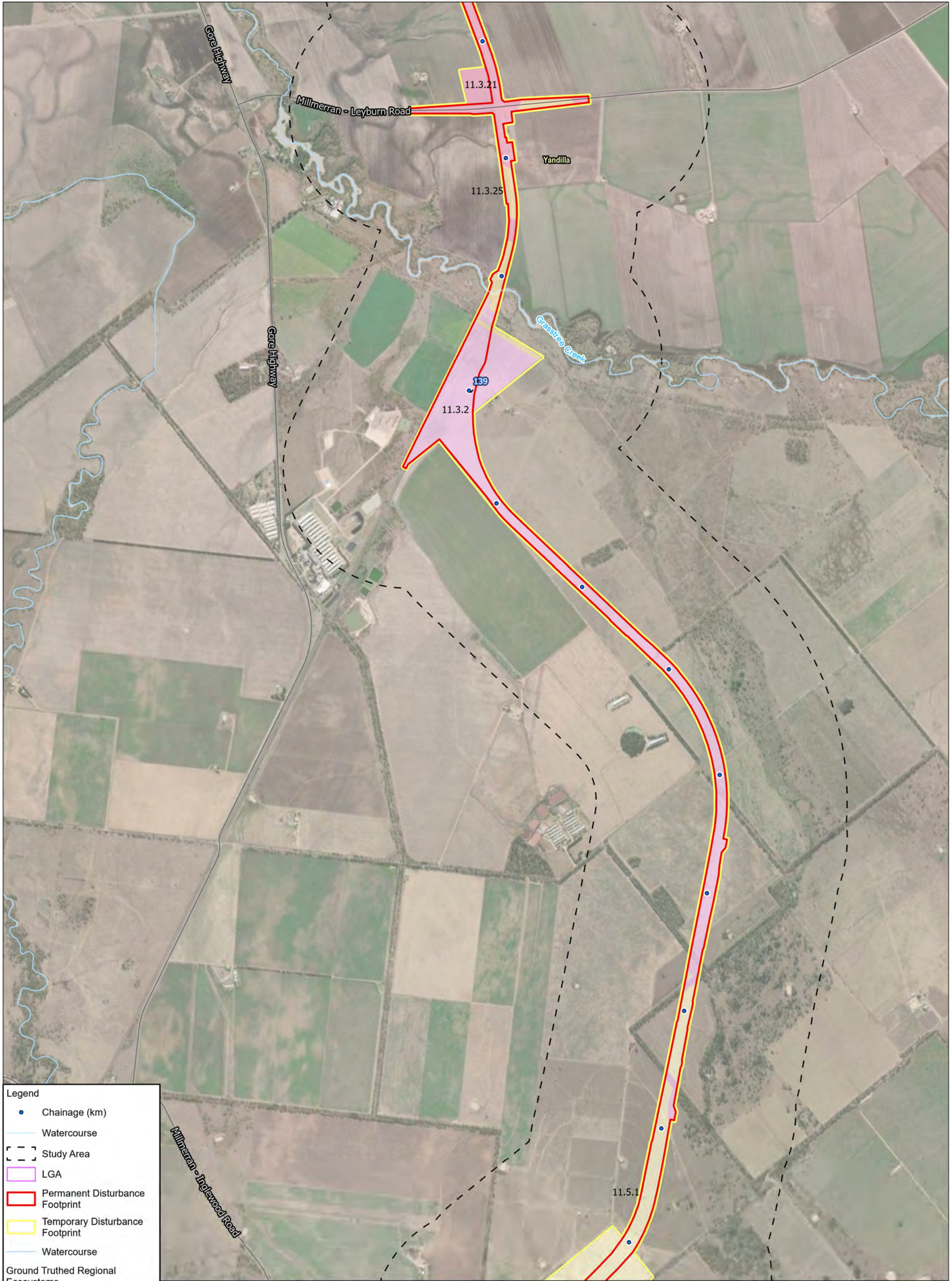
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F4.2(20) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

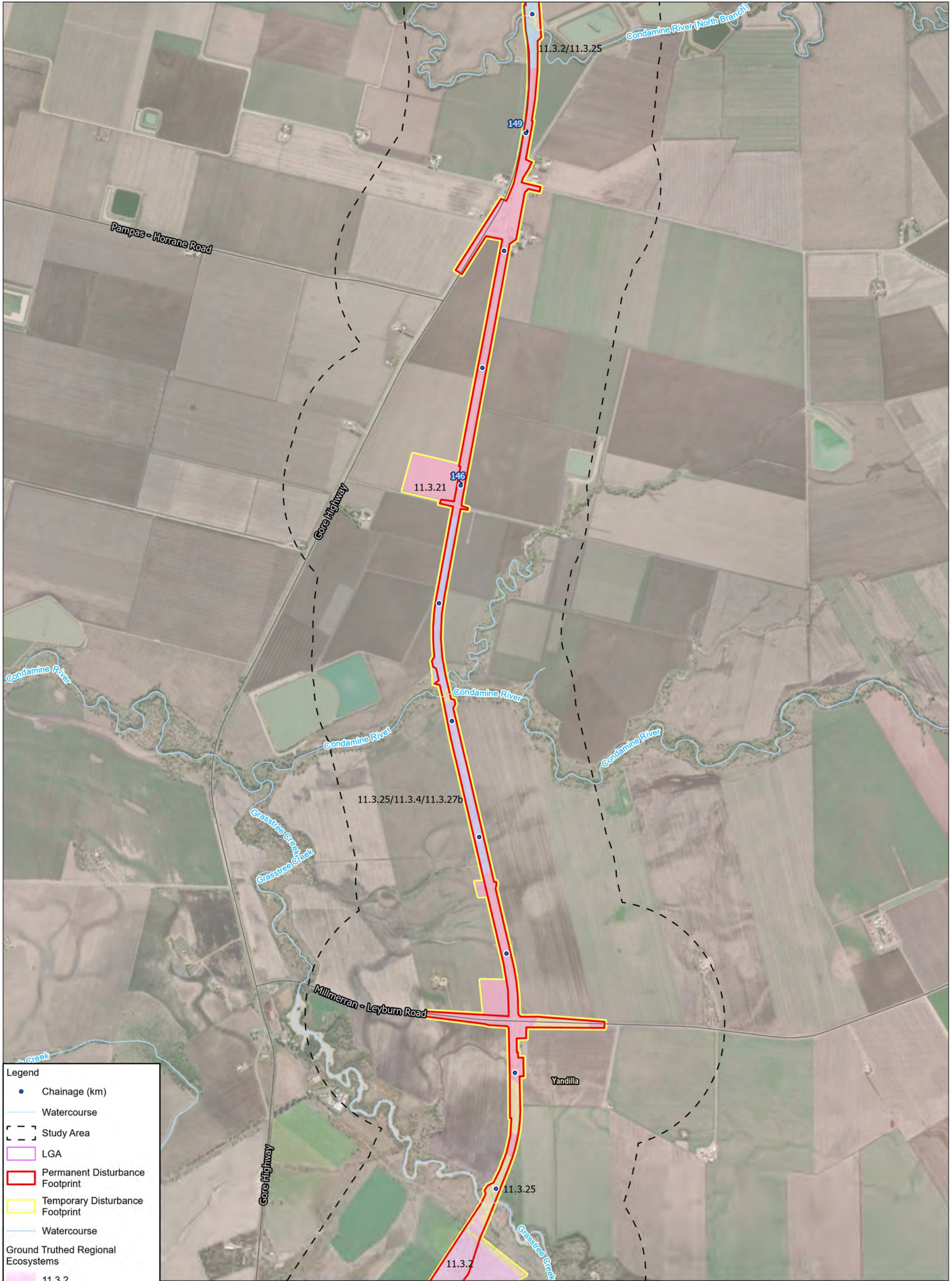
Ground Truthed Regional Ecosystems

- 11.3.2
- 11.3.21
- 11.3.25
- 11.5.1

Coordinate System:
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F4.2(21) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.2
- 11.3.2/11.3.25
- 11.3.21
- 11.3.25
- 11.3.25/11.3.4/11.3.27b

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Date: 17/10/2024

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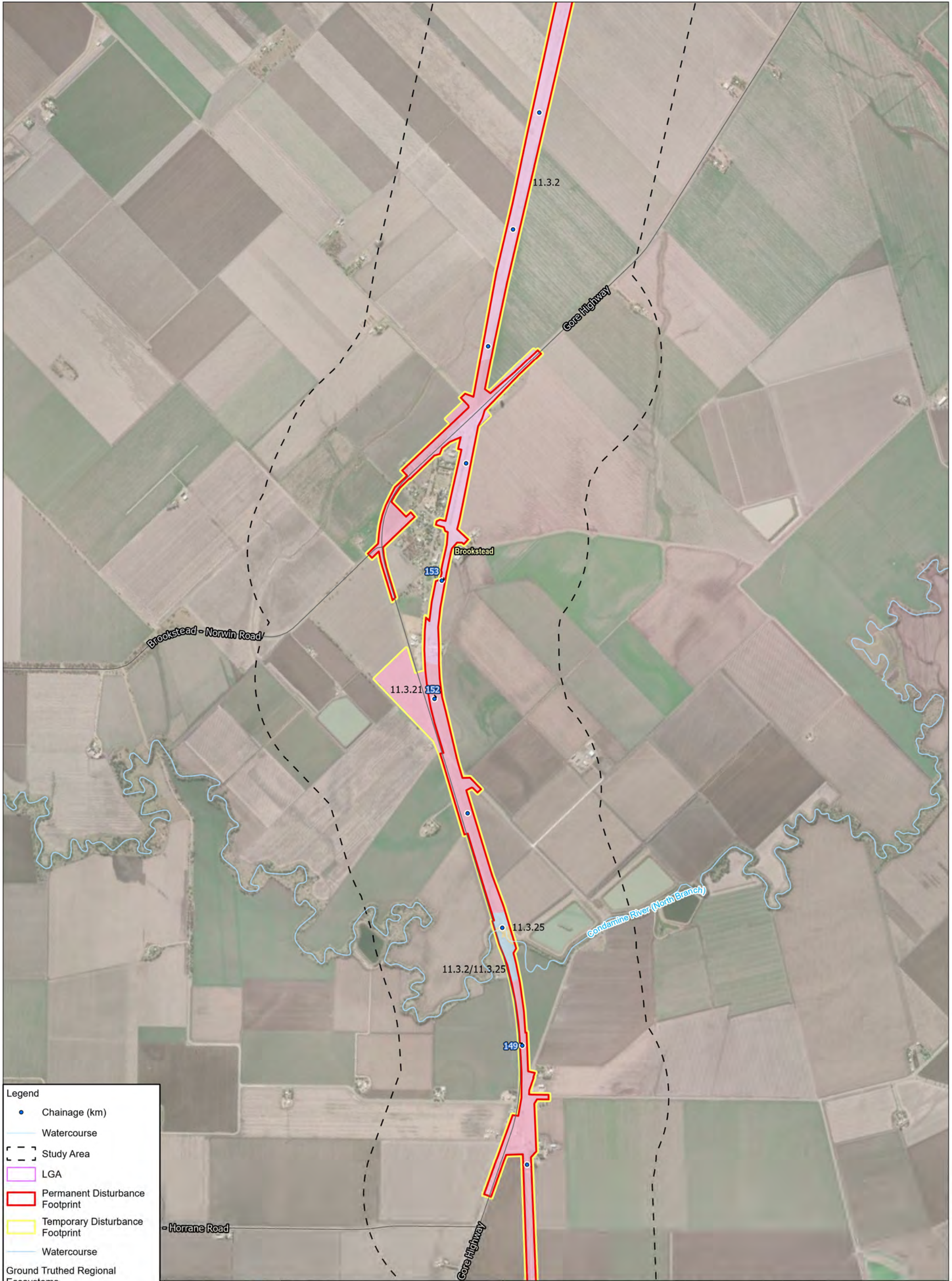
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F4.2(22) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.2
- 11.3.2/11.3.25
- 11.3.21
- 11.3.25

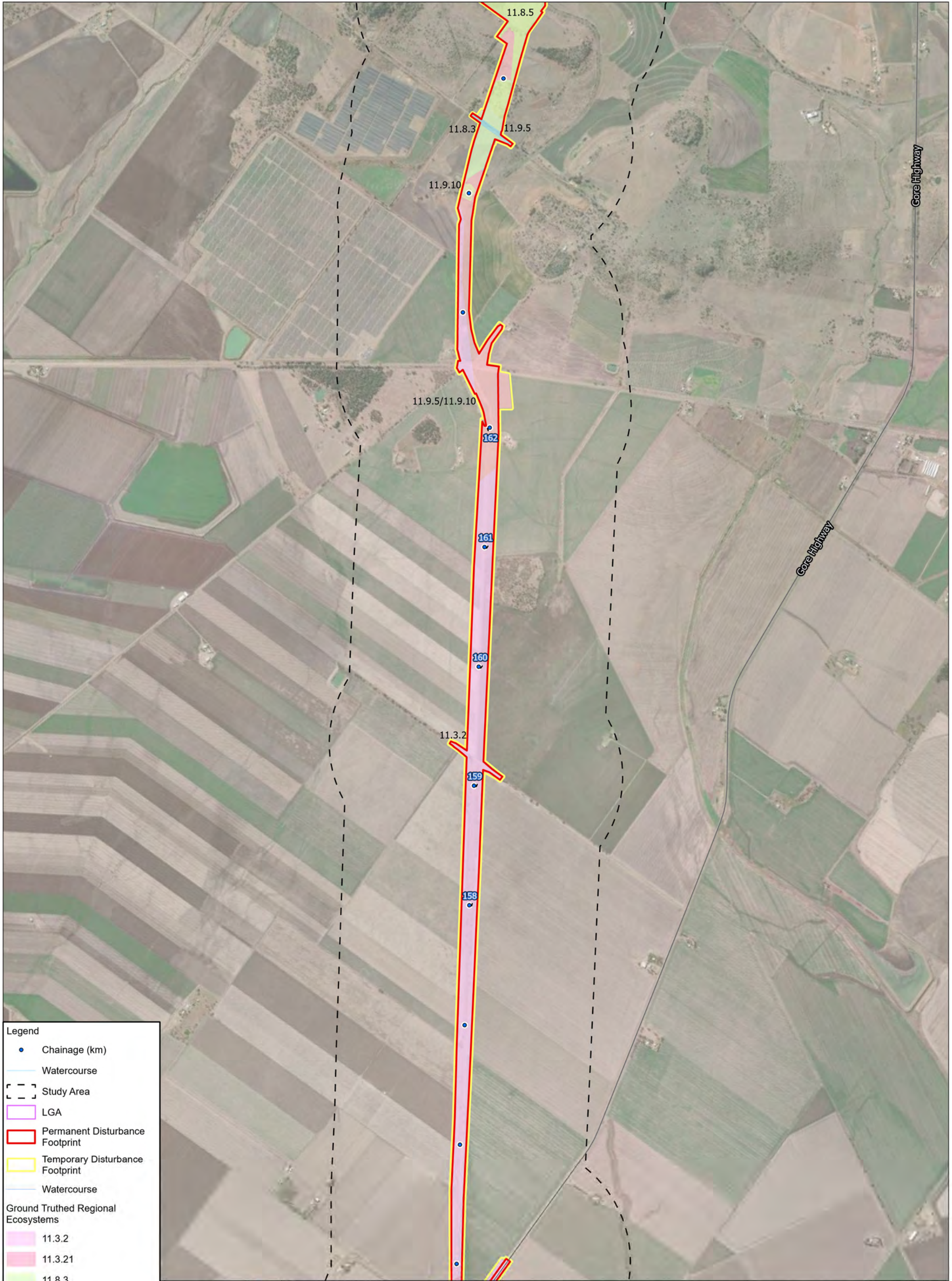


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F4.2(23) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC

ERM



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.2
- 11.3.21
- 11.8.3
- 11.8.5
- 11.9.10
- 11.9.5
- 11.9.5/11.9.10

Coordinate System:
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Date: 17/10/2024

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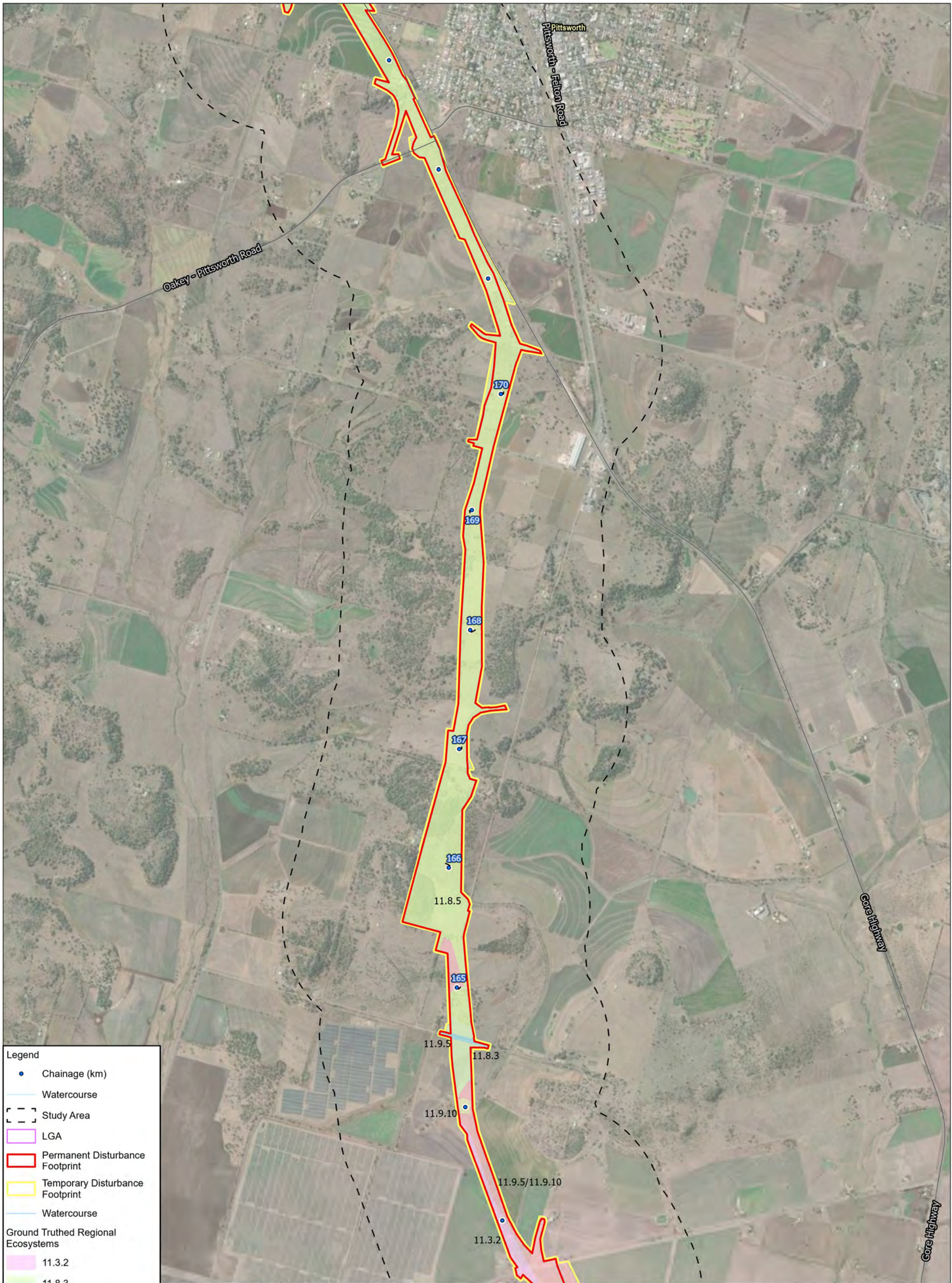
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F4.2(24) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC

 **ERM**



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.2
- 11.8.3
- 11.8.5
- 11.9.10
- 11.9.5
- 11.9.5/11.9.10

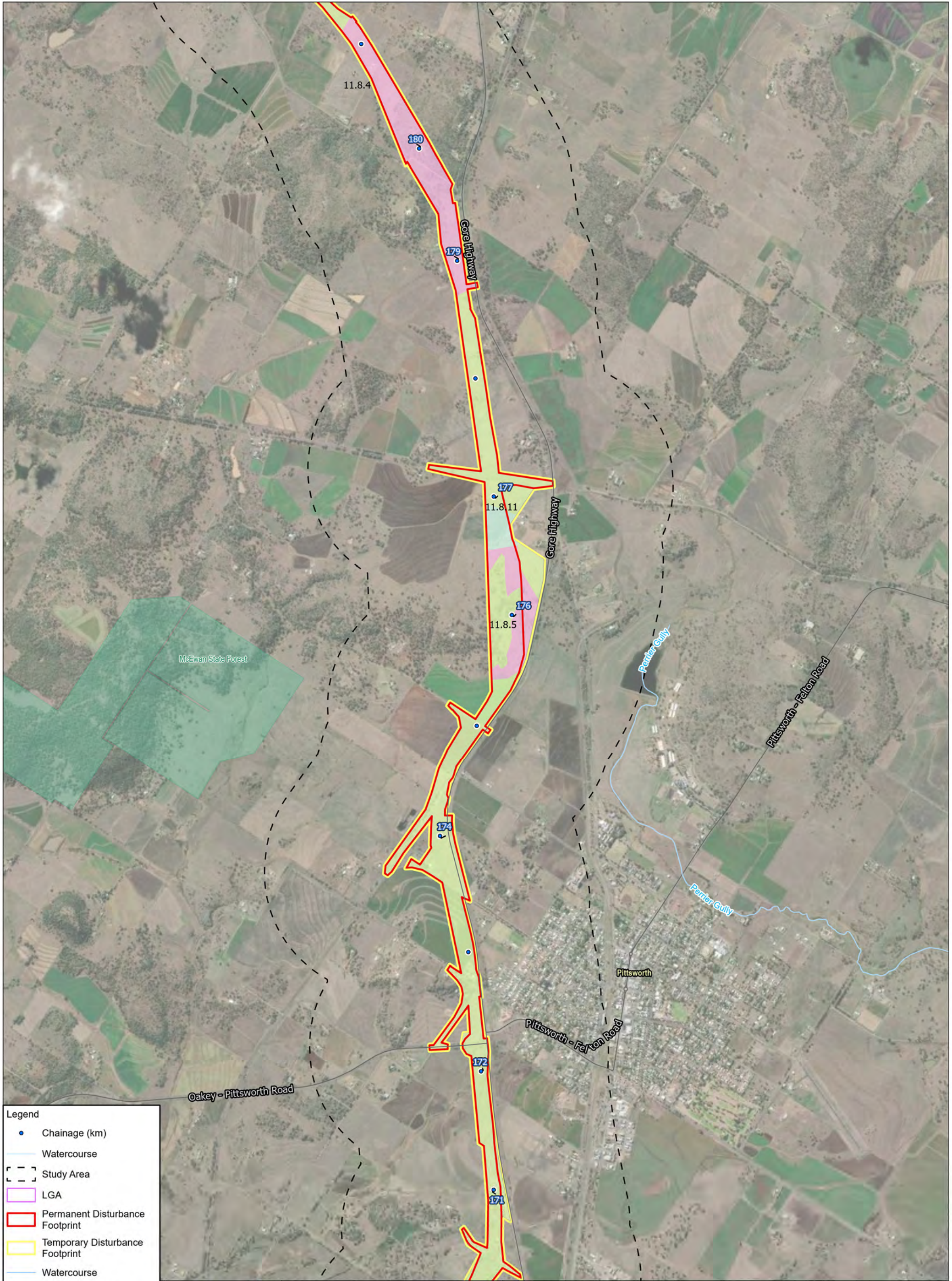


Coordinate System:
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Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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F4.2(25) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.8.11
- 11.8.4
- 11.8.5



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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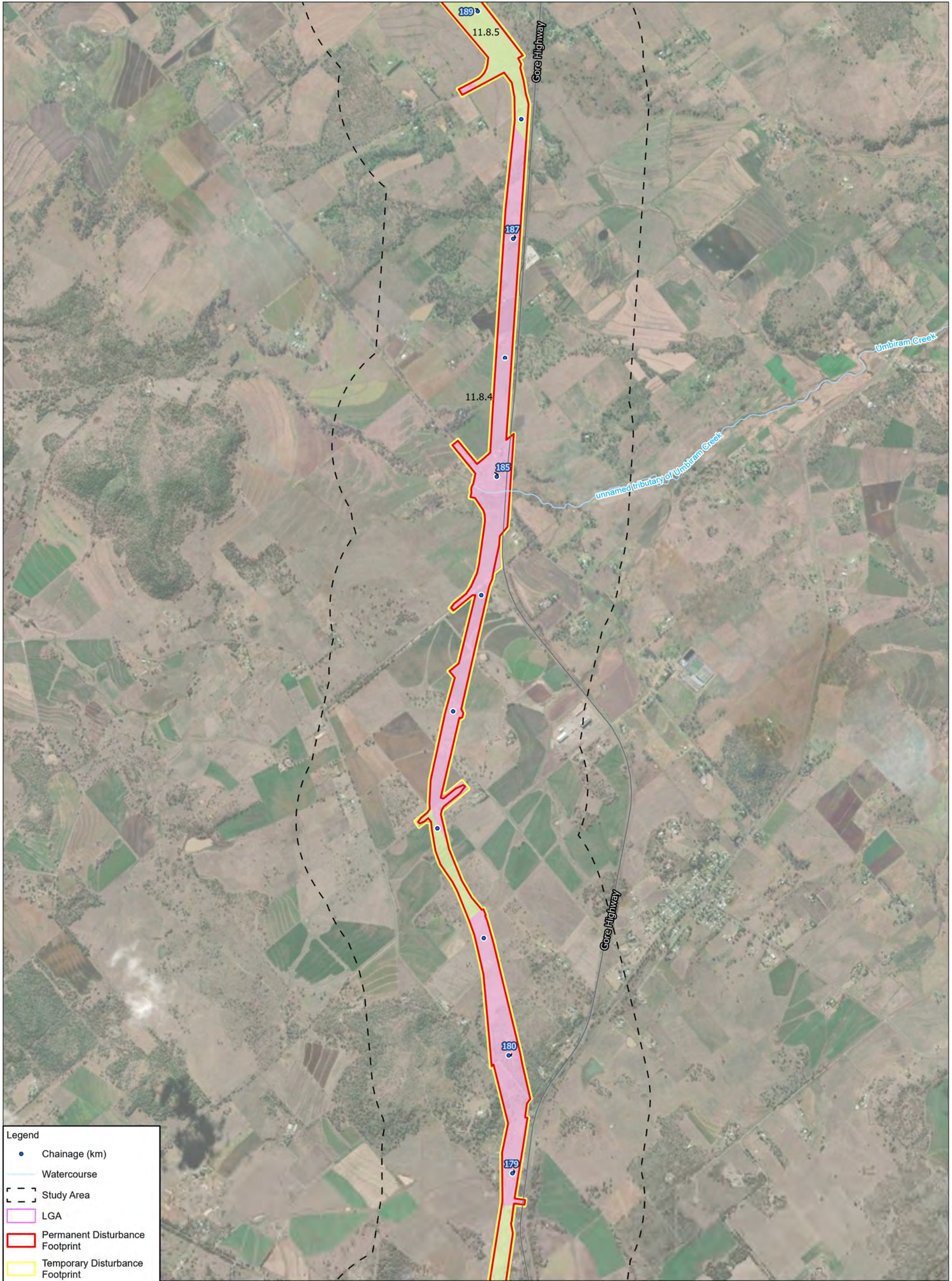
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F4.2(26) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC

 **ERM**



Legend

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

Ground Truthed Regional Ecosystems

- 11.8.4
- 11.8.5

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

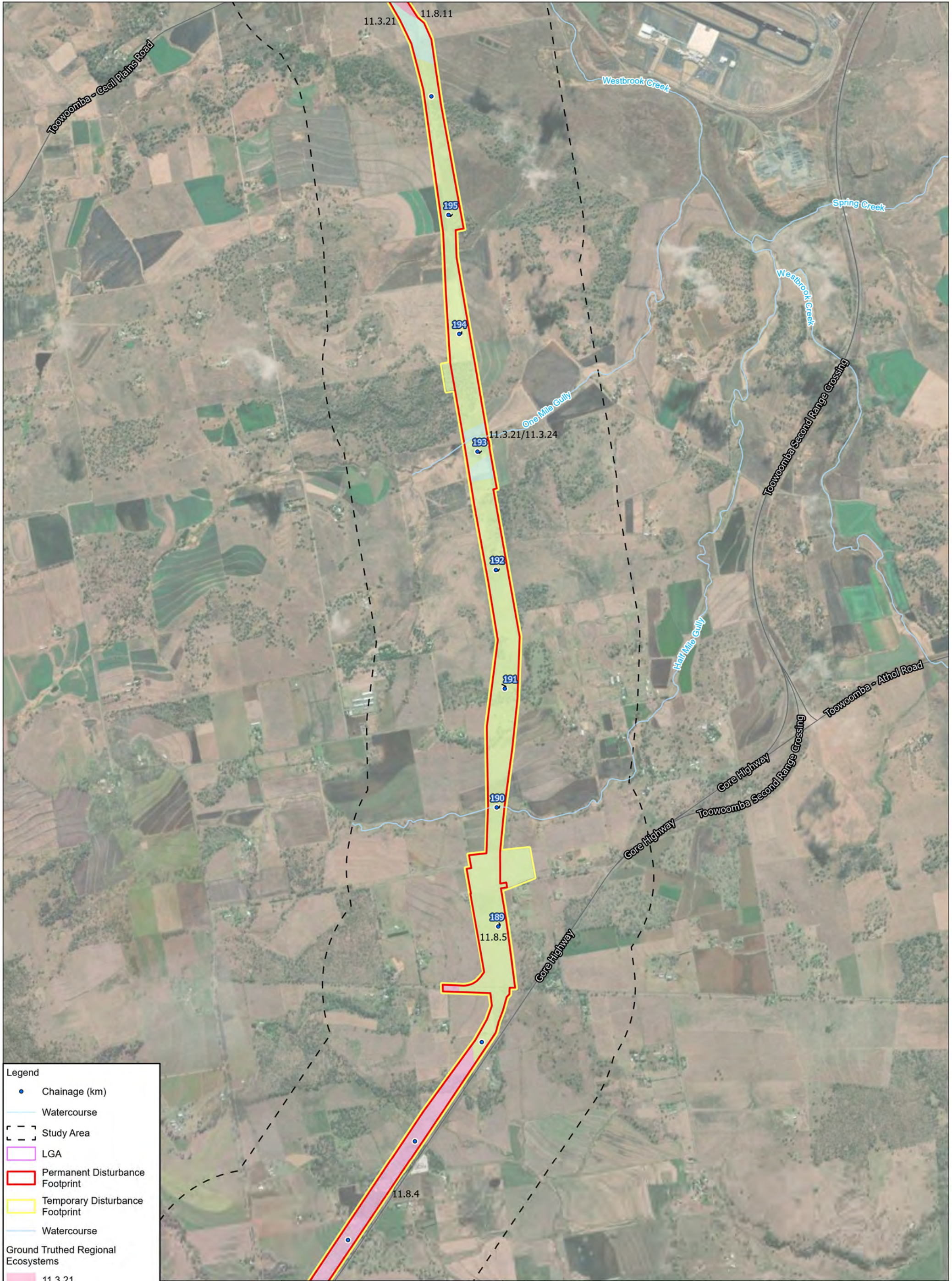
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F4.2(27) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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

Ground Truthed Regional Ecosystems

- 11.3.21
- 11.3.21/11.3.24
- 11.8.11
- 11.8.4
- 11.8.5

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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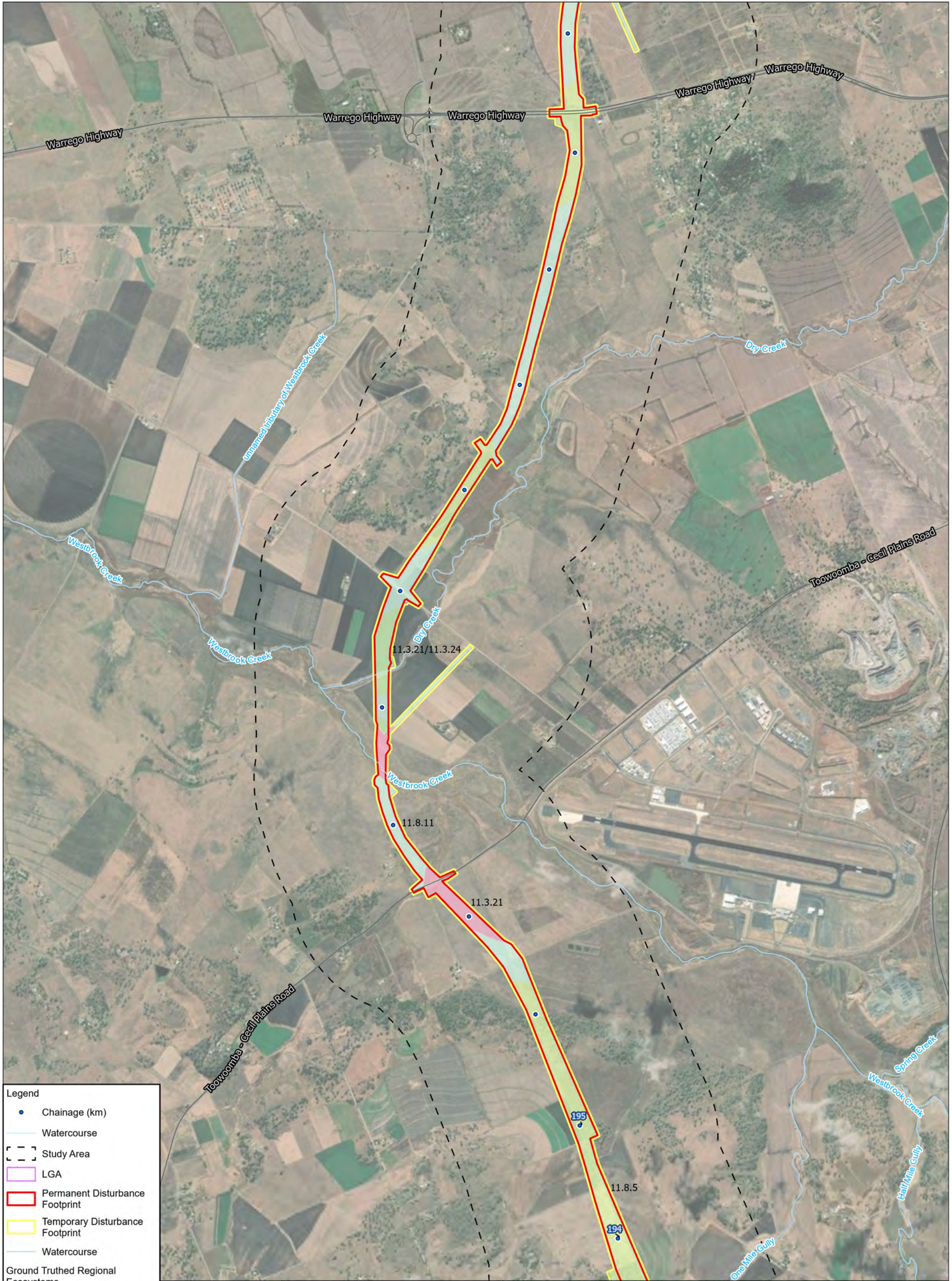
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F4.2(28) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

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

Ground Truthed Regional Ecosystems

- 11.3.21
- 11.3.21/11.3.24
- 11.8.11
- 11.8.5

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 200 400 600m

1:29,000

F4.2(29) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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

Ground Truthed Regional Ecosystems

- 11.3.21/11.3.24
- 11.8.11
- 11.8.5



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 200 400 600m

1:29,000

F4.2(30) - Ground Truthed Regional Ecosystems

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



4.2 HABITAT TYPES

A total of eight broad habitat types have been identified within the Project footprint (Table 4-2), noting that groundwater dependent ecosystems (GDEs) are minor occurrences within other habitat types. The broad habitat types were delineated by grouping vegetation communities according to their vegetation structure, composition, and geomorphological characteristics. The extent of ground-truthed habitat types within the Project footprint is provided in Table 4-2. As a result of the dry conditions during the survey period the extent of GDEs and watercourses were unable to be ground-truthed and are included as minor components of the broad habitat types.

TABLE 4-2 GROUND-TRUTHED HABITAT TYPES WITHIN THE PROJECT FOOTPRINT

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

4.2.1 NON-REMNANT (DISTURBED PASTURE, CROPPING AREAS AND OTHER LAND USES)

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

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

Non-remnant and cultivated areas are known to provide habitat for squatter pigeon (southern) (*Geophaps scripta scripta*), Condamine earless dragon (*Tympanocryptis condaminensis*), and Belson's panic (*Homopholis belsonii*). The availability of soil cracks and other microhabitat

refugia is greatly reduced by soil cultivation, reducing the likelihood of occurrence of soil crack dwelling fauna species.

Within grasslands on basalt soils, potential habitat for NC Act listed *Digitaria porrecta*, *Cyperus clarus*, and *Picris barbarorum* occurs, regardless of the degraded state of some areas.

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

4.2.2 REMNANT DRY SCLEROPHYLL EUCALYPT WOODLANDS

Dry sclerophyll woodlands occur throughout the Project footprint on a range of geology and soil types. The dominant vegetation communities occurring on each of these soil types differ in species composition and structure, and therefore, changes the potential for habitat suitability for a range of species. As such, they have been differentiated into four sub-habitat types as presented below.

4.2.2.1 ON SEDIMENTARY AND IGNEOUS ROCKS

Mature eucalypt open forest and woodland on sedimentary/igneous rocks dominated by mountain grey gum (*Eucalyptus orgadophila*), narrow-leaved ironbark (*E. crebra*), Queensland bluegum (*E. tereticornis*), poplar box (*E. populnea*), and yellow box (*E. melliodora*) occur within some portions of the Project footprint. These areas 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 (Plate 4.1).

The condition and structure of these habitats was highly variable across the Project footprint, 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. Microhabitat features present within 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 microbats, gliders, possums, birds (including parrots, cockatoos, and owls), arboreal snakes, and monitors. Canopy trees and some shrubs species 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 have a reduced capacity to support woodland and forest species and are more likely to provide habitat value to transitional species and support mammal and bird species typical of disturbed areas. Nonetheless, these isolated trees may provide important feed resources to vagile species during their flowering periods.

4.2.2.2 ON ALLUVIAL PLAINS

Mature eucalypt open forest and woodland on alluvial plains dominated by Queensland bluegum (*E. tereticornis*), poplar box (*E. populnea*), and river red gum (*E. camaldulensis*) occur within some portions of the Study area. These areas are represented in the community REs of 11.3.4, 11.3.2, 11.3.14, and 11.3.18, which are associated with the floodplains and creek flats within the Study area.

This habitat generally exhibits low structural complexity, particularly at lower strata levels such as the shrub layer (Plate 4.2). Ground cover is typically low due to livestock use, and the understorey is very sparse with an open canopy of large Queensland blue gums or river red gums. 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.

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 birds including ducks, geese, grebes, snipe, crakes, rails, egrets, and herons.



PLATE 4.1 MATURE EUCALYPT WOODLAND ON SEDIMENTARY ROCK, LOCATED WITHIN THE INGLEWOOD REGION (2018)



PLATE 4.2 ALLUVIAL POPLAR BOX WOODLAND NEAR MILLMERRAN (2018)

4.2.2.3 ON SAND PLAINS

Mature eucalypt woodland and forest on sand plains within the Project footprint represented by RE 11.5.20. This habitat type is described as gum-topped box (*E. moluccana*) or grey box (*E. macrocarpa*) or narrow-leaved box (*E. woollsiana*) woodland to open forest.

Species including bull-oak (*Allocasuarina luehmannii*) and white cypress-pine (*Callitris glaucophylla*) often form a low woodland layer. This habitat occurs on flat to gently undulating plains formed from Cainozoic/Quaternary sediments. The clustered structure of some portions of this habitat type provides suitable habitat for some species of microbat. Bull-oak cones may provide suitable foraging habitat for glossy black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*) and areas of thick leaf litter provide suitable habitat for the ambush species, the common death adder (*Acanthophis antarcticus*). Eucalypt forests and woodlands on sand plains may also provide habitat for south-eastern long-eared bat (*Nyctophilus corbeni*).

4.2.2.4 ON DURICRUSTS

Mature eucalypt forest and woodland on duricrusts within the Project footprint represented community of RE 11.7.7. This habitat type is described as open forest to woodland dominated by broad-leaved red ironbark (*E. fibrosa* subsp. *nubilis*) forming a distinct but discontinuous open forest to woodland canopy (22 to 25 m high) (Plate 4.3).

Broad-leaved red ironbark provides nectar and hollow resources for fauna including birds, arboreal mammals, insects, reptiles, and bats such as the south-eastern long-eared bat (*Nyctophilus corbeni*).

Narrow-leaved ironbark (*E. crebra*) often co dominates or is locally dominant, particularly on lower slopes. This habitat also includes areas with lemon-scented gum (*Corymbia citriodora*) as a codominant. There is usually a low woodland mid layer dominated by *Acacia* spp. or sometimes bulloak (*A. luehmannii*) and black cypress-pine (*C. 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. This habitat occurs on low hills and ranges formed from deeply weathered sediments.



PLATE 4.3 EUCALYPT WOODLAND ON DURICRUST (2018)



PLATE 4.4 MATURE EUCALYPT RIPARIAN WOODLAND LOCATED SOUTH OF INGLEWOOD (2018)

4.2.3 REGROWTH EUCALYPT COMMUNITIES

Areas of regrowth vegetation, largely represented by the HVR vegetation mapping, are present throughout the Project footprint. The patches of regrowth vegetation within the Study 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.



PLATE 4.5 REGROWTH COMMUNITY DOMINATED BY EUCALYPTUS AND ACACIA SPECIES, LOCATED WITHIN THE INGLEWOOD REGION (2018)

4.2.4 ACACIA HARPOPHYLLA-CASUARINA CRISTATA OPEN FOREST

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

Within the Study area this community on sedimentary rocks was represented by RE 11.9.5. This habitat type is dominated by brigalow (*Acacia harpophylla*) and/or belah (*Casuarina cristata*), or brigalow with a semi-evergreen vine thicket understorey (Plate 4.6). A prominent low tree or tall shrub layer dominated by species including wilga (*Geijera parviflora*) and false sandalwood (*Eremophila mitchellii*), and often with currant bush (*Carissa ovata*), emu apple (*Owenia acidula*), silver croton (*Croton insularis*), stiff Denhamia (*Denhamia oleaster*) and velvet mock olive (*Notelaea macrocarpa*). Black tea-tree (*Melaleuca bracteata*) was 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 a range of species, particularly amphibian species.

On clay plains, this community within the Project footprint was represented by RE 11.4.3. This habitat type is dominated by brigalow (*A. harpophylla*) and/or belah (*C. cristata*). Brigalow (10 to 16 m high) predominates, forming a continuous canopy with varying densities of belah (14 to 18 m high), forming part of the canopy or emerging above it (Plate 4.7). *Eucalyptus* spp. including mountain coolabah (*E. orgadophila*), poplar box (*E. populnea*), grey box (*E. macrocarpa*), narrow-leaved box (*E. woollsiana*), Dawson gum (*E. cambageana*), and *E. thozetiana* (on shallower soils and upper slopes) may be scattered through the canopy or occur as emergents up to 22 m high. 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 to 8 m. Black tea-tree (*Melaleuca bracteata*) may be present in low-lying areas.

The ground layer is sparse to open and composed of grasses and forbs. Occurring on Cainozoic clay plains with cracking clay soils which are often with a weak gilgai microrelief (Plate 4.7).

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, however the loose bark of brigalow provides important refugia for arboreal geckoes and insectivorous bats.

The habitat type may provide habitat for species including grey snake (*Hemiaspis damelii*), Dunmall's snake (*Furina dunmalli*), common death adder (*Acanthophis antarcticus*) and south-eastern long-eared bat (*Nyctophilus corbeni*) where shelter-sites such as logs, rocks, tree hollows, decorticating bark and root cavities are available. The brigalow woodland snail (*Adclarkia cameroni*) is associated with this habitat type and suitable habitat for painted honeyeater (*Grantiella picta*) is present in areas with abundant mistletoe (*Amyema* spp.).



PLATE 4.6 BRIGALOW/BELAH OPEN FOREST ON SEDIMENTARY ROCK LOCATED TO SOUTH OF MILLMERRAN (2018)



PLATE 4.7 BRIGALOW/BELAH OPEN FOREST ON CLAY PLAINS LOCATED WITHIN ROAD RESERVES SOUTH OF YELARBON (2018)

4.2.5 NATURAL GRASSLANDS

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

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

Native and derived grasslands are considered as one fauna habitat type due to similarities in structure and floristics. Grasslands in the Project footprint are typically located on alluvial floodplains and creek flats and basalt plains. These grassland habitats are commonly utilised for agricultural purposes including livestock grazing and fodder harvesting. Grasslands in road reserves provide the least impacted representation of this habitat (Plate 4.8 and Plate 4.9).

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

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



PLATE 4.8 EXAMPLE OF NATIVE GRASSLAND IN ROAD RESERVE LOCATED SOUTH OF MILLMERRAN (2018)



PLATE 4.9 GRASSLAND COMPOSED OF NATIVE AND NON-NATIVE SPECIES WITHIN ROAD RESERVE SOUTH OF TOOWOOMBA (2018)

4.2.6 FRESHWATER WETLANDS

Wetland habitats within the Study area include farm dams, wetlands associated with the floodplains of major watercourses (riverine), and vegetated swamps (palustrine). Farm dams, which are abundant across agricultural landscapes, are included as they potentially at times provide suitable wetland alternatives for vertebrate fauna. These include typically small stock-watering dams and much larger turkey-nest dams associated with irrigated cropping, and 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 (0.11 ha). Typical aquatic and emergent plants include *Chara* spp., *Nitella* spp., *Myriophyllum verrucosum*, blue lily (*Nymphaea violacea*), *Pyrgillus javanicus*, curled pondweed (*Potamogeton crispus*), *P. tricarinatus*, swamp lily (*Ottelia ovalifolia*), *Vallisneria caulescens*, and marshwort (*Nymphoides indica*). A narrow fringing woodland commonly dominated by river red gum (*E. camaldulensis*) or *E. coolabah* may occur. Wetland habitats within the region are highly ephemeral, particularly in the southern and drier sections of the alignment (Plate 4.10).

Wetland habitats within the Project footprint are considered to provide suitable habitat for a variety of amphibian, reptile, and bird species (such as glossy ibis (*Plegadis falcinellus*) and sharp-tailed sandpiper (*Calidris acuminata*). Larger palustrine wetlands potentially provide important refuge habitat for many bird species and may act as steppingstones during periods of travel.



PLATE 4.10 EPHEMERAL WETLAND AREAS LOCATED AT YELARBON, ASSOCIATED WITH THE YELARBON SCALD (2018)

Wetland habitats within the Project footprint 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. It is noted that farm dams are less likely to provide these habitat elements and floodplain wetlands are highly ephemeral.

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

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

4.2.7 WATERCOURSES

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

Targeted aquatic ecology assessments were carried out by Eco Logical Australia (2020) and Hydrobiology (2023) across several waterways intersected by the Project footprint. Aquatic ecology and surface water values were variable across the Project footprint. Ephemeral watercourses, which have been subject to previous disturbance from agricultural development and public infrastructure such as road crossings are dominant. Many of the waterways surveyed were dry at the time of the assessments and were not deemed to provide suitable

habitat for threatened aquatic species. However, those that contain permanent waterbodies may provide suitable habitat for the platypus (*Ornithorhynchus anatinus*) and Murray cod (*Maccullochella peelii*) (such as Macintyre Brook, Condamine River, Back Creek, Bringalily Creek, and Cabbage Creek).

MNES aquatic species, Murray cod, has been recorded in the Macintyre River and in the Macintyre Brook (Eco Logical Australia, 2020; Hydrobiology, 2023). Key sites in Bringalily Creek, Pariagara Creek, Nicol Creek, Native Dog Creek, Back Creek and Grasstree Creek have also been identified as potential habitat for this species (Aquatic Biopassage Services, 2024). Murray cod is known from the Condamine River system and may utilise channels within the Study area and the broader river system during prolonged wet periods.

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

Water flow and occurrence is variable and dependent on seasons. Sites on the Condamine River floodplain were generally dry with very little water in the channel (water generally present in small pools with infrequent deeper pools) (Plate 4.11 and Plate 4.12) during the Eco Logical Australia inspection (2020). However, the area of Condamine River inspected during the Hydrobiology survey (2023) was observed to be flowing.



PLATE 4.11 GRASSTREE CREEK - SOUTHERN CONdamine RIVER FLOODPLAIN AREA



PLATE 4.12 CONdamine RIVER (NORTH BRANCH)

Source: Eco Logical Australia (2020)

4.2.8 GROUNDWATER DEPENDENT ECOSYSTEMS

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

4.3 FLORA

4.3.1 DESKTOP ASSESSMENT RESULTS

4.3.1.1 THREATENED FLORA

The desktop assessment identified a total of 33 flora species known, likely or with the potential to occur within the Project footprint (Appendix H flora Species Lists). These species include those listed under the EPBC Act (22) and/or the NC Act (29) and are listed in Table 4-3. SLC flora species have not been included as they are not required to be assessed under the SRI Guidelines (DEHP, 2014b).

TABLE 4-3 SUMMARY OF THREATENED FLORA WITH THE POTENTIAL TO OCCUR IN THE PROJECT FOOTPRINT FOLLOWING DESKTOP ASSESSMENT

Scientific name	Common name	EPBC Act status	NC Act status	Desktop likelihood of occurrence
Threatened flora				
<i>Acacia argyrotricha</i>	Bracker wattle	-	V	Potential
<i>Acacia lauta</i>	Tara wattle	V	V	Potential
<i>Aristida forsteri</i>	-	-	E	Potential
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	Potential
<i>Bertya opposens</i>	Coolabah bertya	V	-	Potential
<i>Cadellia pentastylis</i>	Ooline	V	V	Potential
<i>Camptacra perdita</i>	-	-	E	Potential
<i>Clematis fawcettii</i>	Stream clematis	V	V	Potential
<i>Coleus insularis</i>	Millmerran mint bush	-	CE	Potential
<i>Commersonia ingelewoodensis</i>	-	-	CE	Potential
<i>Cymbonotus maidenii</i>	-	-	E	Potential
<i>Cyperus clarus</i>	-	-	V	Known
<i>Dichanthium queenslandicum</i>	King bluegrass	E	V	Likely
<i>Dichanthium setosum</i>	Bluegrass	V	-	Potential
<i>Eucalyptus virens</i>	Shiny-leaved ironbark	V	V	Potential
<i>Homopholis belsonii</i>	Belson's panic	V	E	Known
<i>Lepidium monoplacoides</i>	Winged peppergrass	E	-	Likely
<i>Lepidium peregrinum</i>	Wandering peppergrass	E	-	Potential
<i>Macrozamia conferta</i>	-	V	V	Potential
<i>Macrozamia machinii</i>	Machin's macrozamia	V	V	Potential

Scientific name	Common name	EPBC Act status	NC Act status	Desktop likelihood of occurrence
<i>Picris barbarorum</i>	-	-	V	Likely
<i>Picris evae</i>	Hawkweed	V	V	Known
<i>Pomaderris coomingalensis</i>	-	-	E	Potential
<i>Rhaponticum australe</i> ¹	Austral cornflower	V ⁱ	V	Likely
<i>Solanum papaverifolium</i>	-	-	E	Potential
<i>Solanum stenopterum</i>	-	-	V	Potential
<i>Sophora fraseri</i>	Brush sophora	V	V	Potential
<i>Styphelia</i> sp. <i>Coolmunda</i> (D.Halford Q1635)	-	E	E	Potential
<i>Swainsona murrayana</i>	Slender Darling-pea	V	V	Potential
<i>Thesium austral</i>	Austral toadflax	V	V	Likely
<i>Vincetoxicum forsteri</i> (formerly known as <i>Tylophora linearis</i>)	-	E	E	Potential
<i>Westringia parvifolia</i>	Small-flowered westringia	V	V	Likely
<i>Xerothamnella herbacea</i>	-	E	E	Known

Table notes:

CE – Critically Endangered; E – Endangered; V – Vulnerable

Controlled action date: 09.04.2018

¹Listed as *Leuzea australis*

4.3.2 FIELD SURVEY RESULTS

4.3.2.1 SPECIES RICHNESS

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

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

The majority of aquatic flora species were common emergent species such as aquatic (or semi-aquatic) grasses, sedges, and rushes. The lack of both diversity and abundance of aquatic plants at some survey 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.

4.3.2.2 THREATENED FLORA

A total of nine listed threatened species were identified within the Project footprint during field surveys and one species (king bluegrass (*Dichanthium queenslandicum*)) was recorded adjacent to the Project footprint (0.8 m from the edge of the footprint).

Table 4-4 summarises the likelihood of occurrence assessments following desktop assessments and targeted field surveys and habitat assessments. Ten species are known to occur within the Project footprint, and a further eleven species were assessed as potentially occurring. The remaining species identified in the desktop likelihood of occurrence were considered unlikely to occur within the Project footprint and therefore have not been included in Table 4-4. Targeted surveys for *Westringia parvifolia*, *Xerothamnella herbacea*, *Lepidium monoplocoides*, *Thesium australe*, *Acacia lauta*, and *Eucalyptus virens* were conducted in the Project footprint and the surrounding landscape where historical records occur to better understand the population sizes and locations of these species. Preliminary results support the likelihood of occurrence outcome for *Acacia lauta* as potential and *Eucalyptus virens* as unlikely. More detail is provided in Appendix B Likelihood of Occurrence.

Suitable habitat for species listed under the NC Act and/or the EPBC Act which are known to occur, and species listed under the EPBC Act with potential to occur within the Project footprint has been ground-truthed, mapped and quantified. Ground-truthed habitat calculations for species known or likely to occur, and EPBC Act listed species with potential to occur within the Project footprint, are provided in Table 4-4. Habitat descriptions and habitat mapping for each species are in Appendix G Species Profiles.

TABLE 4-4 THREATENED FLORA SPECIES FIELD VERIFIED LIKELIHOOD OF OCCURRENCE

Scientific name	Common name	EPBC Act status	NC Act status	Likelihood of occurrence		Ground-truthed habitat within the Project footprint (ha)	Number of individuals recorded
				Desktop	Field verified		
<i>Acacia argyrotricha</i>	Bracker wattle	-	V	Potential	Potential	-	-
<i>Acacia lauta</i>	Tara wattle	V	V	Potential	Potential	410.00	-
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	Potential	Potential	13.13	-
<i>Camptacra perditia</i>	-	-	E	Potential	Potential	-	-
<i>Clematis fawcettii</i>	Stream clematis	V	V	Potential	Potential	2.27	-
<i>Coleus insularis</i>	Millmerran mint bush		CE	Potential	Potential	-	
<i>Cymbonotus maidenii</i>	-	-	E	Potential	Potential	-	
<i>Cyperus clarus</i>	-	-	V	Known	Known	166.07	~200
<i>Dichanthium queenslandicum</i>	King bluegrass	E	V	Likely	Known	50.31	On edge of the Project footprint
<i>Dichanthium setosum</i>	Bluegrass	V	-	Potential	Potential	260.52	-
<i>Homopholis belsonii</i>	Belson's panic	V	E	Known	Known	242.25	~100
<i>Lepidium monoplacoides</i>	Winged peppergrass	E	-	Likely	Known	79.86	~180
<i>Picris barbarorum</i>	-	-	V	Likely	Known	174.98	~416
<i>Picris evae</i>	Hawkweed	V	V	Known	Known	110.67	~448,842
<i>Pomaderris coomingalensis</i>	-	-	E	Potential	Potential	-	
<i>Rhaponticum australe</i> ¹	Austral cornflower	V	V	Likely	Known	83.49	~164
<i>Solanum papverifolium</i>	-		E	Potential	Potential	-	
<i>Solanum stenopterum</i>	-		V	Potential	Potential	-	

Scientific name	Common name	EPBC Act status	NC Act status	Likelihood of occurrence		Ground-truthed habitat within the Project footprint (ha)	Number of individuals recorded
				Desktop	Field verified		
<i>Thesium australe</i>	Austral toadflax	V	V	Likely	Known	46.44	~474
<i>Westringia parvifolia</i>	Small-flowered westringia	V	V	Likely	Known	27.19	~214
<i>Xerothamnella herbacea</i>	-	E	E	Known	Known	11.99	~70

Table notes:

CE= Critically Endangered E = Endangered; V = Vulnerable

² listed as *Leuzea australis*

4.3.2.3 SPECIAL LEAST CONCERN FLORA SPECIES

Six Special Least Concern flora species were observed within the Project footprint including *Crinum arenarium*, tufted bluebell (*Wahlenbergia capillaris*), sprawling bluebell (*Wahlenbergia gracilis*), tall bluebell (*Wahlenbergia stricta*), pink fingers (*Caladenia carnea*) and black orchid (*Cymbidium canaliculatum*). Species profiles, including biology/ecology, habitat, threatening processes and relevant threat abatement and/or recovery plans (if applicable) are provided for each SLC flora species, in Appendix G Species Profiles.

4.3.2.4 RESTRICTED MATTERS

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

Eight Category 3 restricted matter flora species (under the Biosecurity Act) were identified within the Project footprint (Table 4-5). Of these species, six species are also listed as Weeds of National Significance (WoNS).

TABLE 4-5 RESTRICTED MATTERS IDENTIFIED WITHIN THE PROJECT FOOTPRINT

Species name	Common name	WoNS	Schedule 2 of the Biosecurity Act*
<i>Bryophyllum delagoense</i>	Mother-of-millions	Yes	Category 3
<i>Eichhornia crassipes</i>	Water hyacinth	Yes	Category 3
<i>Harrisia martinii</i>	Harrisia cactus	No	Category 3
<i>Lantana camara</i>	Lantana	Yes	Category 3
<i>Lantana montevidensis</i>	Creeping lantana	No	Category 3
<i>Opuntia aurantiaca</i>	Tiger pear	Yes	Category 3
<i>Opuntia stricta</i>	Prickly pear	Yes	Category 3
<i>Opuntia tomentosa</i>	Velvety tree pear	Yes	Category 3

Table notes:

* Category 3 = includes noxious fish, weeds, and pest animals.

4.4 FAUNA

4.4.1 DESKTOP ASSESSMENT RESULTS

4.4.1.1 THREATENED FAUNA

The desktop assessment identified a total of 45 threatened fauna species known, likely or with the potential to occur within the Project footprint (Appendix I Fauna Species Lists). These species include those listed under the EPBC Act (40) and/or the NC Act (44) and are listed in Table 4-6.

TABLE 4-6 SUMMARY OF EPBC ACT AND NC ACT THREATENED/SLC FAUNA KNOWN, LIKELY OR WITH THE POTENTIAL TO OCCUR IN THE PROJECT FOOTPRINT FOLLOWING DESKTOP ASSESSMENT

Scientific name	Common name	EPBC Act status	NC Act status	Desktop likelihood of occurrence
<i>Acanthophis antarcticus</i>	Common death adder	-	V	Likely
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	V	Potential
<i>Adclarkia dulacca</i>	Dulacca woodland snail	E	E	Potential
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	V	E	Likely
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	CE	Potential
<i>Aphelocephala leucopsis</i>	Southern whiteface	V (listed 31.03.2023)	V	Known
<i>Apus pacificus</i>	Fork-tailed swift	Mi (CAMBA, JAMBA, ROKAMBA)))	SLC	Known
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	E	Likely
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	V (listed 05.01.2024) Mi (Bonn, CAMBA, JAMBA, ROKAMBA) at time of the referral	SLC	Likely
<i>Calidris ferruginea</i>	Curlew sandpiper	CE; Ma; Mi (Bonn, CAMBA, JAMBA, ROKAMBA)	CE	Potential
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (south-eastern)	V (listed 10.08.2022)	V	Likely
<i>Chalinolobus dwyeri</i>	Large-eared pied bat	V (at time of the referral)	E	Potential

Scientific name	Common name	EPBC Act status	NC Act status	Desktop likelihood of occurrence
		(uplisted to E effective 15.11.2023)		
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	V (listed 31.03.2023)	V	Known
<i>Cuculus optatus</i>	Oriental cuckoo	Mi (CAMBA, JAMBA, ROKAMBA)	SLC	Potential
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (southeastern mainland population)	E	E	Likely
<i>Delma torquata</i>	Collared delma	V	V	Potential
<i>Egernia rugosa</i>	Yakka skink	V	V	Potential
<i>Furina dunmalli</i>	Dunmall's snake	V	V	Likely
<i>Gallinago hardwickii</i>	Latham's snipe	V (listed 05.01.2024) Mi (Bonn, JAMBA, ROKAMBA) at the time of the referral	SLC	Known
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	Likely
<i>Grantiella picta</i>	Painted honeyeater	V	V	Likely
<i>Hemiaspis damelii</i>	Grey snake	E (listed 05.10.2022)	E	Likely
<i>Hirundapus caudacutus</i>	White-throated needletail	V (listed 04.07.2019) Ma; Mi (CAMBA, JAMBA, ROKAMBA)	V	Likely
<i>Hypochrysops piceatus</i>	Bullock jewel butterfly	-	E	Potential
<i>Jalmenus eubulus</i>	Pale imperial hairstreak	-	V	Potential
<i>Lathamus discolor</i>	Swift parrot	CE; Ma	E	Potential
<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo	E (listed 31.03.2023)	V	Potential
<i>Maccullochella peelii</i>	Murray cod	V	-	Likely
<i>Melanodryas cucullata cucullata</i> ²	Hooded robin (south-eastern)	E (listed 31.03.2023)	E	Potential

Scientific name	Common name	EPBC Act status	NC Act status	Desktop likelihood of occurrence
<i>Myiagra cyanoleuca</i>	Satin flycatcher	Mi (Bonn)	SLC	Likely
<i>Ninox strenua</i> ²	Powerful owl	-	V	Potential
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	V	Likely
<i>Ornithorhynchus anatinus</i>	Platypus	-	SLC	Likely
<i>Petauroides volans</i>	Greater glider (southern and central)	V (at time of the referral) (uplisted to E effective 05.07.2022)	E	Likely
<i>Petaurus australis australis</i>	Yellow-bellied glider (south-eastern)	V (listed 02.03.2023)	V	Potential
<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	V	V	Potential
<i>Phascolarctos cinereus</i>	Koala	V (at the time of the referral) (uplisted to E effective 12.02.2022)	E	Likely
<i>Plegadis falcinellus</i>	Glossy ibis	Mi (Bonn)	SLC	Known
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V	-	Likely
<i>Rhipidura rufifrons</i>	Rufous fantail	Mi (Bonn)	SLC	Likely
<i>Rostratula australis</i>	Australian painted snipe	E; Ma	E	Potential
<i>Stagonopleura guttata</i>	Diamond firetail	V (listed 31.03.2023)	V	Likely
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	-	SLC	Known
<i>Tringa nebularia</i>	Common greenshank	E (listed 05.01.2024) Mi (Bonn, CAMBA, JAMBA, ROKAMBA) at the time of the referral	SLC	Likely
<i>Turnix melanogaster</i>	Black-breasted button-quail	V	V	Potential
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	E	Likely

Table notes:

CE – Critically Endangered; E – Endangered; V – Vulnerable; SLC – Special Least Concern; Mi – Migratory; Ma – Marine

Controlled action date: 09.04.2018

4.4.2 FIELD SURVEY RESULTS

4.4.2.1 SPECIES RICHNESS

Field investigations identified a total of 281 fauna species (Appendix A Additional Ecological Investigations and Appendix I Fauna Species Lists), including 264 (93.95 per cent) native species and 17 (6.05 per cent) non-native species, nine of which were restricted matters (Section 4.3.2.4). Species recorded include 164 (58.36 per cent) birds, 48 (17.08 per cent) mammals, 43 (15.30 per cent) reptiles, 23 (8.19 per cent) amphibians, two (0.71 per cent) gastropods and one (0.36 per cent) crustacean.

4.4.2.2 THREATENED FAUNA

A total of 30 threatened fauna species were identified within the Project footprint by the likelihood of occurrence, 13 of which are considered known to occur within the Project footprint following field surveys. A further six species are considered likely to occur and 11 species have potential to occur within the Project footprint based on the results of targeted field surveys and habitat mapping. The remaining six species were considered unlikely to occur within the Project footprint based on the desktop assessment and reconfirmed by the field assessment results (Appendix A Additional Ecological Investigations). These species have not been assessed further.

Although not observed during field surveys, common death adder is considered known to occur based on the presence of suitable habitat, the proximity of several existing records and the species being opportunistically observed during offset surveys.

Two species (pale imperial hairstreak and Major Mitchell's cockatoo) assessed as potential to occur in the desktop assessment were considered unlikely to occur post-field surveys due to the absence of suitable habitat or environmental conditions (Appendix A Additional Ecological Investigations). Pale imperial hairstreak occupies old growth brigalow, and these habitats are largely absent from the Project footprint. There was only limited suitable habitat as described in the literature for the Major Mitchell's cockatoo which is mainly found in areas that receive 250 to 400 mm of rain per annum and the Project footprint occurs in an environment that receives on average >650 mm of rain per annum.

The greater glider was initially considered to be likely to occur, however following a targeted survey in December 2023 (ERM, 2024a) they have been assessed as being potentially occurring. Most sites that were previously considered to be greater glider habitat by Ausecology (2022) were identified as unsuitable habitat under more recent guidelines (Eyre et al., 2022b). ERM's survey identified one patch of potential breeding habitat, and two patches of potential foraging habitat. However, as three patches were unable to be surveyed, they have been conservatively included as potential foraging habitat. Further detailed results from this survey can be found in the report memo in Appendix A Additional Ecological Investigations.

Records from supplementary surveys have been added into the likelihood of occurrence and species profiles for the relevant species and in some instances changed the determination for

the species. The majority of these observations were outside the Project footprint. Species recorded incidentally or during these surveys but not during other ecological surveys included:

- Squatter pigeon (southern) on the Canning Creek offset property;
- Australian painted snipe on the Glenlovely offset property;
- Common death adder within Bringalily State Forest, south of Canning Creek;
- Spotted-tailed quoll in Bringalily State Forest (~4.5 km from the Project footprint); and
- Dunmall's snake in Bringalily State Forest (within the Project footprint).

Further detailed results and discussion of the likelihood of occurrence of threatened species is provided in Appendix B Likelihood of Occurrence. Information relating to the ecology, biology, distribution, habitat description and habitat mapping for threatened fauna species known, likely or with the potential to occur with the Project footprint is provided in Appendix G Species Profiles.

Table 4-7 compares the threatened fauna species desktop likelihood of occurrence with that completed after field surveys and provides the total ground-truthed habitat area for NC Act listed threatened fauna species known or likely to occur, and EPBC Act listed species with potential to occur.

TABLE 4-7 THREATENED FAUNA SPECIES FIELD VERIFIED LIKELIHOOD OF OCCURRENCE RESULTS

Scientific name	Common name	EPBC Act status	NC Act status	Likelihood of occurrence		Ground-truthed habitat within the Project footprint
				Desktop	Field verified	
Birds						
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	CE	Potential	Potential	285.01 ha
<i>Aphelocephala leucopsis</i>	Southern whiteface	V ¹	V	Known	Known	216.89 ha
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	E	Likely	Likely	7.91 ha
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	CE	Potential	Potential	Not quantified
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (south-eastern)	V ¹	V	Likely	Known	120.01 ha: 1.08 ha of breeding and roosting habitat 118.94 ha of foraging habitat
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	V ¹	V	Known	Known	240.66 ha
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	Likely	Likely	421.42 ha: 166.89 ha of breeding habitat 254.53 ha of foraging habitat
<i>Grantiella picta</i>	Painted honeyeater	V	V	Likely	Known	330.66 ha
<i>Hirundapus caudacutus</i>	White-throated needletail	V ¹	V	Likely	Known	2,853.24 ha of foraging habitat

Scientific name	Common name	EPBC Act status	NC Act status	Likelihood of occurrence		Ground-truthed habitat within the Project footprint
				Desktop	Field verified	
<i>Lathamus discolor</i>	Swift parrot	CE	E	Potential	Potential	614.93 ha of foraging habitat
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern)	E ¹	E	Potential	Potential	216.89 ha
<i>Ninox strenua</i>	Powerful owl	-	V	Potential	Potential	8.64 ha: 8.28 ha of breeding and roosting habitat 0.36 ha of foraging habitat
<i>Rostratula australis</i>	Australian painted snipe	E	E	Potential	Likely	7.91 ha
<i>Stagonopleura guttata</i>	Diamond firetail	V ¹	V	Likely	Likely	216.89 ha
Mammals						
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll	E	E	Likely	Likely	387.48 ha: 259.93 ha of high quality denning and foraging habitat 127.55 ha of low quality foraging and breeding habitat
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V ⁴	V	Likely	Known	696.25 ha: 301.28 ha of roosting habitat 394.97 ha of foraging habitat
<i>Petauroides volans</i>	Greater glider (southern and central)	V ³	E	Likely	Potential	15.97 ha: 1.60 ha of potential breeding habitat 14.37 ha of potential foraging habitat
<i>Petaurus australis australis</i>	Yellow-bellied glider (south-eastern)	V ¹	V	Potential	Potential	298.05 ha: 164.80 of breeding and denning habitat 21.99 ha of foraging habitat

Scientific name	Common name	EPBC Act status	NC Act status	Likelihood of occurrence		Ground-truthed habitat within the Project footprint
				Desktop	Field verified	
						111.27 ha of dispersal habitat
<i>Phascolarctos cinereus</i>	Koala	V ²	E	Likely	Known	1,362.53 ha: 769.40 ha of foraging and breeding habitat 593.13 ha of dispersal habitat
<i>Pteropus poliocephalus</i>	Grey-headed flying fox	V	-	Likely	Known	788.39 ha of foraging habitat
Fish						
<i>Maccullochella peelii</i>	Murray cod	V	-	Likely	Known	60.50 ha
Reptiles						
<i>Acanthophs antarcticus</i>	Common death adder	-	V	Likely	Known	277.27 ha
<i>Anomalopus mackayi</i>	Five clawed worm-skink	V	E	Likely	Likely	241.61 ha
<i>Delma torquata</i>	Collared delma	V	V	Potential	Potential	36.83 ha
<i>Egernia rugosa</i>	Yakka skink	V	V	Potential	Potential	241.13 ha
<i>Furina dunmalli</i>	Dunmall's snake	V	V	Likely	Known	262.69 ha
<i>Hemiaspis damelii</i>	Grey snake	E ¹	E	Likely	Known	259.80 ha
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	E	Likely	Known	51.20 ha

Scientific name	Common name	EPBC Act status	NC Act status	Likelihood of occurrence		Ground-truthed habitat within the Project footprint
				Desktop	Field verified	
Invertebrates						
<i>Adclarkia cameroni</i>	Brigalow woodland snail	E	V	Potential	Known	146.72 ha
<i>Hypochrysops piceatus</i>	Bulloak jewel butterfly	CE	CE	Potential	Potential	231.29 ha

Table notes:
CE = Critically Endangered E = Endangered V = Vulnerable

¹Species listed after controlled action date, for specific dates see likelihood of occurrence tables presented in Appendix B Likelihood of Occurrence.
²Koala uplisted to Endangered effective 12 February 2022, after controlled action date.
³Greater glider (southern and central) uplisted to Endangered effective 5 February 2022, after controlled action date.
⁴South-east long-eared bat uplisted to Endangered effective 15 November 2023, after controlled action date.

4.4.2.3 NC ACT SPECIAL LEAST CONCERN FAUNA

Eight species listed as SLC under the NC Act are known or likely to occur within the Project footprint. Table 4-8 summaries the NC Act SLC fauna field verified likelihood of occurrence compared to the desktop likelihood, and the total ground-truthed habitat area for each such species known or likely to occur (noting that migratory bird species may occur as vagrants and in a range of habitats within the Study area during migration and therefore habitat has not been quantified). One species, oriental cuckoo (*Cuculus optatus*) was determined to be unlikely due to the species known distribution being outside the Project footprint (Appendix B Likelihood of Occurrence).

Suitable habitat for platypus (*Ornithorhynchus anatinus*) and echidna (*Tachyglossus aculeatus*) has been ground-truthed for the Project footprint and is presented in Appendix G Species Profiles. Species locations, population counts and ground-truthed suitable habitat within the Project footprint are also detailed in Appendix G Species Profiles.

TABLE 4-8 NC ACT SLC FIELD VERIFIED LIKELIHOOD OF OCCURRENCE RESULTS

Scientific name	Common name	NC Act status	Desktop likelihood of occurrence	Field verified likelihood of occurrence	Ground truthed habitat within the Project footprint (ha)
<i>Apus pacificus</i>	Fork-tailed swift	SLC	Likely	Known	Not quantified
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	SLC	Likely	Likely	Not quantified
<i>Cuculus optatus</i>	Oriental cuckoo	SLC	Potential	Unlikely	Not quantified
<i>Gallinago hardwickii</i>	Latham's snipe	SLC	Known	Known	Not quantified
<i>Myiagra cyanoleuca</i>	Satin flycatcher	SLC	Likely	Known	Not quantified
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	Known	Known	24.81
<i>Plegadis falcinellus</i>	Glossy ibis	SLC	Likely	Known	Not quantified
<i>Rhipidura rufifrons</i>	Rufous fantail	SLC	Likely	Likely	Not quantified
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	Known	Known	1,397.48

Table notes:

SLC = Special Least Concern

4.4.2.4 ANIMAL BREEDING PLACES

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

Hollows were observed to be the most abundant potential breeding feature, ranging from small (2 cm) to large (>20 cm) sized hollows. Smaller hollows have potential to provide habitat for hollow-breeding microbats, birds, and reptiles. The larger hollows have potential to be utilised by glossy black-cockatoo (*Calyptorhynchus lathami lathami*), greater glider (southern and central) (*Petauroides volans*) and yellow-bellied gliders (*Petaurus australis australis*).

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

4.4.2.5 RESTRICTED MATTERS

Nine non-native fauna species declared as restricted matters (invasive animals) under the Biosecurity Act, were identified within the Project footprint during field investigations (Appendix A Additional Ecological Investigations and Appendix I Fauna Species Lists). These species were widespread across the entire Study area (Table 4-9).

The Project intersects the Darling Downs Moreton Rabbit Board (DDMRB) rabbit-proof fence at approximate Ch 120.2 km, when traversing through the locality of Clontarf.

TABLE 4-9 RESTRICTED MATTER FAUNA SPECIES IDENTIFIED WITHIN THE PROJECT FOOTPRINT

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

4.5 BORROW PIT SURVEY RESULTS

A number of borrow pits will be required between Goondiwindi and Millmerran to supply an estimated 298,000m³ of suitable fill to support the construction of the Project. Field surveys were conducted by Ausecology (2024a) to ensure suitable borrow pit and access track locations were selected to minimise impacts to flora and fauna including avoiding impacts to MNES and MSES. The results of the field surveys are presented below for each site.

4.5.1 SITE ID 1 – 2SP229051 – MOOROOBIE LANE

The site comprises of a flat, cropped field with no remaining remnant vegetation. Scattered mature trees are present along the access track, however a suitable access track has been selected to avoid clearing these trees. Additionally, no MNES or MSES were recorded during field efforts. The outcome of the assessment resulted in a site selection for borrow pit and access track that does not require clearing of MNES or MSES (Ausecology, 2024a).



PLATE 4-1: SITE ID 1 - 2SP229051 – MOOROOBIE LANE

4.5.2 SITE ID 2 – 53MH233 – TAIT'S RED RIDGE

The site is a cleared non-remnant (Category X) paddock dominated by exotic grass such as *Eragrostis curvula* (African lovegrass) and forbs including *Sclerolaena* spp., *Calotis* spp. along with scattered *Eucalyptus populnea*. Restricted invasive species *Opuntia tomentosa* (velvety tree pear) and *Harrisia martinii* (harrisia cactus) were additionally recorded at the site. The field results did not record any MNES or MSES within the site. During due diligence site selection, the area was identified to be suitable for borrow pits. However, to ensure that the impacts to fauna is minimised, the borrow pit and access track have been located to avoid any larger / mature paddock trees that may provide dispersal function for koala (Ausecology, 2024a).



PLATE 4-2: SITE ID 2 – 53MH233 – TAIT'S RED RIDGE

4.5.3 SITE ID 3 – 116BNT467 – MOSQUITO CREEK ROAD

The site contains shrubby non-remnant RE 11.9.13 (Category X), dominated by *Allocasuarina luehmannii*, *Acacia polybotrya*, *Daviesia ulicifolia*, and *Leptospermum* sp. The ground layer consists predominately of the native grass *Aristida caput-medusae*, with some cover of exotic forb species *Glandularia aristigera*. The area between the proposed borrow pit and the adjacent road contains RE 11.9.9a dominated by mature *Eucalyptus tereticornis*, *E. crebra*, *Angophora leiocarpa*, and *E. woollsiana*. This area could qualify as white box TEC under the EPBC Act; however, by using an existing track from the entrance gate to access the borrow pit all impacts to the potential MSES and MNES have been avoided (Ausecology, 2024a). The outcome of the assessment illustrates that the area is suitable for borrow pits due to avoiding any impact to the potential white box TEC through utilising a pre-existing track.



PLATE 4-3: SITE ID 3 – 116BNT467 – MOSQUITO CREEK ROAD

4.5.4 SITE ID 4 – ROAD PARCEL AGAINST MILLMERRAN-INGLEWOOD ROAD

The site is mostly cleared with scattered mature *Eucalyptus woolsianna*, and sparse shrubs including *Acacia shirleyi*, and *Acacia decora*. The access track to the proposed borrow pit site displays RE 11.5.20 (Category X) dominated by *Callitris glaucophylla*, *Eucalyptus macrocarpa*, and *Eucalyptus crebra*. An existing track has been selected for borrow pit access however will require clearing of a 15 meter section of non-remnant Eucalyptus woodland (Category X) to widen the track to a suitable safe width. Overall, the area is suitable for the proposed borrow pit, noting that mature paddock trees will be avoided (Ausecology, 2024a).



PLATE 4-4: SITE ID 4 – ROAD PARCEL AGAINST MILLMERRAN-INGLEWOOD ROAD

4.5.5 SITE ID 5 – 33MA3499 – KOOROONGARRA-ANDERSONS ROAD

This site is entirely cleared paddock dominated by *Chloris gayana*. There is a mix of native forbs such as *Sclerolaena muricata* and *Wahlenbergia gracilis* that were additionally recorded. No MNES or MSES were recorded within the site. During due diligence site selection, the area was identified to be suitable for borrow pits, with no impact to MNES or MSES (Ausecology, 2024a).



PLATE 4-5: SITE ID 5 – 33MA3499 – KOOROONGARRA-ANDERSONS ROAD

4.5.6 SITE ID 6A – 98DY182 – HECKENDORFS ROAD

The site is a grazed non-remnant (Category X) cleared paddock comprising of mainly exotic pasture grasses like *Chloris Gayana* with a mix of native forbs such as *Sclerolaena muricata* and *Wahlenbergia gracilis*. No MNES or MSES were recorded within the site. During due diligence site selection surveys, one specimen of *Santalum lanceolatum* was recorded within the site. However, the site is suitable for borrow pits utilising existing access tracks and will have no impact to any MNES or MSES (Ausecology, 2024a).



PLATE 4-6: SITE ID 6A – 98DY182 – HECKENDORFS ROAD

4.5.7 SITE ID 6B – 111DY182 – HECKENDORFS ROAD

The site is heavily grazed non-remnant (Category X) paddock of *Chloris gayana*. Scattered exotic shrubs include the restricted invasive species *Lycium ferocissimum* (African boxthorn) and *Gomphocarpus physocarpus* (balloon cotton bush). During due diligence site selection, the area was identified to be suitable for borrow pits. There were no MNES or MSES recorded within the site (Ausecology, 2024a).



PLATE 4-7: SITE ID 6B – 111DY182 – HECKENDORFS ROAD

4.6 WHETSTONE MATERIAL DISTRIBUTION CENTRE ECOLOGICAL ASSESSMENT

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

Along the boundary and existing tracks, occasional small patches of regrowth eucalypt vegetation with scattered mature silver-leaved ironbark (*Eucalyptus melanophloia*), Queensland blue gum (*E. tereticornis*), poplar box (*E. populnea*), Moreton Bay ash (*Corymbia tessellaris*) were identified (total of 1.1 ha) (refer to Plate 4-8). These areas of regrowth vegetation supported some habitat values, resources and potential animal breeding places (for least concern, special least concern, threatened and colonial species) and for a diversity of flora and fauna species, including listed threatened and migratory species. However, despite the presence of potential habitat, field investigations did not confirm the presence (via direct or indirect methods) of any conservation significant fauna or flora species.



