5.4 Terrestrial fauna

5.4.1 Desktop assessment results

5.4.1.1 Threatened fauna species

The EPBC Act PMST database identified 28 threatened fauna species that have the potential to occur within the desktop search extent. State based searches (i.e. WildNet, Species Profile Search and Biomaps) identified 20 threatened fauna species that have been historically recorded within the desktop search extent. Note that marine species have been addressed in Section 5.6.

In aggregate, the searches identified 32 State and/or Federal threatened fauna species that are either predicted to occur or have been confirmed as occurring, within the desktop search extent. This comprised 18 birds, eight mammals and six reptiles. Some historical records identified within the desktop search extent are classified and therefore the exact location of these records within the search extent are unknown. The PMST and WildNet desktop search results are provided in Appendix A and summarised in Table 5-6.

Table 5-6 also identifies seven threatened fauna species that were identified as controlling provisions at the time of the EPBC approval.

Table 5-6 Threatened fauna species identified within the desktop search extent

Scientific name	Common name	Status		Source	Records	Nearest record to ROW	EPBC Approval
		EPBC Act	NC Act				
Birds							
Botaurus poiciloptilus	Australasian bittern	E	E	PMST	-	-	
Calidris ferruginea	Curlew sandpiper	CE, Mig	CE	WN; PMST	7	3.2 km	
Cyclopsitta diophthalma coxeni	Coxen's fig-parrot	E	E	PMST	-	-	
Epthianura crocea macgregori	Yellow chat (Dawson)	CE	E	WN; PMST	1	*	✓
Erythrotriorchis radiatus	Red goshawk	V	E	WN; PSMT	2	6.0 km	✓
Falco hypoleucos	Grey falcon	V	V	PMST	-	8.4 km	
Geophaps scripta scripta	Squatter pigeon (southern)	V	V	WN; PMST	2	100 m	✓
Grantiella picta	Painted honeyeater	V	V	PMST	-	-	
Hirundapus caudacutus	White-throated needletail	V, Mig	V	WN; PMST	3	5.0 km	
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	V	V	WN; PMST	4	2.0 km	
Lophochroa leadbeateri	Major Mitchell's cockatoo	NL	V	WN	1	*	
Macronectes giganteus	Southern giant petrel	E, Mig	E	PMST	-	-	
Neochmia ruficauda ruficauda	Star finch (eastern, southern)	E	E	WN; PMST	1	*	
Numenius madagascariensis	Eastern curlew	CE, Mig	E	PMST	-	-	
Poephila cincta cincta	Black-throated finch (southern)	E	E	WN; PMST	2	9.0 km	

Scientific name	Common name	Status		Source	Records	Nearest record to ROW	EPBC Approval
		EPBC Act	NC Act				
Rostratula australis	Australian painted-snipe	E	E	WN; PMST	4	*	
Thalassarche impavida	Campbell albatross	V, Mig	LC	PMST	-	-	
Turnix melanogaster	Black-breasted button-quail	V	V	WN; PMST	1	5.0 km	
Mammals							
Chalinolobus dwyeri	Large-eared pied bat	V	V	PMST	-	-	
Dasyurus hallucatus	Northern quoll	E	LC	WN; PMST	4	0.5 km	
Macroderma gigas	Ghost bat	V	E	WN; PMST	1	*	
Nyctophilus corbeni	Corben's long-eared bat	V	V	PMST	-	-	
Ornithorhynchus anatinus	Platypus	NL	SL	WN	4	3.8 km	
Petauroides volans	Greater glider (southern and central)	E	E	PMST	-	-	
Phascolarctos cinereus	Koala	E	E	WN; PMST	5	5.3 km	
Pteropus poliocephalus	Grey-headed flying-fox	V	LC	WN; PMST	3	9.22 km	✓
Reptiles							
Acanthophis antarcticus	Common death adder	NL	V	WN	1	770 m	
Delma torquata	Collared delma	V	V	PMST	-	-	✓
Denisonia maculata	Ornamental snake	V	V	WN; PMST	11	10.0 km	✓
Egernia rugosa	Yakka skink	V	V	WN; PMST	3	*	✓
Furina dunmalli	Dunmall's snake	V	V	PMST	-	-	
Hemiaspis damelii	Grey snake	NL	E	WN	7	5.4 km	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed;

WN – WildNet; PMST – Protected Matters Search Tool.

* – location of historical record classified

5.4.1.2 Migratory species

The desktop searches (i.e. PMST, WildNet, Species Profile Search and Biomaps) identified 30 migratory species that have the potential to occur within the desktop search extent (Table 5-7). The PMST and WildNet desktop search results of migratory species are provided in Appendix A and summarised in Table 5-7. Migratory species listed as threatened under the EPBC Act and NC Act have also been included in Table 5-7.

At the time of the EPBC Referral and EPBC approval, migratory species were not identified as controlling provisions.

Table 5-7 Migratory species identified within the desktop search extent

Scientific name	Common name	Status		Source	Records
		EPBC Act	NC Act		
Actitis hypoleucos	Common sandpiper	Mig	SL	PMST	-
Apus pacificus	Fork-tailed swift	Mig	SL	WN; PMST	7
Calidris acuminata	Sharp-tailed sandpiper	Mig	SL	WN; PMST	28
Calidris ferruginea	Curlew sandpiper	CE, Mig	CE	PMST	-
Calidris melanotos	Pectoral sandpiper	Mig	SL	PMST	-
Calonectris leucomelas	Streaked shearwater	Mig	SL	PMST	-
Charadrius dubius	Little ringed plover	Mig	SL	WN	1
Chlidonias leucopterus	White-winged black tern	Mig	SL	WN	2
Cuculus optatus	Oriental cuckoo	Mig	SL	PMST	-
Gallinago hardwickii	Latham's snipe	Mig	SL	WN; PMST	37
Gelochelidon nilotica	Gull-billed tern	Mig	SL	WN	8
Hirundapus caudacutus	White-throated needletail	V, Mig	V	PMST	-
Hydroprogne caspia	Caspian tern	Mig	SL	WN	34
Limosa lapponica	Bar-tailed godwit	Mig	SL	PMST	-
Limosa limosa	Black-tailed godwit	Mig	SL	WN	22
Macronectes giganteus	Southern giant petrel	E, Mig	E	PMST	-
Monarcha melanopsis	Black-faced monarch	Mig	SL	WN; PMST	7
Monarcha trivirgatus	Spectacled monarch	Mig	SL	WN; PMST	5
Myiagra cyanoleuca	Satin flycatcher	Mig	SL	WN; PMST	1
Numenius madagascariensis	Eastern curlew	CE, Mig	E	PMST	-
Numenius minutus	Little curlew	Mig	SL	WN	1
Pandion haliaetus	Osprey	Mig	SL	WN; PMST	9
Plegadis falcinellus	Glossy ibis	Mig	SL	WN	63
Pluvialis fulva	Pacific golden plover	Mig	SL	WN	2
Rhipidura rufifrons	Rufous fantail	Mig	SL	WN; PMST	7
Sternula albifrons	Little tern	Mig	SL	WN	1
Thalassarche impavida	Campbell albatross	V, Mig	SL	PMST	-
Tringa brevipes	Grey-tailed tattler	Mig	SL	WN	1
Tringa nebularia	Common greenshank	Mig	SL	WN; PMST	6
Tringa stagnatilis	Marsh sandpiper	Mig	SL	WN	42

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed;

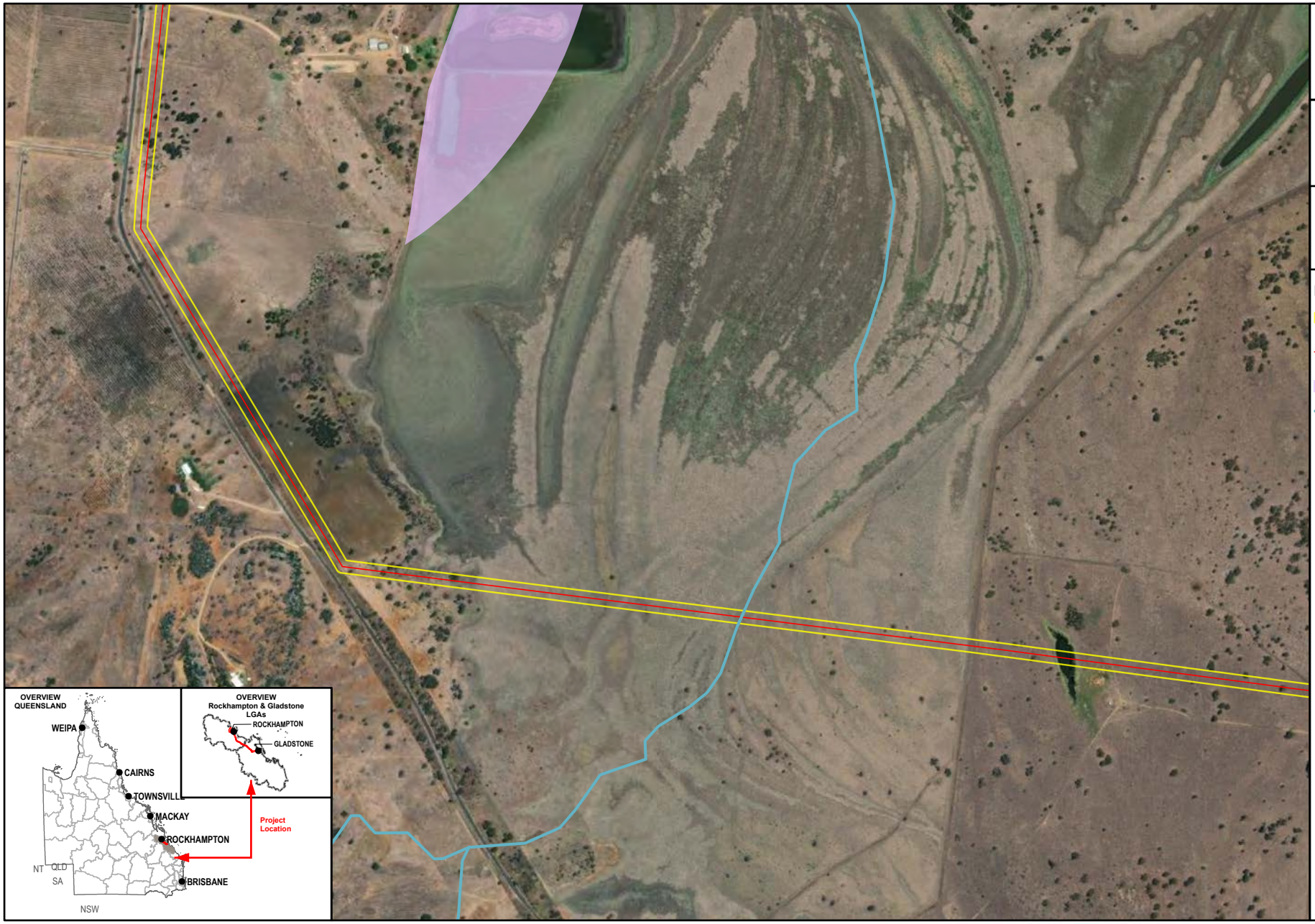
WN – WildNet; PMST – Protected Matters Search Tool.

5.4.1.3 Essential habitat

The Northern Section pipeline alignment intersects two areas of mapped essential habitat for conservation significant species listed under the NC Act. These areas include essential habitat for the ornamental snake (*Denisonia maculata*) and grey snake (*Hemiaspis damelii*) (Figure 5-3).

5.4.1.4 State and regional wildlife corridors

The Northern Section pipeline alignment crosses one regional riparian corridor which follows Lion Creek in a north-east direction, approximately 750 m north of Nine Mile Road (Figure 5-3). The Northern Section pipeline alignment also intersects one state riparian corridor which follows the Fitzroy River in a south-east direction (Figure 5-3).



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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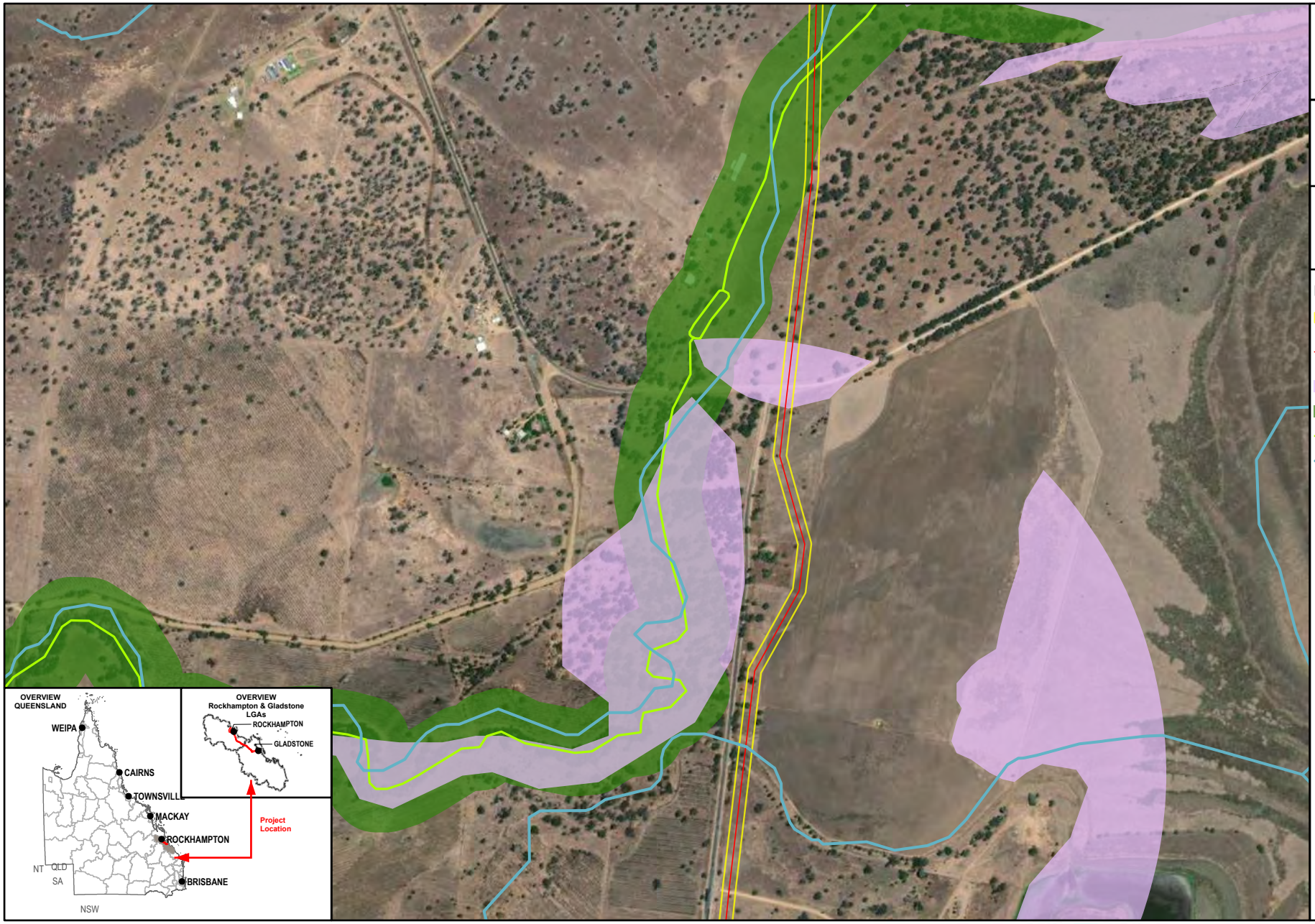
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3a
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Regional Wildlife Corriors
- Riparian Corridor Centrelines
- Waterways

Data Sources:
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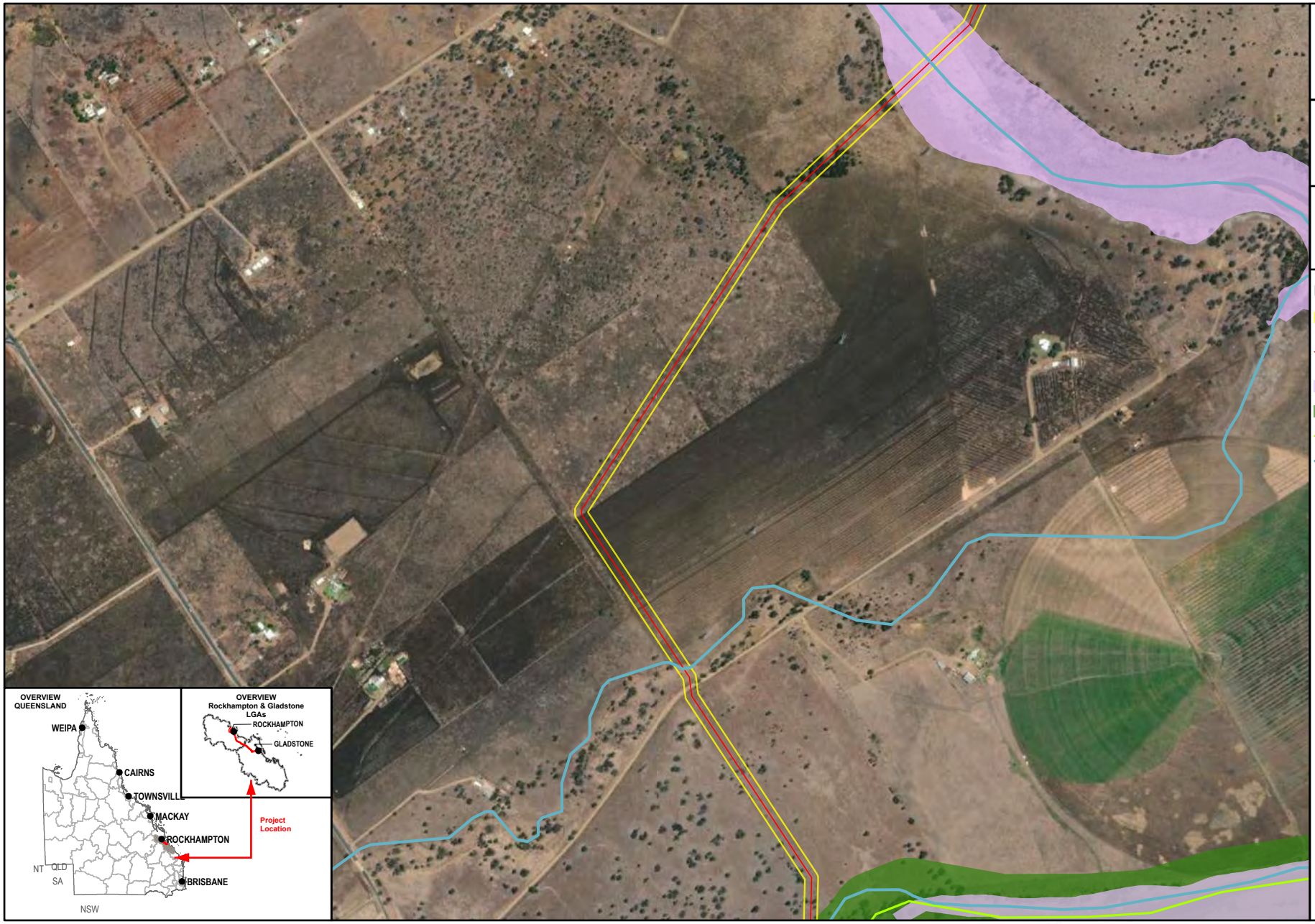
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3b
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Regional Wildlife Corriors
- Riparian Corridor Centrelines
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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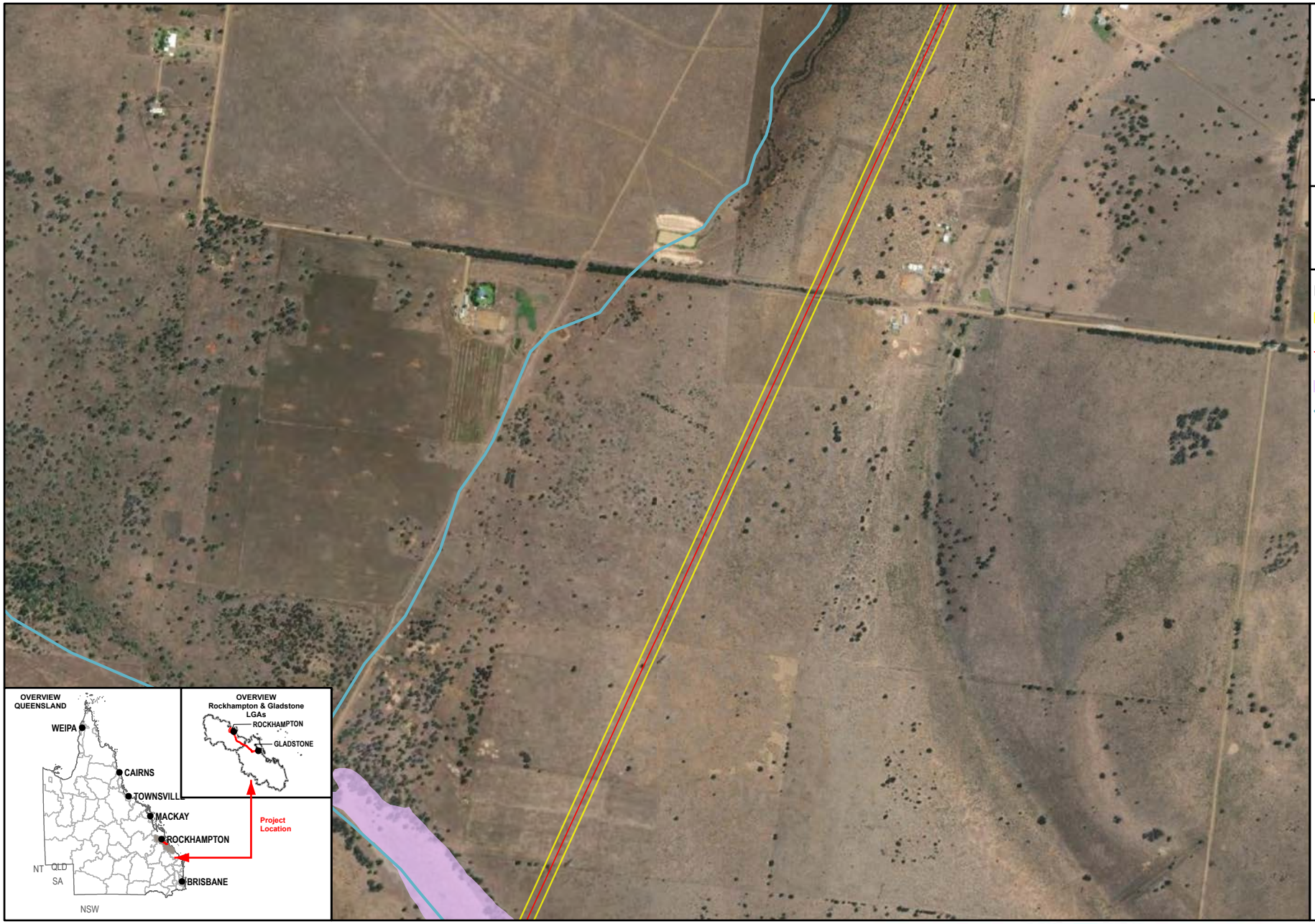
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3c
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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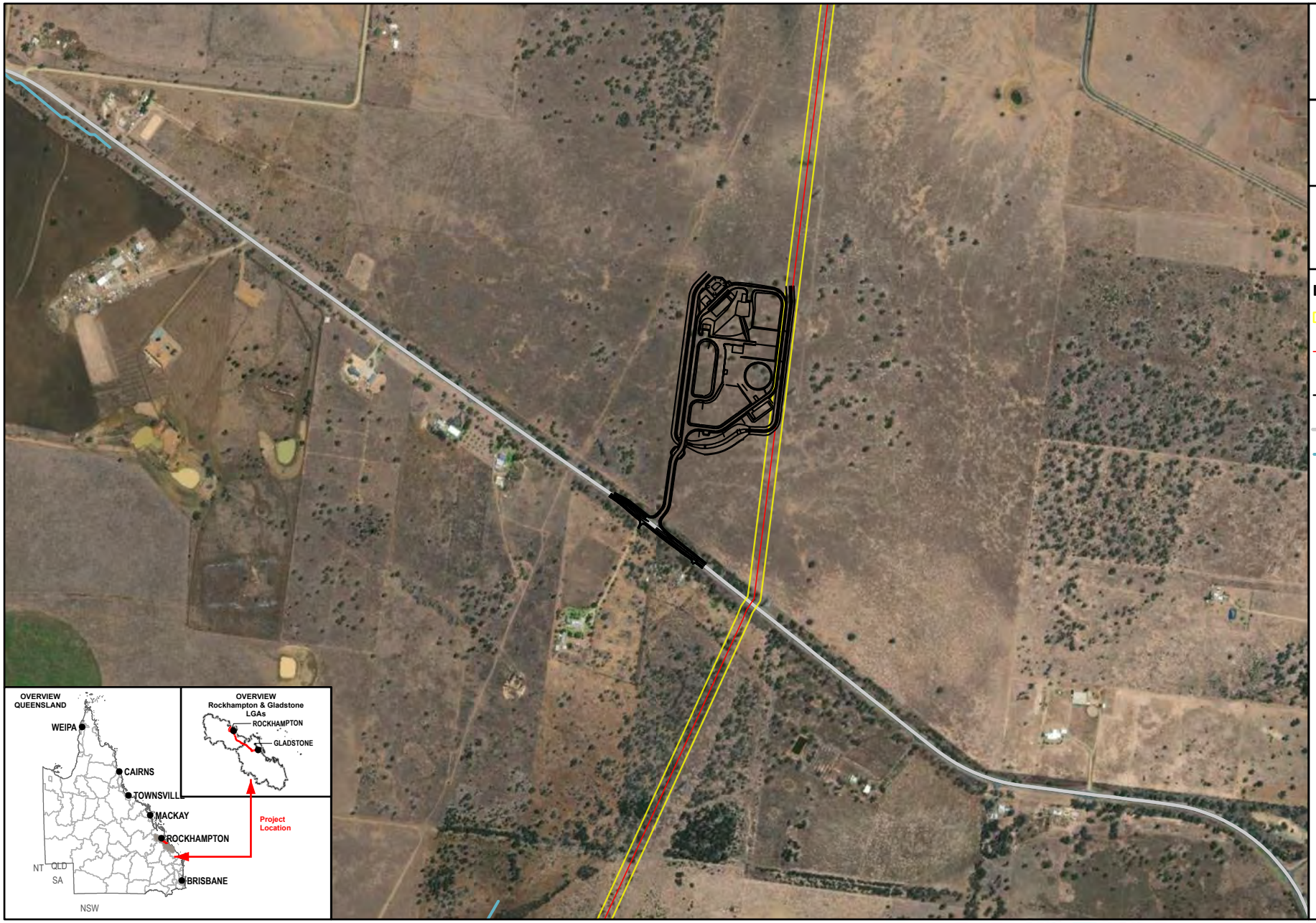
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3d
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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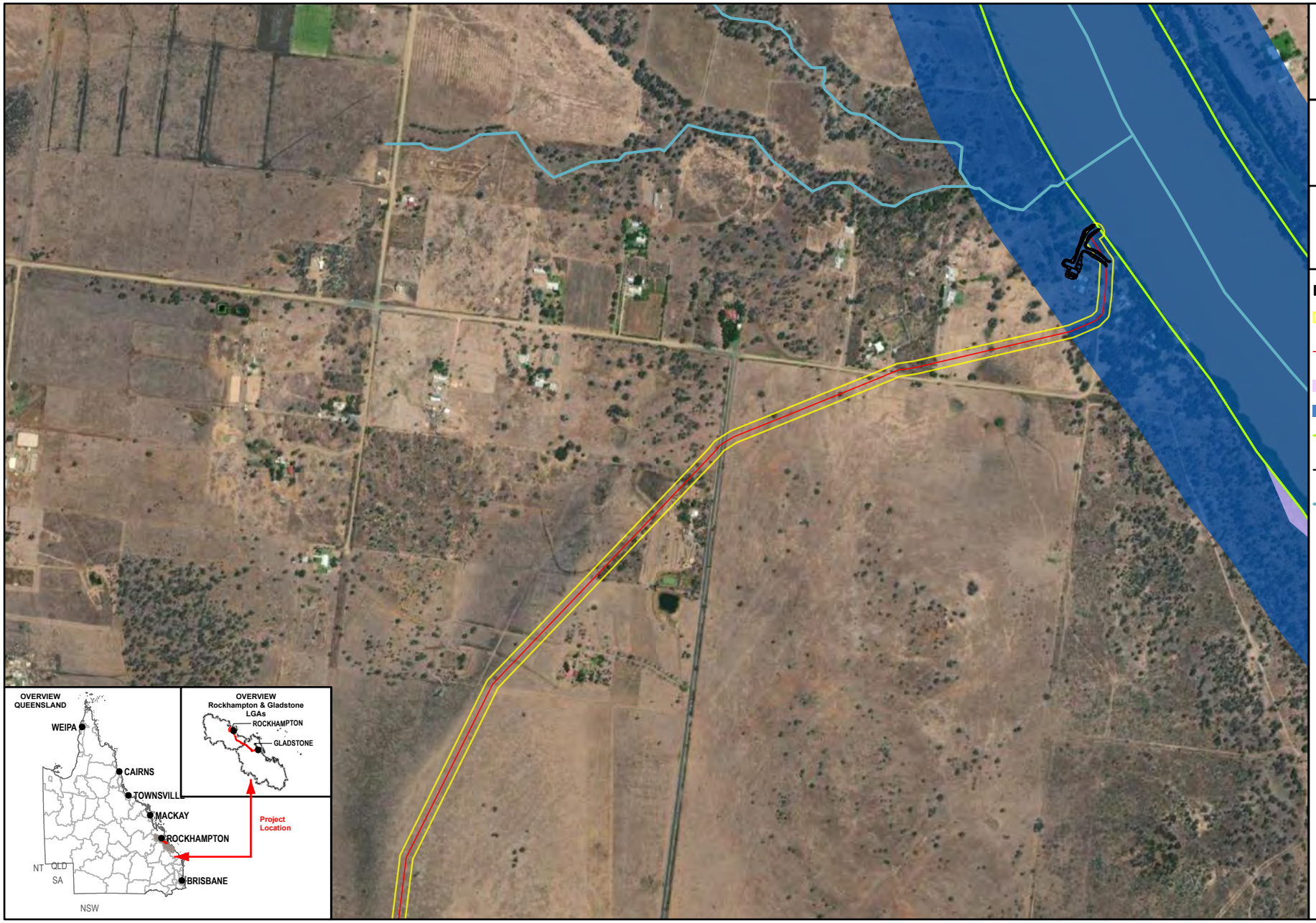
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3e
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- Essential Habitat
- State Wildlife Corriors
- Riparian Corridor Centrelines
- Fitzroy River Intake and Pump Station Layout
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-3f
Essential Habitat and Wildlife Corridors Within the Northern Section Desktop Search Extent
000-G-MAP-2420 Version:3 Date:2022/09/12

5.4.2 Field survey results

5.4.2.1 Terrestrial fauna survey methods

Survey methods undertaken within the Northern Section study area are listed below:

– Habitat assessments
– Bird surveys
– Active searches
– Hollow-bearing tree counts
– Nocturnal searches and spotlighting
– Opportunistic searches.

Details of each survey method is provided in Table 2-5.

5.4.2.2 Terrestrial fauna communities

A total of 51 terrestrial fauna species were recorded during the ecological surveys within the Northern Section study area. This comprised of 38 species of birds, three species of mammals, four species of reptiles and six species of amphibians. A description of each of the fauna groups is provided below. A list of fauna species encountered in the field survey is provided in Appendix H.

Birds

No conservation significant bird species were confirmed present within the Northern Section study area during the 2022 field surveys. The squatter pigeon (southern) (Section 7.3.1.1), white-throated needletail (Section 0) and Australian painted snipe (Section 7.3.1.4) are considered likely to occur.

A total of 38 bird species were recorded during the field surveys within the Northern Section study area. Compared to habitat types present within the GSDA and SGIC SDA study areas, the vegetation within the Northern Section study area was relatively simplistic with notably less woody vegetation. This lack of woodland habitats was reflected by fewer woodland bird species recorded within the Northern Section study area. Woodland associated bird species included the apostlebird (*Struthidea cinerea*), willie wagtail and the rainbow bee-eater.

Open areas provided foraging habitat for raptors including the whistling kite, and nankeen kestrel. Grassland bird specialists including the emu (*Dromaius novaehollandiae*) and golden-headed cisticola, were observed utilising both the native and exotic grassland elements of the landscape. Aquatic bird species were much more abundant within the Northern Section study area. Species such as the Australasian grebe (*Tachybaptus novaehollandiae*), Australian white ibis (*Threskiornis molucca*) and little pied cormorant (*Microcarbo melanoleucos*), were observed frequenting freshwater water bodies and their fringing riparian vegetation.

Mammals

No conservation significant mammal species were recorded within the Northern Section study area during the 2022 field surveys. The koala (Section 7.3.1.3) is considered likely to occur.

A total of three introduced mammal species were recorded within the Northern Section during the field surveys. These included the cat (*Felis catus*), European rabbit and feral pig. No remote cameras or anabat detectors were deployed within the Northern Section study area.

Reptiles

No conservation significant terrestrial reptile species were recorded within the Northern Section during the 2022 field surveys. No conservation significant terrestrial reptiles are considered likely to occur. More information is detailed in the likelihood of occurrence assessment in Appendix E.

Four reptile species were identified within the Northern Section study area. Reptile species recorded during the field surveys included dubious dtella, Bynoe's gecko, eastern bearded dragon and keelback *(Tropidonophis mairii*). Species observations were not recorded within the highly disturbed areas, with increased records sighted within woodland and riparian habitats.

Amphibians

No conservation significant frog species were recorded within the Northern Section during the 2022 field surveys. No conservation significant frogs are considered likely to occur.

A total of six amphibian species were recorded within the Northern Section study area during the field surveys. Amphibian species were almost exclusively recorded within fringing riparian vegetation and freshwater waterbodies. Species observed included the ornate burrowing frog (*Platyplectrum ornatum*), the cane toad, desert tree frog, green-striped burrowing frog (*Cyclorana alboguttata*), spotted marsh frog (*Limnodynastes tasmaniensis*) and green tree frog.

5.4.2.3 Conservation significant fauna species

No conservation significant fauna species were confirmed present during 2022 and Arup (2008) field surveys in the Northern Section study area. Survey effort undertaken for threatened fauna species within the study area is outlined in Table 2-6.

5.4.2.4 Essential habitat

Based on the field verified REs within the Northern Section study area, the mapped essential habitat for conservation significant species, identified in Section 5.4.1.3, did not change.

5.4.2.5 Habitat types

Historically, the landscape has been impacted by decades of disturbance from cattle grazing, vegetation clearing and intrusion by invasive weeds. These processes have altered local ecosystem composition and processes, reducing in places the density of native vegetation including eucalypts, and habitat for threatened species. Despite this, sizeable remnants of natural habitat have been retained.

Four broad habitat types were identified within the Northern Section during the field survey, including:

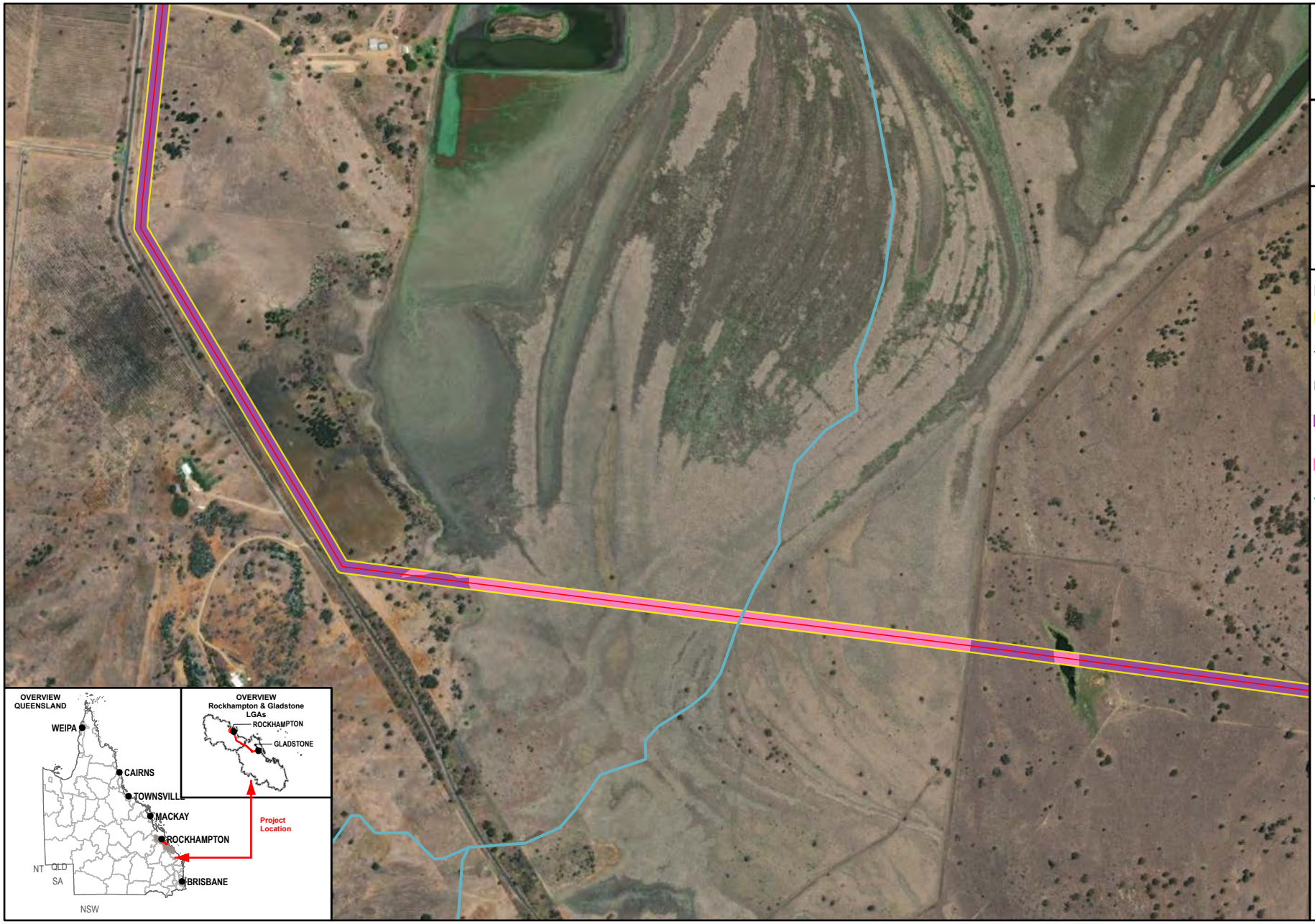
– Regrowth and scattered *Eucalyptus/Corymbia/Acacia* trees
– Freshwater waterbodies and seasonal wetlands
– Fringing riparian vegetation
– Cleared and highly modified landscapes.

Broad habitat types were defined and broadly mapped throughout the study area based on habitat assessments, DoR and field verified RE mapping, and aerial imagery. These habitat types were validated, and mapping refined, through the ecological field surveys. A representative photograph and description of each of these habitat types are provided in Table 5-8, together with identification of which habitat types provide potential habitat for fauna that are MNES and MSES. Habitat types identified within the study area are mapped in Figure 5-4.

Table 5-8 Habitat types recorded within the Northern Section study area

Habitat type	General characteristics and ecological values
Regrowth and scattered *Eucalyptus/Corymbia/Acacia* trees 	– Characterised by low to moderate density of mature and regrowth vegetation and is dominated by introduced pasture grasses. – Eucalypts provide blossoms and nesting opportunities for honeyeaters, and foraging habitat for flying-foxes. – Variety of koala food trees present, including *Eucalyptus tereticornis*, *E. populnea* and *E. crebra*. – Few hollow-bearing trees present. – Arboreal termite mounds with an excavated hole provide suitable nesting sites for bird species, including the laughing kookaburra, blue-winged kookaburra and forest kingfisher. – Shrub layer was very sparse, consisting of various shrub species and juvenile canopy species. The shrub layer that does exist provides some nesting and foraging resources for shrub-nesting birds such as finches. – Ground-level microhabitats (e.g. logs, woody debris, leaf litter) was very sparse. These microhabitats provide shelter and foraging microhabitat for ground-dwelling mammals and reptiles. – Ground cover was relatively dense with a mixture of introduced grasses herbaceous weeds. Grasses provide food resources for some granivorous birds and herbivorous mammals. – Small, isolated patches of *Casuarina cristata* occurred within the landscape.
	MNES and MSES species: – Potential foraging habitat for the squatter pigeon (southern) within 1 km (for breeding) and 3 km (for foraging) of a suitable, permanent or seasonal waterbody. – Potential foraging habitat for the koala.
Freshwater waterbodies and seasonal wetlands 	– Permanent to semi-permanent waterbodies (i.e. wetlands) provide foraging, breeding and nesting habitat for a range of waterbirds, such as the plumed whistling duck (*Dendrocygna eytoni*), Australian pelican (*Pelecanus conspicillatus*) and white-faced heron (*Egretta novaehollandiae*). – Within the context of the local environment, permanent waterbodies provide an important reliable source of drinking water for birds, macropods, reptiles and amphibians. These features are particularly important during times of drought. – Waterbodies support local food webs. A local abundance of invertebrates provides prey items for microbats and amphibians. In turn, these attract predators including snakes, waterbirds, and raptors. – Canopy and/or shrub layer was either very sparse or absent. – Wetlands contained dense sedges, rushes and grasses, as well as dead stags within small (<10 cm) hollows, ground logs and woody debris. – Low density of deep cracking clays present.
	MNES and MSES species: – Potential foraging habitat for the Australian painted-snipe and migratory bird species. – Potential foraging habitat for the squatter pigeon (southern).

Habitat type	General characteristics and ecological values
Fringing riparian vegetation 	– Fringing riparian vegetation along the banks of the Fitzroy River was dominated by Melaleuca sp. With associated Eucalyptus camaldulensis. – Eucalyptus and Melaleuca species provide blossoms and nesting opportunities for honeyeaters and parrots, and foraging habitat for flying-foxes. – Low density of small (< 10 cm) tree hollows along the banks of the Fitzroy River. Small hollow-bearing trees provide suitable habitat for microbats, snakes and tree frogs. – Fringing Melaleuca trees is moderately dense providing shelter and nesting habitat for finches, fairy-wrens and other shrub-dwelling birds. – Ground-level microhabitats, including coarse woody debris and dense ground cover, provide shelter and foraging habitat for a variety of reptile and frog species. – An important movement corridor for native mammals, birds, reptiles and amphibians, and are important foraging routes and flyways for microbats. – Important source of drinking water that is utilised by a variety of fauna species for months after the wet season has ended.
	MNES and MSES species: – Potential foraging habitat for the koala. – Potential foraging habitat for the squatter pigeon (southern). – Potential foraging habitat for migratory bird species.
Cleared and highly modified landscapes 	– Characterised by the absence or very low density of canopy and shrub vegetation and is dominated by introduced pasture grasses. – Very low density of koala food trees present (< 1 tree per ha), including *Eucalyptus, Corymbia* and *Acacia* species. – Introduced grass species provide food resources for some grassland birds, and herbivorous mammals such as macropods. – The open landscape provides foraging habitat for raptors and snakes. – Ground-level microhabitats have been historically cleared and lack structural complexity. – In most areas, the ground-layer has been heavily altered by cattle grazing and trampling, and intensive cultivation. These alterations have reduced the presence of suitable microhabitats for a range of fauna species.
	MNES and MSES species: – No suitable habitat for conservation significant fauna species.



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- Study Area
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Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Freshwater Waterbodies and Seasonal Wetlands
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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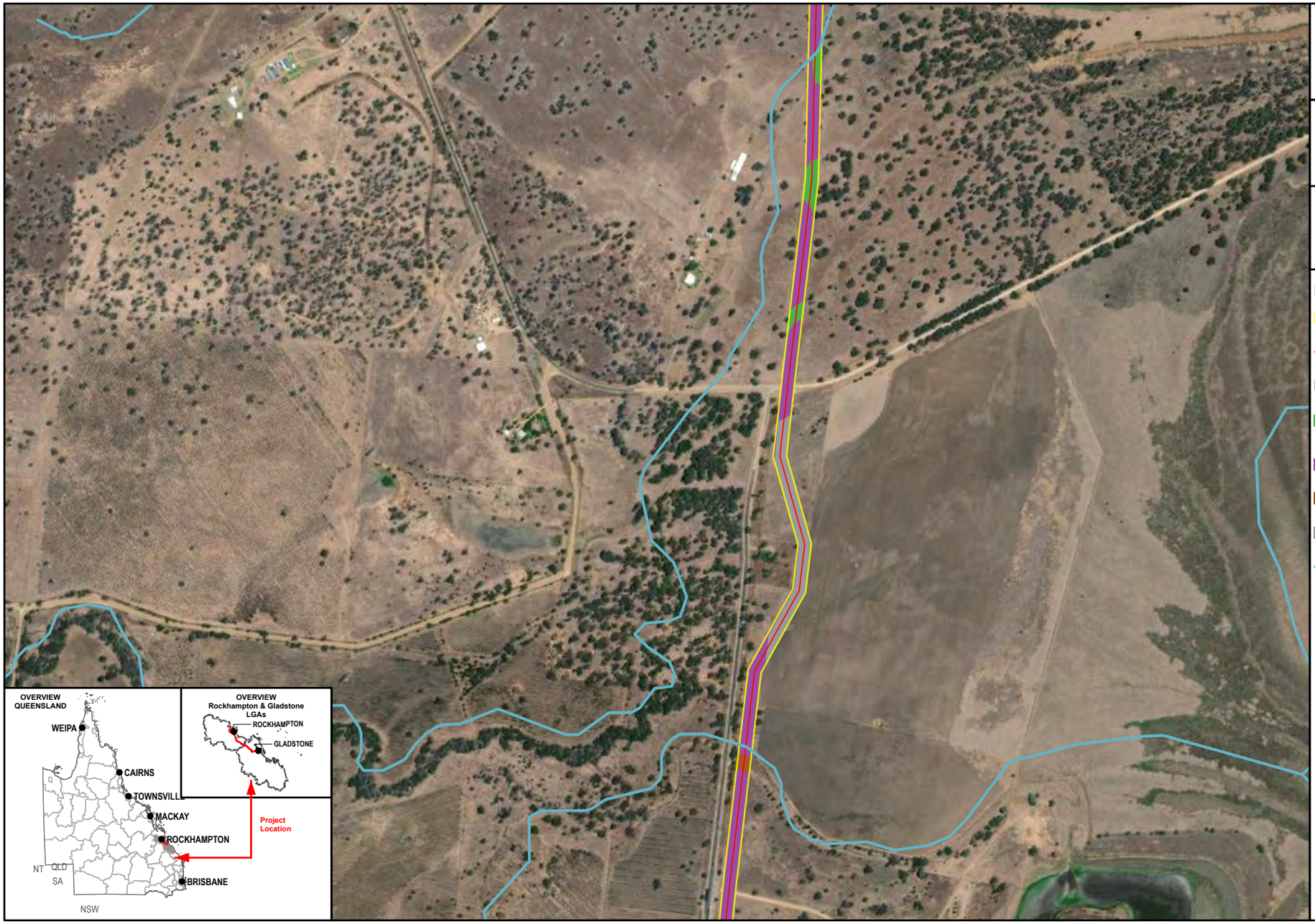
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-4a
Habitat Types Identified Within the Northern Section Study Area
000-G-MAP-2421 Version:3 Date:2022/09/12



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Habitat Type

- Mixed Eucalyptus/Corymbia Woodland
- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Cleared and Highly Modified Landscapes
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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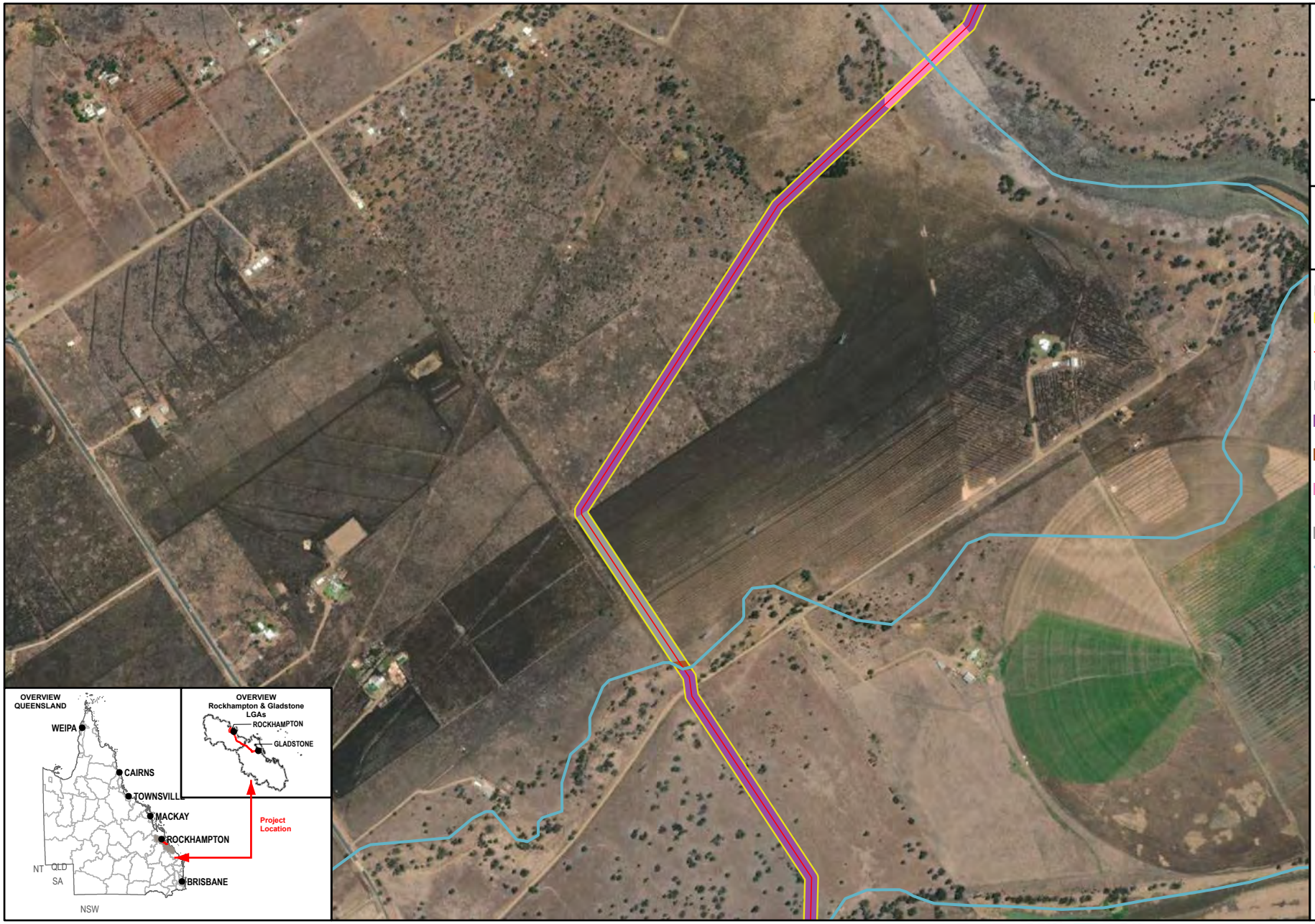

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Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Waterways