PLATE 4-8: WHETSTONE MDC EXOTIC PASTURE, REGROWTH EUCALYPT WOODLAND AND WHEAT CROPPING

The field investigations were observational due to the small and disconnected nature of the patches, making the area too small to be surveyed in accordance with relevant State and Federal survey guidelines. In the absence of baseline fauna and flora surveys, Umwelt used

desktop and field-based habitat assessments to determine the potential for listed threatened and migratory species to occur. This resulted in the determination that two threatened fauna, koala (*Phascolarctos cinereus*) and grey-headed flying fox (*Pteropus poliocephalus*), and one special least concern fauna species, echidna (*Tachyglossus aculeatus*) listed under the NC Act or EPBC Act were considered as having the potential to occur in the MDC development footprint.

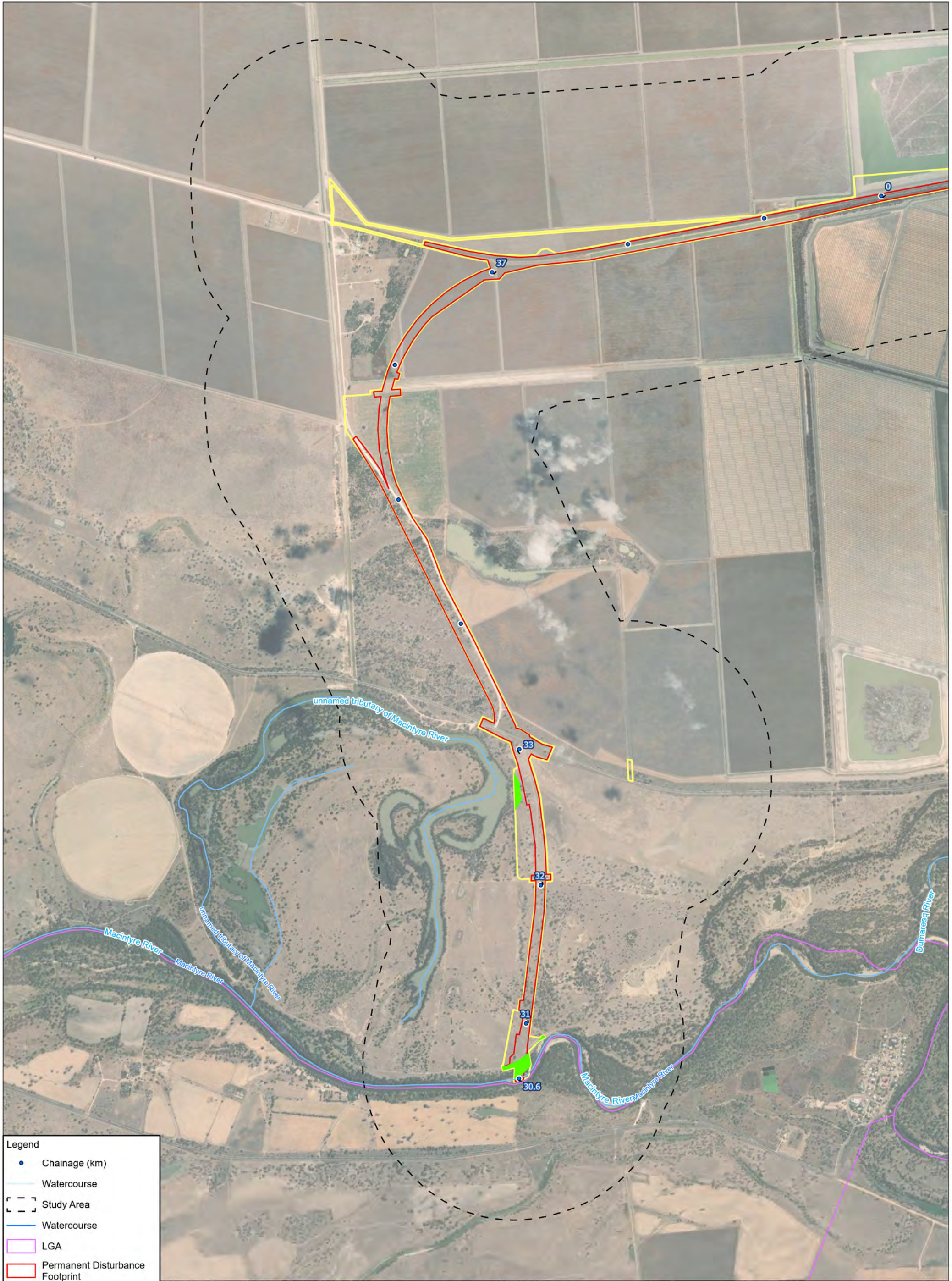
Further information related to the assessment of environmental values of the MDC and the outcomes of the significant impact assessment are contained in the Whetstone Material Distribution Centre Preliminary Environmental Assessment (Umwelt, 2022) within Appendix A

4.7 GROUNDWATER DEPENDENT ECOSYSTEMS

Terrestrial GDEs have been mapped by DESI along the Project footprint between the NSW/QLD border and Millmerran. Terrestrial GDEs are most dominant and concentrated in the Inglewood to Millmerran section of the Project (see Figure 4-3).

Areas where terrestrial GDEs (terrestrial vegetation dependent on groundwater resources) are identified by the GDE Atlas as occurring within 5 km of the Project footprint includes:

- One high potential terrestrial GDE is crossed by the Project footprint between Ch 25.0 km and Ch 28.0 km, near Yelarbon. This GDE is associated with the alkaline landscape of the Yelarbon Desert sandy plains. Here, permeable sediments of the Border Rivers Alluvium store and readily transmit groundwater from the underlying Great Artesian Basin to provide a permanent connection to this GDE;
- Broad areas of moderate potential for terrestrial GDEs occur between Ch 55.0 km and Ch 95.0 km. These areas are characterised to have intermittent connection to brackish aquifers associated with shallow alluvium; and
- Irregular areas of moderate potential for terrestrial GDEs are crossed by and surround the Project footprint between Ch 165.0 km to Ch 200.0 km. These GDEs are associated with fractured-rock aquifers which may provide an intermittent connection to these ecosystems.



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.3 (1) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.3 (2) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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Drawing Size: A3

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F4.3 (3) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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ARTC



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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Drawing Size: A3

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F4.3 (4) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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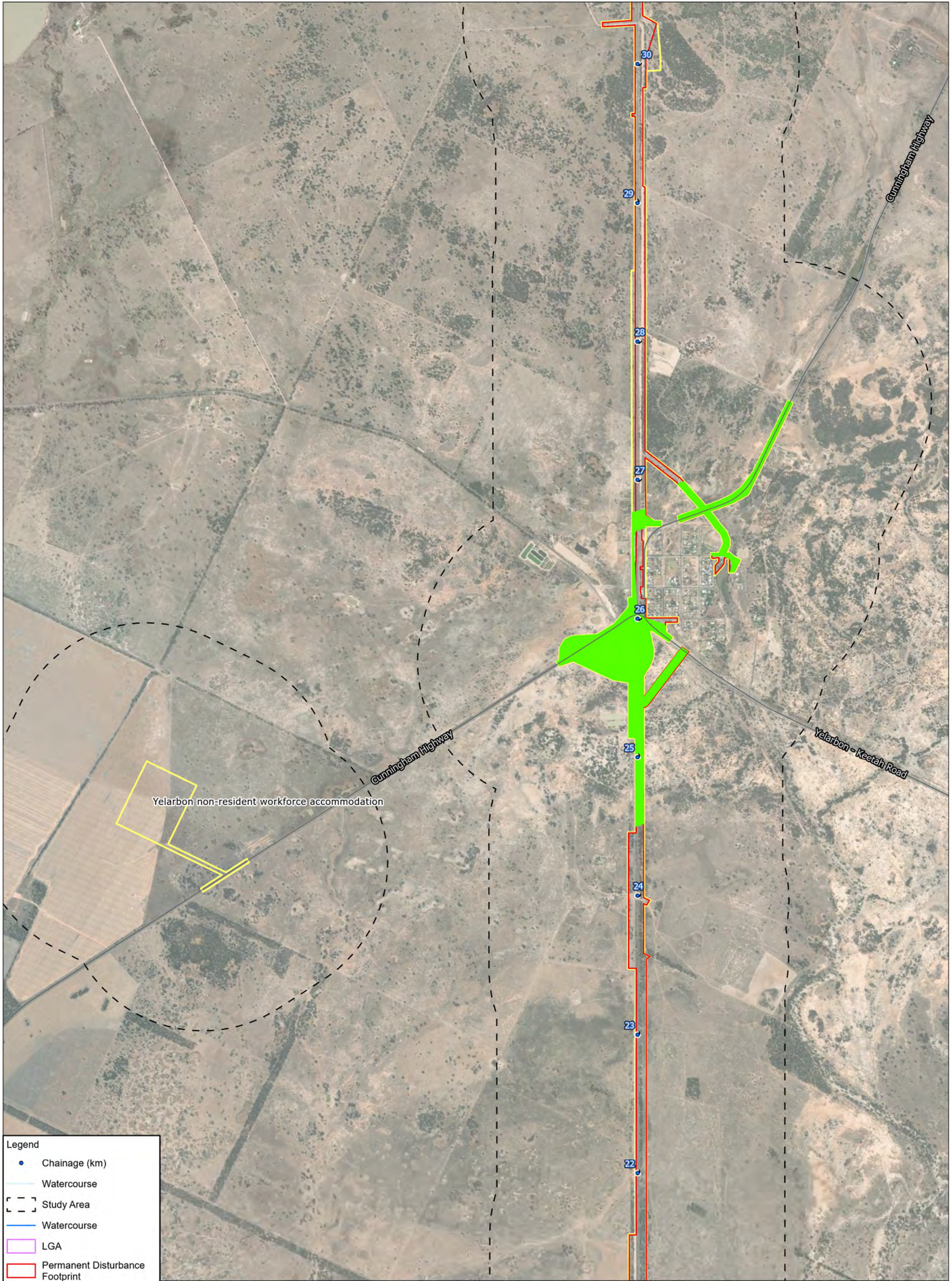
F4.3 (5) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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ARTC





Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
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Date: 17/10/2024

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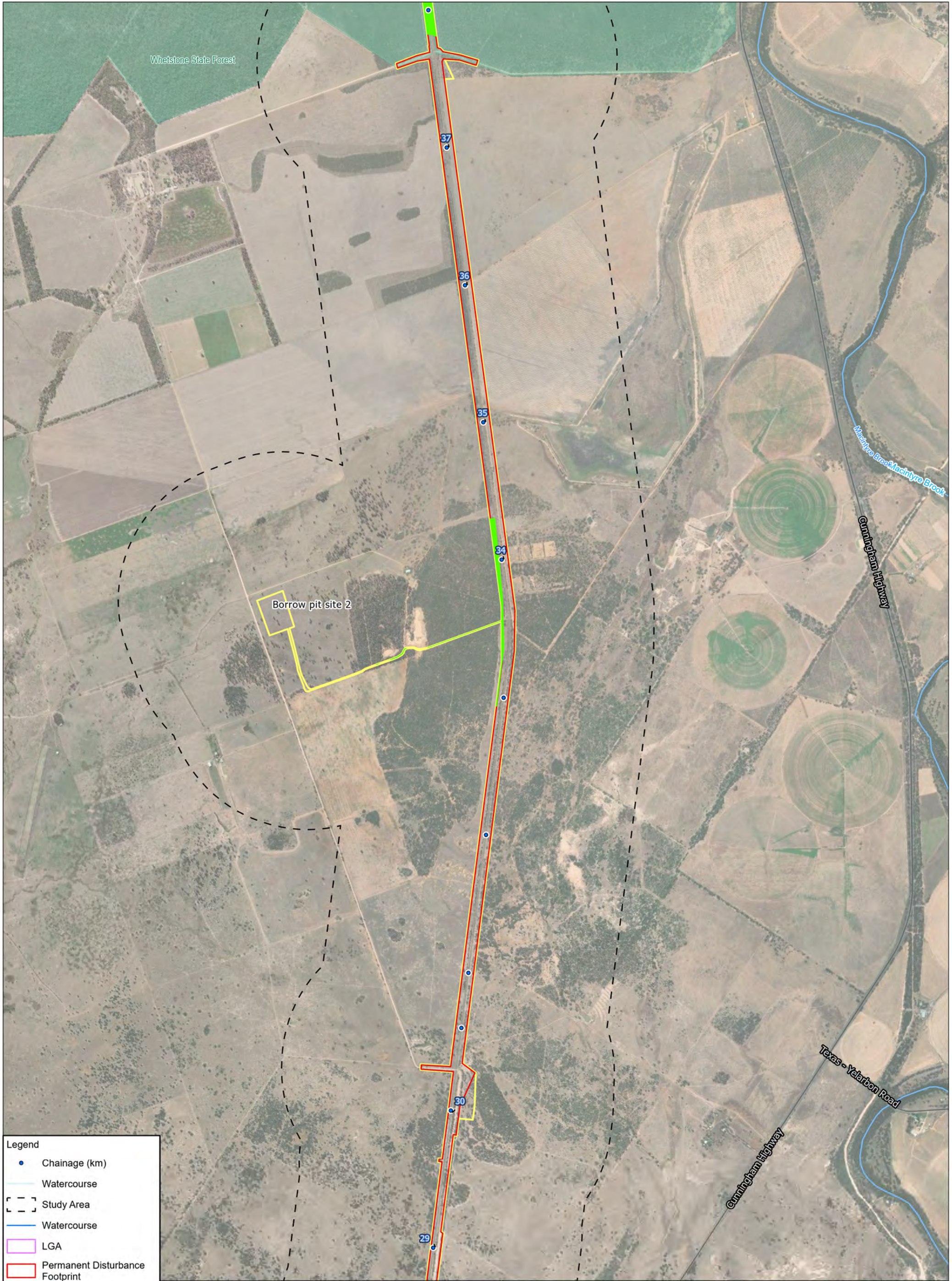
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F4.3 (6) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems

Coordinate System:
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Date: 17/10/2024

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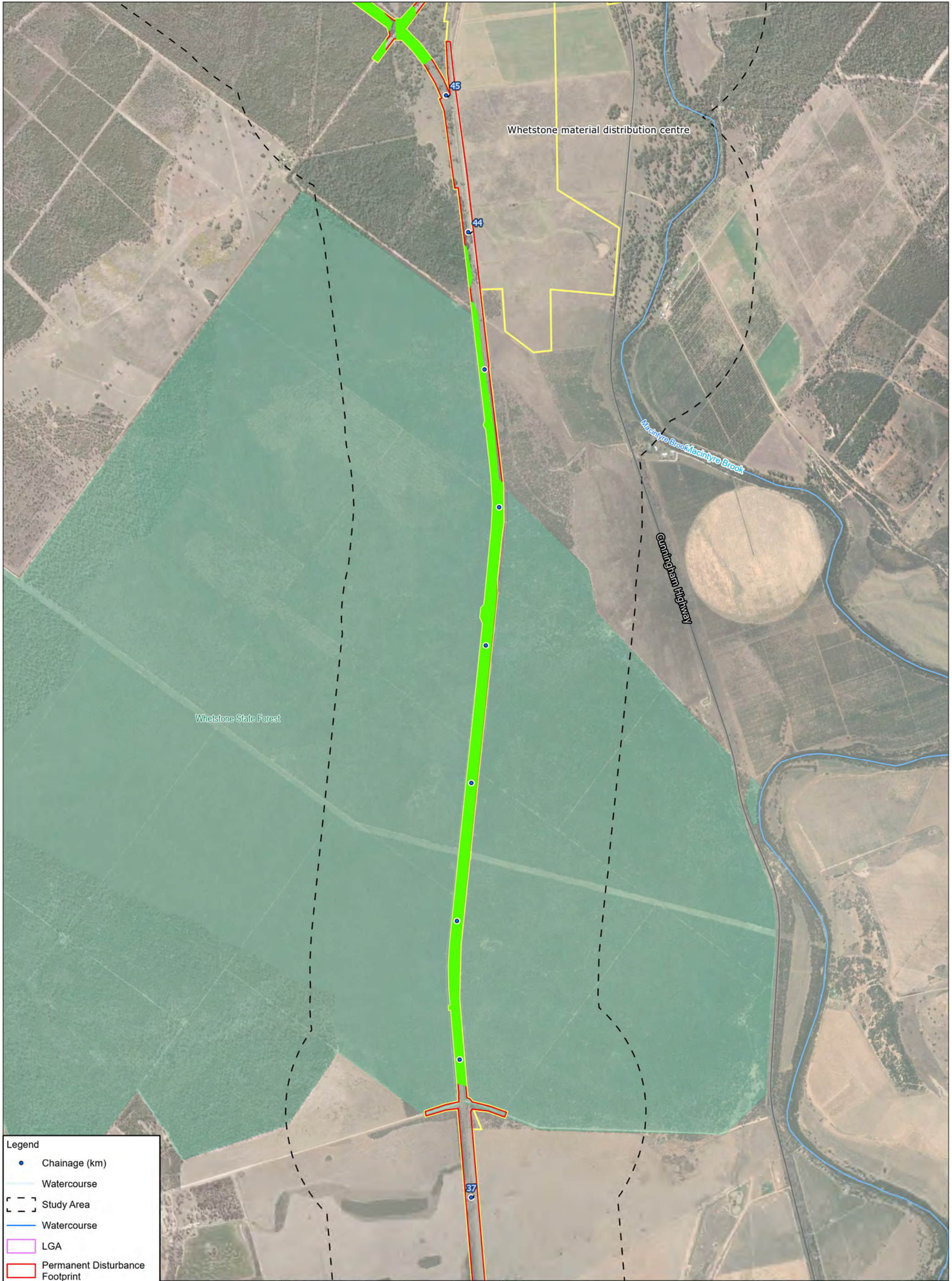
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F4.3 (7) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
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Date: 17/10/2024

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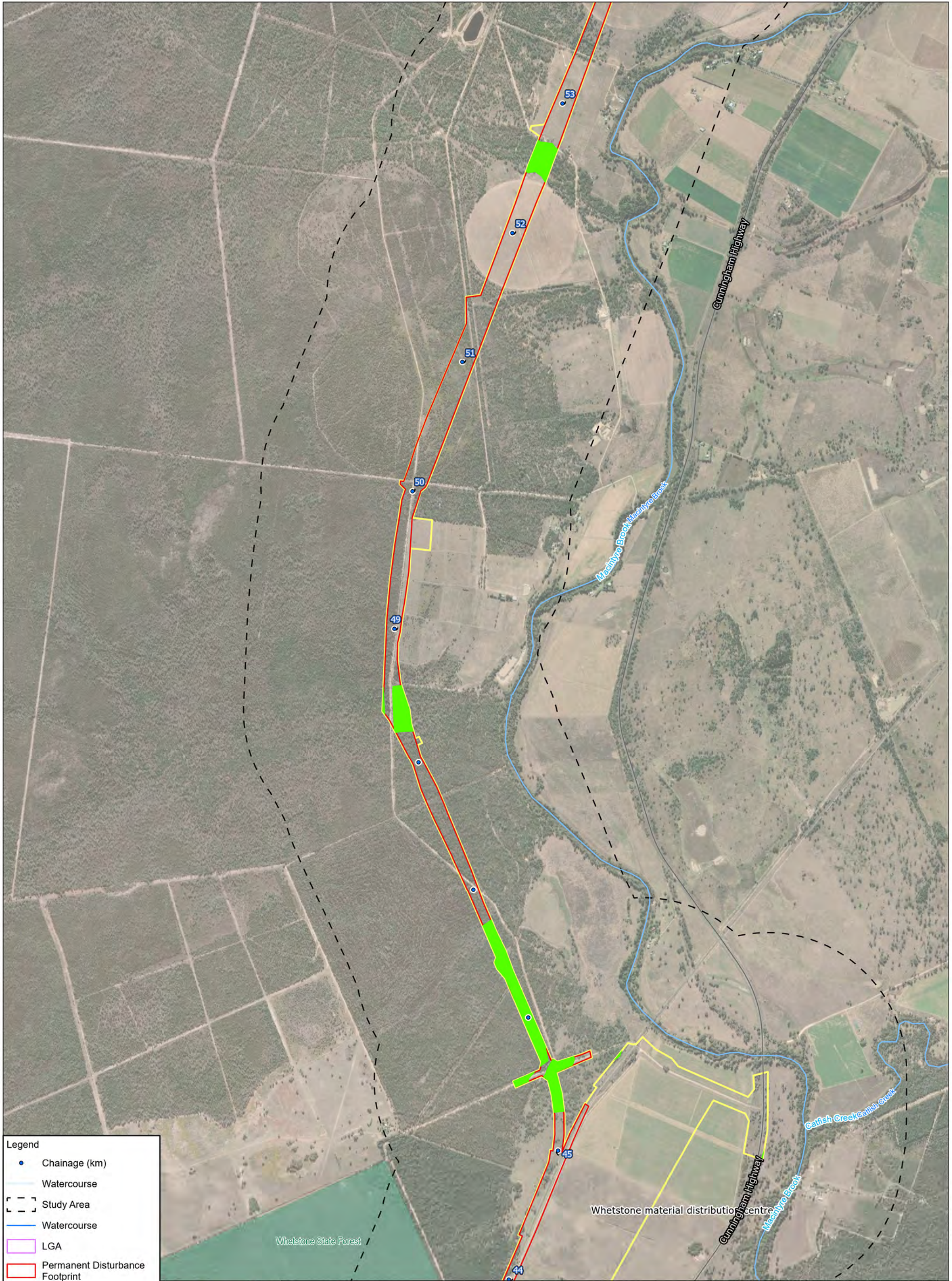
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F4.3 (8) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
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Date: 17/10/2024

Created By: CB/VN

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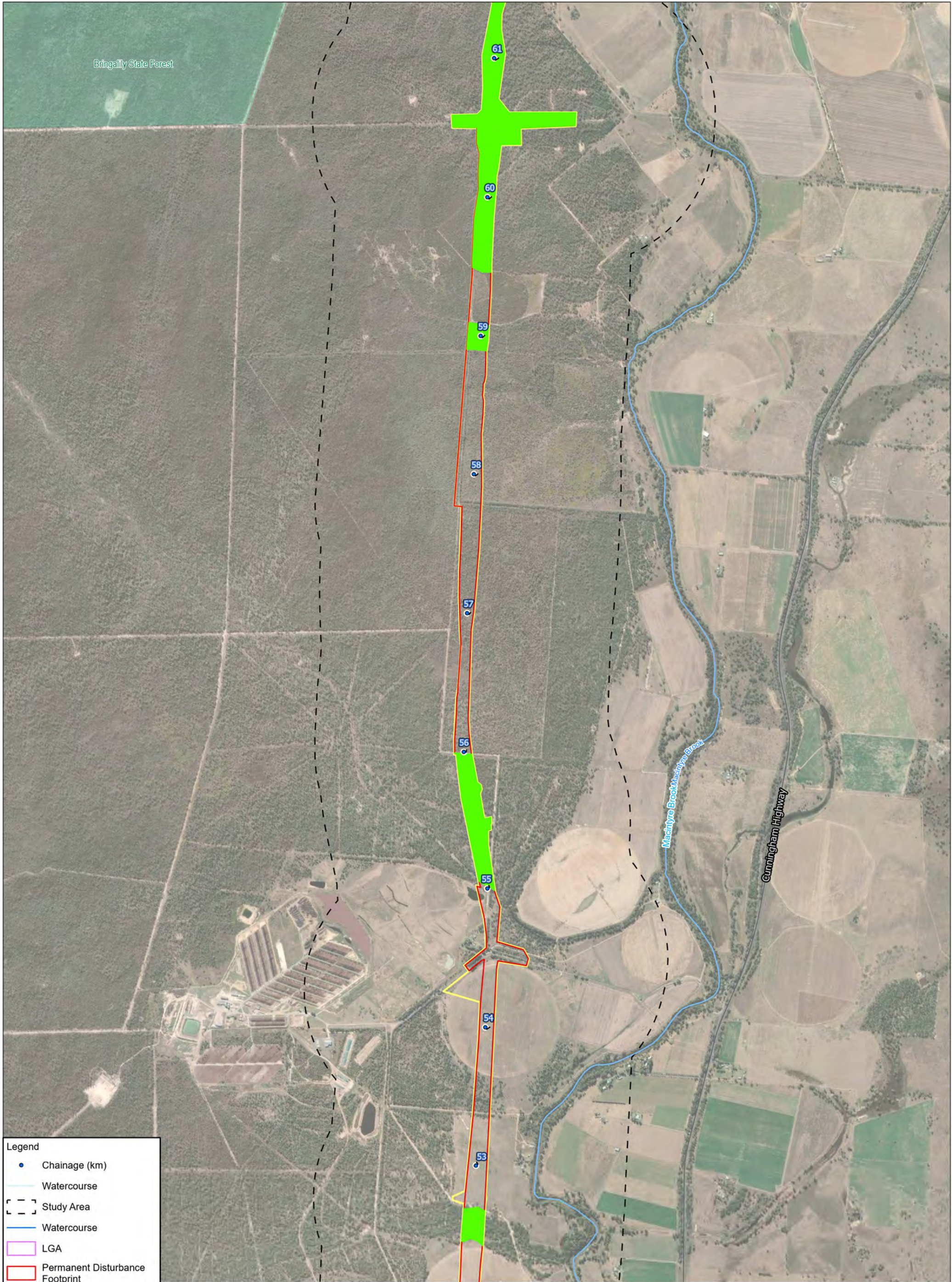
F4.3 (9) - Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
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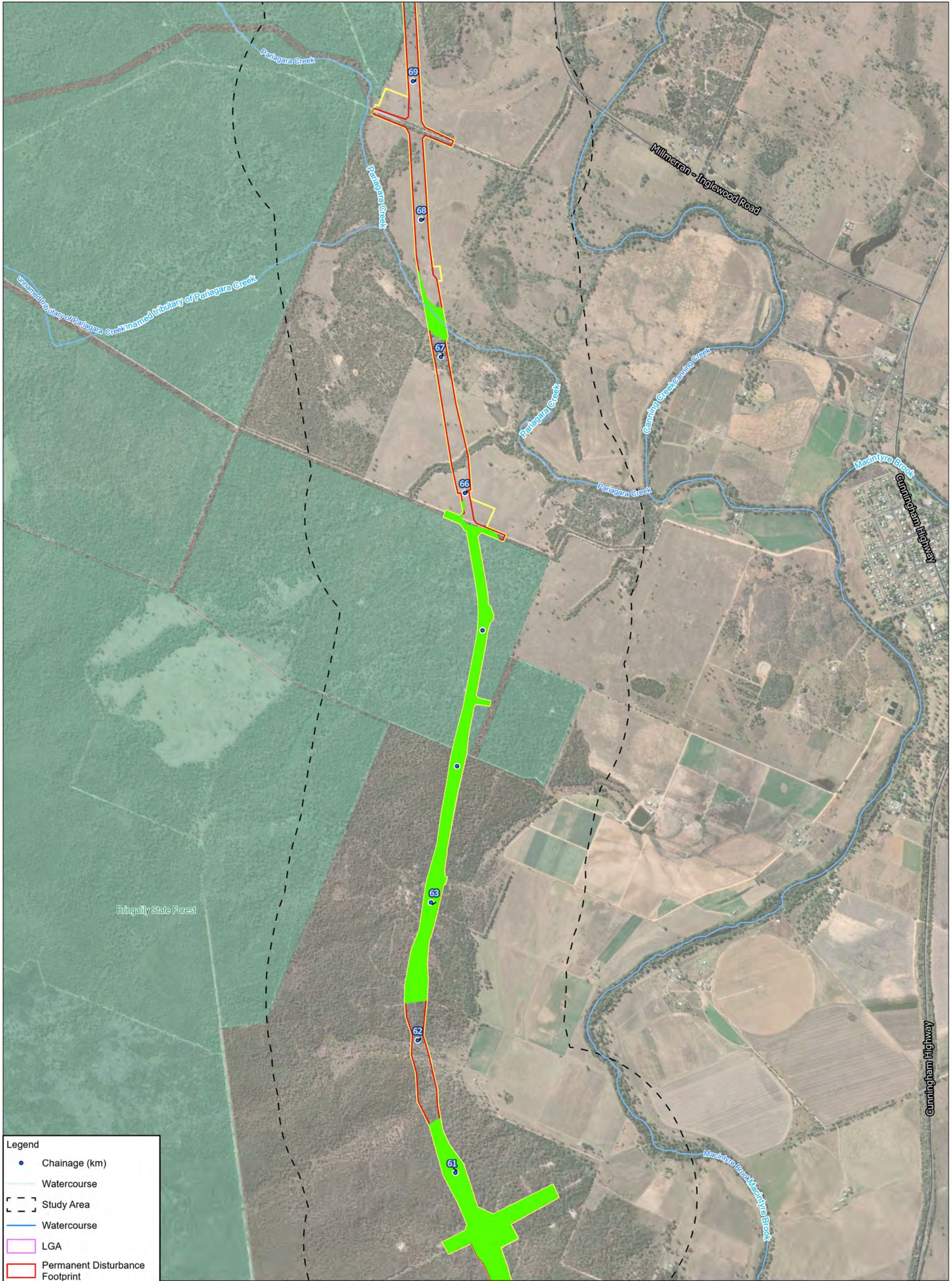
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F4.3 (10) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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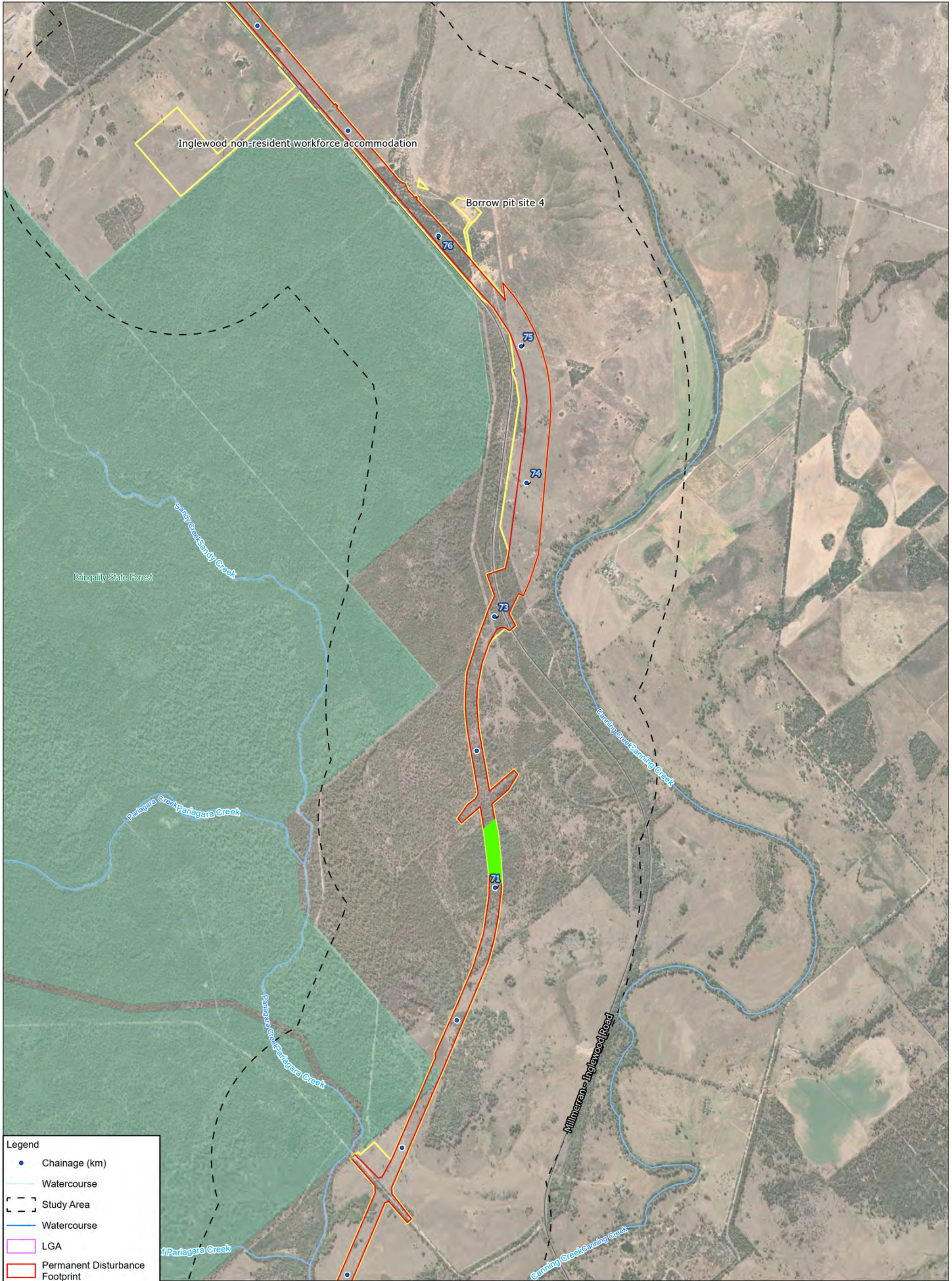
F4.3 (11) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

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Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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F4.3 (12) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
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Date: 17/10/2024

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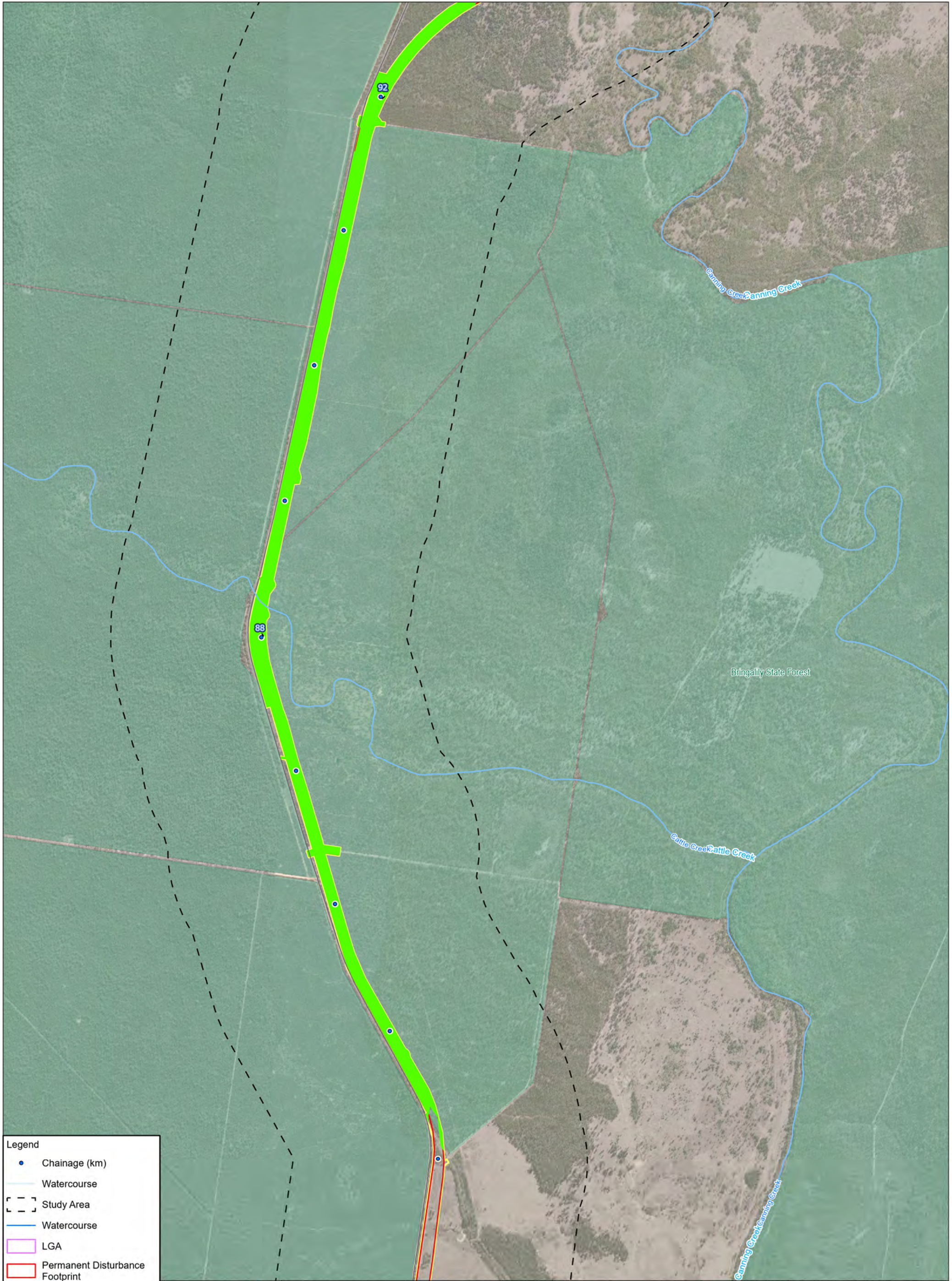
F4.3 (13) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

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ERM



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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F4.3 (14) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

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Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
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- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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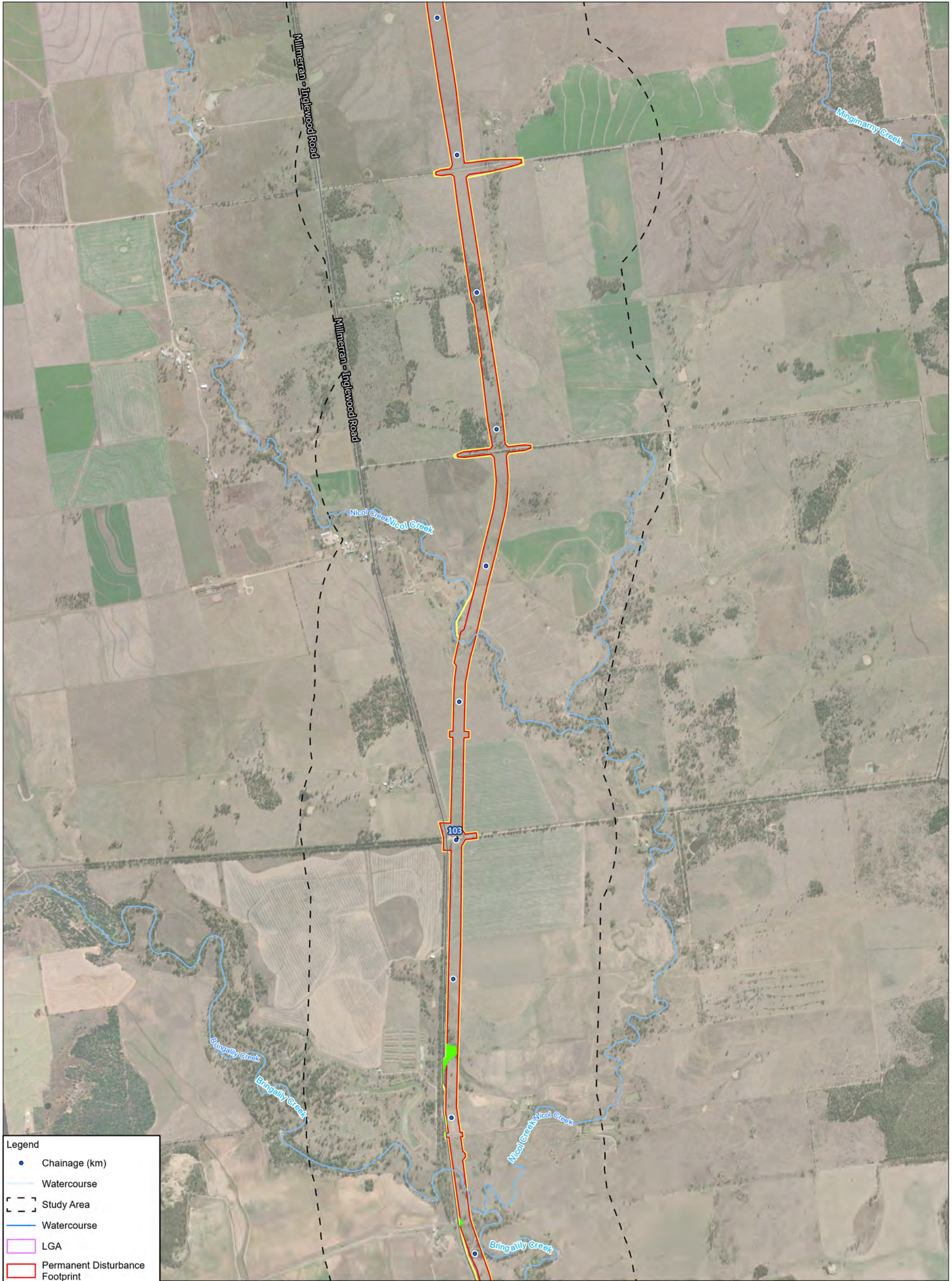
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F4.3 (15) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.3 (16) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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ARTC



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.3 (17) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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 **ERM**



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
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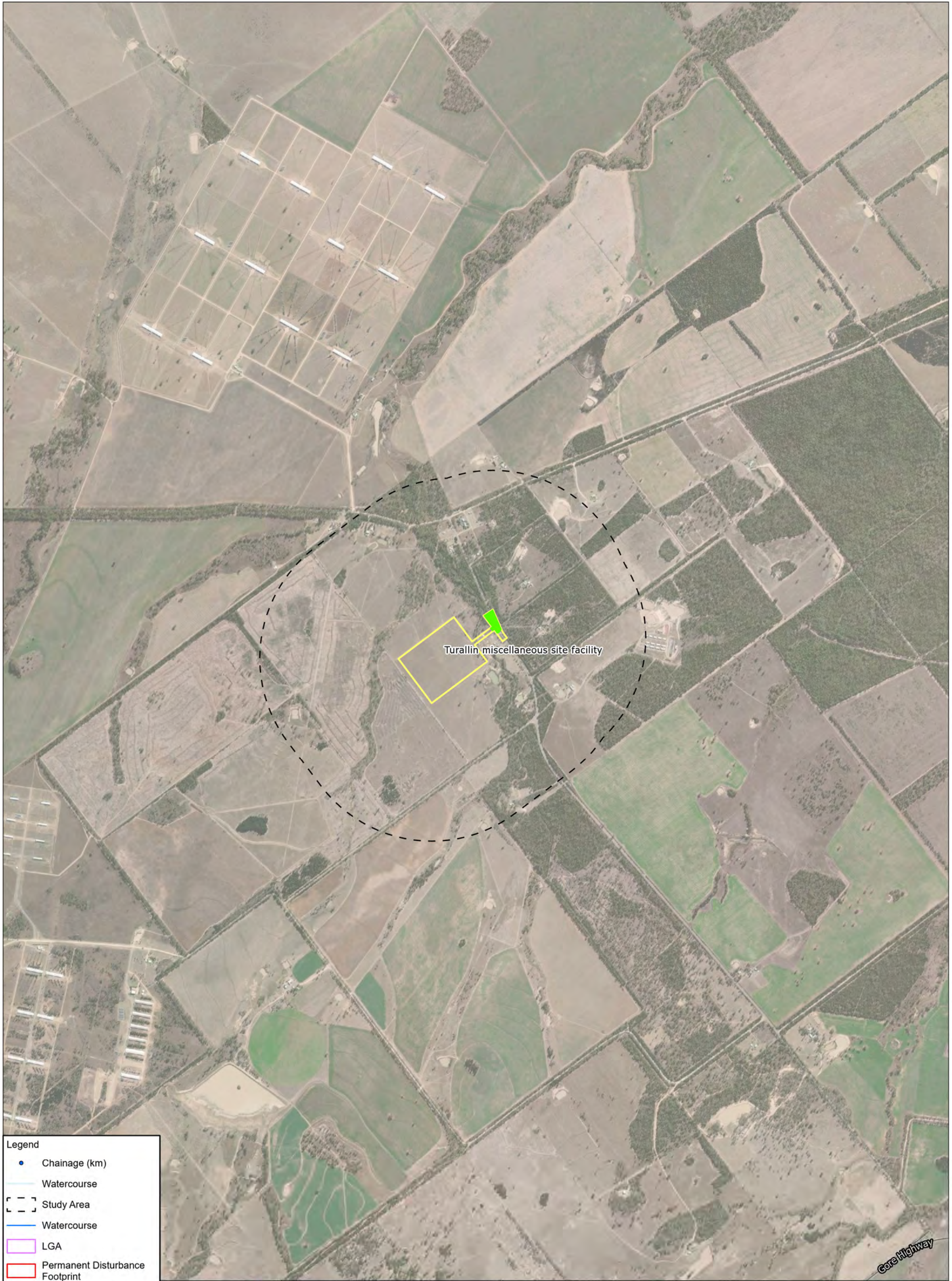
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F4.3 (18) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.3 (19) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

ERM



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.3 (20) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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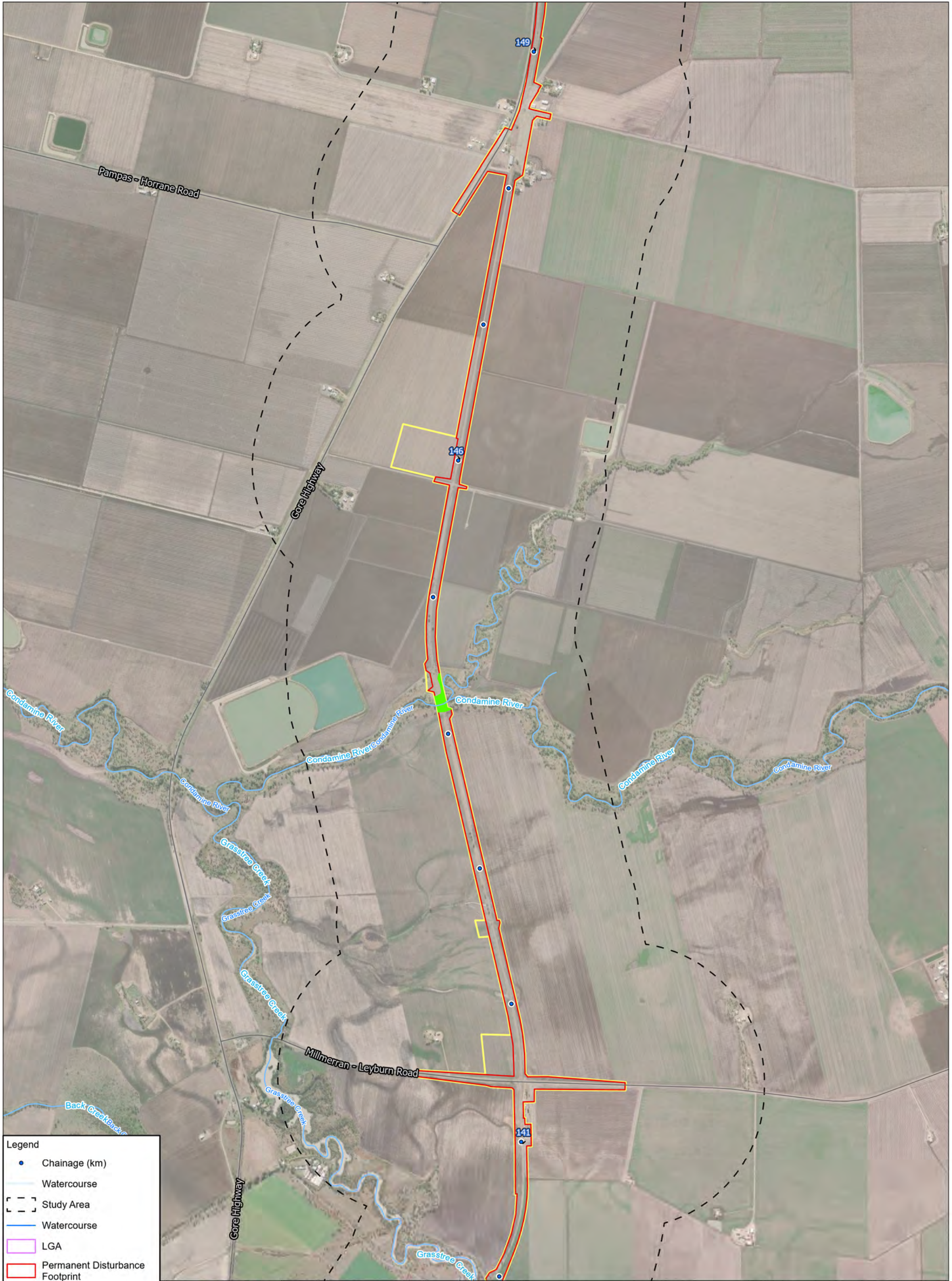
Drawing Size: A3

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F4.3 (21) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
0 200 400 600m



F4.3 (22) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.3 (23) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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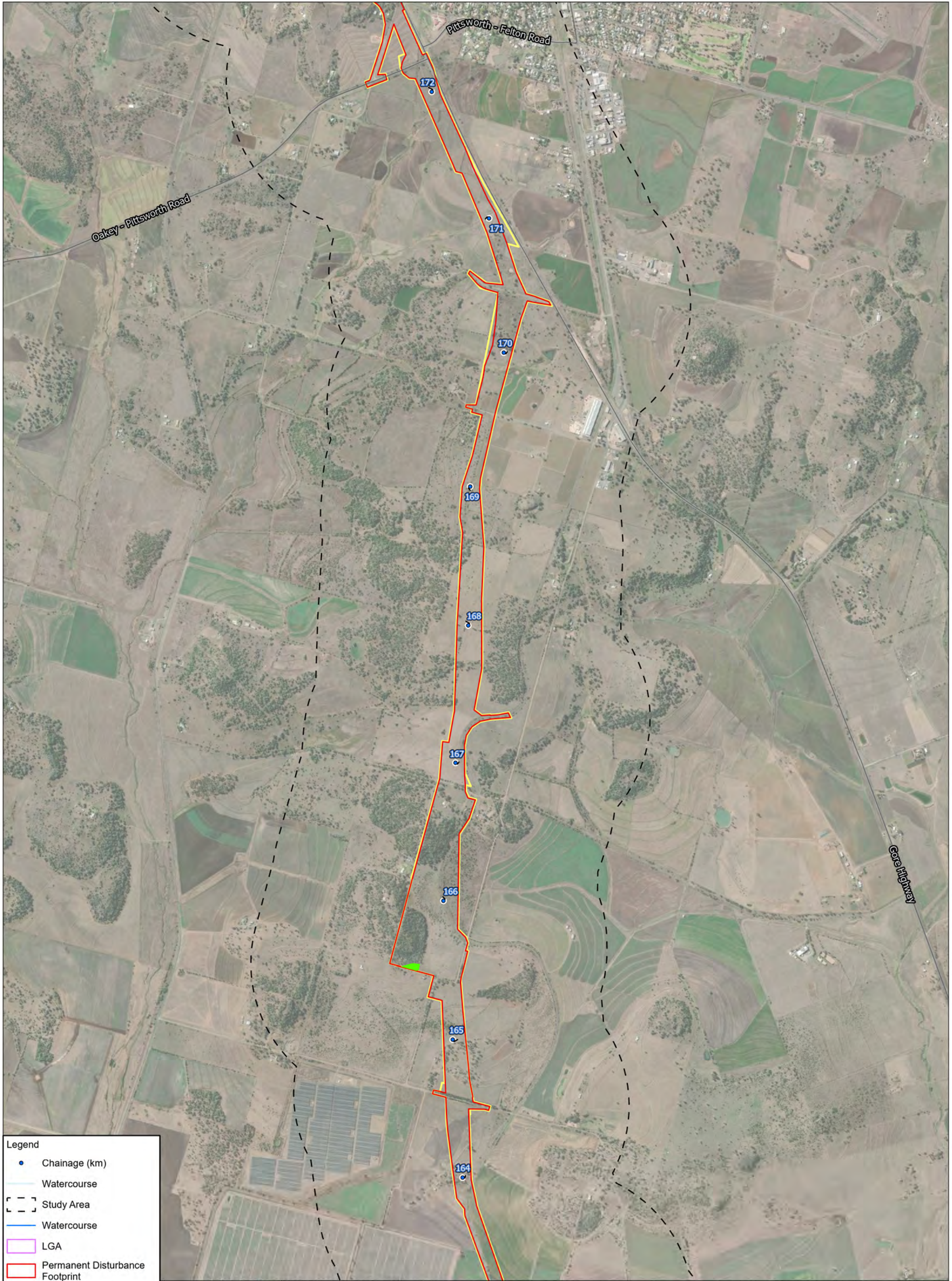
F4.3 (24) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

ERM



Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
Drawing Size: A3
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F4.3 (25) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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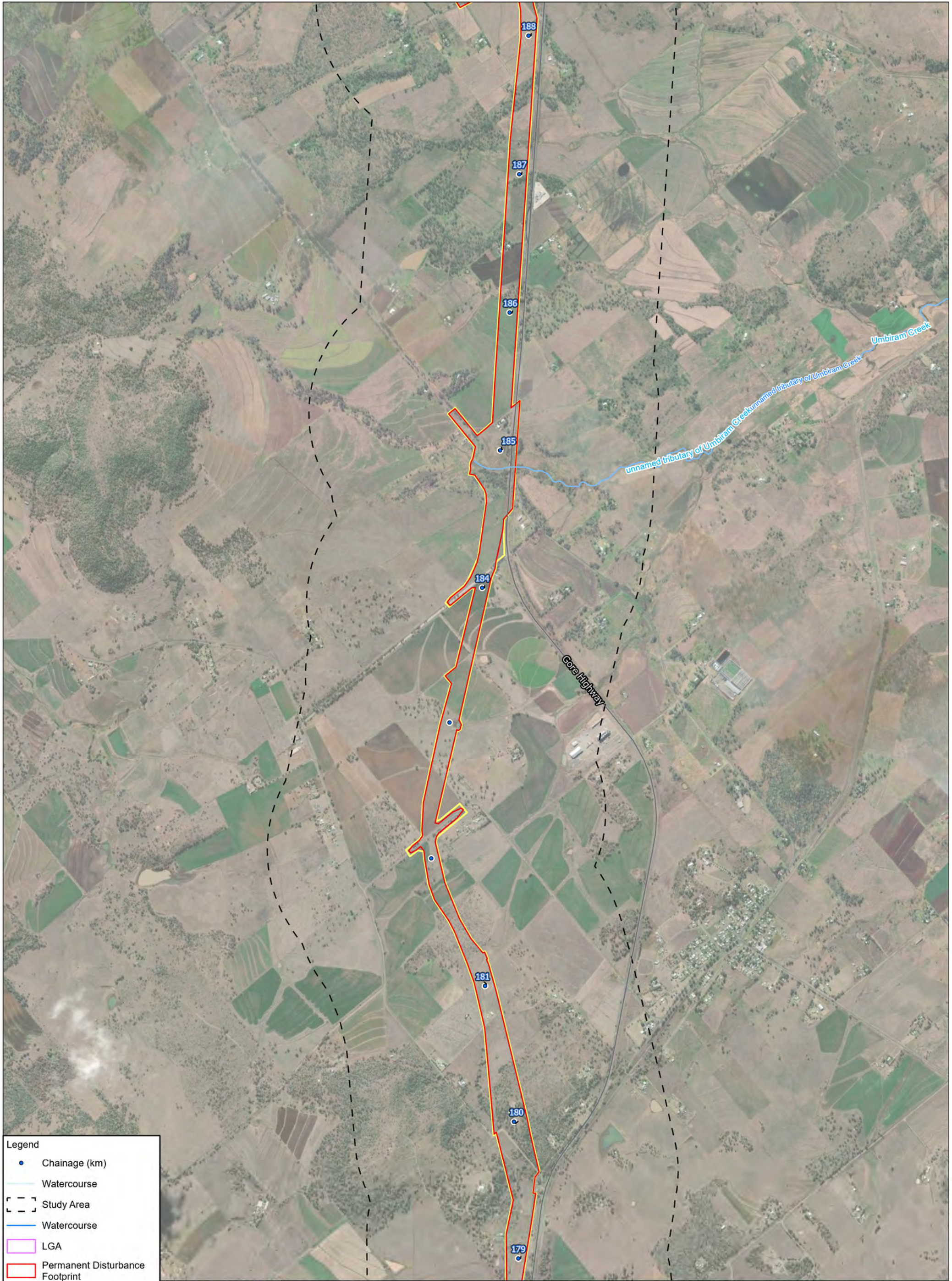
F4.3 (26) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

 **ERM**



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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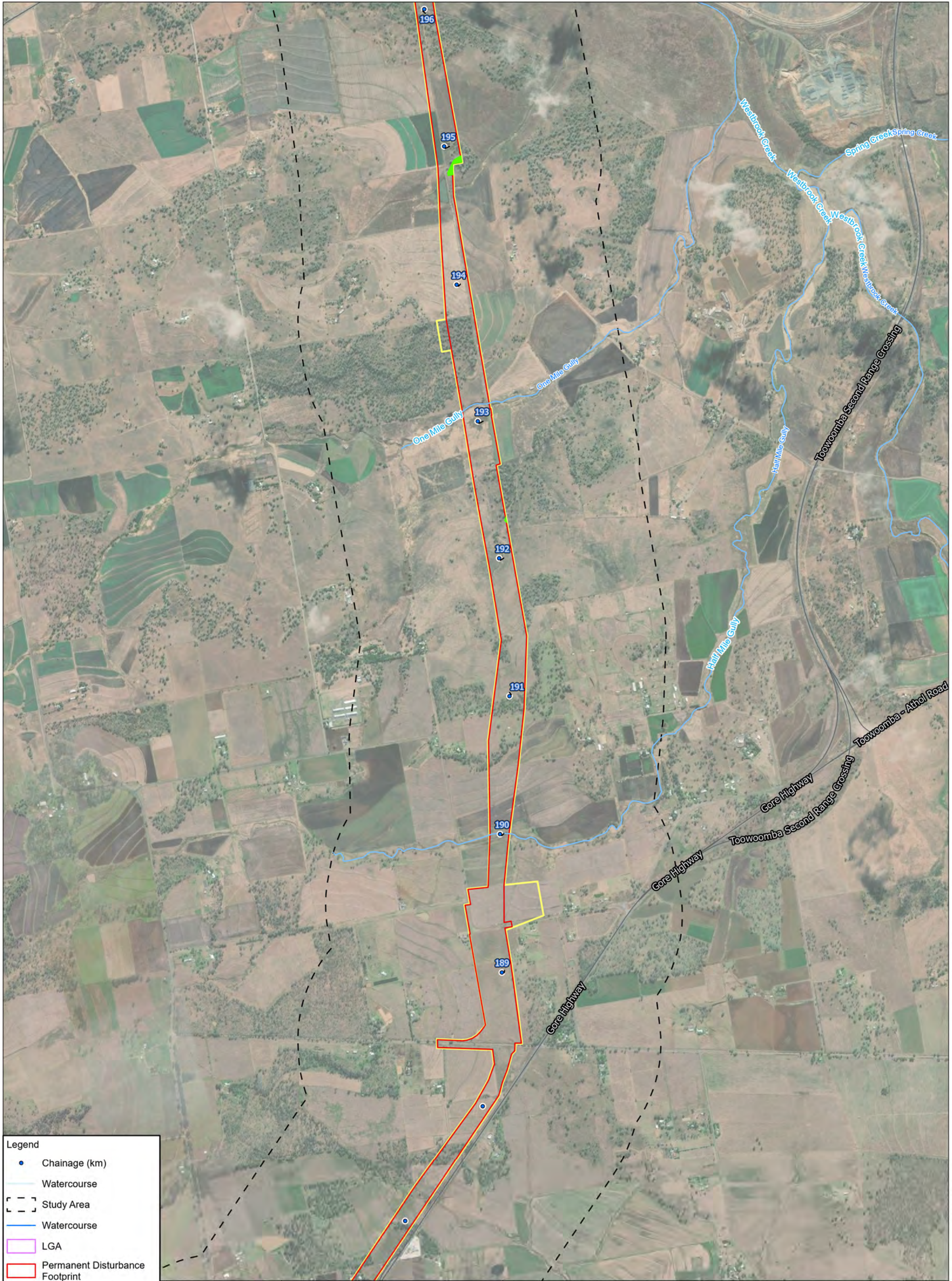
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F4.3 (27) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

 **ERM**



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
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F4.3 (28) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC

ERM



Legend

- Chainage (km)
- Watercourse
- [- -] Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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F4.3 (29) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

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ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Mapped Terrestrial Groundwater Dependent Ecosystems



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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F4.3 (30) Mapped Terrestrial Groundwater Dependent Ecosystems and Surface Water Areas Present Within the Study Area

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

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4.8 AQUATIC ECOSYSTEMS

4.8.1 AQUATIC HABITAT ASSESSMENTS

Eco Logical Australia (2020) conducted AusRivAS physical habitat assessments at 13 sites throughout the Project footprint. These sites were located in Cattle Creek, Condamine River (including the northern branch), Dry Creek, Grasstree Creek, Macintyre River, Nicol Creek, Pariagara Creek, Westbrook Creek, and several unnamed waterways.

Aquatic Biopassage Services (2024) conducted a desktop assessment and review of the existing aquatic assessments to provide information relating to a connectivity strategy for Murray Cod.

AusRivAS Physical assessment

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

AusRivAS Macroinvertebrate sampling

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

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

Desktop review for Murray cod habitat

Of the 85 proposed crossing sites over DAF designated waterways, 64.7% were categorised as low risk for passage of Murray cod, 16.5% were categorised as moderate risk, 8.2% were categorised as high risk, and 10.6% were categorised as extreme risk. Ten rail crossing sites in Bringalily Creek, Pariagara Creek, Nicol Creek, Native Dog Creek, Back Creek and Grasstree Creek and the Macintyre and Condamine Rivers were identified as suitable habitat for this species (Aquatic Biopassage Services, 2024).

4.8.2 SPRINGS AND GROUNDWATER DEPENDENT ECOSYSTEMS

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

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

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

Several ephemeral springs (sourced from bedrock aquifer systems) have been mapped by DESI at the Gowrie end of the Project footprint, however, they occur outside the Project footprint. Springs that occur in proximity to the Project footprint, and that may provide a source of water for GDEs, are listed in Table 4-10. Revised draft EIS Appendix U: Groundwater Technical Report provides further detail.

TABLE 4-10 SUMMARY OF GROUNDWATER DEPENDENT ECOSYSTEM SPRINGS

Spring name/site #	Distance from alignment (km)	Direction from alignment	Spring type	Source aquifer
Stone Spring/1145	2	Northwest of Ch 173.0 km	Active and non-permanent	Main Range Volcanics
Jimna Springs/1147	5.3	Southeast of Ch 178.0 km		Main Range Volcanics
Springside/1146	5.7	North of Ch 168.0 km		Main Range Volcanics
Wellcamp Spring/1150	7.4	East of Ch 195.0 km		Main Range Volcanics
Leigh Spring/1144	8.8	Northwest of Ch 173.0 km		Main Range Volcanics
Merigandan Creek/1155	9.4	Northeast of Ch 206.0 km		Main Range Volcanics
Eustondale Spring/1154	11.6	East of Ch 195.0 km		Main Range Volcanics
Lilligren Spring/1156	12.1	Northeast of Ch 206.0 km		Main Range Volcanics

Spring name/site #	Distance from alignment (km)	Direction from alignment	Spring type	Source aquifer
Westbrook Creek/1153	14.4	East of Ch 195.0 km		Main Range Volcanics
Kearneys Spring/1139	17.5	East of Ch 195.0 km	Active - Permanent	Main Range Volcanics

4.8.3 QUEENSLAND WATERWAYS FOR WATERWAY BARRIER WORKS

A review of the DAF *Queensland Waterways for Waterway Barrier Works* mapping was undertaken, identifying a total of 100 waterways for waterway barrier works, which are intersected by the Project (Figure 4-4).

The 100 waterways intersecting the Project disturbance footprint are classified (derived from DAF mapped waterways) as follows (Table 4-11):

- ten waterways mapped as purple (major risk);
- nine waterways mapped as red (high risk);
- 15 waterways mapped as amber (moderate risk); and
- 66 waterways mapped as green (low risk).

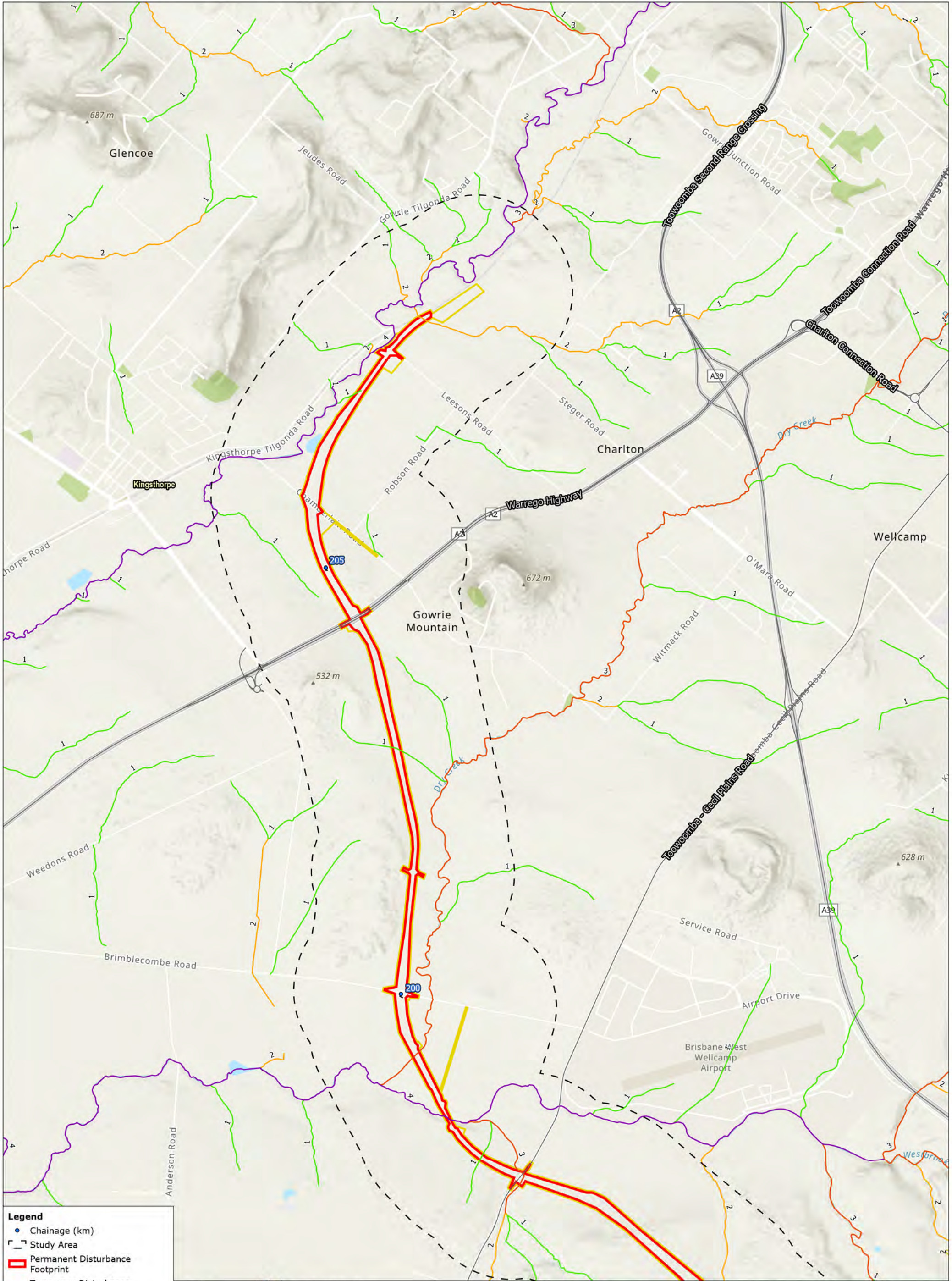
The Project does not impact any tidal waterways (major risk; mapped as grey). Revised draft EIS Appendix S: Surface Water Quality Technical Report and Eco Logical Australia (2020) provide more detail on the water quality and condition of some of these waterways.

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

TABLE 4-11 WATERWAYS FOR WATERWAY BARRIER WORKS THAT INTERCEPT THE PROJECT FOOTPRINT

Waterway impact risk (DAF)	Waterway and approximate chainage (Ch) of intersection (km)
Purple (major risk)	• Unnamed tributary of Macintyre Brook (Ch 55.6 km) • Pariagara Creek (Ch 67.3 km) • Unnamed tributary of Pariagara Creek (Ch 67.3 km) • Bringalily Creek (Ch 100.5 km) • Nicol Creek (Ch 104.4 km) • Back Creek (Ch 128.0 km) • Grasstree Creek (Ch 139.9 km) • Condamine River (Ch 144.2 km) • Condamine River (Northern Branch) (Ch 150.0 km) • Westbrook Creek drainage feature (Ch 198.5 km)
Red (high risk)	• Unnamed tributary of Macintyre Brook (Ch 52.6 km) • Cattle Creek (Ch 88.2 km) • Native Dog Creek (Ch 93.9 km) • Back Creek (Ch 97.6 km) • Unnamed tributary of Back Creek Gully (Ch 120.3 km)

Waterway impact risk (DAF)	Waterway and approximate chainage (Ch) of intersection (km)
	• Unnamed tributary of Back Creek Gully (Ch 127.0 km) • One Mile Gully tributary of Westbrook Creek (Ch 193.1 km, Ch 197.4 km) • Four Mile Gully tributary of Westbrook Creek (Ch 197.4 km) • Dry Creek drainage feature (Ch 199 km)
Amber (moderate risk)	• Unnamed tributary of Macintyre Brook (Ch 48.4 km, Ch 60.5 km, Ch 61.9 km, Ch 63.1 km) • Unnamed tributary of Pariagara Creek (Ch 66.2 km) • Unnamed tributary of Canning Creek (Ch 91.0 km,) • Unnamed tributary of Nicol Creek (Ch 109.4 km, Ch 114.4 km) • Unnamed tributary of Grasstree Creek (Ch 141.0 km) • Unnamed drainage feature (Ch 160 km) • Unnamed tributary of Umbiram Creek (Ch 184.9 km, Ch 187.2 km) • Half Mile Creek – drainage feature (Ch 190.0 km) • Unnamed tributary of Westbrook Creek (Ch 194.7 km) • Unnamed tributary of Pine Creek near Turallin Facility
Green (low risk)	• Unnamed tributary of Macintyre Brook (Ch 43.2 km (also crosses Whetstone Material Distribution Centre), Ch 58.2 km, Ch 59km, Ch 59.6 km, Ch 61.6 km, Ch 62.9 km, Ch 63.9 km) • Unnamed tributary of Pariagara Creek (Ch 64.7 km, Ch 66.8 km, Ch 67.55 km, Ch 67.56 km, Ch 68 km, Ch 68.7 km) • Unnamed tributary to Sandy Creek (Inglewood workforce camp) • Unnamed tributary of Canning Creek (Ch 73.7 km, Ch 78.9 km, Ch 80.0 km, Ch 81.1, Ch 82.3 km, Ch 84.4 km, Ch 85.4 km) • Unnamed tributary of Cattle Creek (Ch 87.4 km) • Unnamed tributary of Canning Creek (Ch 92.1 km, Ch 92.9 km) • Unnamed tributary of Nicol Creek (Ch 107.2 km, Ch 108.5 km, Ch 110.9 km, Ch 111.3 km, Ch 111.9 km) • Unnamed drainage feature (Ch 112.3 km, Ch 113 km) • Unnamed tributary of Nicol Creek (Ch 113.3 km, Ch 114.9 km, Ch 115.5 km, Ch 115.6 km, Ch 116.2 km) • Unnamed tributary of Leonard (Back Creek) Gully (Ch 117.4 km) • Unnamed tributary Back Creek Gully (Ch 118.4 km, 119.4 km, Ch 120.8 km, Ch 121.4 km, Ch 124.3 km, Ch 124.4 km, Ch 125.5 km) • Unnamed drainage feature (Ch 130.2 km) • Unnamed drainage feature (Ch 162.2 km, Ch 162.8 km) • Unnamed tributary of Fourteen Mile Creek (Ch 164.2 km, Ch 164.4 km, Ch 165.1 km, Ch 168.6 km, Ch 169.9 km, Ch 170.6 km, Ch 171.9 km, Ch 172.2 km, Ch 173.6 km) • Unnamed tributary of Perrier Gully (Ch 176.9 km, Ch 177.7 km, Ch 178.7 km) • Unnamed tributary of Umbiram Creek (Ch 186.20) • Unnamed tributary of Umbiram Creek (181.1 km, Ch 181.8 km, Ch 182.9 km) • Unnamed tributary of One Mile Gully (Ch 191.9 km) • Unnamed tributary of Four Mile Gully (Ch 197.9 km) • Unnamed tributary of Dry Creek (Ch 202.8 km)



Legend

- Chainage (km)
- Study Area
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Risk For Fish Passage**
- 1
- 2
- 3
- 4



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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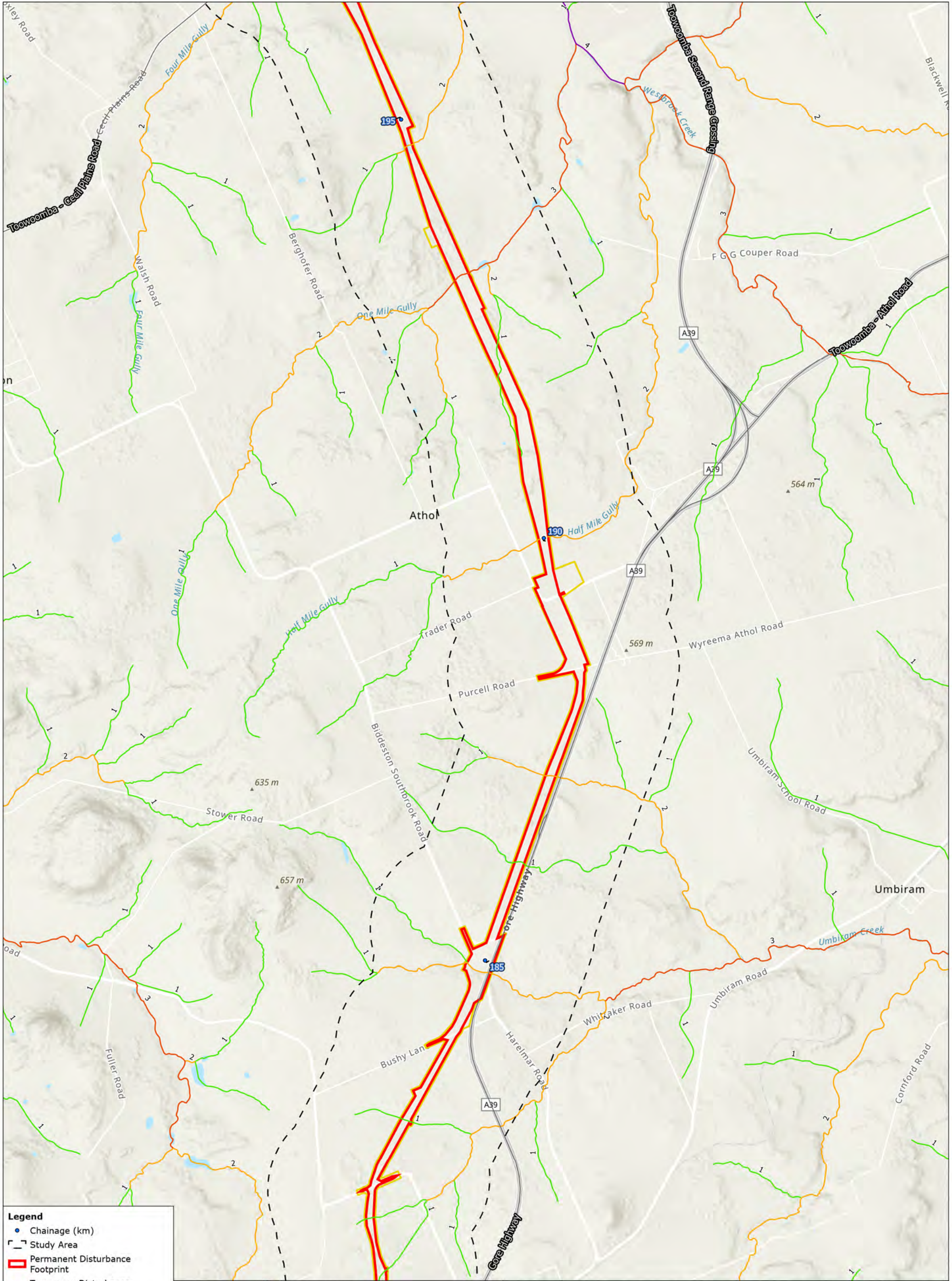
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F4.4 (1) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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

Risk For Fish Passage

- 1
- 2
- 3
- 4

Coordinate System:
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Date: 17/10/2024

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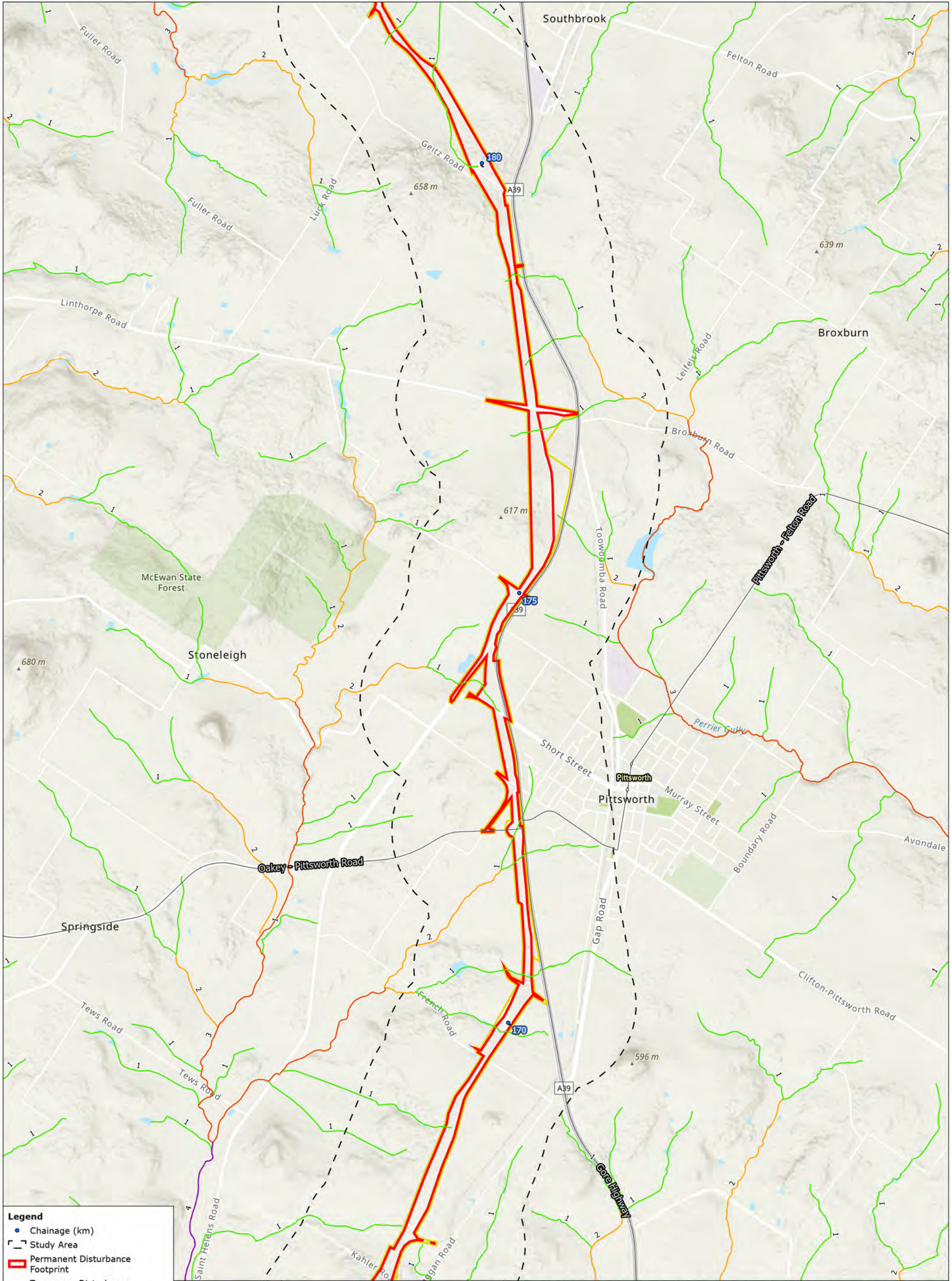
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F4.4 (2) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Study Area
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Risk For Fish Passage**
- 1
- 2
- 3
- 4