Data Sources:
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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-4c
Habitat Types Identified Within the Northern Section Study Area
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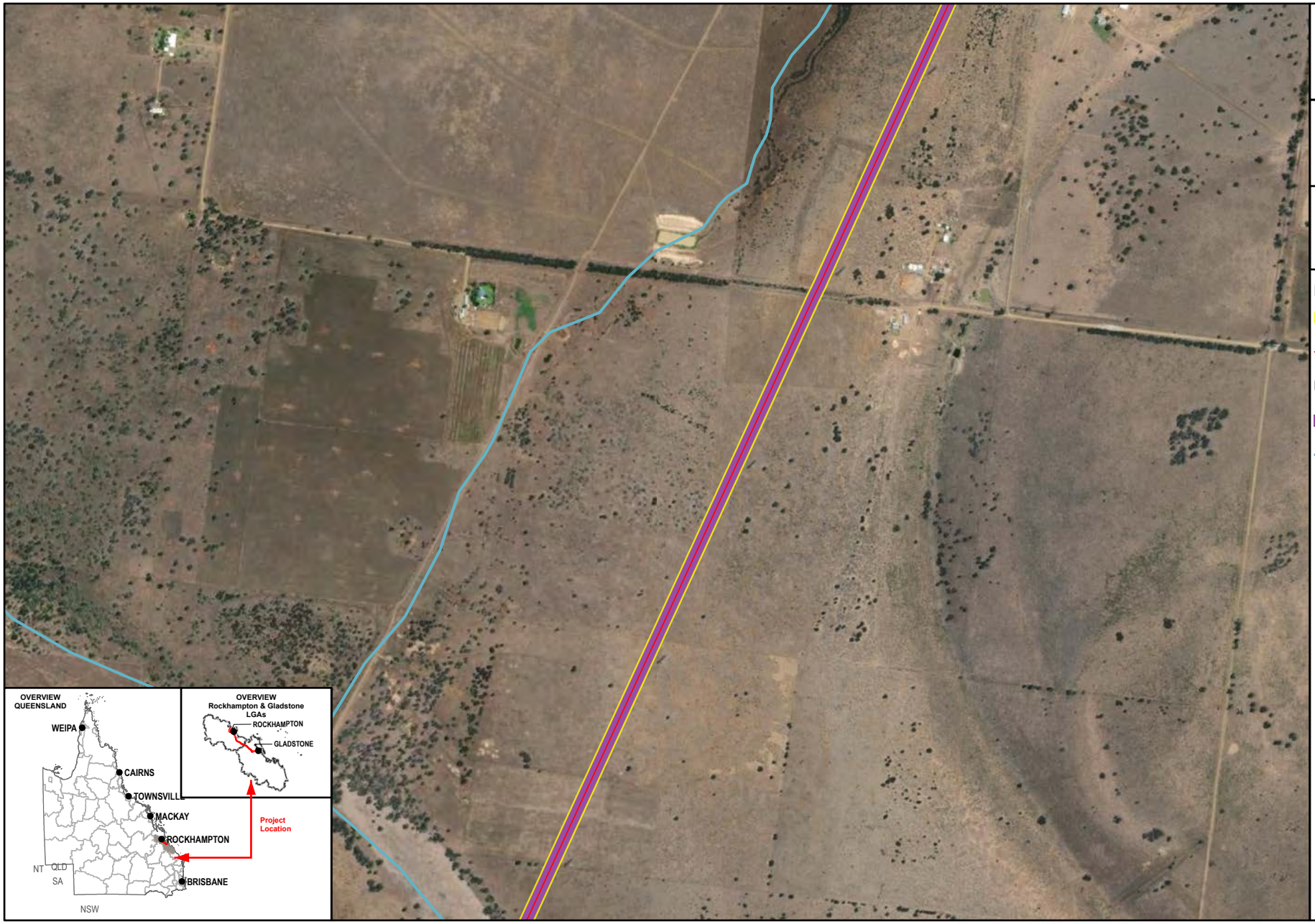

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- Study Area
- Northern Section Pipeline Alignment

Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Waterways

Data Sources:
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Figure 5-4d
Habitat Types Identified Within the Northern Section Study Area

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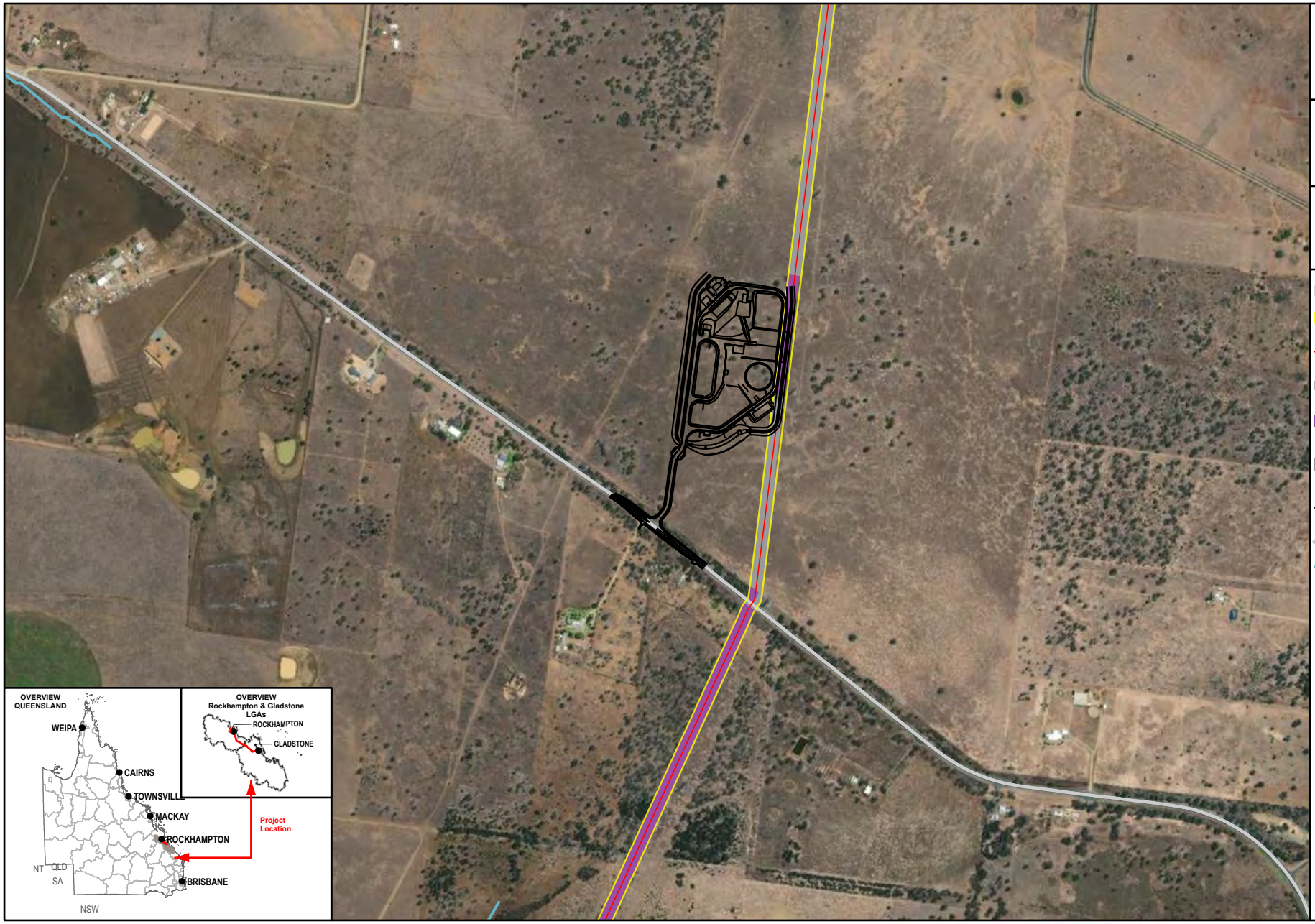

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Legend

- Study Area
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Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Cleared and Highly Modified Landscapes
- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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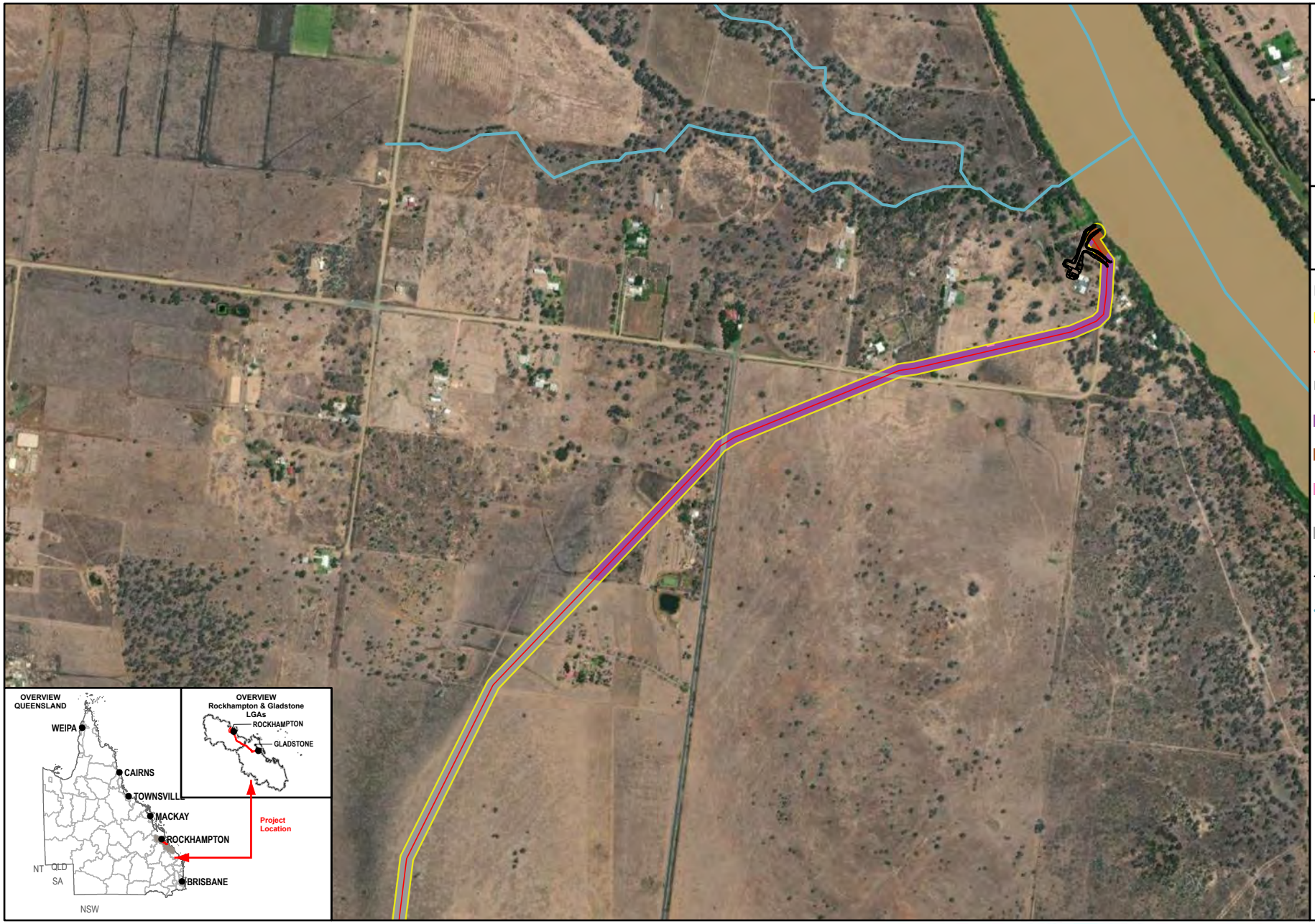

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- Study Area
- Northern Section Pipeline Alignment

Habitat Type

- Regrowth and/or scattered Eucalyptus/Corymbia/Acacia Trees
- Fringing Riparian Vegetation
- Freshwater Waterbodies and Seasonal Wetlands
- Cleared and Highly Modified Landscapes
- Fitzroy River Intake and Pump Station Layout
- Waterways

Data Sources:
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Figure 5-4f

Habitat Types Identified Within the Northern Section Study Area

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5.5 Biosecurity matters

5.5.1 Field survey results

5.5.1.1 Introduced flora species

Weed species were commonly observed throughout the study area. WoNS and restricted invasive weeds (listed under the Biosecurity Act) recorded in the Northern Section study area are listed in Table 5-9. All restricted invasive plants recorded are Category 3 restricted matters.

Table 5-9 Introduced flora species recorded within the Northern Section study area

Species name	Common name	WoNS	State declaration Biosecurity Act
Parthenium hysterophorus	Parthenium	X	Category 3
Lantana camara	Lantana	X	Category 3
Opuntia stricta	Common pest pear	X	Category 3
Opuntia tomentosa	Velvet tree pear	X	Category 3
Sporobolus pyramidalis	Giant rat's tail grass		Category 3
Cryptostegia grandiflora	Rubber vine	X	Category 3
Harrisia martinii	Harrisia cactus		Category 3
Parkinsonia aculeata	Parkinsonia	X	Category 3
Cardiospermum grandiflorum	Balloon vine		Category 3
Hymenachne amplexicaulis	Hymenachne		Category 3
Eichhornia crassipes syn. Pontederia crassipes	Water hyacinth	X	Category 3
Lantana montevidensis	Creeping lantana		Category 3

5.5.1.2 Introduced fauna species

Four introduced fauna species were identified within the Northern Section study area (Table 5-10), including three mammal species declared as restricted invasive animals under the Queensland's *Biosecurity Act 2014* (DAF 2017).

Table 5-10 Introduced fauna species recorded within the Northern Section study area

Species name	Common name	State declaration Biosecurity Act
Oryctolagus cuniculus	European rabbit	Category 3, 4 and 6
Rhinella marina	Cane toad	-
Felis catus	Cat	Category 3, 4 and 6
Sus scrofa	Feral pig	Category 3, 4 and 6

5.6 Aquatic environment

5.6.1 Desktop assessment results

5.6.1.1 Threatened aquatic species

The EPBC Act PMST database identified 10 threatened aquatic species that have the potential to occur within the desktop search extent. State based searches (i.e. WildNet, Species Profile Search and Biomaps) identified two threatened aquatic species that have been historically recorded within the desktop search extent. The white-throated snapping turtle has been recorded within 3 km upstream of the intake structure, while the platypus has been recorded in the Fitzroy River 15 km downstream of the intake structure (ALA 2022). Combined., all searches identified 11 threatened aquatic species within the desktop search extent. This comprised the estuarine crocodile, green sawfish, platypus and eight turtle species, two of which were freshwater species, while the other six species were marine.

The PMST and WildNet desktop search results are provided in Appendix A and summarised in Table 5-11. This table also includes threatened aquatic species that were identified as controlling provisions under the EPBC approval.

Several species identified within the database searches are not expected to be located within study area due to unsuitable habitat conditions. The loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle, olive ridley turtle, flatback turtle, and the green sawfish are all marine species. Although they can also be found in estuarine waters, the Northern Section pipeline alignment and intersections with waterways, are upstream of the tidal areas and with many natural barriers, including the Fitzroy River barrage, preventing movement upstream into the freshwater reaches of the Fitzroy River. Therefore, these species are unlikely to occur within the study area and are therefore excluded from any further assessment within the Northern Section.

Other aquatic species including the Fitzroy River turtle, estuarine crocodile, white-throated snapping turtle, and platypus are likely to occur within the study area and are further discussed below.

Table 5-11 Threatened aquatic species identified within the Northern desktop search extent

Scientific name	Common name	Status		Source	WN Records	Nearest Record to ROW	EPBC Approval
		EPBC Act	NC Act				
Reptiles							
Caretta caretta	Loggerhead turtle	E, Mig	E	PMST		52.0 km	
Chelonia mydas	Green turtle	V, Mig	V	PMST		52.22 km	
Crocodylus porosus	Estuarine crocodile	Mig	V	PMST		12.07 km	
Dermochelys coriacea	Leatherback turtle	E, Mig	E	PMST		52.08 km	
Elseya albagula	White-throated snapping turtle	CE	CR	WN, PMST	1	11.4 km	
Eretmochelys imbricata	Hawksbill turtle	V, Mig	E	PMST		52.86 km	
Lepidochelys olivacea	Olive Ridley turtle	E, Mig	E	PMST		>250 km	
Natator depressus	Flatback turtle	V, Mig	V	PMST		52.20 km	
Rheodytes leukops	Fitzroy River turtle	V	V	PMST		17.67 km	✓

Scientific name	Common name	Status		Source	WN Records	Nearest Record to ROW	EPBC Approval
		EPBC Act	NC Act				
Sharks							
Pristis zijsron	Green sawfish	V, Mig	NL	PMST		>1,000 km	
Mammals							
Ornithorhynchus anatinus	Platypus	NL	SL	WN	4	4.48 km	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; LC – least concern; NL – not listed;

WN – WildNet; PMST – Protected Matters Search Tool.

5.6.1.2 Great Barrier Reef Marine Park

The GBR is listed as a World Heritage Area, National Heritage Property, Marine Park and nationally important wetland. The GBR supports a large number of conservation significant species including marine megafauna, shorebirds, and marine fish species. It contains approximately ten per cent of the coral reef ecosystems in the world and supports an enormous amount of biodiversity.

The Northern Section pipeline alignment is located 71 km upstream of the GBR where the Northern Section pipeline alignment intersects with the Fitzroy River (Figure 5-5). The Northern Section pipeline alignment intersects Lion Creek, 9 km south of the intake structure on the Fitzroy River. Lion Creek flows into the Fitzroy River and subsequently the GBR (Figure 5-5). The Northern Section pipeline alignment with have no direct impacts upon the GBR, and mitigation measures (see Section 6) enacted to minimise potential risks to the GBR.

5.6.1.3 Wetlands

Three Nationally Important Wetlands listed under the Directory of Important Wetlands in Australia are located downstream of the Northern Section pipeline alignment along the coastline at the confluence with the Fitzroy River as outlined in Table 5-12 and shown in Figure 5-5. The Northern Section pipeline alignment intersects one Nationally Important Wetland, the Fitzroy River Floodplain, at two separate locations.

Table 5-12 Nationally Important Wetlands in relation to the Northern Section pipeline alignment

Wetland ID	Wetland name	Location
QLD013	Fitzroy River Floodplain	Intersects with alignment 10 km northwest of Rockhampton and 9.5 km west of Rockhampton
QLD012	Fitzroy River Delta	17 km downstream of the intake structure at Fitzroy River
QLD021	The Narrows	75 km downstream of the intake structure at Fitzroy River
QLD100	Great Barrier Reef Marine Park	67 km downstream of the intake structure at Fitzroy River

The Northern Pipeline intersects two MSES listed wetlands which are mapped as high ecological significance wetlands and wetland protection areas as shown in Figure 5-5. These two wetlands are also listed within the Fitzroy River Floodplain wetland. The pipeline intake structure is located on the Fitzroy River and located adjacent to the Fitzroy River Floodplain. The Northern section pipeline alignment crosses another two waterways nine and 10 km south of the intake structure respectively. All three waterways have MSES listed wetlands downstream of the Northern Section pipeline alignment as shown in Figure 5-5.

There are numerous mapped MSES high ecological significance wetlands further downstream of the Northern Section pipeline alignment within the Fitzroy River Delta, from its most northern point (17 km downstream of the intake structure) to its eastern point at Balaclava Island (Figure 5-5).

5.6.1.4 Waterways and fish habitat

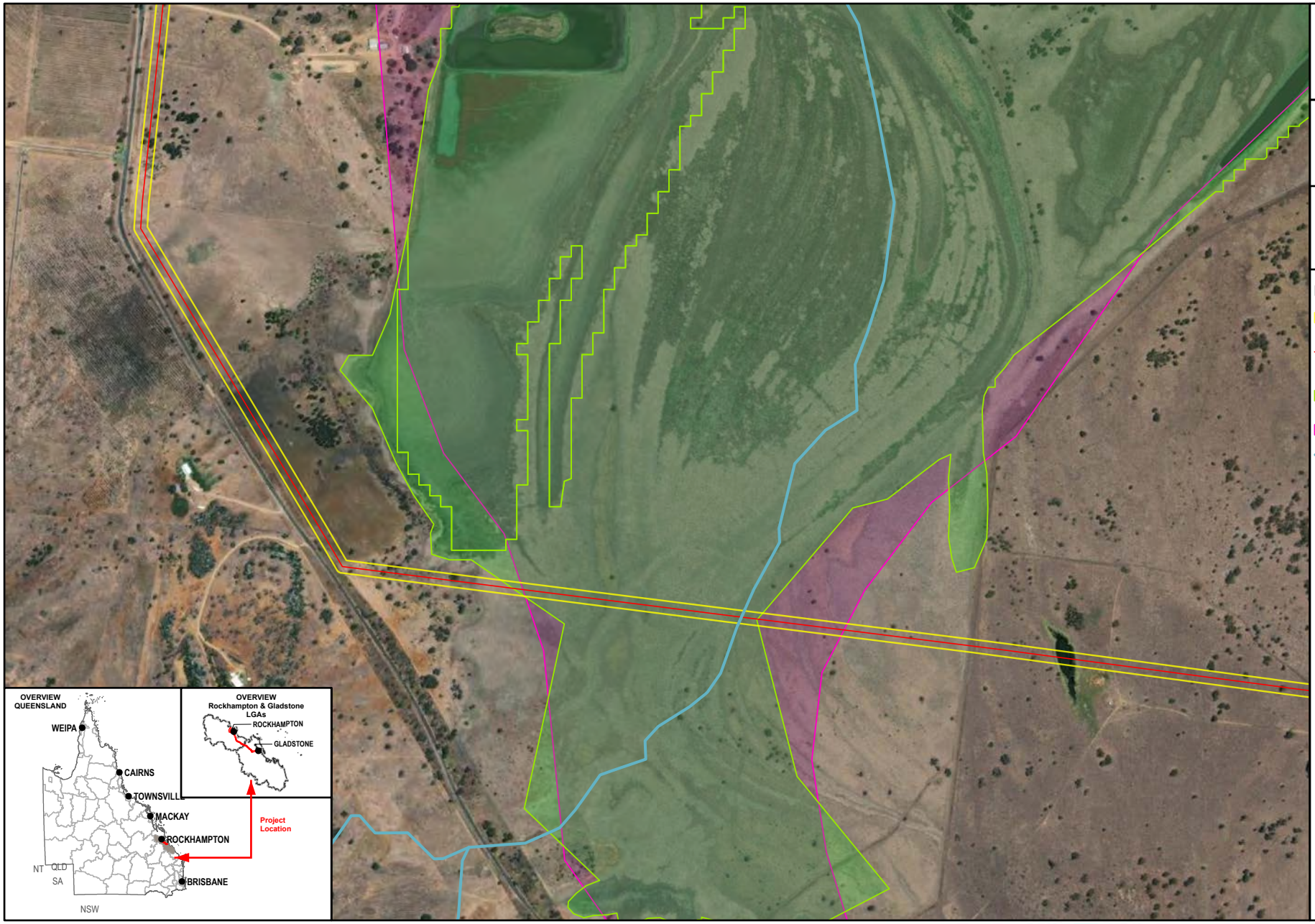
The waterways within the desktop search extent are generally mapped moderate risk (amber) waterways for fish passage under the WWBW spatial layer (Figure 5-6). The Fitzroy River (purple) is mapped as major risk for fish passage and is the location for the intake structure. There is also Lion Creek which is mapped as major risk for fish passage (purple) and four moderate risk (amber) waterways that are intersected by the Northern Section pipeline alignment (Figure 5-6). All waterways mapped within the desktop search extent flow into either the Fitzroy River or Lions Creek. A summary of all waterway crossings is provided in Table 5-13.

The risk ratings assist with the determination of DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), based on the shape and location of the waterway in the catchment, as well as the characteristics of species that reside within them (DAF 2021). Waterways with a rating of major or high-risk to fish passage generally contain larger biomasses of fish populations and contain species that are more likely to have weaker swimming abilities (DAF 2021). Low or moderate risk waterways for fish passage are often in the upper reaches of a catchment and have steeper slopes and would generally have a lower biomass of fish populations than downstream reaches (DAF 2021).

Table 5-13 Summary of all waterway crossings in the Northern Section

Waterway barrier works risk rating	Number of waterways intersected
Purple (major)	2
Amber (moderate)	4

Thirty kilometres downstream of the Northern Section pipeline alignment is a mapped fish habitat area (management A) within the Fitzroy River (Figure 5-6) that extends beyond the mouth of the river.



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- QLD013 Fitzroy River Floodplain
- Waterways

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Figure 5-5a
Mapped Wetlands Within the Northern Section Desktop Search Area
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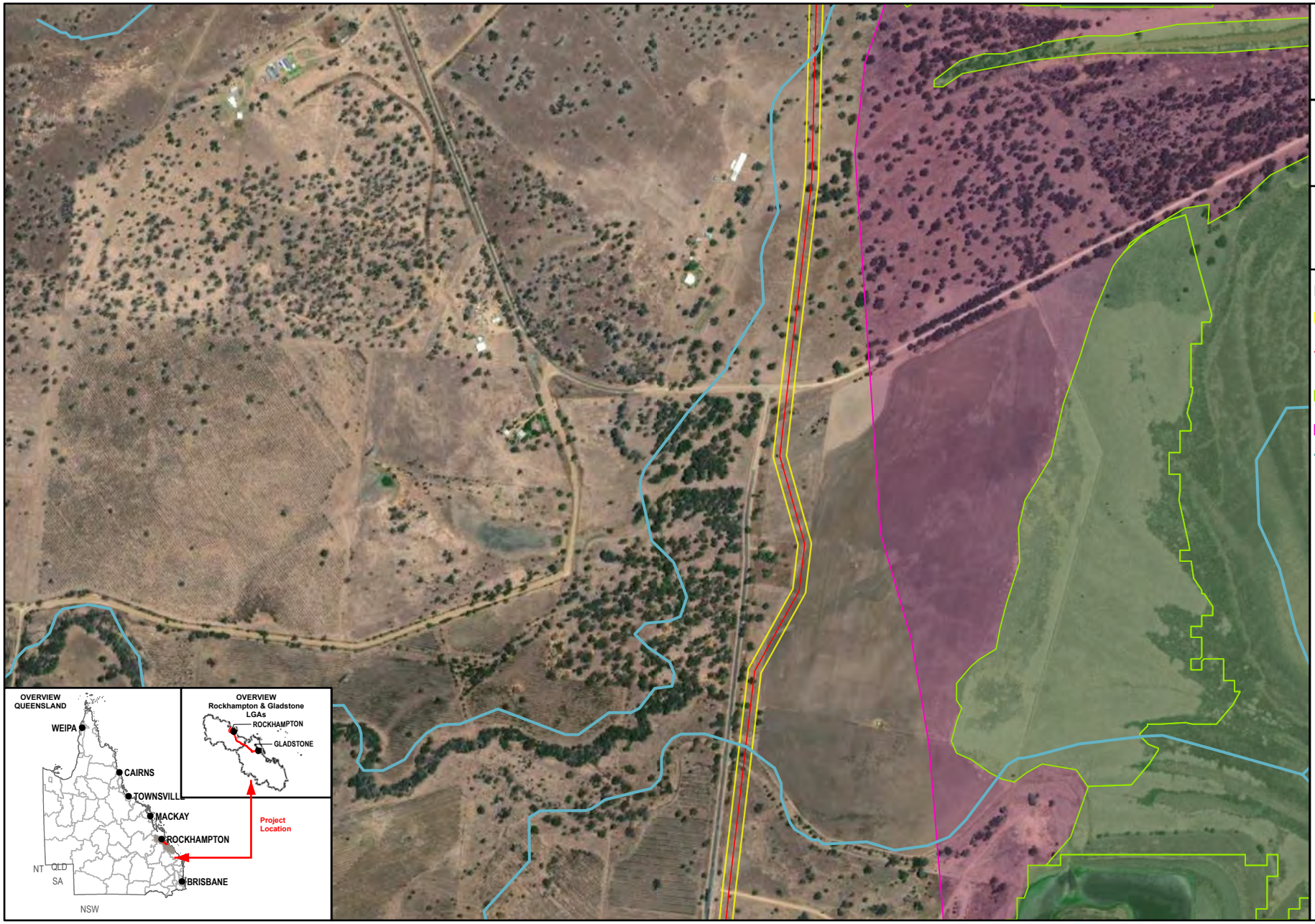

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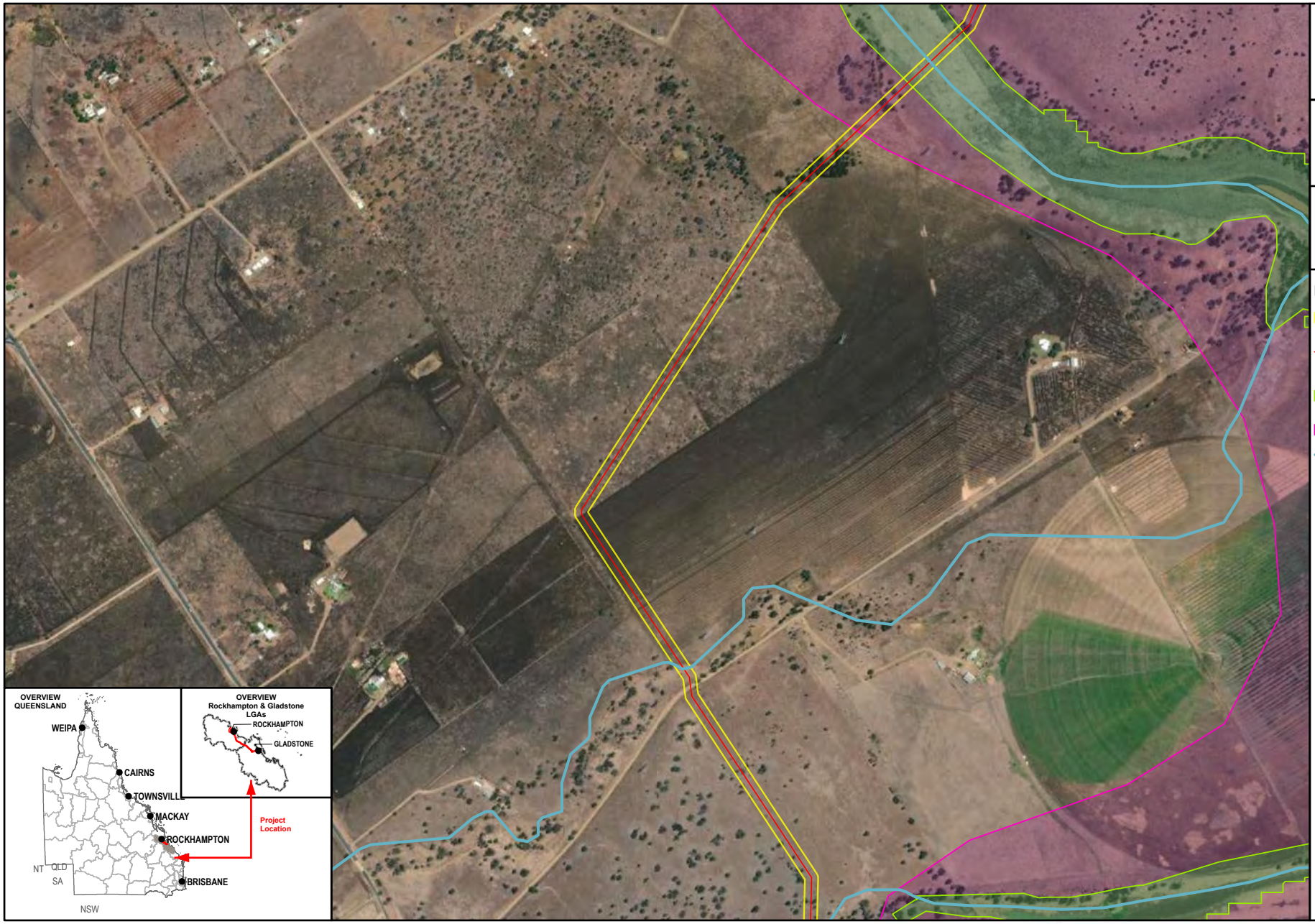

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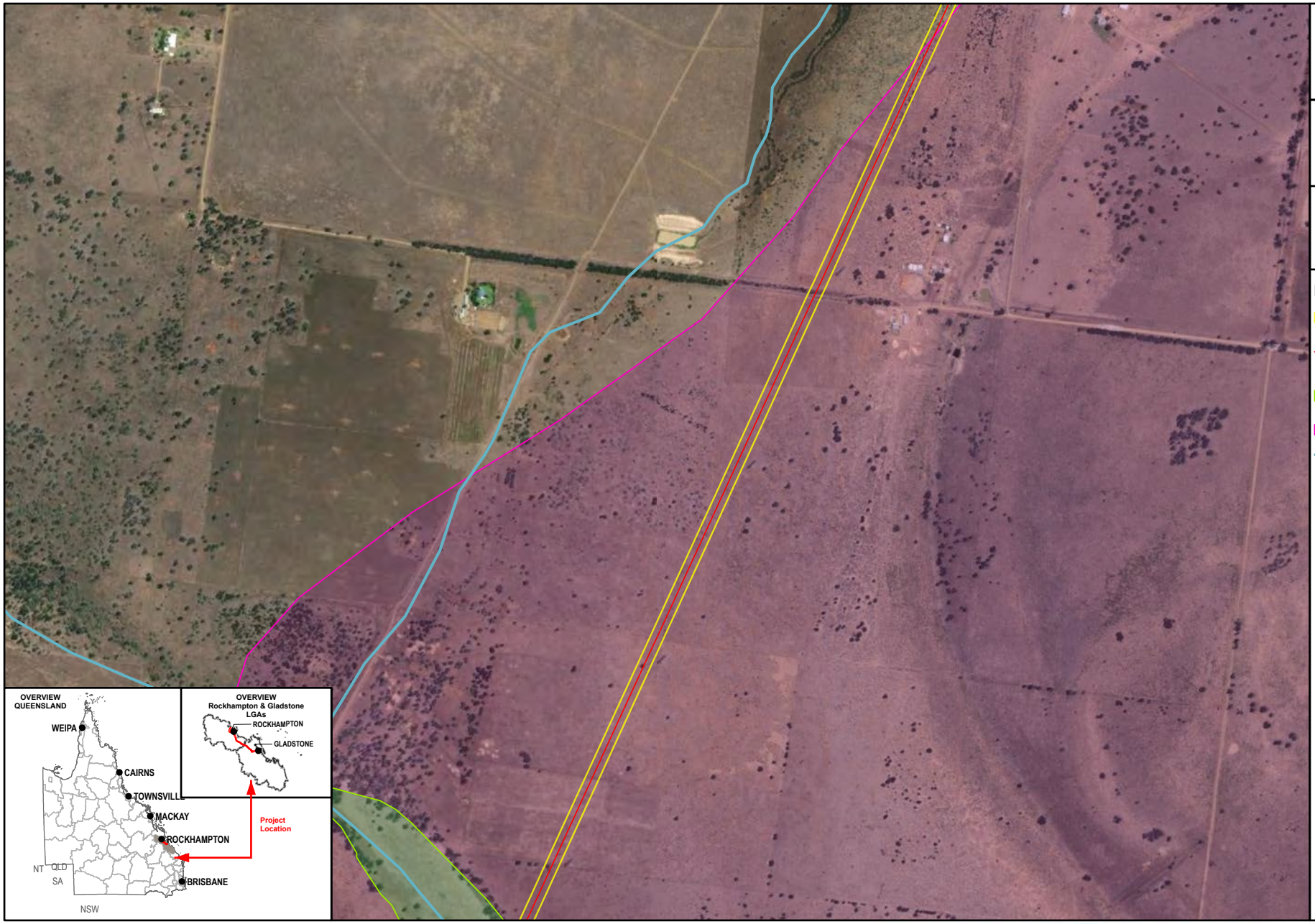

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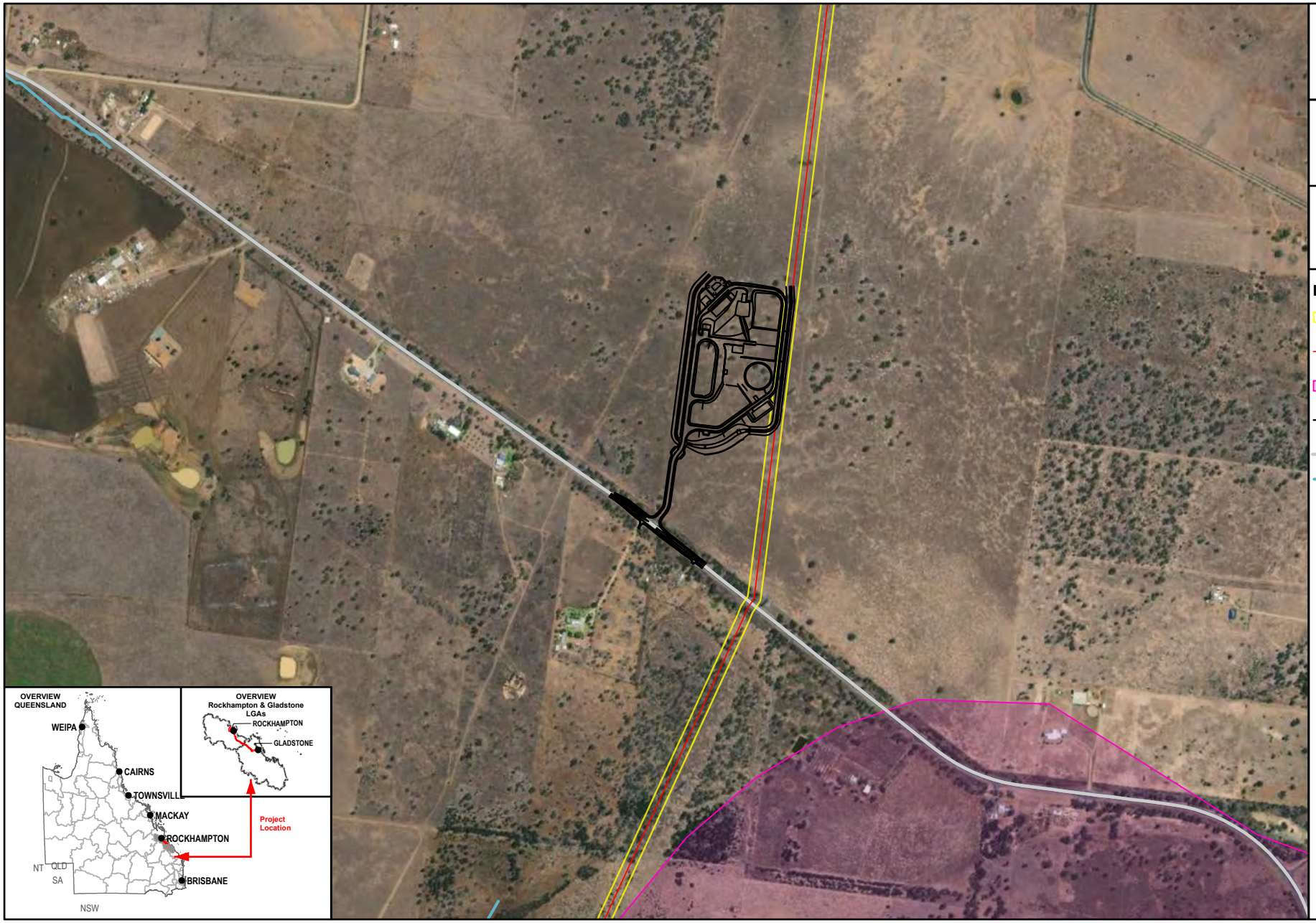
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- QLD013 Fitzroy River Floodplain
- Alton Down WTP, Pump Station and Reservoir Layout
- Main Roads
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
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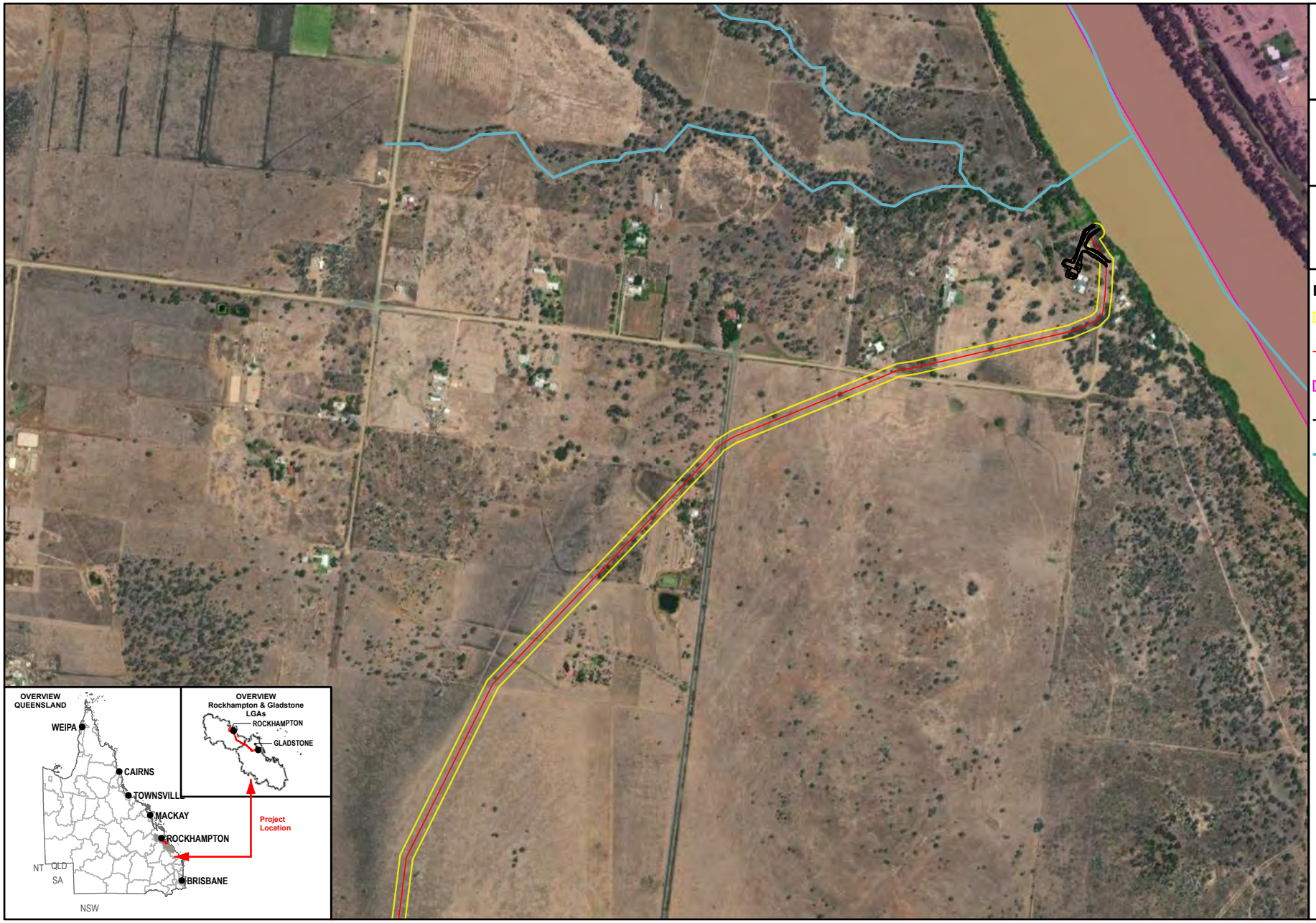
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-5e
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Legend

- Study Area
- Northern Section Pipeline Alignment
- QLD013 Fitzroy River Floodplain
- Fitzroy River Intake and Pump Station Layout
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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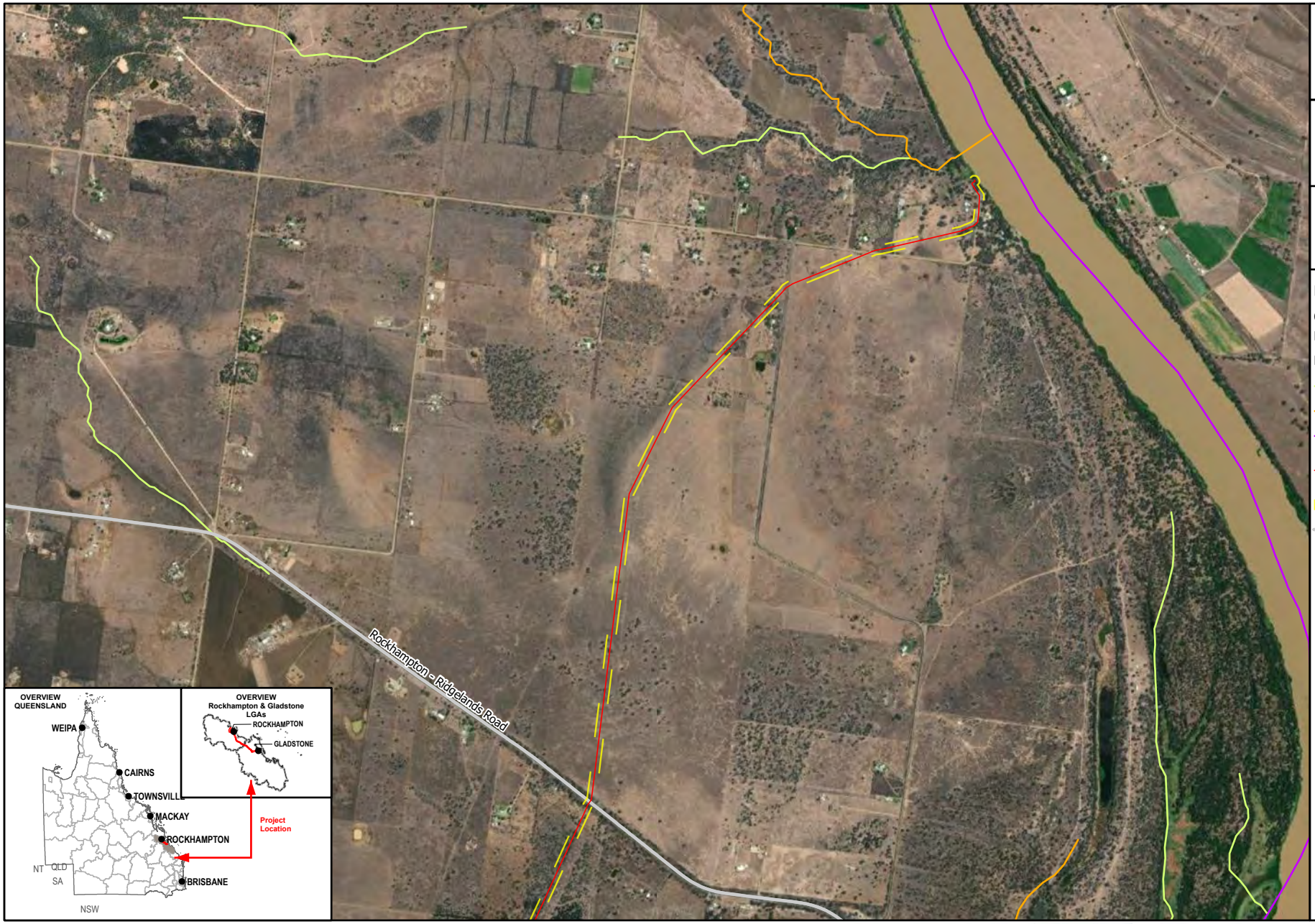
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-5f
Mapped Wetlands Within the Northern Section Desktop Search Area
000-G-MAP-2422 Version:3 Date:2022/09/12



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Queensland Waterways for Waterway Barrier Works

FISH_PASS

- 1 - Low
- 2 - Moderate
- 4 - Major
- Northern Section Pipeline Alignment
- Study Area
- Main Roads

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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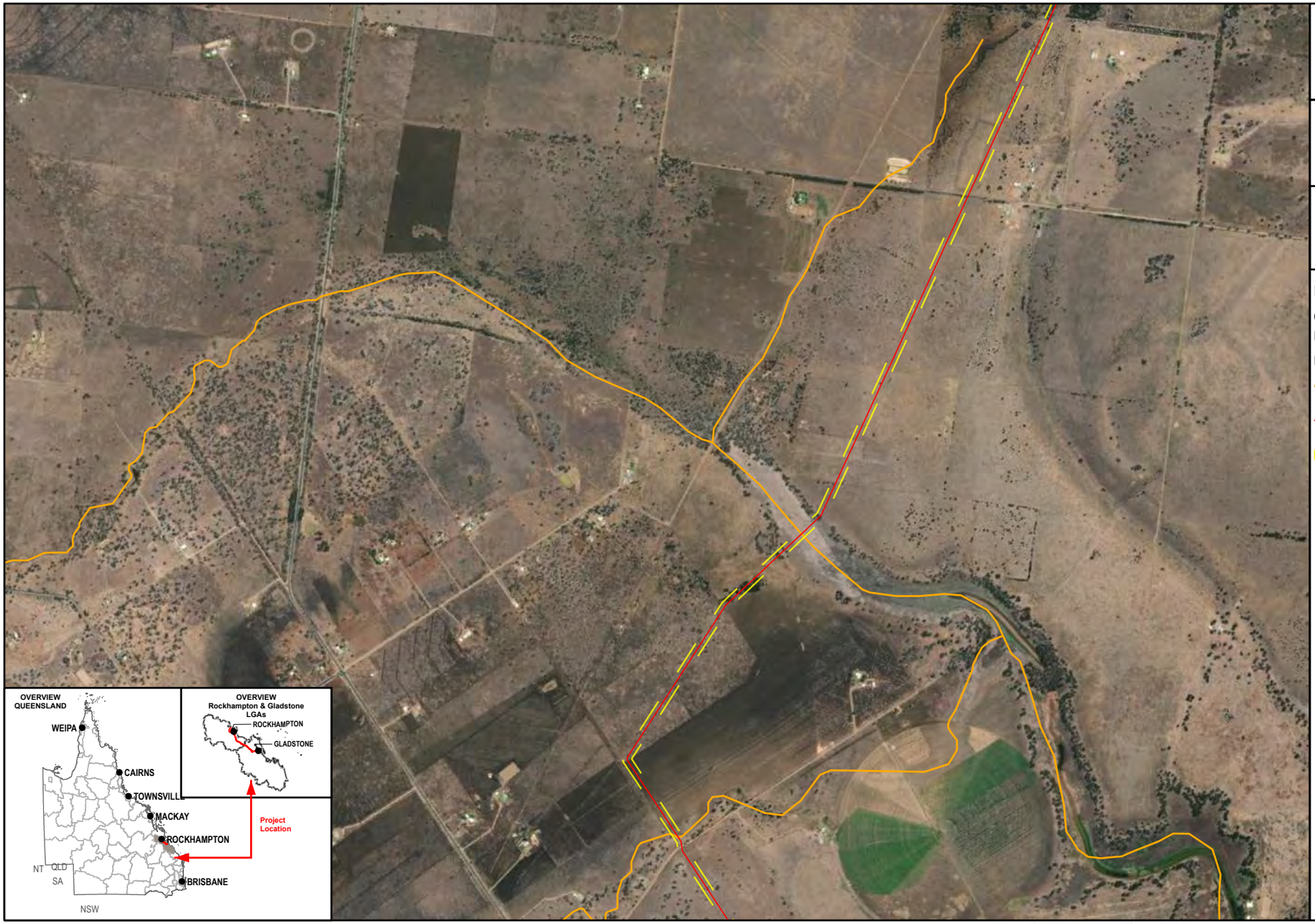
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-6a Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the Northern Section Desktop Search Extent
000-G-MAP-2423 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

FISH_PASS

- 2 - Moderate
- Northern Section Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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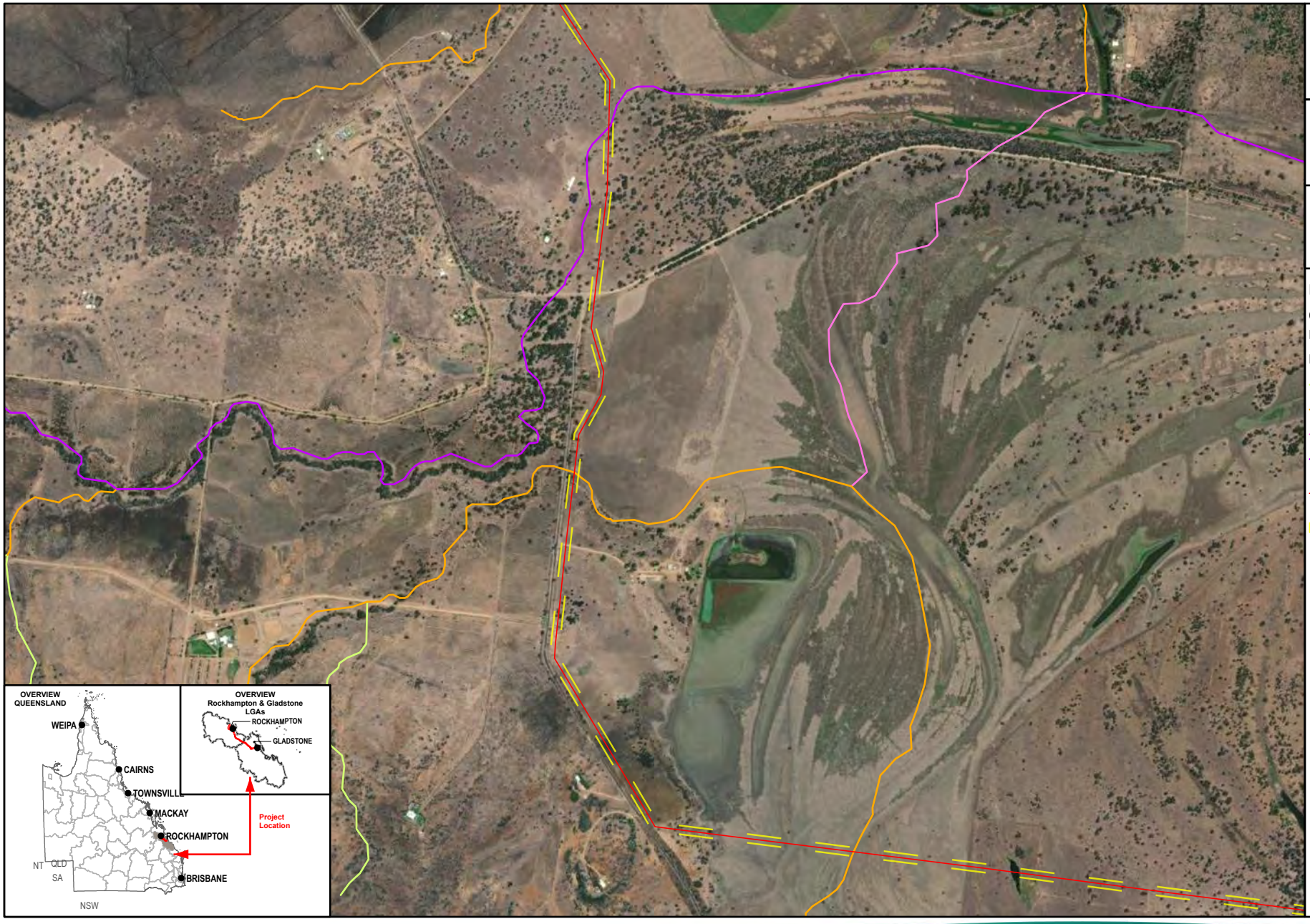
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-6b Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the Northern Section Desktop Search Extent

000-G-MAP-2423 Version:1 Date:7/07/2022



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Queensland Waterways for Waterway Barrier Works

FISH_PASS

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- Northern Section Pipeline Alignment
- Study Area

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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(Datum GDA2020)

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 5-6c Mapped Waterways for Waterway Barrier Works and Fish Habitat Areas Within the Northern Section Desktop Search Extent

000-G-MAP-2423 Version:1 Date:7/07/2022

5.6.2 Field survey results

5.6.2.1 Aquatic habitat

Habitat bioassessment scores were conducted from three riverine sites within the Northern Section (Table 5-14). Habitat bioassessments did not occur at the two high ecological significance (HES) wetland sites (site 31 and site 32) as this assessment is designed for riverine sites and would therefore provide inaccurate assessment of the overall condition of the wetland.