Coordinate System:
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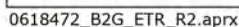
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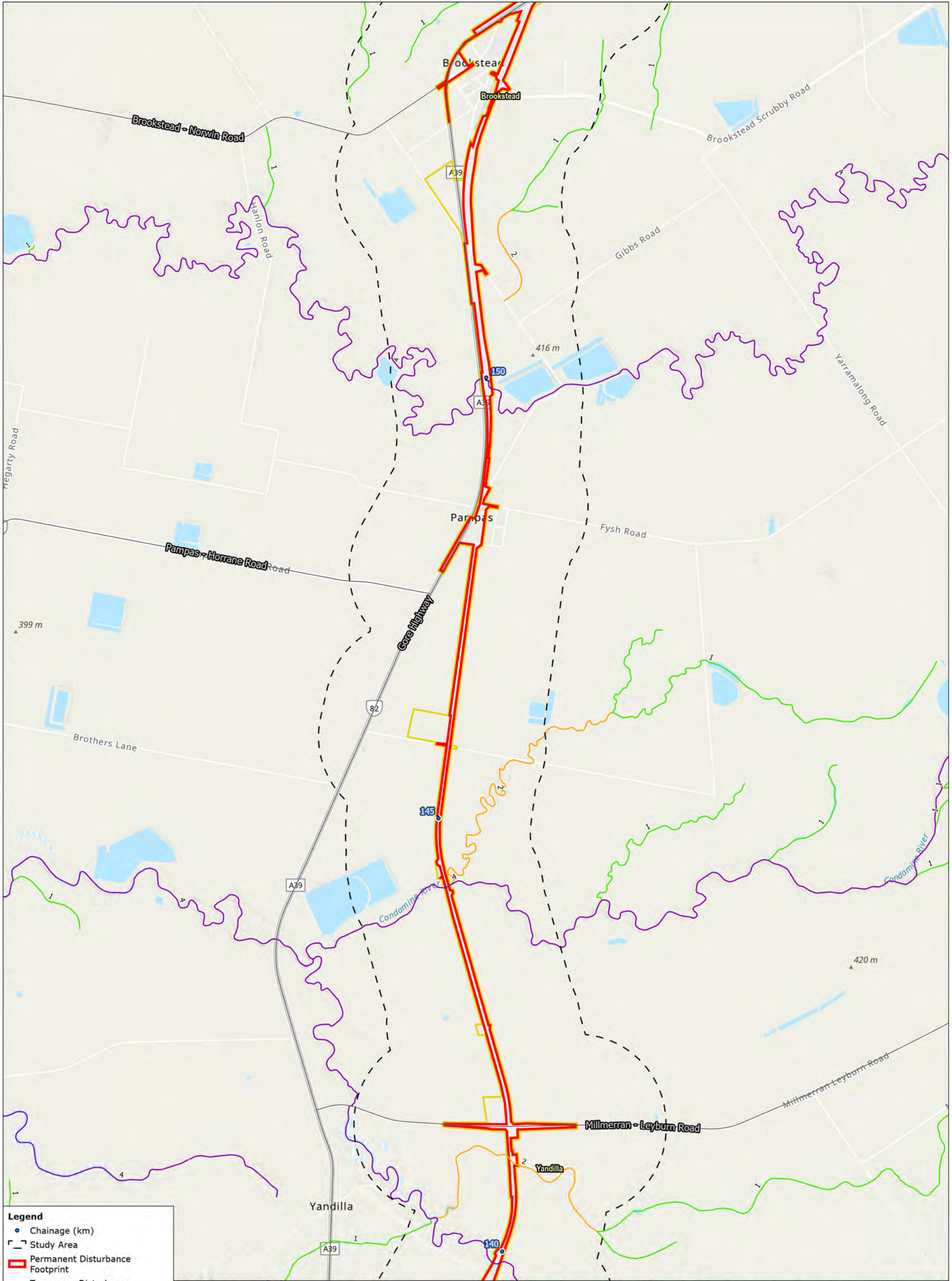
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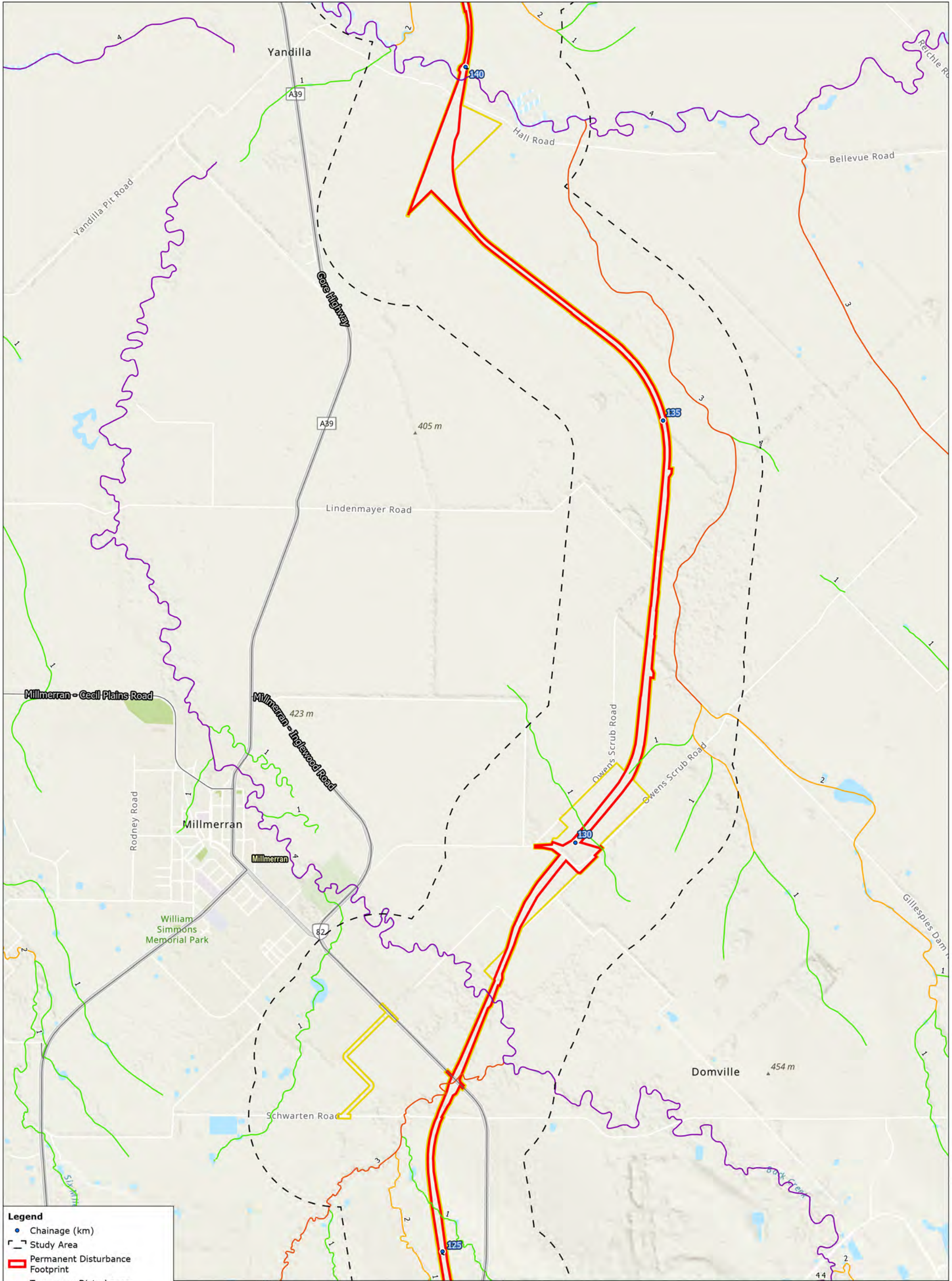
F4.4 (3) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC









- Legend**
- Chainage (km)
 - Study Area
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Risk For Fish Passage**
 - 1
 - 2
 - 3
 - 4

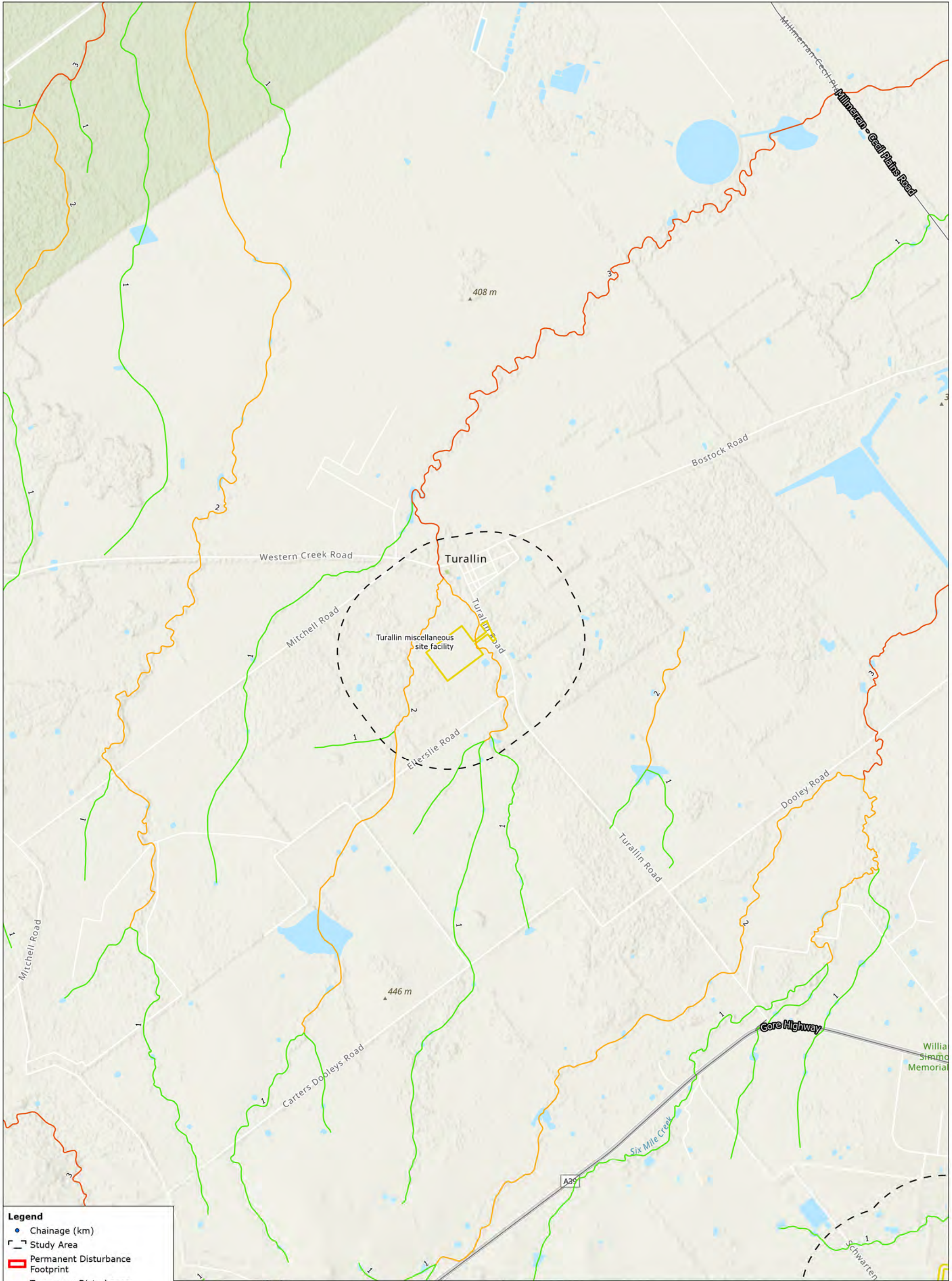
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F4.4 (6) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology Technical Report
ARTC





- Legend**
- Chainage (km)
 - Study Area
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Risk For Fish Passage**
 - 1
 - 2
 - 3
 - 4

Coordinate System:
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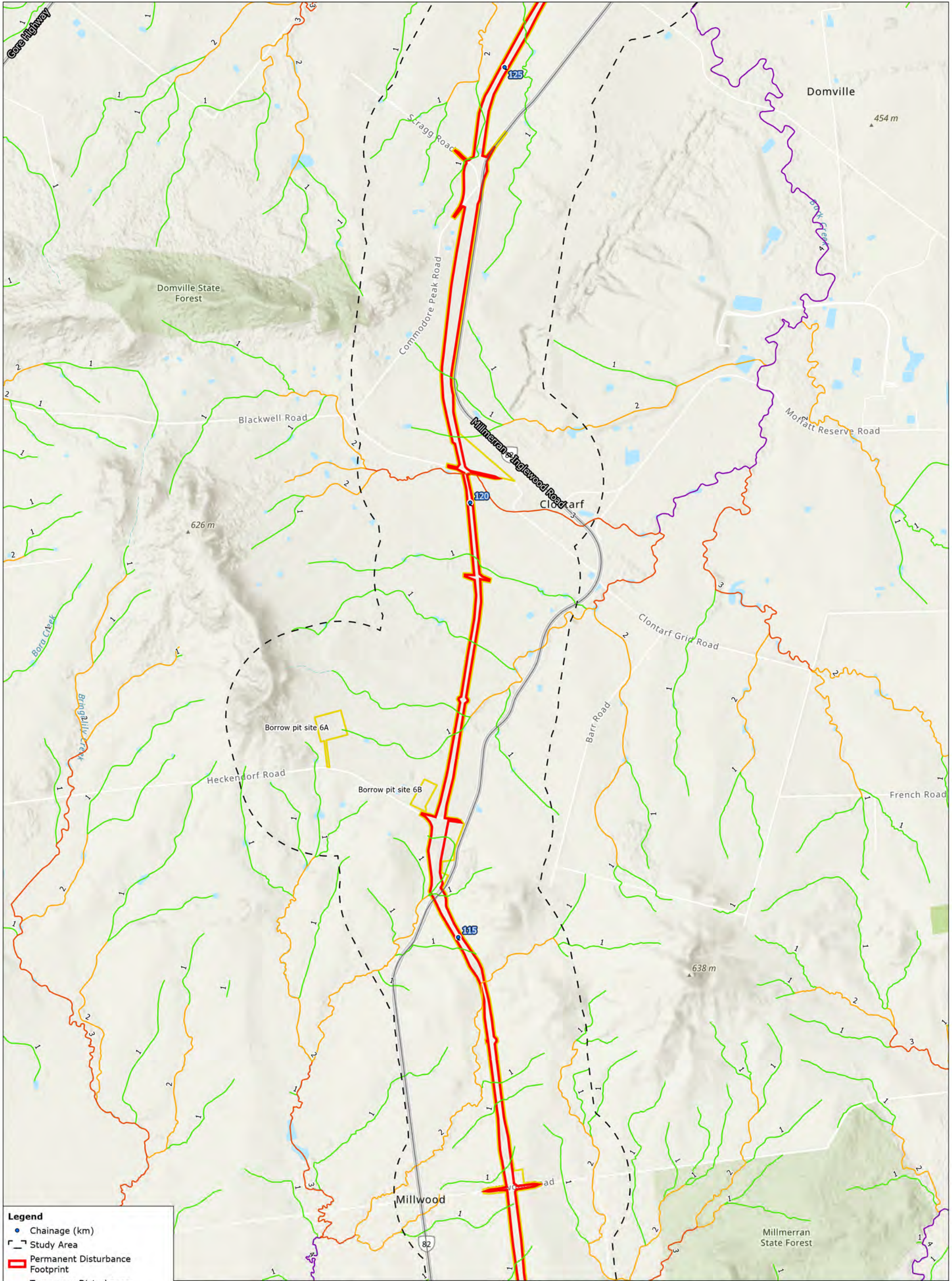
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F4.4 (7) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Chainage (km)
- Study Area
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Risk For Fish Passage**
- 1
- 2
- 3
- 4

Coordinate System:
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Date: 17/10/2024

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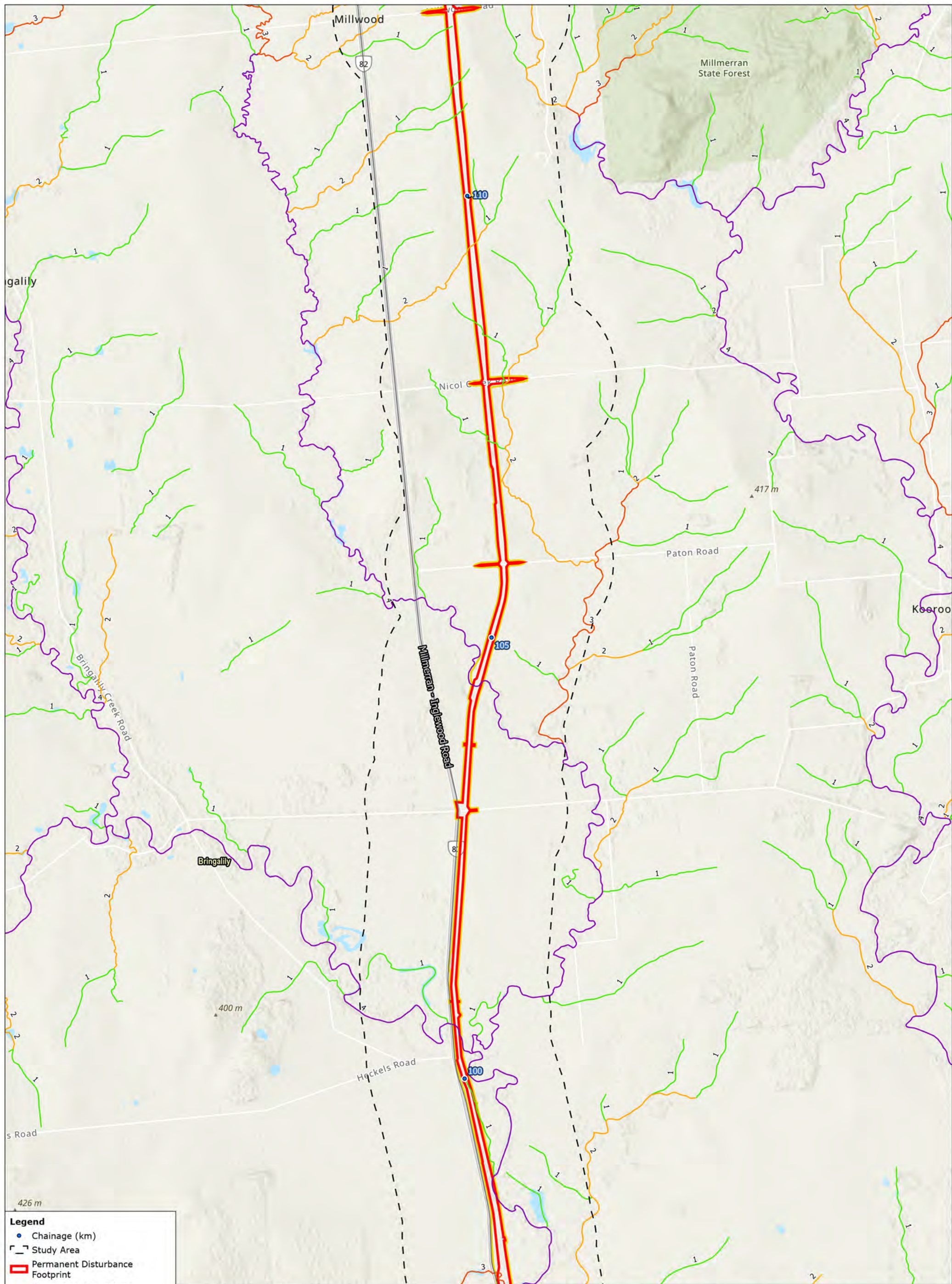
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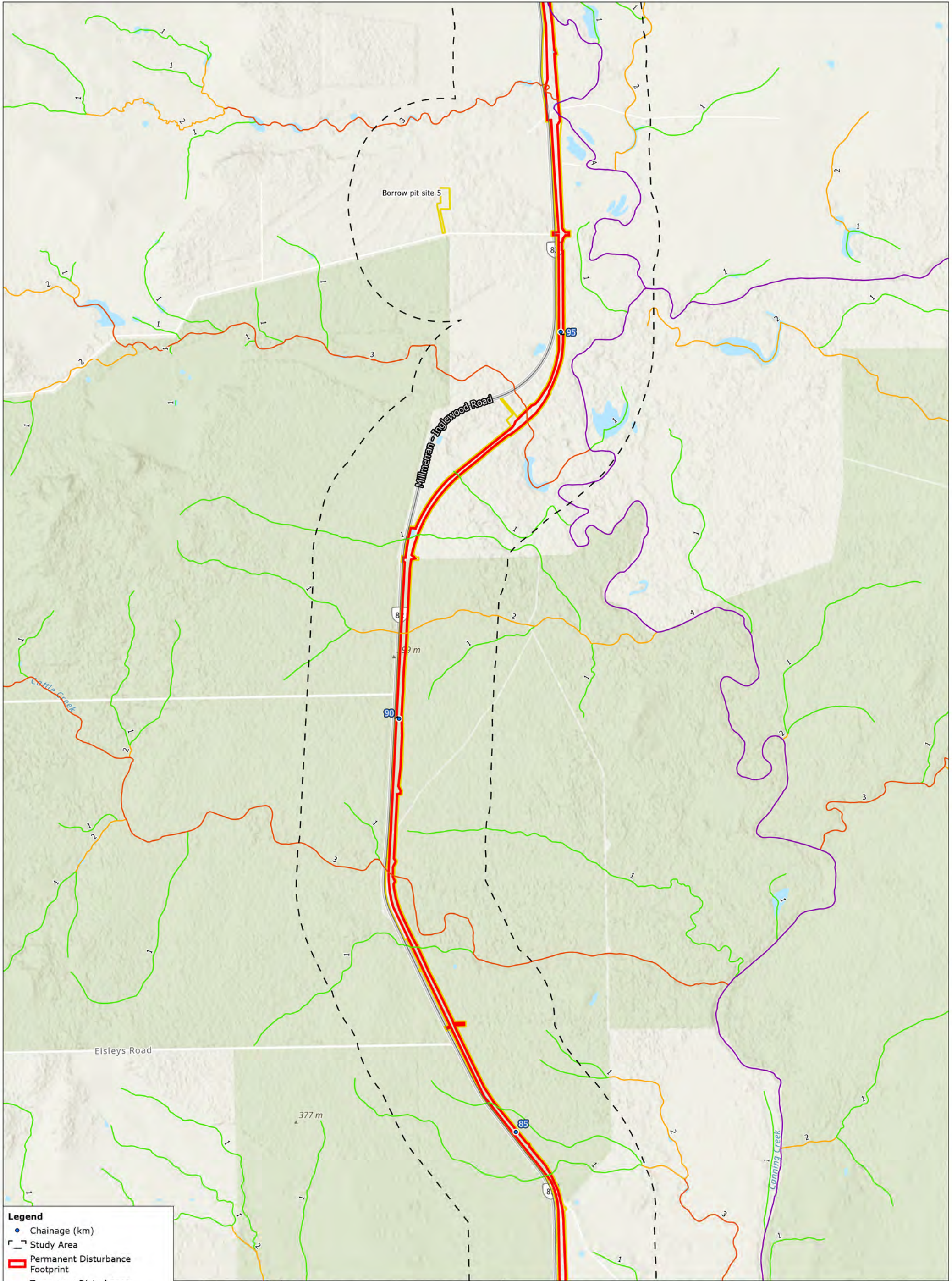
F4.4 (8) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

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

Risk For Fish Passage

- 1
- 2
- 3
- 4

Coordinate System:
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Date: 17/10/2024

Created By: CB/VN

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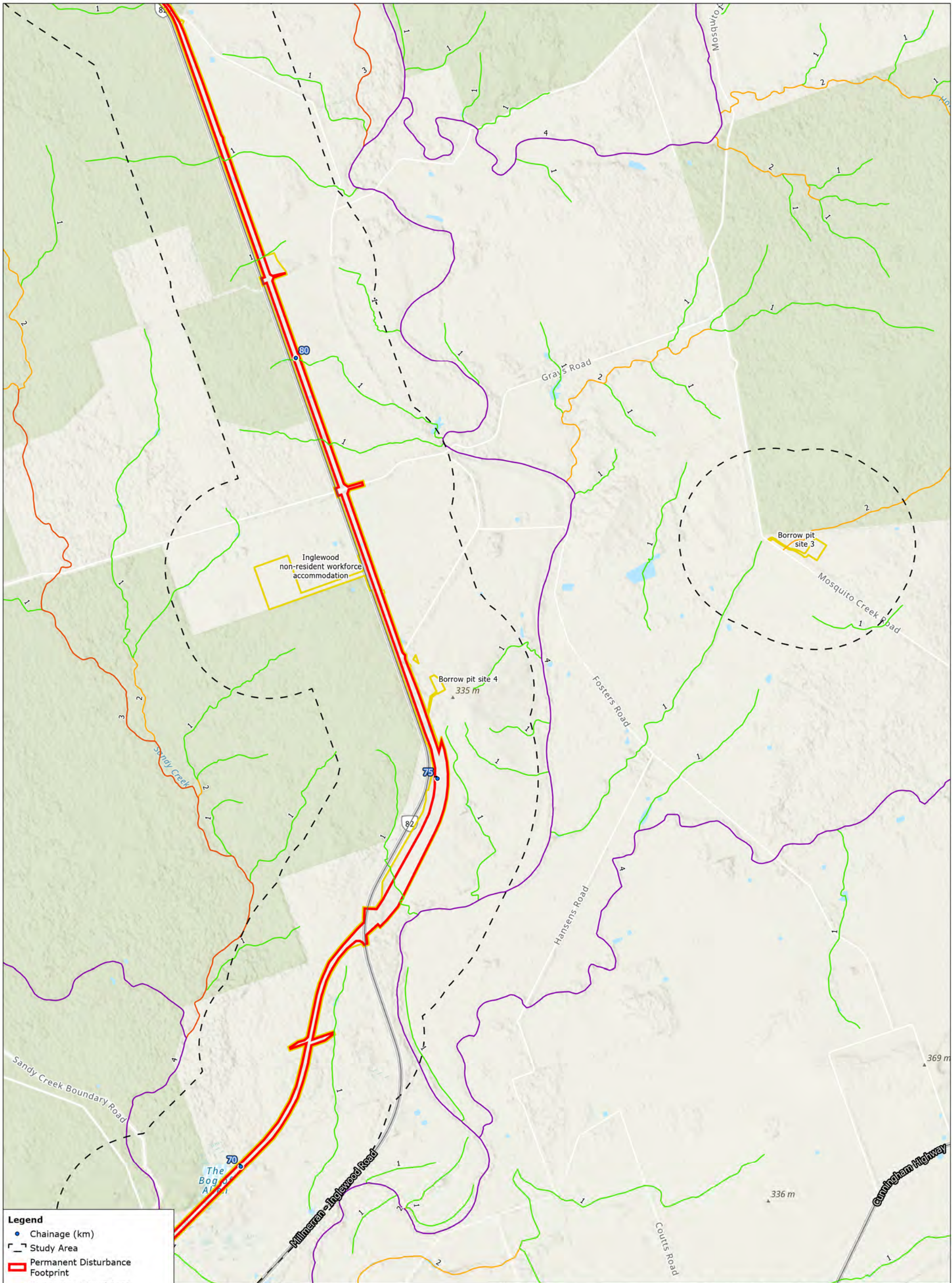
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F4.4 (10) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Study Area
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Risk For Fish Passage**
- 1
- 2
- 3
- 4

Coordinate System:
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Date: 17/10/2024

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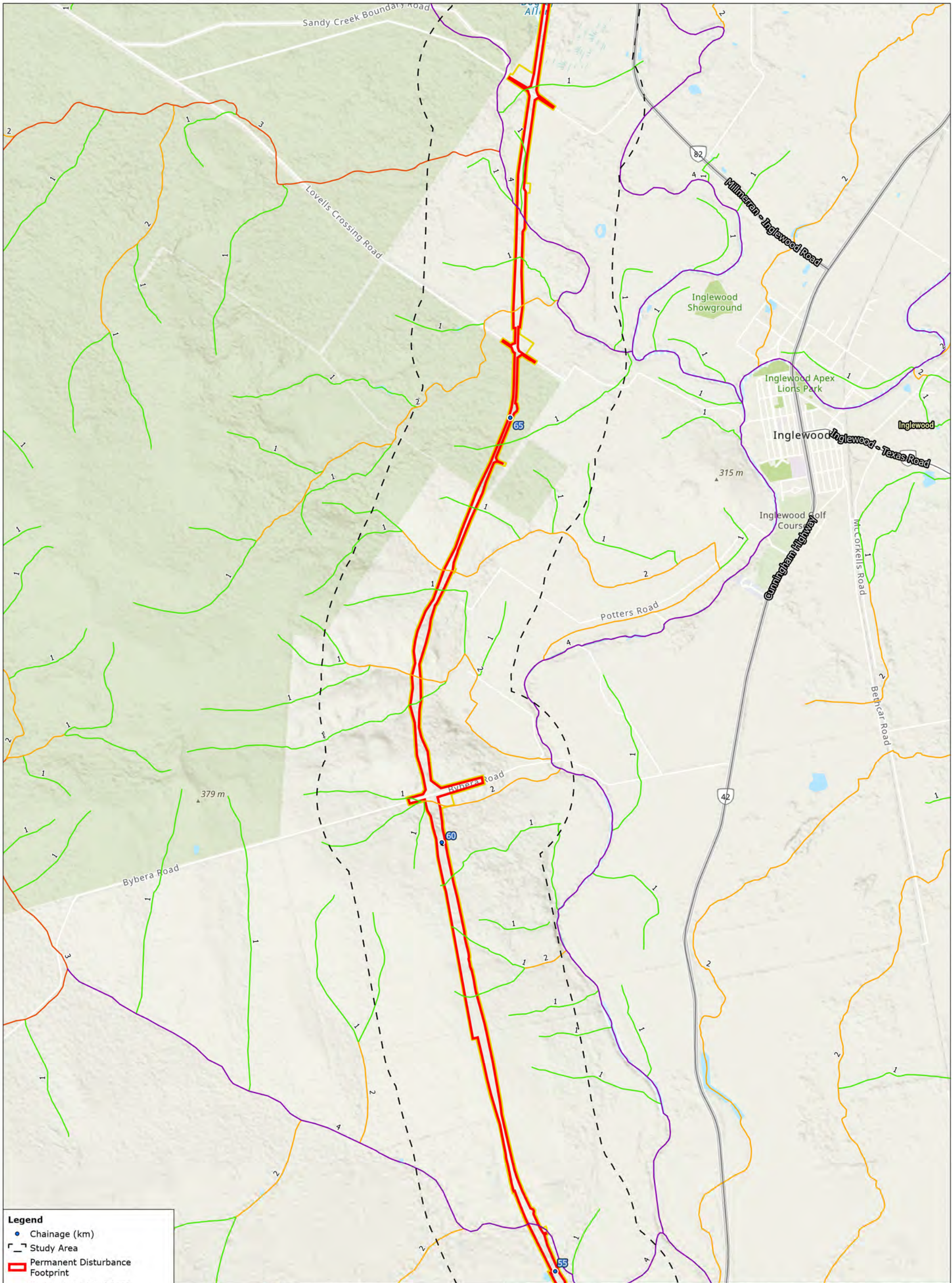
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F4.4 (11) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





- Legend**
- Chainage (km)
 - Study Area
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Risk For Fish Passage**
 - 1
 - 2
 - 3
 - 4

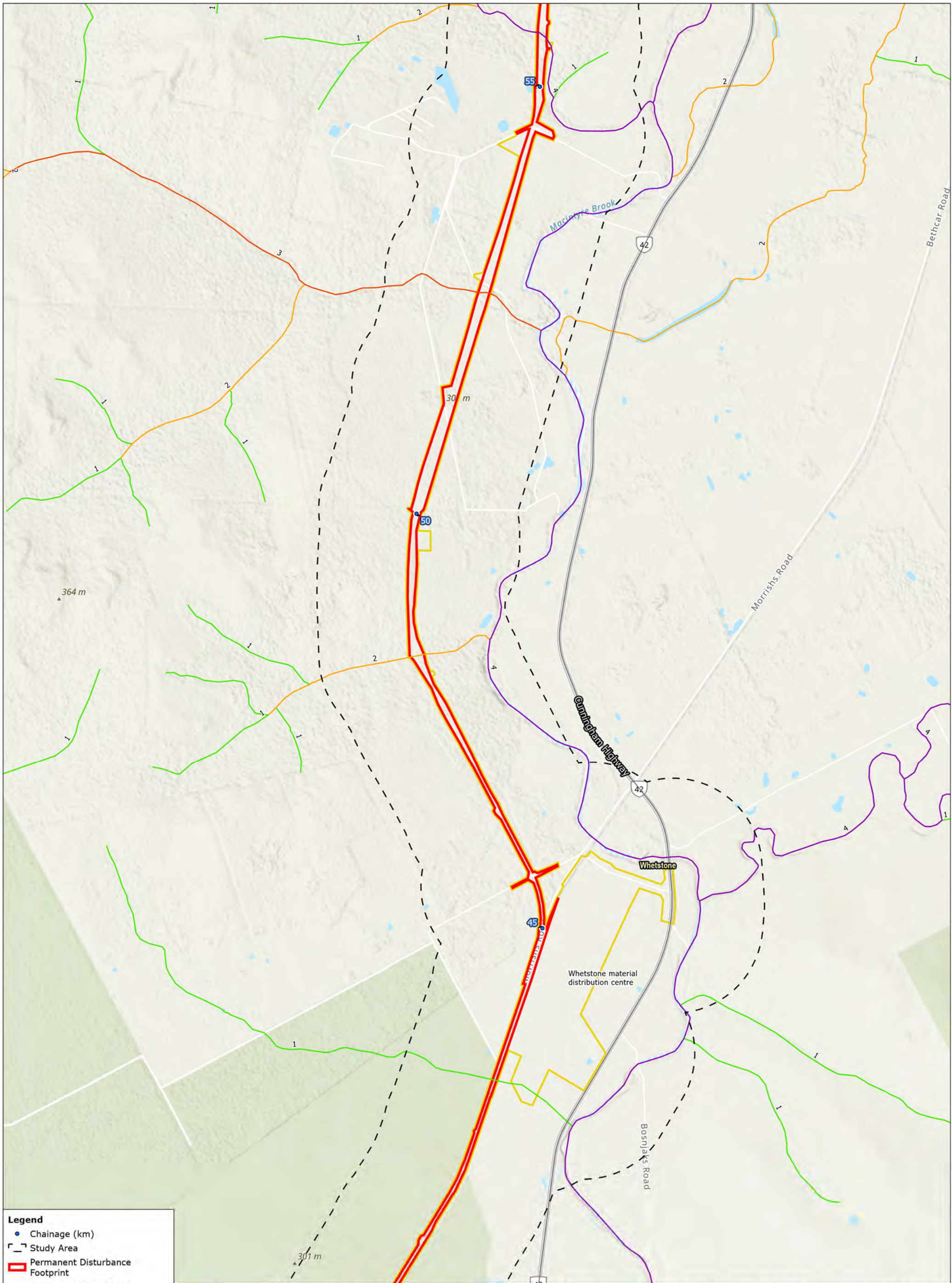
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F4.4 (12) - Department of Agriculture and Fisheries Waterway Barrier Works

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC**





Legend

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

Risk For Fish Passage

- 1
- 2
- 3
- 4



Coordinate System:
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Date: 17/10/2024

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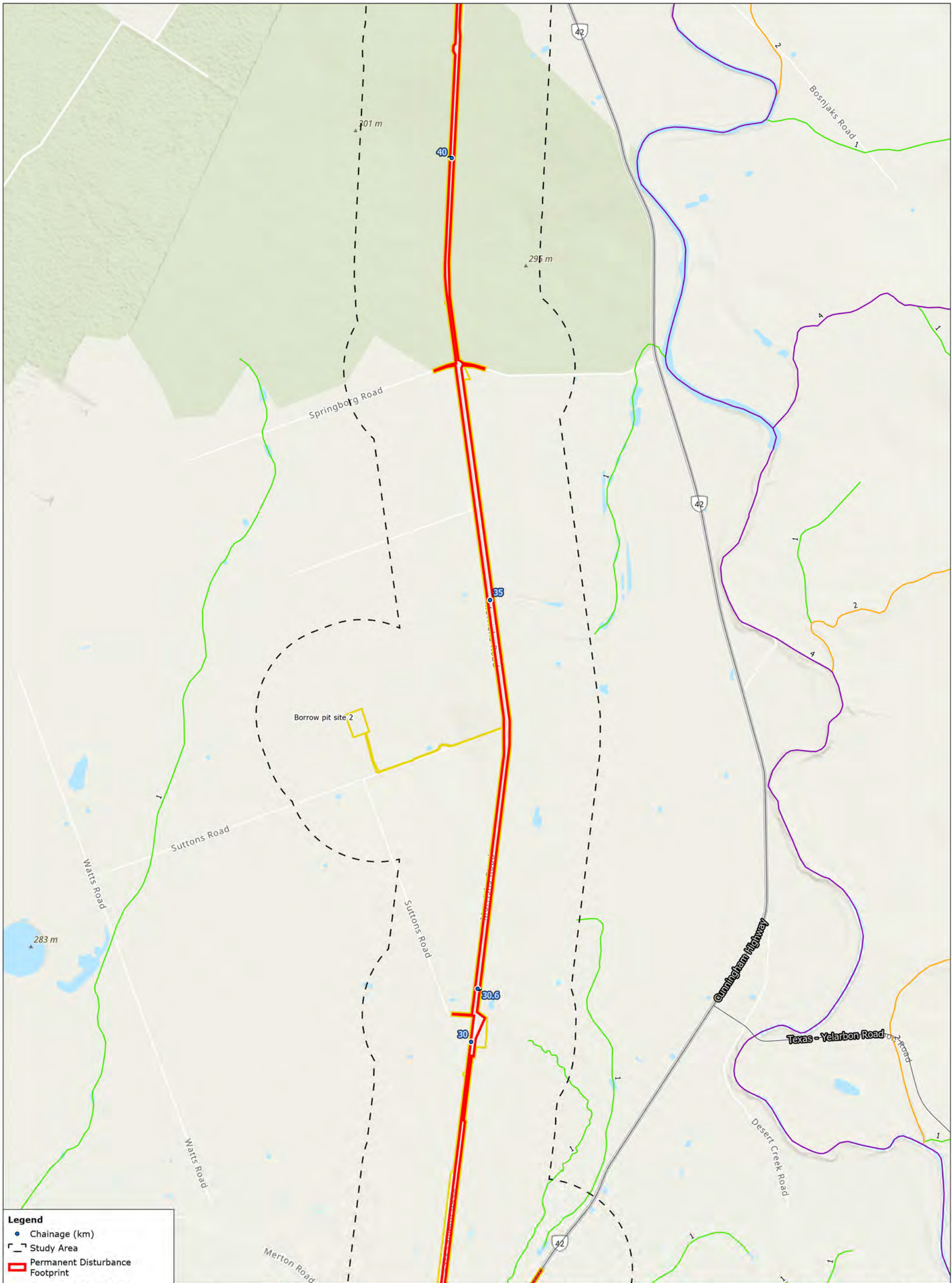
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F4.4 (13) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





- Legend**
- Chainage (km)
 - Study Area
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Risk For Fish Passage**
 - 1
 - 2
 - 3
 - 4

Coordinate System:
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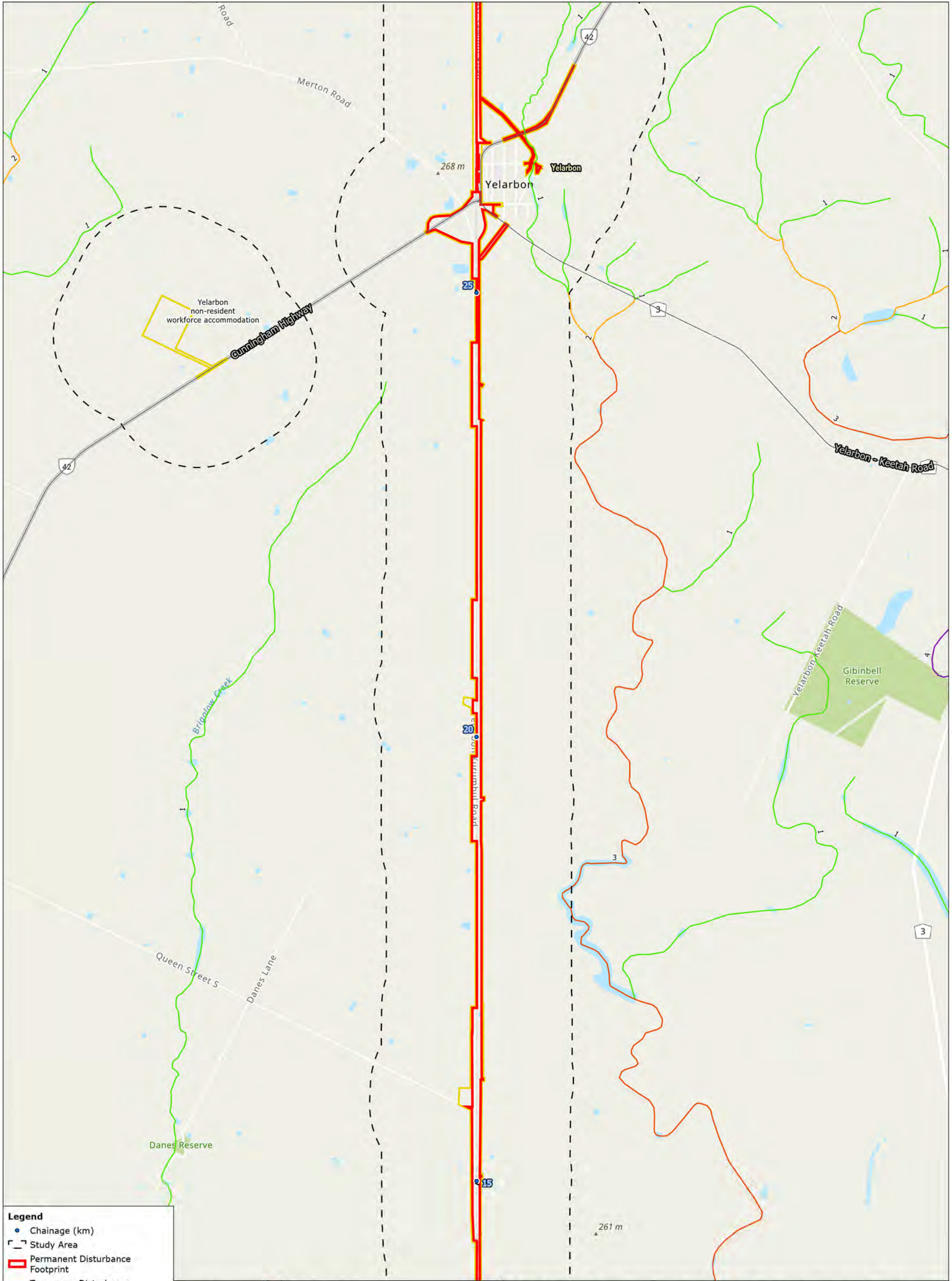
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F4.4 (14) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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

Risk For Fish Passage

- 1
- 2
- 3
- 4



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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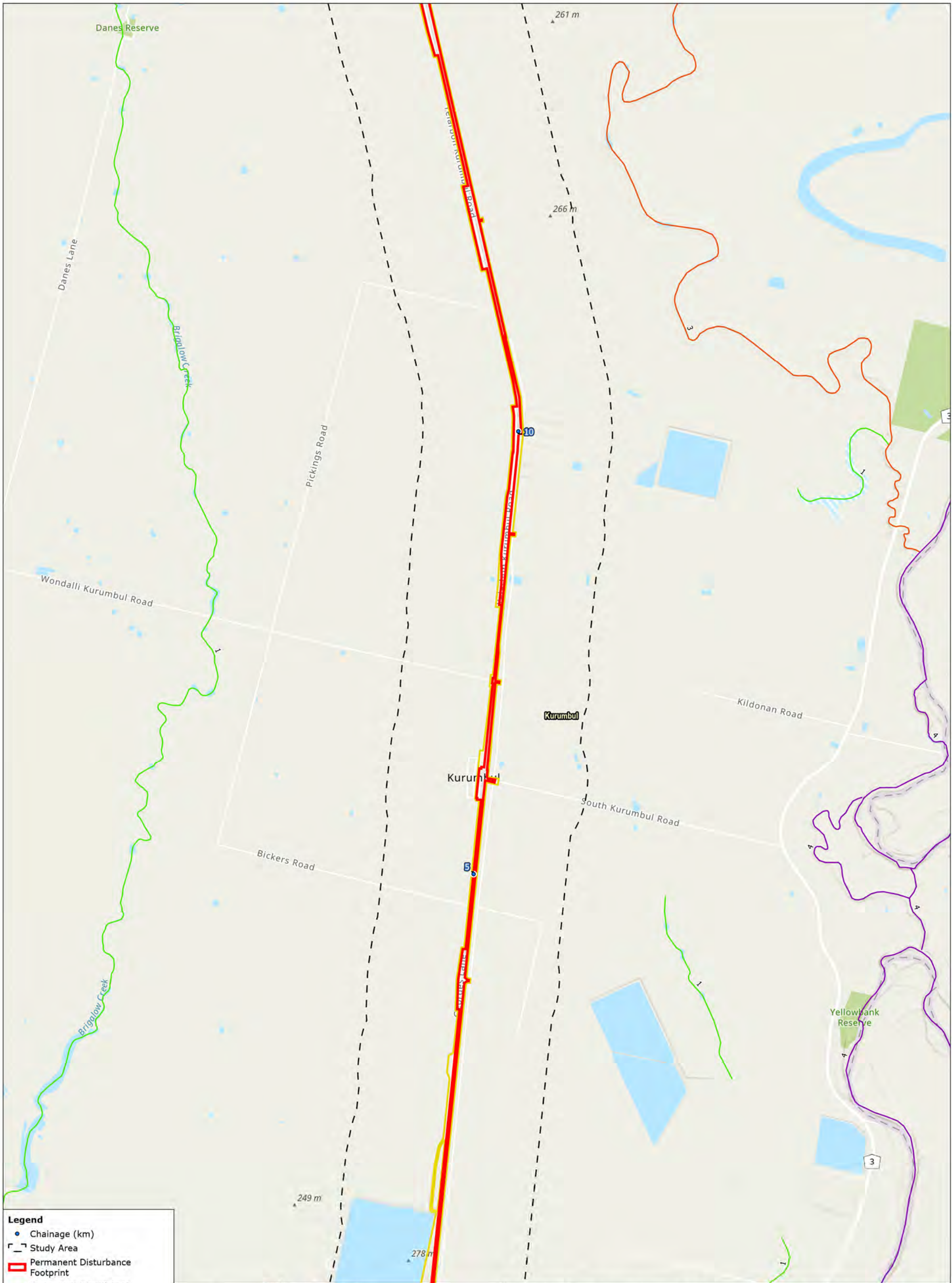
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F4.4 (15) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





- Legend**
- Chainage (km)
 - Study Area
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
- Risk For Fish Passage**
- 1
 - 2
 - 3
 - 4



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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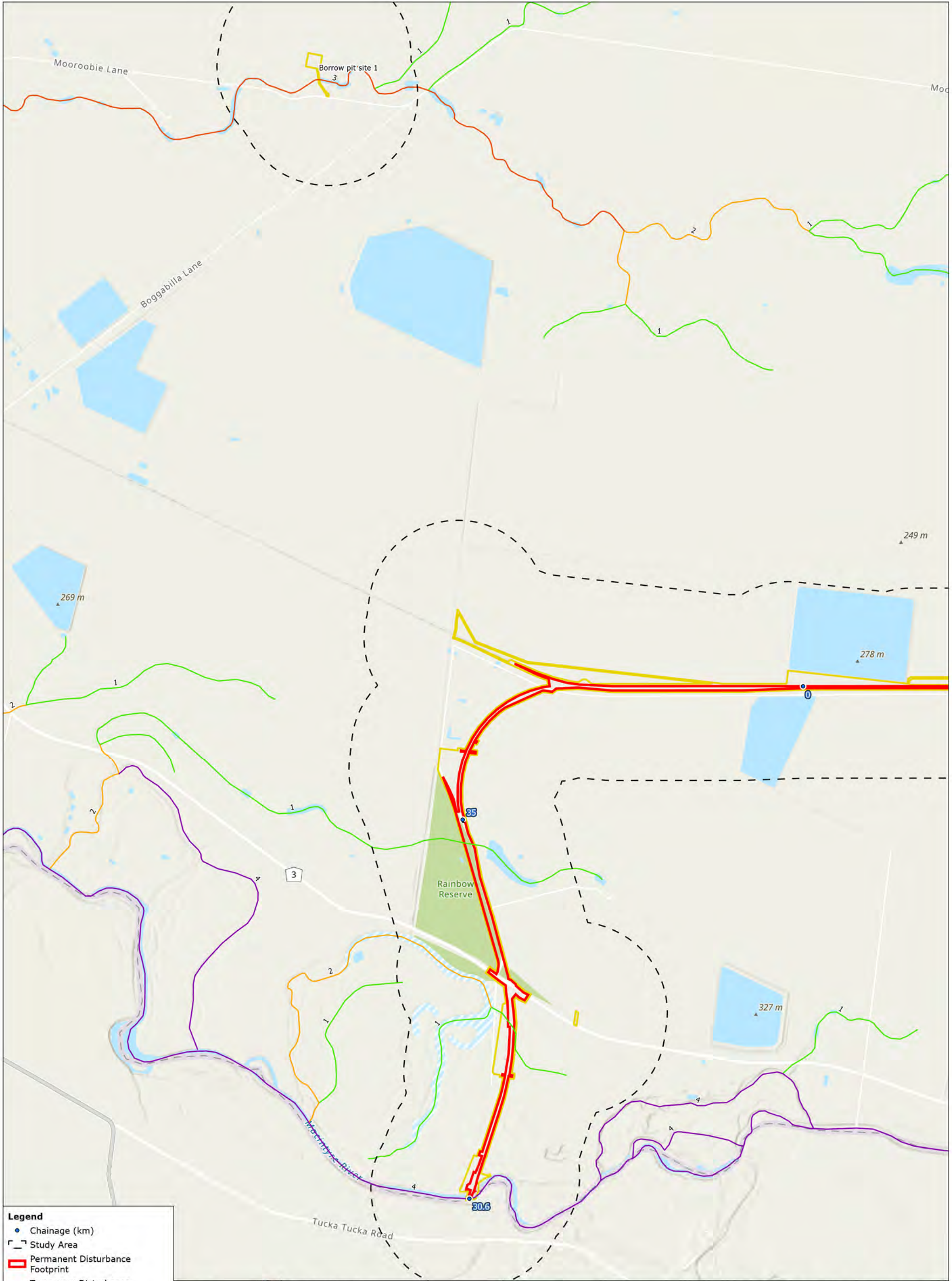
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F4.4 (16) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Chainage (km)
- Study Area
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Risk For Fish Passage**
- 1
- 2
- 3
- 4



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 0.5 1 1.5km

1:39,000

F4.4 (17) - Department of Agriculture and Fisheries Waterway Barrier Works

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC



4.8.4 WETLANDS

Riverine wetlands and REs, which potentially contain riverine wetland values, are common throughout the Project footprint as are palustrine wetlands and their RE counterparts. Lacustrine wetlands are also mapped within proximity to the Project footprint, however, these water bodies are relatively small. For the majority, areas consisting of a mosaic of REs containing a small proportion of potential wetland values (1 to 50 per cent) frequently intersect the Project footprint.

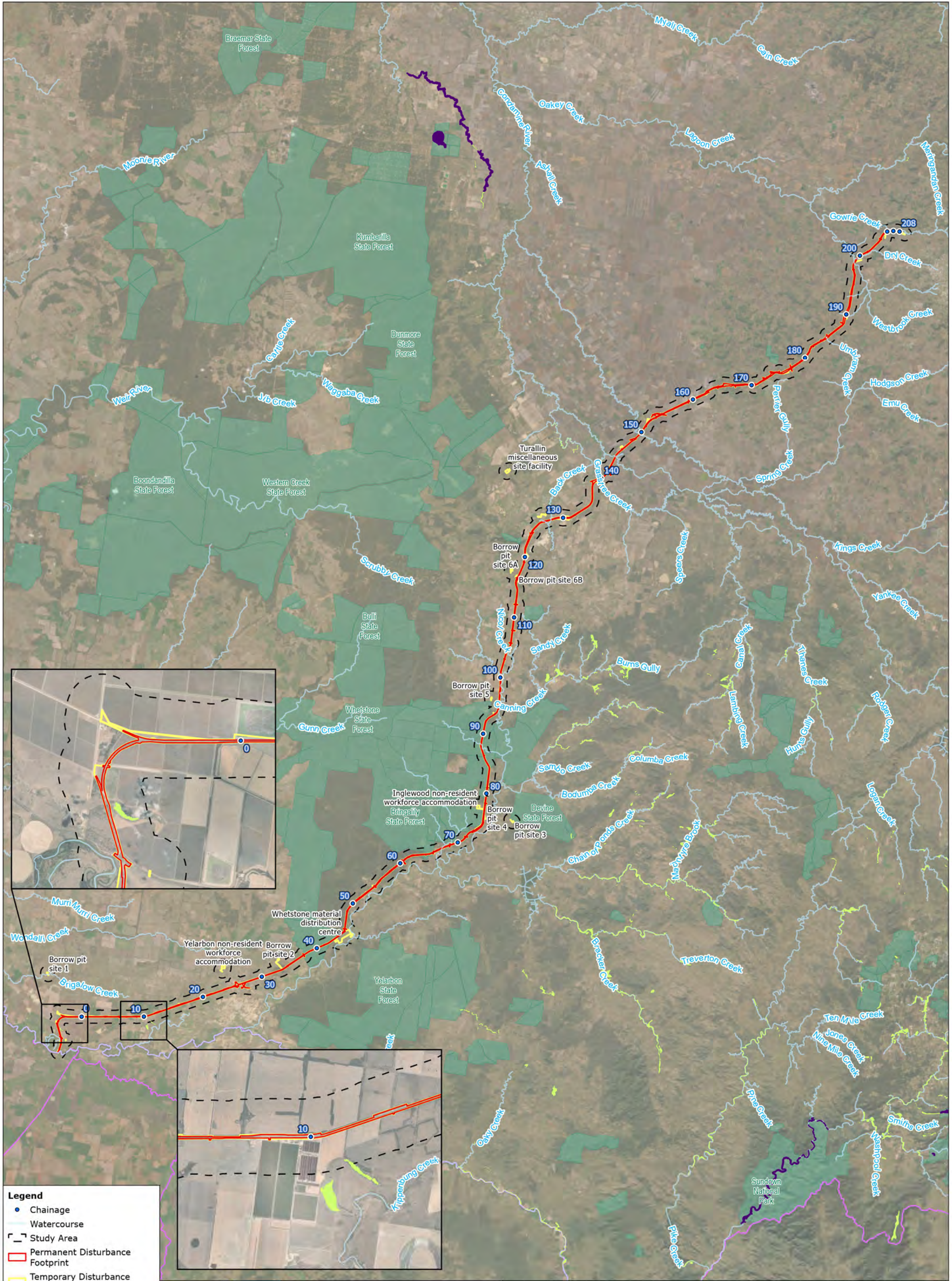
There are no Wetlands of International Importance (Ramsar wetlands) or national importance located in, or within 10 km of the Project footprint. Multiple palustrine wetlands and some REs (11.3.4 and 11.3.5) have been identified as of HES, which are considered MSES under the Environmental Protection Regulation 2019. However, none of these occur within mapped HEV waters. The closest HES wetland mapped within HEV waters is approximately 25 km east of the Gowrie end of Project footprint (Table 4-12 Figure 4-5 and Figure 4-5).

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

The area that the HEV and HES wetlands occur in the Study area and Project footprint is presented in Table 4-12.

TABLE 4-12 HIGH ECOLOGICAL SIGNIFICANCE WETLANDS PRESENT WITHIN THE STUDY AREA AND PROJECT FOOTPRINT

Habitat values	Extent contained within the Study area (ha)	Extent contained within the Project footprint (ha)
HEV Wetlands	0.00	0.00
HES Wetlands	10.32	0.00



Legend

- Chainage
- Watercourse
- Study Area
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- LGA
- State Forests
- High Ecological Value Wetlands
- High Ecological Significance Wetlands

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CS/VN

Drawing Size: A3

0 5 10 15km

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F4.5 - High Ecological Significance Wetlands and High Ecological Value Wetlands

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Numerous anthropogenic wetlands or artificially constructed waterbodies⁷ are present within the Project footprint. These are predominantly rural farm dams and typically occur along unnamed watercourses, waterways and other drainage features. These areas may have the potential to provide important resources for local fauna species.

The Project footprint passes through a diversity of aquatic systems which have been assessed and mapped according to available Queensland Government AquaBAMM spatial data and reporting. The resulting modelled score (Table 4-13) shows the Project footprint scored an average of a “medium” rating.

TABLE 4-13 SPECIFIC RIVERINE AQUABAMM AQUAScore FOR ALL WATER QUALITY MONITORING SITES

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

Table note:

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

4.8.5 WATERCOURSES AND DRAINAGE FEATURES

Several defined watercourses under the Water Act and unmapped waterways and waterbodies occur within the Study area. The 18 defined watercourses crossed by the Project footprint are identified in Table 4-14. Where the watercourse is intersected by, or parallel to the Project alignment, the approximate chainage is given.

TABLE 4-14 DEFINED WATERCOURSES CROSSED BY THE PROJECT

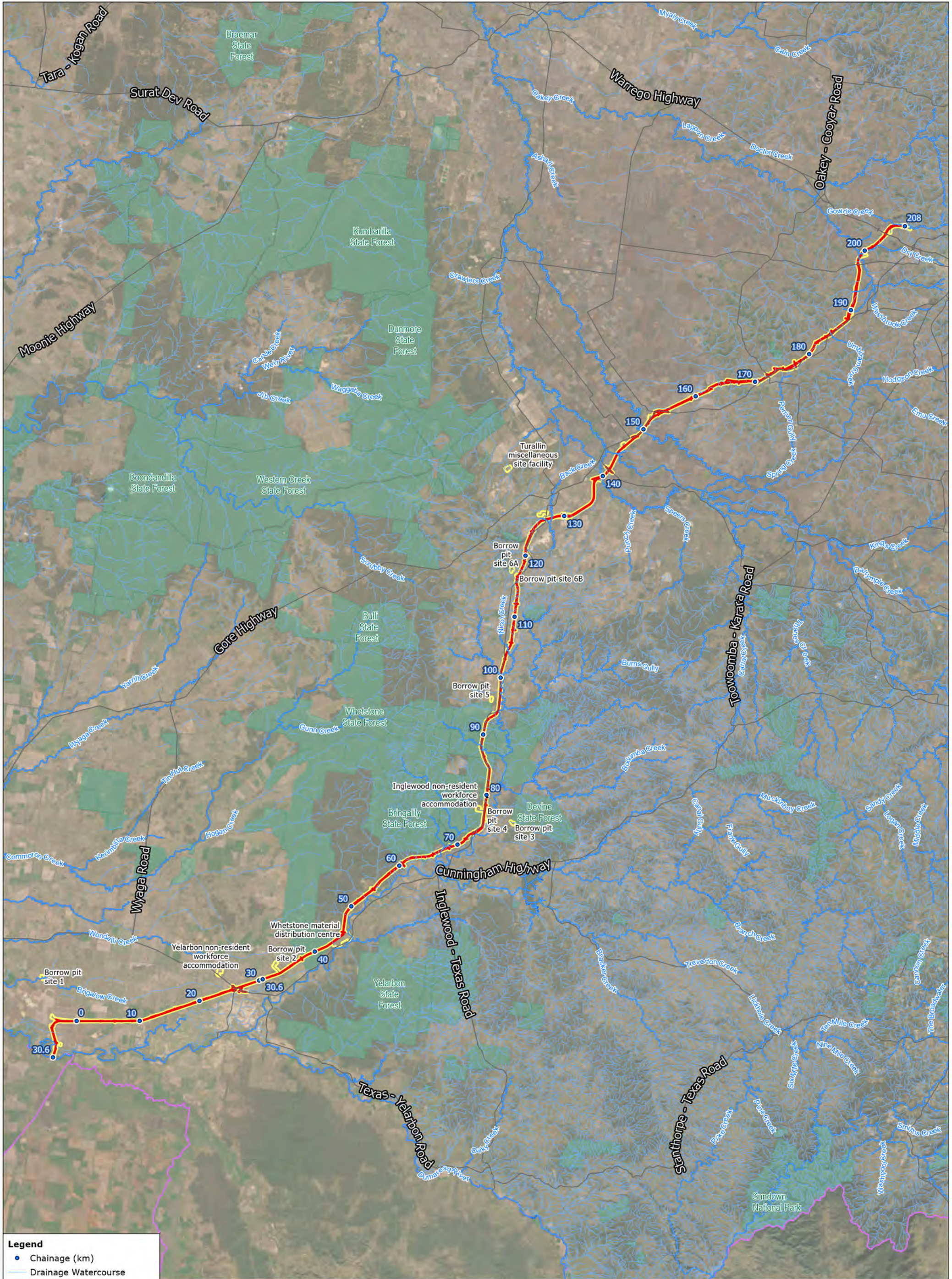
Watercourse	Location (Chainage)
Macintyre River	Ch 30.6 km (NS2B)
Macintyre Brook	Ch 52.4 km and Ch 55.4 km
Pariagara Creek	Ch 67.3 km
Cattle Creek	Ch 88.2 km
Canning Creek	Ch 94.5 km

Watercourse	Location (Chainage)
Bringalily Creek	Ch 100.6 km
Nicol Creek	Ch 104.4 km
Back Creek unnamed tributary	Ch 126.9 km
Back Creek	Ch 128.0 km
Grasstree Creek	Ch 139.9 km
Condamine River (Main Branch)	Ch 144.2 km
Condamine River (North Branch)	Ch 149.9 km
Umbiram Creek unnamed tributary	Ch 184.9 km
Half Mile Gully	Ch 190.0 km
One Mile Gully	Ch 193.1 km
Westbrook Creek	Ch 198.5 km
Dry Creek	Ch 199.3 km
Gowrie Creek	Ch 206.9 km

The stream orders for waterways contained within the Study area are shown in Figure 4-6. Note that the majority of the first-order waterways flow only during periods of high seasonal rainfall and are not expected to provide high-value fish habitat except during periods of high rainfall or unless semi-permanent or permanent pool habitat is present.

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

Defined watercourses within the Study area have been identified in reference to Department of Regional Development, Manufacturing and Water's Water identification map—watercourses—Queensland, last published 2 April 2022. Further classification of waterways within the Study area is discussed in revised draft EIS Chapter 13: Surface Water.



- Legend**
- Chainage (km)
 - Drainage Watercourse
 - Defined Watercourse
 - LGA
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - State Forests



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
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Drawing Size: A3
0 5 10 15km
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F4.6 - Water Act 2000 Watercourses

**Appendix L: Terrestrial and Aquatic Ecology
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4.9 INVASIVE SPECIES BIOSECURITY AREAS

The Project footprint intersects the wild dog check fence at three locations and will be realigned in two locations, as specified in Table 1-1. The GRC is responsible for the maintenance of approximately 283 km of the wild dog check fence.

In addition, the Project intersects the 555 km long DDMRB rabbit-proof fence through the locality of Clontarf, at approximate Ch 120.2 km. Management and maintenance of the fence is undertaken by the DDMRB. The fence stretches from Lamington National Park in the east, to Goombi in the southwest, where it connects to the wild dog barrier fence.

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

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

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

4.10 MATTERS OF LOCAL ENVIRONMENTAL SIGNIFICANCE

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

4.10.1 GOONDIWINDI REGIONAL COUNCIL

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

(1) The purpose of the Biodiversity areas Overlay Code is to ensure that matters of environmental significance are identified and protected. B(2) The purpose of the code will be achieved through the following overall outcomes: BA: development protects MSES to maintain ecological integrity;

B: development manages impacts on MSES to avoid adverse impacts on environmental values; and

C: development enhances the health and resilience of ecological systems and supports ecological connectivity.

MSES are assessed under relevant State legislation.

4.10.2 TOOWOOMBA REGIONAL COUNCIL

Areas of the Project footprint are mapped within the TRC Planning Scheme Environmental Significance Overlay Code, including biodiversity corridors and areas of ecological significance. The purpose and overall outcomes of this code states:

(1) The purpose of the Environmental Significance Overlay Code is to avoid or minimise the impacts of development on:

(a) The biodiversity values of ecosystems, ecological processes, areas of ecological significance and biodiversity corridors; and

(b) The ecological, hydrological and water quality values of natural waterways and wetlands.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) Impacts on biodiversity values of ecosystems, areas of ecological significance and biodiversity corridors are avoided, or where they cannot be avoided impacts are minimised and impacts on biodiversity values are offset consistent with the Queensland Government Environmental Offsets Policy and other applicable biodiversity/environmental offsets policies;

(b) Ecological processes and the ecosystem services provided by areas of ecological significance are maintained;

(c) Habitat areas are connected by viable biodiversity corridors;

(d) Degraded ecosystems, habitats and corridors are restored;

(e) Ecological values and processes of waterways and wetlands are protected;

(f) The hydrological regime of wetlands and waterways is protected and rehabilitated to its natural state; and

(g) Water quality is maintained or improved.

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

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

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

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

MSES are assessed under relevant State legislation.

4.11 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

MSES are defined in Schedule 2 of the *Environmental Offsets Regulation 2014*. MSES occurring within the Project footprint have been identified via field investigations and relevant State MSES mapping and are described in the following sections.

The following MSES have been identified within the Project footprint:

- Regulated vegetation:
 - Category B (remnant) vegetation that is an 'endangered' or 'of concern' RE,
 - Category B (remnant) vegetation that intersects wetlands identified on the vegetation management wetlands map,
 - Category B (remnant) prescribed REs intersecting a watercourse, and
 - Essential habitat,
- Connectivity areas;
- Protected wildlife habitat, including MSES wildlife habitat; and
- Waterways providing for fish passage.

There are Protected Areas (as defined in Schedule 2 of the Environmental Offsets Regulation 2014) in the surrounding landscape around the Project footprint (refer to Section 1.3.2). However, they will not be impacted by the Project, see Figure 4-10.

4.11.1 REGULATED VEGETATION

4.11.1.1 PRESCRIBED REGIONAL ECOSYSTEMS THAT ARE ENDANGERED (VM ACT)

A total of 49.39 ha of prescribed REs that are Endangered (VM Act) to the extent that they occur within Category B of the Vegetation Management Map exist within the Project footprint (refer to Table 4-15 and Figure 4-1).

TABLE 4-15 PRESCRIBED REGIONAL ECOSYSTEMS (ENDANGERED) WITHIN THE PROJECT FOOTPRINT

VM Act status	Regional ecosystem	Description	Area (ha)
E	11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	48.65
E	11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	0.74
Total			49.39

Table notes:

E - Endangered.

4.11.1.2 PRESCRIBED REGIONAL ECOSYSTEMS THAT ARE OF CONCERN (VM ACT)

Seven prescribed REs that are Of Concern (VM Act) to the extent that they occur within Category B of the Vegetation Management Map exist within the Project footprint, totalling 85.06 ha (refer to Table 4-16 and Figure 4-1).

TABLE 4-16 PRESCRIBED REGIONAL ECOSYSTEMS (OF CONCERN) WITHIN THE PROJECT FOOTPRINT

VM Act status	Regional ecosystem	Description	Area (ha)
OC	11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	25.90
OC	11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	7.57
OC	11.3.21	<i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains	0.0003
OC	11.5.14	<i>Triodia</i> spp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	49.07
OC	11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks	0.0038
OC	11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	2.39

VM Act status	Regional ecosystem	Description	Area (ha)
OC	11.9.13	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> open forest on fine grained sedimentary rocks	0.13
Total			85.06

Table notes:

OC – Of Concern.

4.11.1.3 PRESCRIBED REGIONAL ECOSYSTEMS THAT ARE WITHIN A MAPPED WETLAND

Category B (remnant) prescribed REs that intersect with or are within an area shown as wetland on the Vegetation Management Wetlands Map and occur within the Project footprint are shown in Table 4-17 and Figure 4-7. A total of 11.71 ha of Category B (remnant) prescribed REs from six REs are within 50 m of a mapped wetland (refer to Table 4-18).

TABLE 4-17 CATEGORY B (REMANT) PRESCRIBED REGIONAL ECOSYSTEMS THAT INTERSECT A WETLAND

VM Act status	RE	Description	Area (ha)
OC	11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	0.31
OC	11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	1.04
LC	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	0.66
LC	11.3.27	Freshwater wetlands	0.13
LC	11.3.27b	Freshwater wetlands with open water +/- aquatic and emergent vegetation	0.07
OC	11.5.14	<i>Triodia</i> spp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	3.31
Total			5.52

Table notes:

OC – Of Concern, LC – Least Concern.

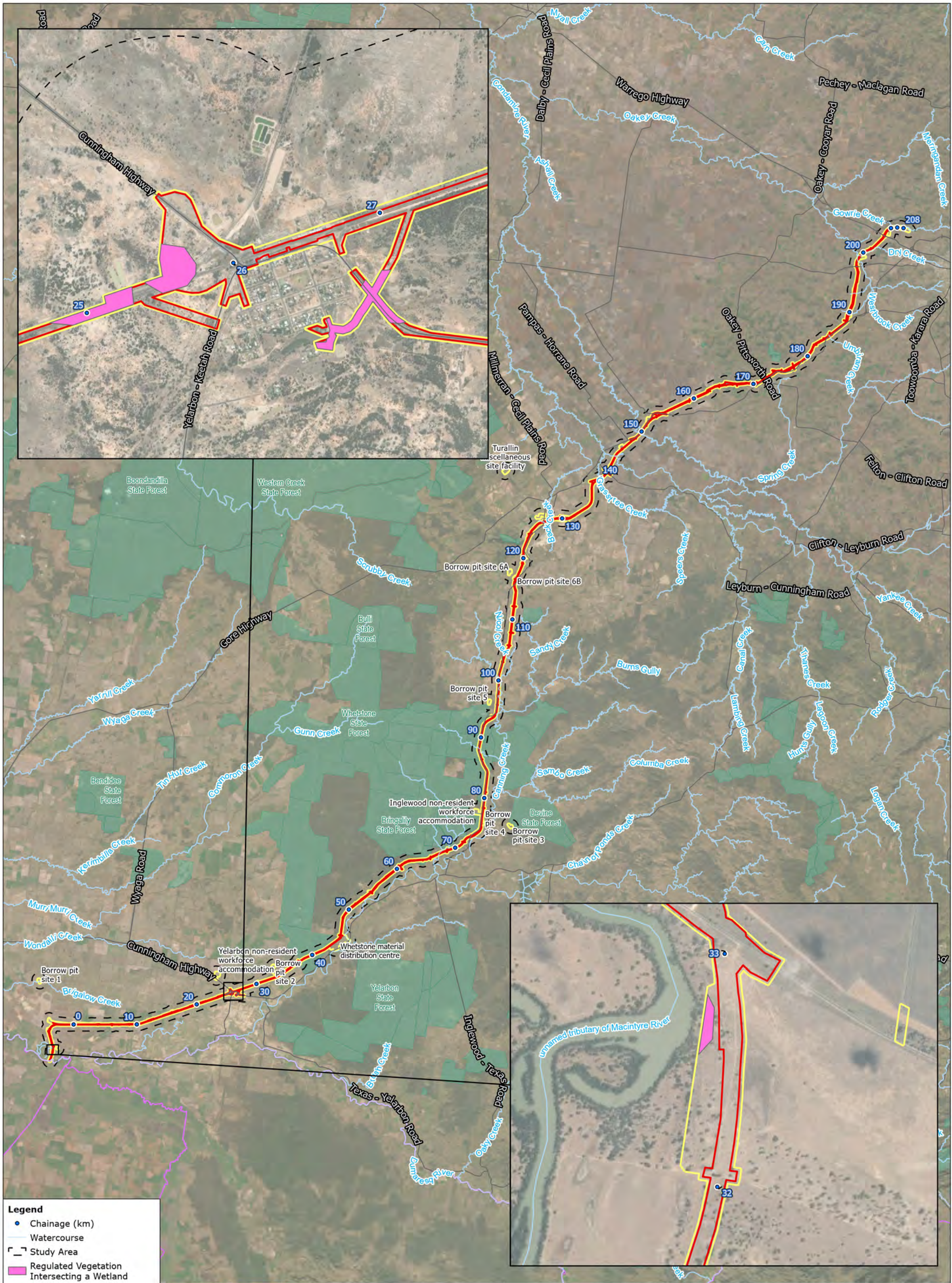
TABLE 4-18 CATEGORY B (REMANT) PRESCRIBED REGIONAL ECOSYSTEMS WITHIN 50 M OF A DEFINING BANK OF A MAPPED WETLAND

VM Act status	Regional Ecosystem	Description	Area (ha)
OC	11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	0.31
OC	11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	1.04
LC	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	0.66

VM Act status	Regional Ecosystem	Description	Area (ha)
LC	11.3.27	Freshwater wetlands	0.13
LC	11.3.27b	Freshwater wetlands with open water +/- aquatic and emergent vegetation	0.07
OC	11.5.14	<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains	9.50
Total			11.71

Table notes:

OC – Of Concern, LC – Least Concern.



Legend

- Chainage (km)
- Watercourse
- Study Area
- Regulated Vegetation Intersecting a Wetland
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 5 10 15km

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F4.7 - Regulated Vegetation Intersecting a Wetland

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4.11.1.4 PRESCRIBED REGIONAL ECOSYSTEMS WITHIN A DEFINED DISTANCE OF A WATERCOURSE

A total of 11.31 ha of Category B (remnant) prescribed REs to the extent the ecosystem is located within a defined distance from the defining banks of a relevant watercourse or drainage feature occur within the Project footprint (refer to Table 4-19). The defined distance for 1st and 2nd order, and 3rd and 4th order streams in the Project footprint is 10 m and 25 m respectively from a defined bank.

TABLE 4-19 CATEGORY B (REMNANT) PRESCRIBED REGIONAL ECOSYSTEMS WITHIN A DEFINED DISTANCE OF A WATERCOURSE

VM Act status	Regional Ecosystem	Description	Area (ha)
OC	11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	2.10
OC	11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	0.57
OC	11.3.14	<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains	1.49
LC	11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	0.15
OC	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	1.88
LC	11.3.27	Freshwater wetlands	0.02
LC	11.3.27b	Freshwater wetlands with open water +/- aquatic and emergent vegetation	0.02
LC	11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	1.37
LC	11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	1.82
OC	11.5.14	<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains	0.54
LC	11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	0.34
LC	11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	0.28
LC	11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust	0.22
LC	11.8.4	<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks	0.27
LC	11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	0.18
E	11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	0.03

VM Act status	Regional Ecosystem	Description	Area (ha)
LC	11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks	0.01
LC	11.9.9a	11.9.9a: <i>Eucalyptus albens</i> +/- <i>E. crebra</i> +/- <i>E. tereticornis</i> +/- <i>Callitris baileyi</i> woodland	0.01
OC	11.9.13	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> open forest on fine grained sedimentary rocks	0.01
Total			11.31

Table notes:

E – Endangered, OC – Of Concern, LC – Least Concern.

4.11.1.5 ESSENTIAL HABITAT

A total of 113.19 ha of mapped essential habitat for an animal or plant that is critically endangered wildlife, endangered wildlife or vulnerable wildlife (VM Act, 1999) occurs within the Project footprint (Figure 4-8). A breakdown of areas of essential habitat attributed to relevant species is provided in Table 4-20. Essential habitat for the pale imperial hairstreak (*Jalmenus eubulus*) is also mapped within the Project footprint, however, this species is unlikely to occur due to inconsistencies between the GTRE and State-based mapping (see Appendix B Likelihood of Occurrence for detailed justification).

TABLE 4-20 MAPPED ESSENTIAL HABITAT BY SPECIES

Species name	Common name	Essential habitat (ha)
Flora		
<i>Cyperus clarus</i>	-	0.20
<i>Dichanthium queenslandicum</i>	King bluegrass	33.09
<i>Homopholis belsonii</i>	Belson's panic	0.21
<i>Picris evae</i>	Hawkweed	15.89
<i>Westringia parvifolia</i>	Small-flowered westringia	1.69
<i>Xerothamnella herbacea</i>	-	8.45
Fauna		
<i>Acanthophis antarcticus</i>	Common death adder	2.85
<i>Anomalopus mackayi</i>	Five clawed worm-skink	33.09
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	5.87
<i>Furina dunmali</i>	Dunmall's snake	49.04
<i>Jalmenus eubulus</i>	Pale imperial hairstreak	26.59
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	49.04

Species name	Common name	Essential habitat (ha)
<i>Phascolarctos cinereus</i>	Koala	74.02



Legend

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



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
Created By: CB/VN
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F4.8 (1) - Matters of State Environmental Significance - Essential Habitat

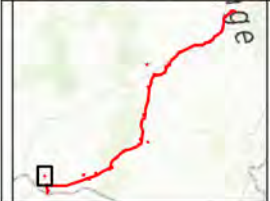
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Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.8 (2) - Matters of State Environmental Significance - Essential Habitat

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Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.8 (3) - Matters of State Environmental Significance - Essential Habitat

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Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.8 (4) - Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 400 800 1,200m

1:37,000

F4.8 (5) - Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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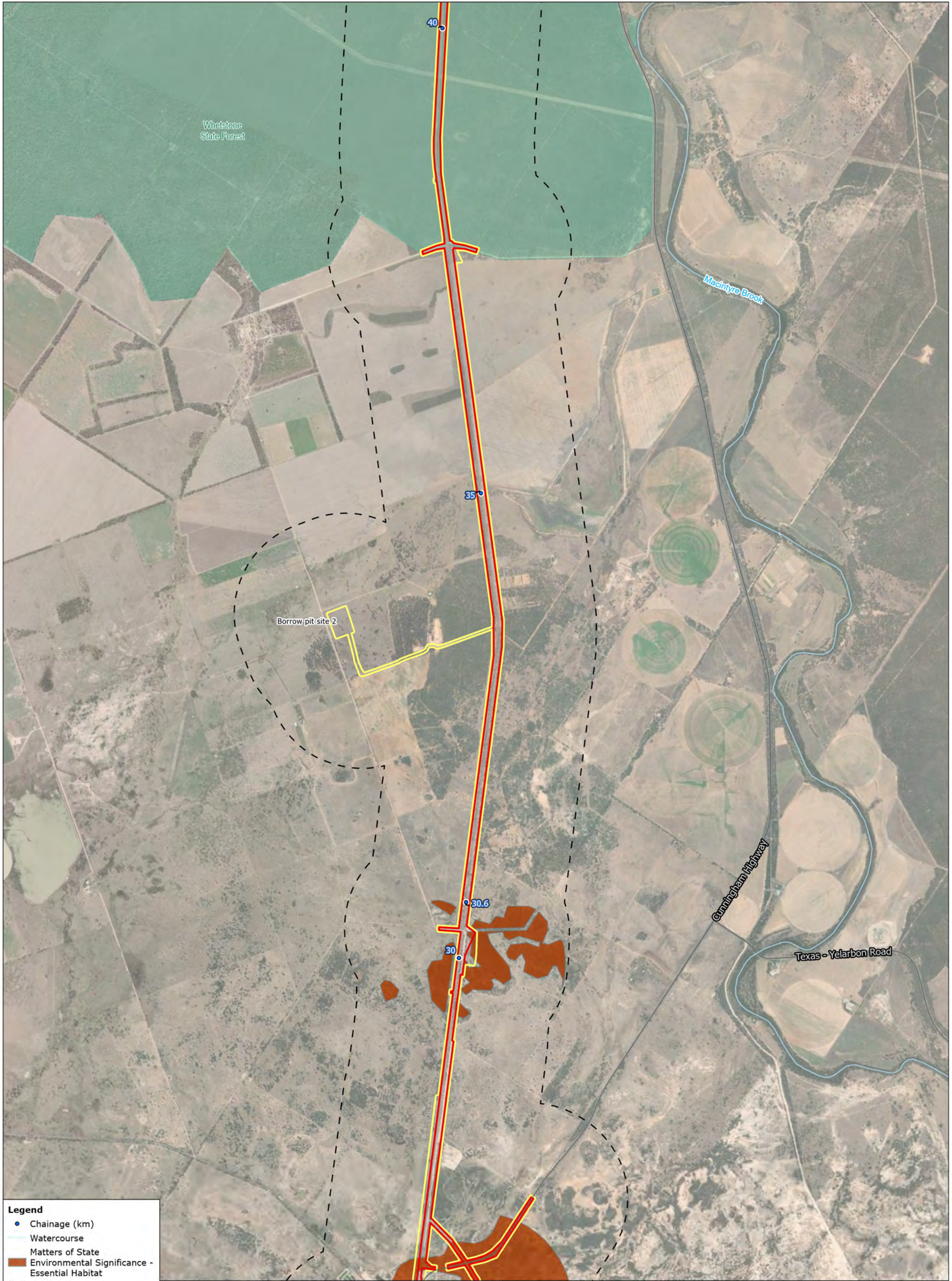
F4.8 (6) - Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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Drawing Size: A3

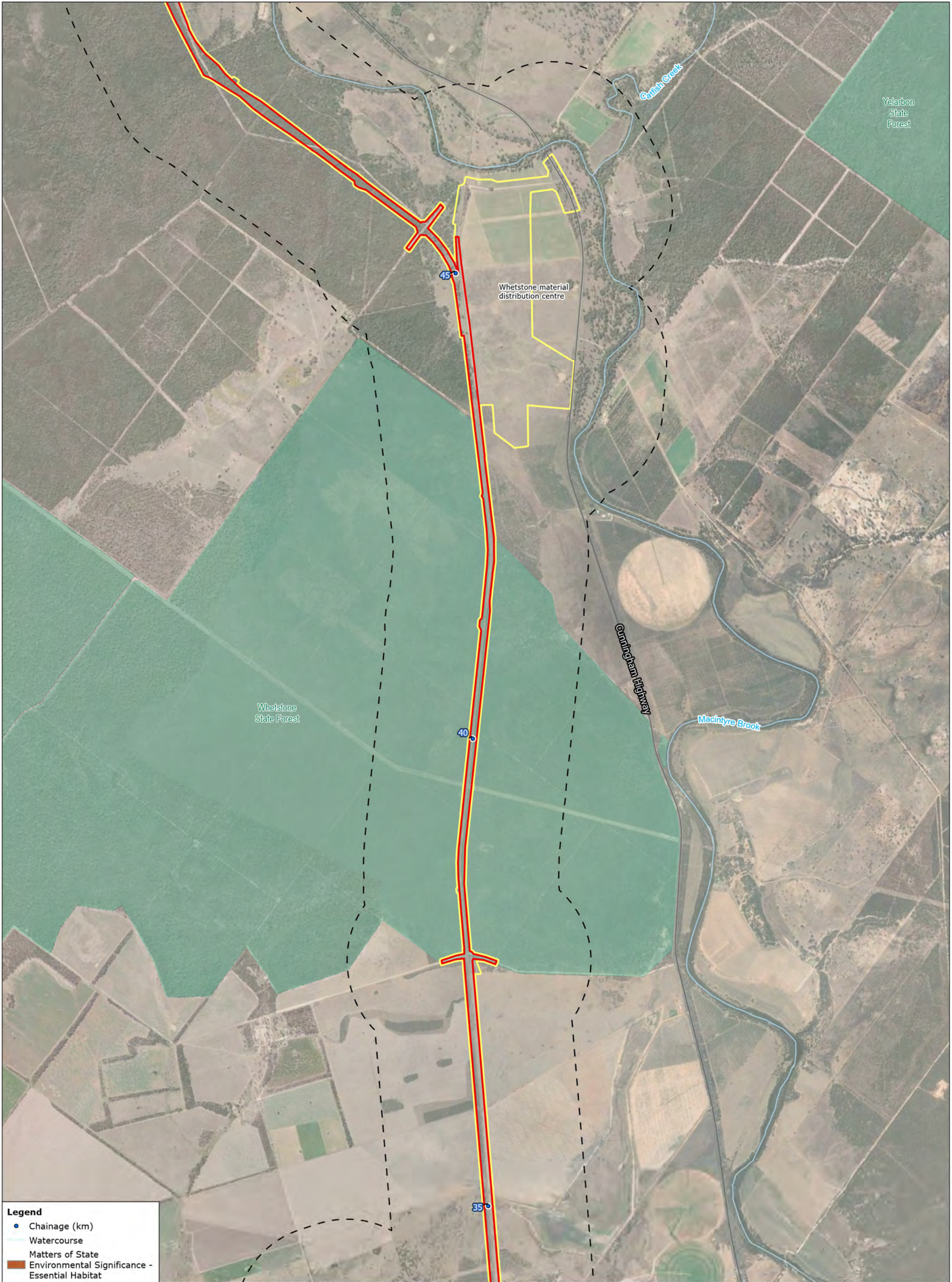
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F4.8 (7) - Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



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



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
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**F4.8 (8) - Matters of State Environmental Significance -
Essential Habitat**

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**
ARTC





Legend

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



Coordinate System:
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Date: 17/10/2024

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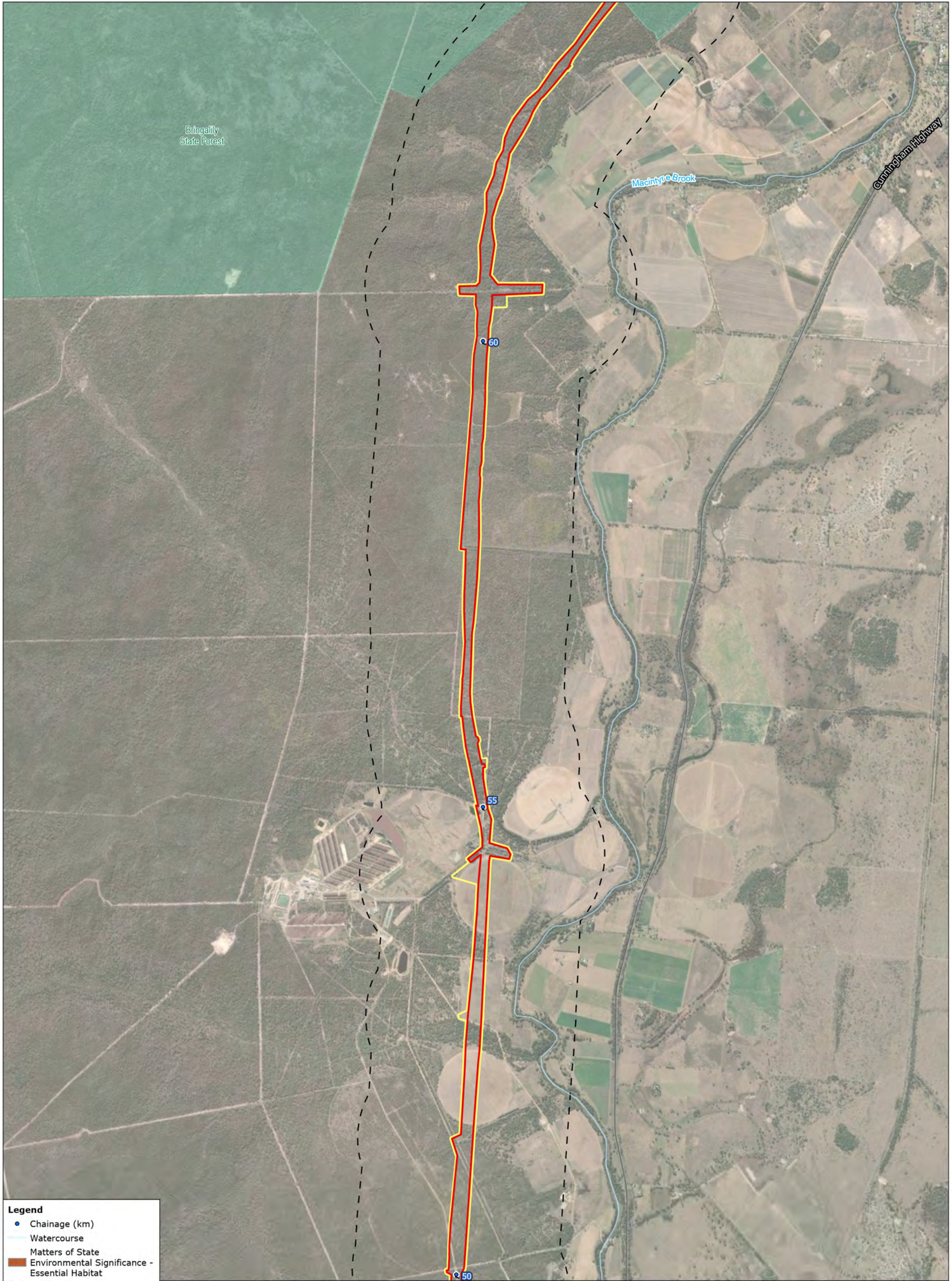
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**F4.8 (9) - Matters of State Environmental Significance -
Essential Habitat**

**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**

ARTC





Legend

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



Coordinate System:
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Date: 17/10/2024

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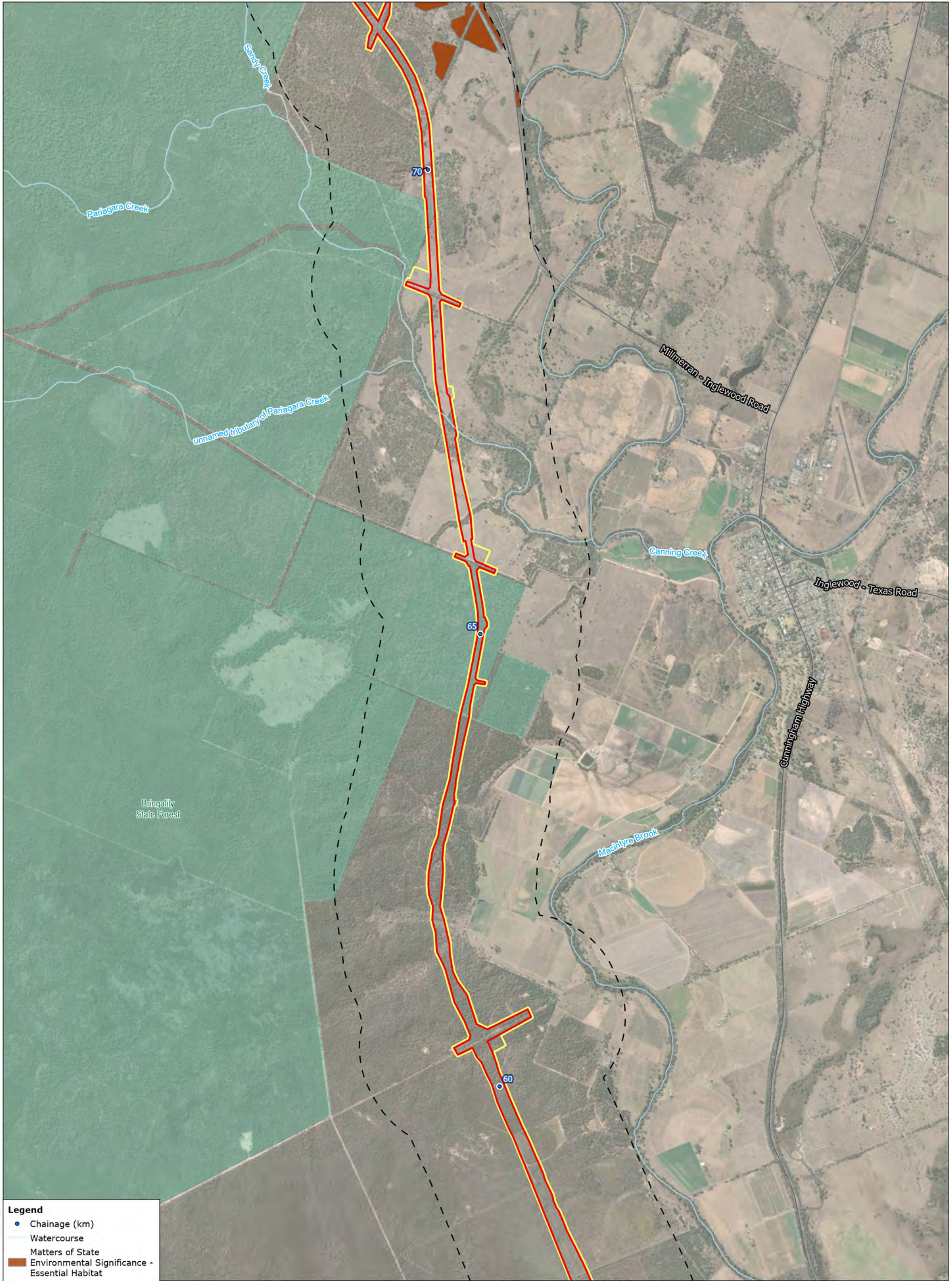
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F4.8 (10) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

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



Coordinate System:
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Date: 17/10/2024

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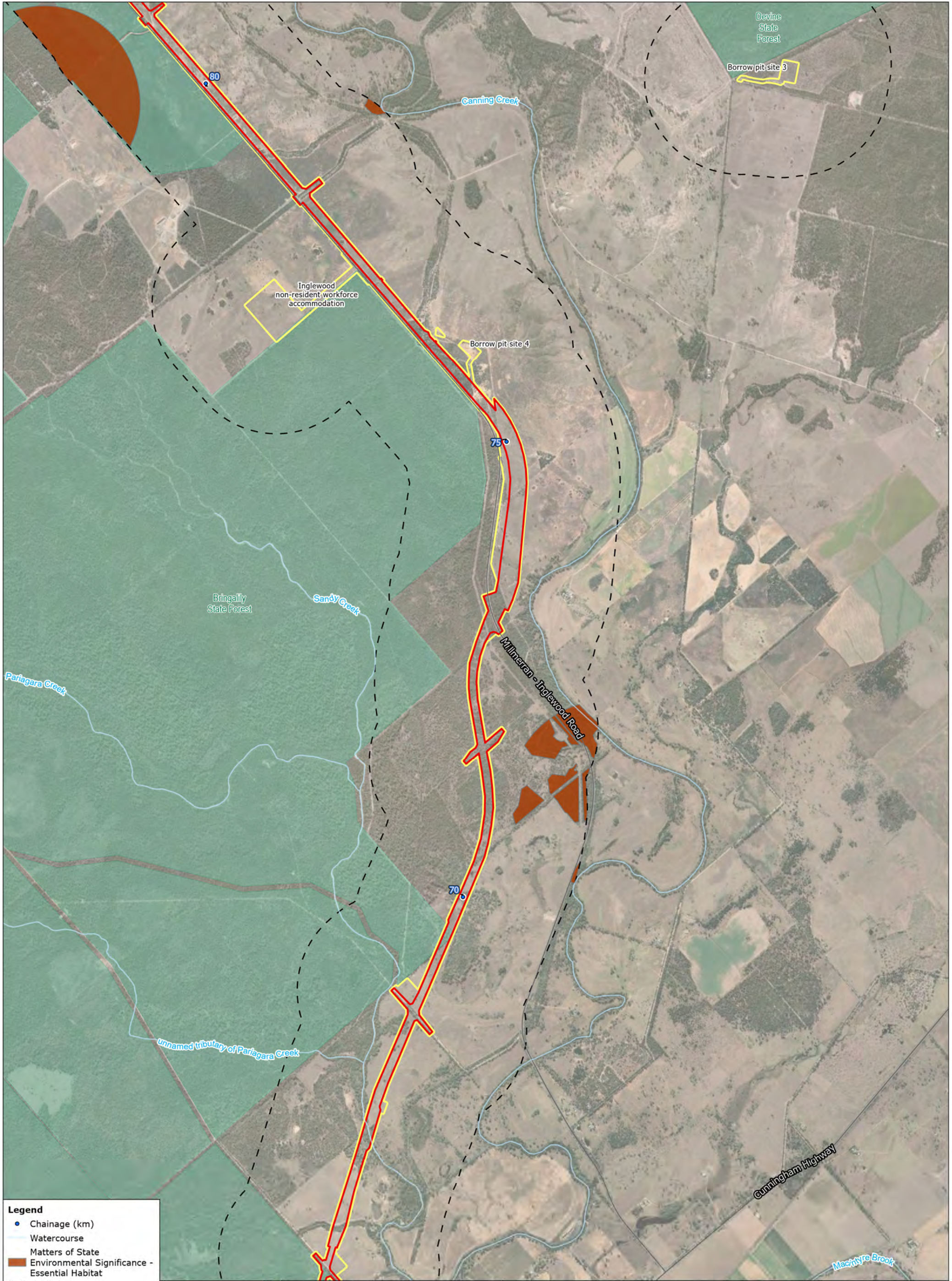
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F4.8 (11) Matters of State Environmental Significance - Essential Habitat

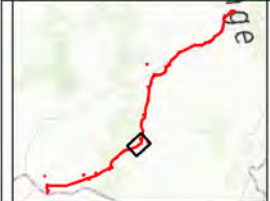
Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

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



Coordinate System:
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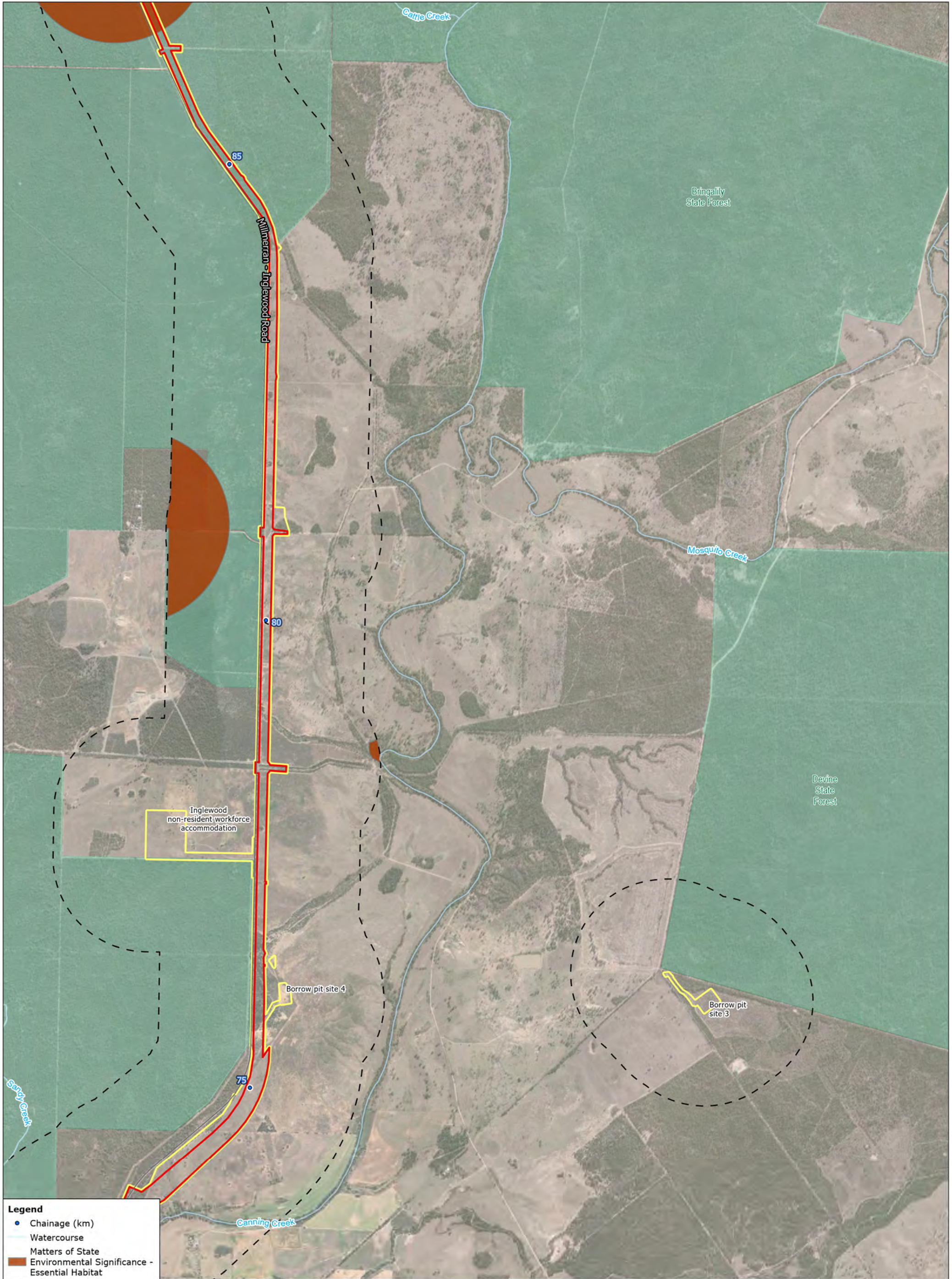
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F4.8 (12) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

 **ERM**



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



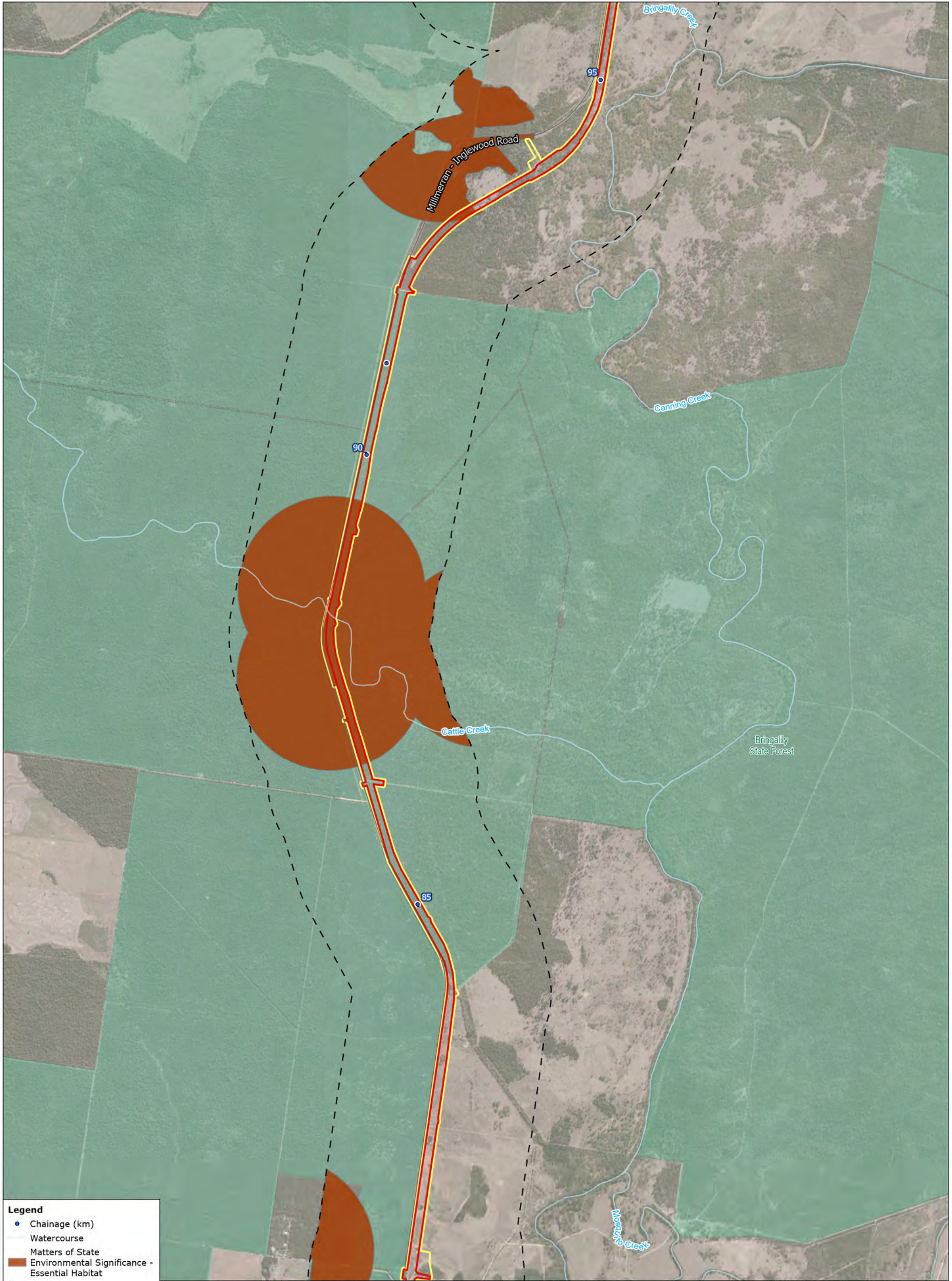
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F4.8 (13) Matters of State Environmental Significance - Essential Habitat

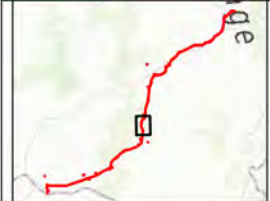
Appendix L: Terrestrial and Aquatic Ecology Technical Report
ARTC





Legend

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



Coordinate System:
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Date: 17/10/2024

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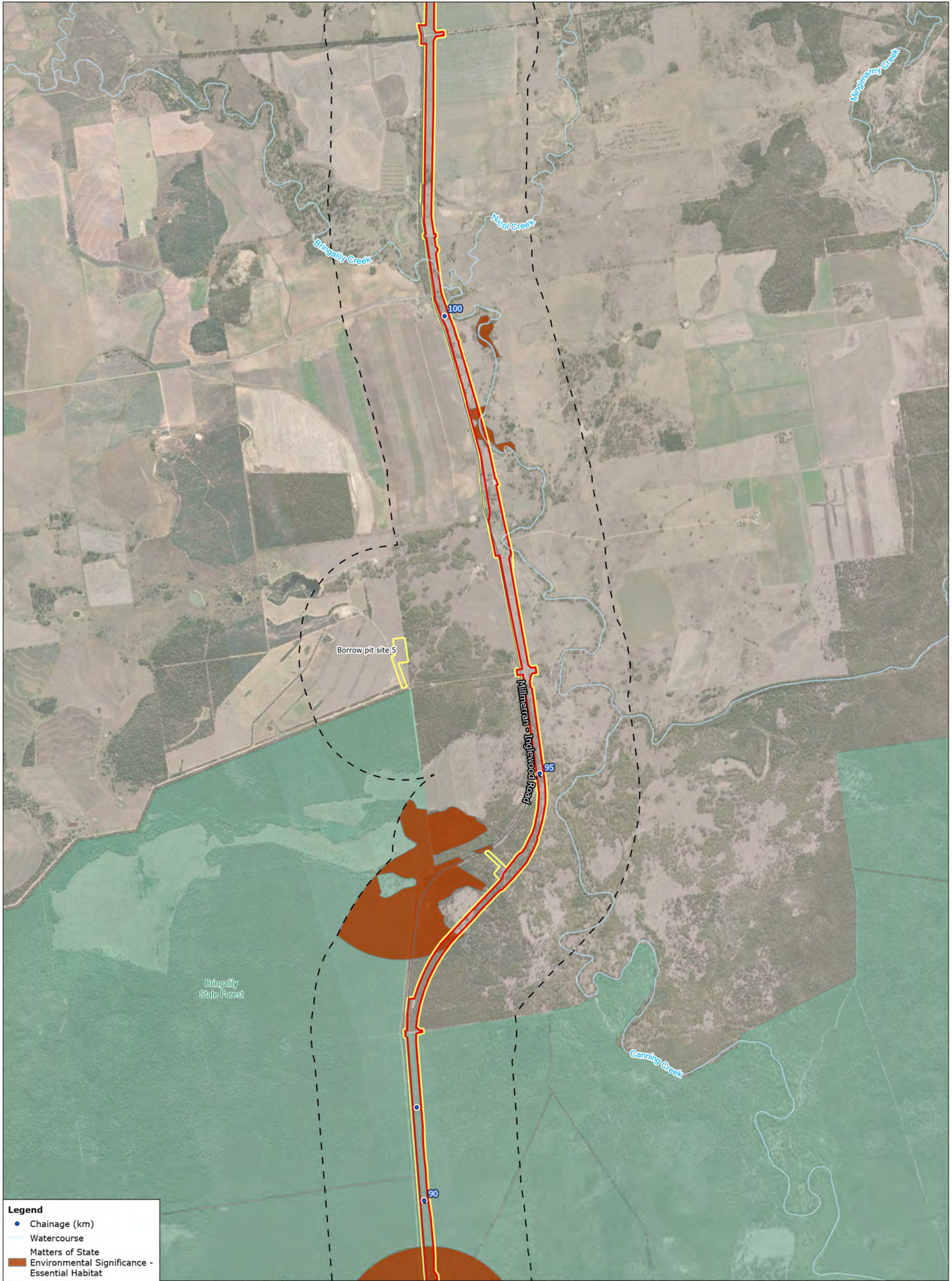
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F4.8 (14) Matters of State Environmental Significance - Essential Habitat

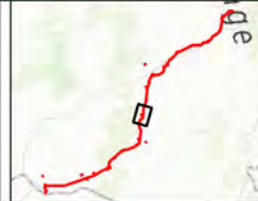
Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





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



Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
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Drawing Size: A3
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F4.8 (15) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.8 (16) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

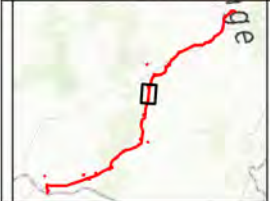
ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.8 (17) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

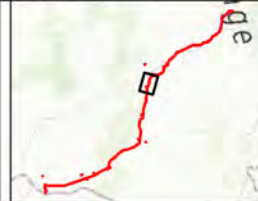
ARTC

 **ERM**



Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.8 (18) Matters of State Environmental Significance - Essential Habitat

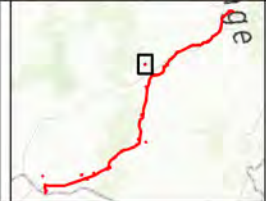
Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



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



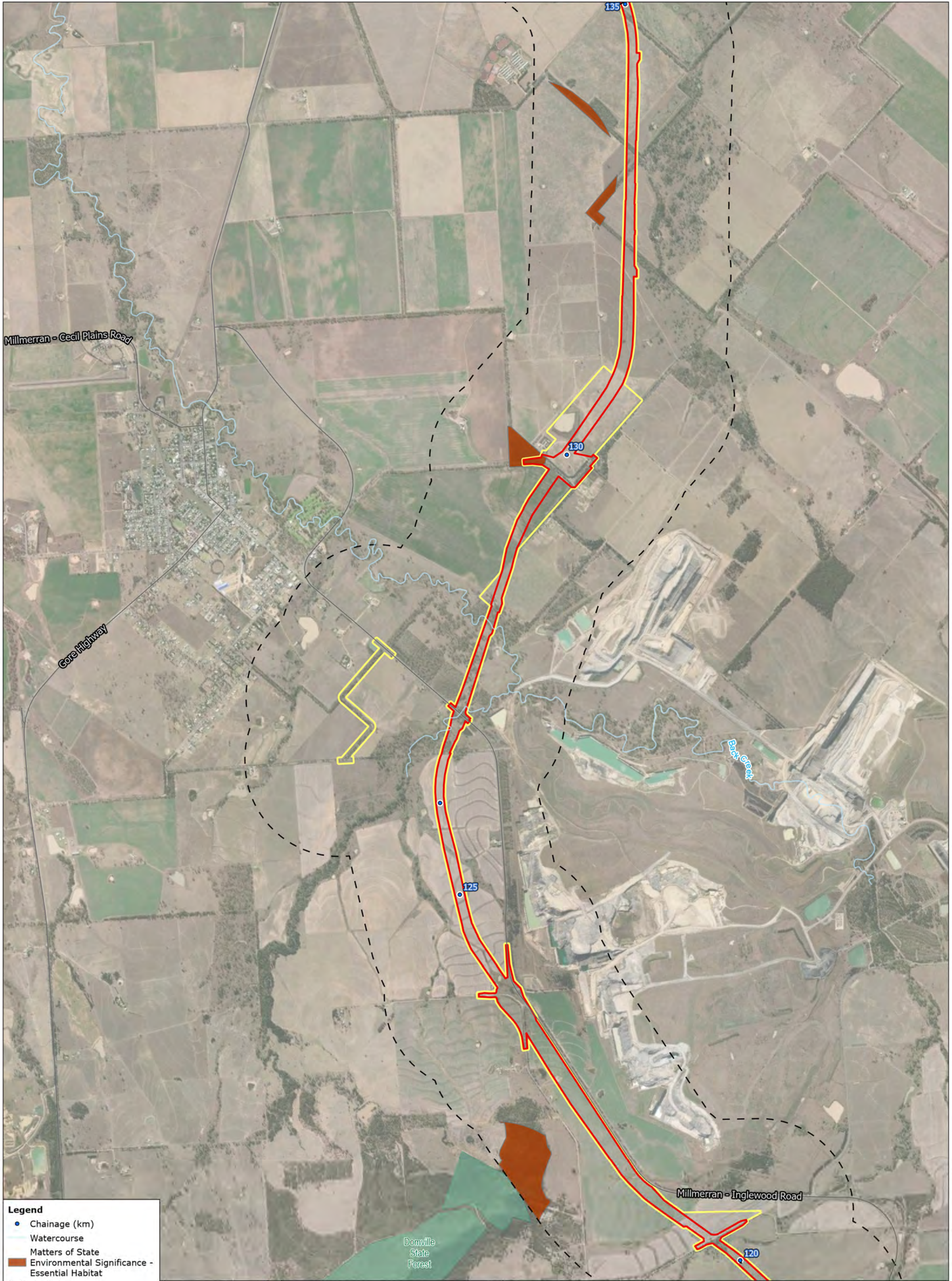
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Date: 17/10/2024
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F4.8 (19) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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Drawing Size: A3

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F4.8 (20) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

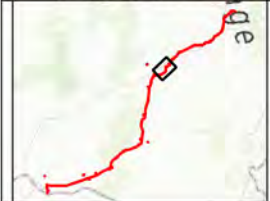
ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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F4.8 (21) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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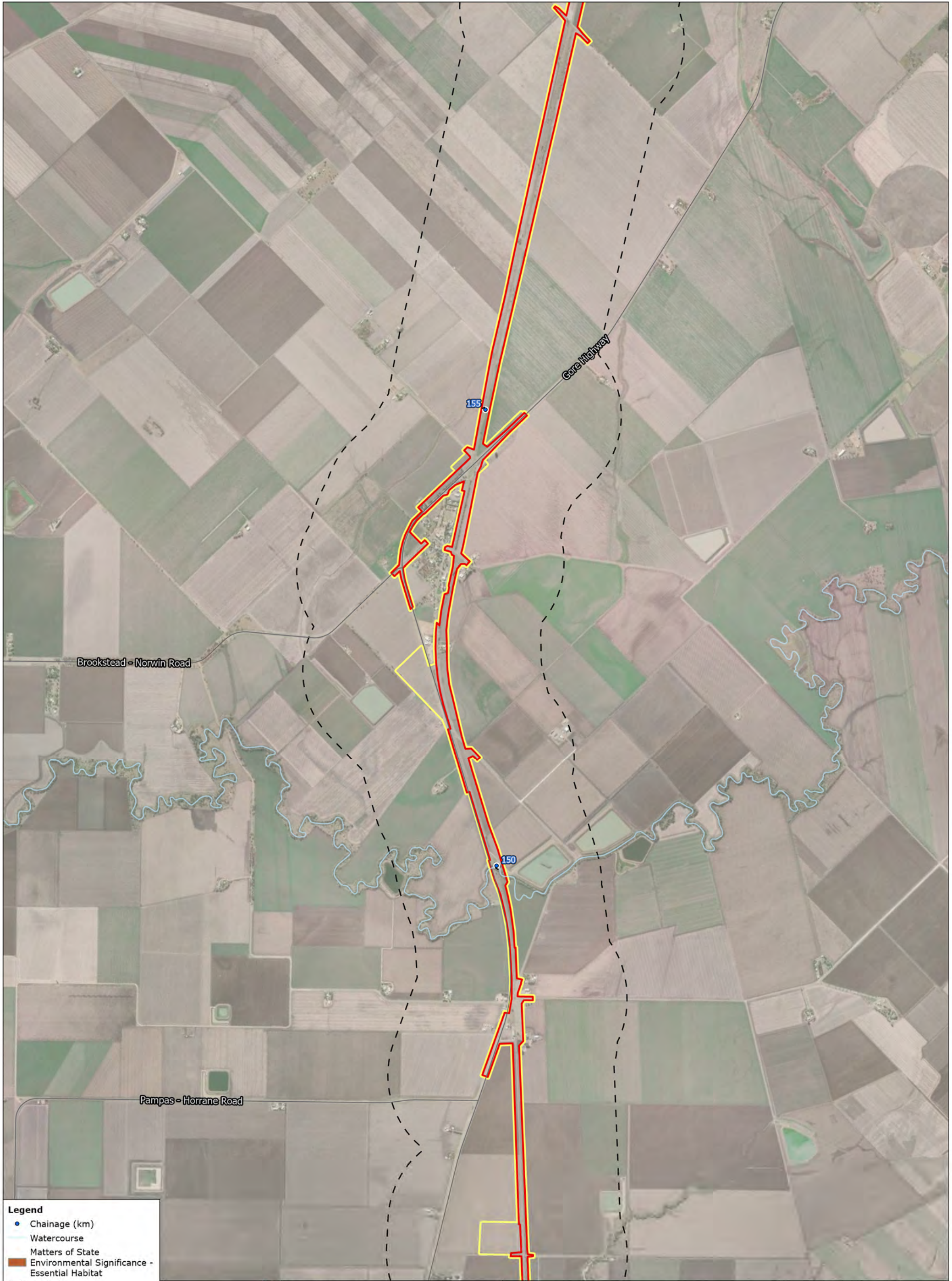
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F4.8 (22) Matters of State Environmental Significance - Essential Habitat

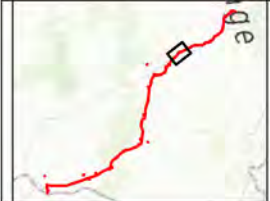
Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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F4.8 (23) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology

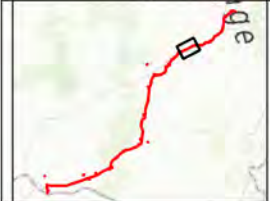
Technical Report

ARTC



Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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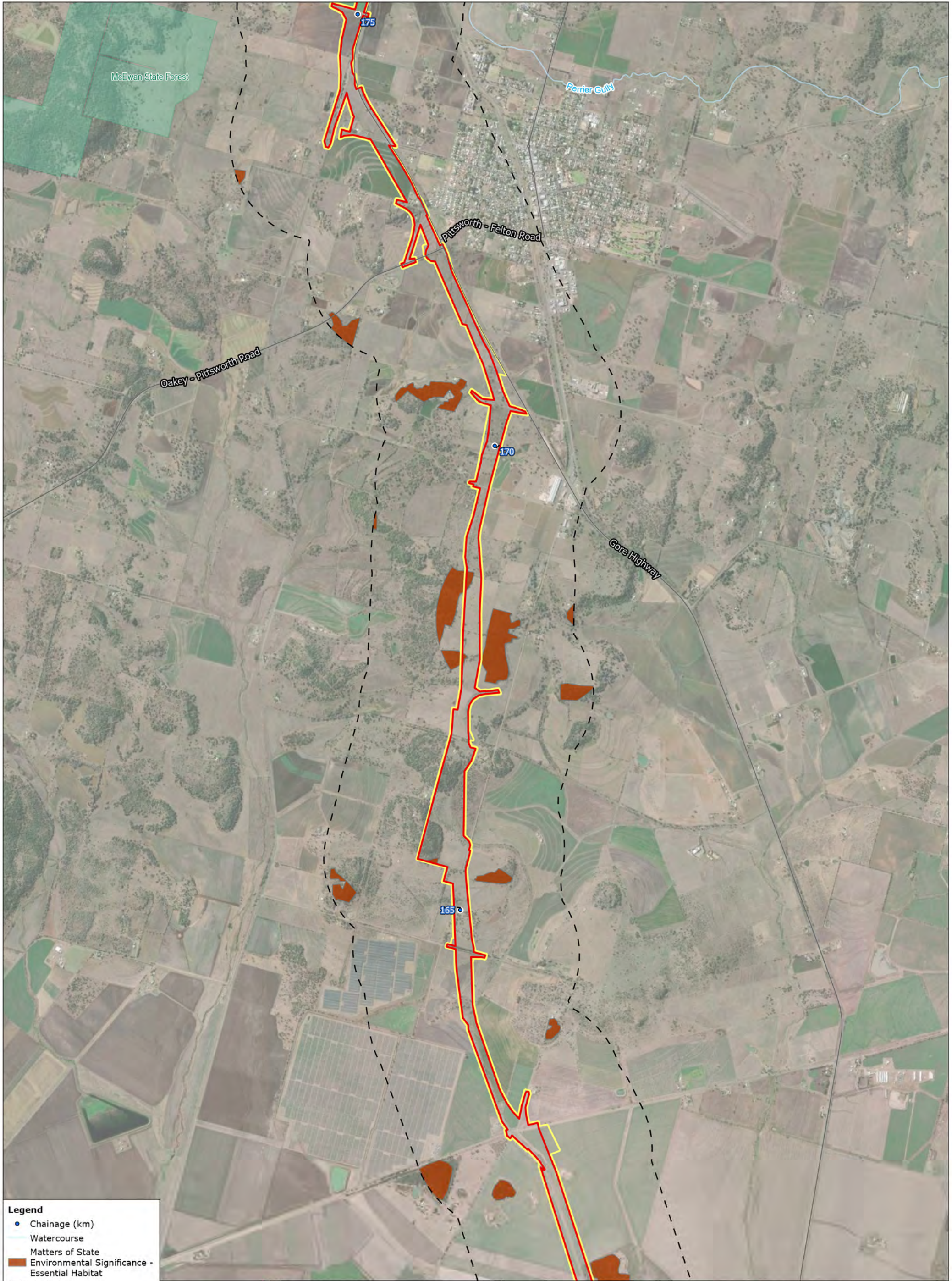
F4.8 (24) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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**F4.8 (25) Matters of State Environmental Significance -
Essential Habitat**

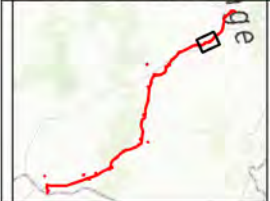
**Appendix L: Terrestrial and Aquatic Ecology
Technical Report**
ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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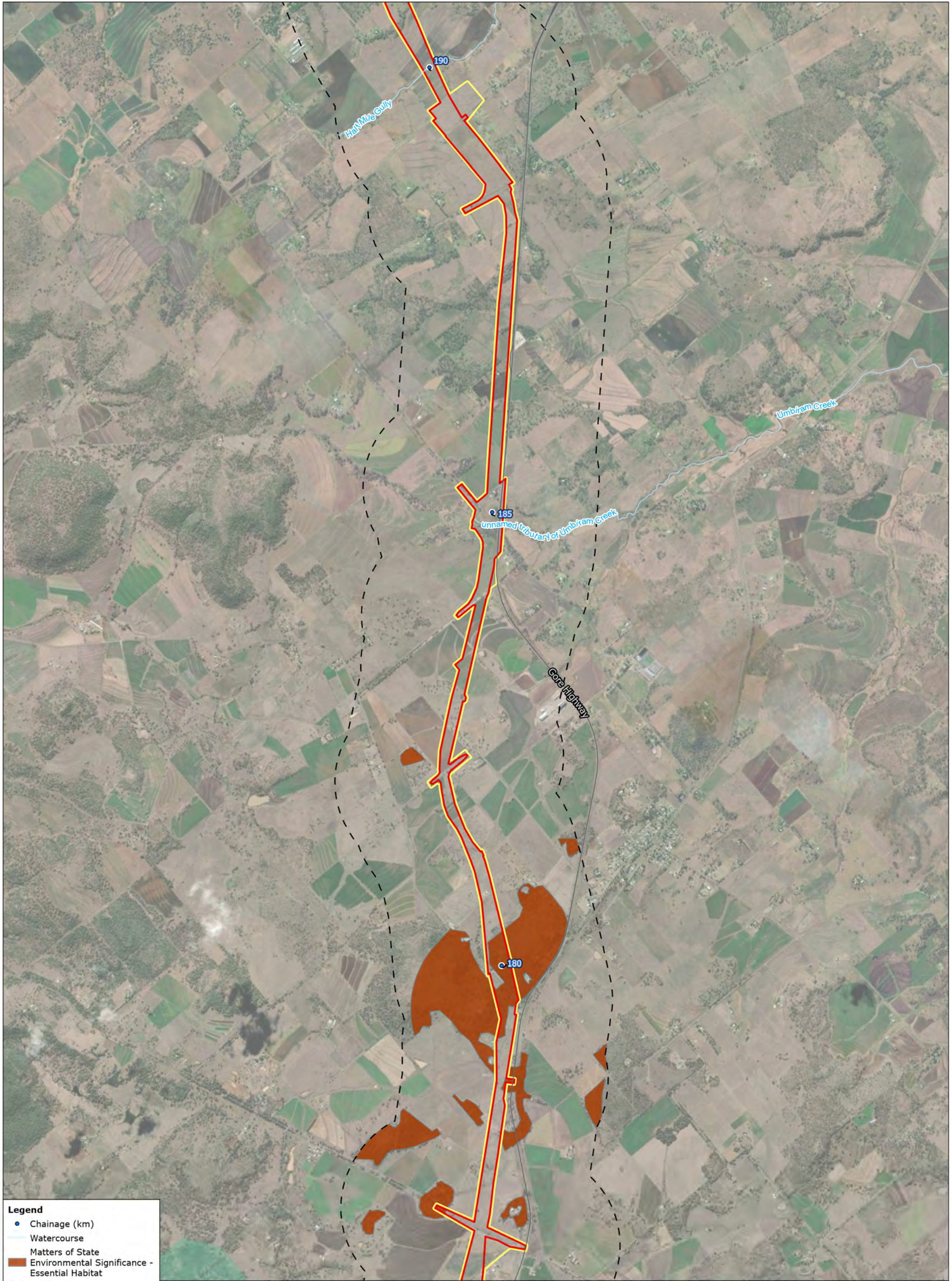
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F4.8 (26) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC





Legend

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



Coordinate System:
GDA2020 MGA Zone 56

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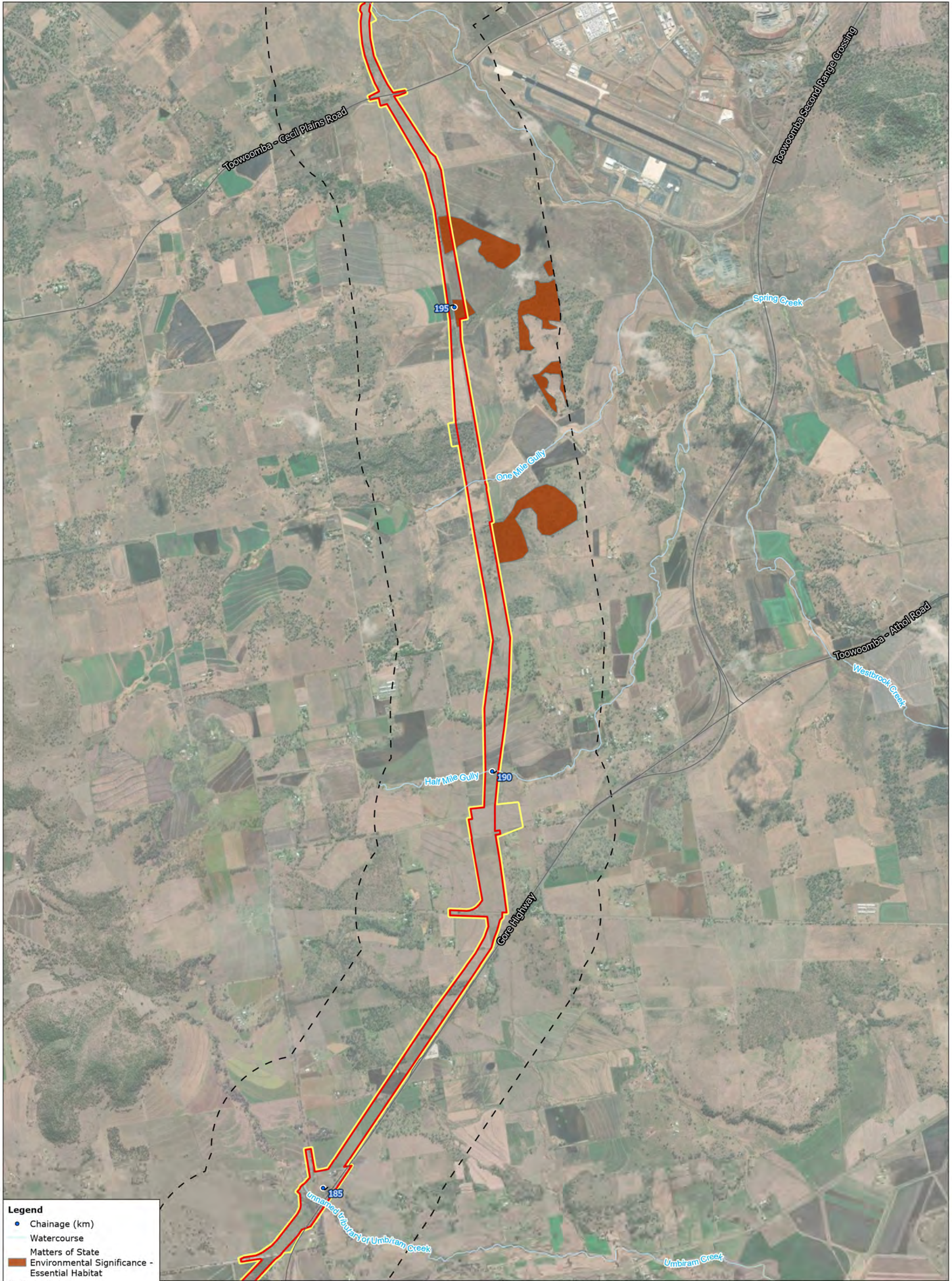
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F4.8 (27) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology

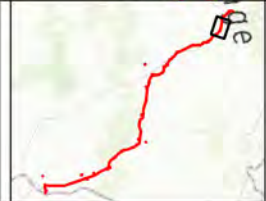
Technical Report

ARTC



Legend

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



Coordinate System:
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Date: 17/10/2024

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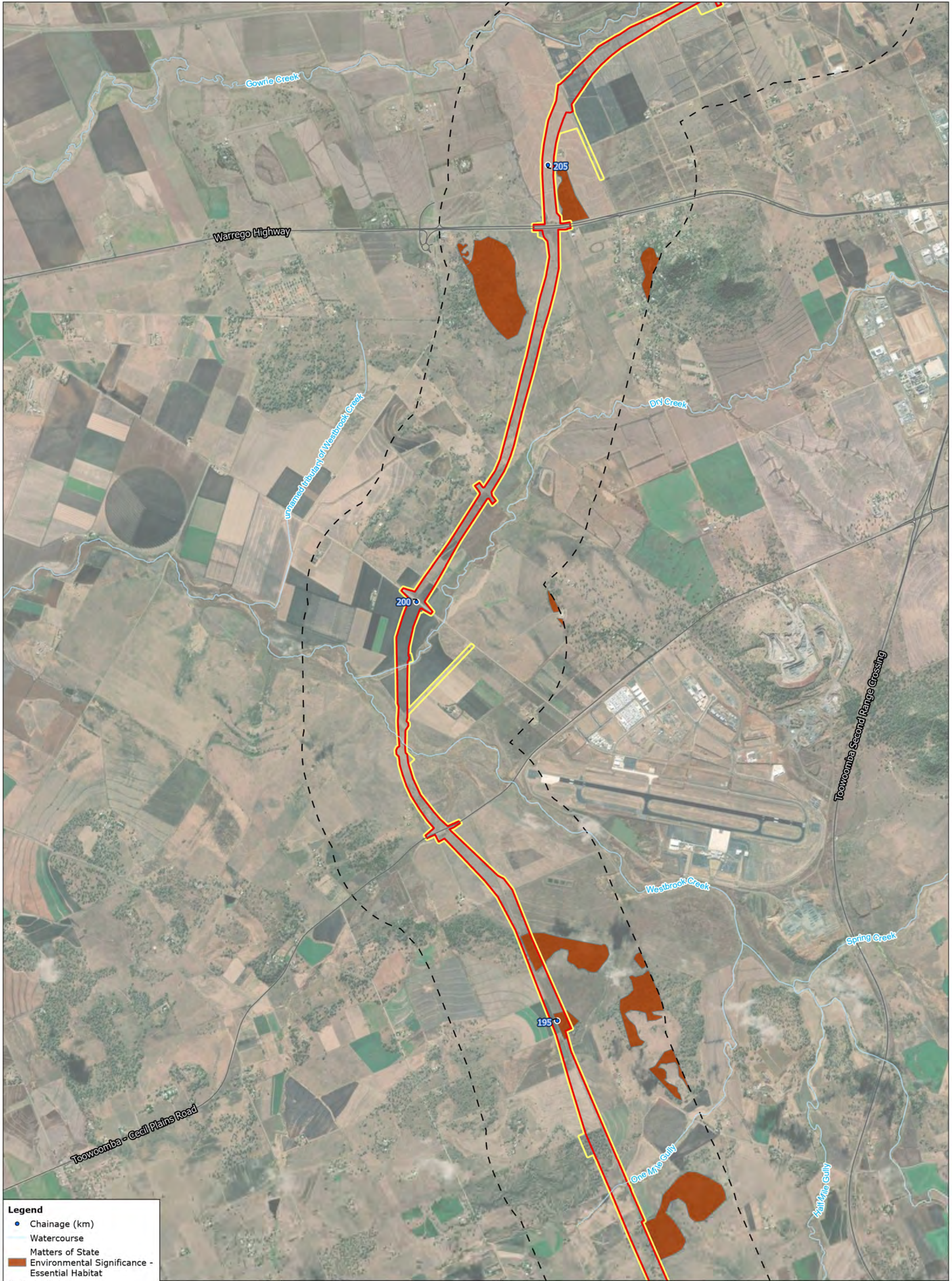
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F4.8 (28) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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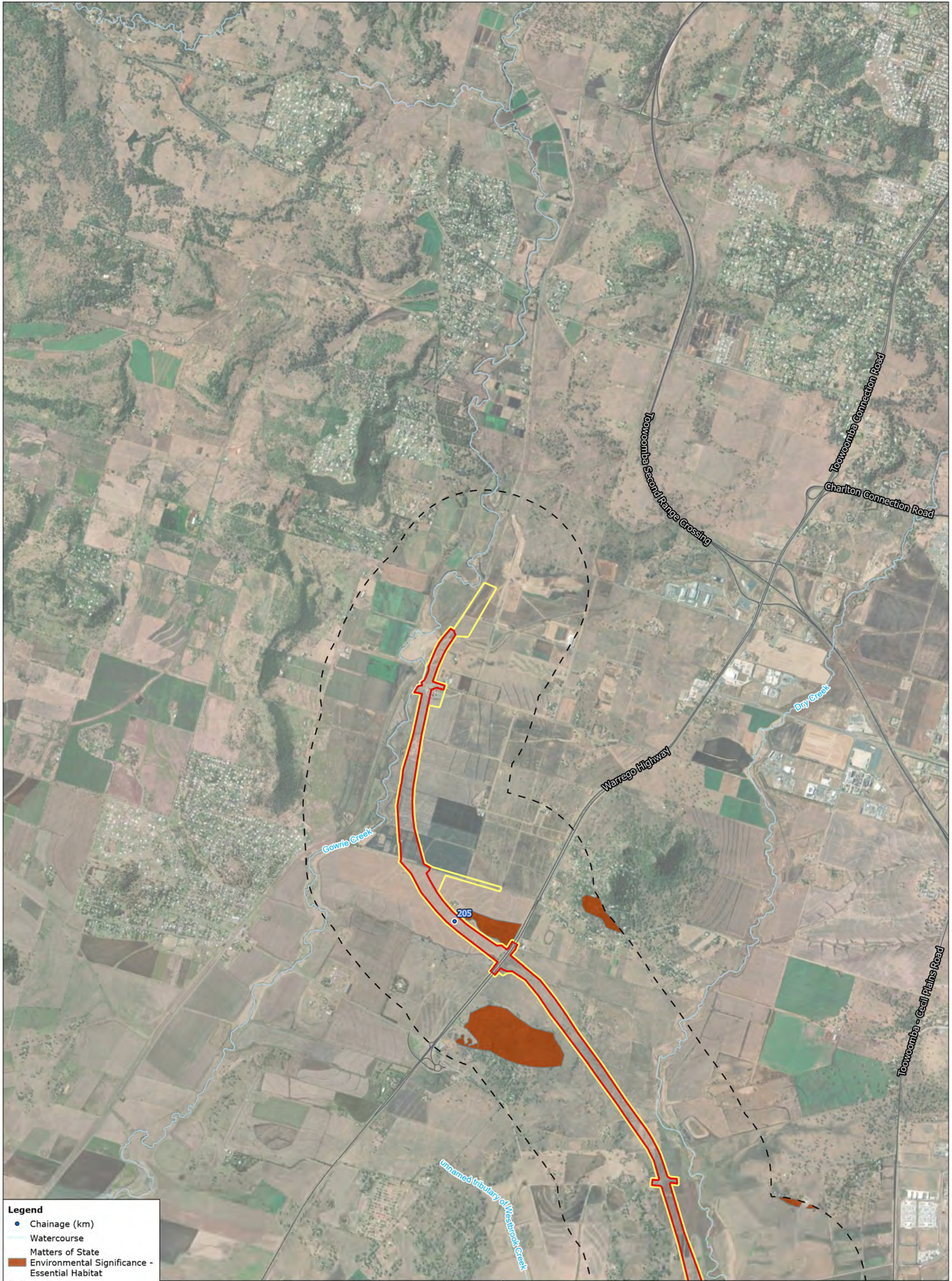
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F4.8 (29) Matters of State Environmental Significance - Essential Habitat

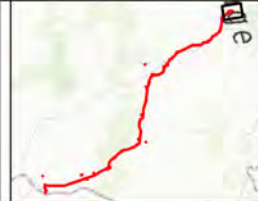
Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

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F4.8 (30) Matters of State Environmental Significance - Essential Habitat

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



4.11.2 CONNECTIVITY

A total of 475.33 ha of 'Endangered', 'Of Concern' and 'Least Concern' Category B vegetation within the Project footprint is to be cleared for the Project, as per the regulated vegetation management mapping.

Biodiversity corridors (including those associated with waterways) can be defined as systems of linear habitat which enhance the connectivity of wildlife habitat 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. These can include daily foraging movements of individuals to broad-scale genetic gradients across biogeographical regions. Fragmentation of such corridors have been identified as a key threatening process to many threatened species.

The BPA mapping for Brigalow Belt (Queensland Government, 2016) depicts regional and State corridors within the Study area, which identifies vegetation that is significant for the connectivity and movement of flora and fauna. Both riparian and terrestrial State ecological corridors have been mapped across the Project footprint (Figure 4-9)

A connectivity assessment has been undertaken as part of revised draft EIS Appendix P: Fauna Connectivity Strategy with the aim of ensuring the functional movement of fauna is not compromised by the Project and to meet the regulatory requirements. As part of this assessment, BPA corridors were included as priority connectivity zones for the Project.



Legend

- Chainage (km)
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- State Forests
- Terrestrial and Riparian Ecological Corridors
 - Regional, Riparian
 - State, Riparian
 - State, Riparian/Terrestrial
 - State, Terrestrial

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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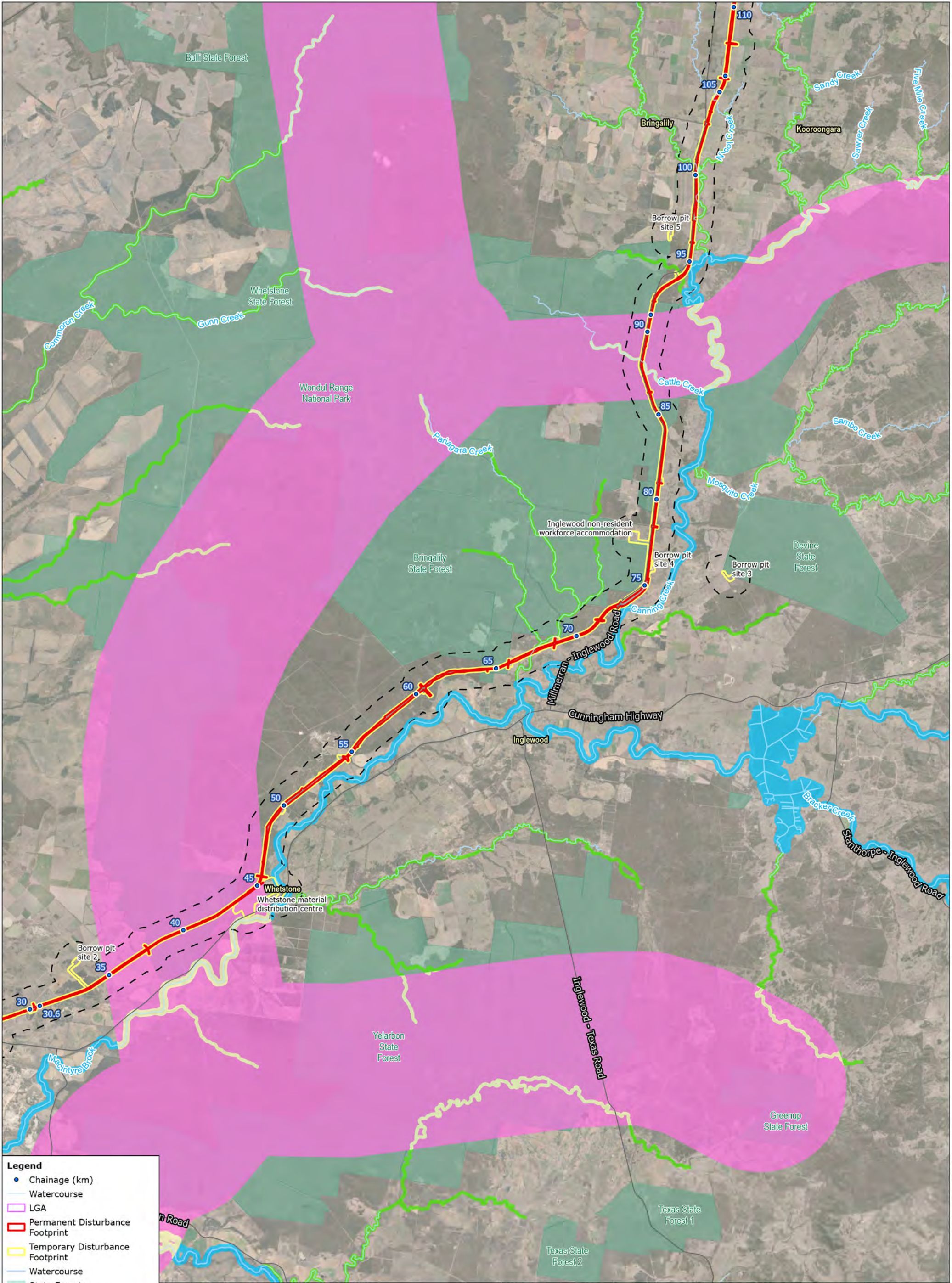
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F4.9 (1) - Terrestrial and Riparian Ecological Corridors

Appendix L: Terrestrial and Aquatic Ecology Technical Report
ARTC





Legend

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

Terrestrial and Riparian Ecological Corridors

- Regional/Riparian
- State/Riparian
- State/Riparian/Terrestrial
- State/Terrestrial



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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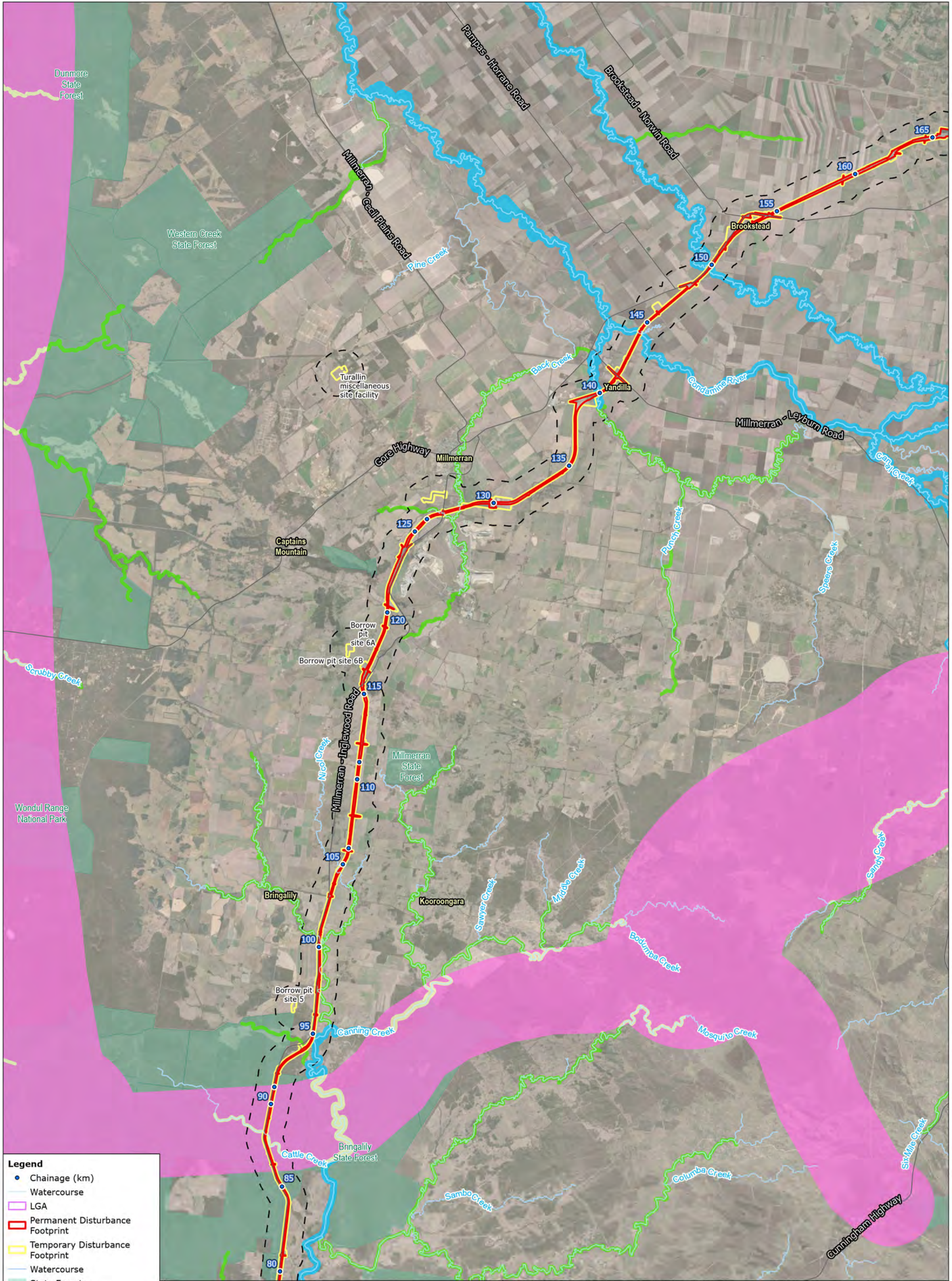
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F4.9 (2) - Terrestrial and Riparian Ecological Corridors

Appendix L: Terrestrial and Aquatic Ecology Technical Report
ARTC





Legend

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

Terrestrial and Riparian Ecological Corridors

- Regional, Riparian
- State, Riparian
- State, Riparian/Terrestrial
- State, Terrestrial

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

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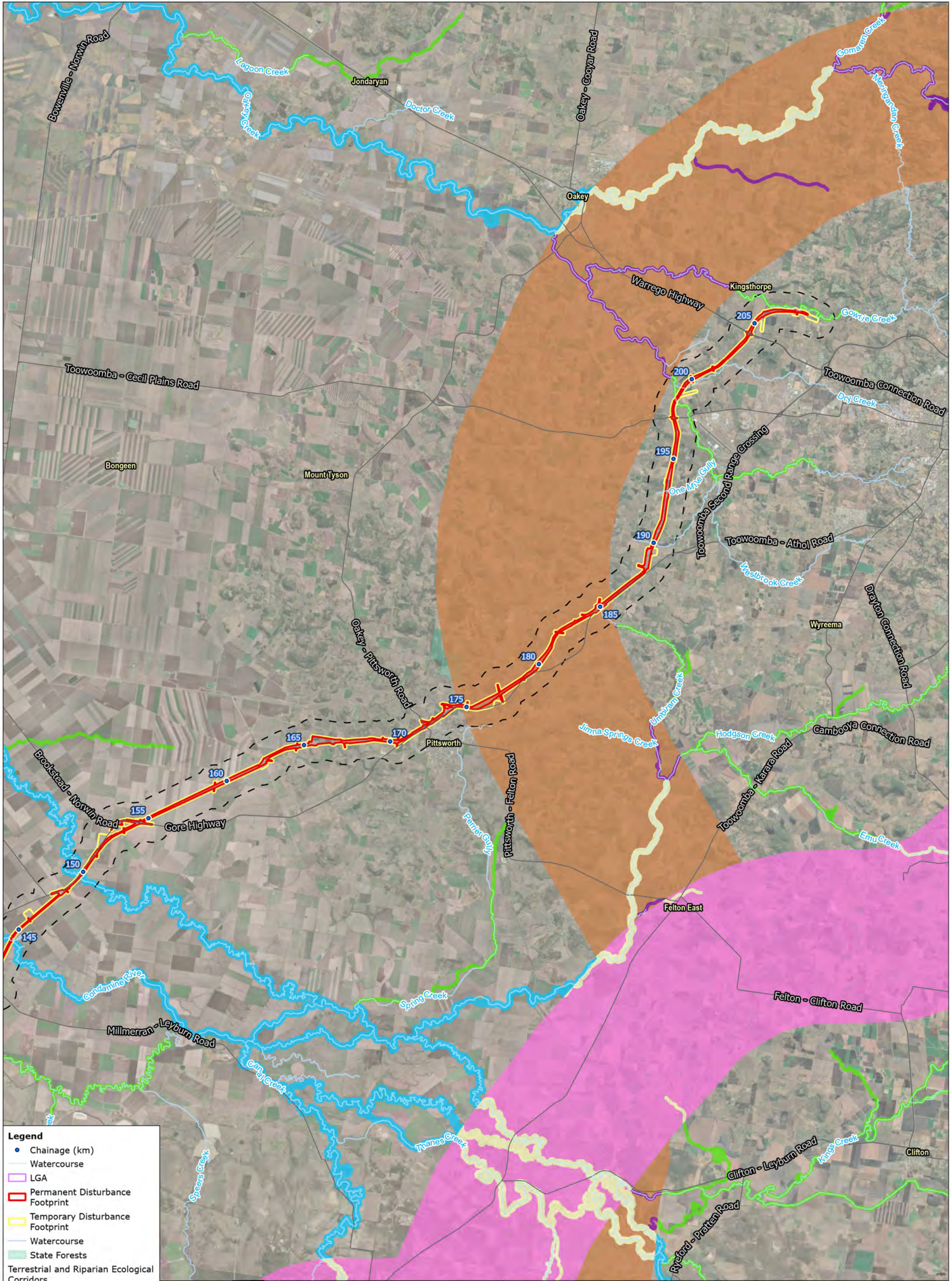
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F4.9 (3) - Terrestrial and Riparian Ecological Corridors

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC



F4.9 (4) - Terrestrial and Riparian Ecological Corridors

Appendix L: Terrestrial and Aquatic Ecology Technical Report
ARTC



4.11.3 PROTECTED WILDLIFE HABITAT

Forty-six protected wildlife species, comprising forty-four threatened species (Critically Endangered, Endangered or Vulnerable under the NC Act), and two SLC species have potential or known habitat within the Project footprint (Table 4-21).

Under the Environmental Offset Regulation, the definition of protected wildlife habitat includes:

- An area of essential habitat on the essential habitat map for an animal or plant that is endangered or vulnerable wildlife;
- An area that is shown as a high risk area on the flora survey trigger map and that contains plants that are endangered or vulnerable wildlife;
- An area that is not shown as a high risk area on the flora survey trigger map, to the extent the area contains plants that are endangered or vulnerable wildlife;
- An area of habitat (e.g. foraging, roosting, nesting or breeding habitat) for an animal that is endangered, vulnerable or a special least concern animal.

Protected wildlife habitat does not include near threatened species, therefore, excludes *Digitaria porrecta* and the definition of SLC is limited to echidna and platypus, as migratory species are not included. As a result of this, habitat for the species listed as migratory SLC has not been quantified.

MSES wildlife habitat (endangered or vulnerable) occurs within the Project footprint, the majority of which is also mapped as essential habitat (refer to Section 4.11.1.5 and Figure 4-8). A total of 31.17 ha of MSES wildlife habitat is additional to essential habitat, including habitat for *Cyperus clarus*, brown tree creeper (south-eastern) (*Climacteris picumnus victoriae*), squatter pigeon (southern) (*Geophaps scripta scripta*), koala (*Phascolarctos cinereus*), and pale imperial hairstreak (*Jalmenus eubulus*). Both MSES wildlife habitat and essential habitat have been included in the total protected wildlife habitat areas for relevant species. As with essential habitat for the pale imperial hairstreak, mapped MSES wildlife habitat for this species does not constitute ground-truthed habitat, therefore, this species remains unlikely to occur due to inconsistencies between the GTRE and State-based mapping (see Appendix B Likelihood of Occurrence for detailed justification).

TABLE 4-21 PROTECTED WILDLIFE HABITAT WITHIN THE PROJECT FOOTPRINT

Species name	Common name	NC Act status	Ground-truthed habitat within the Project footprint
MSES Flora			
<i>Acacia lauta</i>	Tara wattle	V	410.00 ha
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	13.13 ha
<i>Clematis fawcetti</i>	Stream clematis	V	2.27 ha
<i>Cyperus clarus</i>	-	V	166.07 ha, including 0.20 ha of essential habitat
<i>Dichanthium queenslandicum</i>	King bluegrass	V	50.31 ha, including 33.09 ha of essential habitat

Species name	Common name	NC Act status	Ground-truthed habitat within the Project footprint
<i>Homopholis belsonii</i>	Belson's panic	E	242.25 ha, including 0.21 ha of essential habitat
<i>Picris barbarorum</i>	-	V	174.98 ha
<i>Picris evae</i>	Hawkweed	V	110.67 ha, including 15.89 ha of essential habitat
<i>Rhaponticum australe</i>	Austral cornflower	V ¹	83.49 ha
<i>Thesium australe</i>	Austral toadflax	V	46.44 ha
<i>Westringia parvifolia</i>	-	V	27.19 ha, including 1.69 ha of essential habitat
<i>Xerothamnella herbacea</i>	-	E	11.99 ha, including 8.45 ha of essential habitat

MSES Fauna

<i>Acanthopis antarcticus</i>	Common death adder	V	277.27 ha, including 2.85 ha of essential habitat
<i>Adclarkia cameroni</i>	Brigalow woodland snail	V	146.72 ha
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	E	241.61 ha, including 33.09 ha of essential habitat
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	285.01 ha
<i>Aphelocephala leucopsis</i>	Southern whiteface	V	216.89 ha
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	7.91 ha
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	Not quantified
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (south-eastern)	V	120.01 ha
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	V	240.66 ha, including 5.87 ha of essential habitat
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (southeastern mainland population)	E	387.48 ha
<i>Delma torquata</i>	Collared delma	V	36.83 ha
<i>Egernia rugosa</i>	Yakka skink	V	241.13 ha
<i>Furina dunmalli</i>	Dunmall's snake	V	262.69 ha, including 49.04 ha of essential habitat
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	421.42 ha

Species name	Common name	NC Act status	Ground-truthed habitat within the Project footprint
<i>Grantiella picta</i>	Painted honeyeater	V	330.66 ha
<i>Hemiaspis damelii</i>	Grey snake	E	259.80 ha
<i>Hirundapus caudacutus</i>	White-throated needletail	V	2,853.24 ha
<i>Hypochrysops piceatus</i>	Bullock jewel butterfly	CE	231.29 ha
<i>Jalmenus eubulus</i>	Pale imperial hairstreak		26.59 ha of essential habitat only
<i>Lathamus discolor</i>	Swift parrot	E	614.93 ha
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern)	E	216.89 ha
<i>Ninox strenua</i>	Powerful owl	V	8.64 ha
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	696.25 ha, including 49.04 ha of essential habitat
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	24.81 ha
<i>Petauroides volans</i>	Greater glider (southern and central)	E	15.97 ha
<i>Petaurus australis australis</i>	Yellow-bellied glider (south-eastern)	V	298.05 ha
<i>Phascolarctos cinereus</i>	Koala	E	1,362.53 ha, including 74.02 ha of essential habitat
<i>Rostratula australis</i>	Australian painted snipe	E	7.91 ha
<i>Stagonopleura guttata</i>	Diamond firetail	V	216.89 ha
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	1,397.48 ha
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	51.20 ha
Habitat Areas			
Koala habitat areas under the Nature Conservation (Koala) Conservation Plan 2017	-	-	7.44 ha

Table notes:

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

¹ listed as *Leuzea australis*

4.11.4 WATERWAY PROVIDING FOR FISH PASSAGE

Fish waterways relevant to waterway barrier works have been identified along the Project footprint, refer to Section 4.8.3. These waterways reflect areas that provide fish passage and are defined under the Fisheries Act. One hundred waterways intersect the Project footprint and are classified (DAF mapped waterways; see Figure 4-4 and Table 4-11):

- ten waterways mapped as purple (major risk);
- nine waterways mapped as red (high risk);
- 15 waterways mapped as amber (moderate risk); and
- 66 waterways mapped as green (low risk).

The Project does not impact any tidal waterways (major risk; mapped as grey). The revised draft EIS Appendix S: Surface Water Quality Technical Report provides further context on these waterways.