Site 22 is an unnamed creek that flows into Lion Creek and is located 10 km south of the intake structure. The site was assessed as 'fair', with a score of 44. This site performed poorly in the embeddedness, velocity and depth, and riffle/run, run/bend ratio categories due mainly to the small water body present and the lack of flowing water and connectivity within the reach.

The overall condition of the Fitzroy River at site 23, the location of the intake structure, was assessed as 'good', with a score of 75. The site characteristics of bottom substrate and embeddedness consisted of large woody debris and rocky habitats. The riffle/run, run/bend ratio categories were assessed as poor. This reach of the Fitzroy River is a large slow flowing channel with lack of riffles and runs due to the barrage downstream. The banks of the river are well vegetated with large trees, grasses and aquatic macrophytes creating stable banks and streamside cover in excellent condition.

Site 25 is located on Lion Creek and is upstream of Lions Lagoon. The overall condition of site 25 was assessed as 'fair', with a score of 49. This site performed poorly in the bottom substrate, embeddedness, velocity and depth, and riffle/run, run/bend ratio categories due mainly to the absence of surface water within the reach. The channel alteration, bottom scouring and deposition, and the bank stability categories were assessed as in excellent condition.

Site characteristics and ecological values from the habitat assessment for all sites located within the Northern Section as detailed below in Table 5-15. AusRivAS bioassessments are used as a standardised method to monitor and assess the ecological condition of Australian rivers. These bioassessments were only conducted upon riverine sites as they are not relevant to wetland sites.

Table 5-14 Bioassessment scores for sites within the Northern Section

Habitat variable	Scale	Site 22	Site 23	Site 25
Bottom substrate	0-20	6	8	2
Embeddedness	0-20	5	8	2
Velocity and depth category	0-20	1	10	0
Channel alteration	0-15	6	10	13
Bottom scouring and deposition	0-15	7	11	12
Pool/riffle, run/bend ratio	0-15	3	3	0
Bank stability	0-10	5	7	9
Bank vegetation and stability	0-10	6	9	6
Streamside cover	0-10	5	9	5
Totals	**0-135**	**44**	**75**	**49**
Habitat score category		**Fair**	**Good**	**Fair**

Table 5-15 Site characteristics and ec7ological values of sites within the Northern Section

Site	Characteristics	Ecological values
Site 22 – unnamed waterway		
Upstream  Downstream 	– Orange – moderate risk waterway mapped under the WWBW spatial layer. – Water was isolated in a small pool within the main channel. – Channel width was approximately 9 m, with vertical banks on both banks 2.5 m high. – The wetted width of the pool at this location was approximately 4.5 m, and was 17 m long, the maximum depth was approximately 0.3 m. – Land use adjacent to the survey area was subject to cattle grazing. – Adjacent riparian zone had no bare ground and was covered extensively in grass. – Large barrier immediately upstream of the study site. – There was evidence of scouring occurring in the reach from the culvert upstream and moderation erosion of the streambed. – Water within pool was highly turbid. – Bed substrate was primarily silt/clays, with some cobbles, pebbles, and gravel.	– Overall habitat condition rating was poor (44). – Instream habitat consisted of a small pool that contained some small woody debris. – The pool would support some small bodied fish species, for a limited time, with the ephemeral nature of the waterway the pool is likely to dry out during the dry season. – During large flows the pool would provide refuge and habitat for transient fish species. – No aquatic plant species were recorded. – Large culvert upstream of site likely to cause some restriction on aquatic fauna movement. – Site not suitable for white-throated snapping turtle foraging or nesting. – Site not suitable for Fitzroy River turtle foraging or nesting. – Site not suitable for platypus foraging or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.

Site	Characteristics	Ecological values
Site 23 – Fitzroy River		
Upstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – The Fitzroy River at Site 23 consisted meandering channel that was approximately 350 m wide. – Water flow was only very slow at the time of the survey but was above the watermark. – Water clarity was very turbid. – Land use adjacent to the survey area was native forest, national park and cattle grazing. – Bed substrate was stable, with deposition of silt upon the substrate. – The banks on both sides of the river were moderately steep, moderately stable and concave in shape with little erosion. – Riparian vegetation was semi-continuous on both banks with moderate amounts of *Eucalyptus* and *Melaleuca* trees >10 m high, and a moderate amount of grasses.	– Overall habitat condition rating was good (75). – Instream habitat consisted of deep pools, and aquatic macrophytes that consisted of the exotic water hyacinth (*Eichhornia crassipes*) and other grass like species. – The Fitzroy River at this location provides suitable habitat for many fish and turtle species, platypus, as well as estuarine crocodiles. – Optimal foraging habitat for white-throated snapping turtle and likely to occur. Unlikely to support aggregated nesting, however isolated nesting may occur. – Optimal foraging habitat for Fitzroy River turtle and likely to occur. Unlikely to support aggregated nesting, however isolated nesting may occur. – Provides optimal habitat and likely optimal burrowing opportunities for platypi and is therefore likely to occur at this site. – Optimal foraging habitat occurs at this site, as well as sub-optimal breeding habitat for estuarine crocodile and therefore the species is likely to occur at this site.
Downstream 		

Site	Characteristics	Ecological values
Site 25 – Lion Creek, Upstream of Lions Lagoons		
Upstream  Downstream 	– Purple – major risk waterway mapped under the WWBW spatial layer. – The location at the time of survey was dry. – The site was a low-lying area with no defined creek bed or banks. – Land use adjacent to the survey area was predominantly cattle grazing and land clearing. – The substrate was stable, with moderate compaction and comprised entirely of silt/clay. – The bank consisted of material similar to the substrate at the survey site and has a low to flat slope. – Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and in the understorey. – The riparian vegetation was isolated along the banks and semi-continuous with the study location and provided vegetation for cover.	– Overall habitat condition rating was fair (49). – The site was dominated entirely by terrestrial trees and grasses. There was some large and small woody debris present that when inundated by water would provide the site with some habitat and refugia. Overall site not suitable for aquatic species. – Site not suitable for white-throated snapping turtle refuge or nesting. – Site not suitable for Fitzroy River turtle refuge or nesting. – Site not suitable for platypus refuge or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.

Site	Characteristics	Ecological values
Site 31 – unnamed, upstream of Gracemere Lagoon		
Upstream  Downstream 	– Mapped HSE wetland. – The wetland type is described as an open wetland with grass understorey. – The site was dry during the survey with no evidence of recent inundation. – The site is located less than 200 m from the nearest wetland which contained water at the time of survey. – Adjacent land use is predominantly used for cattle grazing. – No native aquatic plant species was present. – The site had a high proportion of weeds present, including *Parthenium hysterophorus*. – Tall trees were rare, all were eucalypts. – The banks were stable with little signs of erosion, similarly to the substrate.	– The site was dominated entirely by grasses. There was some large and small woody debris present that when inundated by water would provide the site with some habitat and refugia. Overall, with the absence of surface waters the site is not suitable for aquatic species. – Site not suitable for white-throated snapping turtle refuge or nesting. – Site not suitable for Fitzroy River turtle refuge or nesting. – Site not suitable for platypus refuge or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.

Site	Characteristics	Ecological values
Site 32 – Lion Lagoon		
Upstream 	– Mapped HSE wetland. – The site was dry during the survey with no evidence of recent inundation. – The wetland type is described as an open wetland with grass understorey. – The site is located less than 200 m from the nearest wetland which contained water during the time of survey. – Adjadent land use is predominantly used for cattle grazing. – Native aquatic species included *Eleocharis* sp., *Persicaria attenuate*, *Cyperus difformis*, *Ludwigia peploides*, and nardoo. – Exotic aquatic plant species present included *Eichhornia crassipes*. – The site had grass weeds present, including *Parthenium hysterophorus*. – Tall and medium sized trees were frequent, all were eucalypts. – The banks were stable with little signs of erosion, similarly to the substrate.	– The site was dominated entirely by grasses. There was some large and small woody debris present that when inundated by water would provide the site with some habitat and refugia. Overall, with the absence of surface waters the site is not suitable for aquatic species. – Site not suitable for white-throated snapping turtle refuge or nesting. – Site not suitable for Fitzroy River turtle refuge or nesting. – Site not suitable for platypus refuge or borrowing opportunities. – Site not suitable for estuarine crocodile refuge or nesting.
Downstream 		

5.6.2.2 Physico-chemical water quality

No *in-situ* water quality samples were able to be obtained at Site 23 for safety reasons associated with the potential presence of estuarine crocodiles. The pool at site 22 was too shallow to obtain reliable measurements of water quality. The remaining locations, sites 25, 31, and 32, had no surface water present and, therefore unable to obtain samples.

5.6.2.3 Aquatic flora

There were no threatened aquatic flora species confirmed present or predicted to occur within the study area. Details of the aquatic species present during the survey is in Table 5-15.

5.6.2.4 Freshwater fishes

A total of 34 native and three pest freshwater fish species are known to occur within the Fitzroy catchment (Pusey *et al.* 2004). Of the native species to occur within the Fitzroy River catchment, none are conservation significant.

All sites surveyed in the Northern Section were rapid assessment sites, which included AusRivAS habitat assessment, aquatic macrophyte inventory and AusRivAS bioassessments. Targeted surveys for fish species were not conducted, although opportunistic observations of fish species were undertaken. No fish were observed whilst undertaking surveys.

5.6.2.5 Other aquatic fauna

Five species of freshwater turtles are known to occur in the study area, two of which, the white-throated snapping turtle and Fitzroy River turtle, are conservation significant species. These two species are known to occur along the Fitzroy River in the reach at site 23; however, no records for the species occur in the other sites surveyed in the Northern Section. Optimal foraging habitat occurs at site 23 for the conservation significant turtle species, however the site is unlikely to support aggregated nesting, although isolated nesting may occur.

Sites 22, 25, 31, and 32 were unsuitable for refuge for all turtle species, and also unsuitable for nesting. No turtles were observed whilst undertaking surveys.

Previous records of platypus have been observed in the Fitzroy River in the reaches near site 23 (ALA 2022). Habitat conditions, such as large woody debris, tree roots and aquatic macrophytes present at site 23 provide optimal foraging habitat for the species. Due to safety reasons associated with the potential presence of estuarine crocodiles, a confirmation on the presence of burrows was unable to occur. However, suitable observations of the bank conditions and visual habitats present were assessed and the site considered likely to contain suitable burrowing habitat. The remaining locations, sites 22, 25, 31, and 32, had little or no surface water present and therefore were not suitable to maintain the species throughout the year, no individuals or evidence of burrows were observed whilst undertaking surveys at these sites.

Similar to the platypus, previous records of estuarine crocodiles have been observed in the Fitzroy River in the reaches near site 23 (ALA 2022). Optimal foraging habitat for crocodiles occurs at this site, as well as sub-optimal breeding habitat. The remaining locations, sites 22, 25, 31, and 32, had little or no surface water present and therefore were not suitable to maintain the species throughout the year, no individuals or evidence of nesting were observed whilst undertaking surveys at these sites.

5.7 Likelihood of occurrence

Based on the desktop searches and field survey results, the following conservation significant species have the potential to occur within the Northern Section study area (Table 5-16). The Fitzroy River turtle was identified as controlling provisions at the time of EPBC approval. The Fitzroy River Turtle is also listed under the NC Act was assessed against Queensland Government's *Significant Residual Impact Guidelines* (DEHP 2014b) for MSES (Section 7.3). A detailed likelihood of occurrence assessment is provided in Appendix E.

Table 5-16 Likelihood of occurrence summary

Scientific name	Common name	Status		Likelihood of occurrence	EPBC Approval
		EPBC Act	NC Act		
Threatened species					
Crocodylus porosus	Estuarine crocodile	Mig, Mar	V	**Likely to occur**	
Elseya albagula	White-throated snapping-turtle	CE	CE	**Known to occur**	
Geophaps scripta scripta	Squatter pigeon (southern)	V	V	**Likely to occur**	
Hirundapus caudacutus	White-throated needletail	V, Mig	V	**Likely to occur**	
Phascolarctos cinereus	Koala	E	E	**Likely to occur**	
Rheodytes leukops	Fitzroy River turtle	V	V	**Likely to occur**	✓
Rostratula australis	Australian painted snipe	E	E	**Likely to occur**	
Migratory species					
Apus pacificus	Fork-tailed swift	Mig	SL	**Likely to occur**	
Calidris acuminata	Sharp-tailed sandpiper	Mig	SL	**Likely to occur**	
Chlidonias leucopterus	White-winged black tern	Mig	SL	**Likely to occur**	
Gallinago hardwickii	Latham's snipe	Mig	SL	**Likely to occur**	
Gelochelidon nilotica	Gull-billed tern	Mig	SL	**Likely to occur**	
Hydroprogne caspia	Caspian tern	Mig	SL	**Likely to occur**	
Limosa limosa	Black-tailed godwit	Mig	SL	**Likely to occur**	
Numenius minutus	Little curlew	Mig	SL	**Likely to occur**	
Pandion haliaetus	Osprey	Mig	SL	**Likely to occur**	
Plegadis falcinellus	Glossy ibis	Mig	SL	**Likely to occur**	
Tringa nebularia	Common greenshank	Mig	SL	**Likely to occur**	
Tringa stagnatilis	Marsh sandpiper	Mig	SL	**Likely to occur**	
Species least concern					
Ornithorhynchus anatinus	Platypus	NL	SL	**Likely to occur**	

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NT – near threatened; Mig – migratory; SL – special least concern; NL – not listed.

6. Potential impacts and mitigation measures

6.1.1 Avoided impacts

In progressing the proposed pipeline and its ancillary and requisite (construction) infrastructure, the following design decisions were made and actions committed to, in order to avoid impacts to the ecological values of the GSDA, SGIC SDA and Northern Section:

– The pipeline alignment has sought to collocate within existing cleared and disturbed areas along easements, within road reserves, existing waterway crossings, along fence lines and property boundaries
– Access and ancillary infrastructure – as far as practicable, site access will be collocated with existing tracks requiring augmentation and expansion rather than wholesale new clearing and development
– Trenchless construction methods will be considered for all major and high-risk waterways to avoid impact to these waterways during construction
– Sensitive areas will be identified and protected.

6.1.2 Minimisation of impacts

Best practice construction techniques have been specifically selected to reduce direct works within waterways and terrestrial habitats wherever possible. These construction techniques will substantially reduce the potential for impacts to matters of national, state and local environmental significance for achievement of proposed ecological outcomes. Reduction measures will include a commitment to design and implement the following plans:

– Site specific construction environmental management plan (CEMP) will be developed and implemented to detail actions and procedures for the protection of the aquatic and terrestrial environments. The CEMP will include:
    - Drainage, Erosion and Sediment Control measures will be developed and implemented. Management actions will be in accordance with the Best Practice Erosion and Sediment Control Guidelines (IECA 2008)
    - Waste and Hazardous Materials Management measures will be developed and implemented. Management actions will be in accordance with Australian Standards (Hazardous Material Management Programme)
    - Weed and Pest Management measures will be developed and implemented as detailed in the terrestrial ecology assessment
    - Water Quality Management Plan which is to consider upstream and downstream monitoring during creek works, and during discharge in accordance with the performance criteria outlined in the CEMP.

In addition to the avoidance and minimisation measures outline above, best practice construction techniques and stringent site-specific management actions have been specifically selected to further minimise potential risks to matters of national, state and local environmental significance and achieve proposed environmental outcomes. Key actions are described below against each potential impact.

6.1.3 Overview

This section discusses the potential impacts and associated mitigation measures for the terrestrial and aquatic ecological values within the pipeline alignment.

Avoidance measures have been considered to reduce impacts from the project, where possible (Section 6.2). Management strategies have been proposed to mitigate or minimise potential impacts of the project on ecological values. A rigorous assessment to quantify and contextualise residual significant impacts, following avoidance and minimisation, has been undertaken against the Queensland Environmental Offsets Policy *Significant Residual Impact Guideline* (DEHP 2014b). One conservation significant species, namely grey-headed flying-fox, was assessed against the Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013). The MSES and MNES significant impact assessments are provided in in Section 7.

This section details anticipated impacts to ecological values during the construction and operation phases of the project.

During the construction phase, the project is expected to result in the loss of vegetation and habitat, due to clearing for the following:

– Pipeline right of way (ROW) and associated infrastructure
– Ancillary infrastructure including access tracks, construction camps and laydown areas.

Vegetation clearing and construction activities may result in direct mortality and injury of wildlife. Indirect ecological impacts such as temporary disturbance of wildlife through construction light, noise, vibration and increased vehicle movements, restricted fauna movement and barrier effects as well as the degradation of adjacent habitats through erosion and sedimentation and weed and pest invasion may also occur.

Permanent habitat loss will also occur where new infrastructure is required to remain in-situ post-construction (e.g. access tracks). The ecological integrity of the local landscape may be altered due to a potential reduction in the availability of habitat, and changes to the ecological landscape.

The operation phase will result in a small number of additional, ongoing impacts to terrestrial biodiversity (i.e. above and beyond the impacts caused by pipeline's construction): for example relatively low-level risks of disturbance and injury/mortality of wildlife and spread of weeds and pests due to movement of maintenance vehicles.

The significance of residual impacts (i.e. those that remain after application of avoidance, minimisation and mitigation) is assessed in the significant impact assessments for MSES and MNES (listed at the time of the approval) values in Section 7.c

A general overview of the construction and operation impacts of the project identified in the EIS (Arup 2008) and CEMP (GHD, 2022) is summarised in Table 6-1 together with the principal measures that will be used to avoid and mitigate impacts.

Table 6-1 Summary of construction and operation impacts and mitigation measures

Potential impacts	Avoidance and mitigation measures
Construction phase	
Vegetation clearing within the pipeline alignment resulting in: – Loss of TECs – Loss of remnant and regrowth vegetation – Loss of marine plants – Loss of essential habitat – Loss of aquatic habitat – Loss of habitat for conservation significant species	– Avoid vegetation clearing where alternative options to site infrastructure exist, particularly within areas of higher environmental value – Minimise the clearing footprint – Clearly denote clearing areas – Clearly denote no go areas – Locate temporary construction footprint in areas of existing disturbance, where possible – Conduct trenchless construction methods for waterways mapped as major and high-risk waterways under the WWBW spatial layer and likely to contain water and contain aquatic values at the time of construction – Conduct trenchless construction methods underneath Raglan and Inkerman Creek to minimise impacts to marine plants occurring within the pipeline alignment – Construction of the pipeline at ephemeral waterways to occur via open trenching during the dry season – Rehabilitate and revegetate temporary construction areas – Restrict works to daylight hours as far as practicable
Injury and mortality of wildlife due to: – Vegetation clearing – Collision with construction vehicles and machinery – Entrapment in construction areas	– Enforce site speed limits – Restrict works to daylight hours as far as practicable – Educate employees on environmental values and nesting sites – Erect warning signage in high-risk areas – Install temporary fencing – Use fauna spotter catchers during clearing

Potential impacts	Avoidance and mitigation measures
	– Employ trenchless construction methods for major and high-risk waterways as necessary – Clearly demarcate no go zones for sensitive areas – Utilise sequential clearing practices – Allow fauna to disperse on their own accord – Install escape poles, logs etc., in open excavations – Minimise vehicles within site – Regular inspections of trenches – Develop adverse incident procedures as relevant
Disturbance of wildlife behaviour: – Light – Noise – Vibration	– Restrict works to daylight hours as far as practicable – Minimise use of artificial lighting – Install directional lighting where appropriate – Service and maintain all plant equipment – Maintain and monitor vehicle/plant noise
Fragmentation of terrestrial habitats resulting in: – Barrier effects and – Restricted fauna movement	– Limit construction or temporary fencing, and where needed, implement in a way that minimises disruption to fauna movement – Plan works area to maintain habitat connectivity, where possible – Maintain areas of existing vegetation to assist in providing a source of seed for local rehabilitation works – Co-locate or upgrade existing access tracks in areas that are already disturbed, wherever possible. – Use native species for rehabilitation wherever possible. If native species are unsuccessful introduced stoloniferous grasses may be used to achieve rapid surface coverage. – Limit construction laydown areas and stockpiles to areas that have already been cleared to minimise unnecessary clearing wherever possible
Restriction of aquatic movement by: – Trenching works within waterways	– Prepare and implement a Construction Environmental Management Plan (CEMP) – Utilise trenchless over trenching methods where possible
Degradation of aquatic habitats by: – Loss of marine plants – Increased sedimentation – Increased erosion – Potential for Acid Sulfate Soils	– Prepare and implement a CEMP which includes a Water Quality Monitoring Program (WQMP) and an Acid Sulfate Soils (ASS) Management Pan – Rehabilitate riparian habitats post construction – Inform construction personnel of environmental responsibilities – Monitor aquatic habitats immediately upstream and downstream of construction area for signs of degradation – Restrict works to daylight hours as far as practicable – Situate storage of contaminating material away from watercourses – Ensure emergency spill equipment is available onsite – Reinstate trenches with geofabric and rock spalls if erosion risk
Degradation of adjacent terrestrial habitats due to: – Erosion, dust and sedimentation	– Prepare a site-specific Erosion and Sediment Control Plan for the project – Map high-risk areas requiring protection – Install erosion and sediment controls prior to significant vegetation clearing – Monitor and maintain integrity of controls – Monitor weather to anticipate/avoid works in high-risk rainfall events – Restrict speed limits onsite – Develop a site-specific Waste and Hazardous Materials Management Plan, or similar – Undertake regular site inspections – Suppress dust using water carts, or other suitable methods – Rehabilitate temporary works areas as soon as possible post-construction.

Potential impacts	Avoidance and mitigation measures
	– Retain important habitat features (hollow-bearing trees, timber that will become instream snag and perch material), where possible
Introduction and/or spread of weeds and pests due to: – Movement of contaminated vehicles – Importation of contaminated fill – Creation of disturbance	– Prepare a site-specific Weed Management Plan and Introduced Fauna Management Plan, – Clean and certify vehicles and equipment prior to entering site – Use clean local fill where needed – Dispose of cut responsibly – Educate employees – Limit the clearing footprint – Manage existing weed/pest infestations
Operation phase	
Injury and mortality of terrestrial wildlife due to: – Entrapment/entanglement in structures – Collision with maintenance and recreational vehicles	– Enforce site speed limits – Educate employees – Erect warning signage in high-risk areas – Exclude fauna from high-risk areas – Exclude recreational use from ecologically sensitive areas – Restrict works to daylight hours as far as practicable
Aquatic fauna injury or mortality due to: – Entrapment/entanglement in structures – Collision with maintenance and recreational vehicles	– The intake structure will incorporate a design to reduce the potential for entrapment of aquatic fauna – Gradually increase flow rate to prevent turbulence – Prepare and implement an operations environmental management plan (OEMP) for management of weeds and feral pests
Disturbance of wildlife behaviour due to: – Operational light and noise – Vehicle movements	– Limit recreational vehicle movements, where possible – Enforce site speed limits – Install directional lighting where appropriate
Introduction and spread of weeds and pests	– Undertake weed monitoring and management as per the OEMP – Prohibit operational employees and recreational visitors from bringing domestic pets – Maintain construction weed wash-down facilities for long-term use of maintenance staff and recreational visitors to the area – Enforce weed hygiene protocols as per the OEMP

6.2 Construction phase impacts and mitigation

6.2.1 Loss and degradation of vegetation and terrestrial habitat

6.2.1.1 Potential impacts

In aggregate, construction of the pipeline alignment, its ancillary infrastructure, and all other construction-related disturbance, will cover an area of 375.14 ha, and will likely result in the loss of approximately 65.55 ha of vegetation, of which approximately 17.51 ha is mapped remnant vegetation. Impact areas for respective REs within each section of the pipeline alignment are provided in sections 3.2.2, 4.2.2 and 5.2.2.

Impacts associated with construction of the project will be minimised by locating the pipeline alignment in open (cleared) areas to the greatest extent possible. Despite this, construction of the project will involve clearing of mature eucalypt woodland, mixed *Eucalyptus/Corymbia* woodland, Brigalow woodland, estuarine environments, and fringing riparian environments. Estimated clearing extent of each habitat type for the pipeline alignment is listed in Table 6-2.

Table 6-2 Estimated habitat clearing extent for the pipeline alignment

Habitat type	Estimated clearing extent (ha)
Mature eucalypt woodland	4.78
Mixed *Eucalyptus* / *Corymbia* woodland	69.69
Regrowth and / or scattered *Eucalyptus* / *Corymbia* / *Acacia* trees	143.64
Brigalow (*Acacia harpophylla*) woodland	4.34
Estuarine environments	2.87
Freshwater waterbodies and seasonal wetlands	18.23
Fringing riparian environments	4.84
Cleared and highly modified landscapes	102.04

Vegetation clearing for the project will result in the direct loss of habitat for fauna. Direct loss of vegetation includes the removal of structural features (i.e. mature vegetation, hollow-bearing trees and hollow logs) that provide microhabitats and resources for an array of fauna. Loss of these habitat features creates a loss of perching, foraging and den/nesting resources for native species. This may reduce the number of individual animals that can be sustained in a given area and may increase competition for resources such as food and shelter in remaining remnant habitats. Hollow-bearing trees are recognised as a limited resource in lands that have been subject to grazing due to previous clearing and therefore, the loss of these habitat features is considered to be a major threat to Australia's biodiversity (Gibbons and Lindenmayer 2002). Reducing the abundance of tree hollows through land clearing potentially causes imbalances and restructured community assemblages in woodland areas (Isaac *et al*. 2014).

This report focuses on the values of impacted habitat for conservation significant species that were confirmed present in the study area or are considered likely to occur (see detailed assessment against the Queensland Government's *Significant Residual Impact Guideline* (DEHP 2014b) and Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013) in Section 7).

6.2.1.2 Mitigation measures

Where possible, concept design of the pipeline alignment, associated infrastructure, access tracks and laydown areas has sought to minimise the clearing footprint. Nonetheless, some unavoidable losses of remnant, regrowth and riparian vegetation (and the habitat values these support) will occur. To mitigate impacts of the loss of habitat resulting from construction activities for the pipeline alignment, the following measures will be instigated:

– Clearly marking vegetation clearing areas on construction plans and in the field. Areas that must not be cleared or damaged must also be identified
– Clearly identifying all fauna breeding habitat (e.g. hollow bearing trees) within the project footprint and managing in accordance with conditions of an approved Species Management Plan (SMP) for animal breeding places under the Queensland *Nature Conservation Act 1992* (NC Act)
– Commencing revegetation activities within the project footprint as soon as possible after the pipeline has been installed and buried
– Developing and implementing a site-specific CEMP to detail actions and procedures for the protection of the terrestrial and aquatic environments. The CEMP (GHD 2022) will include the following actions below to manage weeds, pests, dust, and waste and hazardous materials:
    - Implementation of a Weed Management Plan to remove existing weeds and prevent the introduction of new weeds and minimise the spread of declared weeds within the construction footprint prior to construction activities
    - Training key personnel on site to be capable of identifying weed species and preventing their spread and translocation
    - Undertaking daily inspections to monitor control and implementation of appropriate preventative measures for weed and pest species. The construction contractor must and treat all prohibited and restricted matters in accordance with the *Biosecurity Act 2014*

- Requiring all plant and equipment to be washed down prior to arriving on site, with a declaration stipulating that the plant and equipment is clean, in accordance with relevant project requirements.
- Minimising the generation of dust through restriction of speed limits and watering of exposed ground surfaces
- Developing and implementing fuel and chemical storage protocols and spill responses.

6.2.2 Loss and degradation of aquatic habitat

6.2.2.1 Potential impacts

Aquatic habitat will be temporarily impacted during the construction of the pipeline alignment through removal of riparian vegetation, disturbance of the bed and bank from trenching, trenchless construction methods, and the construction of the intake structure.

There are a total of 68 mapped waterway crossings within the pipeline alignment, including major waterways and high-risk waterways (Table 3-14, Table 4-17 and Table 5-13). In these areas, various trenchless construction methods will be used where possible, minimising the impacts to the aquatic ecosystems. Whilst these techniques do not physically disturb the bed and banks of the watercourse, they may require the removal of small amount of riparian vegetation. The removal of riparian vegetation within the pipeline alignment can reduce the extent of shade along the waterway, which provides overhanging and tailing bank structure for aquatic fauna, controls instream primary productivity and influences temperatures (Bunn *et al*. 1998, Davies *et al*. 2004).

The pipeline alignment is adjacent to numerous MSES declared high ecological significance wetlands. These are outside the pipeline alignment and as such no direct impact is expected to occur. However, there are a several HES declared wetlands that will be intersected by the pipeline alignment. Many of these wetlands are ephemeral and trenching methods will be used with restoration of bed and habitats to occur post construction to minimise impacts on aquatic habitat. There are several HES wetlands that contain water throughout the year, including site 32, in which microtunnelling will occur.

The conservation significant estuarine crocodile, platypus, Fitzroy River turtle, and white-throated snapping turtle are expected to occur within the Fitzroy River at the pipeline intake location only within the Northern Section. The estuarine crocodile is likely to or may occur at several riverine and tidal locations within the SGIC SDA which include sites 2, 3, 4, 6, and 30. Platypus are likely to occur at site 3, site 5, and site 6 within the SGIC SDA. The snubfin dolphin and the humpback dolphin may occur at sites 2 and 4. While the green turtle is confirmed as present at site 4, and likely to occur at site 2. The waterway crossings for the remainder of the pipeline alignment are not suitable habitat for these species. A pipe bridge will be constructed at Raglan Creek at site 2, and horizontal directional drilling (HDD) used at Inkerman Creek at site 4, and therefore no direct impacts will occur to these waterways or the aquatic species within.

Earthworks and construction activities may result in the indirect degradation of habitat due to increased erosion and sedimentation from surface water run-off and the disturbance of sediment at the intake structure. Erosion and sedimentation within aquatic environments can negatively impact water quality by increasing turbidity, decreasing oxygen levels and reducing light penetration, whilst also smothering habitat resources and impacting substrate composition (Wood and Armitage 1997; Wheeler *et al*. 2005). Surface runoff, and resultant gullying, is already a common occurrence throughout the study area. Initiation or exacerbation of gullying and bank instability is a concern during construction, particularly in banks consisting of highly erodible soils. Sediment mobilisation is most likely to be generated during the constructing of pipeline trenches and road crossings as a result of heavy machinery use, removal of riparian vegetation and erosive effects of construction in the vicinity of banks. Trenchless construction methods will be used under major waterways and are unlikely to generate a significant increase in sedimentation rates, as the entry and exit points of the tunnels will be situated outside the riparian zone. However, sediment and side-cast materials from pipeline trenches positioned near waterways could be mobilised if heavy rainfall occurs during construction. This has the potential to effect aquatic fauna via impacts to water quality. If impacts to water quality are realised, depending on the locality of the impact there is also potential for flow on impacts to high ecological significance wetlands located within and adjacent to the works.

During construction, large machinery will be required to transport materials and conduct earthworks for trenching, bed-level crossings, and pump installation. The use of machinery within waterways has the potential to degrade downstream environments as a result of accidental spillage of contaminants (e.g. fuels and lubricants). Many

chemicals, such as petrol and diesel fuel, drilling lubricants and pesticides, are particularly toxic to freshwater macroinvertebrate taxa. Construction materials like cement slurries are also highly caustic and can raise Ph above tolerable limits for aquatic taxa. In severe cases, a large-scale hydrocarbon spill would result in the formation of a toxic surface slick with the potential to cause death, poor health and / or reduced reproductive success in aquatic communities for a period of months to years.

6.2.2.2 Mitigation measures

- Minimising the loss of aquatic habitat during the design phase by locating pipeline alignment outside waterways where possible
- Where crossing waterways is required for construction, habitat loss will be minimised by developing temporary waterway barrier crossing in accordance with DAF's acceptable development requirements.
- Locating any additional construction areas or construction sites, such as laydown areas, access tracks and machinery/equipment storage within existing cleared areas and away from the waterway bed and banks
- Preparing and implementing a stringent and site-specific CEMP to detail actions and procedures for the protection of the aquatic environments
- Preparing and implementing site specific ESCPs as part of the CEMP in accordance with practices described in the International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline and/or Queensland Division of the Australian Institute of Engineers' Erosion and Sediment Control: Engineering Guidelines for Queensland Construction Sites. The ESCP will be prepared by a highly experienced certified professional in erosion and sediment control and will include the following methods to minimise degradation of aquatic habitats:
  - Installing sediment control devices to minimise downstream transport of sediments released during vegetation clearing and earthworks
  - Minimising erosion potential through scour protection treatments at abutments
  - Minimising vegetation clearing and the area of bare ground required for construction to only that which is necessary
  - Appropriately managing and protecting stockpiles.
- Monitoring of water quality conditions (visual and in situ recordings) as per the requirements in the WQMP to identify the potential for water quality degradation within waterways and allow for adaptive management if required
- Minimise the project footprint by restricting the clearing area to the smallest practical area and only where necessitated by the approved construction of roads, services, access and cut and fill
- HDD drilling will be investigated to be employed underneath major and high-risk waterways to avoid temporary loss of aquatic habitat
- Undertake construction in aquatic habitats during the dry season, where possible to coincide with the time that ephemeral watercourses are least utilised by aquatic fauna
- Locate laydown areas, site offices and other temporary works areas in areas already subject to existing disturbance wherever possible
- Inform all construction personnel of environmental responsibility with respect to the protection of vegetation and fauna habitat. Site inductions will include information on the location of important habitat to prevent disturbance and/or destruction of these areas
- Demarcate no-go areas of ecological sensitivity both on site and in construction plans, including all vegetation not to be cleared. All vegetation to be retained should be surveyed and clearly demarcated
- Rehabilitate and revegetate temporary construction areas as soon as possible after the completion of local construction works
- Restore bed and banks to pre-existing profiles and riparian vegetation re-established following completion of works.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No damage/degradation of ecologically-sensitive sites beyond demarcated construction zones
– No damage or degradation of waterways beyond demarcated construction zones
– No clearing of vegetation clearing where an alternative option to site requisite ancillary and temporary infrastructure/disturbance exists in cleared/degraded land
– No impact to waterways from ancillary infrastructure (excluding access track crossings)
– Rehabilitation of all temporary disturbance areas to at least their pre-disturbance floristic composition and ecological condition, and preferably an improved condition.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.3 Acid Sulfate Soils

6.2.3.1 Potential impacts

Acid sulfate soils (ASS) are commonly found at elevations below 5 m AHD and sometimes beneath newer soils below elevations of 20 m AHD. Acid sulfate soils are safe when undisturbed but when dug up or drained, the pyrite in the soil reacts with oxygen and oxidises. This process turns pyrite into sulfuric acid, which can damage the environment, buildings, roads and other structures (Queensland Government 2020). The likelihood that ASS would be encountered during construction activities as excavation below 20 m AHD is not anticipated, however there are several tidal crossings within SGIC SDA that occur at low elevations and therefore have a larger risk of ASS occurring than the majority of sites throughout the pipeline alignment.

If ASS are excavated and exposed to air, i.e. oxidised, the potential environmental impacts may include:

– Reduction in water quality resulting in damage to estuarine environments and reduction of wetland biodiversity
– Acidification
– Heavy metal precipitation (e.g. aluminium, iron and manganese), which causes poor plant productivity and smothers plant vegetation and microhabitat
– Corrosion of infrastructure.

6.2.3.2 Mitigation measures

The Construction Contractor will develop a site-specific ASS Management Plan, as required, to address the requirements of the ASS Investigations and in consideration of adopted construction methodologies. The ASS Management Plan will meet the requirements outlined in Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines (State of Queensland, 2014), and will include:

– Construction staff will be made aware of the signs of ASS
– Identified areas of ASS will be clearly shown on construction plans
– Where ASS investigations have identified the need to neutralise spoil this will be carried out within 24 hours of it being exposed at the designated rate and liming verification sampling and analysis be undertaken to confirm that adequate lime has been used
– A designated bunded area will be used for neutralisation (if not in-situ)
– Surface run-off is to be controlled and captured through appropriate stormwater management
– The Construction Contractor will develop a procedure to discharge water from the trench. The Ph of any water pooled onsite (groundwater seepage and after rainfall events), that requires to be discharged off site for any reason, will be monitored. If the Ph is acidic the water will be treated with hydrated lime if necessary. Bags of hydrated lime will be kept onsite in a dry state for this purpose but used as approved by the Delivery Authority.

6.2.4 Injury and mortality of wildlife

6.2.4.1 Potential impacts

The construction of the pipeline alignment has the potential to cause injury and mortality of wildlife through collision with construction vehicles and machinery, entanglement in site fencing, entrapment in open excavations and direct injury or mortality during clearing.

Approximately 65.55 hectares of vegetation clearing will be required within the pipeline alignment, of which approximately 17.51 ha is mapped remnant vegetation. Additional clearing will also be required for access tracks and laydown areas. Clearing activities have the potential to cause injury and mortality to local fauna sheltering in hollows, nests, trees and ground habitat (logs, burrows, soil, leaf litter, beneath rocks). Species that are most susceptible include nocturnal species that are likely to be sheltering during clearing activities (e.g. gliders and possums) and slow moving species or sedentary species that are unlikely to be able to flee the clearing zone (e.g. koala's, small ground–dwelling mammals, reptiles and frogs).

Construction activities associated with the project will involve a temporary increase in vehicular traffic and plant movement to, from and at the site, including traffic on existing access roads. This has the potential to increase the incidence of wildlife mortality from vehicle strike. Conservation significant fauna species at particular risk of vehicle strike include the squatter pigeon (southern), koala and ornamental snake, as well as ground-dwelling bird, mammal and reptile species that commonly occur on tracks throughout the region.

Breeding places for conservation significant species, including the squatter pigeon (southern), have the potential to be directly impacted during clearing of the pipeline alignment, causing a loss of critical ecological resources and the potential for injury and mortality of individual animals. Other conservation significant species with heightened risk of injury or mortality during construction include the koala (due to its likely occurrence and noting its relatively slow movement).

The risk of injury / mortality to aquatic fauna can occur at waterway crossings. Construction of the intake structure poses the highest risk of potential fauna injury and mortality with aquatic fauna likely to be present within the direct footprint of works. Habitat degradation of waterways within the project footprint resulting in poor water quality, alteration of flow, isolation of habitat, increase predation pressure and increased competition, may also indirectly cause injury and mortality of aquatic fauna.

Entrapment of wildlife within excavations pits, particularly within the pipeline network, poses an additional threat to wildlife. Most at risk wildlife includes wide-roaming fauna like macropods, snakes, and echidnas.

6.2.4.2 Mitigation measures

The following measures will be instigated to minimise wildlife injury and mortality during construction of the project:

– A pre-construction survey for breeding habitat will be conducted within disturbance footprints to determine the requirement for Species Management Plan (SMP) under the NC Act. Pre-clearance surveys by suitably trained and qualified ecologists
– Pre-clearance surveys will be undertaken prior to construction disturbance. This includes marking and retaining (where possible) trees with large hollows, marking all habitat trees retaining hollows, stick nests and arboreal termite mounds, and checking ground habitat features, including ground logs, woody debris and burrows. Fauna will be relocated to the nearest safe place within suitable habitat prior to clearing
– Fauna spotter/catchers to be present during all construction works that have the potential to cause injury / mortality to terrestrial and aquatic fauna within the construction footprint. This will involve checking felled habitat trees retaining hollows, stick nests or arboreal termite mounds, and safely removing and relocating resident fauna to the nearest suitable, safe habitat outside of the project footprint
– Flush areas of predicted habitat for the squatter pigeon (southern) immediately prior to clearing (i.e. spotter-catcher to walk in front of clearing machinery)
– Fauna spotter catchers to undertake daily inspections of trenches, excavations and machinery for the presence of trapped fauna
– Minimise the length and time that trenches and excavations are open

- Open trenches and excavations to contain fauna ramps to allow large fauna such as macropods to escape and damp hessian cloth to provide shelter for small fauna such as reptiles and frogs. This is especially relevant to any trenching required for the construction of the pipeline
- Construction at ephemeral waterways will occur during the dry season, where possible
- Aquatic fauna salvage, if required, will be undertaken in accordance with DAF Aquatic Fauna Salvage Guidelines
- Clearly demarcate no-go areas of sensitive vegetation and habitat, including all vegetation and habitat not to be cleared
- Sequential clearing of vegetation to allow resident fauna the opportunity to disperse away from the immediate project footprint
- A Traffic Management Plan will be developed for the construction site with designated access routes, speed limits and sensitive ecological areas (i.e. particularly areas where squatter pigeon (southern) have the potential to occur on access roads)
- All vehicles and plant will adhere to site rules relating to speed limits. Speed limits will be clearly signposted to minimise the potential for roadkill
- Given the specific susceptibility of the squatter pigeon (southern) and koala to vehicle collision, warning signs will be erected on all tracks that intersect potential habitat for the squatter pigeon (southern), koala and ornamental snake. Squatter pigeon (southern), koala and ornamental snake awareness will be included in all worker inductions, as well as speed limits and traffic volume in the Traffic Management Plan. A register of squatter pigeon (southern), koala and ornamental snake sightings will be maintained to identify current areas that have a risk of collision
- Minimising the need to travel near dawn or dusk, limit haulage and delivery of materials to the day time and/or where possible, minimise the number of vehicles travelling during this period through the use of car-pooling to transport construction personnel where possible
- Educating employees regarding the presence of conservation significant species and other fauna and livestock on access roads
- Erecting temporary construction fencing to exclude mobile animals such as macropods and livestock from the construction areas
- HDD drilling underneath major and high-risk waterways will be employed to avoid fauna injury or mortality during construction as necessary (subject to design development and site-specific construction methodologies)
- Develop adverse incident response procedures to detail actions to be taken in the event of wildlife injury or mortality during clearing. This will include procedures for capture and transport of injured wildlife to qualified veterinarian or humane on-site euthanasia and formalisation of arrangements with a local veterinarian to treat and care for wildlife injured during for the construction period.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

- No disturbance of active and utilised breeding sites for conservation significant-species– where active breeding sites for conservation-significant species are identified, construction activities will be managed in accordance with a high-risk SMP to allow for breeding to be successfully completed
- No injury or mortality of conservation-significant species as a result of vehicle and plant movements linked to the project
- No injury or mortality of conservation-significant species as a result of entanglement in fencing (or other site infrastructure), nor entrapment in excavations
- All aquatic fauna relocated from within active construction footprints within the pipeline alignment.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.5 Disturbance of wildlife through light, noise and vibration

6.2.5.1 Potential impacts

The operation of machinery and equipment has the potential to disrupt local fauna behaviour, through increased exposure to light, noise and vibration. This can adversely impact native wildlife through the disruption of foraging, breeding and nesting behaviours (Longcore and Rich 2004; Slabbekoorn *et al*. 2010; Popper and Hawkins 2016). Increased light, noise and vibration can alter the behaviour of individual animals and disrupt the balance of intra- and interspecies interactions. Such disruptions typically favour feral predators and generalist species that owe their success to broad ecological tolerances and have the possess the ability to tolerate or actively exploit disturbed environments.

Construction activities may require works to be undertaken at night. The impacts of artificial lighting will differ between faunal groups and individual species. Artificial lighting for safety and to facilitate night works has the potential to disturb wildlife and will likely result in the temporary movement of some nocturnal fauna away from the construction area. Nocturnal fauna can be particularly sensitive to light disturbance, causing more sensitive species to avoid areas exposed to artificial lighting (Longcore and Rich 2004). Artificial lighting can also attract opportunistic microchiropteran bat species that feed on insects at artificial light sources, to the detriment of more sensitive bat species.

Increased levels of disturbance (e.g. from noise, vibration, light, vehicles, machinery, personnel) also have the potential to disrupt the behaviour and dynamics (i.e. foraging, movement) of aquatic fauna inhabiting waterways and waterbodies within and adjacent to the project footprint. Behavioural changes expected to occur include avoidance and evasive (startled) movement leading to displacement from habitat and loss of resources within the direct areas of impact.

6.2.5.2 Mitigation measures

Routine mitigation measures should be undertaken to minimise the impact that noise, light, vibration and disturbance have on local wildlife populations during construction. This will be particularly important within the vicinity of habitat for conservation significant fauna species (refer to mapped habitat for conservation significant species in Section 7). The following measures will be instigated to minimise the impacts of light, noise and vibration during construction:

– The in-stream construction duration for major and high-risk waterways should be in accordance with the DAF guidelines and/or approval conditions. All works within waterway crossings will be in accordance with CEMP
– Maintaining river flow and aquatic fauna movement within its natural course for as long as possible and in accordance with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018) for operational work that is constructing or raising waterway barrier works' (DAF, 2018). A flow diversity strategy will be developed to limit river diversion to a single dry season and maintain flows during the construction period
– Using noise dampening devices on machinery wherever practical and requiring that all equipment is maintained and serviced in accordance with manufacturer's instructions to reduce noise levels
– Develop a Traffic Management Plan for the construction site to control vehicle movements and speeds and reduce the unnecessary generation of vehicular noise
– Minimise the number of vehicle movements during construction through the use of local construction camps and buses to transport construction personnel
– Limit construction activities to daylight hours wherever possible to reduce the need for lighting and resultant light spill into adjacent habitat and to reduce noise and vibration impacts on nocturnal fauna species
– Minimise site lighting to the minimum needed for safety. Install directional lighting and shields to minimise light spill outside of the immediate work areas having consideration for health and safety requirements
– Comply with construction vehicle maintenance schedules and operational restrictions designed to limit noise impacts during construction.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No illumination of remnant vegetation by non-essential construction lighting
– No injury or mortality of conservation-significant species due to vehicle and plant movements linked to the project.

6.2.6 Fragmentation of terrestrial habitats

6.2.6.1 Potential impacts

Habitat fragmentation is the process in which large, continuous habitats are converted into smaller, more isolated patches, often separated by a matrix of human-induced land cover (Haddad *et al* 2015; Wilcove *et al*. 1986). Habitat fragmentation can isolate populations by creating barriers to local fauna movement and the dispersal of plant seeds and fruit and increase habitat degradation due to concentration of animals in isolated patches. Fragmentation increases the amount of 'edge' habitat – while such ecotones are beneficial for some generalist and/or highly competitive species, they are prone to degradation through so-called 'edge effects'. Edge habitats tend to be exposed to increased exposure to light, noise, sediment-laden run-off, erosion and weed and pest infestation.

Vegetation clearing during construction has the potential to result in localised fragmentation of habitats adjacent to the project. Species susceptible to habitat fragmentation typically become more reliant on local resources and more vulnerable to impact from local disturbances (e.g. fires or localised flooding) (Fridley *et al*. 2007; Gilpin and Soule 1986; Kneitel and Chase 2004). Altering the pattern of the local landscape can reduce the resilience of some species' populations to perturbation. The nature and severity of habitat fragmentation impacts also tends to vary depending on the level of existing fragmentation within the landscape.

The pipeline alignment occurs in a landscape that has been transformed by agricultural and mining land use – the extent to which the landscape pattern is altered varies along the pipeline alignment. Within that context, habitat fragmentation resulting from the proposed pipeline alignment is unlikely to have a regional impact on fauna diversity (e.g. species richness) due to already modified nature of the landscape matrix. However, noting that the effects of fragmentation operate at multiple spatial scales, and manifest differently for species based on their ecological traits and life history attributes, it is likely to cause localised impacts for some less mobile and/or more specialised species, by intersecting corridors that may be important conduits for local wildlife movement (e.g. along watercourses). This barrier effect is likely to be insignificant for many species, noting that, as the pipeline alignment will be rehabilitated after the pipeline has been installed and buried. The movement of koalas, and other conservation significant fauna species that are known or likely to occur in woodlands and fringing riparian vegetation within and near the proposed pipeline alignment, are unlikely to be limited by such an alteration, although it could potentially expose some (arboreal) species to increased predation risk where it forces animals to spend more time on the ground.

The fragmentation of habitat may also have localised impacts on the composition of assemblages of woodland birds, reptiles and small ground mammals, by reducing the area of available habitat for edge-sensitive species that prefer intact woodland remnants, or 'core' habitat within fragmented patches. Of note is that such edges in fragmented agricultural landscapes may benefit hyperaggressive *Manorina* honeyeaters – birds which are known to depress the abundance of small woodland bird species. While woodland birds may experience localised adverse impacts from the fragmentation (increased edge) caused by the project, this is unlikely to be of consequence for any conservation significant bird species.

6.2.6.2 Mitigation measures

The following mitigation measures will be instigated to limit fragmentation and reduced connectivity:

– Limit construction or temporary fencing or utilise wildlife permeable fencing where risk of injury is low
– Demarcate areas of native vegetation requiring removal to equipment operators and supervisors before any clearance to ensure disturbance is minimised
– Maintain areas of existing vegetation to assist in providing a source of seed for local rehabilitation works.
– Co-locate or upgrade existing access tracks in areas that are already disturbed, wherever possible
– Use native species for rehabilitation wherever possible. If native species are unsuccessful introduced stoloniferous grasses may be to achieve rapid surface coverage

– Limit construction laydown areas and stockpiles to areas that have already been cleared to minimise unnecessary clearing wherever possible.
– Use of HDD drilling underneath waterways to avoid clearing riparian wildlife corridors.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No establishment of weeds at edges created as a result of construction activities – where new weed infestations are observed, these will be managed in accordance with the project's CEMP
– Notwithstanding requirements for access to maintain the pipeline during operations, 20 m of the 30 m wide pipeline alignment will be rehabilitated once constructed (buried).

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.7 Restriction of aquatic species movement

6.2.7.1 Potential impacts

Migrations are important for many of Australia's native aquatic fauna, with numerous aquatic fish species undertaking migrations as part of their lifecycle and/or movements as part of their day-to-day foraging activities. During construction, water flow within intersected waterways has the potential to be impact by construction works, particularly trenching across ephemeral and lower order waterways. As a consequence, upstream and downstream movement of aquatic fauna may be temporarily restricted thus affecting dispersal, life history movement stages, breeding and foraging.

The majority of other watercourses within the project footprint are ephemeral in nature, containing only seasonal running water in the wake of sustained rainfall events. For most of the year, these low and moderate risk waterways consist of dry creek beds or watercourses, while some waterways contain occasional disconnected pools, with no opportunity for broad-scale migrations/ movements for the majority of the year. Instream works have been timed in a manner that minimises impacts to aquatic fauna and are planned to occur during the dry season, as far as practicable. When intersecting an ephemeral watercourse, the pipelines will be buried in trenches, with disturbed substrate reinstated to construct bed level crossings. As construction is to occur within the dry season, flow controls or diversions are unlikely to be required. Should high rainfall climatic conditions occur during construction, these trenches may constitute a temporary barrier for aquatic species that may utilise the ephemeral tributaries as refuge habitat.

Several waterways were identified as being a high to major risk, as well as tidal within the WWBW for aquatic fauna. These waterways are likely to be permanent waterways with suitable refuge pools and habitat resources for aquatic fauna or are semi-permanent and offer some isolated habitat. Due to the adopted construction approach of trenchless methods, the project works are unlikely to restrict the movement of aquatic taxa within major and high-risk waterways as no physical barrier will be constructed. If trenchless methods are not a viable option at a waterway containing aquatic habitat during construction the aquatic fauna movement will be temporally disrupted during the period of construction activities within the waterway. This disruption is likely to occur for a short period up of to several weeks and therefore the disruption of movement is unlikely to disrupt breeding or season migrations.

The structure at the Fitzroy River has the potential for temporary restriction of movement whilst construction is underway. Construction will require the diversion / exclusion of the river around the footprints with the use of coffer dams. Considering the coffer dam will not extend across the entirety of the watercourse, fauna movement is expected to be maintained. Pre-construction surveys will be undertaken to identify breeding habitat for conservation significant species and a high-risk SMP will be prepared and implemented if required.

Works will be undertaken in accordance with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018) and will allow for continued or facilitated movements. Temporary works will also comply with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018). Where works con not comply with the DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), a WWBW development approval will be required to demonstrate that

adequate fish passage will be maintained during construction. Overall, restriction of fauna movement will be localised and temporary.