Legend

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



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 2 4 6km

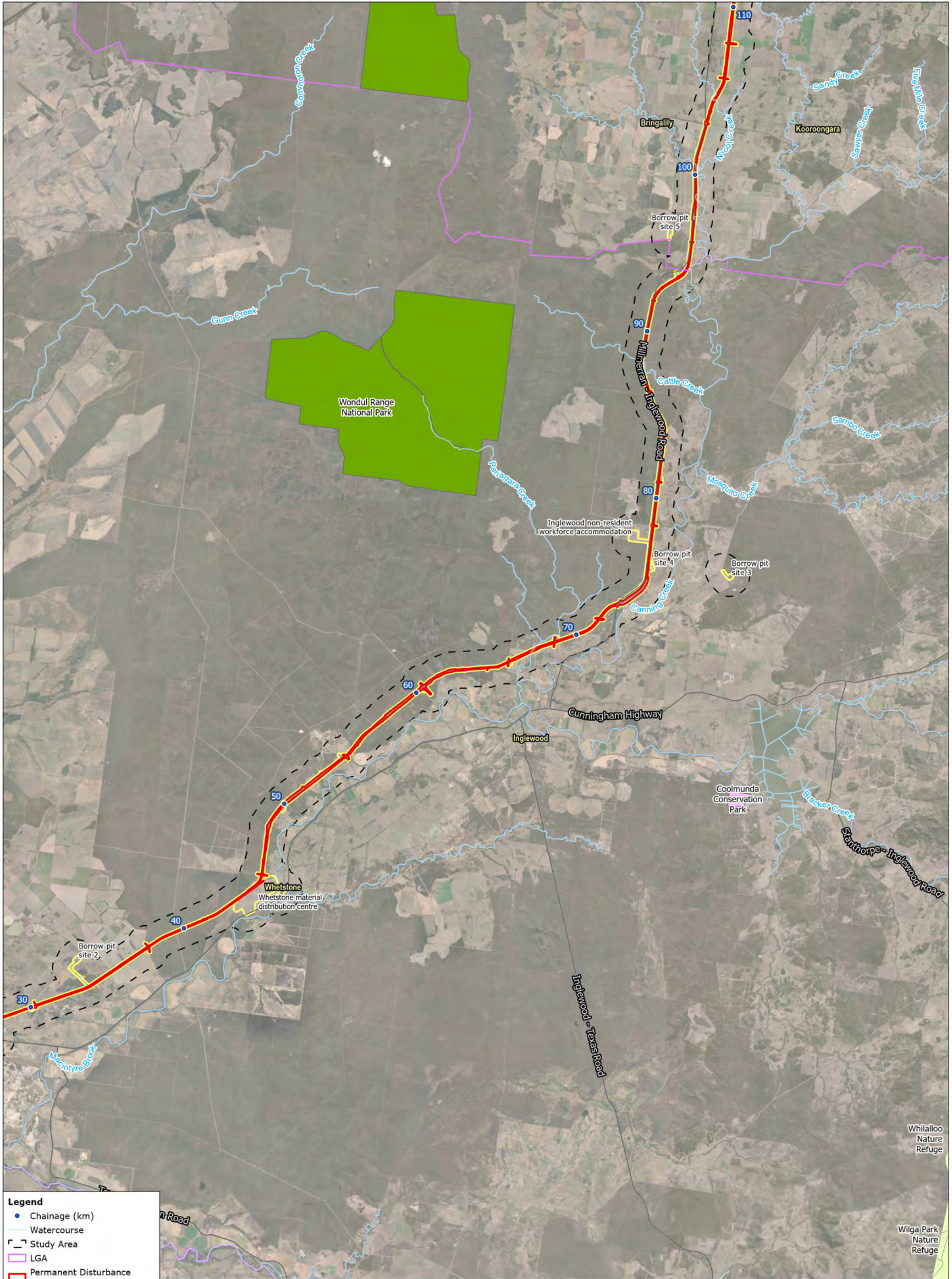
1:200,000

F4.10 - Protected Areas Under the Nature Conservation Act 1992

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC



Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- Conservation Park
- National Park
- Nature Refuges



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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F4.10 - Protected Areas Under the Nature Conservation Act 1992

Appendix L: Terrestrial and Aquatic Ecology

Technical Report

ARTC

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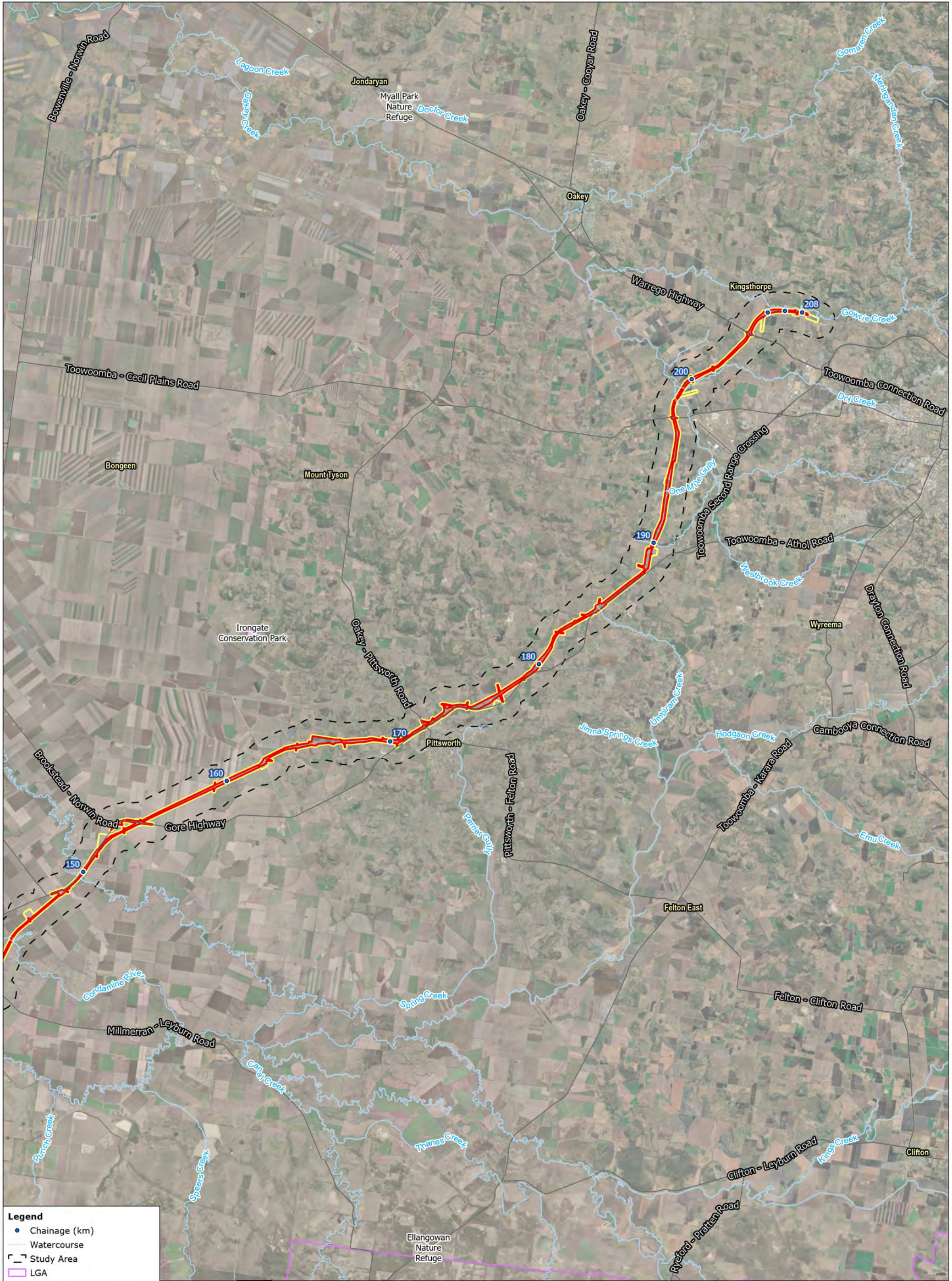
- Legend**
- Chainage (km)
 - Watercourse
 - Study Area
 - LGA
 - Permanent Disturbance Footprint
 - Temporary Disturbance Footprint
 - Watercourse
 - Conservation Park
 - National Park

Coordinate System:
GDA2020 MGA Zone 56
Date: 17/10/2024
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F4.10 - Protected Areas Under the Nature Conservation Act 1992

Appendix L: Terrestrial and Aquatic Ecology Technical Report
ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- Watercourse
- Conservation Park
- Nature Refuges



Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

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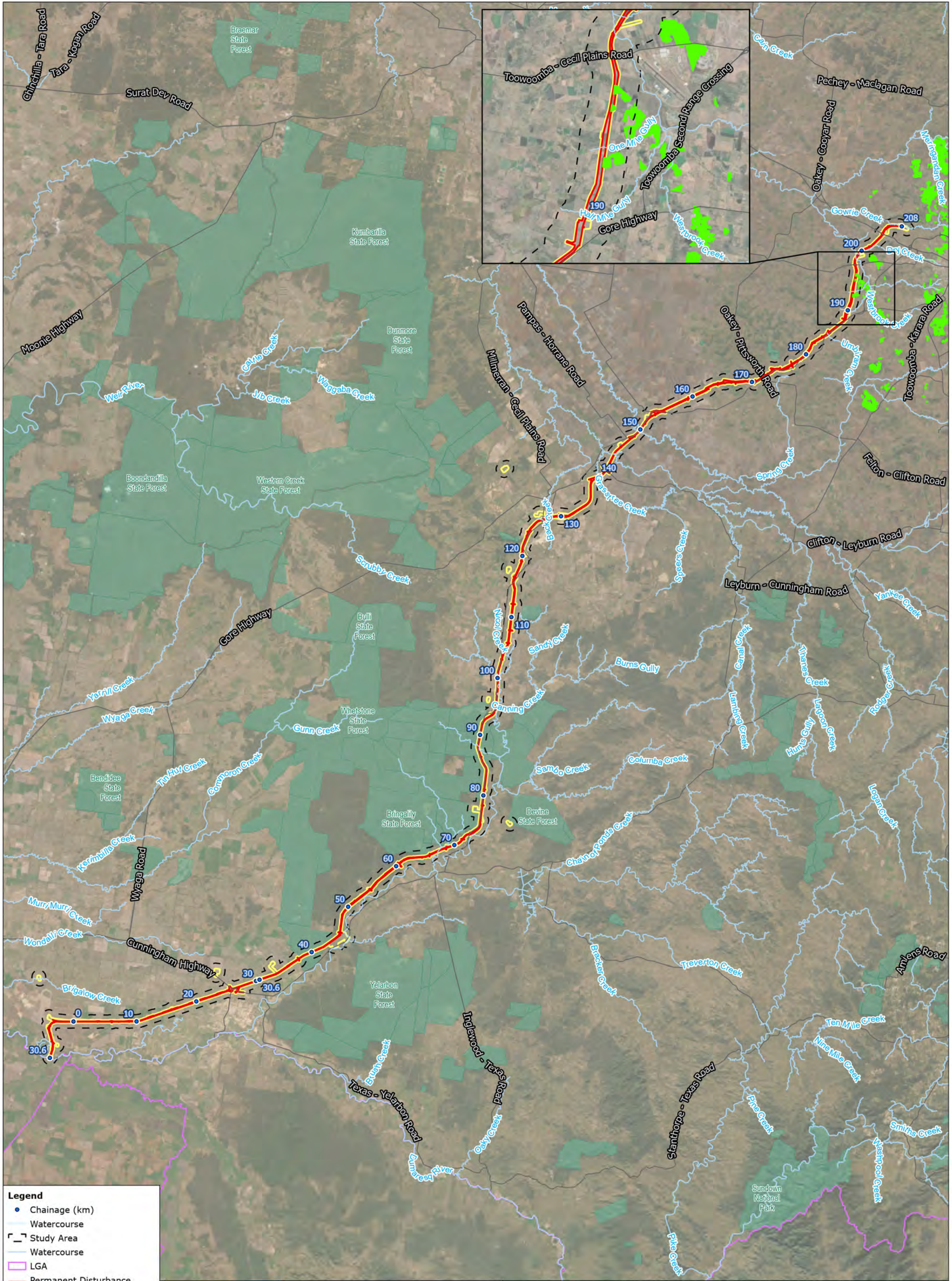
0 2 4 6km

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F4.10 - Protected Areas Under the Nature Conservation Act 1992

Appendix L: Terrestrial and Aquatic Ecology
Technical Report
ARTC





Legend

- Chainage (km)
- Watercourse
- Study Area
- Watercourse
- LGA
- Permanent Disturbance Footprint
- Temporary Disturbance Footprint
- State Forests
- Protected Koala Areas Under Nature Conservation Plan 2017

Coordinate System:
GDA2020 MGA Zone 56

Date: 17/10/2024

Created By: CB/VN

Drawing Size: A3

0 5 10 15km

F4.11 - Koala Mapping As prescribed Under the Nature Conservation (Koala) Conservation Plan 2017

Appendix L: Terrestrial and Aquatic Ecology Technical Report

ARTC

5. POTENTIAL IMPACTS

This section discusses the Project activities, by phase, that have potential to result in impacts on ecological values. Descriptions of the specific direct and indirect impacts that may occur are provided.

Potential impacts to ecological values may occur during all applicable Project stages including pre-construction and early works, construction and commissioning and operations. The potential impacts are summarised in Table 5-1. This section outlines unmitigated potential impacts to MNES associated with the Project. Whether each pathway is a direct or indirect impact may be unclear at times, however the purpose of this table is to recognise all potential impact pathways.

TABLE 5-1 SUMMARY OF UNMITIGATED IMPACTS AND AFFECTED MSES MATTERS

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

5.1 PROJECT ACTIVITIES

Activities proposed as part of the Project that may impact on ecological values have been categorised into two phases: pre-construction and construction, and commissioning and operation.

A summary of Project related activities is provided in Table 5-2. The durations listed for each disturbance activity have been classified as per the *Queensland EIS Guideline* (DSDI, 2024)

TABLE 5-2 SUMMARY OF PROJECT RELATED ACTIVITIES ASSOCIATED WITH PRE-CONSTRUCTION, CONSTRUCTION, COMMISSIONING AND OPERATION PHASES

Phase	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
Pre-construction and construction	Site preparation (relating to all work sites)	Vegetation clearing	Permanent
		Topsoil stripping	Medium term
		Construction of temporary site compounds including fencing	Medium term
		Construction of rail access roads	Permanent
		Installation of boreholes and construction water storage	Medium term
		Installation of offices, hardstands, etc.	Medium term
		Stockpiling	Medium term
		Establishment of initial laydown areas	Medium term
		Establishment of temporary drainage infrastructure (e.g., sediment ponds)	Medium term
		Borrow pit establishment and excavation of fill	Medium term
	Additional surveys	Potential further geotechnical investigations	Short term
	Traffic and transport	Delivery of materials to the Project footprint	Medium term
		Movement of workforce	Medium term
		Transportation/collection of plant, equipment and other machinery	Medium term
		Delivery of non-resident workforce accommodation cabins to site	Medium term
		Rail-to-road diversions due to track closures	Medium term
	Fencing	Modification of biosecurity fencing	Long term
		Installation of boundary fencing	Short term
		Moving / protection of QR assets	Medium term

Phase	Infrastructure activity	Description of activities	Anticipated duration of disturbance*
	Relocation of QR assets and utilities / services	Establishing utilities and services	Medium term
	Accommodation	Establishment of non-resident workforce accommodation	Medium term
	Utility diversions	Excavation	Short term
		Trenching	Short term
		Modification, diversion and realignment of utilities and associated infrastructure	Short term/medium term
	Drainage	Installation of drainage infrastructure (culverts, longitudinal drainage, scour).	Permanent
	Structures	Construction of waterway crossings (bridges and piers)	Permanent
		Road/rail bridge construction	Permanent
	Civil works	Earthworks and embankment construction involving excavation for cuts, cut to fill, importation of fill from quarries and other external sources where required and bank stabilisation.	Medium term
		Construction of temporary haul roads	Medium term
	Road works	Road realignment	Permanent
		Construction of permanent rail maintenance access roads	Permanent
	Rail logistics	Sleeper stockpiling	Medium term
		Rail stockpiling	Medium term
	Rail construction	Drilling	Short term
		Ballast installation	Short term
		Sleeper placement	Long term
		Rail placement	Permanent
		Installation of train signals and communications infrastructure	Long term
		Demobilising site compounds	Short term
	Signals and communications installation	Installation of telecommunications and signalling infrastructure.	Short term

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

Table note:

*Duration of disturbance timeframes (DSDI, 2024):

Short term – up to 12 months

Medium term – from 1 to 3 years
 Long term – from 3 to 100 years
 Permanent.

5.2 POTENTIAL IMPACT TO TERRESTRIAL ECOLOGICAL VALUES

5.2.1 HABITAT LOSS THROUGH CLEARING

Habitat loss within the Project footprint through vegetation clearing will pose the largest risk of direct adverse impacts for biodiversity arising from the Project construction. Vegetation clearing will occur during the pre-construction and construction phases and will result in the loss of available habitat within the Project footprint for NC Act threatened and special least concern (SLC) species, and other MSES.

The Project footprint encompasses a total of 3,382.17 ha, with 2,544.86 ha being within the permanent footprint and 837.31 ha being temporarily disturbed. Ground-truthed vegetation mapping indicates that the Project footprint comprises 570.75 ha of remnant vegetation, 16.48 ha of mature regrowth vegetation, 270.92 ha of immature regrowth vegetation and 2,524.02 ha of non-remnant areas. The remaining 2,524.02 ha (74.6% of the Project footprint) has been subject to previous clearing for agriculture, grazing, mining, industry, or transport (road and rail corridors) and is classified as non-remnant areas.

An assessment of the significant residual impact associated with vegetation clearing on each of the relevant MSES is provided in Section 7.2.

5.2.2 FAUNA SPECIES INJURY OR MORTALITY

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

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

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

5.2.2.1 VEGETATION CLEARING, EARTHWORKS AND TRENCHING

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

Some diurnal and mobile species, such as birds, may move away from areas being disturbed and may not suffer direct physical trauma unless they are nesting. However, other species that are less mobile (i.e. ground-dwelling reptiles, and some mammal species), or those that are nocturnal and nest or roost in tree or tree hollows during the day may find it difficult to move away from roosts or active breeding places.

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

5.2.2.2 VEHICLE STRIKE

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

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

5.2.2.3 FENCING ENTANGLEMENT

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

Due to the length to be constructed, fauna exclusion fencing constructed for the Project has the potential to cause widespread mortality and injury to a large variety of resident fauna species. The fencing approach for the Project is described in revised draft EIS Chapter 5:

Project Description. Many kilometres of such fencing already exist in the area and Project fencing will in part replace existing fencing. For example, the existing wild dog fence will need to be reinstated on the northwest side of the rail corridor in a number of locations as rectification for severance of this fence, as described in revised draft EIS Chapter 5: Project Description.

5.2.3 REDUCTION IN BIOLOGICAL VIABILITY OF SOIL

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

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

5.2.4 INTRODUCTION AND SPREAD OF WEEDS, PATHOGENS AND PEST SPECIES

Weeds, pathogens and pest species have the potential to impact on terrestrial and aquatic biodiversity through displacement, predation, and competition. Pest species can also damage native vegetation by grazing and trampling (Adair and Groves, 1998; Clarke *et al.*, 2000; Thorp and Lynch, 2011). Accordingly, it is possible that spread of weed and pest species may reduce the extent of available habitat for threatened flora and fauna species. This may have the effect of increasing mortality and reducing the size and viability of populations through resource limitation and associated stresses.

Proliferation of weed and pest species has the potential to occur during all phases of the Project. However, colonisation potential is increased during vegetation clearing and soil disturbance activities during the construction phase, as well as rehabilitation activities of the temporary disturbance footprint.

It should be noted that weed and pest species are already present and often widespread within the Study area. Twenty-one Category 3 restricted matter flora species (under the Biosecurity Act) are known to occur within the Study area with 13 species of these also listed as WoNS (Table 4-5). Additionally, nine non-native fauna species, all declared as restricted matters (invasive animals) under the Biosecurity Act, were identified within Study area during field investigations (Appendix A Additional Ecological Investigations and Appendix I Fauna Species Lists). These species were widespread within the Study area.

Activities associated with all phases of the Project also have the potential to increase the spread of pathogens including myrtle rust. Myrtle rust is caused by the fungus *Austropuccinia psidii* and threatens the tree and shrub species of the Myrtaceae family, including *Melaleuca*

spp., *Eucalyptus spp.*, *Angophora spp.*, and *Corymbia spp.*. Myrtle rust spreads and reproduces via spores carried on: clothing; infected plants and plant material; equipment, machinery and vehicles; and insects and animals (DCCEEW, 2024). Without appropriate management strategies, the Project activities have the potential to disperse existing weeds and facilitate the movement of pests and pathogens into the surrounding vegetation (outside of the Project footprint).

Project activities also have the potential to introduce new weed species into the Study area through earthworks, movement and disturbance of soil and attachment of seed (and other propagules) to vehicles and machinery.

Activities associated with the Project may also provide increased refuge and scavenging resources (e.g. discarded food scraps) for introduced fauna species during construction.

5.2.5 HABITAT FRAGMENTATION

Habitat fragmentation relates to the physical separation of a continuous habitat into disjointed smaller fragments (Fahrig, 2002). Habitat fragments are smaller and separated from each other by a matrix of less suitable habitat. Habitat fragmentation has the potential to result in loss of habitat connectivity, edge effects and barrier effects, each discussed below.

The landscape in which the Project is situated is already highly fragmented due to previous agricultural practices. Within the Study area, many patches of vegetation are small, irregularly shaped, and as such are already subject to considerable edge effects, refer to Section 5.2.5.2.

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

Highly mobile species such as large birds and bats may not be affected by this localised fragmentation, as the Project is unlikely to restrict aerial dispersal between habitat patches.

Potential habitat fragmentation (and associated edge/barrier effects) have been reduced as much as possible through the revised reference design as described in Section 6.

5.2.5.1 LOSS OF CONNECTIVITY IN BIODIVERSITY CORRIDORS

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

Biodiversity corridors are described in Section 4.11.2. These linkages are likely to provide landscape permeability for mobile species such as birds and bats. Such mobile species are less likely to be fragmented because of the Project.

A connectivity assessment has been undertaken as part of revised draft EIS Appendix P: Fauna Connectivity Strategy. The potential impacts of linear infrastructure impacting these biodiversity corridors include habitat fragmentation, edge effects and barrier effects. These potential impacts are discussed further in the following sections. An additional potential impact upon biodiversity corridors resulting from the Project is the proliferation of weeds and pest species, as mentioned in Section 5.2.4.

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

An assessment of the impacts to connectivity for threatened fauna species was undertaken and is described in revised draft EIS Appendix P: Fauna Connectivity Strategy. The assessment identified species whose movements may be impacted by the Project and these were grouped into the following guilds for assessment purposes:

- Brigalow woodland snail;
- Condamine earless dragon;
- Koala;
- Spotted-tailed quoll;
- Murray cod;
- Cracking clay reptiles (five-clawed worm-skink, grey snake);
- Gliding mammals (greater glider, yellow-bellied glider);
- Woodland birds (regent honeyeater, squatter pigeon, painted honeyeater, brown treecreeper, diamond firetail, southern whiteface, hooded robin); and
- Woodland reptiles (Dunmall's snake, collared delma, yakka skink, common death adder).

The importance of different sections of the Project for connectivity for these species and species guilds has been assessed in revised draft EIS Appendix P: Fauna Connectivity Strategy, to identify areas that contribute significantly. A total of 35 priority connectivity zones were identified along the Project (see Figure 4.10 in revised draft EIS Appendix P: Fauna Connectivity Strategy). These zones are located where high levels of ecological connectivity currently exists which will be impacted by the Project footprint and mitigation is required to maintain landscape connectivity for both threatened and non-threatened fauna.

5.2.5.2 BARRIER EFFECTS

Barrier effects (permanent and/or temporary) occur where 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);
- a physical barrier such as: a fence, railway line, road or track, earthworks embankments, cuttings, noise barriers, or alteration to a waterway or a culvert that does not provide movement opportunities to terrestrial fauna; or
- a non-physical barrier created by light or noise.

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

Potential barriers to fauna movement were assessed as part of the Appendix P: Fauna Connectivity Strategy. Gliders such as the yellow-bellied glider (south-eastern) (*Petaurus australis australis*) are susceptible to habitat fragmentation and gaps in vegetation that exceed their glide capability are barriers to movement.

Existing fencing such as the WDCF and the rabbit fence will be reinstated along the Project footprint. New sections of fencing will also be implemented to prevent fauna from crossing the Project footprint to reduce the risk of vehicle strike. Barbed wire and knot mesh fencing will be used minimally, and the majority of the fencing implemented will be plain mesh to reduce risk to fauna. No barbed wire or knot mesh wire will be utilised at designated crossing points with appropriate infrastructure. While the unmitigated implementation of fencing has the potential to create barrier effects that will have long lasting negative impacts to fauna, the implementation of crossing structures such as culverts, glider poles, and bridges will ensure connectivity can be maintained.

Human activity and infrastructure (creating noise, dust, light, and movement) are likely to create a barrier as many species are known to avoid areas of human activity resulting in indirect habitat loss and degradation. Human presence may affect species in different ways. Some species display avoidance behaviour while others may habituate and become attracted to areas of human activity. 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 are likely to produce avoidance responses in larger mammalian predators that are sensitive to disturbance (e.g., spotted-tailed quoll), 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 (Catling and Burt, 1995).

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

5.2.5.3 EDGE EFFECTS

Edge effects refer to the changes in environmental conditions (e.g. altered light levels, wind speed, temperature) that occur along the edges of habitats. Clearing and fragmentation creates more edges. These new environmental conditions can promote the growth of different vegetation types (including weed species), promote invasion by pest animals and/or native species specialising in edge habitats, or change the behaviour of resident native animals (Moenting and Morris, 2006). Edge zones can be subject to higher levels of predation by

introduced mammalian and native avian predators. The distance of edge effect influences can vary and has been previously recorded from 50 m to greater than 1 km in from an edge (Forman *et al.*, 2003; Bali, 2005).

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

Edge effects have the potential to impact on the range of flora and fauna species identified as occurring in the Project footprint, especially upon the species with specific micro-habitat requirements that are less tolerant to disturbance (e.g. glossy black-cockatoo and five-clawed worm-skink). However, some species (e.g., *Picris barbarorum*) are generally tolerant of edge related impacts and are often found within road reserves.

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

5.2.6 NOISE AND VIBRATION

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

There are no current State or Commonwealth government policies, guidelines or standards that recommend noise thresholds or limits associated with impacts to fauna, in part because the effects of noise on most fauna species are poorly understood. This is because hearing characteristics are species specific. Where the hearing range of humans is typically 20 Hz to 20,000 Hz, fauna have varying hearing ranges (see Table 5-3)

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

TABLE 5-3 TYPICAL HEARING RANGE FOR VARIOUS ANIMAL SPECIES

Species	Typical hearing range (Hz)
Human (for reference)	64 – 23,000

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

Source: Adapted from Fay and Popper (1994)

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

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

Additional considerations to understanding the effects of noise on fauna include the varying responses to noise disturbance across species and genera. Table 5-4 provides a summary of research findings reviewed for this assessment.

TABLE 5-4 SUMMARY OF REVIEWED LITERATURE

Fauna taxa	Description	Source
Snakes and lizards	Snakes lack external ears and a tympanic middle ear ('ear drum'). "The lack of a tympanic ear comes at the cost of a reduction in hearing sensitivity by some 40 dB or more".	Christensen <i>et al.</i> (2012)
	Some studies reviewed indicate hearing damage to some lizard species after exposure to steady noise levels above 95 dB.	Manci <i>et al.</i> (1988)
	A study on how snakes respond to airborne and ground-borne sounds. Snake responses were genus specific, with behavioural variability among different snake genera and across sound frequencies. Of the five genera involved in the study, only one genus (Aspidites, Woma Pythons) significantly increased their probability of movement in response to sound, but three other genera (Acanthophis	Zdenek <i>et al.</i> (2023)

Fauna taxa	Description	Source
	(Death Adders), Oxyuranus (Taipans), and Pseudonaja (Brown Snakes)) were more likely to move away from sound, signalling potential avoidance behaviour	
Animals (domestic and wild)	If SEL of 100 dB(A) exceeded, there is a potential for effects on animals.	Hanson <i>et al.</i> (2012)
Invertebrates	Some insects (including bees) stop moving when exposed to high noise levels. Honey bees stopped moving for up to 20 minutes in response to frequencies of approximately 200 Hz-2000 Hz with intensities varying from 107 – 119 dB, and did not appear to habituate.	Manci <i>et al.</i> (1988)
	Terrestrial gastropod molluscs have no acoustic sense and are unlikely to be impacted by noise	Barker (2001)
Mammals	Noise disturbance below 65.5 dB(A) was less likely to elicit strong behavioural responses for insectivorous mammals. "In the absence of national guidelines, and based on the findings of the applied research literature, a threshold level of LAeq 65 dB(A) be considered as a screening tool for ecological noise impacts".	Multiple references, as cited in Agnew and McBean (2020)
	"Sound levels above about 90 dB are likely to be adverse to mammals and are associated with a number of behaviors such as retreat from the sound source, freezing, or a strong startle response. Sound levels below about 90 dB usually cause much less adverse behavior. Laboratory studies of domestic mammals have indicated that behavioral responses vary with noise types and levels, and that domestic animals appear to acclimate to some sound disturbance"	Manchi <i>et al.</i> (1988)
Birds	Episodic noise can impact birds' behaviour at 60 – 80 dBA (nesting/roosting), and over 80 dBA (nesting/roosting/feeding)	Archer (2014)
	Average noise level at which population density of these birds began to decline ¹ Woodland birds - 42 dB(A) Grassland birds - 48 dB(A)	Forman <i>et al.</i> (2003, pp.125 and 274)
	- Quail: 80 dB - Accelerated hatching - Canary: 95-100 dB - hearing loss - Seabirds (general): sonic boom - Startle, flush from nest - Tern: sonic boom, frequent – reduced reproduction - California condor: blasting, drilling etc – flush from nest, abandon area - Raptors: sonic boom – alarm	Hanson <i>et al.</i> (2012)
	Noise disturbance below 65.5 dB(A) was less likely to elicit strong behavioural responses for birds	Multiple references, as cited in Agnew and McBean (2020)
	"Anthropogenic noise can also trigger flight and alert responses in birds and altered behaviour after the noise disturbance, which can lead to reduced breeding success, at noise levels	Dawe and Goosem (2008)

Fauna taxa	Description	Source
	<i>ranging from 65-85 dB(A). Complete habituation to such disturbances does not always occur, even in less noise-sensitive species"</i>	
	Studies and reviews undertaken suggest that to minimise impacts on birds, traffic noise should ideally be kept below 55-60 dB(A)(18 hr exposure), especially during the morning chorus.	DTMR (2024)

¹ These studies focused on traffic noise from a highway, so exposure was to almost continuous noise.

As discussed above, the scientific and published literature is inconclusive with regard to thresholds or threshold criteria for terrestrial fauna, however, available literature indicates that moderate impacts to habitat use may occur when noise levels are above 60 to 65 dB(A) and fauna are likely to leave the area when noise levels are around 80 dB(A) or above.

Table 5-5 provides a summary of the typical activities potentially impacted. Only minor disturbance of terrestrial fauna is anticipated at noise levels below 60 to 65 dB(A).

TABLE 5-5 LIKELY EFFECTS ON TERRESTRIAL FAUNA AS A RESULT OF PROJECT CONSTRUCTION ACTIVITIES

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

Notes:

Source: SLR (2015)

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

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

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

5.2.6.1 CONSTRUCTION NOISE AND VIBRATION

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

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

Analysis of the sound power and frequency range associated with construction activities indicates that the harmonic ranges produced (i.e., Hz) overlap with the typical hearing range for species likely to occur within the area (refer to Table 5-3).

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

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

Construction scenarios which are exceptions to this include:

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

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

Whetstone MDC and Borrow Pits

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

Habitat for three MSES fauna species is likely to be indirectly impacted by noise associated with works at the Whetstone MDC; the short-beaked echidna (*Tachyglossus aculeatus*), grey snake (*Hemiaspis damelii*) and the common death adder (*Acanthophis antarcticus*). Habitat for the short-beaked echidna (*Tachyglossus aculeatus*) will also be indirectly impacted at four borrow pit sites (sites 2, 4, 6A and 6B) and common death adder (*Acanthophis antarcticus*) habitat at three borrow pit sites (sites 3, 4 and 5).

Project Structures (bridges)

Bridge construction is comprised of three key stages:

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

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

The degree to which fauna will be impacted is likely to vary. Where noise levels at the source are around 85 dB(A) or above, mobile species (i.e. birds, yellow-bellied glider, and common death adder) are likely to move away from the immediate area. Less mobile species such as the grey snake (*Hemiaspis damelii*) while less able to move away from the source due to their dependence on specific habitat, may potentially experience lower levels of impact given snakes have limited acoustic sense and are unlikely to be impacted by noise (Christensen et al., 2012). They are, however, sensitive to vibration.

Predicted noise levels associated with construction of Project structures, notably foundations and piers have the potential to impact fauna within 400 m of the construction area however these impacts will be short term (three to four months). Given the temporary nature of construction works, it is considered likely that fauna will initially move away from the source of the noise disturbance. In this time, use of habitat areas for foraging, nesting and roosting may be affected however species will either habituate to the sound when they realise that it is not associated with danger, or return on completion of works. However, only airborne sound pressure levels are reported in revised draft EIS Chapter 16: Noise and Vibration, and there is no equivalent assessment of waterborne sound levels. Therefore, impacts on aquatic or semi-

aquatic fauna (e.g., platypus (*Ornithorhynchus anatinus*)) cannot be fully assessed. As such a conservative approach must be taken. Platypus (*Ornithorhynchus anatinus*) breed in spring and this will need to be considered in impact management. Potential impacts to use of breeding habitat during construction is considered to potentially have the largest impact, especially for construction activities that persist over a longer period of time, potentially effecting multiple breeding seasons.

The short-beaked echidna (*Tachyglossus aculeatus*) has a hearing sensitivity comparable to that of therian (bearing live young) mammals (Mills and Shepherd, 2001). The response of the short-beaked echidna to noise impacts is unknown, however they are a mobile species with large home ranges, between 20.6 ha and 93.3 ha (Wilkinson et al., 1998). It is considered likely that individuals will temporarily move away from the source of disturbance into other areas of suitable habitat. Echidnas breed from the end of June to early September. Noise impacts are considered unlikely to disrupt the breeding cycle due to the species' ability to move outside the area, returning once construction is completed.

Snakes lack external ears and a tympanic middle ear ('ear drum') leading to a reduction in hearing sensitivity compared to mammals by some 40 dB or more (Christensen *et al.*, 2012). While snakes can hear, they lost effective pressure hearing with the loss of a functional outer and middle ear, and 'hear' via sound-induced head vibrations (Christensen *et al.*, 2012). Nevertheless, high impact construction noise may cause temporary or permanent hearing loss in reptiles and vibration may limit their ability to detect prey (DTMR, 2024). Reptiles including grey snake, and the common death adder have the potential to be impacted by construction noise, however a study on how snakes respond to airborne and ground-borne sounds found that snake responses were genus specific, with behavioural variability among different snake genera and across sound frequencies. Of the five genera involved in the study, Only one genus (*Aspidites*, Woma Pythons) significantly increased their probability of movement in response to sound, but three other genera (*Acanthophis* (death adders), *Oxyuranus* (taipans), and *Pseudonaja* (brown snakes)) were more likely to move away from sound, signalling potential avoidance behaviour (Zdenek *et al.*, 2023). The extent to which reptile species native to Queensland rely on aural cues for reproduction or other important behaviour is unknown (Sordello *et al.*, 2020). Grey snake (*Hemiaspis damelii*) and common death adder (*Acanthophis antarcticus*) are viviparous. The grey snake (*Hemiaspis damelii*) gives birth to live young between January and March (Shine, 1987; cited in DCCEEW, 2022b). Common death adder (*Acanthophis antarcticus*) mating usually occurs in spring, however, females reproduce only every second year (DESI, 2024b). It is considered likely that these reptile species have the mobility and range to move away from the source of disturbance for the duration of works, and return on completion.

Listed wetland bird species including the glossy ibis (*Plegadis falcinellus*), rufous fantail (*Rhipidura rufifrons*), and satin flycatcher (*Myiagra cyanoleuca*) have the potential to use habitat in the area. and suitable breeding habitat exists in the area for each species. All three species are considered likely to only utilise habitat in the area intermittently and opportunistically however, as there are more significant and suitable wetland areas in the greater landscape.

5.2.6.2 OPERATIONAL NOISE AND VIBRATION

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

The main sources of noise for a freight train are the diesel engine, the engine exhaust located near the top of the locomotive and the interaction of the wheels with the rails. The wheel-rail interaction results in rolling noise and vibration from both the locomotives and the wagons. Discrete noise events can also occur as trains transfer between tracks at turnouts, and when trains travel uphill, downhill, or along curved track sections. At crossing loops, noise can be produced by locomotive or train horns, crossing bells, idling locomotive engines, acceleration and braking operations and wagon bunching. Noise from railway operations will be infrequent and only occur when trains are passing in the immediate local area. Once a train has passed through, there will be no further railway noise until the next train is scheduled. It is estimated that once operational, the Project will involve an annual average of 14 train services per day during initial years of operation. This is likely to increase to an average of 20 trains per day after 15 years, and approximately one train an hour during peak operational periods.

Modelling has been undertaken for the predicted noise and vibration impacts associated with operational activities along the entire Project footprint, and is summarised in revised draft EIS Chapter 16: Noise and Vibration. Analysis of sound power and frequency range associated with operational activities indicates that the harmonic ranges produced (i.e. Hz) overlap with the hearing range of birds and other species likely to occur in the area and therefore will be perceivable by these species.

Operational rail noise levels considered have been based on the predicted single event maximum (SEM) noise levels which are an average LA_{max} noise level from rail pass-by events. The unmitigated noise modelling completed shows that areas approximately 500m on average, on either side of the rail line will be impacted by 80 + dB(A) levels, reducing to around 60 dB(A) within approximately 1,500 m from the rail line. It should be noted that sound levels that exceed 80 dB(A) will only occur during locomotive pass by and is usually a result of locomotive or train horns.

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

The overlap in the frequency range for bird song and those species identified in Table 5-3, or similar, has the potential to result in masking communication where the noise interferes with the use of acoustic signals critical to many species (Halfwerk *et al.*, 2011), including calling to attract mates, territory defence, and warning of predators. Australian frogs adjacent to road noise have also been shown to reduce in diversity, increase calling effort and subsequently

reduce in body mass closer to the roads (Hoskin and Goosem, 2010). However, the duration of the noise (i.e., pulse) and the intensity (dB) are unlikely to result in significant changes to species behaviour or avoidance of the area.

Linear transport infrastructure already occurs throughout the Study area, in the form of highways, local roads and rail. Approximately 68 km of the Project will utilise existing rail corridor and, whilst the Project will result in an increased intensity of rail operation, operational rail noise is an existing component of the local conditions in these areas. Based on this, it is expected that most, if not all resident species are accustomed to some form of transport noise and are likely to have mechanisms to adapt to the increased train movements. Ghosh et al. (2010) illustrated that house sparrows (*Passer domesticus*) were able to adapt to loud noise from passing trains (between 35 – 95 dB(A)) (Ghosh et al., 2010; Lucas et al., 2017).

Although a large portion of the Project will utilise pre-existing rail, greater noise impacts will likely be in areas of newly constructed rail, particularly within Bringalily State Forest, small riparian areas and patches of small woodlands, and undeveloped areas where noise mitigation measures are not in place to minimise impacts to human sensitive receptors throughout the Project footprint. Operational noise may lead to some fauna temporarily vacating/avoiding nearby habitat, particularly mobile species such as brown treecreeper (south-eastern) (*Climacteris picumnus victoriae*), southern whiteface (*Aphelocephala leucopsis*), and glossy black-cockatoo (south-eastern) (*Calyptrorhynchus lathami lathami*). A study which examined fauna response to noise impacts found that the most frequently reported response to traffic noise from cars, trains and aircraft is animal movement away from the noise source (Erbe et al., 2022). However, many animals become habituated to noise (Radle, 2007). Wiącek et al. (2015) found that the noise generated by passing trains did not have a negative impact on either the abundance of birds or the numbers of woodland bird species.

Reptiles appear to ignore rail traffic (Lucas et al., 2017) and are highly mobile, with large enough home ranges that they are able to move in and out of surrounding habitats to avoid disturbance if desired. Reptiles are not considered likely to be significantly impacted by noise and vibration as a result of operational activities.

There is no available literature documenting the effect of transport noise on Australian breeding wetland birds. One study of the effects of road traffic found no evidence of a relationship between road traffic noise and wetland birds, however none of the measurements in the study exceeded 62 dB(A) (Phoenix Environmental Sciences, 2011). Kushlan (1979) found that behavioural responses of wading birds to helicopter and aircraft flyovers at a nesting colony in southern Florida found that in 90% of the observations, birds either showed no reaction or merely looked up, and that no bird that left its nest failed to return within five minutes. It is likely that even if breeding birds are present, they will utilise suitable habitat away from the source of disturbance.

Operational rail noise does have the potential to interfere with fauna connectivity, where fauna may be disinclined to use crossing structures as a result of higher levels of noise close to the rail line. This will be an important consideration in areas where the rail line intersects known wildlife corridors to avoid indirect impacts of fragmentation. Mitigation measures to reduce the impacts of operational noise to sensitive receptors are discussed in Section 6.3.

5.2.7 AIR QUALITY AND DUST

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

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

5.2.8 LIGHTING

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

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 Long core, 2006), although other species may avoid well-lit areas (Threlfall *et al.*, 2013). Nocturnal mammals (e.g. greater glider (*Petauroides volans*), and rodents) have been shown to reduce the total duration of activity under artificial light, as they risk higher rates of predation (DCCEEW, 2023f).

Artificial lighting can also impact plants, which rely on natural light cycles to regulate daily activities including photosynthesis, water and nutrient cycles, growth rest and repair. Natural light cycles also provide a signal to adjust morphology and physiology to match natural lighting conditions and for the timing of seasonal events (DCCEEW, 2023f).

Lighting associated with construction of the Project will include security lighting at laydowns and office, flashing beacons and temporary spotlights in support of short-duration night works, if required and will be relatively short term in nature.

Lighting associated with the Operational phase (head lamp on rollingstock and safety lighting at road-rail interfaces), will exist as pulses of shorter duration (for rolling stock) at frequencies determined by operational schedules.

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

5.2.9 INCREASE IN WASTE

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

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

Regulated waste generated by the Project, will be managed in accordance with the *Queensland Environmental Protection Act 1994, Environmental Protection Regulation 2019*. As such, it is considered not likely to have an impact on threatened flora and fauna.

5.2.10 ALTERED HYDROLOGY AND FLOODING

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

Potential impacts on local and regional flooding behaviour, the community and the environment have been assessed for the Project's Operations stage. A detailed hydraulic assessment has been undertaken to establish the existing flooding regime (the 'existing case') and the development of hydraulic models based on the revised reference design to model expected change (the 'developed case'). Modelling and analysis has identified changes to the existing

flooding and fluvial geomorphic regime that can be expected as a result of the Project and to identify areas where additional mitigation is required.

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

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

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

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

Unmitigated, the Project has the potential to impact the surrounding environment (including MSES species and associated habitat) by altering flooding and hydrological regimes, including increased and decreased areas of inundation. Impacts on MSES associated with flooding were assessed through a stepped process detailed in the following sections.

5.2.10.1 RISK ASSESSMENT

Protected matters were included in the initial flooding assessment if they met one of the following criteria:

- Sensitive to or threatened by changes in hydrological regimes as identified in the literature.
- Inhabits aquatic, wetland, riparian or floodplain environments (so that indirect impacts to habitats is considered).
- Have low and/or terrestrial mobility (highly mobile species (e.g., birds and bats) and species that do not come to the ground (e.g., gliders) can generally avoid changes in flood regimes). Additionally, the potential impacts to the habitat for these species (i.e., birds, bats and gliders) would have to be substantial for the habitat to become unusable for them (e.g., death of large trees, long-term reduction in flowering productivity, vegetation structural changes).

These criteria were used to assess whether protected matters are at negligible, low, medium or high risk to changes in hydrology (see Table 5-6). Although migratory wetland birds do inhabit wetland areas, their risk rating was determined to be negligible due to their likely increased use of the area following flood events. The changes to flooding caused by the Project are unlikely to impact these species, as they can be attracted to suitable habitat during and after floods. The Project will not impact on the overall frequency and size of flood events, and therefore, will not impact the use of the area surrounding the Project by these species.

TABLE 5-6 RISK ASSESSMENT FOR FLOODING IMPACTS TO NC ACT LISTED SPECIES

Scientific name	Common name	NC Act	EPBC Act	Low and/or terrestrial mobility	Inhabits aquatic, wetland, riparian, or floodplain environments	Threatened by changes in hydrology	Risk rating
<i>Cyperus clarus</i>	-	V	-	Yes	-	-	Low
<i>Picris barbarorum</i>	-	V	-	Yes	Yes	-	Medium
<i>Aphelocephala leucopsis</i>	Southern whiteface	V	V (listed 31/03/23)	-	-	-	Negligible
<i>Apus pacificus</i>	Fork-tailed swift	SLC	Mi	-	-	-	Negligible
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	SLC	V (listed 05/01/24); Mi	-	Yes	-	Negligible – see text above table
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (south-eastern)	V	V (listed 10/08/22)	-	-	-	Negligible
<i>Climacteris picumnus victoriae</i>	Brown tree-creeper (south-eastern)	V	V (listed 31/03/23)	-	-	-	Negligible
<i>Gallinago hardwickii</i>	Latham's snipe	SLC	V (listed 05/01/24); Mi	-	Yes	-	Negligible – see text above table
<i>Hirundapus caudacutus</i>	White-throated needletail	V	V (listed 04/07/19); Ma; Mi	-	-	-	Negligible
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern)	E	E (listed 31/03/23)	-	-	-	Negligible
<i>Myiagra cyanoleuca</i>	Satin flycatcher	SLC	Mi	-	-	-	Negligible
<i>Ninox strenua</i>	Powerful owl	V	-	-	-	-	Negligible
<i>Plegadis falcinellus</i>	Glossy ibis	SLC	Mi	-	Yes	-	Negligible – see text above table

Scientific name	Common name	NC Act	EPBC Act	Low and/or terrestrial mobility	Inhabits aquatic, wetland, riparian, or floodplain environments	Threatened by changes in hydrology	Risk rating
<i>Rhipidura rufifrons</i>	Rufous fantail	SLC	Mi	-	-	-	Negligible
<i>Stagonopleura guttata</i>	Diamond firetail	V	V (listed 31/03/23)	-	-	-	Negligible
<i>Tringa nebularia</i>	Common greenshank	SLC	E (listed 05/01/24); Mi	-	Yes	-	Negligible – see text above table
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	-	-	Yes	-	Low
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	-	Yes	-	-	Low
<i>Acanthophis antarcticus</i>	Common death adder	V	-	Yes	-	-	Low
<i>Hemiaspis damelii</i>	Grey snake	E	E (listed 05/10/22)	Yes	Yes	-	Medium

5.2.10.2 HABITAT MAPPING OUTSIDE OF THE PROJECT FOOTPRINT

Habitat for threatened species was mapped outside of the Project footprint to 5 km from the centre of the rail line using the habitat mapping rules for each species, as presented in Appendix G Species Profiles. This area covered the modelled changes in flooding for the 1% AEP scenario as presented in revised draft EIS Chapter 14: Flooding and Geomorphology. While using the same mapping rules, the key difference in habitat mapping in this 5 km buffered area to the habitat mapping within the Project footprint is the use of State regulated vegetation mapping (desktop based) in the 5 km buffer area compared to ground-truthed RE mapping (field verified) within the Project footprint. Where available in some areas (e.g., offset properties), ground-truthed RE mapping was used to inform habitat mapping. Ozius Biome Specht classified data (20m pixel (20m x 20m)) was also used to map habitat more accurately (Ozius Pty Ltd).

5.2.10.3 ASSESSMENT OF SUSCEPTIBILITY

This habitat mapping was overlaid with the change maps for inundation area for the 1% AEP flood scenario and the percentage of habitat impacted outside of the Project footprint was calculated. This assessment was conducted for habitat within a 1 km buffer of the rail line to compensate for potential dilution of impacts to habitat due to not all flood impacts extending out to 5 km from the rail line. Each threatened species was assigned a susceptibility rating, based on the percentage of habitat impacted. Ratings were either negligible (<1% of habitat impacted), low (1-3%), medium (3-5%) or high (>5%) (see Table 5-7). Threatened species with a medium or high susceptibility rating (>3% of habitat impacted) were then assessed for flooding impacts in detail.

This assessment identified three species for further assessment, being hairy-joint grass (*Arthraxon hispidus*), winged peppercress (*Lepidium monoplacoides*), and small-flowered westringia (*Westringia parvifolia*). These three species are all MNES and their detailed assessment is in revised draft EIS Appendix O: Matters of National Environmental Significance Report. No fauna habitat or MSES species' habitat were triggered for further assessment. Despite this, the assessment (quantification of flooding impacts and impact assessment) methodology is outlined for completeness.

TABLE 5-7 FLOOD SUSCEPTIBILITY ASSESSMENT USING THE 1% AEP (1 IN 100 YEAR) FLOOD SCENARIO

Scientific name	Common name	NC Act	EPBC Act	Risk rating	Habitat impacted by change in inundation area (%) ¹	Susceptibility rating ²
<i>Cyperus clarus</i>	-	V	-	Low	0.23	Negligible
<i>Picris barbarorum</i>	-	V	-	Medium	0.23	Negligible
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	-	Low	0.75	Negligible
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	-	Low	1.22	Low

Scientific name	Common name	NC Act	EPBC Act	Risk rating	Habitat impacted by change in inundation area (%) ¹	Susceptibility rating ²
<i>Acanthopis antarcticus</i>	Common death adder	V	-	Low	0.62	Negligible
<i>Hemiaspis damelii</i>	Grey snake	E	E (listed 05/10/22)	Medium	1.44	Low

Table note:

¹The percentage of habitat was calculated within 1 km of the rail line.

²Susceptibility ratings: negligible (<1% of habitat impacted), low (1-3%), medium (3-5%), high (>5%).

5.2.10.4 QUANTIFICATION OF FLOODING IMPACTS

Water flow changes for the flood events 20% AEP, 10% AEP, and 5% AEP were used to assess impacts to the three flora species and their habitats. These more frequent flood events are likely to be more relevant to threatened species, communities and their habitats. Any changes to water flow during larger, less frequent floods (2% AEP or 1 in 50-year flood and larger) are unlikely to be biologically meaningful during such large flood events.

In assessing potential impacts, each species was considered as well as potential changes to essential features of species habitat. Impacting variables and thresholds for significant impact used were species-specific. For flora species, this generally included areas of increased or decreased inundation, duration of inundation exceeding 36 hours (only where this was below 36 hours for the existing case) and increases in velocity greater than 1 m/s. The threshold of 36 hours for flora was used as an estimation of the inundation time for anoxia to occur.

Changes to peak flood depth was not considered to be a significantly impacting variable when assessing potential impacts.

5.2.10.5 IMPACT ASSESSMENT

A significant impact was determined to occur over 10% of habitat is predicted to be impacted beyond the set threshold for the impacting variable. For example, for a significant impact to be determined for a flora species, over 10% of its habitat would be impacted by either additional (or reduced, depending on the species) inundation area, increased flow velocities >1 m/s, and/or increase in inundation duration to over 36 hours.

The quantification and impact assessment results for hairy-joint grass (*Arthraxon hispidus*), winged peppergrass (*Lepidium monolocoides*), and small-flowered westringia (*Westringia parvifolia*) are presented in revised draft EIS Appendix O: Matters of National Environmental Significance Report. No species were assessed as significantly impacted by changes to flooding.

The revised reference design has incorporated significant flooding infrastructure such as bridges and culverts to maintain existing flow paths and flood-flow distributions and minimise the potential for adverse impacts to the surrounding environment from changed overland flow and flooding conditions leading to erosion, sedimentation, increased risks of flooding and environmental concerns. This includes the Condamine River floodplain where significant

bridges have been incorporated into the Project's revised reference design with a combined opening width of greater than 6 km. The Project's cross drainage infrastructure (bridges and culverts) includes 1,193 reinforced concrete box culverts, 2,134 reinforced concrete pipe culverts, a series of viaducts/bridge structures spanning approximately 11 km and rock scour protection at culvert outlets.

Bridge and culvert structures have been located and sized to minimise increases in peak water levels, flow distribution, velocities, time of inundation and hazard in order to minimise risks to surrounding property and the environment. Sections of existing rail track currently have only small drainage culverts, and the upgrading of this track with larger drainage structures will in fact return the drainage and flow conditions in these areas to a more natural state than currently exists.

Site specific soil and geomorphology assessments have been undertaken to ensure potentially dispersive and other high risk soils have been identified, including in floodplains and watercourses, and design mitigations incorporated such as culvert configurations and scour and erosion protection measures, to mitigate erosion, sedimentation and landform risks.

The Project's impacts on hydrology and flooding in relation to non-ecological matters are discussed in detail within Appendix T1: Hydrology and Flooding Technical Report.

5.2.11 EROSION AND SEDIMENTATION

During construction and operation of the Project, there is potential for impact to soils resulting from disturbance and exposure of subsurface soils vulnerable to accelerated erosion, dispersivity, and/or salinity due to their physical and chemical characteristics, without mitigations. Soils within the Project footprint are described in revised draft EIS Chapter 9: Land Resources.

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

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

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

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

principally associated with a loss of substrate stability around vegetation and may result in a loss of vegetation quality and cover.

5.2.12 CHANGES TO GROUNDWATER RESOURCES

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

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

Terrestrial GDEs are susceptible to indirect impacts from changes to groundwater resources. For example, a reduction in groundwater level may cause spring wetlands (refer to Table 4-10) to reduce in size or dry up, resulting in a contraction of wetland extent, loss of aquatic habitat and reduction in species diversity. A decline in groundwater quality may also affect aquatic organisms living underground (e.g. stygofauna) or present within surface waters that are sources from impacted aquifers.

An evaluation of the potential impacts of the Project on groundwater resources (Chapter 15: Groundwater) concluded that the majority of potential impacts are temporary in nature and related to the construction phase of the Project. A small number of locations were identified where construction activities have the potential to intersect shallow groundwater resources, however, it is unlikely that the Project will have a significant impact on drawdown, and any impact will be temporary. Several studies in the region have concluded that a significant impact to vegetation condition within GDEs occurs when drawdown is reduced by 9 meters or greater (Kath et al., 2014; Pfautsch et al., 2015). As such, engineering controls were assessed to be sufficient to manage the extent of impacts. Additionally, due to the nature of the floodplain, the region is accustomed to seasonal variation in surface water levels (Holland et al., 2016; DES, 2019) to recharge the groundwater aquifer. Further details on the predicted changes to groundwater resources are provided in the Appendix U: Groundwater Technical Report.

5.2.13 CONTAMINATION

5.2.13.1 CREATION OF CONTAMINATED LAND

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

- Movement of contaminated materials (soils or water) from a source of contamination to an uncontaminated location, for example:

- The stockpiling of contaminated material on land that is not contaminated; and
- The discharge or dispersion of contaminated water onto land that is not contaminated.
- Accidental leaks or spills leading to migration of contaminants through surface water, soil and/or groundwater. Such incidents may arise due to inappropriate storage of dangerous goods and hazardous materials or poor handling of these materials.

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

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

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

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

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

5.2.13.1 DISTURBANCE OF CONTAMINATED LAND

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

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

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 (via pathways), and the sensitivity of the receptor.

Based on the land uses within the Study area, findings of a desktop assessment and field investigations, the potential sources of contamination in the vicinity of the Project footprint 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. Operation: hydrocarbons, metals, and pesticides/herbicides.

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

5.3 POTENTIAL IMPACTS TO AQUATIC ECOLOGICAL VALUES

5.3.1 CLEARING OF RIPARIAN VEGETATION

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

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

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

Impacts of clearing riparian vegetation and associated aquatic microhabitat features has the potential to impact platypus habitat.

5.3.2 MODIFICATION OF AQUATIC HABITAT

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

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

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

5.3.3 WATERWAY BARRIER EFFECTS

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

There are six major creeks (Pariagara Creek, Bringalily Creek, Nicol Creek, Native Dog Creek, Back Creek and Grasstree Creek) and two major rivers, being the Macintyre River and Condamine River with potential habitat for Murray cod (*Maccullochella peelii*), which will be intersected by the Project (Aquatic Biopassage Services, 2024). Fish-friendly bridge crossings are proposed at most higher order waterway crossings to minimise potential physical and behavioural fish movement impacts.

5.3.4 ALTERED HYDROLOGY

The installation of artificial structures such as culverts has the potential to alter natural stream flows and flow paths in some locations (Chapter 14: Flooding and Geomorphology). Hydrologic and hydraulic modelling predicted minimal impacts from Project infrastructure on flood flows, floodplain coverage and flow velocities under a range of flow scenarios, including extreme events. Predicted changes in flow velocities were limited in scale to immediately upstream and

downstream of culverts. At these locations, such changes may cause minor changes to the location, abundance, and structure of aquatic habitats, such as pools, channels, riffles, and dry creek beds. This can be expected to result in minor changes to the composition and diversity of aquatic organisms in affected locations and disturbance of aquatic species lifecycles may occur. Additionally, changes to hydrologic flow may result in habitat degradation through the introduction and establishment of weeds.

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

Changes to the timing and quantity of water flow downstream during major rainfall events are expected to be minor. These changes, have some potential to affect fauna migration and breeding activities such as spawning in fish, which are often linked to water levels and flow rates. Connectivity for aquatic fauna across the flood plains of the impact assessment area is not expected to be affected, due to the design of railway infrastructure. Culverts have also been incorporated into the revised reference design, with a majority of culverts within the Condamine River flood plain having a width or diameter of >2 m. These design features will minimise changes to hydrology and are adequate to facilitate continued connectivity among habitats of the flood plain by aquatic fauna, including fish and freshwater turtles. Further details on the predicted changes to hydrology are provided in revised draft EIS Appendix T1: Hydrology and Flooding Technical Report.

The platypus was included in the flooding impact assessment (see Section 5.2.10) and it was determined that the impacts are likely to be insignificant, with detailed quantification and assessment not being required.

5.3.5 WATER QUALITY

As discussed in detail in Section 5.2.13, construction activities have the potential to result in the introduction of contaminants into waterways, resulting in declines in water quality (e.g. from fuel spills). Similarly, the use of herbicides during future track maintenance has the potential to impact on vegetation and fauna living in and adjacent to waterways. An increase in access to aquatic habitat by people during construction (i.e. construction workforce) has the potential to result in litter being deposited within or adjacent to waterways. Such contaminants can be expected to reduce water quality and the quality of aquatic habitats in areas affected, and adjacent areas downstream.

5.3.5.1 INCREASED TURBIDITY AND SEDIMENTATION

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

render them ineffective in relation to their ability to support aquatic species. Large sediment accumulations can cause upstream flooding or deflect the flow into the adjacent stream bank or even onto adjacent land, causing further erosion. Transported sediments can fill the deep permanent pools of rivers to ruin this critical refuge habitat.

Works adjacent to waterways will result in the exposure of soils which may be mobilised by rainfall and runoff into adjacent aquatic habitats, and also affect areas downstream.

Stockpiling of soils close to waterways is also a potential source of sediment inputs into aquatic habitats. Increased runoff to waterways is likely to result in a decline in water quality, through an increase in turbidity and total suspended solids concentrations, and potentially, an increase in the concentration of sediment-bound contaminants such as metals.

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

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

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

5.3.5.2 ALTERED WATER CHEMISTRY

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

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

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

stockpiling of sediment and Project-associated earthworks may result in saline discharge at drainage points into watercourses proximal to high salinity hazard areas.

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

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

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

Contaminants may also leach from the following sources during construction:

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

5.3.6 INVASION OF AQUATIC WEEDS AND PEST SPECIES

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

Some farm dams likely to contain exotic species will need to be dewatered to facilitate construction of the Project. This may result in the spread of pest (e.g. exotic fish species) and weed species, such as alligator weed (*Alternanthera philoxeroides*) and para grass (*Urochloa mutica*), to adjacent waterways, if not managed appropriately, resulting in a reduction in aquatic habitat quality and species diversity. There are some aquatic weed species that are present in the GRC and TRC local government areas that are present in one and not the other or the surrounding local government areas (GRC, 2019; TRC, 2020). The movement of machinery and vehicles across the Study area during the pre-construction, construction and operational phases of the Project has the potential to spread weeds into new localities.

5.3.7 DISTURBANCE FROM NOISE, VIBRATION AND LIGHTING

A range of construction activities are likely to result in an increase in noise and vibrations in the vicinity of waterways, reducing habitat quality and increasing disturbance to sensitive fauna. Noise modelling conducted for the Project did not assess noise impacts in water (as modelling was primarily an assessment of airborne noise; however, noise impacts in water

have not been assessed). Therefore, impacts to native fauna that reside within waterways (i.e., aquatic in nature, e.g., platypus (*Ornithorhynchus anatinus*)) have not been quantitatively assessed with respect to noise and vibrations for either the construction or operation phases of the Project (refer to Section 5.2.6.1).

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

5.3.8 CHANGES TO GROUNDWATER RESOURCES AFFECTING GROUNDWATER DEPENDENT ECOSYSTEMS

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

Regional aquatic GDE data from the GDE Atlas indicates that there are no high potential aquatic GDEs traversed by, or in proximity to, the Project footprint and one high potential terrestrial GDE located near Yelarbon. The nearest spring is Stone Spring, located 2 km west of Ch 173.0. There are numerous areas with low-to-moderate potential to support aquatic GDEs; therefore, there is potential for such GDEs to be impacted by possible dewatering or changes in groundwater quality and/or levels during the construction stage of the Project.

An evaluation of the potential impacts of the Project on groundwater resources (revised draft EIS Chapter 15: Groundwater) concluded that the majority of potential impacts are temporary in nature and related to the construction phase of the Project. As discussed previously in Section 5.2.12, a small number of locations were identified where construction activities have the potential to intersect shallow groundwater resources, however engineering controls were assessed to be sufficient to mitigate the extent of impacts. Controls to reduce the risk of contamination of groundwater quality from Project activities (e.g. spills) are also in place and are similar to those related to surface water quality. Further details on the predicted changes to groundwater resources are provided in revised draft EIS Appendix U: Groundwater Technical Report.

6. AVOIDANCE, MITIGATION AND MANAGEMENT MEASURES

The revised draft EIS has identified the proposed approach to environmental management and the mitigation measures that would be implemented to avoid or minimise the potential impacts of the Project. This section provides discussion of mitigation measures and controls that have been incorporated into the revised reference design development process (Section 6.2), and those measures that are proposed to be adopted for future phases of Project delivery (Section 6.3)

6.1 PRINCIPLES OF ECOLOGICALLY SUSTAINABLE DEVELOPMENT

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

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

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

6.1.1 PRECAUTIONARY PRINCIPLE

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

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

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

- The assessment of potential impacts is based on best practice, using the best available information. The assessment has involved key stakeholders and the relevant government agencies.
- The impact assessment considered the maximum area of disturbance.
- The broader Inland Rail program has been subject to a number of options assessments considering various route options, in consultation with key stakeholders, to inform the finalised route cognisant of the various constraints. This has been undertaken to lead to the most optimal outcome for the delivery of the Project in a manner that avoids and minimises impacts to the greatest extent practicable.

- The revised draft EIS draws attention to aspects of the Project that may cause serious and/or irreversible environmental damage, especially if the nature and extent of the damage is uncertain. Where environmental damage cannot be avoided, mitigation and management measures to protect the receiving environment are proposed. This includes securing offsets for unavoidable impacts to biodiversity values.
- Lack of full scientific certainty has not been used as a reason for postponing measures to prevent environmental damage. For example, if the likelihood of a threatened species occurring within the Project footprint was uncertain, for instance where the habitat preferences of the species are not well known or because the species is highly cryptic, a precautionary approach was taken, and the species was considered to have potential to occur within the Project footprint. Measures to avoid and/or mitigate impacts on threatened species are proposed, on the basis that these threatened species may be present within the Study area.

The detailed design phase will aim to further minimise impacts, and site and species-specific mitigation measures will then be applied to ensure that the significance ratings of any potential impacts are classified as low as reasonably practicable, and the significant impacts are offset.

- During development of the Project, the Project footprint has been refined to:
 - Avoid sensitive vegetation, areas with known threatened flora and fauna communities, and key habitat areas, where possible;
 - Avoid known items/areas of cultural heritage significance;
 - Minimise flooding impacts; and
 - Minimise impacts on existing agricultural land and infrastructure, while also considering potential future land uses.

6.1.2 INTERGENERATIONAL EQUITY

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

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

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

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

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

6.1.3 CONSERVATION OF BIOLOGICAL DIVERSITY AND ECOLOGICAL INTEGRITY

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

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

Impacts on biological diversity and ecological integrity have been avoided to the greatest extent possible given the stage of the Project. For example, surveys were conducted to verify the presence, extent and quality of threatened species' habitat and ecological communities within the Project footprint. The results were used to inform the development of the revised reference design (e.g. the Project footprint has been adjusted to avoid direct and indirect impacts to SEVT TEC and narrowed to reduce impacts to box-gum grassy woodland TEC as a result of further surveys that were undertaken (refer to Sections 3.3.2.2 and Section 4.2.2) and location of opportunities for fauna connectivity measures, fauna exclusion fencing, and landscaping, revegetation and rehabilitation works.

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

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

throughout the construction phase to reduce the impact of the Project on the surrounding environment.

- Other plans that will be developed to minimise potential impacts on biodiversity during the construction phase include a Biodiversity Management Plan, Biosecurity Management Plan and a Soil Management Plan as components of the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (Operational EMP).

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

6.1.4 IMPROVED VALUATION, PRICING, AND INCENTIVE MECHANISMS

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

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

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

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

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

- Reuse;
 - Recycle;
 - Recover energy;
 - Treat; and
 - Dispose.
- Increased economic growth and reduced freight transport costs because of Inland Rail have been recognised in revised draft EIS Chapter 18: Economics.

6.2 MITIGATION THROUGH THE REVISED REFERENCE DESIGN PHASE

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

- The Project has been positioned to maximise the use of existing rail corridors and, where possible, to be co-located with existing road infrastructure. Co-location with existing linear infrastructure minimises the need to develop natural and rural landscapes that have not previously been subject to disturbance.
- The Project footprint has been restricted to the area required to construct and operate the works in a safe and efficient manner. Restricting the temporary construction footprint and the permanent operational footprint minimises the extent of disturbance required to vegetation and habitats during construction and operation. The location and layout of the project including construction laydowns and workforce accommodation sites was reviewed iteratively in conjunction with field survey information to avoid and reduce impacts to environmental matters.
- Greenfield components of the Project have been aligned to minimise the extent of impact to:
 - Habitat for EPBC Act and NC Act threatened flora and fauna species;
 - Remnant and HVR 'Endangered' and 'Of Concern' REs;
 - Bringalily and Whetstone State Forests;
 - Watercourses;
 - Riparian vegetation and associated riverbanks; and
 - Steep slopes.
- Watercourse crossing structures (including culverts and bridges) have been designed to maintain aquatic fauna passage and minimise the risk of blockages.
- The Project has been designed to minimise impacts to watercourses, riparian vegetation, and instream habitats, and to maintain aquatic fauna passage by adopting high flood standards and through the incorporation of bridges and large culverts for permeability of overland flow and hydrological conditions through for landscape and catchments.
- Bridge and culvert structures have been located and sized to mitigate increases in peak water levels, flow velocities, and durations of inundation.

- The Project's drainage design was updated to include scour and erosion protection measures such as around culvert headwalls, drainage discharge pathways and bridge abutments to further reduce impacts at environmentally sensitive locations.
- The Project incorporates bridge and culvert structures designed to high flood standards to minimise change to the existing flood regimes and the potential for indirect impacts to threatened fauna and flora in the surrounding environment.

As part of the development of the revised reference design, and to reduce potential impacts to protected matters within the disturbance footprint (including workforce accommodation and laydown areas), the following actions were undertaken:

- Proposed railway and access tracks and potential Project laydown areas were located in areas where maximum disturbance footprints had already been proposed.
- Potential habitat for ecological values (flora and fauna) was identified and avoided where possible, utilising ground-truthed habitat mapping. This included the identification of where multiple species existed within the same area.
- Both the permanent and temporary footprint was adjusted in response to field surveys to void and minimise impact upon ecological values.

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

Waterway and watercourse crossings are part of the Project and have been incorporated into the design of bridges, viaducts and culvert arrays associated with permanent road, railway, and railway maintenance infrastructure. The flooding infrastructure associated with the Project involves the construction of 18 rail-over-watercourse bridges, 1,193 reinforced concrete box culverts, 2,134 reinforced concrete pipe culverts and a series of viaducts / bridge structures spanning approximately 11 km. The Project has been designed to minimise change to overland flow and surrounding hydrological profiles attributable to the Project, including minimising impacts to riparian vegetation and the bed and banks of watercourses and floodplains. This has been achieved through:

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

purpose and that unnecessary impact to the surrounding environment (waterways and scour / erosion) is avoided.

6.3 PROPOSED MITIGATION MEASURES

Mitigation measures that are proposed to be implemented to avoid or minimise the potential impacts of the Project are described in Sections 6.3.1, 6.3.2 and 6.3.3 for detailed design, pre-construction and construction, and operation stages, respectively. These mitigation measures address Project specific issues and opportunities and will form the basis for the development of the Project Biodiversity Management Plan, or where indicated, highlight how mitigation will be achieved through the implementation of other relevant plans. These mitigation measures have been considered in the assessment of significant residual impacts for all MNES/MSES protected matters in Section 7.

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

Revised draft EIS Chapter 24: Draft Outline Environmental Management Plan provides further context and the framework for implementation of these proposed mitigation and management measures. A summary of inspections, monitoring, auditing, and reporting to be undertaken for the project during the pre-construction and construction phase is provided in Table 6.5

6.3.1 MITIGATION MEASURES DURING DETAILED DESIGN

Table 6-1 outlines the proposed mitigation measures that have been developed and will be implemented during detailed design.

TABLE 6-1 PROJECT IMPACT MITIGATION MEASURES DURING DETAILED DESIGN

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

Aspect	Mitigation and management measures
	- Remnant riparian vegetation at Bringalily Creek; and - Remnant riparian vegetation at Native Dog Creek.
Fauna species injury and mortality	- Opportunities for potential translocation of threatened fauna individuals within the Project footprint will be investigated, particularly for reptile species and the brigalow woodland snail. This will include the following: - Appropriate habitat outside the Project footprint will be identified and surveyed during pre-construction surveys to inform potential translocation recipient sites. Offset sites will be used as a first preference for potential translocation recipient sites. - Development of a species-specific Translocation Management Plan, in accordance with the <i>Protected Animal Translocation Interim Policy</i> (DES, 2022). - Reduce train strike risk through the assessment and development of the design and location of fauna exclusion fencing, pursuant to the Fauna Connectivity Strategy having regard for the following: - The compatibility of each crossing structure approach with the general fencing principles at each location. - Safety requirements for the rail corridor and adjoining properties (e.g., rail corridor fencing has not been proposed across the Condamine River floodplain to prevent the possibility of debris accumulation in fencing during flood events). - Consultation with adjoining landowners to confirm the acceptability of a localised fencing approach and confirm compatibility with their land use operation. - Maintenance constraints that a fauna connectivity or fencing opportunity may introduce. - The provision of escape mechanisms such as jump outs, escape poles and one-way gates at regular intervals, which will be based on a review of results of monitoring of fauna fence escape mechanisms on other sections of Inland Rail (and other relevant studies) and incorporate these results into the detailed design of the Project. - Guidelines documented in the <i>Fauna Sensitive Transport Infrastructure Delivery manual</i> (DTMR, 2024). Where required, additional expert guidance in relation to specific design features will be sought during the detailed design process as required.
Introduction and spread of weeds, pathogens and pest species	- Consultation with TRC and GRC on the approach and priorities of biosecurity management for the Project to be consistent with the <i>Toowoomba Region Biosecurity Plan 2020</i> and the <i>Goondiwindi Regional Council Strategic Biosecurity Plan 2022</i>. - Liaison with GRC and DDMRB will be undertaken to confirm the fencing specifications for the wild dog check and rabbit exclusion fence, respectively. - Where the Project footprint impacts the operational sections of the wild dog check fence, the detailed design will require reinstatement of the fence on a like-for-like basis in consultation and agreement with the relevant stakeholders, including DESI, impacted landholders and lessees, DAF and GRC.
Habitat fragmentation (Loss of connectivity and barrier effects)	Incorporation of design requirements outlined in the Fauna Connectivity Strategy in Appendix P of the revised draft EIS in the Project's detailed design and documented in the Wildlife Connectivity Plan will be undertaken. Fauna crossing structures and other design features will be progressively developed over the Project's design duration to integrate fauna

Aspect	Mitigation and management measures
	connectivity in design decisions iteratively at the appropriate level of design maturity in conjunction with other requirements and constraints such as safety, cost, engineering and flooding through detailed design review gates. This will provide for ecological connectivity and dispersal function through the following: ○ The provision of additional fauna crossing structures, where suitable crossing opportunities are currently absent and considered required for the target species. ○ Modification of revised reference design drainage structures (size, configuration, shape, etc.) to facilitate fauna movement through the structure where required. E.g., Converting pipe culverts to box culverts, converting culverts to a bridge structure, or modifying dimensions. ○ Location and configuration of glider poles and canopy bridges to bridge gaps in canopy cover for successful crossing by arboreal mammals. These structures will extend to adjacent habitat trees that are a safe distance from the rail corridor to enable direct tree canopy to crossing structure movements for arboreal species. ○ Inclusion of fauna furniture within and adjacent to approaches of crossing structures, including but not limited to koala refuge poles and rails. ○ Vegetation clearing to be minimised as much as possible at watercourse crossings and PCZs identified as important zones for landscape-scale corridor connectivity, to reduce the size of gaps in tree-cover to facilitate movement of gap-sensitive woodland birds and other target species. ○ Fauna-exclusion fencing to funnel fauna into crossing structures and prevent them from accessing the railway to reduce the risk of wildlife-train collisions. ○ Noise and light controls (e.g., baffles or walls) where noise and light impacts have the potential to impede the use of the fauna crossing structures. These controls will be detailed in the Wildlife Connectivity Plan. ○ Landscaping and strategic revegetation within PCZs and in approaches to all fauna crossing structures to enable consideration of ground coverings and low shrubs for fauna movement. ○ Bridge design at major watercourses will aim to minimise disturbance to riparian vegetation as far as practicable to support fauna movement, particularly in PCZs. ○ Permanent physical barriers will not be created in defined watercourses that could present a risk to aquatic fauna by restricting flow or result in changed flow conditions such as increased velocity, changed flooding behaviour or introduced turbulence that may adversely impact aquatic fauna. • Placement of bridge piers and other infrastructure required in the bed of defined waterways will avoid low flow zones to minimise disturbance to aquatic fauna passage and water flow during periods of low flow.
Noise and vibration	• Management measures for any indirect noise and vibration impacts will be considered and detailed in the Wildlife Connectivity Plan where required, with reference to the rationale and approach of the <i>Fauna Connectivity Strategy and Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024).
Lighting	• A risk-based Wildlife Lighting Assessment would be undertaken and a Wildlife Lighting Management Plan would be prepared in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023) to consider and manage impacts of artificial light on wildlife for both the construction and operational Project stages. The Wildlife Lighting Management Plan would also incorporate mitigation recommendations

Aspect	Mitigation and management measures
	outlined in the <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024). The outcomes of the assessment will be incorporated into construction methodology and design attenuation measures to manage artificial light for those species where artificial light has been demonstrated to affect behaviour, survivorship or reproduction. Mitigation measures will consider the use of blue light filters, shields for reducing light spillage, at-receptor treatments and any attenuation measures required to mitigate adverse impacts of artificial light on biodiversity corridors and fauna passage function. Project lighting will be developed in accordance with the minimum level required to meet safety requirements for the Project.
Altered hydrology and flooding	- The Project design will continue to refine the cross drainage to preserve existing flood patterns and characteristics as far as practicable to minimise and manage indirect impacts to ecological receptors through the following: - Minimising changes in natural flow patterns and changes to flood-flow distribution across floodplain areas. - Maintaining drainage paths that are conveying runoff from adjoining terrain, minor watercourses, and gullies, to avoid ponding of water and/or excessive duration of inundation. - Reassessing flooding mitigations, if required based on the outcomes of additional erosive threshold velocity (ETV) analysis using site-specific and direct assessments by a suitably qualified specialist (e.g. flume method). - Minimising water ponding through surface levelling and use of cross-drainage and longitudinal drains within the rail corridor. - Designing water retention structures, such as sediment basins, to prevent downward leakage of water, with the use of lining or similar. - Avoiding, where possible, the need for diversions or alterations to water resources.
Erosion and sedimentation	- Additional geotechnical and soils investigations will be undertaken to inform the design of earthworks, drainage infrastructure, foundations, and construction methodology for the Project including: - Cuts and embankments; - Bridge piers and abutments; - Floodplains, streams and gullies; - Disturbance of potentially erodible soils and in areas in or near high value receiving environments such as watercourses, floodplains, high value vegetation and agricultural land; and - Disturbance of any potentially hazardous soils, specifically material within or on the floodplains in cut off relict streams and billabongs or lakes adjacent to Macintyre River, Macintyre Brook, Condamine River and Oxley Creek. - The following will be considered during detailed design as described in revised draft EIS Chapter 9: Land Resources: - The ETV for natural ground surfaces will be established from a site-specific assessment by a suitably qualified specialist, and in consideration of engineering guidelines. Drainage design and mitigations will be re-visited in response to updated assessments. - Identify and pursue further opportunities to minimise disturbance to existing landform to construct, operate and maintain the Project safely and efficiently.

Aspect	Mitigation and management measures
	○ Opportunities for embankment batter slope optimisation will be investigated with respect to soil type and geological profiles to incorporate best practice treatment controls and erosion protection in the final project design. ○ Optimise civil earthworks to minimise the overall fill deficit of the project, maximise opportunities for material re-use and lead to as close to a net balance in earthworks as possible, including reusing excess material for works within the permanent footprint (e.g. landscaping) and for restoration of modified landform within the temporary footprint (e.g. restoring borrow pits). ○ Reuse of excess material for other developments (i.e., neighbouring construction activities), with priority given to other adjoining Inland Rail projects. ○ Identify opportunities for optimised embankment and batter slopes for optimal stability and erosion protection. ○ Identify sources of materials which may be needed for any soil stabilisation requirements (e.g., lime) from licenced facilities and seek required approvals. Appropriate risk mitigation and safety measures will be identified for the safe transport and onsite storage of stabilisation materials including to lime and gypsum, to avoid spillage and minimise associated dust. The placement and treatment of the stabilisers during construction will also be planned to avoid spillage and minimise associated dust.
Aquatic habitat degradation	• The Project will be designed to avoid then minimise the potential for diversion of watercourses (as defined under the Water Act) and waterways (as defined under the Fisheries Act) where practicable. • Develop the detailed design to further minimise impacts to waterways, riparian vegetation and in-stream flora and habitats, in accordance with the intent of the following: ○ Adopting a waterway crossing structure hierarchy: bridges preferred to culverts, to maintain permeability for fauna through identified priority connectivity zones such as riverine corridors, biodiversity corridors for target fauna, however local conditions and constructability impacts must be considered when determining the preferred environmental solution. ○ Continuing to refine the Project in response to hydraulic modelling outcomes. This includes addressing flood impact objectives which include consideration of peak water levels, flow distribution, velocities, and duration of inundation, and implications for fish passage. This will confirm bridge lengths, culvert sizing and numbers, localised scour, and erosion protection measures for both rail, road and other permanent Project infrastructure. • An in-stream monitoring program will be developed and commenced to inform design and management measures to be used at proposed waterway crossing activities during construction. • Design watercourse crossing structures (including culverts and bridges) to maintain fish passage where applicable in accordance with <i>Accepted development requirements for operational work that is constructing or raising waterway barrier works</i> (DAF, 2018) or conditions of development approval for operational work that is constructing or raising waterway barrier works. Detailed design to minimise the need for ongoing maintenance and inspection to maintain fish passage.

Aspect	Mitigation and management measures
	Further seasonal fish surveys, for any waterway intersections that do not meet accepted development requirements for waterway barrier works requirements, to be conducted during times of adequate flow to gain an understanding of the baseline fish species composition and population abundance of these species
	Stormwater controls, such as scour protection, will be developed and incorporated, where necessary, in accordance with the Project's flooding and geomorphology mitigation framework to manage impacts to the surrounding environment including water quality of wetlands and waterways and subsequent impacts to aquatic and terrestrial species that rely upon receiving environments a source of water. Measures will be appropriate to the site conditions, responding to the erosion risk assessment, environmental receptors, climatic zone, and seasonal factors.
	Design modifications during the detailed design 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.

6.3.2 MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTRUCTION

Table 6-2 outlines the proposed mitigation measures that have been developed and will be implemented during pre-construction and construction.

TABLE 6-2 PROJECT IMPACT MITIGATION MEASURES DURING PRE-CONSTRUCTION AND CONSTRUCTION

Aspect	Mitigation and management measures
Habitat loss through clearing	- A Biodiversity Management Plan will be developed and implemented as part of the CEMP for relevant works. This plan will include appropriate criteria, directives and procedures in relation to the following: - Methods and sequencing of protected plant preclearance surveys. Flora species to be targeted through these surveys include MNES and MSES flora identified as known, likely or with potential to occur within the Project footprint. - Methods and sequencing of pre-clearance fauna surveys for relevant species. - Staging works so that they avoid animal breeding periods (for species that breed within Australia) as much as possible within areas of habitat where relevant works are proposed - Staged and sequential clearing protocols to all areas impacted by the Project where threatened species have been identified.