6.2.7.2 Mitigation measures

Management controls being investigated for mitigating impacts to the restriction of movement for aquatic species include:

– Undertaking works in accordance with DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018)
– Use of HDD on high and major risk waterways, where possible
– Maintain flow and fauna movement within the waterways if trenchless construction methods are not possible
– Maintain flow and fauna movement within the Fitzroy River during construction of the intake structure
– A pre-construction survey for breeding habitat will be conducted within disturbance footprints of waterways, including the intake structure at the Fitzroy River, to determine the requirement for Species Management Plan (SMP) under the NC Act. Pre-clearance surveys by suitably trained and qualified ecologists.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– Upstream and downstream movement of aquatic fauna will be maintained during the construction period
– Construction methodology complies with Acceptable Development Requirements.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.2.8 Introduction and spread of weeds and pests

6.2.8.1 Potential impact

Construction activities have the potential to introduce and/or spread exotic pests throughout the project. This can result in disruptions to natural ecosystem functioning by altering the balance of inter-species competition and predation. Inappropriate waste disposal and provision of water have the capacity to attract higher local concentrations of feral predators, increasing the predation pressures on local wildlife. Pest fauna species recorded within the study area included the feral pig European red fox, European rabbit and cane toad. The pipeline alignment and access tracks created for the project have the potential to facilitate movement of feral predators such as wild dogs and foxes, thereby increasing predation pressures on local wildlife, including koalas and freshwater turtles. Additionally, cane toads are considered to pose a threat to the ornamental snake. Control programs are recommended to mitigate impacts on terrestrial and aquatic fauna species. Although the study area is likely already exposed to relatively high levels of pest infestation, mitigation measures will be required to limit the spread of pest animals that could result from construction activities.

An increase in bare ground and open areas, associated with land clearance will favour weed species, which can suppress the regeneration of native species and reduce the available habitat. This can cause significant damage to Queensland's primary industries and undermine the ecological integrity of bushland remnants by competitively excluding native plant species that provide food, shelter and nesting resources for native wildlife.

A total of 13 restricted invasive weeds were recorded during the field surveys (Section 3.5, 4.5 and 5.5). Construction activities typically have the potential to introduce invasive weeds through the increased movement of people and machinery. Additionally, established weed populations may be spread throughout the project footprint by personnel and work vehicles during construction of the project. Additionally, surface water flow has the potential to distribute weed species from construction areas to nearby watercourses, resulting in weeds being distributed further downstream.

Given the project is located within a predominantly agricultural landscape, the risks of weed introductions carry heightened consequences. Strict vehicle hygiene and weed management protocols will be required to control risks of introducing or spreading weeds during construction.

6.2.8.2 Mitigation measures

The following measures will be instigated to minimise the introduction and spread of introduced species throughout the study area:

- Identification and management of pest species will be undertaken in accordance with the plans and strategies in the *Biosecurity Act 2014*. Likewise, management of declared local pests will be undertaken in accordance with relevant local government strategies and plans, including the Gladstone Regional Council Biosecurity Plan 2021-25 (GRC 2021) and Rockhampton Regional Council Biosecurity Plan for Pest Management 2017-2021 (RRC 2017)
- Develop and implement a site-specific Weed and Pest Management Plan to inform all construction activities that outlines protocols to prevent the introduction of weed and pest species into the area and minimise the spread of declared weeds and pests within the project footprint
- Undertake prevention and management of pest animal and invasive species in accordance with the *Biosecurity Act 2014*. Likewise, management of declared local pests and invasive species will be undertaken in accordance with relevant local government strategies and plans, including the Gladstone Regional Council Biosecurity Plan 2021-25 (GRC 2021) and Rockhampton Regional Council Biosecurity Plan for Pest Management 2017-2021 (RRC 2017), as applicable
- Establish appropriate on-site waste-storage and disposal protocols, with designated waste-storage areas and appropriate (i.e. closed) waste receptacles and frequent waste disposal schedules to minimise attracting feral animals (e.g. dogs, foxes and pigs)
- Include weed and pest management protocols in all worker inductions
- Prohibit employees from bringing domestic animals onto the construction accommodation camps or site
- Enforce strict weed hygiene protocols including weed-washdowns, inspections and weed and seed certifications of all vehicles, machinery and plant prior to entering the construction site. Wash-downs and inspections should also be undertaken regularly for vehicles travelling to different parts of the site to minimise internal spread of weeds within the works area
- Establish a designated access track network and restrict all vehicle movements to designated access tracks. Enforce no off-road driving
- Undertake pre-construction inventory and mapping of all weed-affected areas and identify areas of high-risk that should be designated as no-go areas or areas requiring active weed management during and after construction
- Undertake periodic inspections of weed-affected areas throughout the construction period and implement weed control to weeds of management concern, including declared and environmental weeds
- Identify and control all declared weed infestations on the construction site throughout construction
- Monitor treated areas to assess the success of declared pest/weed eradication
- Rehabilitate and revegetate temporary works areas as soon as possible to minimise the potential for weed establishment
- Utilise stockpiled topsoil and mulched vegetation during landscaping and revegetation
- Utilise native species endemic to the region in revegetation to minimise importation of plants
- Undertake regular post-construction monitoring of rehabilitation areas and high-risk weed areas.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

- No establishment of previously unrecorded weed species at or near construction sites associated with the pipeline alignment.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.3 Operation phase impacts and mitigation

The operational phase will have relatively minor, localised impacts on ecological values. Impacts and mitigation measures are detailed below.

6.3.1 Injury and mortality of terrestrial wildlife

6.3.1.1 Potential impacts

Noting the pipeline will be buried once operational, the project has minimal potential to cause wildlife injury and mortality. Any risk would be from direct collision (e.g. with maintenance vehicles) or entanglement of wildlife with structures including exclusion fencing (should this be required to protect any above-ground infrastructure/for safety purposes). While occasional injury and mortality of fauna is anticipated, this will be at a level that impacts on individuals only with no anticipated impact on the long-term viability of local fauna populations.

6.3.1.2 Mitigation measures

The following measures will be instigated to mitigate injury and mortality of wildlife during the operation phase:

– Enforce on-site speed limits to restrict the incidence of vehicle strike. Enforce no off-road driving rules
– Educate maintenance and operations employees regarding the presence of conservation significant species, particularly species with increased risk of injury and mortality such as the squatter pigeon (southern), koala and ornamental snake
– Avoid the use of barbed wire in perimeter fencing wherever possible. Consider following the Queensland Government's guidelines for koala-friendly fencing where fencing required around permanent infrastructure
– Prohibit public recreational access to areas of high ecological sensitivity or high roadkill risk areas such as local drinking and breeding sites for the squatter pigeon (southern).

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No injury or mortality of conservation-significant species due to vehicle movements once the pipeline is operational
– No injury or mortality of conservation-significant species as a result of entanglement in fencing (or other site infrastructure).

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.3.2 Aquatic fauna injury and mortality at pipeline intakes and outlets

6.3.2.1 Potential impact

Operation phase impacts are primarily located at the intake site on the Fitzroy River, which has the potential to injure or result in mortality of resident aquatic fauna. Entrainment of biota has the potential to occur where intake velocities exceed the swimming speed of aquatic fauna, or where fauna can directly enter a wet well.

Water extraction from the intake structure presents a potential risk of physical harm and drowning of resident aquatic fauna at the river intake site. To mitigate the risk the intake structure will incorporate a design to reduce the potential for macroinvertebrate and fish entrainment, as outlined below. Therefore, the overall likelihood of fauna injury or mortality at the pipeline intake locations is considered low.

6.3 Operation phase impacts and mitigation

The operational phase will have relatively minor, localised impacts on ecological values. Impacts and mitigation measures are detailed below.

6.3.1 Injury and mortality of terrestrial wildlife

6.3.1.1 Potential impacts

Noting the pipeline will be buried once operational, the project has minimal potential to cause wildlife injury and mortality. Any risk would be from direct collision (e.g. with maintenance vehicles) or entanglement of wildlife with structures including exclusion fencing (should this be required to protect any above-ground infrastructure/for safety purposes). While occasional injury and mortality of fauna is anticipated, this will be at a level that impacts on individuals only with no anticipated impact on the long-term viability of local fauna populations.

6.3.1.2 Mitigation measures

The following measures will be instigated to mitigate injury and mortality of wildlife during the operation phase:

– Enforce on-site speed limits to restrict the incidence of vehicle strike. Enforce no off-road driving rules
– Educate maintenance and operations employees regarding the presence of conservation significant species, particularly species with increased risk of injury and mortality such as the squatter pigeon (southern), koala and ornamental snake
– Avoid the use of barbed wire in perimeter fencing wherever possible. Consider following the Queensland Government's guidelines for koala-friendly fencing where fencing required around permanent infrastructure
– Prohibit public recreational access to areas of high ecological sensitivity or high roadkill risk areas such as local drinking and breeding sites for the squatter pigeon (southern).

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No injury or mortality of conservation-significant species due to vehicle movements once the pipeline is operational
– No injury or mortality of conservation-significant species as a result of entanglement in fencing (or other site infrastructure).

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.3.2 Aquatic fauna injury and mortality at pipeline intakes and outlets

6.3.2.1 Potential impact

Operation phase impacts are primarily located at the intake site on the Fitzroy River, which has the potential to injure or result in mortality of resident aquatic fauna. Entrainment of biota has the potential to occur where intake velocities exceed the swimming speed of aquatic fauna, or where fauna can directly enter a wet well.

Water extraction from the intake structure presents a potential risk of physical harm and drowning of resident aquatic fauna at the river intake site. To mitigate the risk the intake structure will incorporate a design to reduce the potential for macroinvertebrate and fish entrainment, as outlined below. Therefore, the overall likelihood of fauna injury or mortality at the pipeline intake locations is considered low.

6.3.2.2 Mitigation measures

The following measures are proposed to avoid/minimise injury and mortality to aquatic fauna during operation:

– Placing the intake at a depth that aims to prevent bed scour
– Providing an adequate distance between the pump and the intake screens to reduce the risk of fauna being impinged of the intake screens
– Designing the intake to include scour protection by using suitable rock/grout construction.
– Flow rates will gradually increase into and out of the pipeline structures to prevent sudden changes in water velocity and turbulence to prevent physical harm to aquatic fauna such as turtles, platypus and fish
– Rapid drawdowns at the river extraction site will be avoided to maintain flow downstream and quality of aquatic habitat within the Fitzroy River
– A site-specific OEMP will be prepared to detail actions and procedures for the protection of the aquatic environments. The OEMP will include procedure for the control and management of weeds and feral pest species.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No aquatic fauna injured or killed at the pipeline intake infrastructure
– Aquatic habitat condition maintained within the Fitzroy River.

Regular monitoring and auditing will be undertaken in accordance with approval conditions, with corrective actions strictly enforced where performance criteria are not being met.

6.3.3 Disturbance of wildlife by light, noise and vibration

6.3.3.1 Potential impacts

Operation of the pipeline will have minimal, highly localised disturbances to wildlife from noise and light. Pumps required along the pipeline alignment will generate low frequency and amplitude noise impacts. These will have only localised impact on fauna within the immediate vicinity of pumping stations. Operation of the project will involve occasional vehicle movements to transport staff to and from the site which generate additional noise, however these impacts are anticipated to have limited ecological impact considering the low frequency of vehicle movements.

6.3.3.2 Mitigation measures

The following measures are being investigated to mitigate noise and light impacts on native wildlife:

– Incorporate routine noise-suppression design features in the design of the pumping stations
– Inspect and maintain all vehicles, machinery and plant regularly to minimise operational noise
– Prohibit employees from bringing domestic animals to the pipeline area when conducting operations/maintenance work.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– All equipment is to be inspected and maintained in accordance with operational CEMP.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

6.3.4 Introduction and spread of weeds and pests

6.3.4.1 Potential impacts

A maximum width of 10 m adjacent to the pipeline alignment will be permanently cleared to allow access for service and maintenance vehicles during the operation phase. Although access tracks could facilitate movement by feral predators, particularly wild dogs and foxes, it is unlikely that the project will increase introduced fauna species abundance beyond existing levels.

Operation activities typically has the potential to introduce and disperse invasive weeds through the movement of people and machinery. Additionally, established weed populations may be spread along the pipeline alignment by personnel and work vehicles during operation and decommissioning of the project. Given the project is located within a predominantly agricultural landscape, the risks of weed introductions carry heightened consequences. Strict vehicle hygiene and weed management protocols will be required to control risks of introducing or spreading weeds during the operational phase.

Operation of the pipeline and the intake structure have the potential to translocate aquatic flora as organic material (e.g. plant fragments and seeds) may be drawn into the pipeline and transferred to the receiving environment. Algae (particularly blue green algae), algal blooms and other water borne pest and weed species also have the potential to become a problem if they are not contained promptly at the beginning before entering the pipeline.

Aquatic pests and weed species may become more prevalent along the pipeline corridors as well as the intake structure due to the previous increase in disturbance of habitats during construction. Maintenance vehicles during routine management may also serve as vectors should weed washdown protocols be inappropriately addressed, allowing organic material to be transported upon the vehicle.

6.3.4.2 Mitigation measures

The following measures will be instigated to minimise the introduction and spread of introduced species during the operation of the project:

– Undertake prevention and management of pest animal and invasive species in accordance with the *Biosecurity Act 2014*. Likewise, management of declared local pests and invasive species will be undertaken in accordance with relevant local government strategies and plans, including the Gladstone Regional Council Biosecurity Plan 2021-25 (GRC 2021) and Rockhampton Regional Council Biosecurity Plan for Pest Management 2017-2021 (RRC 2017), as applicable
– Develop and implement a site-specific Weed and Pest Management Plan to inform all activities that outlines protocols to prevent the introduction of weed and pest species into the area and minimise the spread of declared weeds and pests along the pipeline alignment
– Runoff and sedimentation from easements to waterways will be minimised
– Maintain weed wash-down facilities for long-term use of maintenance staff. These facilities will be bunded and located away from drainage lines to minimise the risk of weed spread
– Enforce strict weed hygiene protocols including weed-washdowns and inspections for maintenance vehicles travelling along permanent pipeline and powerline easements
– Restrict all vehicle movements to designated access tracks. Enforce no off-road driving, unless required for safety reasons and following approval by the relevant GAWB person.

Performance criteria will be established to monitor and audit compliance with, and successful delivery of the actions outlined above. Specific details will be refined as construction plans are finalised, but as a general guide, these should include:

– No establishment of previously unrecorded weed species within the pipeline alignment.

Regular monitoring and auditing will be undertaken, with corrective actions strictly enforced where performance criteria are not being met.

7. Significant Impact Assessments

As identified in Section 1.2, EPBC approval has been granted for the project, with the controlling provisions being threatened species and ecological communities listed at the time of the approval. A SIA was undertaken in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines – MNES (May 2006) as part of the EIS and SEIS and the approval conditions based on this assessment for these MNES controlling provisions. In this report, a significant residual impact (SRI) assessment was undertaken in accordance with the Queensland *Significant Residual Impact Guideline* (DEHP 2014b) for 20 flora and fauna species currently listed under both the EPBC Act and NC Act that have been confirmed present or likely to occur. In addition, the grey-headed flying-fox (*Pteropus poliocephalus*) is only listed under the EPBC Act, and therefore, an SIA was undertaken for this species.

7.1 GSDA

7.1.1 Significant Impact on MNES and MSES species

This section assesses the significance of the GSDA impacts on MNES and MSES that have been confirmed present or are considered likely to occur within the GSDA study area. The significance of impact assessment has been undertaken in accordance with the Queensland Government's *Significant Residual Impact Guidelines* (DEHP 2014b). The grey-headed flying-fox is listed only under the EPBC Act and Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013). A summary of outcomes of the MNES and MSES significant impact assessment are presented in Table 7-1.

Table 7-1 Summary of residual significant impact assessment on MSES and MNES

Species	Significant impact	EPBC Approval	Assessed as MSES	Assessed as MNES
Flora				
Cycas megacarpa	Unlikely	✓	✓	
Samadera bidwillii	Unlikely	✓	✓	
Fauna				
Glossy black-cockatoo	Unlikely		✓	
Squatter pigeon (southern)	Likely	✓	✓	
White-throated needletail	Unlikely		✓	
Powerful owl	Unlikely		✓	
Greater glider (southern and central)	Likely		✓	
Yellow-bellied glider (south-eastern)	Likely		✓	
Koala	Likely		✓	
Grey-headed flying-fox	Likely	✓		✓

7.1.1.1 Cycas megacarpa

Conservation status and species ecology

Cycas megacarpa is listed as endangered under both the NC Act and the EPBC Act and was listed as an MNES at the time of the approval. It grows to 5 – 8 m in height, with a trunk 8 – 14 cm diameter and a glossy green crown with leaves 40 – 110 cm long (Queensland Herbarium 2007; DES 2021). Seeds are produced at the top of the trunk, within the crown of fronds and are ovoid in shape, and 35 – 45 mm in diameter (Hill 1992). As a member of the *Cycadaceae* family, the plant is dioecious (i.e. individual plants are either male or female).

It is thought that pollen dispersal occurs via wind and insects, including moths and beetles (James *et al*. 2018; DES 2021). Forster *et al*. 1994 (cited in Queensland Herbarium 2007) reported beetles from the genera Hapalips

and Ulomoides have been recorded on the male cones of *Cycas megacarpa*. Fruiting cones are produced on female plants between May and February, with seeds ripening from March onwards. Seeds do not germinate for at least nine months. Male cones shed pollen and female megasporophylls are receptive in November (Queensland Herbarium 2007). Seed dispersal is restricted by the large seed size, resulting in short range dispersal (James *et al.* 2018).

Significance of impact assessment

The project is considered unlikely to result in a significant residual impact on *Cycas megacarpa*. A significance of impact assessment of the project on *Cycas megacarpa* (endangered under the EPBC Act and NC Act) is provided in Table 7-2.

Table 7-2 Significance of impact on Cycas megacarpa

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** Although this species is considered likely to occur based on the species distribution and habitat present, no individuals have been confirmed present in the GSDA pipeline alignment during successive on-ground survey efforts by various consultants. Furthermore, the closest historical record is 5.5 km west of the GSDA study area. As such the project is unlikely to result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project is unlikely to result in a reduction in the extent of occurrence of the species.
Fragment an existing population	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no fragmentation of an existing population is expected to occur.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The project is unlikely to impact any local occurrences or their supporting habitats and opportunities for breeding and dispersal are not expected to be impeded by the project. As such, the project is unlikely to result in the isolation of habitats for the species or the formation of genetically distinct populations.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The project is unlikely to result in an invasive species becoming established within the GSDA pipeline alignment. Strict biosecurity measures will be incorporated in the Project's Construction Environmental Management Program (CEMP) to limit the introduction of weeds and other organic matter from outside of the project footprint.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not considered to be a key threat to *Cycas megacarpa*; however, hygiene management measures will be utilised during the construction phase to limit the introduction of organic matter into the GSDA pipeline alignment.
Interfere with the recovery of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no interference with the recovery of the species has been identified.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project area is not considered to be ecologically significant for this species.
Conclusion	The project is unlikely to result in a significant residual impact on *Cycas megacarpa*. No individuals or population have been recorded historically or during recent surveys efforts within the GSDA pipeline alignment. Biosecurity and hygiene measures will be incorporated in the project's CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.

7.1.1.2 Samadera bidwillii

Conservation status and species ecology

Samadera bidwillii is listed as a vulnerable under both the NC Act and the EPBC Act and was listed as an MNES at the time of the approval. It is a small shrub or tree that grows up to 6 m in height. Its leaves are stiff and leathery and up to 9 cm in length and 6 to 12 mm wide. Flowering occurs from November to March. Inflorescences occur in axillary clusters of 1 to 4; sepals are 0.75 mm to 1 mm long and petals are up to 2.5 mm long. The fruit is a drupe (up to 1 cm long) with short hairs (DotE, 2015). Fruiting typically occurs from February to April but only a small proportion of plants produce viable seed in any one season. Plants often resprout from rootstock following disturbance.

Samadera bidwillii typically inhabits lowland rainforest or rainforest margins and can also be found in other forest types including open forest and woodland and habitats adjacent to temporary and permanent watercourses (DotE, 2015).

Significance of impact assessment

The project is unlikely to result in a significant residual impact on *Samadera bidwillii*. A significance of impact assessment of the project on *Samadera bidwillii* (vulnerable under the EPBC Act and NC Act) is provided in Table 7-3.

Table 7-3 Significance of impact on Samadera bidwillii

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** Although this species is considered likely to occur based on the species distribution and habitat present, no individuals have been confirmed present in the GSDA pipeline alignment during successive on-ground survey efforts by various consultants. Furthermore, the closest historical record is 4.5 km from the GSDA study area. As such the project is unlikely to result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project is unlikely to result in a reduction in the extent of occurrence of the species.
Fragment an existing population	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no fragmentation of an existing population is expected to occur.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The project is unlikely to impact any local occurrences or their supporting habitats and opportunities for breeding and dispersal are not expected to be impeded by the project. As such, the project is unlikely to result in the isolation of habitats for the species or the formation of genetically distinct populations.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The project is unlikely to result in an invasive species becoming established within the GSDA pipeline alignment. Strict biosecurity measures will be incorporated in the Project CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not considered to be a key threat to *S. bidwillii*; however, hygiene management measures will be utilised during the construction phase to limit the introduction of organic matter into the GSDA pipeline alignment.
Interfere with the recovery of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, no interference with the recovery of the species has been identified.

Significant residual impact criteria	Assessment
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** No population has been recorded historically or during recent survey efforts within the GSDA pipeline alignment. Therefore, the project footprint is not considered to be ecologically significant for this species.
Conclusion	The project is unlikely to result in a significant residual impact on *Samadera bidwillii.* No individuals or population have been recorded historically or during recent surveys efforts within the GSDA pipeline alignment. Biosecurity and hygiene measures will be incorporated in the project's CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.

7.1.1.3 Glossy black-cockatoo

Conservation status and species ecology

The glossy black-cockatoo is listed as vulnerable under the NC Act. Glossy black-cockatoos occur in forest and open woodland areas of south-east Queensland and coastal New South Wales. The species has a specialist diet, feeding selectively on cones of *Casuarina* and *Allocasuarina*. The species forages widely throughout its range, moving between areas of foraging habitat, as feeding resources become available. Key food tree species include *Allocasuarina littoralis* (black she-oak), *Allocasuarina torulosa* (forest she-oak) and to a lesser extent, *Casuarina equisetifolia* (coastal she-oak), *Casuarina cunninghamiana* (river she-oak) and *Casuarina cristata* (belah) (Glossy Black Conservancy 2010). Glossy black-cockatoos nest in large living or dead hollow-bearing trees, typically in vertical chimneys 10 - 20 m above ground-level (Glossy Black Conservancy 2010).

Field survey results and distribution of suitable habitat

The glossy black-cockatoo was confirmed present during the Arup (2008) field surveys. One individual was recorded within remnant vegetation near the existing slurry pipeline easement in the southern extent of the GSDA study area. The species was not recorded during the 2022 field surveys. Predicted suitable foraging and nesting habitat is restricted in the south-east extent of the GSDA pipeline alignment. Narrow strips of *Casuarina cunninghamiana* were recorded along riparian woodland areas, providing potentially suitable foraging habitat for the species. The density of suitable hollow-bearing trees were low within woodland areas in proximity to suitable foraging habitat, but does provide limited potential suitable nesting habitat for the species. The distribution of predicted glossy black-cockatoo habitat is mapped in Figure 7-1.

Significance of impact assessment

The project is unlikely to result in a significant residual impact on the glossy black-cockatoo. A significance of impact assessment of the project on the glossy black-cockatoo (vulnerable under the NC Act) is provided in Table 7-4.

Table 7-4 Significance of impact on the glossy black-cockatoo

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The project will result in the loss of 4.68 ha of potential foraging and nesting habitat. This represents 0.04 % of the potential habitat available within a 5 km buffer. The glossy black-cockatoo has not been historically recorded within the GSDA pipeline alignment or study area (i.e. no records in desktop databases); however, one individual was recorded within the local landscape during the Arup (2008) field surveys. Potential breeding and nesting habitat was widely recorded along riparian corridors outside of the GSDA pipeline alignment. Pre-clearance surveys will be undertaken prior to clearing to identify and mark suitable nesting trees. Sequential clearing and the use of a fauna spotter-catcher during clearing will be included to further reduce the potential impacts on the species. Given the scarcity of records, and recognising the availability of habitat within the local landscape and the species' capacity to fly up to 12 km to forage, loss of strips of vegetation within the GSDA pipeline alignment are unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources (especially noting that the dearth of historical records indicates that

Significant residual impact criteria	Assessment
	adjacent habitats are unlikely to be at carrying capacity). 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 GSDA pipeline alignment is proposed to traverse waterways retaining suitable foraging habitat (i.e. *Casuarina cunninghamiana*) and woodland areas retaining potentially suitable nesting habitat (i.e. hollow-bearing trees). A large proportion of vegetation within the GSDA pipeline alignment retains regrowth vegetation or younger remnant vegetation that has been fragmented by linear infrastructure such as railways, roads, access tracks and pipelines. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. The project will result in a loss of 4.68 ha of potential habitat for the glossy black-cockatoo. This represents only a small percentage of the predicted habitat available within a 5 km buffer (0.04 %). Clearing along the GSDA pipeline alignment is unlikely to impact the species' ability to move nor access resources in adjacent habitats, as the proposed clearing extent is narrow (30 m) and mostly linear, and unlikely to generate edge effects or impact ecosystem structure and functioning. The nature of the project is unlikely to result in substantial indirect disturbance to the species that would inhibit the species' capacity to utilise adjacent habitat areas. The localised impacts experienced through loss of habitat or direct collision mortality is unlikely to result in a reduction in the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon.*
Fragment an existing population	**Unlikely** The GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared for linear infrastructure such as railways, roads, access tracks and pipelines. Given the species is known to travel up to 12 km to foraging habitats (Garnett *et al*. 1999), clearing a 30 m wide corridor for the GSDA pipeline alignment is not expected to impact the species' ability to move across the local landscape. Habitat losses projected for the project represent 0.04% of the predicted habitat available within a 5 km buffer. As such, this represents a relatively localised impact within the context of the species' home range and is not anticipated to fragment an existing population. It is noted that populations of this bird in the landscape are likely to be very low, noting the lack of historic records.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is not likely to cause any loss of gene transfer that would cause genetically distinct populations to form.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** There is potential for the spread of invasive weeds during the construction and operation phase. This potential will be addressed within the CEMP and could provide the opportunity to enhance the quality of the environment utilised by the glossy black-cockatoo by providing measures to mitigate introduced species. The removal of climbing weeds, particularly rubber vine (*Cryptostegia grandiflora*), as rubber vine can adversely affect trees of the genera *Eucalyptus* and *Corymbia*. With appropriate mitigation, the project is unlikely to result in the introduction of invasive species that are harmful to the glossy black-cockatoo.
Introduce disease that may cause the population to decline	**Unlikely** The project is not anticipated to introduce new diseases that may cause the species to decline. Although the glossy black-cockatoo is susceptible to Psittacine Beak and Feather Disease, the disease has not been recorded within Queensland glossy black-cockatoo populations and the project is highly unlikely to facilitate an increase in the transmission or incidence of this disease (DoE 2015).
Interfere with the recovery of the species	**Unlikely** The project will remove 4.68 ha of potentially suitable habitat, equating to 0.04% of habitat available within a 5 km buffer. Targeted pre-clearance surveys will be undertaken by a suitably trained fauna spotter catcher to identify and retain (where possible) suitable nesting trees within the GSDA pipeline alignment. Therefore, the project is unlikely to cause a loss of habitat during the construction phase. Noting the above points relating to very limited if any effects on local

Significant residual impact criteria	Assessment
	populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the glossy black-cockatoo.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** The project will result in a direct loss of 4.68 ha of potentially suitable foraging and nesting habitat for the glossy black-cockatoo. Clearing for the GSDA pipeline alignment therefore has the potential to directly impact the species nesting sites and suitable foraging trees (i.e. *Casuarina cunninghamiana*) along watercourses. During targeted pre-clearance surveys, a suitably trained fauna spotter catcher will identify and mark suitable nesting trees to be retained (where possible) during the construction phase of the project. Provided this is undertaken, disruption to significant breeding sites is considered unlikely. No ecologically significant feeding locations were recorded within the investigation areas; however, foraging habitat is locally abundant.
Conclusion	The project is unlikely to result in a significant residual impact on the glossy black-cockatoo. The project will result in a small loss (4.68 ha) of potentially suitable foraging and breeding habitat for the glossy black-cockatoo; however, given the species is known to travel up to 12 km to foraging habitats (Garnett *et al*. 1999) and large remnants of suitable habitat will persist within the surrounding landscape, clearing a 30 m wide corridor for the GSDA pipeline alignment is not expected to impact the species. Pre-clearance surveys will be undertaken to retain (where possible) suitable nesting habitat, to further reduce the impact to potential breeding places within the GSDA pipeline alignment.