Aspect	Mitigation and management measures
	○ Animal handling protocols, including engagement of an approved fauna handler with a valid damage mitigation permit. ○ Relocation of plants and habitat features for threatened species, where possible, and documented evidence of previous relocation success. ○ Requirements for inspections and corrective actions during construction and rehabilitation activities. ○ Biodiversity/fauna and flora management actions will be undertaken by suitably qualified persons. ○ Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction. ○ Corrective actions if the outcomes do not achieve the adopted objectives. • Clearing limits and location of known sensitive areas (e.g., known MNES/MSES threatened species records and habitat areas) identified through pre-construction habitat surveys undertaken during the detailed design stage, will be supplied to the Principal Contractor via environmental constraints maps. • Construction personnel are to be informed of the environmentally sensitive aspects of the Project site, including plans for impacted and adjoining areas showing vegetation communities, important flora and fauna habitat areas, and locations where threatened species, populations or ecological communities have been recorded. • Clearing of native vegetation is to be minimised to the greatest extent practicable with the objective of reducing impacts to threatened ecological communities and threatened species. Clearing extents will be limited to the area safely and reasonably required for permanent and temporary works, avoiding impacts to native vegetation and habitats as far as practicable. • Prior to any pre-construction clearing works being undertaken, the clearing extents/site boundary/limit of works will be clearly defined and marked. Designated revegetation/rehabilitation zones and other no-go areas (including large significant trees and any threatened flora to be retained) will also be marked. High-visibility tape, barricade webbing or similar will be used. All contractors will be briefed on clearing requirements and restrictions (including fines) to prevent over-clearing of these areas. Construction areas, including compounds, stockpiles, fuel storage areas, laydown areas and staff parking, will be located and established outside the tree protection zone as defined in <i>AS4970-2009 Protection of trees on development sites</i>. • Pre-clearance surveys, including terrestrial and aquatic habitats undertaken in accordance with the Fauna Management Plan to include demarcation of habitat resources and habitat features that are suitable for translocation or salvage. • Salvage and relocation of microhabitat features for offset properties or other adjacent suitable habitat will be undertaken as part of rehabilitation, reinstatement, habitat enhancement and beneficial re-use activities, as far as practicable, including in areas identified as important for functional movement corridors (e.g. priority connectivity zones) with consideration of the <i>Fauna Sensitive Transport Infrastructure Delivery</i> manual (DTMR, 2024).

Aspect	Mitigation and management measures
	Destruction and disposal of microhabitat features will only be considered where there are no practicable re-use options. • Post-clearance surveys of disturbed areas to be undertaken to record extent of clearing that has occurred and to confirm that approved clearing limits have not been exceeded. • Where necessary, clearing activities are to be conducted in accordance with approved performance requirements under the accepted development vegetation management codes. • Where threatened flora species are retained or found to occur within the Project footprint, species-specific biosecurity controls will be implemented in proximity to the area of occurrence, where required. • A Rehabilitation and Landscaping Management Plan will be prepared as a component of the CEMP and finalised prior to project works. This plan will be based on the Inland Rail Landscape and Rehabilitation Strategy, Inland Rail Landscape and Rehabilitation Framework. It will establish the following: ○ Location-specific objectives, indicators, and success criteria for rehabilitation, reinstatement and/or stabilisation based on the hierarchy for rehabilitation. ○ Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilisation areas (including biodiversity, vegetation establishment and erosion and sediment control outcomes to be achieved). ○ Consideration for maintenance or performance issues of rehabilitation, e.g. use of groundcover that does not grow and obscure signals or impact the longevity of rail infrastructure, and suitable monitoring and contingency procedures for rehabilitation maintenance and redesign if required. ○ How the objectives align with relevant recovery plans, threat abatement plans, conservation advices, or policy guidance for target species in areas identified for rehabilitation. ○ Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, whilst minimising the duration of exposure in disturbed areas. ○ How the reinstatement approach considers native flora species to the Darling Downs and Toowoomba regions, the pre-cleared regional ecosystems and other suitable species appropriate to the landscape context and nursery/seed stock sources. ○ Revegetation of areas affected by the proposed project is to occur and will include cut and fill embankments. ○ Include rehabilitation requirements such as: – Milling and removal of bitumen pavement; – Removal of any decommissioned culverts; – Tying and ripping of base and sub-base material; – Application of soil ameliorants; – Topsoiling and/or compost blanket; and – Stabilisation and rehabilitation (e.g., planting and/or seeding).

Aspect	Mitigation and management measures
	○ Timeframes, measurable performance objectives and responsibilities for the success of rehabilitation and/or reinstatement/stabilisation areas. ○ Where appropriate, how the objectives align with relevant recovery plans, threat abatement plans, conservation advices, or policy guidance for target species in areas identified for rehabilitation. ○ Corrective actions if the outcomes of rehabilitation and/or reinstatement/stabilisation are not achieved. • Where temporary construction facilities are required, land will be returned to a stable condition that complies with the applicable landowner agreements and if relevant, regulatory approvals. • Reinstatement, stabilisation and rehabilitation of disturbed areas will be undertaken progressively, as work fronts are completed.
Fauna species injury or mortality	• In accordance with the Fauna Management Plan, the following mitigation measures will be incorporated into the Biodiversity Management Plan and implemented as part of the CEMP to prevent fauna injury or mortality during vegetation clearing activities: ○ Local wildlife groups will be contacted at least seven days prior to clearing to confirm they can receive any injured wildlife ○ Pre-clearance surveys to be undertaken by a suitably qualified ecologist within 48 hours of tree felling works and include the following: – Identification and marking of habitat resources and habitat trees (e.g., those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows and boulder piles). – Identification of threatened species or habitat features that are suitable for translocation or salvage. ○ Tree felling to be completed within 48 hours of pre-clearance surveys to limit the potential for new issues to arise (such as new active nests being built), adhering to recommendations made during the pre-clearance surveys. ○ Tree felling supervision will be undertaken by a suitably qualified Fauna Spotter Catcher after pre-clearance surveys have identified potential habitat features. ○ Prior to felling habitat trees identified in the pre-clearance survey, the following must be undertaken: – Completion of action of actions recommended from the pre-clearing surveys including salvage of identified habitat trees, additional assessments to determine threatened fauna usage of the area (if required), identification of active burrows or dens, any actions required to discourage fauna occupation and weed or feral animal requirements. – Removal of any non-habitat trees/vegetation as close to the habitat tree as possible in order to create disturbance to discourage fauna usage of the habitat trees – Shaking of habitat trees (with heavy machinery) as appropriate may be undertaken to encourage fauna to abandon trees. ○ On the day of felling habitat trees, the following must be undertaken: – All habitat trees will be subject to a visual inspection to survey for threatened species.

Aspect	Mitigation and management measures
	– Trees previously identified as containing fauna will be shaken and then felled, providing no fauna are identified. – The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery. – If fauna are identified in a habitat tree on the day of felling, the Fauna Spotter Catcher is to advise the most appropriate method to minimise harm. This may include leaving the tree overnight, further shaking, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in place, or measures to capture and relocate the animal to secure habitat. – Uninjured animals shall be released on the day of capture into nearby secure habitat and should not be held for extended periods of time. – Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised. – All felled trees shall remain in place for at least one night to allow any remaining fauna to escape. – Handling and relocation of terrestrial and aquatic fauna to suitable habitat and insuring injured and/or sick fauna are assessed and treated accordingly will be undertaken and recorded by a suitably qualified Fauna Spotter Catcher. – Allow safe and responsible handling of fauna (where required) and repatriation in pre-identified appropriate habitat outside of the Project footprint, in consultation with applicable landholders. • If any fauna is to sustain injury at any time during construction, the fauna must be handed over to appropriate wildlife carer personnel or veterinary clinic within 24 hours and correct ARTC personnel notified. • Management measures will be implemented to minimise fauna entrapment in excavations, including: ○ Minimising to the extent practicable, the period of time the excavation is left open, ○ Providing opportunities for fauna to exit the excavation; ○ Daily pre-start inspections of work areas and removal of trapped fauna by suitably qualified fauna handler as required. • In the event that native fauna are detected within the construction footprint, all mobile construction in the area will cease work. Mobile construction equipment will not recommence until a wildlife handler has removed the individual or it has been confirmed that the individual has left the workspace. Any captured wildlife will be removed and relocated to nearby adjacent habitat away from the construction area in accordance with the fauna handling procedure and recorded in the fauna handling record sheet. • Works which have the potential to impact on a protected animal breeding place will be subject to a Species Management Program. • A protected matters unexpected finds procedure will be prepared prior to construction and implemented as part of the CEMP Biodiversity Management Plan. In the event that unexpected threatened flora, fauna or TECs are discovered during construction the unexpected finds procedure will be implemented as follows: ○ Stop works, protect threatened species and inform ARTC.

Aspect	Mitigation and management measures
	○ Engage suitably qualified ecologist to undertake assessment and provide recommendations for management ○ Where impacts can be avoided: – Works may proceed. ○ Where impacts cannot be avoided: – Consult with agencies and submit management plan for approval, and – Recommence works with updated controls where necessary. ○ Update Biodiversity Management Plan and include species in subsequent inductions, toolbox talks, etc. • Vehicle speed limits will be controlled onsite to no more than 40 km/hr. • Temporary fencing will be installed around construction works where practicable, to discourage fauna from entering active construction zones. • The salvage and relocation of fish within isolated aquatic environments will be managed in accordance with <i>Guidelines for fish salvage</i> (Queensland Government, 2024). • 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; and ○ Records of all fish recovered, and the location of their release will be maintained. • Dewatering of dams/waterbodies to be supervised by a suitably qualified Fauna Spotter Catcher. • In the event of a spill incident during construction, any impacted aquatic environments will be assessed for the presence of fauna. If necessary, salvage and recovery efforts will be undertaken.
Reduction in biological viability of soil	• A Soil Management Plan will be developed and implemented as part of the CEMP which will include measures to avoid compaction and manage topsoils. • Topsoil stockpiles will be managed to maintain the viability of soil seed banks for threatened flora species. Topsoil stockpiles will be a maximum of 2.5 m in height to avoid heat sterilisation of the seed bank. • Structural impacts to soils will be minimised by restricting the temporary construction footprint to what is required to enable safe and efficient construction of the Project. • Construction activities will be sequenced to avoid longer than necessary duration of land disturbance and to enable timely rehabilitation post occupation when the land is no longer required to support the Project establishment.

Aspect	Mitigation and management measures
	- High traffic and heavy load works within areas of clayey and silty soils will be minimised during wet periods where possible. - Land that is temporarily disturbed in support of construction activities (e.g. for access tracks, laydown areas and storage areas, etc.) will be rehabilitated at the end of its use for construction progressively and as soon as possible, in accordance with the Rehabilitation and Landscaping Management Plan.
Introduction and spread of weeds, pathogens and pest species	- A Biosecurity Management Plan will be developed and implemented in accordance with the requirements of the <i>Biosecurity Act 2014</i> (QLD), as part of the CEMP. This will be developed in consultation with TRC and GRC to provide an approach and priorities that align with the <i>Toowoomba Region Biosecurity Plan 2020</i> and the <i>Goondiwindi Regional Council Strategic Biosecurity Plan 2022</i>. The plan will be based on current weed and pest listing advice and will include the following: - Requirements for pre-clearing surveys to determine current risks of weeds or pest animals being present within the Project footprint. - Maps of the existing extent, confirmed through surveys, and severity of weed infestation (e.g. restricted matters including mother-of-millions (<i>Bryophyllum delagoense</i>), opuntoid cacti, African boxthorn (<i>Lycium ferocissimum</i>), lippia (<i>Phyla canescens</i>) and lantana (<i>Lantana camara</i>) and weed management requirements. - Pest animal management controls, including protocols for severing, realigning, and reinstating the wild dog check fence and the Darling Downs Moreton Rabbit Board (DDMRB) rabbit fence. - Measures to confirm that soil movement complies with Queensland biosecurity requirements for managing the spread of imported fire ants (<i>Solenopsis invicta</i>). - Site hygiene and waste management procedures to deter pest animals. - Locations and procedures for vehicle washdown (light vehicle and oversize vehicles), wheel washes and rumble grids. - Weed surveillance and treatment during construction and rehabilitation activities such as: - Vehicle and plant washdown requirements for fleet moving from low-risk areas to and high-risk areas; and - 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. - Monitoring of the effectiveness of weed hygiene measures as a component of the environmental monitoring procedure for the Project. - Corrective actions should the outcomes not achieve the adopted objectives. - Property-specific weed hygiene requirements will be developed in consultation with the relevant landowners/operators prior to pre-construction/construction activities occurring on that property, outside of the permanent footprint. Protocols will be documented in individual property management agreements.

Aspect	Mitigation and management measures
	- Where the Project crosses the DDMRB fence at Ch 120.2 km, the fence will be reinstated, and a rabbit trap will be established in accordance with the design solution developed in consultation with DDMRB through the detailed design process. - Any vegetated material containing, or with the potential to contain, weed seed material will not be used for on-site mulching or erosion protection. - A complaints management system will be developed to enable members of the public, landholders or other stakeholders to make enquires or complaints, including concerns regarding weeds and pests on a 24-hour, seven-days-a-week basis during the construction stage.
Habitat fragmentation	- Implementation of the Wildlife Connectivity Plan, in accordance with the Fauna Connectivity Strategy to construct connectivity opportunities to maintain ecological connectivity and dispersal function is maintained. - Fauna movement opportunities will be constructed to reinstate safe fauna passage as soon as possible, in accordance with the detailed design and Wildlife Connectivity Plan. - Cleared vegetation, which may be mulched or stored as is depending on the reinstatement/rehabilitation requirements for specific areas, will be stockpiled separately in a manner that does not unreasonably impede wildlife - Rehabilitation to the banks of watercourses will occur as soon as possible after construction works in the area have been completed and will consist of suitable substrate to support fauna movement, with details documented in the Wildlife Connectivity Plan. - Construction works will be undertaken sequentially to allow fauna to move around construction work areas.
Noise and vibration	- A Noise and Vibration Management Plan will be prepared and implemented as a component of the CEMP, to minimise noise and vibration impacts as a result of construction of the Project through the following: - Plant and equipment will be selected to minimise noise emissions, in-so-far-as possible whilst maintaining efficiency of function. Mufflers will be fitted, and all noise control equipment will be maintained in good working order. - Where possible, plant will be located away from ecologically sensitive receptors. Appropriate mitigation measures will be investigated. If required, site access roads will be located as far as practicable away from noise sensitive areas. - Construction personnel are to be informed of any environmentally sensitive aspects of the Project site, including plans for impacted and adjoining areas showing fauna breeding habitat within a 500 m buffer, identified during pre-clearance surveys, and locations where threatened species, populations or ecological communities have been recorded.

Aspect	Mitigation and management measures
	• Works to be staged so that they avoid animal breeding periods as much as possible within areas of breeding habitat. Works which have the potential to impact an identified protected animal breeding place will be subject to a Species Management Program. • Where possible, plant will be located/oriented to direct noise away from ecologically sensitive receptors. Materials and stockpiles are to be used to increase acoustic shielding, where feasible. If required, site access roads will be located as far as practicable away from noise sensitive areas. • Where practicable, night works near ecologically sensitive receptors (e.g., breeding places, 'koala hotspots') will be scheduled to a restricted number of nights per week, with night-time traffic redirected away from noise-sensitive receptors. • All workers will be briefed on the importance of threatened fauna species, their location (where they are found to occur within or near the Project footprint), and procedures for working around them. Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration impacts.
Air quality and dust	• Implement controls to prevent or minimise dust generation during activities involving excavation or disturbance of soils or vegetation, or handling ballast (e.g. use water sprays or water carts for dust suppression as required) in accordance with the Air Quality Management Plan that will be prepared and implemented as part of the CEMP. This will reduce impacts to flora species and vegetation communities, as increased dust and reduced air quality can impact photosynthesis, and therefore the health of individual plants and vegetation.
Lighting	• Implementation of the Wildlife Lighting Management Plan to consider and manage impacts of artificial light on wildlife during construction in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023f). • As a minimum, off-site lighting impacts will be minimised by: ◦ External lighting is installed as low intensity lighting (except where required for safety or emergency purposes); ◦ External lighting does not shine above the horizontal; and ◦ Management of light generated during construction complies with <i>Australian Standard AS4282 (INT) 1997 – Control of obtrusive effects of outdoor lighting</i>, or its latest version.
Increase in waste	• Implementation of the Waste Management Plan as part of the CEMP to manage site hygiene and waste to avoid impacts relating to fauna. • • After implementing reuse opportunities where practicable, dispose of spoil (material with no reuse potential) offsite at a licensed facility.

Aspect	Mitigation and management measures
Altered hydrology and flooding	Short term impacts to fauna as a result of altered hydrology and flooding will be mitigated through construction planning and the layout of construction work sites and compounds which would be undertaken with consideration of overland flow paths and flood risk, avoiding flood liable land and flood events where practicable.
	Design temporary earthworks for the Project to avoid unwanted water ponding. This objective will be achieved through surface levelling and drainage, where required.
	Design water retention structures, such as sediment basins, to prevent downward leakage of water, with the use of lining or similar.
	Avoid, where possible, the need for diversions or alterations to water resources.
Erosion and sedimentation	A Soil Management Plan will be developed and implemented as part of the CEMP. The plan will include measures, process and responsibilities to minimise the potential for soil and water impacts, including impacts to groundwater, during construction.
	- An Erosion and Sediment Control Plan (ESCP) as a component of the CEMP will be developed prior to commencement of project works to manage project activities and works in a manner that minimizes harm to the surrounding environmental values. The ESCP will guide development of area, site, or section specific ESCPs and include detailed erosion hazard assessments and erosion and sediment control structure designs. The erosion and sediment control measures will be developed by a certified practitioner in erosion and sediment control and be in accordance with the International Erosion Control Association's <i>Best Practice Erosion and Sediment Control</i> (2008). Details will include the following: - Locations for specific temporary/permanent erosion and sediment control measures, such as: - Sediment retention basins; - Scour protection (included in the revised reference design); - Sediment fencing; and - 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. - Minimisation of the area of disturbance during each stage to that required to enable the safe construction, operation and maintenance of the project - Revegetating sites in a timely manner following completion of construction - Minimising disturbance (timing of clearing to minimise amount of exposed soil) - Scheduling of works with consideration to periods of higher rainfall (summer months) - Establishing and specifying the monitoring and performance objectives for handover on completion of construction - Stockpiling and management/segregation of topsoil where it contains native plants, seedbank or weed material. Establish and specify the monitoring and performance objectives for handover on completion of construction.

Aspect	Mitigation and management measures
Contamination of land	- A Contaminated Land Management Plan will be developed by a suitably qualified person, as recognised under the EP Act, and incorporated into the CEMP prior to commencement of Project works. To minimise/remove adverse impacts to ecological receptors during Project earthworks, this plan will include the following: - Specify management controls for works on land that is known or suspected of being contaminated and will outline the process to identify, document and manage contaminated sites. - Seek to minimise soil disturbance in areas listed on the Environmental Management Register (EMR). - Establish the methodology and sampling and analysis plan for environmental site investigation where soil disturbance is required on an EMR site in the potentially contaminated area. - Establish an unexpected finds protocol/procedure if potentially contaminated materials, including unexploded ordnance (UXO), are encountered during construction activities.
Modification of aquatic habitat	Avoid, then minimise the extent of temporary and permanent waterway diversions. Where temporary diversions are unavoidable, implement water quality and ESCP measures to minimise impacts to downstream environments and water users. Where permanent diversions are unavoidable, waterway diversion design to include simulation of natural features e.g. meanders, pools, riffles, shaded and open sections, deep and shallow sections, and different types of sub-strata, depending on the pre-disturbance environmental values, as per relevant guidelines and legislation. Maintenance activity locations, construction compounds and storage areas will be positioned away from waterways to the extent possible.
	Scheduling of construction activities to minimise time of works in or adjacent to drainage lines, waterways, or watercourses particularly during periods of flow.
	Laydown sites and stockpiles will be located an appropriate distance from riparian habitat to avoid indirect impacts on aquatic habitats. Direct impacts on in-stream vegetation and native vegetation on the banks of watercourses would be avoided, as far as practicable.
Waterway barrier effects	- Works within the bed and banks of a waterway or adjacent to watercourses will be conducted in accordance with the intent of the following: - Riverine protection permit exemption requirements (WSS/2013/726) or conditions of a riverine protection permit issued for the Project. <i>Accepted development requirements (ADR) for construction works that is constructing or raising waterway barrier works</i> (DAF, 2018), for example, construction methodologies within waterways. Where the Project is unable to comply with the ADR for construction works that is constructing or raising waterway barrier works, a development approval will be sought. - Vehicle crossings for construction of the Project will in the first instance, aim to meet the requirements for bed level crossings within the ADR for operational work that is constructing or raising waterway barrier works. Any waterway crossings that cannot meet the specifications within the ADR will require a development approval.

Aspect	Mitigation and management measures
Water quality	• A Surface Water Management Plan will be prepared and finalised prior to Project works and implemented as a component of the CEMP. The plan will be prepared in consultation with local governments, relevant agencies and other stakeholders, after the establishment of location-specific water quality objectives and prior to construction commencing. The Plan will provide a surface water monitoring framework which will be prepared in accordance with the <i>Receiving Environment Monitoring Program Guideline – for use with environmentally relevant activities under the EP Act</i> (DESI, 2014). The Surface Water Management Plan will provide information to support (if necessary) an evaluation of the potential impacts of releases of contaminants into wetlands and waterways (both ephemeral and permanent), including impacts on aquatic species, aquatic habitats, and species that rely upon the receiving environment as a water source. As a minimum the Plan will establish: ○ A description of the Project and construction activities of relevance to surface water quality; ○ A description of the receiving waters; ○ Water quality indicators (chemistry, turbidity, temperature, turbidity, electroconductivity) as specified in the Water Quality Guidelines; ○ Management strategies and mitigation measures proposed to satisfy the performance criteria and achieve the surface water environmental outcomes; ○ Monitoring details such as locations of monitoring sites, sampling frequency and timing having regard to seasonal variations, sampling methods and analysis of results; ○ Spill prevention measures, as well as spill response procedures (should an accidental discharge take place); ○ Spill management and discharge permitting system to reduce the risk of accidental discharge from site; ○ Compliance and corrective action requirements; and ○ Reporting requirements and schedule. • The Surface Water Monitoring Framework (see Chapter 13: Surface Water) will consider, where appropriate, aligning with the in-stream monitoring program. The in-stream monitoring program is to be developed for the purposes of monitoring impacts to riparian vegetation, aquatic fauna and habitats. It will be developed through the detailed design process to inform engineering design and management measures to be used at proposed waterway crossing activities during construction. • Refuelling will only occur at designated locations within the Project footprint and sited at suitable separation distances from ecological values, including surface water features and drainage lines. These refuelling locations will be equipped with on-site chemical and hydrocarbon absorbent socks/booms, spill kits and bunded as appropriate. • Where the dewatering of excavations (e.g., trenches, pier holes, etc.) is required, water will need to meet the established water quality objectives for receiving waterways before being released/discharged into local waterways. This will be managed in accordance with applicable guidelines and standards.
Invasion of aquatic weeds and pest species	• If dewatering of existing storages is required, dewatering strategies will be required to comply with the Biosecurity Act to take reasonable measures to avoid the spread of pest species, for example, screening of pump intake.

Aspect	Mitigation and management measures
Changes to groundwater resources affecting GDEs	A Construction Groundwater Management and Monitoring Program will be developed, with monitoring and sampling requirements dependent on the likelihood of construction activities encountering groundwater and the location of such activities. Monitoring will be targeted in areas where construction activities have potential to impact on groundwater quality and/or levels, as confirmed through detailed design.

6.3.3 MITIGATION MEASURES DURING OPERATION

Table 6-3 outlines the proposed mitigation measures that have been developed and will be implemented during operation.

TABLE 6-3 PROJECT IMPACT MITIGATION MEASURES DURING OPERATION

Aspect	Mitigation and management measures
Threatened flora	Should individuals of a threatened flora species be retained or be found to be growing within the Project footprint during or following rehabilitation, annual monitoring will be conducted for three years and corrective actions to be implemented where Project-associated impacts are identified.
Fauna species injury or mortality	ARTC will provide a communication mechanism for members of the public to notify ARTC of issues, including concerns regarding fauna injury or mortality, and the spread of weeds, pest animals and pathogens.
	Fauna exclusion fencing, fence escape mechanisms, connectivity structures and adjoining fauna furniture and vegetation within the rail corridor will be inspected and maintained in accordance with the Wildlife Connectivity Plan to retain integrity and reduce the likelihood of interaction between trains and fauna species
	Vegetation maintenance on the habitat side of the fauna exclusion fencing will be required to maintain a clearance zone such that species cannot use vegetation to climb onto the exclusion fencing, in accordance with the Wildlife Connectivity Plan.
	- The rail corridor will be inspected for trapped fauna during standard operational maintenance, in accordance with ARTC's rail corridor maintenance procedures and policies. - When an animal is detected within the rail corridor, if possible and safe to do so, the animal will be encouraged towards a fauna escape ramp, other escape mechanism or fence end, whichever is closest and provides a safe exit from the corridor. - Where required, a suitably qualified wildlife carer/handler will be engaged to remove trapped fauna and a health assessment will be undertaken by a wildlife veterinarian. - Information on the likely location of fauna breach of the fence will be used inform potential further measures to be applied to minimise/eliminate the risk of future incidents.

Aspect	Mitigation and management measures
	- All fauna detected within the rail corridor including healthy, injured, sick or dead fauna will be recorded and reported in the operations fauna management and incident register. - Injured or sick fauna as assessed by a wildlife veterinarian must be handed over to appropriate wildlife carer personnel or veterinary clinic in accordance with the Fauna Management Plan. - Permanent boundary fencing will be inspected and maintained as part of standard operational maintenance, in accordance with the ARTC's rail corridor maintenance procedures and policies to maintain integrity and reduce the likelihood of fauna entanglement. - Rail maintenance access roads will be speed limited to no more than 40 km/hr to reduce the risk of vehicle strike.
Introduction and spread of weeds, pathogens and pest species	- A Biosecurity Management Plan will be developed in accordance with the requirements of the <i>Biosecurity Act 2014</i> (QLD), GRC and TRC biosecurity plans and <i>ARTC operation and maintenance procedures and policies</i>, as part of the Operational EMP and implemented. This plan will be based on relevant weed and pest listing advice and will include the following: - Identification, locations and procedures for vehicle wash down, requirements for operational surveys to determine current risks of weeds or pest animals and appropriate weed management procedures. - Maps of the existing extent, confirmed through surveys, and severity of weed infestation (e.g. restricted matters and Weeds of National Significance) and weed management requirements. - Pest animal management controls. - Site hygiene and waste management procedures to deter pest animals. - Weed surveillance and treatment during maintenance activities. - Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to watercourses, known areas of MNES or MSES receptors and habitat, or land uses sensitive to spray-drift from the application of pesticides and herbicides. - Erosion and sediment control risks associated with broad scale weed removal or treatment. - Monitoring of the effectiveness of weed hygiene measures as a component of the environmental monitoring procedure for the Project. Ongoing weed monitoring within the rail corridor will aim to maintain the pre-construction condition of TECs and habitats that adjoin the rail corridor. - Any outbreak of priority weeds and/or weeds of national environmental significance would be managed in accordance with the <i>Biosecurity Act 2014</i>, the <i>Weeds of National Significance Weed Management Guide</i> (DEH, 2003), and the requirements of relevant authorities. - 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.

Aspect	Mitigation and management measures
	A predator monitor and control program will be developed as a component of the Wildlife Connectivity Plan to assess the abundance and use of crossing structures by predators that may reduce usage rates by target species. The program will be implemented for up to five years or until the habitat has been restored to a level that provides threatened fauna with protection from predators.
Habitat fragmentation and fauna connectivity	The post construction monitoring, evaluation and reporting program will be developed and detailed the Wildlife Connectivity Plan and will include monitoring of target fauna movements at crossing to assess the success of the fauna connectivity measures and crossing structures at managing fauna train strike risk and managing connectivity.
Lighting	Lighting associated with operation of the Project including from rollingstock and static infrastructure such as safety lighting at road-rail interfaces will be maintained in accordance with the Wildlife Lighting Management Plan to consider and manage impacts of artificial light on wildlife in accordance with the approach, monitoring and reporting detailed in the <i>National Light Pollution Guidelines for Wildlife</i> (DCCEEW, 2023f).
Aquatic habitat degradation	Maintenance activities within or adjacent to watercourses will be conducted in accordance with <i>Riverine protection permit exemption requirements</i> (WSS/2013/726) or conditions of a riverine protection permit issued for the Project.
Waterway barrier effects	- Works will be conducted in accordance with the <i>Accepted development requirements for operational work that is constructing or raising waterway barrier works</i> (DAF, 2018) or conditions of development approval for operational work that is constructing or raising waterway barrier works, as required. - Drainage infrastructure that provides for the flow of watercourses would be inspected and maintained in accordance with ARTC's standard operating procedures to address any issues that may contribute to the blockage of fish passage.
Erosion and sediment control	- The effectiveness and maintenance of permanent erosion controls (e.g. scour protection or vegetated swales) and surface and subsurface drains (including longitudinal drainage) would be monitored in accordance with ARTC's standard operating procedures. This will minimise detrimental effects on adjacent TECs, threatened flora species, wildlife habitat, wetlands and waterways, particularly downstream environments. - Additional inspections would be undertaken during and/or after flood events, dependent on the ability of operators to complete an inspection safely. - Controls that are found to be failing or not performing as intended will either be modified or replaced. - Where defects are identified and where it is deemed necessary, corrective actions will be undertaken as soon as reasonably practicable and where it is safe to do so. - Rail embankment slopes will be maintained to prevent slope face degradation.

6.3.4 MITIGATION MEASURES SPECIFIC TO MSES

Table 6-4

TABLE 6-4 outlines proposed mitigation measures that are specific to MSES.

TABLE 6-4 PROPOSED MITIGATION MEASURES SPECIFIC TO MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

MSES	Receptor-specific mitigation and management measures
Pre-construction and construction (in addition to those specified in Table 6-2)	
Aquatic SLC species: Platypus (<i>Ornithorhynchus anatinus</i>)	- Construction activities scheduled to avoid/minimise instream works and associated riparian habitat in identified habitat, where possible. - Construction works will, where possible, take place outside of the wet season when low flows in floodplain systems are more likely and potential impacts to platypus habitat can be reduced (e.g. erosion and sedimentation impacts to water quality). - Where a temporary impoundment or diversion is required for construction purposes and the species is found to be present, an appropriately qualified person will be consulted to make an assessment on the requirement for a species management program, should breeding places (i.e. burrows) be present. - Where possible, instream habitat will be reinstated to pre-construction state immediately upstream and downstream of bridges (e.g. replacement of large woody debris and excavated substrate to provide no or limited change to instream flows and passage). - No high noise impact generating construction activities, including construction of foundations and piers, to be undertaken in known platypus habitat during breeding/spawning periods (August to September, inclusive). - Consider alternative construction methodologies to driven piling (i.e. bored piles with a screw in casing) in platypus habitat to avoid the potential for impacts associated with noise.

6.4 FLORA AND FAUNA MONITORING

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

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

- Should a TEC patch be retained within the Project footprint, annual monitoring will be conducted against the initial BioCondition assessment for five years following commencement of operations. Corrective actions to be implemented where Project-associated impacts are identified.
- Should individuals of a threatened flora species be retained or be found to be growing within the Project footprint during or following rehabilitation, annual monitoring will be conducted against the pre-construction flora surveys and will be continued for up to five years following commencement of operations. Corrective actions to be implemented where Project-associated impacts are identified.
- Evidence of fauna incursions into the fenced rail corridor will be recorded and investigated, including wildlife-train collisions.
- An ongoing weed monitoring program will measure the effectiveness of weed hygiene and control measures and target problem areas for weed control.
- Ongoing collection and analysis of koala DNA samples from adjacent and broader areas from the Project and an analysis of gene flow at five-yearly intervals for 20 years.
- A monitoring program to assess the abundance and use of crossing structures by predators that may reduce usage rates by target species will be undertaken in accordance with the Wildlife Connectivity Plan. A predator control program will be undertaken at crossing structures within priority connectivity zones for up to five years or until the habitat has been restored to a level that provides threatened fauna with protection from predators.
- The fauna crossing structures and wildlife populations on either side of the Project will be monitored where practicable before construction, during construction and after construction to determine their level of effectiveness in maintaining ecological connectivity, avoiding risk to ecological function due to habitat fragmentation and minimising the risk of injury and mortality of fauna from wildlife-train collisions. Preliminary SMART mitigation goals and survey methods to evaluate the effectiveness of the crossing structures are outlined in Table 6.5 as per the Fauna Connectivity Strategy. These will be finalised and detailed in the Wildlife Connectivity Plan, the monitoring, evaluation and reporting (MER) and the wild dog predation monitoring program. This monitoring and evaluation program will adopt a scientifically robust approach in accordance with the *Fauna Sensitive Transport Infrastructure Delivery* manual (DTMR, 2024).
- Noise and vibration monitoring at fauna crossing structures may be considered if monitoring of structures indicates the level of effectiveness of the structures is inadequate to determine whether levels may be a deterrent for utilisation, particularly within areas of

known wildlife corridors. This will be used to determine behavioural responses of fauna to train pass-bys and inform potential modifications to structures should noise or vibration from train pass-bys be identified to be discouraging use of the structures by wildlife.

TABLE 6.5 PRELIMINARY SMART MITIGATION GOALS FOR THE TARGET SPECIES AND GUILDS¹

Target species	SMART goals	Survey methods and study design considerations to evaluate success at achieving SMART goals
Woodland birds	- The rate of daily movement across the Project at designated bird crossing locations (i.e., under bridges and at the at-grade crossings) and elsewhere along the alignment occurs at a similar rate to movement across comparable control sites with similar gap sizes and vegetation characteristics before construction and at five years after operation. - Higher rates of daily crossing at designated bird crossing locations compared to elsewhere on the Project.	- Assessment to adopt a replicated Before-After-Control-Impact study design. - Field studies quantify the rate of movement of woodland birds across gaps in woodland cover. Study design to take into account woodland type, gap size, type of barrier (e.g., rail, powerline, farmland, etc.), and to commence prior to clearing of vegetation for Project construction. Studies to commence before construction, continue during construction and for at least five years after construction. - Targeted surveys of dead birds due to wildlife-train collisions within areas where woodland birds have been observed crossing the railway.
Spotted-tailed quoll	- Spotted-tailed quoll use the crossing structures (e.g. culverts and bridge underpasses) at five years after construction at rates in proportion to their occurrence in the landscape in the vicinity of each wildlife crossing structure. - No genetic differentiation of populations on opposite sides of the Project at 10 years post operation.	- Installing motion-triggered cameras on targeted crossing structures and in adjacent habitat to assess presence, abundance, and rate of use of crossing structures. - Use GPS or satellite tracking to assess movement of animals living in the vicinity of the Project. - If insufficient spotted-tailed quolls occur in the broader area for effective monitoring, consider using other species of small- to medium-sized ground-dwelling mammals as surrogates. - Explore DNA survey options if spotted-tailed quoll are found in proximity to the Project. Investigate feasibility of evaluating effectiveness of crossing structures using DNA sampling or tracking methods before and after construction. - Undertake mortality surveys of quolls on railway.
Gliding mammals	Gliding mammals use the crossing structures (e.g. above-rail and below-rail canopy bridges and glider poles) at five years after construction at rates in proportion to their occurrence in the landscape in the	- Install motion-triggered cameras on targeted crossing structures and in adjacent habitat to assess presence, abundance, and rate of use of crossing structures. - If insufficient greater gliders in area for effective monitoring, use other

Target species	SMART goals	Survey methods and study design considerations to evaluate success at achieving SMART goals
	vicinity of each wildlife crossing structure. No genetic differentiation of populations on opposite sides of the Project at 10 years post operation.	species of glider and/or possums as surrogates. - Explore DNA survey options if greater gliders are found during field assessment in proximity to rail. Investigate feasibility of evaluating effectiveness of crossing structures using DNA sampling or tracking methods before and after construction. - Undertake mortality surveys of greater glider on railway.
Woodland reptiles, cracking-clay reptiles, Condamine earless dragon	- Target reptile species are present in habitat within Project footprint leading to the crossing structures at five years after construction. - Target species use crossing structures (e.g. culverts and bridge underpasses) at five years after construction for dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each crossing structure.	- Undertake surveys of target species in habitats adjacent to crossing structures and in habitats away from the railway. - Use capture-mark-recapture methods, sensitive cameras and/or other techniques to detect reptiles using the crossing structures.
Brigalow woodland snail	- Brigalow woodland snail are present in habitat within Project footprint leading to snail crossing structures at five years after construction. - Brigalow woodland snails use the crossing structures (e.g. culverts and bridge underpasses) at five years after construction for dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each crossing structure.	- Undertake surveys of target species in habitats adjacent to crossing structures and in habitats away from the railway. - Use capture-mark-recapture methods and/or other techniques to detect snails using the crossing structures. - If insufficient brigalow woodland snails occur in the area for effective monitoring, use other species of snail as surrogates. - Undertake genetic studies to measure gene flow.
Koala	- The movement of koalas around and across the railway will reach pre-construction levels within five years of opening to train movements. - Koalas use the crossing structures (e.g. culverts and bridge underpasses) at five years after construction for daily movements and dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each crossing structure. - Sufficient gene flow across the Project within 10 years of operation that ensures no genetic differentiation of populations on opposite sides due to the Project.	- The movement of individual koalas will be assessed using GPS tracking using same methods as currently employed by the University of Southern Queensland. - Ongoing collection and analysis of koala DNA samples from adjacent and broader areas from the Project and an analysis of gene flow at five-yearly intervals for 20 years. Koala DNA samples to be collected from a range of sources, including scat samples, tissue biopsies to be collected as part of ongoing research sponsored by ARTC, roadkill animals, rescued animals, etc. - The use of targeted crossing structures by koala is measured using camera traps and tracking of koalas in vicinity of the Project.

Target species	SMART goals	Survey methods and study design considerations to evaluate success at achieving SMART goals
		• Mortality of koalas to be measured from train driver reporting, tracking results and targeted wildlife-train collision surveys conducted during and after construction.
Murray cod	• No reduction in cross-rail movement within 12 months of construction. • Murray cod use bridge underpasses for daily movements and dispersal at rates in proportion to their occurrence in the landscape in the vicinity of each bridge structure. • Murray cod present in waterways upstream and downstream of each bridge. • No genetic differentiation of populations on opposite sides of the Project at five years post operation.	• Investigate feasibility of eDNA and other genetic sampling techniques to assess presence of Murray cod in waterways and to measure changes in population structure across the Project. • The rate of use of crossing structures by Murray cod is in proportion to their occurrence in the adjacent area. • Use surrogate fish species if Murray cod occur at low densities and are unable to be effectively studied.

¹ Table source: Revised draft EIS Appendix P: Fauna Connectivity Strategy (WSP, 2024).

7. SIGNIFICANT RESIDUAL IMPACT ASSESSMENT

Potential Project impacts to ecological values are discussed in Section 5, with avoidance, mitigation and management measures discussed in Section 5.3.8. Potential impacts to MSES values during pre-construction and construction, and operation have been assessed in accordance with the residual impact assessment methodology outlined in Section 3.4.

The total Project construction footprint is a total of 3,382.17 ha. For the purposes of significant residual impact assessment, the maximum potential disturbance to each ecological value has been used.

No significant impacts are predicted to occur as a result of clearing for and operation of the borrow pits. Borrow pits have been located to avoid impacts to MSES and MNES. All impacts relating to the borrow pits will be temporary during pre-construction and construction phases. Further information related to the assessment of environmental values of the borrow pits and the outcomes of the significant impact assessment are contained in Section 4.5 and the B2G Borrow Pit Ecological Surveys (Ausecology, 2024a) within Appendix A Additional Ecological Investigations.

The mapping for threatened species assumes that habitat is present unless there is sufficient and robust scientific information to support a species being excluded from the assessment. This represents an application of the precautionary principle and a conservative estimate of Project impacts.

The Project footprint will be refined during the detailed design phase of the Project to reflect the final Project design and the land required to accommodate the adopted construction methodology. This process will seek to reduce the Project footprint and subsequent impacts to ecological values, to the extent possible.

7.1 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Detailed significant impact assessments for MNES are presented in Sections 7.1, 7.2 and 7.3 of revised draft EIS Appendix O. Significant impact assessments have been undertaken in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines* 1.1 (DoE, 2013). Some of the species listed as threatened under the EPBC Act (assessed as MNES in Appendix O: Matters of National Environmental Significance Report) are also listed as threatened under the NC Act and are therefore considered MSES. Where species specific habitat was considered in impact assessments documented in Appendix O, and where it can be demonstrated that the habitat mapped for the listed threatened species listed under both the EPBC Act and NC Act is the same or substantially the same according to the definition of Prescribed environmental matters under the EO Regulation, then an impact assessment in accordance with the *Queensland Environmental Offsets Policy: Significant Residual Impact Guideline* (DEHP, 2014b) is not required and no additional offset is considered. The MSES that require assessment are provided in Table 7-1

Essential habitat and MSES wildlife habitat were examined on a species-by-species basis and was included in the habitat mapping for the Project to ensure all habitat areas were covered. Therefore, species that were assessed in revised draft EIS Appendix O: Matters of National Environmental Significance, included assessment of the areas that are mapped as essential

habitat. Essential habitat is considered in its own right in accordance with the *Significant Residual Impact Guideline* (DEHP, 2014b), Section 5 – Protected Wildlife Habitat: “an area of essential habitat on the essential habitat map for an animal or plant that is endangered or vulnerable wildlife (section 2(3)(b), Schedule 2, EO Reg)”.

TABLE 7-1 EVALUATION OF REQUIREMENT FOR MSES SRI ASSESSMENT BASED ON SAME OR SUBSTANTIALLY THE SAME IMPACT ASSESSMENT OUTCOME

MSES and NC Act listed matters	EPBC Act listing	NC Act listing	Likelihood of occurrence	Assessment Status	MSES SRI assessment required
Regulated vegetation (VM Act)					
Prescribed REs that are Endangered or Of Concern REs	Box-gum TEC – CE Brigalow TEC – E Natural Grasslands TEC – CE	N/A	Known	A total of 172.30 ha documented and assessed as TECs in revised draft EIS Appendix O MNES Report. Of this area, 24.98 ha were prescribed REs that are Endangered or Of Concern.	No additional assessment required
	N/A	Refer to Table 7-2	Known	109.73 ha not yet assessed	Yes
A prescribed RE within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature	N/A	N/A	Known	Not yet assessed	Yes
Prescribed RE that intersects with a VM Act wetland	N/A	N/A	Known	Not yet assessed	Yes
Protected Wildlife Habitat					
Flora					
Austral cornflower (<i>Rhaponticum australe</i>)	V	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required

MSES and NC Act listed matters	EPBC Act listing	NC Act listing	Likelihood of occurrence	Assessment Status	MSES SRI assessment required
Austral toadflax (<i>Thesium australe</i>)	V	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Belson's panic (<i>Homopholis belsonii</i>)	V	E	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
<i>Cyperus clarus</i>	-	V	Known	Not yet assessed	Yes
Hawkweed (<i>Picris evae</i>)		V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
King bluegrass (<i>Dichanthium queenslandicum</i>)	E	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
<i>Picris barbarorum</i>	-	V	Known	Not yet assessed	Yes
Small-flowered westringia (<i>Westringia parvifolia</i>)	V	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
<i>Xerothamnella herbacea</i>	E	E	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Fauna					
Australasian bittern (<i>Botaurus poiciloptilus</i>)	E	E	Likely	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Australian painted snipe (<i>Rostratula australis</i>)	E, Mi	E	Known	Documented and assessed in revised	No additional assessment required

MSES and NC Act listed matters	EPBC Act listing	NC Act listing	Likelihood of occurrence	Assessment Status	MSES SRI assessment required
				draft EIS Appendix O MNES Report	
Brigalow woodland snail (<i>Adclarkia cameroni</i>)	E	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Bullock jewel butterfly (<i>Hypochrysops piceatus</i>)	CE*	CE	Potential	Not yet assessed	Yes
Brown treecreeper (south-eastern) (<i>Climacteris picumnus victorae</i>)	V*	V	Known	Not yet assessed	Yes
Common death adder (<i>Acanthophis antarcticus</i>)	-	V	Known	Not yet assessed	Yes
Common greenshank (<i>Tringa nebularia</i>)	E, Mi	SLC	Likely	Not yet assessed	Yes
Condamine earless dragon (<i>Tympanocryptis condaminensis</i>)	E	E	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Diamond firetail (<i>Stagonopleura guttata</i>)	V*	V	Likely	Not yet assessed	Yes
Dunmall's snake (<i>Furina dunmali</i>)	V	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	V	E	Likely	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Fork-tailed swift (<i>Apus pacificus</i>)	Mi	SLC	Known	Not yet assessed	Yes
Glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>)	V*	V	Known	Not yet assessed	Yes

MSES and NC Act listed matters	EPBC Act listing	NC Act listing	Likelihood of occurrence	Assessment Status	MSES SRI assessment required
Glossy ibis (<i>Plegadis falcinellus</i>)	Mi	SLC	Known	Not yet assessed	Yes
Grey snake (<i>Hemiaspis damelii</i>)	E*	E	Known	Not yet assessed	Yes
Hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>)	E*	E	Potential	Not yet assessed	Yes
Koala (<i>Phascolarctos cinereus</i>)	E#	E	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Latham's snipe (<i>Gallinago hardwickii</i>)	V*, Mi	SLC	Known	Not yet assessed	Yes
Painted honeyeater (<i>Grantiella picta</i>)	V	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Platypus (<i>Ornithorhynchus anatinus</i>)	-	SLC	Known	Not yet assessed	Yes
Powerful owl (<i>Ninox strenua</i>)	-	V	Potential	Not yet assessed	Yes
Rufous fantail (<i>Rhipidura rufifrons</i>)	Mi	SLC	Known	Not yet assessed	Yes
Satin flycatcher (<i>Myiagra cyanoleuca</i>)	Mi	SLC	Known	Not yet assessed	Yes
Sharp-tailed sandpiper (<i>Calidris acuminata</i>)	V*, Mi	SLC	Likely	Not yet assessed	Yes
Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	-	SLC	Known	Not yet assessed	Yes
South-eastern long-eared bat (<i>Nyctophilus corbeni</i>)	V	V	Known	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
Southern whiteface (<i>Aphelocephala leucopsis</i>)	V*	V	Known	Not yet assessed	Yes
Spotted-tailed quoll (southeastern mainland population)	E	E	Likely	Documented and assessed in revised	No additional assessment required

MSES and NC Act listed matters	EPBC Act listing	NC Act listing	Likelihood of occurrence	Assessment Status	MSES SRI assessment required
<i>(Dasyurus maculatus maculatus)</i>				draft EIS Appendix O MNES Report	
Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>)	V	V	Likely	Documented and assessed in revised draft EIS Appendix O MNES Report	No additional assessment required
White-throated needletail (<i>Hirundapus caudacutus</i>)	V*	V	Known	Not yet assessed	Yes
Yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>)	V*	V	Potential	Not yet assessed	Yes

Waterways providing for fish passage

Eighty-four waterways intersect the Project footprint and are classified (DAF mapped waterways) as follows: 42 waterways mapped as green (low risk) 26 waterways mapped as amber (moderate risk) 7 waterways mapped as red (high risk) 9 waterways mapped as purple (major risk).	N/A	N/A	N/A	Not yet assessed	Yes
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Connectivity

Remnant vegetation	N/A	N/A	N/A	Not yet assessed	Yes
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Table notes:

CE – Critically Endangered; E – Endangered; V – Vulnerable; SLC – Special Least Concern; Mi – Migratory; Ma – Marine

^RE's that did not meet TEC condition thresholds were not assessed as TEC.

*Listed after the controlled action decision date (09.04.2018) and therefore assessed as MSES.

#Uplisted from vulnerable after the controlled action decision date.

TABLE 7-2 PRESCRIBED REGIONAL ECOSYSTEMS THAT ARE ENDANGERED OR OF CONCERN (EXCLUDING AREAS ASSESSED AS TECS)

VM Act status	Regional ecosystem	Description	Area (ha)
OC	11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	25.90
OC	11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	7.57
OC	11.3.21	<i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains	0.0003
E	11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	24.01
OC	11.5.14	<i>Triodia</i> spp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	49.07
OC	11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks	0.0038
E	11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	0.67
OC	11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	2.39
OC	11.9.13	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> open forest on fine grained sedimentary rocks	0.13
Total			109.73

Table notes:

E – Endangered, OC – Of Concern

7.2 SIGNIFICANT RESIDUAL IMPACT ASSESSMENT FOR MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

This section provides the significant residual impact (SRI) assessment of the Project on MSES. The QEOP requires assessment of the Project against the criteria set out in the SRI Guidelines (DEHP, 2014b). The SRI Guideline criteria details when an action is likely to have a 'significant residual impact' to a MSES as defined in the *Environmental Offsets Regulation 2014*. The Project is likely to result in residual impacts to a number of MSES. The description of the extent of these matters within the Project footprint is provided in Section 4.11. Essential habitat for the pale imperial hairstreak (*Jalmenus eubulus*) is mapped within the Project footprint, however, this species is unlikely to occur within the Project footprint due to inconsistencies between the GTRE and State-based mapping (see Appendix B Likelihood of Occurrence for detailed justification). Essential habitat for this species will be offset as a mapped Prescribed environmental matter, however, due to its likelihood of occurrence remaining unlikely, no SRI assessment has been conducted. Direct and indirect impacts to environmental values as a result of the Project are discussed in Section 5.

7.2.1 REGULATED VEGETATION

The impacts to regulated vegetation within the Project footprint has been assessed using the criteria for the significant residual impact test in the SRI Guidelines (DEHP, 2014b; DoR, 2024). Areas of REs that are considered regulated vegetation that have not been assessed as TEC are presented in Table 7-2. The results are presented in Table 7-3. All areas of prescribed regional ecosystems relevant to this assessment (i.e., remnant endangered or of concern REs, within a mapped wetland and within the defined distance of a watercourse) were wider than 25 m for grassland REs and 10 m for mid-dense to dense REs. No sparse REs are present.

TABLE 7-3 REGULATED VEGETATION SIGNIFICANT RESIDUAL IMPACT TEST

Criteria	Clearing in a regional ecosystem that is: endangered, or of concern	Clearing in the portion of a regional ecosystem that lies within a mapped wetland	Clearing in a regional ecosystem that is within the defined distance of a watercourse
For clearing for linear infrastructure: - greater than 25m wide in a grassland (structural category) regional ecosystem; or - greater than 20m wide in a sparse (structural category) regional ecosystem; or - greater than 10m wide in a dense to mid-dense (structural category) regional ecosystem.	Likely 109.73 ha	Likely 5.52 ha	Likely 5.56 ha of regional ecosystems within the defined distance of a stream order 1 or 2 watercourse is expected to be cleared within the Project footprint. 5.75 ha of regional ecosystems within the defined distance of a stream order 3 or 4 watercourse is expected to be cleared within the Project footprint. For a total of 11.31 ha, which is likely to have a significant residual impact.
Clearing within 50m of the defining bank	N/A	Likely 11.71 ha	N/A
Clearing within 5m of the defining bank	N/A	N/A	Likely 2.69 ha of regional ecosystems within 5 m of the defined bank of a stream order 1 or 2 watercourse is expected to be cleared within the Project footprint. 1.03 ha of regional ecosystems within 5 m of the defined bank of a stream order 3 or 4 watercourse is expected to be cleared within the Project footprint. For a total of 3.72 ha, which is likely to have a significant residual impact.

7.2.2 CONNECTIVITY AREAS

The impacts to connectivity at the regional and local scale was analysed using DESI's landscape fragmentation and connectivity tool version 2.01.

Significance test one

The regional total area is 948,191.65 ha.

Regional extent of core remnant:

- The regional extent of core remnant is 255,435.46 ha
- The regional extent of core remnant is 26.94%
- This level of regional fragmentation sets a local impact threshold of 5.0%

Area of core:

- Area of core at the local scale (pre-impact): 46,957.75 ha
- Area of core at the local scale (post-impact): 46,277.5 ha
- Percent change of core at the local scale (post-impact): 1.45%

The change in area of core at the local scale is less than 5%, and therefore there is no significant impact based on this test.

Significance test two

- The number of core remnant areas occurring on the site: 33
- The number of core remnant areas remaining on the site post-impact: 30

There are fewer core remnant areas remaining on the site post-impact compared to pre-impact, therefore there is a significant impact based on this test.

Result

- This analysis has determined a SIGNIFICANT impact on connectivity areas due to the reduction in the number of core remnant areas remaining on site post-impact.

The total area of RVM Cat B clearing is 475.33 ha.

7.2.3 WETLANDS AND WATERCOURSES

The Project footprint does not overlap with any wetlands in a wetland protection area, wetlands of high ecological significance, or wetland or watercourse in a high ecological value waters. Therefore, the Project will not have a significant residual impact on wetlands and watercourses, as described in the SRI Guidelines (DEHP, 2014b).

7.2.4 KOALA HABITAT IN SOUTH EAST QUEENSLAND

The South East Queensland planning area, as identified in the South East Regional Plan, slightly overlaps with the northern extent of Project footprint. However, within this area, there is no essential habitat for the koala and no habitat for the koala mapped for the Project.

7.2.5 PROTECTED AREAS

The Project footprint does not overlap with, and therefore will not have a significant residual impact on any Protected Areas.

7.2.6 PROTECTED WILDLIFE HABITAT (FLORA)

Section 4 details protected wildlife habitat for flora species known or likely to occur within the Project footprint. When considering the potential for SRI to flora species during the Project construction phase, pre-clearance surveys were considered. Where State-based information for species SRI assessments has not been available, recognised guidelines (e.g. SPRAT profile, conservation advice, recovery plan) and other available literature have been used.

SRI assessments for protected wildlife habitat for not yet assessed threatened (Vulnerable or Endangered) flora (refer to Table 7-1) are provided in the following tables:

- *Cyperus clarus* (refer to Table 7-4); and
- *Picris barbarorum* (refer to Table 7-5).

Cyperus clarus and *Picris barbarorum* are both listed as Vulnerable under the NC Act and are both known to occur within the Project footprint, due to direct sightings during field surveys. *Cyperus clarus* was recorded between Brookstead and Gowrie, whereas *Picris barbarorum* was recorded further west, between Pittsworth and Brookstead. An in-depth description of both species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans (if applicable) can be found in Appendix G

TABLE 7-4 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (CYPERUS CLARUS)

Criteria	Assessment against SRI criteria <i>Cyperus clarus</i> - Vulnerable
Lead to a long term decrease in the size of a local population of the species	Likely The Project footprint contains 166.07 ha of <i>Cyperus clarus</i> habitat, which will be cleared by the Project. Approximately 200 individuals were recorded during surveys that will be removed by clearing during construction. <i>Cyperus clarus</i> was observed within and adjacent to the Project footprint near Pittsworth, Southbrook, and Gowrie Mountain. The removal of approximately 200 individuals will likely lead to a long-term decrease in the size of local population of the species.
Reduce the extent of occurrence of the species	Unlikely As a result of the Project, approximately 166.07 ha of <i>Cyperus clarus</i> habitat will be impacted during clearing in the construction phase of the Project. The Project footprint is not located at the limit of the species occurrence, and as such, the Project is unlikely to reduce the extent of occurrence of this species.
Fragment an existing population	Unlikely The Project will clear 166.07 ha of <i>Cyperus clarus</i> habitat containing approximately 200 individuals. The species has also been recorded to occur outside of the Project footprint. The Project is linear and unlikely to represent a barrier for dispersal or cross-pollination for the species. As such, the clearing of 166.07 ha is unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely The Project is linear and relatively narrow, and it is unlikely that this will represent a barrier for dispersal or cross-pollination for the species. The Project is not likely to impact the processes associated with wind dispersal and seed dispersal, however if impacts are potential, these are temporary during clearing in the construction stage only. Therefore, it is unlikely the Project will result in genetically distinct populations of this species.
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely Invasive species are not a known threat to <i>Cyperus clarus</i> . Construction works for the Project will be managed to minimise the introduction and spread of weed and pest species. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the population to decline	Unlikely There are currently no known diseases that pose a threat to <i>Cyperus clarus</i> . Invasive species management measures will be used to assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely

Criteria	Assessment against SRI criteria <i>Cyperus clarus</i> - Vulnerable
	There is no adopted or made recovery plan for <i>Cyperus clarus</i>. The species conservation advice (DESI, 2024c) identifies (but is not limited to) the following priority recommendations: • The production of essential habitat mapping which identifies key areas for listed threatened species, Land for Wildlife Program, the Nature Refuges Programmes, Grazing Land Management Workshops and implementation of Enhancing Biodiversity Hot Spots along Western Queensland Stock Routes; and • SW NRM Pasture Recovery Initiative. Land clearing for agriculture and grazing are known threats. Although the Project will remove approximately 200 individuals, it will also implement appropriate weed controls and not allow livestock grazing within the Project footprint. It is unlikely that the project will interfere with the above management recommendations, and thus unlikely to interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Likely Ecologically significant locations for <i>Cyperus clarus</i> is considered suitable habitat where the species is present. The Project will remove approximately 200 individuals and impact approximately 166.07 ha of <i>Cyperus clarus</i> habitat, including 0.20 ha of essential habitat. This includes 111.16 ha of non-remnant vegetation, 12.97 ha of regrowth vegetation, and 41.94 ha of remnant vegetation. Therefore, it is considered likely the Project will cause disruption to ecologically significant locations of a species.
Assessment of potential for SRI	The Project is likely to result in a significant residual impact on <i>Cyperus clarus</i>.

TABLE 7-5 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (*PICRIS BARBARORUM*)

Criteria	Assessment against SRI criteria <i>Picris barbarorum</i> – Vulnerable
Lead to a long term decrease in the size of a local population of the species	Likely A population has been identified to occur within the Project footprint. The species has been recorded at a number of locations in the northern extent of the Project footprint (between Pittsworth and Brookstead), with approximately 416 plants recorded. The species was recorded in non-remnant road reserves, along existing rail and on edges of crops which will be impacted by the Project. The Project may provide future habitat in the verges of the rail line. Despite this, occupation of the Project footprint is cannot guaranteed. The Project footprint contains 174.98 ha of <i>Picris barbarorum</i> habitat, which will be cleared by the Project. As a population is known to occur, and approximately 416 plants will be removed, it is likely that the Project will result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	Unlikely The Project footprint contains 174.98 ha of <i>Picris barbarorum</i> habitat and the species has been identified to occur within the Project footprint. However, the Project footprint traverses the middle of the species modelled distribution and is not located at the limit of the species occurrence. Therefore, the Project is considered unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely A population has been identified to occur within the Project footprint as a result of a cluster of records at the northern extent of the Project footprint. The species has been recorded in road reserves in the Study area and would appear tolerant of linear infrastructure impacts. The species is also known to occur in heavily degraded habitats and the Project is unlikely to represent a barrier for dispersal or cross-pollination for the species. As the Project is linear and relatively narrow, and the species persists in road reserves and heavily degraded habitats, the Project is considered unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely The Project is linear and relatively narrow, and is unlikely to represent a barrier for dispersal or cross-pollination for the species. The Project is not likely to impact the processes associated with wind dispersal and seed dispersal. Therefore, it is unlikely the Project will result in genetically distinct populations of this species.
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely The weed lippia (<i>Phyla canescens</i>) may pose a threat to <i>Picris barbarorum</i> and was recorded within the Project footprint. Measures will be implemented to minimise the introduction and spread of weed and pest species during the construction phase. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.

Criteria	Assessment against SRI criteria <i>Picris barbarorum</i> – Vulnerable
Introduce disease that may cause the population to decline	Unlikely There are currently no known diseases that pose a threat to <i>Picris barbarorum</i>. Measures to manage diseases resulting from Project activities will be implemented. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely There is no recovery plan for the species and no current management or recovery actions or recommendations. Approximately 174.98 ha of <i>Picris barbarorum</i> habitat has the potential to be impacted by the Project. The project will implement appropriate weed controls and remove cropping activities from the Project footprint. Future habitat in the verges of the rail line may occur. Although some habitat loss will occur as a result of the Project, this is offset by several benefits to the species, as they appear to tolerate linear infrastructure and degraded habitat. Therefore, it is considered unlikely that the Project will substantially interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Likely Ecologically significant locations for <i>Picris barbarorum</i> is considered suitable habitat where the species is present. The Project will remove approximately 416 plants and impact approximately 174.98 ha of <i>Picris barbarorum</i> habitat. This includes 155.14 ha of non-remnant vegetation, 9.60 ha of regrowth vegetation, 0.28 ha of HVR, and 9.87 ha of remnant vegetation.
Assessment of potential for SRI	The Project is likely to result in a significant residual impact on <i>Picris barbarorum</i>.

7.2.7 PROTECTED WILDLIFE HABITAT (FAUNA)

Section 4 identifies protected wildlife habitat for fauna species known, likely or potentially occurring within the Project footprint. When considering the potential for SRIs to fauna species during the construction phase, pre-clearance surveys were considered. Where State-based information for species SRI assessments has not been available, recognised guidelines (e.g. SPRAT profile, conservation advice, recovery plan) and other available literature have been used.

SRI assessments for protected wildlife habitat for not yet assessed threatened (Vulnerable or Endangered) fauna and SLC species (refer to Table 7-1) in accordance with the SRI Guideline criteria (DEHP, 2014b) are provided in the following subgroups:

TABLE 7-6 SRI SUBGROUPS

SRI subgroup	Reference
Threatened migratory and marine birds white-throated needletail (<i>Hirundapus caudacutus</i>) – Known to occur	Table 7-8
Small woodland birds - brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>) – known to occur; - diamond firetail (<i>Stagonopleura guttata</i>) – likely to occur; - hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – potential to occur; and, - southern whiteface (<i>Aphelocephala leucopsis</i>) – known to occur.	Table 7-9
Large birds - glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>) – known to occur; and - powerful owl (<i>Ninox strenua</i>) – potential to occur.	Table 7-10
Mammals: yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>) – potential to occur.	Table 7-11
Snakes: - common death adder (<i>Acanthophis antarcticus</i>) – known to occur; and, - grey snake (<i>Hemiaspis damelii</i>) – known to occur.	Table 7-12
Butterflies: bulloak jewel butterfly (<i>Hypochrysops piceatus</i>) – potential to occur.	Table 7-13
SLC species – mammals: - platypus (<i>Ornithorhynchus anatinus</i>) – known to occur; and - short-beaked echidna (<i>Tachyglossus aculeatus</i>) – known to occur.	Table 7-14
SLC species – migratory birds: - fork-tailed swift (<i>Apus pacificus</i>) – known to occur. - Migratory birds with an Australian breeding range: - glossy ibis (<i>Plegadis falcinellus</i>) – known to occur, - rufous fantail (<i>Rhipidura rufifrons</i>) – known to occur, - satin flycatcher (<i>Myiagra cyanoleuca</i>) – known to occur.	Table 7-15

SRI subgroup	Reference
• Migratory shorebirds with an international breeding range: ◦ common greenshank (<i>Tringa nebularia</i>) – likely to occur, ◦ Latham’s snipe (<i>Gallinago hardwickii</i>) – known to occur, ◦ sharp-tailed sandpiper (<i>Calidris acuminata</i>) – likely to occur.	

Although migratory birds are not a prescribed environmental matter under the SRI Guideline (DEHP, 2014b), they have been included in the SRI assessments as SLC species to outline potential residual impacts to these species. In-depth descriptions of these species, their distribution, threats, relation to the Project footprint, conservation advice, recovery objectives and threat abatement plans (if applicable) can be found in Appendix G Species Profiles.

7.2.7.1 THREATENED MIGRATORY AND MARINE BIRDS

The white-throated needletail (*Hirundapus caudacutus*) is listed as Vulnerable under the NC Act and known to occur within the Project footprint. The species was recorded flying over woodland in Bringalily State Forest and near Millmerran.

An in-depth description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for this species is presented in Table 7-7.

TABLE 7-7 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (THREATENED MIGRATORY AND MARINE BIRDS)

Criteria	Assessment against SRI criteria white-throated needletail (<i>Hirundapus caudacutus</i>) – Vulnerable
Lead to a long term decrease in the size of a local population of the species	Unlikely Due to the nature of the white-throated needletail being almost entirely an aerial species (flying at heights of 1-1000 m above ground), the majority of the Project footprint has been mapped as foraging habitat, being 2,853.24 ha of foraging habitat. As this species is aerial, no essential habitat is present for this species. Due to the species rarely roosting there is no local population within the Project footprint. The predicted impacts from the Project are expected to minimally impact the species due to linear clearing of wooded areas allowing the species still to have ample areas of potential roosting habitat and the species being almost entirely aerial. Therefore, the species is unlikely to be significantly impacted from the Project that would lead to a long term decrease in the species local population due to the species being almost entirely aerial and the species unlikely to have a local population.
Reduce the extent of occurrence of the species	Unlikely Whilst in Australia the white-throated needletail is almost exclusively aerial, flying between 1 – 1000 m above ground. Due to the almost aerial behaviour of the species, the majority of the Project footprint has been mapped as foraging habitat, being 2,853.24 ha of foraging habitat. However, due to the nature of the species and the Project footprint traversing through the middle of the species distribution and not being at the limit of the species occurrence, the Project is unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely Due to the species rarely roosting there is no local population within the Project footprint. The predicted impacts from the Project are expected to minimally impact the species due to linear clearing of wooded areas allowing the species still to have ample areas of potential roosting and foraging habitat. As this species is almost entirely aerial and therefore highly mobile, the Project will not limit its movement across the surrounding area. Therefore, the Project is considered unlikely to fragment an existing population.

Criteria	Assessment against SRI criteria white-throated needletail (<i>Hirundapus caudacutus</i>) – Vulnerable
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely Due to the species rarely roosting there is no local population within the Project footprint. the species is migratory and highly mobile, and the Project will not limit movement across the surrounding area. Furthermore, their breeding grounds are located in the northern hemisphere, in eastern Siberia, north-eastern China, the Korean Peninsula and Japan. Therefore, the Project is considered unlikely to result in genetically distinct populations forming from habitat isolation.
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely The white-throated needletail is not currently known to be threatened by invasive species. Mitigation measures will be implemented to minimise the introduction and spread of weed and pest species across the Project footprint during the construction phase. The local landscape is already subject to extensive weed infestation with nine species listed under the Biosecurity Act identified during Project surveys. Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the population to decline	Unlikely There are no identified diseases associated with the white-throated needletail. The white-throated needletail is almost exclusively aerial and does not breed in Australia. Measures to manage diseases resulting from Project activities will be implemented. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely There is no adopted or made recovery plan for the species and a recovery plan is not required as the species' conservation advice is an effective, efficient, and responsive document to guide the implementation of priority management actions, including: • Enhance existing White-throated Needletail monitoring programs, such as BirdLife Australia's Swift Monitoring Sites, particularly to improve coverage in under surveyed parts of Australia. • Identify requirements of important habitat in Australia. • Use remote sensing to assess the extent of habitat loss at the breeding grounds. • Undertake work to more precisely assess White-throated Needletail life history, population size, distribution and ecological requirements in Australia. • Improve knowledge about potential threatening processes including the impacts of infrastructure (i.e. wind turbines and overhead wires). • Quantify levels of organochlorines in individuals and prey species (TSSC, 2019). White-throated needletail is an almost exclusively aerial species and does not breed in Australia, and as such the Project is considered unlikely to interfere with the recovery of the species.
Cause disruption to ecologically	Unlikely

Criteria	Assessment against SRI criteria white-throated needletail (<i>Hirundapus caudacutus</i>) – Vulnerable
significant locations (breeding, feeding, nesting, migration or resting sites) of a species	There are no defined ecologically significant locations for the species as it is almost exclusively aerial in Australia. This species has been recorded roosting in trees in woodland areas within the modelled habitat distribution, however they do not appear to have a preference for a species of tree. The species' breeding grounds are located in the northern hemisphere, in eastern Siberia, north-eastern China, the Korean Peninsula and Japan. Whilst clearing for the Project is planned for woodland areas, the species is highly mobile and can cover large distances given their modelled distribution ranges globally, it is unlikely the Project will cause disruption to ecologically significant locations of the species.
Assessment of potential for SRI	The Project is unlikely to result in a significant residual impact on the white-throated needletail.

7.2.7.2 SMALL WOODLAND BIRDS

Two small woodland birds, the brown treecreeper (south-eastern) (*Climacteris picumnus victoriae*) and southern whiteface (*Aphelocephala leucopsis*) are known to occur within the Project footprint due to database records (one record of the brown treecreeper and 23 of the southern whiteface). Both species have recent records within the Project Footprint near Yelarbon. There are also several recent records of southern whiteface within habitat adjacent to the Project footprint. Both species are listed as Vulnerable under the NC Act.

The diamond firetail (*Stagonopleura guttata*) is likely to occur within the Project footprint and is listed as Vulnerable under the NC Act. The hooded robin (south-eastern) (*Melanodryas cucullata cucullata*) has the potential to occur within the Project footprint and is listed as Endangered under the NC Act.

A description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for these species is presented in Table 7-8.

TABLE 7-8 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (SMALL WOODLAND BIRDS)

Criteria	Assessment against SRI criteria brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
Lead to a long term decrease in the size of a local population of the species	Unlikely As per the Conservation Advice for the species “The total number of mature individuals is estimated to be 68,000 (range 36,000–113,000) (S. Garnett pers. comm. 9 Nov 2021). There are estimated to be 100 subpopulations with a declining trend (Ford et al. 2021). The subspecies’ distribution is not precarious	Unlikely While no individuals were detected during targeted surveys, this species is listed as likely to occur within the Project footprint due to multiple generalised records in the Project footprint. The Project footprint contains 216.89 ha of diamond firetail habitat, which will be cleared for the Project. While this species is largely sedentary,	Unlikely While no individuals were detected during targeted surveys, hooded robin (south-eastern) has potential to occur within the Project footprint. The Project footprint contains 216.89 ha of hooded robin habitat, which will be cleared for the Project. The species occupies local territories throughout the year, one where they	Unlikely While no individuals were detected during targeted surveys, this species is listed as known to occur within the Project footprint due to multiple database records in the Project footprint. The Project footprint contains 216.89 ha of southern whiteface habitat, which will be cleared for the Project. While this species is largely

Criteria	Assessment against SRI criteria brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
	for its survival. The subspecies is not subject to extreme fluctuations in the number of mature individuals (Ford et al. 2021).” (DCCEEW, 2023a). No individuals of the south-eastern subspecies were detected in the Project footprint during targeted surveys. Although brown treecreepers were observed on the Glenlovely offset property, the subspecies was not noted. The south-eastern subspecies is listed as known to occur within the Project footprint due to a WildNet record in the Project footprint in 2021. However, there are no other historic records in adjacent habitat to suggest a local population is present. Therefore, the Project is unlikely to lead to a long-term decrease in a local population of the species.	preferring to live and breed in the same areas, they are known to move locally. Numerous records exist outside of the Project footprint, indicating that suitable habitat is being utilised. Given that the habitat outside of the Project footprint will remain intact, it is unlikely that the Project will lead to a long-term decrease in the size of a local population.	forage outside of breeding season, and another where they nest. There are limited records of the subspecies in the broader landscape, however, should a population exist, remaining habitat outside of the Project footprint is likely to continue to sustain a potentially occurring population. Therefore, given that the habitat outside of the Project footprint will remain intact, it is unlikely that the Project will lead to a long-term decrease in the size of a local population.	sedentary, preferring to live and breed in the same areas, they are able to relocate to a new habitat area if required. Numerous records exist outside of the Project footprint, indicating that suitable habitat is being utilised. Given that the habitat outside of the Project footprint will remain intact, it is unlikely that the Project will lead to a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	Unlikely As per the conservation advice (DCCEEW, 2023a), brown treecreeper’s (south-	Unlikely According to the conservation advice (DCCEEW, 2023b), the	Unlikely According to the conservation advice (DCCEEW, 2023c), the	Unlikely According to the conservation advice (DCCEEW, 2023d), the

Criteria	Assessment against SRI criteria brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
	eastern) extent of occurrence (EOO) is estimated to be 1,100,000 km ² (range 1,000,000–1,200,000 km ²) (Ford et al., 2021). The EOO for the subspecies is stable and the removal of 240.66 ha (which includes 5.89 ha of essential habitat) represents 0.00022% of the EOO. The subspecies is not severely fragmented and is not subject to extreme fluctuations in EOO (Ford et al., 2021). Therefore, the Project is unlikely to reduce the extent of occurrence of the species.	diamond firetail has an estimated extent of occurrence of 1,500,000 km ² (range 1,400,000–1,600,000 km ²) and has a contracting trend. The removal of 216.89 ha represents 0.00014% of the EOO. The Project footprint is not located at the limit of the species distribution, and as such, the Project is unlikely to reduce the extent of occurrence of the species.	hooded robin (south-eastern) has an estimated extent of occurrence of 1,200,000 km ² (range 1,100,000–1,400,000 km ²) and has a contracting trend. The removal of 216.89 ha represents 0.00018% of the EOO. Although the Project is located at the limit of the species distribution, the Project is considered unlikely to reduce the extent of occurrence of the species due to the removal of a very small proportion of potential habitat relative to the estimated extent of occurrence.	southern whiteface has an estimated extent of occurrence of 4,910,000 km ² and is stable. The removal of 216.89 ha represents 0.00004% of the EOO. The species is not subject to extreme fluctuations in EOO (Ehmke et al., 2021). The Project footprint is not at the limit of the species distribution, and as such, it is considered unlikely that the Project will reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely Brown treecreeper (south-eastern) is a sedentary subspecies with a permanent territory and are usually unwilling to cross large open areas when dispersing from the nest. The Project is a linear infrastructure and, if unmitigated, may represent a barrier to movement for the subspecies.	Unlikely Diamond firetails are generally sedentary, although some populations are known to move locally. The Project is a linear infrastructure and is not expected to represent a barrier to movement for the species. Additionally, no individuals were detected during targeted surveys. The Project is a linear	Unlikely Hooded robin (south-eastern) is a sedentary subspecies, occupying local territories throughout the year, one where they forage outside of breeding season, and another where they nest. This species is usually unwilling to cross large, open areas greater than 100 m while moving between territories. The Project is a	Unlikely Southern whiteface is a sedentary species and therefore are unlikely to disperse for long distances. The Project is a linear infrastructure and, if unmitigated, may represent a barrier to movement for the species. Development and implementation of the

Criteria	Assessment against SRI criteria brown tree creeper (south-eastern) (<i>Climacteris picumnus victorae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
	Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide movement opportunities across the Project for woodland birds. Connectivity areas have been identified for woodland birds and structures will be suitably designed (i.e., bridge underpasses). Connectivity for woodland birds may also be maintained through the retention and revegetation of low shrubby vegetation within the Project footprint that is within the gap-crossing distance of small woodland birds (i.e. <100 m apart). This will be considered on a site-by-site basis during detailed design. The residual impact to connectivity after mitigation was assessed in the Fauna Connectivity Strategy as low for woodland birds. Therefore, it is unlikely to fragment an existing population.	infrastructure and, if unmitigated, may represent a barrier to movement for the species, should a population be present. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide movement opportunities across the Project for woodland birds. Connectivity areas have been identified for woodland birds and structures will be suitably designed (i.e., bridge underpasses). Connectivity for woodland birds may also be maintained through the retention and revegetation of low shrubby vegetation within the Project footprint that is within the gap-crossing distance of small woodland birds (i.e. <100 m apart). This will be considered on a site-by-site basis during detailed design. The residual impact to connectivity after mitigation was assessed in the Fauna	linear infrastructure and, if unmitigated, may represent a barrier to movement for the subspecies, should a population be present. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide movement opportunities across the Project for woodland birds. Connectivity areas have been identified for woodland birds and structures will be suitably designed (i.e., bridge underpasses). Connectivity for woodland birds may also be maintained through the retention and revegetation of low shrubby vegetation within the Project footprint that is within the gap-crossing distance of small woodland birds (i.e. <100 m apart). This will be considered on a site-by-site basis during detailed design. The residual impact to connectivity after mitigation was assessed in the Fauna	Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide movement opportunities across the Project for woodland birds. Connectivity areas have been identified for woodland birds and structures will be suitably designed (i.e., bridge underpasses). Connectivity for woodland birds may also be maintained through the retention and revegetation of low shrubby vegetation within the Project footprint that is within the gap-crossing distance of small woodland birds (i.e. <100 m apart). This will be considered on a site-by-site basis during detailed design. The residual impact to connectivity after mitigation was assessed in the Fauna Connectivity Strategy as low for woodland birds. Therefore, it is unlikely to fragment an existing population.

Criteria	Assessment against SRI criteria brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
		Connectivity Strategy as low for woodland birds. Therefore, it is unlikely to fragment an existing population.	Connectivity Strategy as low for woodland birds. Therefore, it is unlikely to fragment an existing population.	
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely Young female brown treecreepers (south-eastern) disperse from the nest and are usually unwilling to cross large, open areas greater than 100 m while doing so. However, provision of appropriate crossing structures and vegetation as outlined in the Wildlife Connectivity Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will maintain gene flow across the Project, should a population occur on both sides. Therefore, the Project is unlikely to result in genetically distinct populations forming from habitat isolation.	Unlikely Breeding occurs throughout the species range, and usually within localised populations as it is a sedentary species. Provision of appropriate crossing structures and vegetation as outlined in the Wildlife Connectivity Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will maintain gene flow across the Project, should a population occur on both sides. Therefore, the Project is unlikely to result in genetically distinct populations forming from habitat isolation.	Unlikely No individuals were detected during targeted surveys. Hooded robins form monogamous breeding pairs, and breeding occurs in localised populations throughout the species range. This species moves between two territories throughout the year, and are usually unwilling to cross large, open areas greater than 100 m while doing so. However, provision of appropriate crossing structures and vegetation as outlined in the Wildlife Connectivity Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will maintain gene flow across the Project, should a population occur on both sides. Therefore, the Project is unlikely to result in genetically distinct	Unlikely Breeding occurs throughout the species range, and usually within localised populations as it is a sedentary species. Provision of appropriate crossing structures and vegetation as outlined in the Wildlife Connectivity Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will maintain gene flow across the Project, should a population occur on both sides. Therefore, the Project is unlikely to result in genetically distinct populations forming from habitat isolation.

Criteria	Assessment against SRI criteria brown treecreeper (south-eastern) (<i>Climacteris picumnus victoricae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
			populations forming from habitat isolation.	
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely These species are likely impacted by predation from cats (<i>Felis catus</i>) and foxes (<i>Vulpes vulpes</i>). Habitat degradation caused by European rabbits (<i>Oryctolagus cuniculus</i>) and deer (<i>Cervidae</i> spp.) are also suspected to threaten these species. Feral animals, including foxes and cats are known to occur within the Project footprint. Invasive weeds, particularly exotic annual grasses, can also reduce the food availability for the diamond firetail. Mitigation measures to minimise the introduction and spread of weed and pest species across the Project footprint and into adjacent areas will be implemented during construction. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.			
Introduce disease that may cause the population to decline	Unlikely There are no diseases that are currently known to threaten these species. Measures to manage diseases resulting from Project activities will be implemented during construction. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.			
Interfere with the recovery of the species	Unlikely A recovery plan for the subspecies has not yet been established, however the conservation advice lists the following as recovery actions that are relevant to the Project: • Cease all land clearing of habitat critical of the survival of brown treecreeper (south-eastern). • Promote ecological management and connectivity of woodland remnants on public and private land.	Likely A recovery plan for the species has not yet been established, however the conservation advice lists the following as recovery actions that are relevant to the Project: • Retain and protect woodland, open forest, grassland and mallee habitat from clearing, fragmentation and disturbance. • Protect and maintain areas of high-quality habitat.	Unlikely A recovery plan for the species has not yet been established, however the conservation advice lists the following as recovery actions that are relevant to the Project: • Cease all land clearing of habitat critical to the survival of hooded robin (south-eastern). • Retain and restore all remnant woodland patches in areas of habitat critical for the survival of hooded robin (south-eastern).	Likely A recovery plan for the species has not yet been established, however the conservation advice lists the following as recovery actions that are relevant to the Project: • Cease all land clearing of habitat critical to the survival of southern whiteface. • Secure occupied habitat patches in areas where the birds have a patchy distribution from further degradation and loss.

Criteria	Assessment against SRI criteria brown tree creeper (south-eastern) (<i>Climacteris picumnus victoricae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
	Ensure populations remain connected. Avoid gaps greater than 100 m between trees (either between scattered paddock trees or in linear corridors). Eliminate gaps through revegetation, either corridors or stepping stone plantings, focusing on important movement pathways. Although sections of the Project will exceed 100 m in width, connectivity will be maintained through implementation of the Wildlife Connectivity Plan. Habitat within the Project footprint is not classified as habitat critical to the survival of the species, and therefore the Project is unlikely to interfere with the recovery of the subspecies.	- Retain mistletoe and scattered patches of dense shrubs for nesting habitat, particularly in areas close to water. - Actively manage pest and pastoral grazing in occupied patches, including control of overabundant herbivores. - Targeted removal of weeds significantly compromising habitat values (e.g., invasive perennial grasses) and restore native vegetation in conjunction with restoration of native perennial grasses, ideally in a landscape mosaic, ensuring that large areas of exotic food plants (such as <i>Ehrharta longiflora</i>, or abundant annual grasses) are not removed at once without provision of an alternative, native food source. As the Project will clear 216.89 ha of diamond firetail, including woodland, open forest, and grassland, it	Ensure populations remain connected. Avoid gaps greater than 100 m between trees (either between scattered paddock trees or in linear corridors). Eliminate gaps through revegetation, either corridors or stepping stone plantings, focusing on important movement pathways. Although the Project will clear 216.89 ha of potential hooded robin (south-eastern) habitat, this habitat is not considered habitat critical to the survival of the species. Although sections of the Project will exceed 100 m in width, connectivity will be maintained through implementation of the Wildlife Connectivity Plan. It is considered that the Project is unlikely to interfere with the recovery of the species.	As the Project will clear 216.89 ha of southern whiteface habitat, which includes areas that could be considered habitat critical to the survival of the species, it is considered that the Project is likely to interfere with the recovery of the species.

Criteria	Assessment against SRI criteria brown tree creeper (south-eastern) (<i>Climacteris picumnus victoriana</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
		is considered that the Project is likely to interfere with the recovery of the species.		
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Unlikely Ecologically significant locations of the subspecies have not been formally defined, and as such, the subspecies' definition of habitat critical to survival of the species (DCCEEW, 2023a) will be used in lieu. Habitat critical for the subspecies is defined as relatively undisturbed grassy woodland with an open, native understorey, fallen logs, and hollows in live or standing dead trees. Any known or likely habitat (as per the modelled distribution map) should be considered as habitat critical to the survival of the subspecies. As the Project footprint is mapped within the species' may occur distribution, habitat within the Project footprint is not considered to be habitat critical to the survival of the subspecies. Therefore, the Project is unlikely to cause disruption	Likely Ecologically significant locations of the species have not been formally defined, and as such, the species' definition of habitat critical to survival of the species (DCCEEW, 2023b) will be used in lieu. Habitat critical for the species is defined as eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats with high grass cover, low tree density, few large logs and little litter cover. Any known or likely habitat (as per the modelled distribution map) should be considered as habitat critical to the survival of the species. As the Project footprint is mapped within the species' known or likely to occur distribution, habitat within the Project footprint is considered to be habitat critical to the survival of the species. The Project footprint	Unlikely Ecologically significant locations of the species have not been formally defined, and as such, the species' definition of habitat critical to survival of the species (DCCEEW, 2023c) will be used in lieu. Habitat critical for the species is defined as: • "dry eucalypt and acacia woodlands and shrublands remnants with an open understorey, some grassy areas and a complex ground layer, often in or near clearings or open areas; • structurally diverse habitats featuring: mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses; • standing dead or live trees and tree stumps are also essential for nesting, roosting and foraging;	Likely Ecologically significant locations of the species have not been formally defined, and as such, the species' definition of habitat critical to survival of the species (DCCEEW, 2023d) will be used in lieu. This includes areas of: • "relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both; • habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat; • living and dead trees with hollows and crevices which are essential for roosting and nesting." • Any known or likely habitat (as per the modelled distribution map) should be considered as habitat

Criteria	Assessment against SRI criteria brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>) – Vulnerable	Assessment against SRI criteria diamond firetail (<i>Stagonopleura guttata</i>) – Vulnerable	Assessment against SRI criteria hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) – Endangered	Assessment against SRI criteria southern whiteface (<i>Aphelocephala leucopsis</i>) – Vulnerable
	to ecologically significant locations for the species.	contains 216.89 ha of diamond firetail habitat, which will be cleared for the Project. Impacts to this habitat will be permanent, and therefore, the Project is likely to cause disruption to ecologically significant locations for the species.	- moderately deep to deep soils, rocks and fallen timber which provides essential foraging habitat.” - Any known or likely habitat (as per the modelled distribution map) should be considered as habitat critical to the survival of the subspecies. - As a small area of the Project footprint at its southern extent is mapped within the species’ may occur distribution, habitat within the Project footprint is not considered to be habitat critical to the survival of the species. Therefore, the Project is unlikely to cause disruption to ecologically significant locations for the species.	critical to the survival of the species. As almost the entire Project footprint is mapped within the species’ known or likely to occur distribution, habitat within the Project footprint is considered to be habitat critical to the survival of the species. The Project footprint contains 216.89 ha of southern whiteface habitat. Impacts to this habitat will be permanent, and therefore, the Project is likely to cause disruption to ecologically significant locations for the species.
Assessment of potential for SRI	The Project is unlikely to result in a significant residual impact on brown treecreeper (south-eastern).	The Project has the likely to result in a significant residual impact on diamond firetail.	The Project is unlikely to result in a significant residual impact on hooded robin (south-eastern).	The Project is likely to result in a significant residual impact on southern whiteface.

7.2.7.3 LARGE BIRDS

The glossy black-cockatoo (south-eastern) (*Calyptrorhynchus lathami lathami*) and powerful owl (*Ninox strenua*) are both listed as Vulnerable under the NC Act. The glossy black-cockatoo (south-eastern) is known to occur within the Project footprint due to sightings of seven individuals and several oorts. The powerful owl has the potential to occur within the Project footprint due to a possible sighting within Bringalily State Forest approximately 3.6 km west of the Project footprint.

An in-depth description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for these species is presented in Table 7-9.

TABLE 7-9 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (LARGE BIRDS)

Criteria	Assessment against SRI criteria glossy black-cockatoo (south-eastern) (<i>Calyptrorhynchus lathami lathami</i>) – Vulnerable	Assessment against SRI criteria powerful owl (<i>Ninox strenua</i>) – Vulnerable
Lead to a long term decrease in the size of a local population of the species	Unlikely Glossy black-cockatoo (south-eastern) were recorded within the Project footprint during field surveys, and there is a historic record (2005) of the species within the Project footprint. There are five additional records within the locality (10 km), with the nearest being 6 km west of the footprint, in Bringalily State Forest. The Project footprint contains 120.01 ha of glossy black-cockatoo (south-eastern) habitat, which will be cleared for the Project. This includes 1.08 ha of breeding habitat and 118.94 ha of foraging habitat. The Project is linear and is considered unlikely to create a barrier for the species movement. Suitable habitat is present in the surrounding landscape, providing potential refugia for the species. The Project will implement mitigation measures to minimise the risk of impacts on the species, including pre-clearance surveys. Therefore, the Project is considered unlikely to result in a long-term decrease in the size of a local population.	Unlikely The powerful owl is generally found across the east coast of Australia, preferring open forests and woodlands along watercourses. An unconfirmed sighting of the species was recorded near the Project footprint (Bringalily State Forest, approximately 3.6 km west of the alignment), during microbat surveys (Williams, 2023). Multiple records exist within 10 km of the Project around Gowrie, Kingsthorpe, Highfields, and Toowoomba (some of these records could be further than 10 km from the Project footprint). Habitat for this species as described in the literature was detected with the Project footprint, however, was very limited. The Project footprint contains 8.64 ha of potential powerful owl habitat, which will be impacted by the Project. This includes 8.28 ha of potential breeding habitat and 0.36 ha of potential foraging habitat. The Project is linear and is considered unlikely to create a barrier for the species movement. The Project will implement mitigation measures to minimise the risk of impacts on the species, including pre-clearance surveys.

Criteria	Assessment against SRI criteria glossy black-cockatoo (south-eastern) (<i>Calyptrorhynchus lathami lathami</i>) – Vulnerable	Assessment against SRI criteria powerful owl (<i>Ninox strenua</i>) – Vulnerable
		Due to the linear nature of the Project and the limited preferred habitat for this species the Project is unlikely to lead to a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	Unlikely The species was recorded within the Project footprint during the field surveys; and several records were identified in Bringalily State Forest within the locality (10 km). According to the subspecies' conservation advice (DCCEEW, 2022a), the estimated extent of occurrence is 470,000 km² (range 447,000-493,500 km²) and has a contracting trend (Cameron et al., 2021). The removal of 120.01 ha represents 0.00026% of the EOO. There is suitable habitat present in the surrounding areas, so it is considered likely that the species will persist in the area following construction. Additionally, the Project footprint is not located towards the limit of the species distribution, and as such, the Project is considered unlikely to reduce the extent of occurrence of the species.	Unlikely The powerful owl's estimated extent of occurrence is 1,290,000 km² (BirdLife International, 2024). The removal of 8.64 ha represents 0.000007% of the EOO. The species was not recorded within the Project footprint during the field surveys; although a possible sighting was recorded in Bringalily State Forest 3.6 km from the Project footprint. Additionally, multiple generalised records were identified within the locality (10 km) around Gowrie, Kingsthorpe, Highfields, and Toowoomba. Whilst the Project footprint is located towards the limit of the species distribution, given a potential sighting in Bringalily State Forest (west of the alignment), it is considered that the Project is unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely Glossy black-cockatoo (south-eastern) is a mobile species, often recorded to fly more than 10 km from roosting or nesting sites to feeding areas (Hourigan, 2012). Seven individuals were recorded within the Project footprint, in addition to five areas containing oorts. The Project follows an existing cleared linear corridor through the areas of State Forest and for much of the alignment, therefore, potential habitat in these areas is already fragmented. Additionally, the Project is not considered to represent a barrier to movement for the species. Therefore, the Project is considered unlikely to fragment an existing population.	Unlikely Powerful owls are generally sedentary, with pairs occupying a large, likely permanent home range. Despite this, young have been observed to disperse up to 18 km after leaving the nest (NSWSC, 2008; Pizzey and Knight, 2007). The Project is not considered to represent a barrier to movement for the species. As such, the clearing of 8.64 ha of potential habitat for the species is considered unlikely to fragment an existing population.

Criteria	Assessment against SRI criteria glossy black-cockatoo (south-eastern) (<i>Calyptrorhynchus lathami lathami</i>) – Vulnerable	Assessment against SRI criteria powerful owl (<i>Ninox strenua</i>) – Vulnerable
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely This species was recorded within the Project footprint; and several records were identified in Bringalily State Forest within the locality (10 km). The Project footprint contains 120.01 ha of potential glossy black-cockatoo (south-eastern) habitat, which will be cleared for the Project. As the Project is not considered to represent a barrier to movement for the species, it is unlikely the Project will result in genetically distinct populations forming from habitat isolation.	Unlikely Powerful owls are generally sedentary, with pairs occupying a large, likely permanent home range. A possible sighting of the species was recorded to occur within the Project footprint during field surveys and additional records exist within the locality (10 km). The Project footprint contains 8.64 ha of powerful owl habitat, which will be impacted by the Project. As the Project is not considered to represent a barrier to movement for the species, it is unlikely the Project will result in genetically distinct populations forming from habitat isolation.
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely Predation by introduced predators such as feral cats (<i>Felis catus</i>) and European red fox (<i>Vulpes vulpes</i>) does occur, however are unlikely to be major threats for these species. Feral animals, including foxes and cats are known to occur within the Project footprint. Mitigation measures to minimise the introduction and spread of weed and pest species across the Project footprint and into adjacent areas will be implemented during construction. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.	
Introduce disease that may cause the population to decline	Unlikely Psittacine beak and feather disease (PBFD) is a relatively low threat to the glossy black-cockatoo and powerful owl. However, with intensified competition for nest hollows, it is possible that the likelihood of disease transmission could be greater in the future. Measures to manage diseases resulting from Project activities will be implement during construction. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.	
Interfere with the recovery of the species	Likely There is currently no recovery plan for this species, although a recovery plan is required. The approved conservation advice (DCCEEW, 2022a) outlines the following priority actions that are relevant to the Project: Protect, restore and enhance the quality of known suitable habitat and increase the extent of habitat (both breeding and foraging) for south-eastern glossy black-cockatoo across the subspecies' range (both current and future) to maintain viability in response to threats, including climate change;	Unlikely There is no recovery plan for this species and a recovery plan is not required. The conservation actions listed in NSW (OEH, 2024) outlines the following actions that are relevant to the Project: - Retain large stands of native vegetation, especially those containing hollow-bearing trees. - Protect riparian vegetation to preserve roosting areas. - Protect hollow-bearing trees for nest sites. Younger recruitment trees should also be retained to replace older trees in the long-term.

Criteria	Assessment against SRI criteria glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>) – Vulnerable	Assessment against SRI criteria powerful owl (<i>Ninox strenua</i>) – Vulnerable
	- Protect large old trees and smaller trees that contain large hollows, including those affected by fires. Ensure the recruitment of large old trees by retaining medium-sized trees, facilitating regeneration, and undertaking replanting; - Maintain connectivity within and between regions; and - Maintain vegetation in proximity to water points, including the presence of smaller trees immediately adjacent to the water's edge, to provide cover and resting place for drinking birds. Clearing of 120.01 ha of glossy black-cockatoo (south-eastern) habitat will directly interfere with the recovery of the species, as listed in the priority actions above, therefore the Project is considered likely to interfere with the recovery of the species.	- Retain at least a 200 m buffer of native vegetation around known nesting sites. - Minimise visits to nests and other disturbances, including surveys using call playback, when owls are breeding. Whilst approximately 8.64 ha of the species' potential habitat will be impacted by the Project, the species is not known to occur within the Project footprint and the Project is considered unlikely to interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Likely Habitat critical to the survival of the glossy black-cockatoo (south-eastern) can be used in lieu of ecologically significant locations. Habitat critical to the subspecies is defined in the conservation advice (DCCEEW, 2022a) as "areas that are necessary: - For activities such as foraging, breeding, roosting, or dispersal; - For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators); - To maintain genetic diversity and long-term evolutionary development; or - For the reintroduction of populations or recovery of the species or ecological community." The Project footprint contains 120.01 ha of potential glossy black-cockatoo (south-eastern) habitat, which will be cleared for the Project. This includes 1.08 ha of breeding habitat and	Unlikely Ecologically significant locations have not been formally defined for this species. However, the species is known to require hollows in old growth trees for roosting and nesting. Additionally, many of their prey species (e.g. greater glider, and ringtail possum) are dependent on hollows for nesting or roosting and breeding (OEH, 2024). Although the Project footprint contains 8.64 ha of potential powerful owl habitat, including 8.28 ha of potential breeding habitat, the species has not been observed in the Project footprint. The Project will implement mitigation measures to minimise the risk of impacts on the species, including pre-clearance surveys and restricted works near any observed nesting sites. As such, the Project is unlikely to cause disruption to ecologically significant locations of the species.

Criteria	Assessment against SRI criteria glossy black-cockatoo (south-eastern) (<i>Calyptrorhynchus lathami lathami</i>) – Vulnerable	Assessment against SRI criteria powerful owl (<i>Ninox strenua</i>) – Vulnerable
	118.94 ha of foraging habitat. As such, the Project is likely to cause disruption to ecologically significant locations of the species.	
Assessment of potential for SRI	The Project is likely to result in a significant residual impact on glossy black-cockatoo (south-eastern).	The Project is unlikely to result in a significant residual impact on powerful owl.

7.2.7.4 MAMMALS

The yellow-bellied glider (south-eastern) (*Petaurus australis australis*) is listed as Vulnerable under the NC Act and has the potential to occur within the Project footprint. A potential scat was observed in one location within the Project footprint adjacent to Whetstone State Forest, however, was unable to be confirmed as yellow-bellied glider (south-eastern). Potential scat and feed-marks were also identified on Lindenmayer Road east of Millmerran approximately 2 km west of the Project footprint.

An in-depth description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for these species is presented in Table 7-10.

TABLE 7-10 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (MAMMALS)

Criteria	Assessment against SRI criteria yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>) – Vulnerable
Lead to a long term decrease in the size of a local population of the species	Unlikely A potential yellow-bellied glider scat was recorded within the Project footprint; however, it was unable to be confirmed during field surveys. An additional, unconfirmed, potential scat was identified adjacent to Whetstone State Forest within the Project footprint. As these scat records cannot be confirmed as yellow-bellied glider (south-eastern) and no direct sightings were recorded, the species is considered to have the potential to occur within the Project footprint. Additionally, this species requires a large home range of 50-65 ha. While this is a large area of potential habitat expected to be cleared, as the species was not recorded within the Project footprint during field surveys, the Project is considered unlikely to result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	Unlikely According to the species' conservation advice (DAWE, 2022), the extent of occurrence for this species is estimated to be 1,285,082 km². The Project footprint contains 298.05 ha of potential yellow-bellied glider (south-eastern) habitat which will be cleared for the Project. This represents 0.0002% of the extent of occurrence. This species is active and requires a home range area of 50–65 ha due to requirements for foraging and denning trees (DAWE, 2022). Although, the Project footprint traverses close to the western edge of the species distribution, there are records further west, in Braemar State Forest (ALA, 2024). Therefore, the Project is considered unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely No individuals were observed during field surveys, and only potential, unconfirmed signs and scats were found within the Project footprint. This species is highly active, requiring a large home range (50-65 ha), however they have an average gliding distance of 25.2 m (DAWE, 2022). As the Project is a linear infrastructure, it is likely to create a barrier to dispersal

Criteria	Assessment against SRI criteria yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>) – Vulnerable
	as it will bisect remnant habitat within Bringalily and Whetstone State Forests, the Project will provide mitigation measures to reduce the impacts. Development of the Wildlife Connectivity Plan based on the Fauna Connectivity Strategy (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will provide for movement across the Project footprint should an undetected yellow-bellied glider population be present. Connectivity areas have been identified for gliders and opportunities for movement will be facilitated by provision of over rail canopy bridges and/or suitably high glider poles. These will likely be located over low bridge structures. Reducing the width of the rail corridor will enhance connectivity outcomes for gliders and is likely to be possible at waterway crossings. Where feasible, suitably high bridge structures may incorporate under-bridge canopy bridges and/or glider poles. The Fauna Connectivity Strategy includes recommendations to remove barbed wire from fencing and revegetate approaches to bridges to ensure connectivity outcomes for gliders. These measures will be incorporated into the detailed design for the Project. The residual impact to connectivity after mitigation was assessed in the Fauna Connectivity Strategy as low for gliders. As a result of this, it is considered unlikely that the Project will fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely While no individuals were observed during field surveys, potential, unconfirmed signs and scats were found within the Project footprint. As the Project is a linear infrastructure that is anticipated that it will cause a barrier to dispersal, thus fragmenting habitat, and genetically isolating populations, the Project will implement measures to mitigate this. Provision of appropriate crossing structures as outlined in the Wildlife Connectivity Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will maintain gene flow across the Project, should a population occur on both sides. Therefore, the Project is unlikely to result in genetically distinct populations forming from habitat isolation.
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely Predation by introduced predators such as feral cats (<i>Felis catus</i>) and European red fox (<i>Vulpes vulpes</i>) may occur, however are not considered to be major threats for this species. Feral deer are a threat to the saplings of habitat trees by trampling, rubbing and browsing (DAWE, 2022). Feral animals, including foxes and cats are known to occur within the Project footprint. Mitigation measures to minimise the introduction and spread of weed and pest species across the Project footprint and into adjacent areas will be implemented during construction. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the population to decline	Unlikely Yellow-bellied gliders (south-eastern) are not currently threatened by diseases. Appropriate disease management measures to prevent the introduction of diseases as a result of Project activities will be implemented during construction. With the appropriate management and mitigation measures applied, it is considered unlikely the Project will introduce disease that may cause a population to decline.
Interfere with the recovery of the species	Unlikely A recovery plan has yet to be established for this species, however the conservation advice (DAWE, 2022) lists several recovery actions, including:

Criteria	Assessment against SRI criteria yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>) – Vulnerable
	• Ensure suitable habitat is maintained and protected from known threats (such as high severity bushfires) around important subpopulations, as well as in areas where subpopulations have already declined through loss of habitat. When protecting an area, retain sufficient suitable habitat for subpopulation viability. • Whenever possible, habitat critical to the survival of the species should not be destroyed or modified. Actions that have indirect impacts on habitat critical to survival should be minimised (e.g. clearing, road construction), and actions that compromise adult and juvenile survival should also be avoided. • Restore connectivity in subpopulations fragmented by major roads, including the use of artificial structures such as rope bridges and glide poles. While the Project may be a potential point source of ignition for fires, this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. Should a population be present, it would not be considered as important subpopulation. Therefore, the Project is considered unlikely to interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Unlikely Habitat critical to the survival of the yellow-bellied glider (south-eastern) can be used in lieu of ecologically significant locations. Habitat critical to the survival of the species is defined as ‘<i>large contiguous areas of floristically diverse eucalypt forest, which are dominated by winter-flowering and smooth-barked eucalypts, including mature living hollow-bearing trees and sap trees, areas identified as refuges under future climate change scenarios, short or long-term post-fire refuges that allow the species to persist, recover and recolonise burnt areas, habitat corridors required to facilitate dispersal of the subspecies between fragmented habitat patches and/or that enable recolonization or movement away from threats, and areas in which some trees have evidence of use for sap extraction by yellow-bellied glider (south-eastern)</i>’ (DAWE, 2022). The Project footprint contains 298.05 ha of potential yellow-bellied glider (south-eastern) habitat, which will be cleared for the Project. This includes 164.80 ha of potential breeding and denning habitat, 21.99 ha of potential foraging habitat, and 111.27 ha of potential dispersal habitat. Yellow-bellied gliders show a preference for mature old growth forest (Eyre & Smith, 1997; Eyre & Goldingay, 2003; Eyre, 2002, 2004; van der Ree et al., 2004). The contiguous forests surrounding the Project footprint has been subject to historical and ongoing forestry practices which has significantly reduced/alterd the availability of mature hollow bearing trees suitable for denning. The Project will implement mitigation measures to minimise the risk of impacts on the species, including pre-clearance surveys and restricted works near any observed nesting sites. As such, the Project is unlikely to cause disruption to ecologically significant locations of the species.
Assessment of potential for SRI	The Project is unlikely to result in a significant residual impact on yellow-bellied glider (south-eastern).

7.2.7.5 SNAKES

The common death adder (*Acanthophis antarcticus*) is listed as Vulnerable and the grey snake (*Hemiaspis damelii*) is listed as Endangered under the NC Act. Both snake species are known to occur within the Project footprint. Common death adders were recorded in or near Bringalily State Forest. Grey snakes were observed at two locations, near Yelarbon and Inglewood.

An in-depth description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for these species is presented in Table 7-11.

TABLE 7-11 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (SNAKES)

Criteria	Assessment against SRI criteria common death adder (<i>Acanthophis antarcticus</i>) – Vulnerable	Assessment against SRI criteria grey snake (<i>Hemiaspis damelii</i>) – Endangered
Lead to a long term decrease in the size of a local population of the species	Unlikely Six specimens of the common death adder have been recorded during field surveys, including two within the Project footprint. The Project footprint contains 277.27 ha of habitat for the species, which will be cleared. This includes 2.85 ha of essential habitat. The Project footprint is located within a network of State forests that act as a corridor between known habitat for the species at Yelarbon State Forest, Bringalily State Forest, and Whetstone State Forest. During construction, fauna spotter catchers will ensure no individuals are harmed. During operation, the implementation of the Wildlife Connectivity Plan (based on revised draft EIS Appendix P: Fauna Connectivity Strategy) will provide for movement across the Project footprint for the common death adder and will therefore maintain meta-population dynamics across the Project footprint. Thus, the Project is considered unlikely to lead to a long term decrease in the size of a local population of the species.	Unlikely The grey snake was detected during targeted surveys within the Project footprint. The species was recorded at two locations within the Project footprint one near Yelarbon and the other near Inglewood. The Project footprint contains 259.80 ha of habitat for the species, which will be cleared. During construction, fauna spotter catchers will ensure no individuals are harmed. During operation, the implementation of the Wildlife Connectivity Plan (based on revised draft EIS Appendix P: Fauna Connectivity Strategy) will provide for movement across the Project footprint for the grey snake and will therefore maintain meta-population dynamics across the Project footprint. Thus, the Project is considered unlikely to lead to a long term decrease in the size of a local population of the species.

Criteria	Assessment against SRI criteria common death adder (<i>Acanthophis antarcticus</i>) – Vulnerable	Assessment against SRI criteria grey snake (<i>Hemiaspis damelii</i>) – Endangered
Reduce the extent of occurrence of the species	Unlikely The extent of occurrence for the common death adder is not known, however it has a very large distribution across eastern and coastal southern Australia. The Project footprint is located through the middle of the species distribution and is not at the limit of the species occurrence, and as such, the Project is considered unlikely to reduce the extent of occurrence of the species.	Unlikely The estimated extent of occurrence for the grey snake is 471,500 km² (DCCEEW, 2022b). The removal of 259.80 ha of habitat for the species, represents 0.0006% of the EOO. The Project footprint is not at the limit of the species occurrence, and, therefore, the Project is considered unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely The Project footprint contains 277.27 ha of habitat for the species. There are areas surrounding the Project which are documented to contain important habitat for the species. As mentioned above, the common death adder has the ability to live in a variety of habitats (food dependent). Given the linear nature of the Project and the fact this is a terrestrial species there is potential to fragment a local population, should mitigation measures not be implemented. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for woodland reptiles. Connectivity areas have been identified for woodland reptiles. Structures with natural substrate will be designed for the species, including provision of suitable habitat features and fauna furniture within these crossing structures and in their approaches. The residual impact to connectivity for woodland reptiles after mitigation was assessed in the Fauna Connectivity Strategy as low at bridges and moderate at culverts. As such, the Project is unlikely to fragment an existing population into two or more populations.	Unlikely The Project footprint contains 259.80 ha of habitat for the species. The Project footprint follows a linear trajectory which intersects the Condamine River floodplain and other waterbodies, which has been assessed as a key habitat for the grey snake. Development and implementation of the Wildlife Connectivity Plan based on revised draft EIS Appendix P: Fauna Connectivity Strategy will provide opportunities for movement across the Project footprint for the cracking clay reptiles. Connectivity areas have been identified for cracking clay reptiles. Structures with natural substrate will be designed for the species, including provision of suitable habitat features and fauna furniture within these crossing structures and in their approaches. The Fauna Connectivity Strategy includes recommendations to preserve cracking clay soils in areas of suitable habitat, where possible. The residual impact to connectivity for cracking clay reptiles after mitigation was assessed in the Fauna Connectivity Strategy as low at bridges and moderate at culverts. As such, the Project is unlikely to fragment an existing important population into two or more populations.
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely Common death adders readily move across linear infrastructure and the provision of appropriate crossing structures as outlined in the Wildlife Connectivity Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy)	Unlikely Given the linear nature of the Project and the fact this is a terrestrial species there is potential to result in genetically distinct populations. However, the provision of appropriate crossing structures as outlined in the Wildlife Connectivity

Criteria	Assessment against SRI criteria common death adder (<i>Acanthophis antarcticus</i>) – Vulnerable	Assessment against SRI criteria grey snake (<i>Hemiaspis damelii</i>) – Endangered
	will likely maintain sufficient gene flow across the Project footprint. Therefore, the Project is unlikely to result in genetically distinct populations forming from habitat isolation.	Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will likely maintain sufficient gene flow across the Project footprint. The Project is considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely Both the common death adder and the grey snake are threatened by the cane toad (<i>Rhinella marina</i>), while both are also potentially also threatened by feral pigs, cats and European foxes. Feral animals, including foxes and cats are known to occur within the Project footprint. Mitigation measures to minimise the introduction and spread of weed and pest species across the Project footprint and into adjacent areas will be implemented during construction. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.	
Introduce disease that may cause the population to decline	Unlikely There are no diseases that are currently known to threaten these species. Measures to manage diseases resulting from Project activities will be implemented during construction. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.	
Interfere with the recovery of the species	Unlikely There is no recovery plan for this species and a recovery plan is not required. Whilst the Project will require the removal of 277.27 ha of common death adder habitat, the Project will implement mitigation measures during clearing which include the presence of qualified fauna spotter/catcher during clearing. Additionally, the species has a widespread distribution, spanning across most of Australia. Therefore, the Project is unlikely to interfere with the recovery of the species.	Unlikely There is no recovery plan for this species and a recovery plan is not required. The approved conservation advice for the grey snake notes the following priority actions applicable to the species that are relevant to the Project: • Ensure developments maintain sufficient hydrological flows, pulses and connectivity across subpopulations. • Protect the grey snake's habitat and prevent impacts in the planning, construction and post construction phases of developments. • Reduce the impact of other threats to grey snake subpopulations and habitat in areas impacted by cane toads to increase the potential for cane-toad resilient populations to persist and recover. • Implement control measures to reduce the impacts of feral pigs, cats and foxes in grey snake habitat across its range.

Criteria	Assessment against SRI criteria common death adder (<i>Acanthophis antarcticus</i>) – Vulnerable	Assessment against SRI criteria grey snake (<i>Hemiaspis damelii</i>) – Endangered
		• Threat abatement plan for predation by feral cats (DoE, 2015c); • Threat abatement plan for predation by the European red fox (DEWHA, 2008); • Threat abatement plan for predation, habitat degradation, competition, and disease transmission by feral pigs (<i>Sus scrofa</i>) (DEE, 2017); and • Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (DSEWPC, 2011b). The species was recorded on numerous occasions throughout the Project footprint. Whilst the Project will require the removal of 259.80 ha of grey snake habitat, the Project will implement mitigation measures which include the presence of qualified fauna spotter/catcher during clearing. Changes to surface water flow during flooding events caused by the Project are considered to have a low impact on the grey snake (see Section 5.2.10), and hydrological flows, pulses and connectivity will remain across the Project. Therefore, the Project is unlikely to interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Unlikely Whilst ecologically significant locations have not been defined for this species, the species habitat has been described as 'a wide variety of habitats in association with well-draining soil and deep leaf litter, including rainforests, wet sclerophyll forests, grasslands, woodland, chenopod dominated shrublands and coastal heathlands' and can be used in lieu. The Project will impact approximately 277.27 ha of common death adder habitat. Mitigation measures will include the presence of qualified fauna spotter/catcher during clearing and pre-clearance surveys to investigate potential habitat features. Individuals will be relocated to habitat away from	Unlikely Whilst ecologically significant locations have not been defined for this species, the species habitat has been described as 'inhabit brigalow (<i>Acacia harpophylla</i>) and belah (<i>Casuarina cristata</i>) woodlands on heavy, dark brown to black cracking clay soils, particularly in association with water bodies, areas with small gullies and ditches, and floodplain environments where the species shelters beneath logs, rocks and soil cracks' and can be used in lieu. The Project will impact approximately 259.80 ha of grey snake habitat. Mitigation measures will include the presence of qualified fauna spotter/catcher during clearing and pre-

Criteria	Assessment against SRI criteria common death adder (<i>Acanthophis antarcticus</i>) – Vulnerable	Assessment against SRI criteria grey snake (<i>Hemiaspis damelii</i>) – Endangered
	the works area. The Project is unlikely to disrupt an ecologically significant location to the extent a significant impact is likely to occur on the species.	clearance surveys to investigate potential habitat features. Individuals will be relocated to habitat away from the works area. The Project is unlikely to disrupt an ecologically significant location to the extent a significant impact is likely to occur on the species.
Assessment of potential for SRI	The Project is unlikely to result in a significant residual impact on the common death adder.	The Project is unlikely to result in a significant residual impact on the grey snake.

7.2.7.6 BUTTERFLIES

The bulloak jewel butterfly (*Hypochrysops piceatus*) is listed as Critically Endangered under the NC Act and has the potential to occur within the Project footprint.

A description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for these species is presented in Table 7-12.

TABLE 7-12 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT CRITERIA – PROTECTED WILDLIFE HABITAT (INVERTEBRATES)

Criteria	Assessment against SRI criteria bulloak jewel butterfly (<i>Hypochrysops piceatus</i>) – Critically Endangered
Lead to a long term decrease in the size of a local population of the species	Unlikely The bulloak jewel butterfly has a very limited distribution, and currently there are only two known subpopulations, located at Bendidee National Park and Bendidee State Forest, and Leyburn. The bulloak jewel butterfly is regarded as being an extremely rare butterfly species and there are no known subpopulations within the Project footprint. The Project footprint contains 231.29 ha of potential habitat for the bulloak jewel butterfly, which will be cleared. However, the Project footprint does not overlap with the known areas of occurrence for the species. The Project will conduct pre-clearance surveys within these areas of potential habitat to confirm presence or absence. Therefore, the Project is considered unlikely to lead to a long term decrease in the size of the local population of the species.
Reduce the extent of occurrence of the species	Unlikely The bulloak jewel butterfly has a very limited distribution, with an estimated extent of occurrence of only 210.7 km² (TSSC, 2023) with a declining trend. The clearing of 231.29 ha of potential habitat represents approximately 1.1% of the EOO. However, the Project footprint is located between the two limited areas of the species distribution, and as such, the Project is considered unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely The species has the potential to occur in the Project footprint but there is no known population within the Project footprint. The bulloak jewel butterfly is only known to exist in the two locations and is regarded as being an extremely rare butterfly species. The species is thought to be capable of dispersing up to 3 km, but potentially as little as 1 km (TSSC, 2023). This dispersal ability indicates that the Project footprint would not pose a barrier to dispersal should the species locate suitable habitat outside of the current limited known occupation. As the species is has a very limited distribution, that is already fragmented and the species is airborne, the clearing of 231.29 ha of potential habitat is considered unlikely to fragment an existing population.

Criteria	Assessment against SRI criteria bulloak jewel butterfly (<i>Hypochrysops piceatus</i>) – Critically Endangered
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely As there are no known populations or subpopulations inhabiting areas within or adjacent to the Project footprint, the Project is considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	Unlikely The bulloak jewel butterfly's habitat is threatened by increased fire intensity from invasive buffel grass (<i>Cenchrus ciliaris</i>) and destruction of bulloak seedlings (potential future habitat) caused by rabbits (TSSC, 2023). Mitigation measures to minimise the introduction and spread of weed and pest species across the Project footprint and into adjacent areas will be implemented during construction. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the population to decline	Unlikely There are no diseases that are currently known to threaten this species. Measures to manage diseases resulting from Project activities will be implemented during construction. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere with the recovery of the species	Unlikely There is no adopted or made recovery plan for this species, and a recovery plan is not required. The species conservation advice (TSSC, 2023) identifies (but not limited to) the following priority actions: • Prevent land clearing and resulting habitat destruction at all known localities. Any further habitat destruction at known localities will have a significant impact on the species. • Prevent the grazing of bulloak recruits by cattle, goats, and rabbits to ensure the future of the species. • Ensuring that the fire frequency in bulloak woodlands is kept low to retain known habitat for the bulloak jewel butterfly and the attendant ant. Clearing of 231.29 ha of potential bulloak jewel butterfly habitat has the potential to interfere with the above recovery actions, particularly regarding the prevention of clearing of habitat for the species. However, the Project will commit to conducting pre-clearance surveys within these areas of potential habitat to confirm presence or absence of the species or its attendant ant. While the Project may be a potential point source of ignition for fires this is considered likely to be a rare event and the provision of adjacent access roads for the Project will enhance access for bushfire control in the wider landscape. Therefore, it is unlikely the Project will interfere with the recovery of the species.
Cause disruption to ecologically significant locations (breeding, feeding,	Unlikely Ecologically significant locations have not been defined for this species, therefore preferred habitat will be used in lieu. The habitat requirements of the bulloak jewel butterfly are complicated, in that the species requires the flora species (in particular

Criteria	Assessment against SRI criteria bulloak jewel butterfly (<i>Hypochrysops piceatus</i>) – Critically Endangered
nesting, migration or resting sites) of a species	<i>Allocasuarina</i> spp.) and an ant species (<i>Anonychomyrma inclinata</i>) that occupies trees that permit female butterflies to dwell. The flora species that are associated with, and are critical to the survival of the butterfly species are: • Bulloak (<i>Allocasuarina luehmannii</i>), to provide substrate for both bulloak jewel butterfly individuals and those of the attendant ant to live and breed in; and • The butterflies have been recorded feeding at flowers, including those of <i>Angophora leiocarpa</i>, <i>Eucalyptus tereticornis</i>, <i>Jacksonia scoparia</i>, <i>Kunzea opposita</i> var. <i>opposita</i> and several mistletoes, including <i>Amyema</i> spp. Therefore, all potential habitat within the Project footprint (231.29 ha) is considered ecologically significant locations. However, the bulloak jewel butterfly has a very limited distribution, being limited to small area in southeast Queensland from Goondiwindi south to Smithfield, then north to Dalby and in areas south of Pittsworth. Additionally, the Project will commit to conducting pre-clearance surveys within these areas of potential habitat to confirm presence or absence of the species or its attendant ant. As such the clearing of potential bulloak jewel butterfly habitat for the Project is unlikely to cause disruption to the ecologically significant locations of the species.
Assessment of potential for SRI	The Project is unlikely to result in a significant residual impact on the bulloak jewel butterfly.

7.2.7.7 SPECIAL LEAST CONCERN MAMMALS

The platypus (*Ornithorhynchus anatinus*) and short-beaked echidna (*Tachyglossus aculeatus*) are both known to occur within the Project footprint and are listed as special least concern under the NC Act. Platypus were also detected in five eDNA survey locations. These were on the southern branch of the Condamine River near Yandilla, Bringalily Creek, and at three survey sites along Back Creek near Millmerran (Hydrobiology, 2023). Echidnas were located at Whetstone State Forest, just north of Inglewood, near the northern end of Bringalily State Forest (outside footprint), and near Millmerran.

An in-depth description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for these species is presented in Table 7-13.

TABLE 7-13 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT GUIDELINE CRITERIA – SPECIAL LEAST CONCERN FAUNA SPECIES – NON-MIGRATORY SPECIES

Criteria	Assessment against SRI criteria platypus (<i>Ornithorhynchus anatinus</i>) - SLC	Assessment against SRI criteria short-beaked echidna (<i>Tachyglossus aculeatus</i>) - SLC
Lead to a long-term decrease in the size of a local population of the species	Unlikely The Project footprint contains 24.81 ha of habitat for the species. This is a conservative estimate and is very likely a substantial overestimate of the actual habitat available for the species. The Project will cross the Macintyre River at its southernmost point and lies close to (but does not intersect) Macintyre Brook for a substantial portion of its length. The Project will cross minor waterways in the Macintyre Brook catchment and the Condamine River. Construction disturbance at crossings will be temporary and localised. The Project will not create flow disturbance or create new impoundments when construction is finished. Any minor changes to hydrology during flood events are likely to have a negligible impact of the platypus (see Section 5.2.10). Refinement of the final reference design will be undertaken to mitigate significant impacts of changes to hydrology and flooding on MSES species habitat.	Unlikely The Project footprint contains 1,397.48 ha of predicted important habitat for the species. Echidnas have ranges observed between 21 and 93 ha and are able to live anywhere that provides a good supply of ants and termites (ALA, 2024). There is extensive habitat surrounding the Project, particularly in bushland remnants around Inglewood, which will remain undisturbed. The Project will largely impact lands already subject to extensive disturbance from agriculture and grazing. Given the relatively small amount of habitat that is estimated to be removed when compared to the species’ likely presence within the surrounding landscape, it is likely the Project would only have minor impact on a local individual’s home range. The Project is not expected to lead to a long-term decrease in the size of a local population.

Criteria	Assessment against SRI criteria platypus (<i>Ornithorhynchus anatinus</i>) - SLC	Assessment against SRI criteria short-beaked echidna (<i>Tachyglossus aculeatus</i>) - SLC
	Changes to water quality may also occur if not appropriately managed during construction (e.g., erosion and sediment controls) or operations (accidental spills and maintenance of waterway barriers). However, the risk of impact is likely to be low and localised. The Project will implement appropriate mitigation measures to ensure surface water quality is not impacted (e.g. erosion and sediment controls and water quality monitoring program). Therefore, the Project is unlikely to lead to a long-term decrease in the size of a local population.	
Reduce the extent of occurrence of the species	Unlikely There is no estimated extent of occurrence for the platypus, however it has a large distribution, covering most of eastern Australia, including Tasmania. The Project footprint contains 24.81 ha of habitat for the species. This is a conservative estimate based on predictive mapping and is very likely a substantial overestimate of the actual habitat available for the species. The species is likely only present in the Macintyre River catchment. The species is widely distributed, and the Project footprint is not at the limit of the species occurrence. Therefore, the Project is considered unlikely to reduce the extent of occurrence of the species.	Unlikely There is no estimated extent of occurrence for the short-beaked echidna, however, it is a wide-ranging species which occurs all over Australia and in most habitats. The Project footprint contains 1,397.48 ha of habitat for the species. Additionally, the Project footprint is not at the limit of the species occurrence. Therefore, the Project is considered unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	Unlikely The Project will cross the Macintyre River at its southernmost point and lies close to (but does not intersect) Macintyre Brook for a substantial portion of its length. The Project will also cross minor waterways in the Macintyre Brook catchment and the Condamine River. Construction disturbance at crossings will be temporary and localised, with bridge structures spanning these waterways. The Project will not create flow disturbance or create new impoundments when construction is complete. Therefore, the Project is unlikely to fragment an existing population.	Unlikely The Project footprint contains 1,397.48 ha of important habitat for the species. There are extensive areas surrounding the Project comprising important habitat for the species. This species is wide ranging and is able to live in a variety of habitats as long as food is available. The Fauna Connectivity Strategy (see revised draft EIS Appendix P: Fauna Connectivity Strategy) has not specifically assessed the provision and suitability of crossing structures for the short-beaked echidna, due to their large home ranges and ability to inhabit and disperse across the majority of the Project. Additionally, echidnas are known to use structures of

Criteria	Assessment against SRI criteria platypus (<i>Ornithorhynchus anatinus</i>) - SLC	Assessment against SRI criteria short-beaked echidna (<i>Tachyglossus aculeatus</i>) - SLC
		a variety of size and type. Therefore, the development of the Wildlife Connectivity Plan based on the Fauna Connectivity Strategy will generally provide opportunities for movement across the Project footprint, which the short-beaked echidna is likely to readily use. Therefore, the Project is considered unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely Construction disturbance at waterway crossings will be temporary and localised. The Project will not create flow disturbance or create new impoundments when construction is finished. The Project is unlikely to result in genetically distinct populations forming as a result of habitat isolation.	Unlikely Echidnas readily use culverts of a variety of dimensions. Provision of appropriate crossing structures as outlined in the Wildlife Connectivity Plan (see revised draft EIS Appendix P: Fauna Connectivity Strategy) will maintain gene flow across the Project. Therefore, the Project is unlikely to result in genetically distinct populations forming from habitat isolation.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration, or resting sites) of a species	Unlikely Ecologically significant locations for this species include streambank burrows which the species uses for breeding and resting. Mitigation measures during construction disturbance will include pre-clearance surveys (i.e. legislative-mandated, high-risk species management plans) to investigate potential platypus presence and burrows in the vicinity of crossing areas (i.e. specific construction zones associated with waterway banks). These surveys will reduce impact on ecologically significant locations to transient impacts at an individual scale during construction. The platypus is known to have home ranges well over 2.5 km and will use multiple burrows. Significant impact is not considered to potentially occur outside of the specific construction zones. The Project is unlikely to disrupt an ecologically significant location of the species. Any minor changes to hydrology during flood events are likely to have a negligible impact of the platypus (see Section 5.2.10). The Project design will be refined to mitigate significant impacts of changes to hydrology and flooding on platypus habitat.	Unlikely Ecologically significant locations include ground timber such as hollow logs in which the species may utilise for feeding, refuge, and reproduction. This species has potential to be encountered during vegetation clearing for the Project. Mitigation measures during clearing will include the presence of qualified fauna spotter/catcher during clearing, including pre-clearance surveys to investigate potential habitat features. Individuals will be relocated to habitat away from the works area. The Project is unlikely to disrupt an ecologically significant location of the species.

Criteria	Assessment against SRI criteria platypus (<i>Ornithorhynchus anatinus</i>) - SLC	Assessment against SRI criteria short-beaked echidna (<i>Tachyglossus aculeatus</i>) - SLC
Assessment of potential for significant residual impacts	The Project is unlikely to result in a significant residual impact on the platypus.	The Project is unlikely to result in a significant residual impact on the short-beaked echidna.

7.2.7.8 SPECIAL LEAST CONCERN MIGRATORY BIRDS

The following migratory birds, listed as SLC under the NC Act, are known to occur within the Project footprint:

- Fork-tailed swift (*Apus pacificus*);
- Glossy ibis (*Plegadis falcinellus*);
- Rufous fantail (*Rhipidura rufifrons*);
- Satin flycatcher (*Myiagra cyanoleuca*); and
- Latham's snipe (*Gallinago hardwickii*).

The common greenshank (*Tringa nebularia*) and sharp-tailed sandpiper (*Calidris acuminata*), also listed as SLC under the NC Act, are likely to occur within the Project footprint.

A description of the species, their distribution, threats and relation to the Project footprint can be found in Appendix G Species Profiles. Impacts and mitigation measures associated with this species are identified within Sections 5 and 5.3.8. An assessment against the significant impact criteria (DEHP, 2014b) for these species is presented in Table 7-14.

TABLE 7-14 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE SIGNIFICANT RESIDUAL IMPACT GUIDELINE CRITERIA – SPECIAL LEAST CONCERN FAUNA SPECIES – MIGRATORY BIRDS

Criteria	Assessment against SRI criteria fork-tailed swift (<i>Apus pacificus</i>) - SLC	Assessment against SRI criteria for migratory birds with Australian breeding range: glossy ibis (<i>Plegadis falcinellus</i>), rufous fantail (<i>Rhipidura rufifrons</i>), and satin flycatcher (<i>Myiagra cyanoleuca</i>) – SLC	Assessment against SRI criteria for migratory shorebirds with international breeding range: common greenshank (<i>Tringa nebularia</i>), Latham's snipe (<i>Gallinago hardwickii</i>), and sharp-tailed sandpiper (<i>Calidris acuminata</i>) – SLC
Lead to a long-term decrease in the size of a local population of the species	Unlikely The fork-tailed swift is known to the Project; however, sightings were recorded while individuals were in the air. In Australia, the fork-tailed swift does not breed and is almost exclusively aerial, as they have the ability to roost and loaf on strong winds. Additionally, as the species breeds internationally, they are considered to be a single global population. Therefore, the Project is unlikely to lead to a long-term decrease in the size of a local population.	Unlikely The glossy ibis is considered migratory and nomadic, undergoing post-breeding dispersal and, within Australia, moving in response to good rainfalls (DoE, 2024a). The rufous fantail occurs in coastal and near coastal regions. In southern Queensland can be found on and to the east of the Great Dividing Range, where several breeding populations have been located (DoE, 2024b). The satin flycatcher is widespread in south-eastern Queensland, on both sides of the Great Dividing Range (DoE, 2024c). The Project footprint contains areas of suitable habitat for the three species and there is widespread habitat for each species in the broader landscape. All three species migrate across Australia, and the Project does not expect to impact breeding habitat for any of the species.	Unlikely Sightings of Latham's snipe within the Project footprint were recorded while individuals were in the air. Latham's snipe is almost exclusively aerial in Queensland, as they spend their non-breeding season south of the Richmond River in NSW (DCCEE, 2024). Both the common greenshank and the sharp-tailed sandpiper are common in Queensland's coastal areas but are sparsely scattered inland. This is likely due to the limited availability of wetlands, mudflats, and shorelines that both species forage within inland Queensland. Habitat for the three species was observed during field surveys, however, the amount of habitat is limited. The Project will cross several wetlands, rivers, and creeks. However, construction disturbance at crossings will be temporary and localised, and permanent impacts will be minimised.

Criteria	Assessment against SRI criteria for fork-tailed swift (<i>Apus pacificus</i>) - SLC	Assessment against SRI criteria for migratory birds with Australian breeding range: glossy ibis (<i>Plegadis falcinellus</i>), rufous fantail (<i>Rhipidura rufifrons</i>), and satin flycatcher (<i>Myiagra cyanoleuca</i>) - SLC	Assessment against SRI criteria for migratory shorebirds with international breeding range: common greenshank (<i>Tringa nebularia</i>), Latham's snipe (<i>Gallinago hardwickii</i>), and sharp-tailed sandpiper (<i>Calidris acuminata</i>) - SLC
		The Project will cross several wetlands, rivers, and creeks. However, construction disturbance at crossings will be temporary and localised, and permanent impacts will be minimised. The Project is unlikely to lead to a long-term decrease in the size of a local population of any of these three species.	Additionally, as these species breed internationally, they are considered to have single global populations. The Project is unlikely to lead to a long-term decrease in the size of a local population of any of these three species.
Reduce the extent of occurrence of the species	Unlikely The fork-tailed swift is almost exclusively aerial in Australia. This species is migratory with a large range across Australia, and the Project footprint is not at the limit of the species occurrence. Therefore, the Project is considered unlikely to reduce the extent of occurrence of the species.	Unlikely All three species have widespread ranges and the Project is not at the limit of any of these species' occurrences. Therefore, the Project is considered unlikely to reduce the extent of occurrence of these three species.	Unlikely Due to there being limited habitat for the common greenshank and the sharp-tailed sandpiper, habitat has not been mapped. The common greenshank and the sharp-tailed sandpiper commonly occupy wetlands, rivers, and creeks, in which are limited along the Project footprint. Latham's snipe is almost exclusively aerial in Queensland, as they spend their non-breeding season south of the Richmond River in NSW. The Project footprint is not at the limit of these species' occurrences for Latham's snipe or sharp-tailed sandpiper. The Project footprint is located outside of the modelled distribution for common greenshank. Therefore, the Project is considered

Criteria	Assessment against SRI criteria fork-tailed swift (<i>Apus pacificus</i>) - SLC	Assessment against SRI criteria for migratory birds with Australian breeding range: glossy ibis (<i>Plegadis falcinellus</i>), rufous fantail (<i>Rhipidura rufifrons</i>), and satin flycatcher (<i>Myiagra cyanoleuca</i>) - SLC	Assessment against SRI criteria for migratory shorebirds with international breeding range: common greenshank (<i>Tringa nebularia</i>), Latham's snipe (<i>Gallinago hardwickii</i>), and sharp- tailed sandpiper (<i>Calidris acuminata</i>) - SLC
			unlikely to reduce the extent of occurrence of these three species.
Fragment an existing population	Unlikely The fork-tailed swift is almost exclusively aerial in Australia. Due to being almost exclusively aerial no habitat mapping was conducted. As this species is migratory with a large range across Australia, and the Project does not expect to impact non-breeding habitat, the Project is considered unlikely to fragment an existing population.	Unlikely The Project footprint contains areas of suitable dry sclerophyll forests and woodlands, and riparian zones however due to the nature of a linear development the Project will have minimal impact to the area of occurrence due to the three species being migratory and there being ample amount of habitat surround the Project footprint. All three species migrate across Australia, and the Project does not expect to impact breeding habitat for any of the species. As a result of this, the Project is considered unlikely to fragment an existing population.	Unlikely The Project contains minimal habitat for the common greenshank and the sharp-tailed sandpiper, as such habitat for the two species has not been mapped. Additionally, Latham's snipe is almost exclusively aerial in Queensland, as they spend their non-breeding season south of the Richmond River in NSW. As all three species are migratory with large ranges across Australia, and the Project does not expect to impact non-breeding habitat, the Project is considered unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Unlikely The fork-tailed swift does not breed in Australia, it migrates to Siberia to breed each year. Therefore, the Project is considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.	Unlikely Breeding habitat in Queensland includes the below: Glossy ibis: Located in the wetlands of the Bulloo, Diamantina and Georgina River systems in the Channel Country. The glossy ibis has low breeding site fidelity and will inhabit new habitat if it	Unlikely Each of these species has a breeding range outside of Australia, therefore the Project is considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.

Criteria	Assessment against SRI criteria fork-tailed swift (<i>Apus pacificus</i>) - SLC	Assessment against SRI criteria for migratory birds with Australian breeding range: glossy ibis (<i>Plegadis falcinellus</i>), rufous fantail (<i>Rhipidura rufifrons</i>), and satin flycatcher (<i>Myiagra cyanoleuca</i>) – SLC	Assessment against SRI criteria for migratory shorebirds with international breeding range: common greenshank (<i>Tringa nebularia</i>), Latham's snipe (<i>Gallinago hardwickii</i>), and sharp- tailed sandpiper (<i>Calidris acuminata</i>) – SLC
		becomes available (Melvin et al., 1999). - Rufous fantail: Dependent on the sub-population but are located on the NSW-QLD border or on and east of the Great Dividing Range. - Satin flycatcher: Nest in a fork of outer branches of trees, such as paperbarks, eucalypts, and banksias in south-eastern areas, south of approximately Maryborough. All three species migrate across Australia, and have wide-ranging breeding habitat. As a result of this, the Project is considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.	
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Unlikely Ecologically significant locations have not been defined, however, areas occupied by nationally significant proportions of the population will be used in lieu. According to the draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015a), areas inhabited by 100 or more fork-tailed swifts are of	Unlikely Ecologically significant locations have not been defined, however, areas occupied by nationally significant proportions of the species' populations will be used in lieu for the rufous fantail and satin flycatcher. Preferred habitat will be used in lieu for the glossy ibis. According to the draft referral guidelines for 14 birds listed as migratory species under the EPBC Act	Unlikely Ecologically significant locations have not been defined, however, nationally important habitat will be used in lieu. The Wildlife Conservation Plan for Migratory Shorebirds (DoE, 2015b) defines nationally important habitat as areas that regularly support: “0.1 per cent of the flyway population of a single species of migratory shorebird, or 2000 migratory shorebirds, or

Criteria	Assessment against SRI criteria for fork-tailed swift (<i>Apus pacificus</i>) - SLC	Assessment against SRI criteria for migratory birds with Australian breeding range: glossy ibis (<i>Plegadis falcinellus</i>), rufous fantail (<i>Rhipidura rufifrons</i>), and satin flycatcher (<i>Myiagra cyanoleuca</i>) - SLC	Assessment against SRI criteria for migratory shorebirds with international breeding range: common greenshank (<i>Tringa nebularia</i>), Latham's snipe (<i>Gallinago hardwickii</i>), and sharp-tailed sandpiper (<i>Calidris acuminata</i>) - SLC
	national significance. Additionally, the fork-tailed swift is almost exclusively aerial in Australia. The species is known to occur from database records only and was not observed during field surveys. Therefore, it is unlikely that the Project will cause a disruption to ecologically significant locations of the species.	(DoE, 2015a), areas inhabited by 344 or more rufous fantails or 170 satin flycatchers are of national significance. A single rufous fantail was observed approximately 600 m from the Project footprint in Bringalily State Forest and two satin flycatchers were observed in nearby minor drainage lines with dense vegetation. Therefore, the Project footprint is unlikely to be inhabited by nationally significant proportions of these species' populations. Glossy ibis' preferred habitat is described as freshwater marshes at the edges of lakes and rivers, lagoons, floodplains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. Additionally, the largest contiguous areas of prime habitat are inland and northern floodplains in the Top End and Channel Country (DoE, 2024a). Therefore, the Project is unlikely to cause disruption to ecologically significant locations for these species.	15 migratory shorebird species." Revisions of population estimates of migratory shorebirds (Hansen et al., 2016) are 110,000 for common greenshank, 30,000 for Latham's snipe, and 85,000 for sharp-tailed sandpiper. Therefore, nationally important habitat would support 110 common greenshanks, 30 Latham's snipes or 85 sharp-tailed sandpipers. No common greenshanks were recorded during field surveys and only two records exist within 10 km of the Project footprint. No Latham's snipes were observed during field surveys, although there are four database records within the Project footprint and numerous in the surrounding 10 km. No sharp-tailed sandpipers were observed during field surveys, and there are only seven database records within 10 km of the Project footprint. Therefore, the Project footprint is unlikely to be nationally important habitat for any of these species and unlikely to cause disruption to ecologically significant locations for these species.

Criteria	Assessment against SRI criteria for fork-tailed swift (<i>Apus pacificus</i>) - SLC	Assessment against SRI criteria for migratory birds with Australian breeding range: glossy ibis (<i>Plegadis falcinellus</i>), rufous fantail (<i>Rhipidura rufifrons</i>), and satin flycatcher (<i>Myiagra cyanoleuca</i>) - SLC	Assessment against SRI criteria for migratory shorebirds with international breeding range: common greenshank (<i>Tringa nebularia</i>), Latham's snipe (<i>Gallinago hardwickii</i>), and sharp-tailed sandpiper (<i>Calidris acuminata</i>) - SLC
Assessment of potential for significant residual impacts	The Project is unlikely to result in a significant residual impact on the fork-tailed swift.	The Project is unlikely to result in a significant residual impact on the glossy ibis, rufous fantail or satin flycatcher.	The Project is unlikely to result in a significant residual impact on the common greenshank, Latham's snipe or sharp-tailed sandpiper.

7.3 SUMMARY OF IMPACTS

Assessment of the potential magnitude of disturbance was undertaken for each of the ecological values identified during the desktop assessment and field surveys. Calculated areas of potential disturbance for each MSES (as assessed under the *Significant Residual Impact Guideline* (DEHP, 2014b)) and the SRI outcome are provided in Table 7-15.

TABLE 7-15 ESTIMATION OF POTENTIAL MAGNITUDE OF DISTURBANCE TO MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

MSES	Total potential disturbance area within the Project footprint ^{1,2}	SRI Decision
Regulated vegetation (VM Act)		
Prescribed REs that are Endangered or Of Concern	109.73 ha	Likely
Clearing in the portion of a regional ecosystem that lies within a mapped wetland	5.52 ha A total of 11.71 ha will be cleared within 50 m of the defining bank	Likely
Clearing in a regional ecosystem that is within the defined distance of a watercourse	11.31 ha (total) 5.56 ha of a stream order 1 or 2 watercourse 5.75 ha of a stream order 3 or 4 watercourse 3.72 ha will be cleared within 5 m of the defined bank: 2.69 ha of a stream order 1 or 2 watercourse 1.03 ha of a stream order 3 or 4 watercourse	Likely
Connectivity areas		
Remnant Category B vegetation	475.33 ha - Percent change of core at the local scale (post-impact): 1.45% - The number of core remnant areas remaining on the site post-impact: 30, reduced from 33	Likely
Wetlands and watercourses		
Wetlands in a Wetland Protection Area	N/A	Unlikely
Wetlands of High Ecological Significance	N/A	Unlikely
Wetland or Watercourse in a High Ecological Value Waters	N/A	Unlikely

MSES	Total potential disturbance area within the Project footprint ^{1,2}	SRI Decision
Protected wildlife habitat		
Flora		
<i>Cyperus clarus</i>	166.07 ha	Likely
<i>Picris barbarorum</i>	174.98 ha	Likely
Fauna		
Brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>)	240.66 ha	Unlikely
Bulloak jewel butterfly (<i>Hypochrysops piceatus</i>)	231.29 ha	Unlikely
Common death adder (<i>Acanthophis antarcticus</i>)	277.27 ha	Unlikely
Common greenshank (<i>Tringa nebularia</i>)	Not quantified	Unlikely
Diamond firetail (<i>Stagonopleura guttata</i>)	216.89 ha	Likely
Fork-tailed swift (<i>Apus pacificus</i>)	Not quantified	Unlikely
Glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>)	120.01 ha	Likely
Glossy ibis (<i>Plegadis falcinellus</i>)	Not quantified	Unlikely
Grey snake (<i>Hemiaspis damelii</i>)	259.80 ha	Unlikely
Hooded robin (south-eastern) (<i>Melanodryas cucullata</i>)	216.89 ha	Unlikely
Latham's snipe (<i>Gallinago hardwickii</i>)	Not quantified	Unlikely
Platypus (<i>Ornithorhynchus anatinus</i>)	24.81 ha	Unlikely
Powerful owl (<i>Ninox strenua</i>)	8.64 ha	Unlikely
Rufous fantail (<i>Rhipidura rufifrons</i>)	Not quantified	Unlikely
Satin flycatcher (<i>Myiagra cyanoleuca</i>)	Not quantified	Unlikely
Sharp-tailed sandpiper (<i>Calidris acuminata</i>)	Not quantified	Unlikely
Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	1,397.48 ha	Unlikely
Southern whiteface (<i>Aphelocephala leucopsis</i>)	216.89 ha	Likely

MSES	Total potential disturbance area within the Project footprint ^{1,2}	SRI Decision
White-throated needletail (<i>Hirundapus caudacutus</i>)	2,853.24 ha	Unlikely
Yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>)	298.05 ha	Unlikely
Koala habitat in South East Queensland		
Koala habitat	N/A	Unlikely
Protected areas		
Protected areas	0 ha	Unlikely
Waterways providing for fish passage		
100 waterways intersect the Project footprint and are classified (DAF mapped waterways) as follows: • 66 waterways mapped as green (low risk) • 15 waterways mapped as amber (moderate risk) • 9 waterways mapped as red (high risk) • 10 waterways mapped as purple (major risk).	N/A	Unlikely

Table notes:

1 – Area of Project footprint: 3,382.17 ha

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

8. ENVIRONMENTAL OFFSETS

The Project will result in significant impacts on MSES, even after the implementation of mitigation measures, including rehabilitation. Therefore, it is expected that environmental offsets will be required for the Project.

An assessment of MSES relevant to the Project has been undertaken in accordance with the MSES significant impact criteria (Section 7) which determined that the Project significant residual impacts for MSES are likely to occur. The significant residual impact to each MSES is presented in Table 8-1.

TABLE 8-1 SIGNIFICANT IMPACTS TO MSES REQUIRING OFFSET

MNES	Significant residual impact area
Regulated vegetation	
Prescribed REs that are Endangered and Of Concern REs	109.73 ha (see Table 8-2)
Prescribed REs that intersect with wetlands identified on the vegetation management wetlands map	0.86 ha (see Table 8-3)
Prescribed REs within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature	8.06 ha (see Table 8-4)
Connectivity areas	
Remnant Category B vegetation	475.33 ha
Protected wildlife habitat	
Threatened flora	
<i>Cyperus clarus</i>	166.07 ha
<i>Picris barbarorum</i>	174.98 ha
Threatened fauna	
Diamond firetail (<i>Stagonopleura guttata</i>)	216.89 ha
Glossy black-cockatoo (south-eastern) (<i>Calyptorhynchus lathami lathami</i>)	1.08 ha of breeding and roosting habitat and 118.94 ha of foraging habitat, totalling 120.01 ha
Southern whiteface (<i>Aphelocephala leucopsis</i>)	216.89 ha
Pale imperial hairstreak (<i>Jalmenus eubulus</i>) essential habitat only	26.59 ha

TABLE 8-2 PRESCRIBED REGIONAL ECOSYSTEMS THAT ARE ENDANGERED OR OF CONCERN REQUIRING OFFSET

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

Table note:

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

TABLE 8-3 CATEGORY B (REMNANT) PRESCRIBED REGIONAL ECOSYSTEMS WITHIN 50 M OF A MAPPED WETLAND REQUIRING OFFSET

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

Table notes:

This table excludes REs listed as either Endangered or Of Concern, as these are included in the offset areas in Table 8-2.

TABLE 8-4 CATEGORY B (REMNANT) PRESCRIBED REGIONAL ECOSYSTEMS WITHIN A DEFINED DISTANCE OF A WATERCOURSE REQUIRING OFFSET

VM Act status	RE	Description	Area (ha)
LC	11.3.14	<i>Eucalyptus</i> spp., <i>Angophora</i> spp., <i>Callitris</i> spp. woodland on alluvial plains	1.49
LC	11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	0.15
LC	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	1.88
LC	11.3.27	Freshwater wetlands	0.02
LC	11.3.27b	Freshwater wetlands with open water +/- aquatic and emergent vegetation	0.02
LC	11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	1.37
LC	11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	1.82
LC	11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	0.34
LC	11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	0.28
LC	11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust	0.22
LC	11.8.4	<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks	0.27
LC	11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	0.18
LC	11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rock	0.01
LC	11.9.9a	<i>Eucalyptus albens</i> +/- <i>E. crebra</i> +/- <i>E. tereticornis</i> +/- <i>Callitris baileyi</i> woodland	0.01
Total			8.06

Table notes:

This table excludes REs listed as either Endangered or Of Concern, as these are included in the areas to be offset in Table 8-2.

ARTC's Environmental Offset Delivery Strategy – B2G is contained in revised draft EIS Appendix Q: Environmental Offset Strategy. This Strategy informs the development of offset delivery components for B2G including specific management intent regarding matter specific conservation outcomes across each relevant offset property presented in the Strategy. Property specific Offset Area Management Plans will be developed and finalised in consultation with relevant Australian Government and State regulatory agencies prior to construction.

The Environmental Offset Delivery Strategy - B2G contained in revised draft EIS Appendix Q: Environmental Offset Strategy will:

- Quantify the significant impact of the Project on MSES;
- Detail offsets to address significant impacts for MSES; and
- Include the following:
 - An overview of the environmental offset compliance framework, principles and objectives at a Commonwealth and State level.
 - An outline of the B2G Project and details the SRIs the Project is predicted to have on MSES matters.
 - A summary the offset property selection process, including desktop assessments and the methodology of rapid and detailed field surveys.
 - Identification of the offset property portfolio selected for the B2G offset portfolio based on the predicted MSES SRIs.
 - Specific management intent to drive matter specific conservation outcomes across each relevant offset property.
 - An outline of the content that will be contained within the property specific OAMP.
 - Details the options for legally securing proposed offset areas not currently secured.
 - An identification and assessment of the risks associated with delivering environmental offsets and what controls will be put in place to manage these risks.

9. CUMULATIVE IMPACT ASSESSMENT

Cumulative impacts have been assessed using the methodology identified in Section 3.2.2. The assessment was undertaken for all MSES identified as known or likely to occur within the Project footprint. Under the *Environmental Offset Regulation* the definition of protected wildlife habitat does not include near threatened species, therefore excludes *D. porrecta* and the definition of SLC is limited to echidna and platypus. As a result of this, habitat for the species listed as migratory SLC has not been quantified and therefore these species were not included in the CIA. It should be noted that three species were added to the EIS assessment as MSES (due to their recent listing in December 2023). As these species were not listed under the NC Act at the time of the assessments for the projects within the AOI, there is no information on the impacts of these species. Therefore, these species have also not been included in the CIA.

A number of projects were initially identified as having potential to contribute to ecological cumulative impacts in combination with the Project (see Table 9-1 and Figure 9-1). These projects are either operational, may undergo future expansion or are going through an approval process. A full list of projects, with a description of each, is presented in the revised draft EIS Chapter 23: Cumulative Impacts.

Cumulative impacts are most appropriately considered at a biologically relevant scale. A distance of 50 km from the Project was selected as many of the MSES of relevance to the Project do not occur beyond this area, and if they do occur, any cumulative impacts associated with the Project are not considered to be relevant beyond this extent. Twenty-one projects have been identified for preliminary consideration for their potential to contribute to cumulative impacts, in combination with the Project. The CIA only considered projects and areas within Queensland as MSES are bound by State borders. Operational projects have been included in the assessment of ecological cumulative impacts due to the potential for such developments to continue to have an ongoing impact on ecological values and processes, for example, through the degradation of adjoining habitats or disturbance of species through noise, operational emissions, light, weed incursion.

The cumulative impacts of multiple projects occurring in the vicinity of the Project will likely include the continued loss of biodiversity in the SEQ and Brigalow Belt Regions and other impacts described in Section 5.

The total impact area of MSES habitat contained within the combined footprint of the 19 projects occurring within the area of influence (AOI) has been quantified and is provided in Table 9-1. The quantitative method of assessment that has been applied establishes a percentage of impact to each MSES as a combined consequence of all projects identified for the CIA. The results of the significance assessment of these cumulative impacts are presented in aggregated form in Table 9-2 (i.e. a level of cumulative impact significance is not attributed for each project).

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

The potential for cumulative impacts to MSES from this Project will be managed through implementation of mitigation measures specified in Sections 6.2 and 6.3, including:

- Development and implementation of the following, as components of the CEMP:
 - Biodiversity Management Plan, which will outline the management strategies, actions and controls to be implemented to avoid or minimise potential impacts of the Project during construction,
 - Biosecurity Management Plan, which will outline biosecurity risks associated with the construction of the Project and the processes that are to be used to manage those risks,
 - Soil Management Plan, which provides procedures and protocols for the management of potential impacts on land resources during construction. The Soil Management Plan will include soil conservation measures and erosion and sediment controls with specific reference to identified habitat for threatened flora (where they are found to occur),
 - Waste Management Plan, which will outline the management strategies, actions and controls to be implemented to avoid or minimise the waste created by the Project during construction. This plan will be underpinned by the 2018 National Waste Policy and Waste Reduction and Recycling Act 2011 (Qld) waste and resource management hierarchy, and
 - Rehabilitation and Landscaping Management Plan, which will be based on the Inland Rail Landscape and Rehabilitation Strategy, Inland Rail Landscape and Rehabilitation Framework and location-specific reinstatement commitments, and will detail actions needed to rehabilitate the areas within the temporary Project footprint that are for use during construction phase only. This plan will be developed in consultation with local councils and affected communities, including Traditional Owners.
- Consultation with owners/operators of adjoining projects regarding the compatibility/comprehensiveness of management measures for the Border to Gowrie Project with their developments to align management objectives, where feasible.
- Refinement of the revised reference design through detailed design to limit the extent of disturbance to MSES to that required to enable safe and efficient construction, operation, and maintenance of the Project.
 - Detailed surveys will be undertaken during the detailed design phase to inform modifications to the Project footprint that may be required to reduce impacts to MSES (or their habitat). Where MSES are found to occur, condition assessment will be undertaken (using BioCondition assessment).
- Should MSES (or their habitat) be retained within the Project footprint, annual monitoring will be undertaken against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified.
- Delivery of offsets for significant residual impacts to MSES due to the Project in accordance with the *Environmental Offsets Act 2014* (Qld).

TABLE 9-1 PROJECTS INCLUDED IN CUMULATIVE IMPACT ASSESSMENT

Projects	Location	Description	Status	Construction dates	Operational years
Wetalla Water Pipeline	From the Wetalla Wastewater Reclamation Facility in Toowoomba to the New Acland coal mine, 35 km northwest of the city. Adjacent to Ch 210.48 km of the Project	A 45 km underground water pipeline to supply up to 5,500 megalitres of treated wastewater to the New Acland coal mine.	EIS approved with conditions in 2008. The Wetalla Water Pipeline is completed and operational.	2010 to 2013	Ongoing
Wagners Intermodal Terminal	Wellcamp Airport, Queensland East of Ch 196.00 km of the Project	Major freight terminal, designed to benefit the freight network and future Inland Rail. The terminal will be 24/7 facility, designed to operate 78,000 containers for almost 400 freight customers. Utilising approximately 150 locomotives and 1,500 wagons. Unique features of Wagners Intermodal terminal are a 2.7 km frontage for 1,800 m freight trains, a daily-use fully licensed and bonded international air cargo terminal and reach up to 500,000 containers capacity by 2040.	Construction	Unknown	Ongoing Karara, Queensland 40 km east of Ch 80.00 km of the Project, 10 km south of Karara
New Acland Coal Mine Stage 3	35 km northwest of Toowoomba 18 km north of Ch 210.48 km of the Project.	Expansion of the existing New Acland open-cut coal mine to up to 7.5 Mtpa.	EIS approved with conditions. Q4 2021, QLD Court recommends environmental	The mine is operational. Potential for Stage 3 expansion works.	Sequential development of resource areas expected to extend coal productive until 2042.

Projects	Location	Description	Status	Construction dates	Operational years
			conditions be reassessed.		
Australia Pacific LNG Project	Walloons gas fields (approximately 20 km west of Millmerran) 13 km west of the Project footprint	Integrated liquefied natural gas (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.	EIS approved with conditions in 2011. Operational but subject to continued expansion.	Project started operation in 2015, but subject to continual gas field development	Expected project life of 30 years.
Toowoomba Bypass (formerly the Toowoomba Second Range Crossing)	The 41 km-long bypass route extends from the Warrego Highway at Helidon Spa in the east to the Gore Highway at Athol in the west, via Charlton. 1 km to south and east of Ch 126.00 km of the Project.	This bypass takes heavy vehicle through-traffic around the north of Toowoomba	Operational	2015 to 2019	Ongoing
InterLinkSQ	13 km west of Toowoomba Adjacent to south of Ch 210.48 km of the Project.	A 200 ha transport, logistics and business hub. Located on the narrow gauge regional rail network and interstate network. Located at the junction of the Gore, Warrego, and New England Highways.	Under construction	Commenced May 2022 and will continue development until Inland Rail is operational in 2028	Ongoing
Toowoomba Wellcamp Airport	Wellcamp, Queensland 1 km east of the Project footprint	Airport servicing Toowoomba, promoting interstate, intrastate and international connection for the Darling Downs, Granite Belt, Surat Basin and Southern Downs regions.	Operational	2013 to 2014	Ongoing

Projects	Location	Description	Status	Construction dates	Operational years
Wellcamp Business Park	Wellcamp, Queensland 1.5 km east of Ch 196.00 km of the Project.	A 500 ha industrial and commercial park that forms part of the Toowoomba Enterprise Hub. The Business Park is located in close proximity to the Toowoomba Wellcamp Airport and other major transportation infrastructure.	Operational	2016 to 2018	Ongoing
Witmack Industry Park and Charlton Logistics Park	Wellcamp, Queensland 3 km southeast of Ch 200.00 km of the Project (Witmack Industry Park) Charlton, Queensland 3 km south of Ch 200.00 km of the Project (Charlton Logistics Park)	The Witmack Industry Park is a large industrial land development that offers large size industrial land parcels. Businesses situated within the Witmack Industrial Park include the Toowoomba Pulse Data Centre. The Charlton Logistics Park is part of the Toowoomba Enterprise Hub and provides fully serviced 2 ha sites and is well situated for potential transport and logistics operators due to its proximity to transport infrastructure.	Operational	2016 to 2018	Ongoing
Asterion Medicinal Cannabis Project	Wellcamp, Queensland Adjoins the Project footprint 1 km south of Toowoomba-Cecil Plains Road, east of Ch 196.00 km of the Project	A high-tech medicinal cannabis cultivation, research, and manufacturing facility. The project involves construction of a 40 ha glasshouse to produce 20,000 plants per day at full capacity. Medicinal grade cannabis grown at the facility will be manufactured into a range of medicinal products, including single patient packs, cannabis	Approved	Unknown	Ongoing

Projects	Location	Description	Status	Construction dates	Operational years
		oils, gels, salts and related products, destined solely for the medicinal market. This facility is anticipated to be the largest facility of its kind in the world. Major Project status granted 14 July 2020			
Commodore Mine and Millmerran Power Station	Domville, Queensland Intersects the Project, located at approximately Ch 122.00 km, primarily to the east.	The Commodore Mine is an open cut coal mine which provides coal for the 850 Mega Watts 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)	Operational	Ongoing to 2056	Ongoing
Pittsworth Industrial Precinct and Enabling Project	Pittsworth, Queensland 500 m to south of the Project footprint, west of Ch 160.00 km of the Project.	Road and sewerage infrastructure upgrades at the Pittsworth Industrial Precinct to allow for industrial land for industries servicing agriculture and the wider region.	Operational	2017 to 2019	Ongoing
Doug Hall Poultry	Millmerran, Queensland Intersects the Project footprint, located primarily to north-west of Ch 138.00 km of the Project.	Poultry farming operation with capacity of approximately 20,000 chickens. Operations include egg grading, a feedmill with output of 1,500 tonnes per week, piggery, cropping and solar farm.	Operational	N/A	Ongoing
Yarranbrook Feedlot	Whetstone, Queensland	Cattle feedlot licenced for 25,000 head.	Operational	N/A	Ongoing

Projects	Location	Description	Status	Construction dates	Operational years
	Intersects the Project footprint, located predominantly to north				
Sapphire Feedlot	Kildonan, Queensland Adjacent to south of the Project at Ch 10.00 km.	Cattle feedlot which currently has a 6,000 head capacity, which expanded to 20,000 head in 2020.	Operational	2018 to 2020	Ongoing
Wyemo Piggery	Glenarbon, Queensland 8 km south of Ch 30.00 km of the Project footprint	Piggery with approval for 55,000 pig units.	Approved with conditions by GRC	Not yet publicly released	Ongoing once complete
Yarranlea Solar	Yarranlea, Queensland Intersects the Project footprint, located Ch 163.5 km at Yarranlea Road, Yarranlea	Solar Farm Stage 1 will span over 250 ha area consisting of 360,000 solar panels. Projected to have a generation capacity of up to 100 Mega Watts once completed.	Operational	2018 to 2019	Ongoing
MacIntyre Wind Farm	Karara, Queensland 40 km east of Ch 80.00 km of the Project, 10 km south of Karara	The Wind Farm Precinct will span approximately 40,000 hectares (ha), predominantly built on sheep farming land. The MacIntyre Wind Farm is expected to generate 1,026 megawatts (MW), using up to 120 turbines.	Construction	2022 to 2024	>30 years
Goondiwindi Abattoir	Goondiwindi, Queensland 19 km northwest of Ch 1 km of the Project.	A new beef Abattoir located on the outskirts of Goondiwindi with beef processing of up to 72,000 tonnes per year.	Approved with conditions by GRC	Not yet publicly released	Unknown

Projects	Location	Description	Status	Construction dates	Operational years
Gowrie to Helidon Project (Inland Rail)	Rail alignment from Gowrie to Helidon, Queensland Adjoins the Project footprint at the northern point of the Project, located at Ch 210.48 km.	New 26 km dual gauge track between Gowrie (north-west of Toowoomba) and Helidon (east of Toowoomba), extending through the Local Government Areas of Toowoomba and Lockyer Valley. The project includes a 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.	Reference design and EIS	To 2024 to 2028 ¹	>100 years
Helidon to Calvert (Inland Rail)	Rail alignment from Helidon to Calvert, Queensland 26 km east of the Project footprint	New 47 km dual gauge rail line connecting Helidon (east of Toowoomba) with Calvert (near Ipswich), via Placid Hills, Gatton, Forest Hill, Laidley, and Grandchester, extending through the Local Government Areas of Lockyer Valley and Ipswich City. The project includes a 1.1 km tunnel to create an efficient route through the steep terrain of the Little Liverpool Range.	Reference design and EIS	2024 to 2028 ¹	>100 years

Note: 1 Construction dates for Inland Rail projects have been assumed for the purposes of the assessment

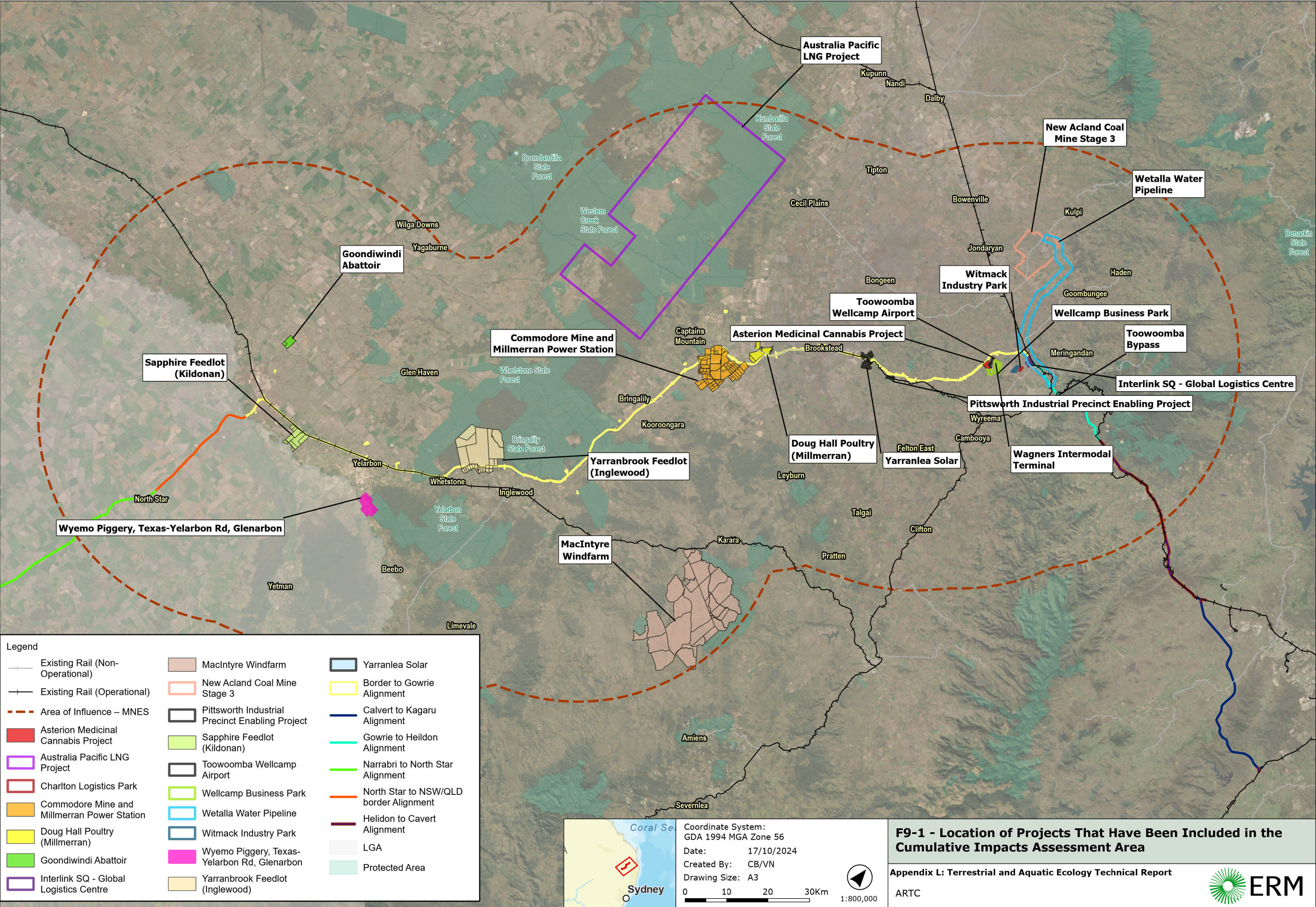


TABLE 9-2 CUMULATIVE IMPACTS AS CALCULATED FOR WITHIN THE CUMULATIVE STUDY AREA

Receptor	Occurrence in the AOI (50 km) (ha)	Occurrence in the footprint of all projects in AOI area (excluding the Project footprint) (ha)	Occurrence in the Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
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 • Whilaloo Nature Refuge • Wilga Park Nature Refuge • Xanthorrhoea Nature Refuge	7,946.28	0.00	0.00	0.00	0.00	0.00	N/A
Protected area estates (<i>excluding state forests</i>): • Bendidee National Park • Coolmunda Conservation Park • Crow's Nest National Park • Dwyers Scrub Conservation Park	295,306.56	4,450.10	0.00	4,450.10	1.51	0.00	Low

Receptor	Occurrence in the AOI (50 km) (ha)	Occurrence in the footprint of all projects in AOI area (excluding the Project footprint) (ha)	Occurrence in the Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
- 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							

Regulated vegetation (VM Act):

Category B – 'Endangered' REs:	46,668.45	201.32	49.39	250.71	0.54	0.11	Low
Category B – 'Of Concern' REs:	202,417.66	3,530.07	85.06	3,615.13	1.79	0.04	Low
Essential habitat (EH)	84,262.99	1,263.97	113.19	1,377.16	1.63	0.13	Low
State significant wetlands (HES Wetlands)	7,476.06	22.02	0	22.02	0.29	0.00	Low

MSES protected wildlife habitat (flora) (NC Act):

<i>Cyperus clarus</i>	41,397.45	936.65	166.07	1,102.72	2.66	0.40	Low
<i>Picris barbarorum</i>	452,656.34	70,447.80	174.98	70,622.78	15.60	0.04	Low

MSES protected wildlife (fauna) habitat (NC Act):

Receptor	Occurrence in the AOI (50 km) (ha)	Occurrence in the footprint of all projects in AOI area (excluding the Project footprint) (ha)	Occurrence in the Project footprint (ha)	Occurrence in the footprint of all projects, including the Project (ha)	Disturbance in AOI of all projects, including the Project (%)	Disturbance in AOI as a result of the Project (%)	Magnitude of disturbance ¹
Common death adder (<i>Acanthophs antarcticus</i>)	775,562.91	98,486.02	277.27	98,763.29	12.73	0.04	Low
Glossy black-cockatoo (<i>Calyptorhynchus lathami lathami</i>)	362,917.60	72,079.64	120.01	72,199.65	19.89	0.03	Low
Grey snake (<i>Hemiaspis damelii</i>)	61,039.51	2,136.76	259.80	2,396.56	3.93	0.43	Low
White-throated needletail (<i>Hirundapus caudacutus</i>)	2,395,033.14	156,019.14	2,853.24	158,872.38	6.63	0.12	Low

MSES Special least concern fauna (NC Act)

Platypus (<i>Ornithorhynchus anatinus</i>)	135,748.44	7,266.51	24.81	7,291.32	5.37	0.02	Low
Echidna (<i>Tachyglossus aculeatus</i>)	45,563.01	2,804.14	1,397.48	4,201.62	9.22	3.07	Low

MSES connectivity (BPA)

Corridor (Regional Terrestrial)	122,194.40	1,723.52	220.39	1,943.91	1.59	0.18	Low
Corridor (State Riparian)	58,074.21	305.42	31.82	337.24	0.58	0.05	Low
Corridor (State Terrestrial)	415,966.65	7,268.32	305.04	7,573.36	1.82	0.07	Low

Table notes:

Magnitude is calculated based on the proportional disturbance from the Project to each receptor within the AOI and the percentage contribution of the Project to the overall disturbance of that receptor: Low magnitude = if either project contribution of less than 2 per cent OR an overall cumulative impact of <10 per cent; Medium magnitude = if either project contribution of 2 - 20 per cent OR an overall cumulative impact of 10-20 per cent; High magnitude = if either project contribution of >20 per cent OR an overall cumulative impact of >20 per cent. For example, the Project's contribution to cumulative impacts to Category B – 'Endangered' REs is X % of X %, which equates to X %

TABLE 9-3 SIGNIFICANCE ASSESSMENT OF IMPACTS WITHIN THE AREA OF INFLUENCE

MSES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
State Significant Ecological Constraints (VM Act)							
Category B – ‘Endangered’ remnant vegetation (REs)	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
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

MSES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
	• 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
• 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
• Category C – High Value Regrowth vegetation	• Habitat loss from vegetation clearing/removal	2	3	1	2	8	Medium
	• Edge effects	1	2	1	2	6	Low

MSES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
	- Habitat fragmentation - Barrier effects - Reduction in connectivity of biodiversity corridors						
	Fauna species injury or mortality	1	1	1	2	5	Low
	Dust and light and contaminant disturbance	1	1	1	2	5	Low
	Increase in litter (waste)	1	1	1	2	5	Low
	Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
State Significant Wetlands (HES)	Habitat loss from vegetation clearing/removal	1	3	1	3	8	Medium
	Habitat fragmentation - Edge effects - 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

MSES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
	Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low
Species listed as threatened (NC Act)							
Flora <i>Cyperus clarus</i> <i>Picris barbarorum</i>	Habitat loss from vegetation clearing/removal	2	3	1	3	9	Medium
Fauna - Common death adder (<i>Acanthopis antarcticus</i>) - Southern whiteface (<i>Aphelocephala leucopsis</i>) - Glossy black-cockatoo (<i>Calyptorhynchus lathami lathami</i>) - Brown treecreeper (south-eastern) (<i>Climacteris picumnus victoriae</i>) - Grey snake (<i>Hemiaspis damelii</i>) - Hooded robin (south-eastern) (<i>Melanodryas cucullata cucullata</i>) - Diamond firetail (<i>Stagonopleura guttata</i>) - White-throated needletail (<i>Hirundapus caudacutus</i>)	- 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	2	1	3	7	Medium
SLC fauna species - Fork-tailed swift (<i>Apus pacificus</i>) - Latham's snipe (<i>Gallinago hardwickii</i>)	Habitat loss from vegetation clearing/removal	1	3	1	2	7	Medium
	- Edge effects - Habitat fragmentation - Barrier effects	1	2	1	2	6	Low

MSES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
- Satin flycatcher (<i>Myiagra cyanoleuca</i>) - Glossy ibis (<i>Plegadis falcinellus</i>) - Common greenshank (<i>Tringa nebularia</i>) - Rufous fantail (<i>Rhipidura rufifrons</i>) - Platypus (<i>Ornithorhynchus anatinus</i>) - Echidna (<i>Tachyglossus aculeatus</i>)	Reduction in connectivity of biodiversity corridors						
	Fauna species injury or mortality	1	1	1	2	5	Low
	Dust and light and contaminant disturbance	1	1	1	2	5	Low
	Increase in litter (waste)	1	1	1	2	5	Low
	Reduction in biological viability of soil to support growth due to soil compaction	1	2	1	2	6	Low
	Displacement of species from invasion of weed and pest species	1	1	1	2	5	Low
MSES Connectivity (BPA)							
- BPA habitat values (State) - 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

MSES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
	Displacement of species from invasion of weed and pest species	1	1	1	3	6	Low
- 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
BPA habitat values (Local or Other)	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

MSES	Potential cumulative impact	Relevance factor of aspects				Sum of relevant factors	Impact significance
		Probability	Duration	Magnitude	Sensitivity		
	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:

- Table 3-6 defines the consequences of the impact significance ratings, as follows:

Low (sum of relevance factors = 1 to 6): Negative impacts need to be managed by standard environmental management practices. Special approval conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program.

Medium (sum of relevance factors = 7 to 9): Mitigation measure likely to be necessary and specific management practices to be applied. Specific approval conditions are likely. Targeted monitoring program required.

High (sum of relevance factors = 10 to 12): Alternative actions would be considered and/or mitigation measures applied to demonstrate improvement. Specific approval conditions required. Targeted monitoring program necessary.

Following the cumulative impact assessment, all MSES were assessed as having a 'low' magnitude of disturbance (refer to Table 9-2), with impacts to be managed by standard environmental management practises, and monitored as part of the general Project monitoring program. No MSES were assessed as having a 'medium' or 'high' magnitude of disturbance.

Impacts with the potential to cause a 'medium' significant impact include:

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

These impacts will be managed through implementation of mitigation measures outlined in Section 6.2 and 6.3

No MSES were assessed as having a 'high' significant impact (refer to Table 9-3).

10. CONCLUSION

This assessment has been prepared in accordance with Sections 11.94 to 11.106 of the ToR, which specifies flora and fauna (terrestrial and aquatic) information and additional information requested for the Project by the Coordinator-General. It has been prepared to accompany revised draft EIS Appendix O: Matters of National Environmental Significance Report, which specifically addresses the EPBC Act controlling provisions of the Project (i.e. threatened species and communities listed under the EPBC Act). Therefore, in order to avoid repetition, information related to the EPBC Act controlling provisions have been excluded from this document.

The Project footprint is located in the Brigalow Belt South bioregion, an area that is subject to historical widespread land clearing for agricultural purposes. Of the 3,382.17 ha of the Project footprint, the majority (74.6%) of the area is comprised of non-remnant areas, with the remainder consisting of either remnant vegetation (16.9%), mature regrowth (0.5%) or immature regrowth (8.0%). Within these vegetated areas, a total of 25 REs, including four 'Endangered', eight 'Of Concern', and 13 'Least Concern' REs (VM Act status) were identified during field surveys as occurring within the Project footprint.

Both remnant, and non-remnant vegetation provide habitat for a range of terrestrial and aquatic flora and fauna species. These areas occurring within the Project footprint were delineated into eight broad habitat type and provide habitat for both least concern species and species that are listed as endangered, vulnerable, near threatened or SLC under the NC Act. These habitat types include natural grasslands, non-remnant areas, dry sclerophyll eucalypt woodlands (remnant), mature eucalypt riparian woodland, mature brigalow-belah open forest, semi-evergreen vine thicket, regrowth eucalypt communities, wetlands and watercourses.

Field surveys of the Project footprint have confirmed the presence of sixteen NC Act threatened flora species. Habitat for these species occurs throughout the Project footprint. Additionally, suitable habitat for both *C. clarus* and *P. barbarorum* comprise MSES – Protected Wildlife habitat within the Project footprint. The remaining 14 species and the associated suitable habitat has been assessed for significant impacts and offsets in revised draft EIS Appendix O: Matters of National Environmental Significance Report.

Nineteen NC Act threatened fauna species were identified as known to occur within the Project footprint during field surveys. The fork-tailed swift has been listed as known, however, it is almost exclusively aerial in Australia, and therefore habitat was recorded across the entire Project footprint. Suitable habitat for these species also provided MSES – Protected Wildlife habitat within the Project footprint.

The following MSES have been identified within the Project footprint:

- Regulated vegetation:
 - Prescribed REs that are 'Endangered' or 'Of Concern';
 - Prescribed REs that intersect wetlands identified on the vegetation management wetlands map;
 - Essential habitat (EH); and
 - Prescribed REs intersecting a watercourse;
- Connectivity;

- Protected areas;
- Wetlands and watercourses;
- Protected wildlife habitat; and
- Waterways providing for fish passage.

In addition to these MSES, bioregional corridors (local, regional, and State significant) occur within the Study area and Project footprint.

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

- Habitat loss and degradation from vegetation clearing/removal;
- Fauna species injury or mortality;
- Displacement of flora and fauna species from invasion of weed and pest species;
- Loss of biodiversity corridors;
- Habitat fragmentation;
- Edge effects;
- Terrestrial barrier effects;
- Noise, dust, and light;
- Increase in waste;
- Erosion and sedimentation;
- Contamination; and
- Flooding.

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

- Clearing of riparian vegetation;
- Erosion and sediment runoff into waterways;
- Disturbance of aquatic habitat;
- Altered hydrology;
- Changes to groundwater resources, affecting GDEs;
- Invasion of aquatic habitats by exotic pest species;
- Disturbance of aquatic fauna from noise, vibration, and lighting;
- Introduction of contaminants into waterways; and
- Waterway barrier effects.

Development of the revised reference design has progressed in parallel with the impact assessment process. Consequently, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the revised reference design as appropriate and where possible. Understanding of the mitigations and controls incorporated into the revised reference design process was combined with the sensitivity of ecological values and the magnitude of the potential impact to determine the significance of a potential impact from the Project.

In addition to revised reference design phase mitigation, measures have been identified for adoption or implementation through future phases of Project delivery.

These additional mitigation measures have been considered to determine the 'post-mitigation' significance of the potential impacts upon the listed threatened species and communities (or 'residual significance').

Project mitigation measures include:

- Reducing the Project footprint as far as reasonably practical through refinement of the detail design;
- Development and implementation of a Biodiversity Management Plan of the CEMP to outline the management strategies, actions and controls to be implemented to avoid or minimise potential impacts of the Project during construction;
- Development and implementation of a Soil Management Plan of the CEMP, to manage potential impacts on land resources during construction;
- Identification and implementation of fauna movement features to reduce barrier effects associated with the Project and enable fauna passage; and
- Development and implementation of a Rehabilitation and Landscaping Management Plan of the CEMP to rehabilitate the areas within the temporary Project footprint that are for use during construction phase only.

Impact assessment concluded that the magnitude of residual impacts to the ecological values were generally reduced following the implementation of additional mitigation measures and management plans. A key reason for disturbance to ecological values is the potential loss of habitat through clearing, to establish the Project footprint. The Project may also result in permanent barrier effects and habitat fragmentation. The loss of habitat from vegetation clearing/removal upon most of the ecological values is not expected to significantly reduce in magnitude of impact following the implementation of mitigation measures.

The Project will result in significant impacts on MSES, 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 be provided in accordance with requirements of the EPBC Act, the *Environmental Offsets Act 2014*, and relevant policies.

ARTC's Environmental Offset Delivery Strategy – B2G is contained in revised draft EIS Appendix Q: Environmental Offset Strategy. This Strategy informs the development of offset delivery components for B2G including specific management intent regarding matter specific conservation outcomes across each relevant offset property presented in the Strategy. Property specific Offset Area Management Plans will be developed and finalised in consultation with relevant Australian Government and State regulatory agencies prior to construction.

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APPENDIX

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Terrestrial and Aquatic Ecology Technical Report

Appendix A Additional ecological investigations

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

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Glossary of Terms

Acronym	Description
ALA	Atlas of Living Australia
ARTC	Australia Rail Track Corporation
AU	Assessment Unit
B2G	Border to Gowrie
BC	BioCondition
Bonn	Bonn Convention. The convention on the conservation of migratory species
Brigalow TEC	Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) Threatened Ecological Community
BS Act	<i>Biosecurity Act 2014</i> (Qld)
CAMBA	China-Australia Migratory Bird Agreement
cm	Centimetres
CR	Critically endangered
CWD	Coarse woody debris
DA	Desktop assessment
DAWE	Department of Agriculture, Water and the Environment (Commonwealth) (Former now DCCEEW)
DBH	Diameter at breast height
DCCEEW	Department of Climate Change,
DES	Department of Environment and Science (Qld)
DEE	Department of Environmental and Energy (Commonwealth)
DoR	Department of Resources (Qld)
E	Endangered
EIS	Environmental Impact Statement
EP Act	<i>Environmental Protection Act 1994</i> (Qld)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
FFJV	Future Freight Joint Venture
GIS	Geographic Information System
GTDTHQ	Guide to Determining Terrestrial Habitat Quality (Version 1.3; DES 2020)
HVR	High Value Regrowth
JAMBA	Japan-Australia Migratory Bird Agreement
km	Kilometres
KRAM	Koala Rapid Assessment Method
LC	Least concern
m	Metres
MLES	Matter of Local Environmental Significance
MNES	Matter of National Environmental Significance
MSES	Matter of State Environmental Significance

Acronym	Description
Natural grasslands TEC	Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland Threatened Ecological Community
NC Act	<i>Nature Conservation Act 1992</i> (Qld)
NJKHT	Non-juvenile Koala Habitat Tree
PKADA	Priority Koala Assessable Development Area
Planning Act	<i>Planning Act 2016</i> (Qld)
PMST	Protected Matters Search Tool (Commonwealth)
Poplar box TEC	Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community
QA	quaternary
RE	Regional Ecosystem
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SEVT TEC	Semi Evergreen Vine Thicket Threatened Ecological Community
SLC	Special Least Concern
sp.	Species (singular)
spp.	Species (plural)
SPP	State Planning Policy
SPRAT	Species Profile and Threats Database (Commonwealth)
sub sp.	Sub species
TEC	Threatened Ecological Community
ToR	Terms of Reference
V	Vulnerable
VM Act	<i>Vegetation Management Act 1999</i> (Qld)
White box TEC	White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands Threatened Ecological Community

1 Executive summary

This ecology report for the Border to Gowrie (B2G) section of the Inland Rail Project, details the additional terrestrial ecological surveys undertaken by Ausecology to map Regional Ecosystems and record habitat assessment data. All of survey work was undertaken in consideration of Matters of National Environmental Significance (MNES) under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Matters of State Environmental Significance (MSES) outlined under the *Queensland Environmental Offsets Regulation 2014* and Matters of Local Environmental Significance (MLES). It should be noted that MLES were covered under both MNES and MSES and have not been considered further in this report.

Desktop assessments researched information from available environmental databases, literature reviews and previous studies and reports to evaluate the terrestrial ecological values within and surrounding the B2G Project footprint. Desktop assessments were verified with field surveys undertaken by Ausecology in accordance with relevant Commonwealth and State guidelines. These field surveys were primarily focused on detailed Regional Ecosystem (RE) mapping and collecting habitat assessment data across the B2G Project footprint, an area of approximately 3,139 ha spanning 218 km.

In total, 23 REs were ground-truthed within the B2G Project footprint, comprising four 'Endangered' REs and eight 'of concern' REs under the *Queensland Vegetation Management Act 1999*.

Five Threatened Ecological Communities (TECs) listed under the EPBC Act were ground-truthed within the B2G Project footprint, namely:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC (Brigalow TEC)
- Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland (Natural Grasslands TEC)
- Poplar Box Grassy Woodland on Alluvial Plains TEC (Poplar Box TEC)
- Semi-Evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC)
- White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands TEC

2 Introduction

2.1 Project overview

The Australian Government selected the Australian Rail Track Corporation (ARTC) to deliver the Inland Rail Project. ARTC is currently seeking project approval for the Inland Rail Border to Gowrie (B2G) section of the Inland Rail Project. This section comprises approximately 176 km of new dual gauge track and 78 km of upgraded track from the New South Wales/Queensland border to Gowrie - northwest of Toowoomba. In March 2018, the Queensland Coordinator-General declared the B2G section a 'coordinated project', under the *State Development and Public Works Organisation Act 1971* triggering the requirement for an Environmental Impact Statement (EIS) to be prepared. As part of this approvals process, impacts to Matters of National, State and Local Environmental Significance (MNES, MSES and MLES) require assessment. The Minister for the Environment determined the Project a 'controlled action' on 9 April 2018, requiring assessment and approval under the EPBC Act. The controlling provision for the controlled action is 'Listed threatened species and communities.'

2.2 Project location and description

The B2G section runs from the NSW/QLD border through to Gowrie, north of Toowoomba (Figure 2-1). The area is situated in the Brigalow Belt South bioregion and includes extensive areas of agricultural land historically cleared for pastures and cropping. The eastern section of the alignment crosses through the Condamine River floodplain and the western section runs along the edge of the Whetstone and Bringalily State Forests.

2.3 Objectives

Ausecology was engaged by ARTC to undertake additional ecological assessments for terrestrial ecology along the B2G footprint to complete the mapping of the extent and condition of vegetation communities across the B2G footprint and undertake habitat assessments for flora and fauna matters using detailed habitat scoring metrics for targeted species. Note no targeted flora and fauna surveys were undertaken as part of this work as these have previously been completed (Appendix C).

2.4 Previous survey efforts

Ecological assessments were first undertaken for the B2G section by Eco Logical Australia (2016) to inform the Initial Advice Statement. Future Freight Joint Venture (FFJV) (2018-2019) and Eco Logical Australia (2018-2019) undertook assessments to support the Terrestrial Ecology technical report (and geotechnical investigations) and Aquatic Ecology technical report, respectively. An additional ecological assessment, including targeted flora and fauna surveys, was undertaken by Cardno to provide a more accurate understanding of the ecology through the B2G section (2020-2021). Note the Cardno report is included as Appendix C.

2.5 This report

The report provides the results of GTRE mapping in the B2G Project footprint to further inform the approvals process.

2.6 Staff qualifications

All senior ecologists that undertook the ground surveys are suitably qualified ecologists. Ausecology ecologists collectively have extensive experience with the Regional Ecosystems that could potentially be present within the survey area.

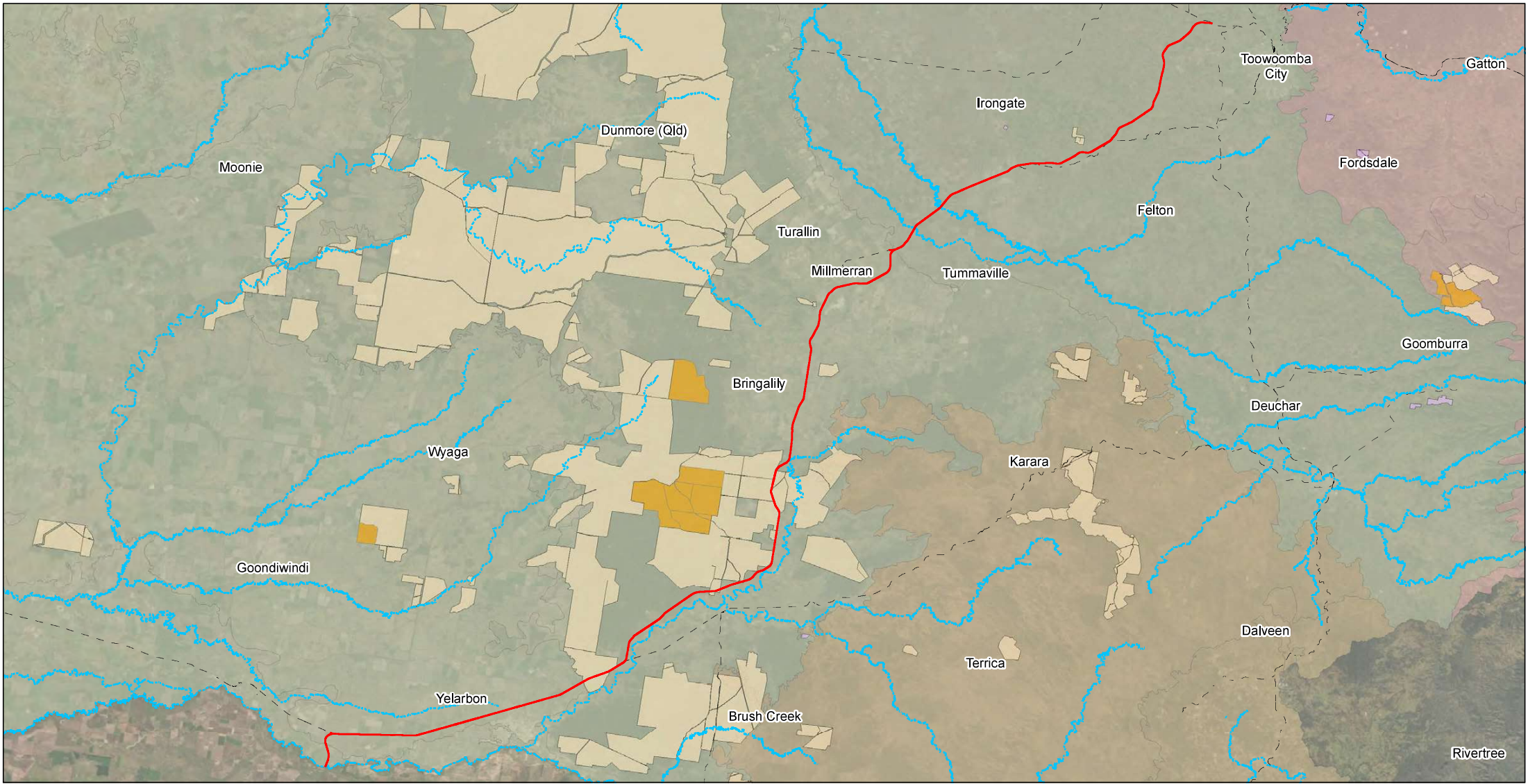
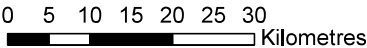




Figure 2-1 - Overview map
ARTC - B2G Alignment



Scale 1:650,000 at A3
Coordinate System: GCS GDA 1994
Datum: GDA 1994

Legend

— B2G Alignment

- - - Rail_network

Major Watercourse Lines

Protected Area Type

National Park

State Forrest

Conservation Park

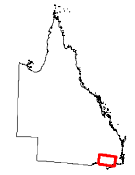
Bioregion Name

Brigalow Belt

New England Tableland

Southeast Queensland

Data Sources:
State of Queensland Department of Resources
Rail Network
State of Queensland Department of Environment
Major watercourse lines
Bioregion Boundary
Protected Areas
Australian Bureau of Statistics
Australian Statistical Geography Standard (ASGS) Edition 3:
Suburb Labels
ARTC
Alignment



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3 Desktop assessment results

3.1 Matters of National Environmental Significance

3.1.1 Threatened Ecological Communities

A total of eight TECs may occur within the B2G Project footprint based on the results of the desktop assessment and supported by the QLD Regional Ecosystem (RE) mapping (Table 3-1).

Table 3-1 Threatened Ecological Communities identified from the desktop assessment

Threatened Ecological Community	EPBC Listing Status	Source
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) ecological community	Endangered	PMST; EIS ;Terms of Reference (ToR)
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	PMST; EIS; ToR
Lowland Rainforest of Subtropical Australia	Critically Endangered	PMST; EIS; ToR
Natural grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland	Critically Endangered	PMST; EIS; ToR
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	PMST; EIS
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	PMST; EIS; ToR
Weeping Myall Woodlands	Endangered	PMST; EIS; ToR
White box-yellow box-Blakely's red gum grassy woodlands and derived native grasslands	Critically Endangered	PMST; EIS; ToR

3.2 Matters of State Environmental Significance

3.2.1 Regulated vegetation

A total of three 'Endangered', eight 'Of Concern' REs identified under the provisions of the VM Act are predicted to occur within the B2G Project (Table 3-2).

Table 3-2 Regulated vegetation identified from the desktop assessment

Regional Ecosystem	Regional ecosystem description (DES)	VM Act Status	Source
11.3.2*	<i>Eucalyptus populnea</i> woodland on alluvial plains	Of Concern	DA, EIS, Cardno
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus spp.</i> woodland on alluvial plains	Of Concern	DA, EIS, Cardno
11.3.21#	<i>Dichanthium sericeum</i> and/or <i>Astrelba spp.</i> grassland on alluvial plains. Cracking clay soils	Of Concern	DA, EIS, Cardno
11.4.3^	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Endangered	DA, EIS, Cardno
11.4.10^	<i>Eucalyptus populnea</i> or <i>E. woollsiana</i> , <i>Acacia harpophylla</i> , <i>Casuarina cristata</i> open forest to woodland on margins of Cainozoic clay plains	Endangered	DA
11.5.14	<i>Triodia sp.</i> open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	Of Concern	DA, EIS, Cardno
11.8.3~	Semi-evergreen vine thicket on Cainozoic igneous rocks	Of Concern	DA, EIS
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of Concern	DA, EIS, Cardno
11.9.5^	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	Endangered	DA, EIS, Cardno
11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	Of Concern	DA, EIS, Cardno
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks	Of Concern	Cardno

*Denotes potential poplar box TEC, #denotes potential natural grasslands TEC, ^ denotes potential brigalow TEC, ~denotes potential SEVT TEC.

4 Field assessment methodology

The field assessment methodology employed was determined based on the results from the desktop assessment described in Section 3. This section outlines the survey methods employed during the field investigations undertaken on the B2G Project including:

1. Ground-truthing Regional Ecosystems (REs) in accordance with Neldner et al. 2020 and determining the RE extents.
2. Assessing Threatened Ecological Communities (TECs) and verifying their status and condition.
3. Undertaking BioCondition assessments in each identified assessment unit across the survey area to determine vegetation condition.
4. Completing detailed habitat assessments in accordance with the *Guide to determining terrestrial habitat quality* (DES 2017 and 2020).

4.1 Ground-truthing Regional Ecosystems

The quaternary assessment methodology was used to collect data on vegetation characteristics (floristic structure and composition), broad ecological condition and the extent and classification of vegetation communities across the survey area. These assessments were conducted as per the *Methodology for Surveying and Mapping Regional Ecosystems and Vegetation Communities in Queensland Version 5.1* (Neldner et al., 2020). Quaternary assessments were undertaken and the RE classification was confirmed using the definitions of remnant, regrowth, and non-remnant vegetation, as defined under the VM Act and using the relevant BioCondition benchmark to assess height and coverage of the canopy and characterises species, in conjunction with technical descriptions for the RE where available. Regrowth was confirmed in the field and where aerial imagery has shown these areas have not previously been cleared for last 15 years the regrowth was classified as High Value Regrowth (HVR) in the data.

4.2 Identifying Threatened Ecological Communities

The legal definition of each potentially occurring TEC was examined and, following ground-truthing of REs, any REs likely to be associated with one (or more) TECs were further assessed in the field against the descriptions, condition categories and thresholds as detailed in the respective approved conservation advice documents and summarised below. TEC assessments were undertaken by Cardno (2021) during spring 2020 and post wet 2021 surveys and additional data was collected by Ausecology during multiple survey events between August and December 2021. Areas adjacent to the TEC impact areas were assessed for viability post impact to ensure that the remaining patches will remain functionally viable and continue to meet the relevant condition threshold/key diagnostic criteria.

4.2.1 Brigalow (*Acacia harpophylla* dominant and co-dominant)

The key diagnostic characteristics for the 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' TEC, henceforth referred to as the 'Brigalow TEC' are as follows (Department of the Environment, 2013):

- The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch¹. *A. harpophylla* is either dominant in the tree layer, or co-dominant with other species (notably *Casuarina cristata*, other species of *Acacia*, or species of *Eucalyptus*).

AND

- In Queensland, within the Brigalow Belt Bioregion, the patch meets the description of one of the following 12 Qld REs: 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21

AND/OR

- The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Brigalow Belt Bioregion REs. This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise.

The patch must also meet the following condition thresholds:

- The patch is 0.5 ha or more in size;

AND

- Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.

Note that in some areas *Casuarina cristata* may be locally dominant and more abundant than *A. harpophylla*, and form pockets of vegetation within or on the margins of the Brigalow TEC, these areas have been included as TEC.

4.2.2 Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions

In Queensland, the following REs are representative of the TEC where the requirements of the key diagnostic characteristics and condition thresholds are met:

- RE 11.3.3 *Eucalyptus coolabah* woodland on alluvial plains;
- RE 11.3.15 *Eucalyptus coolabah*, *Acacia stenophylla*, *Muehlenbeckia florulenta* fringing woodland on alluvial plains;
- RE 11.3.16 *Eucalyptus largiflorens*, $\pm$ *Acacia cambagei* $\pm$ *A. harpophylla* woodland to low open woodland on alluvial plains;
- RE 11.3.28 *Eucalyptus coolabah* $\pm$ *Casuarina cristata* open woodland on alluvial plains;
- RE 11.3.37 *Eucalyptus coolabah* fringing woodland on alluvial plains.

Key diagnostic attributes for Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions TEC, henceforth referred to as the 'black box' TEC, are as follows (Threatened Species Scientific Committee, 2011):

- Distribution is limited to the Darling Riverine Plains and the Brigalow Belt South bioregions (IBRA v6.1).
- It typically occurs on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream levees.
- A tree canopy layer is present that shows these features:

¹ a patch is defined as a discrete and continuous area of the ecological community. However, a patch may include small-scale disturbances, such as tracks or breaks (including exposed soil), watercourses/drainage lines or localised changes in vegetation that do not act as a permanent barrier or significantly alter its overall functionality.

- *Eucalyptus coolabah subsp. coolabah* (Coolibah) must be present in the tree canopy;
- Coolibah typically is dominant ($\geq 50\%$ of tree crown cover);
- Where Coolibah and *E. largiflorens* (Black Box) co-occur, together they make up the dominant species in the tree canopy layer ($\geq 50\%$ of tree crown cover);
- Hybrids of Coolibah or Black Box with each other and other *Eucalyptus* species (typically Bimble Box) are included as dominant tree species.
 - The mid or shrub layer may or may not be present. When present it is typically sparse or clumped and is of variable composition.
 - The ground layer is of variable composition and cover ranging from sparse to dense. Ground cover lifeforms typically comprise native graminoids, other herbs, chenopods and other low shrubs that are typically under 50 cm tall

The patch must also meet certain condition thresholds. A patch is considered the black box TEC if it meets these minimum criteria, listed below:

- Minimum patch size of 5 ha This may include areas of native vegetation that may be naturally open or contain regrowth.

AND

- Tree crown cover in the patch must be $\geq 8\%$

AND

- Coolibah and/or Black Box in the tree canopy must be present in the patch that are either:
 - Mature trees with a main stem that has a DBH ≥ 30 cm; **OR**
 - Hollow-bearing live trees (live or dead); **OR**
 - coppiced trees with a main stem that has a DBH ≥ 20 cm.

AND

- 10% or more of the ground cover comprises native graminoids, other herbs, chenopods and/or native low shrubs (i.e., woody plants typically less than 50 cm tall).

AND

- In the ground layer, the percentage cover of non-native perennial plant species does not exceed the percentage cover of native plant species (annual or perennial).

4.2.3 Lowland rainforest of subtropical Australia

In Queensland, the following REs are representative of the TEC where the requirements of the key diagnostic characteristics and condition thresholds are met:

- RE 12.3.1 Complex to simple notophyll vine forest- Gallery rainforest (notophyll vine forest) on alluvial plains.
- RE 12.5.13 Microphyll to notophyll vine forest +/- *Araucaria cunninghamii*.
- RE 12.8.3 Complex notophyll vine forest – complex notophyll vine forest on Cainozoic igneous rocks.
- RE 12.8.4 Complex notophyll vine forest with *Araucaria spp.* on Cainozoic igneous rocks.
- RE 12.8.13 Araucarian complex microphyll vine forest on Cainozoic igneous rocks.

- RE 12.11.1 Simple notophyll vine forest often with abundant *Archontophoenix cunninghamiana* ("gully vine forest") on metamorphics +/- interbedded volcanics.
- 12.11.10 Notophyll vine forest +/- *Araucaria cunninghamii* on metamorphics +/- interbedded volcanics.
- 12.12.1 Simple notophyll vine forest usually with abundant *Archontophoenix cunninghamiana* ("gully vine forest") on Mesozoic to Proterozoic igneous rocks.
- RE 12.12.16 Notophyll vine forest on Mesozoic to Proterozoic igneous rocks.

Key diagnostic attributes for Lowland rainforest of subtropical Australia TEC, henceforth referred to as the 'lowland rainforest' TEC, are as follows (Threatened Species Scientific Committee, 2011):

- Distribution of the ecological community is primarily in the NSW North Coast and South Eastern Queensland bioregions, according to Interim Biogeographic Regionalisation for Australia (IBRA) version 6.1 (2004).
- The ecological community occurs on: soils derived from basalt or alluvium; or enriched rhyolitic soils; or basaltically enriched metasediments.
- The ecological community generally occurs at an altitude less than 300 m above sea level.
- The ecological community typically occurs in areas with high annual rainfall (>1300mm).
- The ecological community is typically more than 2 km inland from the coast.
- The structure of the ecological community is typically a tall (20 m–30 m) closed forest, often with multiple canopy layers.
- Patches of the ecological community typically have high species richness (at least 30 woody species).

The patch must also meet certain condition thresholds (see Figure 4-1). A patch is considered the lowland rainforest TEC if it meets these minimum criteria.

Patch Type (evidence of remnant vegetation & regeneration status)	A Natural remnant evident by the persistence of mature residual trees from <u>Appendix B</u> .	B Some residual trees from <u>Appendix B</u> are present plus evidence of either: natural regeneration ^{*1} AND/OR regeneration with active management ^{*2}	C A non-remnant patch that has recovered through a) natural regeneration ^{*1} AND/OR b) supplementary planting that has stature and quality that is reflective of the 'Description' ^{*3}
	AND	AND	AND
Patch Size (excludes buffer zone)	≥ 0.1 ha AND	≥ 1 ha AND	≥ 2 ha AND
Canopy Cover (over entire patch) ^{*4}	Emergent/canopy/subcanopy ^{*4} cover is ≥ 70% AND		
Species Richness (over entire patch)	contains ≥ 40 native woody species ^{*5} from Appendix A AND	contains ≥ 30 native woody species ^{*5} from Appendix A AND	
Percent of total vegetation cover that is native ^{*6} (use sample plot)	≥ 70% of vegetation ^{*6} is native	≥ 50% of vegetation ^{*6} is native	
Notes: ^{*1} Evidence of natural regeneration is shown by the presence of seedlings of a range of native species that did not originate through deliberate plantings. ^{*2} A patch that is actively managed has regular (e.g. every 1–2 years) on the ground human regenerative activity such as weed control or supplementary plantings. ^{*3} Closed canopy, 20–30 m tall, of representative species (e.g. white booyong, hoop pine, figs, brush box, yellow carabeen, red cedar, rosewood, white beech) ^{*4} Canopy cover (projective foliage cover) is estimated over the entire patch. When assessing the ecological community, the canopy includes the emergents and subcanopy (everything above 10 m tall). Canopy/sub-canopy includes all trees and vines (native and non-native). ^{*5} Woody species are trees, shrubs or vines that contain wood or wood fibres that consist mainly of hard lignified tissues. Excluded from woody species are graminoids, other herbs and non-woody vines. ^{*6} Total vegetation cover includes emergents/canopy/subcanopy and understorey and ground layers.			

Figure 4-1 Condition thresholds for identifying the Lowland rainforest TEC (Threatened Species Scientific Committee, 2011).

4.2.4 Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern QLD

The key diagnostic characteristics for the 'Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern QLD' TEC, henceforth referred to as the 'natural grassland' TEC, are as follows (Threatened Species Scientific Committee, 2009):

- Distribution mainly in the Darling Downs of southern Queensland
- Associated with fine textured, often cracking clay soils derived from either basalt or alluvium
- Occurrence on landforms that are typically flat to very low slopes (less than 5 percent/1 degree)

- Tree canopy usually absent to sparse, comprising less than 10% projective crown cover
- Ground layer typically dominated by perennial native grasses and contains three or more 'indicator' native species²
- Associated with Qld REs: 11.3.21 or 11.3.24

The patch must also meet certain condition thresholds (Table 4-1). A community is considered the natural grasslands TEC if it meets either the 'best quality' or 'good quality' condition criteria.

Table 4-1 Condition thresholds and classes for identifying the natural grasslands TEC

Attribute	Condition Classes	
	Best Quality	Good Quality
Patch size	At least 0.5 ha; AND	At least 2 ha; AND
Grasses	At least 4 native perennial grass species from the list of indicator species ² ; AND	At least 3 native perennial grass species from the list of indicator species; AND
Tussock cover	At least 200 native perennial grass tussocks; AND	At least 200 native perennial grass tussocks; AND
Woody shrub¹ cover	Total projected canopy cover of shrubs is less than 30%; AND	Total projected canopy cover of shrubs is less than 50%; AND
Introduced species	Perennial non-woody introduced species are less than 5% of the total projected crown cover	Perennial non-woody introduced species are less than 30% of the total projected crown cover

Note that the listing advice specifies that unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain. These conditions were met during Cardno surveys. However, these conditions were not met during Ausecology surveys and so no natural grassland TEC assessments were conducted during this period. Therefore, any patches of potential TEC natural grassland not assessed previously by Cardno were assumed to be the natural grassland TEC based on the precautionary principle.

² Indicator species include: *Aristida leptopoda*, *Astrebla elymoides*, *Astrebla lappacea*, *Rytidosperma bipartitum*, *Austrostipa aristiglumis*, *Bothriochloa biloba*, *Bothriochloa erianthoides*, *Dichanthium sericeum*, *Digitaria divaricatissima*, *Elymus plurinervis*, *Eriochloa crebra*, *Eulalia aurea*, *Panicum decompositum*, *Panicum queenslandicum*, *Thellungia advena*, *Themeda avenacea*, *Themeda triandra* (synonym. *T. australis*) and *Walwhalleya proluta*.

4.2.5 Poplar Box Grassy Woodland on Alluvial Plains

The key diagnostic characteristics for the 'Poplar box grassy woodland on alluvial plains' TEC, henceforth referred to as the 'poplar box' TEC, are as follows (Department of the Environment and Energy, 2019):

- Occurs in the Brigalow Belt North, Brigalow Belt South, Southeast Queensland, Cobar Penneplains, Darling Riverine Plains, NSW Southwestern Slopes, Riverina and Murray Darling Depression IBRA bioregions
- Associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, typically duplex soils or sodosols. This includes areas that may not be part of currently defined floodplains
- A grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale
- A tree canopy must be present that shows these features:
 - Canopy tree species are capable of reaching 10 m or more in height
 - *Eucalyptus populnea* (Poplar Box) must be present in the canopy and is the dominant tree species³
 - Where hybrids of Poplar Box with other *Eucalyptus* spp. are present, they should be counted as part of the *Eucalyptus populnea* component of the tree canopy when assessing the previous criterion
 - Mid layer (1-10 m) crown cover of shrubs to small trees is low, about 30% or less
 - A ground layer (<1 m) mostly dominated across a patch by native grasses, other herbs and occasionally chenopods (during extended dry periods), ranging from sparse to thick.

The patch⁴ must also meet certain condition thresholds (Table 4-2). A patch is considered the poplar box TEC if it meets the minimum 'class C' criteria. Assessments of a patch should initially be centred on the area of highest native floristic diversity and/or cover i.e., the best condition area of the patch.

Note, differences in cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition.

³ a species that accounts for at least 50% of the total crown cover across the patch.

⁴ a patch is a discrete and mostly continuous area of the poplar box TEC, which meets the Key diagnostic characteristics and minimum condition thresholds. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks (including exposed soil, leaf litter, cryptogams and watercourses/drainage lines), or localised variations in vegetation that do not significantly alter the overall functionality of the ecological community.

Table 4-2 Condition thresholds and classes for identifying the poplar box TEC

Attribute	Condition Classes			
	Highest Quality		Good Quality	Moderate Quality
Category	A1	A2	B	C
Patch size¹	At least 1 ha; AND	At least 5 ha; AND	At least 5 ha; AND	At least 5 ha; AND
Crown cover of canopy trees	Crown cover is at least 10%; AND	Crown cover is at least 10%; AND	Crown cover is at least 10%; AND	Crown cover is at least 10%; AND
Perennial native vegetation cover in ground layer	At least 90% of perennial vegetation cover in the ground layer ² is native; AND	At least 70% of perennial vegetation cover in the ground layer ² is native; AND	At least 50% of perennial vegetation cover in the ground layer ² is native; AND	If <50% of perennial vegetation cover in ground layer is native, then the patch must have:
Species diversity	At least 30 native plant spp. per patch in ground layer	At least 30 native plant spp. per patch in ground layer	At least 20 native plant spp. per patch in ground layer; or at least 10 mature trees per ha with ≥ 30 cm dbh (and/or hollows)	At least 20 native plant spp. per patch in the ground layer; AND at least 10 mature trees per ha with at least 30 cm dbh (and/or hollows); AND smaller trees, saplings or seedlings suggestive of periodic recruitment

4.2.6 Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

The semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC, henceforth referred to as the 'SEVT' TEC, are considered an extreme form of dry seasonal subtropical rainforest (McDonald 1996). They occur in areas with a subtropical, seasonally dry climate on soils of high to medium fertility and are generally characterised by the prominence of trees with microphyll sized leaves (2.5–7.5 cm long) and the frequent presence of swollen-stemmed "bottle trees" (*Brachychiton australis*) as emergent from the vegetation (Webb 1959, 1968; Webb & Tracey 1981, 1994).

In Queensland, within the Brigalow Belt (north and south) Bioregion, ten REs are included in the SEVT TEC (McDonald, 2010): 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.6, 11.8.13, 11.9.4, 11.9.8, 11.11.18. There are no additional key characteristics or condition threshold criteria that must be considered.

4.2.7 Weeping myall woodlands

In Queensland, the following REs are representative of the weeping myall woodlands TEC, henceforth referred to as the 'weeping myall' TEC, where the requirements of the condition thresholds are met (Threatened Species Scientific Committee, 2009):

- RE 11.3.2 *Eucalyptus populnea* woodland on alluvial plains.
- RE 11.3.28 *Casuarina cristata* ± *Eucalyptus coolabah* open woodland on alluvial plains.

The minimum condition criteria are as follows:

- the tree canopy is dominated (at least 50% of trees present) by living, dead or defoliated Weeping Myall trees;

AND

- the overstorey must have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees/ha;

AND

- the area is at least 0.5 ha in size;

AND

- the patch has either:
 - more than two layers of regeneration of Weeping Myall present; **OR**
 - the tallest layer of living, dead or defoliated Weeping Myall trees is at least 4 m tall and of the vegetative cover present, 50% is comprised of native species.

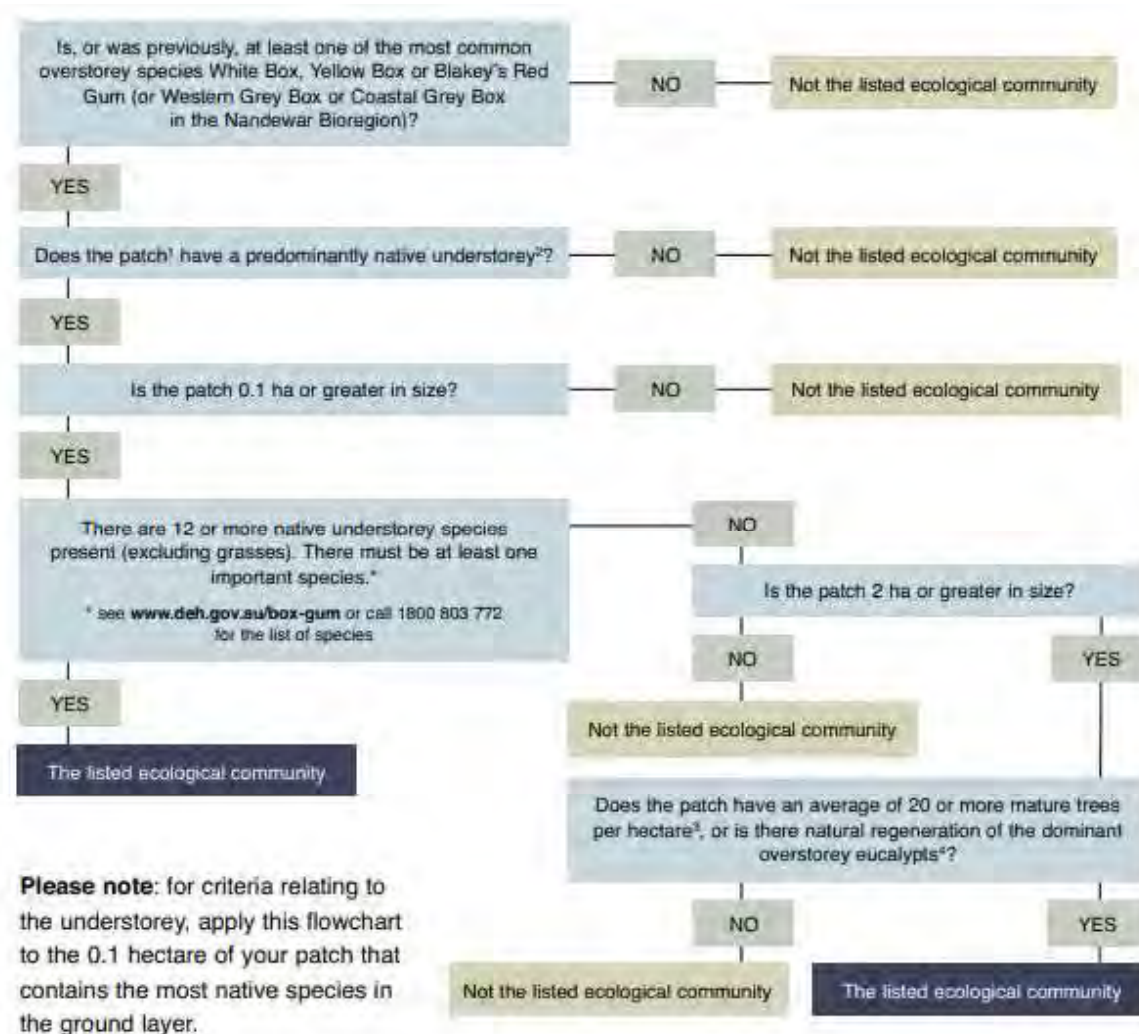
4.2.8 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

The key diagnostic characteristics for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC, henceforth referred to as the 'white box' TEC, are displayed in Figure 4-2.

In Queensland, the ecological community is a primary component of the following Regional Ecosystems: 11.8.2a, 11.8.8, 11.9.9a, 13.3.1, 13.11.8, 13.12.8 and 13.12.9. It can also be a smaller component of the following regional ecosystems: 11.3.23, 12.8.16, 13.3.4, 13.11.3 and 13.11.4.

The white box TEC exists as remnants in three different states:

- An overstorey of eucalypt trees exists, but there is no substantial native understorey
- A native understorey exists, but the trees have been cleared
- Both a native understorey and an overstorey of eucalypts exist in conjunction.



¹ Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:

- an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
- the area over which the understorey is predominantly native.

Patches must be assessed at a scale of 0.1 ha (1000m²) or greater.

² A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine this is late autumn when the annual species have died back and have not yet started to regrow. (At other times of the year, you can determine whether something is perennial or not is if it is difficult to pull out of the soil. Annual species pull out very easily.)

³ Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground.

⁴ Natural regeneration of the dominant overstorey eucalypts when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

Figure 4-2 Flowchart used to determine whether a patch should be included in the listed white box TEC (Department of the Environment and Heritage, 2006)

4.3 BioCondition assessments

In order to assess vegetation quality and condition, BioCondition assessments were undertaken in accordance with Eyre et al. (2015) and the QLD Guide to Determining Terrestrial Habitat Quality (GTDTHQ). BioCondition assessments were undertaken by Cardno (2021) during spring 2020 and post wet 2021 surveys and by Ausecology during multiple survey events between August and December 2021.

Following collection of field data, further analysis was conducted to determine the BioCondition score for each site. To calculate the BioCondition score, the value for each site condition attribute collected during the field survey was compared to reference ('benchmark') site values. Benchmark site values are specific to each RE and are based on the average or median value from reference sites. Benchmarks or draft benchmarks (provided by the Queensland Herbarium) were available for all REs assessed with the exception of 11.9.9a. Due to the difficulty in finding an appropriate site to establish a new reference site for 11.9.9a, the Queensland Herbarium advised that 11.8.8 could be used as a surrogate benchmark (pers. Comms. Sandy Pollock, Queensland Herbarium).

4.3.1 Assessment units

Assessment units have been defined as outlined in GHD *MNES Habitat Suitability Analysis* report (2023) prepared for ARTC.

4.4 Habitat assessment methodology

Habitat assessments were undertaken by Ausecology and were co-located at BioCondition sites and were undertaken in accordance with QLD Guide to Determining Terrestrial Habitat Quality (GTDTHQ). Additional habitat assessments were also undertaken opportunistically within the B2G Project footprint to capture particular habitat features and/or provide a more comprehensive sample of the condition of an assessment unit and the supporting habitat.

Habitat assessments were undertaken across all REs within the B2G Project footprint including those areas that contained remnant, regrowth and non-remnant vegetation. Habitat assessments included the collection of habitat associated data required for undertaking the habitat quality assessment methodology (further details are discussed below). The assessments included the identification of notable habitat features that were representative of the general area, with a particular emphasis on habitat for terrestrial MNES/MSES/MLES matters. For example, features included (but were not limited) to the following:

- Presence and abundance of small, medium and large hollow-bearing trees and stags
- Presence and abundance of fallen logs, hollow logs and woody debris
- Presence, abundance and depth of cracking clay soil
- Presence of watercourses, wetlands, gilgai features or artificial waterbodies (e.g., dams)
- Presence and abundance of important koala food and shelter trees
- Availability and abundance of leaf litter cover, bare ground, grasses, and low forbs/shrubs in which fauna can seek cover and protection
- Presence and abundance of fruiting and nectar producing plant cover
- Presence and abundance of mistletoe etc.

5 Field assessment results – vegetation communities

This section presents the general descriptions of the habitat encountered along the B2G Project footprint are provided in Table 5-1.

Table 5-1 General habitat categories

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Dry sclerophyll (Eucalypt) woodlands (remnant)		
	Dry sclerophyll (i.e. Eucalypt) woodland communities in the B2G Project footprint are typically comprised of a dominant mixed eucalypt species canopy and/or subcanopy of with a sparse shrub layer and a ground layer of mixed native and non-native grasses and forbs. The average canopy tree height through these remnant woodland areas in the B2G Project footprint was 16 m and the average canopy cover was 40%. A large amount (i.e. over 40%) of sites lacked any large trees (as per the BioCondition RE benchmarks), which is likely attributable to recent and/or historical logging and can also be a reflection of less fertile soils through some of these remnant patches. The majority of western sections of the Project footprint (i.e. between Canning Creek and the Qld/NSW border) contain Eucalypt woodlands dominated by mature box, ironbark and red gum woodlands that have remained largely intact including expansive areas of State Forest, as they are typically of low agricultural value with low grazing pressures despite these areas being subjected to previously logging. These woodlands in the west of the Project footprint regularly had a subdominant tree layer of <i>Acacia</i> and/or <i>Casuarina/Allocasuarina</i> species and an abundance of mistletoe, both of which provide good foraging habitat for various bird species including painted honeyeater, glossy black cockatoos and roosting habitat for various microchiropteran bat species. The eucalypt woodland communities to the east of the Project were characterised by more fragmentation, often consisting of ironbark communities including <i>Eucalyptus melanophloia</i> and regularly with a ground layer dominated by exotic herbs/forbs and grasses. These remnant areas to the east were not only often subject to high vegetation fragmentation but also higher levels of grazing pressure; which can be attributable to a history of intensive cropping, grazing and other agricultural land uses. Overall, dry sclerophyll (eucalypt) communities were found to contain a low to medium abundance of small to medium sized tree hollows, which are known to provide suitable habitat for small to medium	11.3.1, 11.3.2, 11.3.18, 11.3.14, 11.3.17, 11.3.25, 11.3.27i, 11.3.4, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.4, 11.7.5, 11.7.7, 11.8.4, 11.8.5, 11.9.7, 11.9.9a

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
	arboreal mammals (e.g., sugar/squirrel gliders), hollow nesting birds and roosting microbats. Despite this, areas of RE 11.3.25 (approx. 12 ha) with <i>E. tereticornis</i> or <i>E. camaldulensis</i> woodland fringing creek and drainage lines was found to contain larger tree hollows; however, these areas often occurred in highly to severely fragmented areas due to intensive cropping and grazing agricultural land uses. The ground layer within this habitat type typically has a shallow layer of leaf litter and a moderate abundance of woody debris. It is these microhabitat features that can provide important refuge and foraging opportunities for a range of reptiles, amphibians and small mammal taxa. Overall, there is a lack of old growth remnant dry sclerophyll communities with intact connectivity across the B2G Project footprint. Notwithstanding, where connected remnant dry sclerophyll vegetation remains, is known or likely to provide important dispersal and/or foraging resources for a range of biodiversity including a diverse range of threatened species (e.g. koala) in an otherwise fragmented landscape.	

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Disturbed areas of Eucalypt woodlands (regrowth)		
	When compared to remnant dry sclerophyll (eucalypt) woodland, regrowth areas of eucalypt woodland have largely been subject to higher levels of historical clearing, tree thinning, poisoning and grazing pressure. Resultingly, number of large hollows, large hollow logs and coarse woody debris and leaf litter recorded across the majority of regrowth sites was significantly less. The average tree canopy height through these areas was 9 m with an average of tree canopy cover of 19%. The sparse tree canopy, modified vegetation structure and lack of ground cover provides a limited level of habitat quality in the B2G Project footprint. Notwithstanding, these areas are still considered important to a range of species including reptile and bird taxa.	11.3.2, 11.3.14, 11.3.25, 11.3.4, 11.5.1, 11.5.4, 11.5.14, 11.5.20, 11.7.7, 11.8.5

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Eucalyptus and/or <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest		
	Along the B2G Project footprint, these areas were characterised by the dominance of belah (<i>Casuarina cristata</i>) and brigalow (<i>Acacia harpophylla</i>) woodland with the occasional mixed Eucalyptus species in the canopy and/or sub-canopy and were typically found on cracking clay soils. The brigalow communities lacks an abundance of medium or large sized tree hollows and the ground layer can be dense, with coarse woody debris and leaf litter providing important habitat for reptiles. Deep cracking clay soils also provide important habitat for a range of amphibians, particularly during the wet season when the gilgai's are inundated. Throughout the B2G project footprint these areas had been largely subjected to vegetation fragmentation with regular occurrences of discrete regrowth and remnant habitat patches. Given the fertile soils known for these communities, these patches were often isolated and surrounded by intense cropping and grazing pressures. To the west of the Project footprint, remaining brigalow patches were often used as shadelines along fencelines and along road reserves. In these areas impacts from sheep and cattle grazing/trampling were evident amongst the ground and shrub layers. These shadelines and road reserves also contained an abundance of mistletoe; providing important habitat for birds including, the painted honeyeater that was recorded regularly through these areas. Importantly, <i>Casuarina cristata</i> was considered the most dominant canopy tree species throughout most of these areas, which is known to provide important foraging and roosting habitat for glossy black cockatoo amongst other bird species.	11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.10

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Natural grasslands		
	Along the B2G Project footprint, natural grassland communities consisted of 11.3.21, 11.8.11 and 11.5.14. RE 11.3.21 consisted of grassland dominated by <i>Dichanthium sericeum</i>, and <i>Aristida leptopoda</i>, scattered mixed native forbs with cracking clay soils on alluvial plains. The average native perennial grass cover in RE 11.3.21 was 60.5% and the average non-native ground cover was 2% (according to BioCondition data). It should be noted that exostic plant species richness and cover was often abundant with weed invasion a common occurrence across almost all survey sites. The most common weeds included <i>Sorghum halepense</i>, <i>Chloris gayana</i>, <i>Salvia reflexa</i>, <i>Rapistrum rugosum</i> and other Brassica species. The RE 11.3.21 grasslands generally contained cracking clay soil with scattered to abundant soil cracks between 1-20 cm depth. These microhabitat features provide refuge and foraging opportunities for reptiles including the Condamine earless dragon; however, presence of intense agricultural impacts was widespread across all areas, due to grazing by livestock and/or proximity of cropping. RE 11.5.14 areas were dominated by <i>Melaleuca densispicata</i> with a groundcover of <i>Sclerolaena</i> spp. and mixed forbs. RE 11.8.11 areas were dominated by <i>Dichanthium sericeum</i>, <i>Panicum decompositum</i> and mixed <i>Aristida</i> spp. The average native perennial grass cover in these areas was ~20% and the average non-native cover was ~10% (according to BioCondition data). The most common weeds included <i>Rapistrum rugosum</i>, <i>Medicago polymorpha</i> and <i>Bidens pilosa</i>, with several infestations of <i>Bryophyllum delagoense</i>. Bare ground cover ranged from scattered to very common, with occasional shallow cracking clay soils. Inundated gilgais were also present at several sites, providing habitat for reptiles and amphibians. Overall, the areas were moderately-severely impacted by cattle grazing/trampling and/or by slashing.	11.3.21, 11.5.14, 11.8.11

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Freshwater wetlands		
	Along the B2G Project footprint, these areas are characterised by the prominence of permanent and ephemeral freshwater wetlands with fringing sedgeland or woodlands on depressions on floodplains, billabongs, and were typically of palustrine nature. Vegetation cover and species richness was variable depending on drainage and water inundation at the time of survey. Throughout all of these areas, hydrophytic sedge and herb species dominated including <i>Eleocharis plana</i>, <i>Marsilea mutica</i>, mixed <i>Cyperus</i> and <i>Juncus</i> spp. At more wooded sites, the average tree canopy height was 12 m with an average canopy cover of 6.4%. Emergent aquatic vegetation was generally present, with a height of 0.2-5 m. Overall, across all areas, weed abundance and grazing intensity was low. Despite the intermittent nature of wetland systems within the Project footprint, when seasonal conditions are suitable, these areas are likely to provide important refuge and potential breeding sites for a diverse range of fauna taxa, especially wader and wetland bird species including, Australasian bittern, Australian painted snipe, Latham's snipe, common greenshank, glossy ibis, and sharp-tailed sandpiper.	11.3.27, 11.3.27b, 11.3.27i

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
Non remnant disturbed pasture, cropping areas and other land uses		
	Along the B2G Project footprint, these areas largely consist of highly modified vegetation communities subject to cropping and grazing. Generally, these areas are non-remnant and usually lack a distinct canopy or subcanopy; although, some areas contained discrete patches of trees including scattered large 'paddock trees' that likely provide refuge to mobile fauna on passage between remnant/regrowth patches. The average perennial native grass cover in these areas was 30.6% and the average non-native cover was 29.3% (according to BioCondition data). The most common weeds included <i>Glandularia aristigera</i>, <i>Cenchrus ciliaris</i>, <i>Cirsium vulgare</i>, <i>Lepidium bonariense</i>, <i>Medicago polymorpha</i>, <i>Rapistrum rugosum</i>, <i>Sonchus oleraceus</i>, <i>Verbena bonariensis</i> and <i>Opuntia</i> spp. The non-remnant areas frequently contained cracking clay soil with scattered to abundant soil cracks between 1-20 cm depth. These microhabitat features provide refuge and foraging opportunities for reptiles. The non-remnant areas were also often located on floodplains or in close proximity to farm dams. Presence of agricultural impacts was widespread across all areas, with low-severe grazing intensity and frequent cattle trampling and/or cropping (often resulting in severe soil compaction).	Non-remnant

Habitat description	Description	Associated Regional Ecosystem in the B2G project footprint
		

5.1 Ground-truthed Regional Ecosystems

In total, 653 quaternary assessments and 128 BioCondition assessments were undertaken to ground-truth the extent and condition of the regulated vegetation community mapping. The ground-truthed mapping frequently differed from the regulated vegetation mapping, with the status, extent and condition of several REs updated accordingly.

The final ground-truthed RE mapping is provided in Appendix A and with assessment photos provided in Appendix C.

A summary of the ground-truthed REs, including the relevant number of BioCondition and Quaternary assessments undertaken, their associated condition status and total areas within the B2G Project footprint are provided in Table 5-2. Note additional BioCondition and Quaternary points noted in the numbers above were located adjacent to the alignment during changes to the footprint. New REs ground-truthed in the alignment not previously found in the Government mapping have been denoted with a (*). In total, there was 2,260 ha of non-remnant vegetation and 586 ha of remnant vegetation, 250 ha of high value regrowth and 43 ha of regrowth vegetation.

Table 5-2 Ground-truthed Regional Ecosystems within the B2G Project footprint

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.3.1*	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Endangered	1.46	1	1	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Of Concern	33.82	3	17	16.83	10.58	0	15	375.28	6	34
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	Least Concern	22.15	3	5	0	6.94	1	3	21.84	-	2
11.3.17*	<i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains	Of Concern	4.12	0	1	0.00	0.00	N/A	N/A	0.00	N/A	-

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	Least Concern	0.00	N/A	N/A	N/A	N/A	N/A	N/A	26.54	0	-
11.3.21	<i>Dichanthium sericeum</i> and/or <i>Astrebla</i> spp. grassland on alluvial plains. Cracking clay soils	Of Concern	18.39	6	14	N/A	N/A	N/A	N/A	181.77	5	41
11.3.24	<i>Themeda avenacea</i> grassland on alluvial plains. Basalt derived soils	Endangered	0.00	N/A	N/A	N/A	N/A	N/A	N/A	3.63	0	-
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Least Concern	18.48	2	13	1.58	0.00	0	0	53.2	2	2
11.3.27	Freshwater wetlands	Least Concern	0.71	0	0	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.27b	Vegetation ranges from open water +/- aquatics and emergents. Often with fringing woodland	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	3.75	0	1
11.3.27i*	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer	Least Concern	7.91	0	0	0.00	0.00	N/A	N/A	0.00	N/A	-
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	Of Concern	9.55	1	2	5.16	2.38	0	2	64.07	0	-

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Endangered	34.43	4	20	61.75	6.6	1	31	277.5	5	8
11.4.10	<i>Eucalyptus populnea</i> or <i>E. woollsiana</i> , <i>Acacia harpophylla</i> , <i>Casuarina cristata</i> open forest to woodland on margins of Cainozoic clay plains	Endangered	23.09	1	9	2.36	1.93	0	1	14.78	1	1
11.5.1*	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Least Concern	113.8	4	30	26.97	2.59	2	4	162.68	1	8
11.5.1a	<i>Eucalyptus populnea</i> woodland with <i>Allocasuarina luehmannii</i> low tree layer	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	10.2	0	1
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	Least Concern	113.06	4	17	58.51	0.3	0	4	61.09	3	16
11.5.14	<i>Triodia</i> sp. open hummock grassland with emergent trees on Cainozoic sand plains and/or remnant surfaces. Highly alkaline soils	Of Concern	32.07	1	4	1.85	2.64	2	4	23.56	1	2
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E.</i>	Least Concern	11.21	2	4	11.03	0.29	2	6	89.03	2	6

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
	<i>crebra</i> woodland on Cainozoic sand plains											
11.7.4	Eucalyptus decorticans and/or Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius woodland on Cainozoic lateritic duricrust	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	0.54	N/A	-
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	Least Concern	0.00	N/A	N/A	0.00	0.00	N/A	N/A	2.87	N/A	-
11.7.7	<i>Eucalyptus fibrosa subsp. nubilis</i> +/- Corymbia spp. +/- Eucalyptus spp. woodland on Cainozoic lateritic duricrust	Least Concern	20.39	1	1	18.04	0.00	0	0	7.68	0	-
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks	Of Concern	0.00	N/A	N/A	0.16	0.00	0	0	9.26	1	-
11.8.4	<i>Eucalyptus melanophloia</i> woodland to open woodland on Cainozoic igneous rocks.	Least Concern	22.05	2	3	5.17	1.03	2	2	131.06	0	10
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	Least Concern	67.18	4	10	19.11	5.65	1	8	375.91	4	35
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of Concern	25.25	1	4	N/A	N/A	N/A	N/A	92.28	2	4

RE code	RE description	VM Act status	Remnant			Regrowth				Non-remnant		
			Area (ha)	No. of BC	No. of QA	HVR (ha)	Regrowth (ha)	No. of BC	No. of QA	Area (ha)	No. of BC	No. of QA
11.9.5 (eastern)	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on fine-grained sedimentary rocks	Endangered	2.42	0	3	21.33	2.48	2	20	224.48	5	11
11.9.7	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks	Of Concern	0.00	N/A	N/A	0.00	N/A	N/A	N/A	36.45	0	-
11.9.9a*	<i>Eucalyptus albens</i> +/- <i>E. crebra</i> +/- <i>E. tereticornis</i> +/- <i>Callitris baileyi</i> woodland. Occurs in southern part of bioregion.	Least Concern	3.19	1	1	0.00	0.00	N/A	N/A	0.00	N/A	-
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks	Of Concern	1.4	0	1	0.00	0.00	N/A	N/A	10.48	0	0
Total			586	41	161	249.8	43.4	12	100	2,260	38	182

A total of four 'Endangered', eight 'Of Concern' (Table 5-3) have been confirmed in the B2G Project footprint based on the results of the ground truthed survey.

Table 5-3 Of Concern and Endangered REs confirmed within the B2G Project footprint

Regional Ecosystem	VM Act Status	Area (ha)			
		Remnant	High Value Regrowth	Regrowth	Total
11.3.1	Endangered	1.46	0.00	0.00	1.46
11.4.3	Endangered	36.44	61.75	4.38	102.57
11.4.10	Endangered	23.09	2.36	1.93	27.38
11.9.5	Endangered	2.42	21.33	2.48	26.23
11.3.2	Of Concern	33.63	16.76	10.66	61.05
11.3.4	Of Concern	9.55	5.16	2.38	17.09
11.3.17	Of Concern	4.12	0.00	0.00	4.12
11.3.21	Of Concern	17.32	0.00	0.00	17.32
11.5.14	Of Concern	32.07	1.85	2.64	36.56
11.8.3	Of Concern	0.00	0.16	0.00	0.16
11.8.11	Of Concern	25.25	0.00	0.00	25.25
11.9.10	Of Concern	1.4	0.00	0.00	1.4
Total		186.75	109.37	24.47	320.59

5.2 Threatened Ecological Communities

Following ground-truthing, 207.16 ha from five EPBC listed TECs were confirmed to occur within the B2G Project footprint. The below sections summarise each confirmed TEC area, condition status (where relevant) and area (ha). The locations of the TECs are displayed in Appendix B.

5.2.1 Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland Threatened Ecological Community

The Natural Grassland TEC was recorded in several areas of the B2G Project footprint. Natural Grassland TEC recorded in the Project footprint met the description of the following two RE's:

- 11.3.21- *Dichanthium sericeum* and/or *Astrelba* spp. grassland on alluvial plains. Cracking clay soils
- 11.8.11- *Dichanthium sericeum* grassland on Cainozoic igneous rocks

A shrub layer was absent across most Natural Grassland TEC sites in the Project footprint. A tree canopy layer and subcanopy layer comprising of scattered trees (i.e. <10% of projective crown cover) was also typically absent across Natural Grassland TEC sites. Areas of RE 11.3.21 were dominated by *Dichanthium sericeum* (Queensland bluegrass) and *Aristida leptopoda* (white speargrass), with scattered mixed native forbs on cracking clay soils on alluvial plains. Common invasive weeds in 11.3.21 included, *Cenchrus ciliaris* (buffel grass), *Cirsium vulgare* (scotch thistle), *Sorghum halepense* (Johnson grass), *Chloris gayana* (Rhodes grass), *Salvia reflexa* (mintweed), *Rapistrum rugosum* (turnipweed) and other Brassica species.

Areas of RE 11.8.11 were dominated by *Dichanthium sericeum* (Queensland bluegrass), *Panicum decompositum* (native millet) and mixed *Aristida* spp. (wiregrass). Common invasive weeds in 11.8.11 sites included, *Cenchrus ciliaris* (buffel grass), *Bryophyllum delagoense* (mother of millions), *Medicago polymorpha* (burr medic), *Bidens pilosa* (cobbler's pegs), *Rapistrum rugosum* (turnipweed) and other Brassica species. Bare ground was often scattered, with microrelief (i.e. gilgai) present at several sites. Areas were moderately to severely impacted by cattle grazing/trampling and/or by slashing throughout most Natural Grassland TEC sites.

Where a comparison of site condition against the condition thresholds listed under the listing advice for Natural Grassland TECs was not able to be undertaken due to the timing and seasonality of the surveys or recent disturbance events (i.e. grazing and slashing), a precautionary measure was applied and 'best quality' condition class was applied. Best quality condition class includes the following criteria to be satisfied:

- A patch size of at least 0.5 ha; and
- At least four native perennial grass species from the list of perennial native grass indicator species (refer to the listing advice for Natural Grassland TEC); and
- At least 200 native grass tussocks; and
- Total projected canopy cover of shrubs is <30%; and
- Perennial non-woody introduced species are <5% of the total projected perennial plant cover

Table 5-4 Natural Grassland TEC mapped in the B2G Project footprint

TEC	Condition status	Area (ha)	Total (ha)
Natural grasslands TEC	Good quality	13.29	66.63
	Best quality	47.74	

5.2.2 Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community

The Brigalow TEC within the B2G Project footprint was characterised by the presence of *Acacia harpophylla* (brigalow) as dominant or co-dominant with other species, particularly, *Casuarina cristata* (belah) or seldomly with other species of *Acacia* or *Eucalyptus* spp. Areas of Brigalow TEC met the description of the following RE's recorded in the Project footprint:

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

Areas of Brigalow TEC within the Project footprint were mostly on acidic and salty clay soils with deep cracking clay soils containing occasional microrelief patterns (i.e. gilgai's), which intermittently fill with water typically during the wet season. The Brigalow TEC occurred mostly on flat to gently undulating Cainozoic clay plains that were not associated with current alluvium, or on gently undulating plains on fine grain sedimentary rocks. The tree layer varied in height from about 10 m to 25 m, which often depended on the soil type and disturbance history. The lower tree layer and shrub layers typically contained species such as *Geijera parviflora* (wilga) and *Eremophila mitchellii* (sandalwood). The ground layer was typically spare with scattered patches of

native perennial grasses including: *Enteropogon acicularis* (curly windmill-grass), *Panicum decompositum* (native millet), *Paspalidium* spp. and *Sporobolus* spp. Herbs and forbs were dominated by *Enchylaena tomentosa* (ruby saltbush), *Einadia nutans* (climbing saltbush), *Sclerolaena* spp., and *Nyssanthus* spp. (barb-wire weed). Dominant forbs included, *Cyperus gracilis* (especially in gilgai areas), and ferns *Cheilanthes distans* and *C. sieberi*. Common invasive weeds included, *Cenchrus ciliaris* (buffel grass), *Opuntia tomentosa* (velvety tree pear), and *Megathysus maximus* (Guinea grass).

The condition of Brigalow TEC varied considerably across the Project footprint in vegetation and composition including remnant, high-value regrowth, and non-remnant condition. All Brigalow TEC areas were 0.5 ha or more in size and contained <50% exotic perennial plants over the total vegetation cover of the patch and were assessed over a minimum sample area of 0.5 ha, in areas that were representative of the patch. Areas of brigalow woodland regrowth were not considered part of the TEC if they were of poor quality including cleared (not just thinned) within the last 15 years, had exotic perennial plant cover >50%, and were <0.5 ha.

Table 5-5 Brigalow TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition status	Area (ha)	Total (ha)
Brigalow TEC	11.3.1	Remnant	1.46	103.68
	11.4.10	Remnant	12.33	
	11.4.3	Remnant	82.28	
	11.9.5	Regrowth	7.61	

5.2.3 Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community

Poplar Box Grassland Woodland on Alluvial Plains (hereafter called 'Poplar Box TEC') within the Project footprint was characterised by a canopy dominated by *Eucalyptus populnea* (poplar box) and an understorey dominated by native perennial grasses and other herbs. Typically, a low density of a shrubby understorey was noted, however in some instances a thickened regrowth understorey occurred. Vegetation ground cover varied considerably especially in areas surveyed during dry periods where ground cover was often sparse. Areas within proximity to ephemeral water sources were subject to occasional inundation and often contained sedges that may become more prolific during wet seasons. The canopy ranged between 8 m to 20 m and occasionally contained other Eucalypt species. A patchy understorey was characterised by *Eremophila mitchellii* (sandalwood), *Geijera parviflora* (Wilga), *Acacia salicina* (Sally's wattle), and *Acacia stenophylla* (river cooba). The ground layer was dominated by native perennial grasses included multiple *Aristida* spp. (wiregrass), *Enteropogon acicularis* (curly windmill grass), *Sporobolus* spp., *Sclerolaena birchii* (galvanised burr). Common invasive weeds included *Cenchrus ciliaris* (buffel grass), *Glandularia aristigera* (Mayne's pest), and *Opuntia tomentosa* (velvety tree pear).

Areas of Poplar Box TEC met the description of the 11.3.2 RE recorded in the Project footprint.

The Poplar Box TEC typically occurred on gently undulating to flat plains, gentle slopes, back plains and occasionally on higher terraces and levees along ephemeral watercourses and depressions. Soil types were of alluvial and recent depositional origin and were variable including, texture contrast, deep uniform clays, massive earths with occasionally cracking clays.

Table 5-6 Poplar Box TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition Class	Area (ha)	Total
Poplar box TEC	11.3.2	A1	0	39.09
		A2	4.5	

TEC	Analogous REs	Condition Class	Area (ha)	Total
		B	22.99	
		C	11.60	

5.2.4 Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions Threatened Ecological Community

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (hereafter called 'SEVT TEC') was recorded in a single small patch in the B2G Project footprint. Areas of SEVT TEC met the description of the following RE recorded in the Project footprint:

- 11.8.3 – Semi-evergreen vine thicket on Caonozoic igneous rocks

The SEVT was located on a small hillock with clay soils and abundant igneous rocks occurring on the surface. The SEVT patch was considered a small regrowth patch and was mostly surrounded by extensively cleared areas for grazing. A very scarce layer (i.e. <5% cover) of emergent trees (7-12.5 m height) included, *Brachychiton populneus* (kurrajong), *Casuarina cristata* (belah), and *Eucalyptus orgadophila* (mountain coolibah). The ecological dominant layer (EDL) consisted of a dense low canopy and subcanopy (4-6 m height) and was characterised by an abundance of *Ehretia membranifolia* (weeping koda) and *Notelaea microcarpa* (native olive), with other associated species including, *Capparis lasiantha* (nipan), *Psyrax odorata* (shiny-leaved canthium) and mixed native vine species. A dense shrub layer was as dominated by *E. membranifolia*, *N. microcarpa* as well as *Alectryon diversifolius* (scrub boonaree), *Carissa ovata* (currentbush), and *Atalaya hemiglauc* (whitewood). A sparse ground layer included native species such as *Coleus australis* (native coleus), *Geitonoplesium cymosum* (scrambling lily), *Clematicissus opaca* (small-leaved water vine), and *Jasminum didymum* (native jasmine). Common invasive weeds were more common along edges of the SEVT patch and included, *Cenchrus ciliaris* (buffel grass), *Solanum nigrum* (black nightshade), *Setaria sphacelata* (pigeon grass), *Opuntia tomentosa* (velvety tree pear) and *Malvastrum americanum* (spiked mallow).

Table 5-7 SEVT TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition status	Total Area (ha)
SEVT TEC	11.8.3	High Value Regrowth	0.16

5.2.5 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened Ecological Community

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (hereafter called 'White-Box TEC') was recorded in a single small patch in the Project footprint. Areas of White-box TEC met the description of the following RE recorded in the Project footprint:

- 11.9.9a – *Eucalyptus albens* +/- *E. crebra* +/- *E. tereticornis* +/- *Callitris baileyi* woodland. Occurs in southern part of bioregion on fine-grained sedimentary rocks.

The White-box TEC contained a remnant patch and was characterised by *Eucalyptus albens* (white box) with a sub-dominant layer of *E. crebra* (narrow-leaved ironbark) (10-17 m canopy height). A subcanopy was scarce and was dominated by a mix of native tree species (5-8 m height). The shrub layer was dominated by patches of *Carissa ovata* (currant bush) with associated species including *Alectryon diversifolius* (scrub boonaree), *Denhamia oleaster* (stiff Denhamia), *Capparis mitchellii* (wild orange), and *Santalum lanceolatum* (Queensland sandalwood). An understorey was predominately native (i.e. ≥50% vegetation ground cover containing native perennial species) with more than 12 native understorey species recorded including mixed herbs and forbs.

Grasses were dominated by mixed native and non-native species however several species were difficult to determine to species level due to recent grazing by horses and seasonality at the time of the survey. Invasive weeds were common and most prolific within proximity to the drainage line whereas other adjoining areas were noted to have less weed cover overall. The overall patch size was greater than 0.1 ha in size.

Table 5-8 White box TEC mapped in the B2G Project footprint

TEC	Analogous REs	Condition status	Total Area (ha)
White box TEC	11.9.9a	Remnant	3.43

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