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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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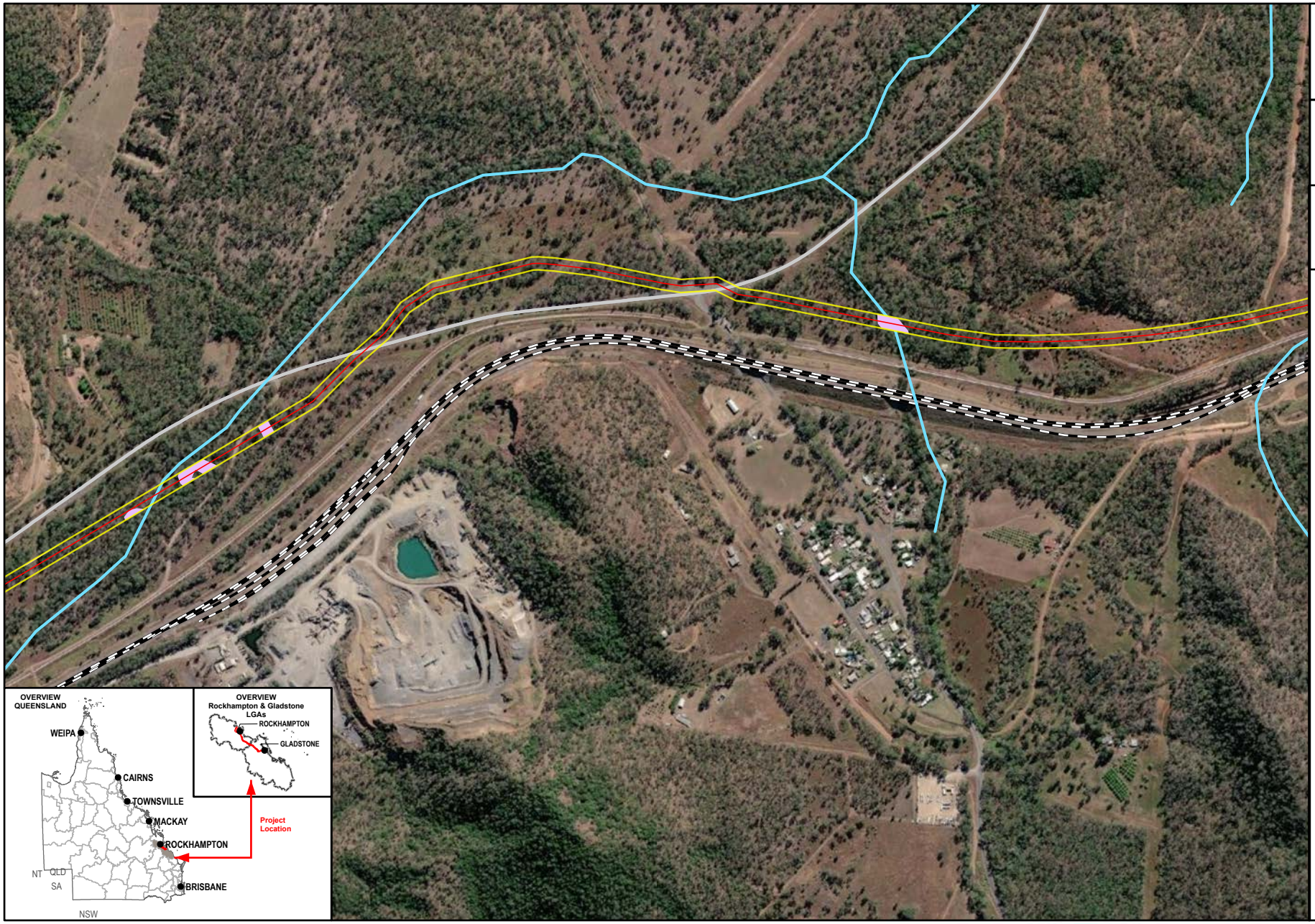
PROJECTION UTM Zone 56
(Datum GDA2020)

Compiled by:YS16239

Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1a
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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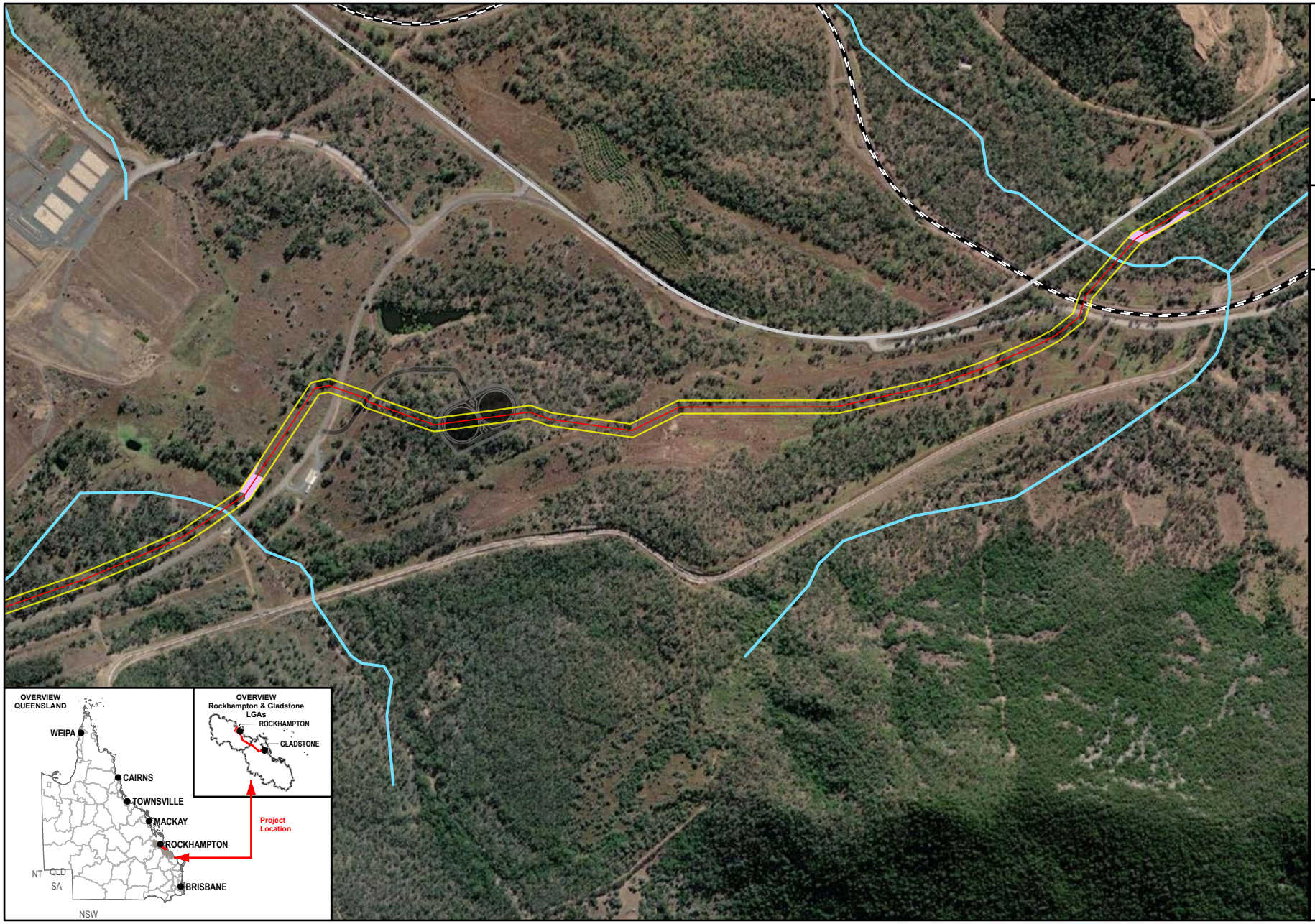
Figure 7-1b
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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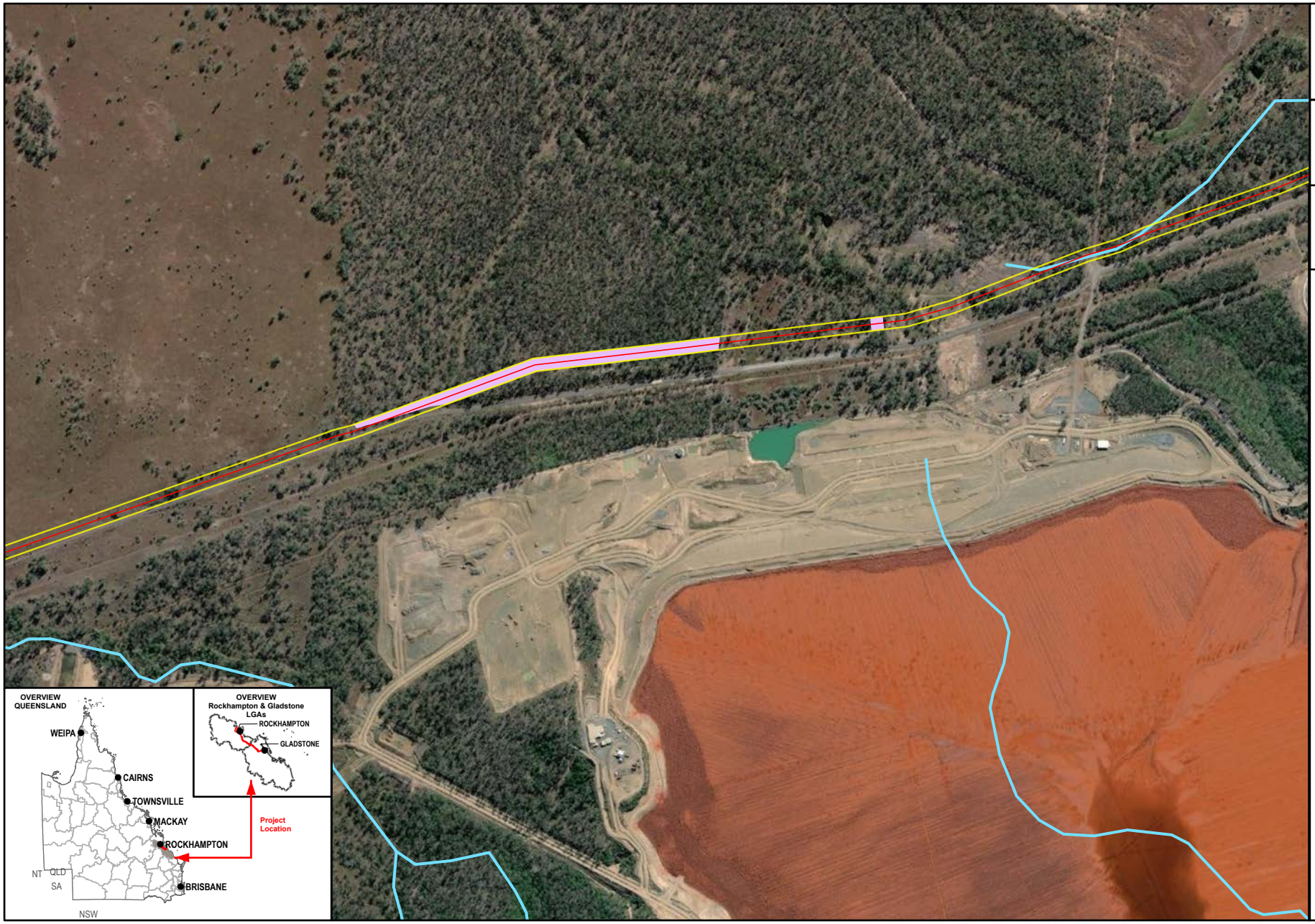
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1c
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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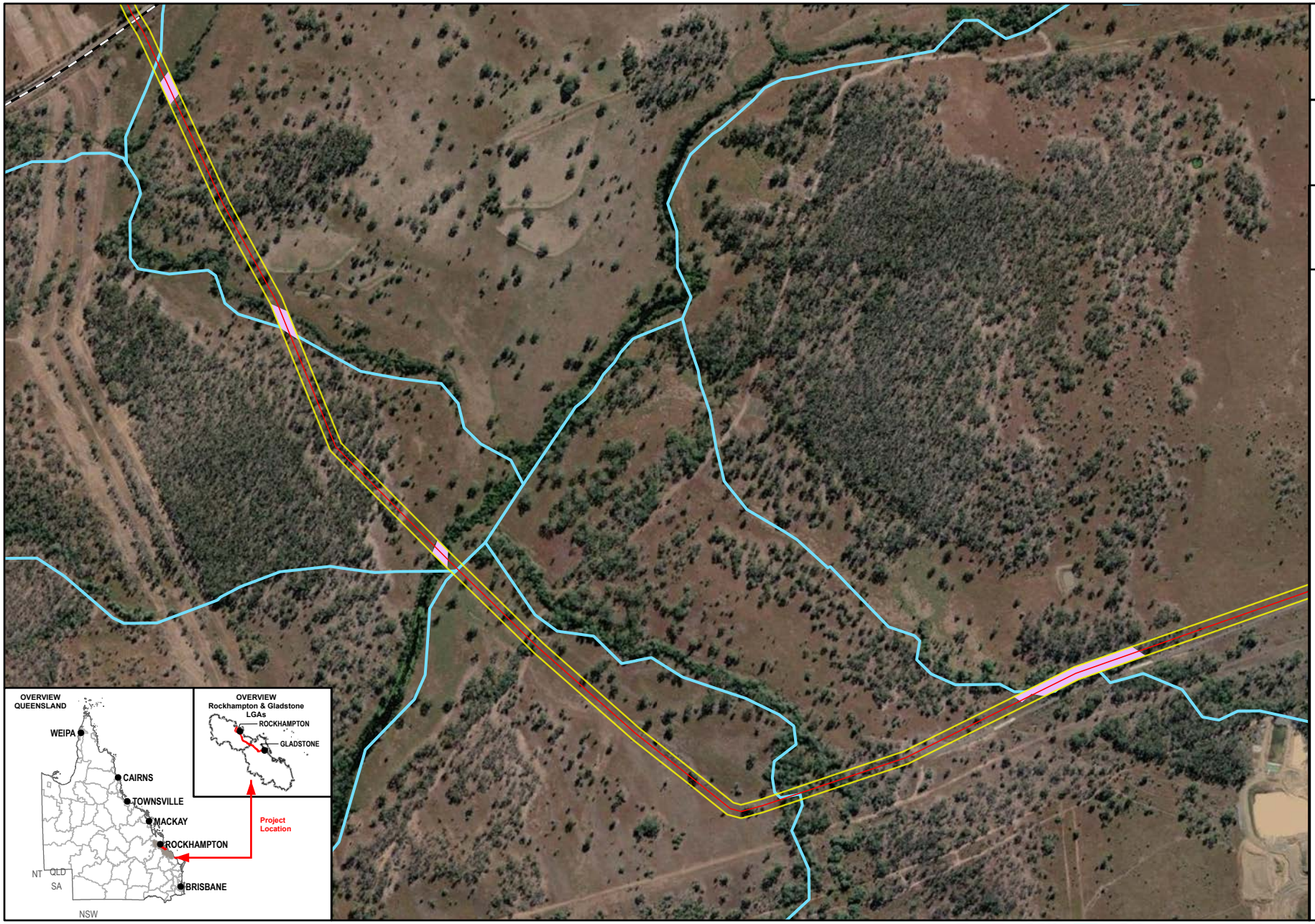
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1d
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area

000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Glossy Black-cockatoo Habitat
- Waterways
- Railways

Data Sources:
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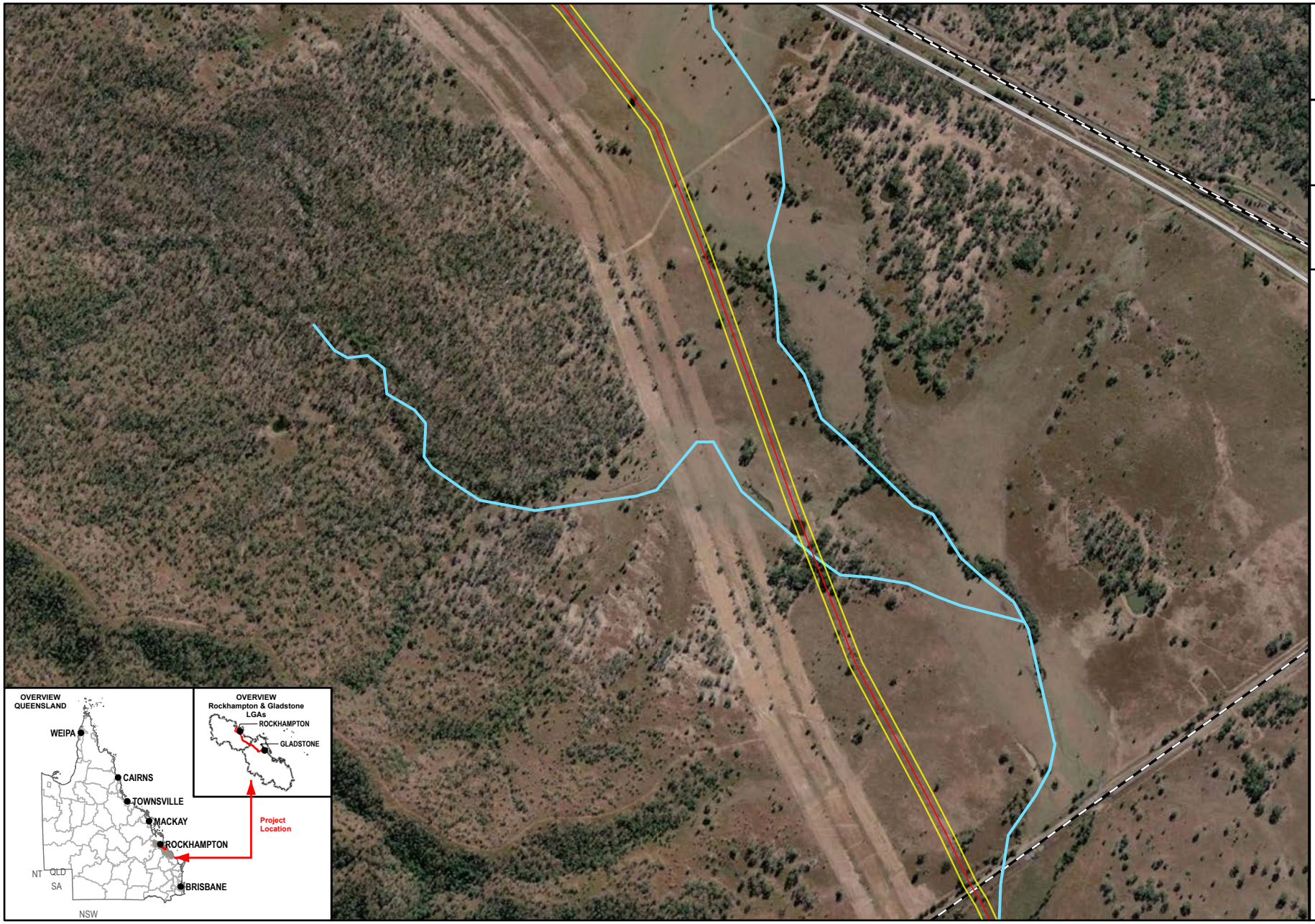
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1e
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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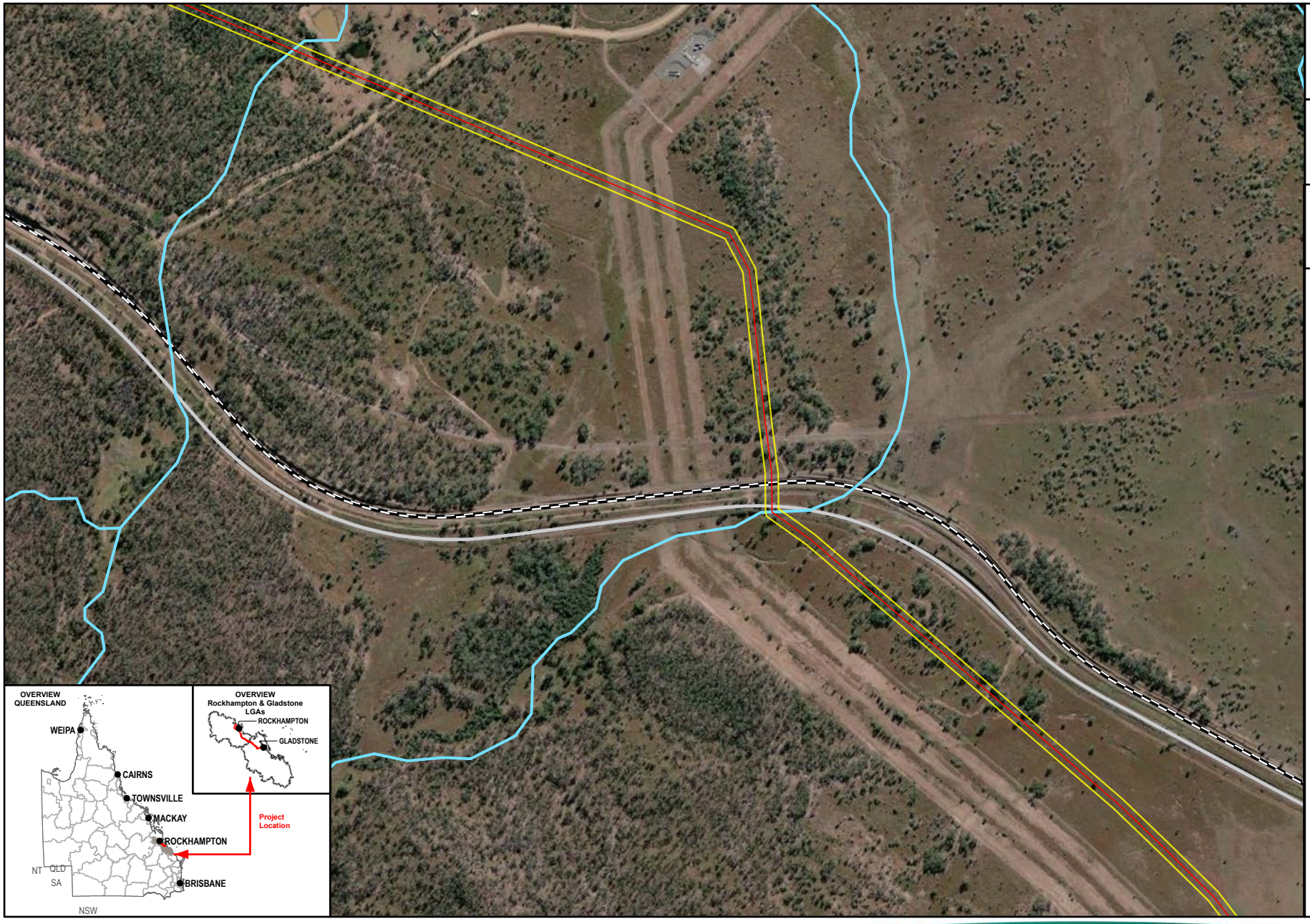
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1f
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-1g
Distribution of Glossy Black-cockatoo Habitat Within the GSDA Study Area
000-G-MAP-2424 Version: 3 Date:19/09/2022

7.1.1.4 Squatter pigeon (southern)

Conservation status and species ecology

The squatter pigeon (southern) is listed as vulnerable under the EPBC Act and NC Act and was listed as an MNES at the time of the approval. Its current distribution extends from central Queensland, west to Longreach and Charleville, and south to New South Wales (DCCEEW 2022h). The species occurs in remnant and regrowth open forest and woodland dominated by *Eucalyptus*, *Corymbia*, *Acacia* and *Callitris* species with tussock grassy understorey with 3 km of water sources (DCCEEW 2022h). Soils are generally a good predictor of their foraging and breeding habitat, which is generally restricted to well-draining, gravelly, sandy or loamy soils. These typically have a patchy ground layer composed of native perennial tussock grasses or a mix of native perennial tussock grasses and low shrubs or forbs (Squatter Pigeon Workshop 2011).

Breeding habitats are typically on stony rises within 1 km of permanent water (Squatter Pigeon Workshop 2011). In Queensland, the Commonwealth listing advice specifically nominates RE Land Zone 5 (well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills) and RE Land Zone 7 (lateritic (duplex) soils on low 'jump-ups' and escarpments) as suitable foraging and breeding habitat for the species. Ground-level vegetation is typically patchy with vegetation cover rarely exceeding 33 percent (Squatter Pigeon Workshop 2011). Waterbodies that are suitable for the squatter pigeon (southern) occur on RE Land Zones 10, 3 and 4 (DCCEEW 2022h). Hence, where natural foraging or breeding habitat occurs (i.e. on RE Land Zones 5 and 7), the squatter pigeon (southern) may be found in vegetation types growing on the above soil types (DAWE 2022b).

The subspecies is unlikely to move far from woodland trees which provide protection from predatory birds (Squatter Pigeon Workshop 2011). Where scattered trees still occur, and the distance of cleared land between remnant trees or patches of habitat does not exceed 100 m, individuals may be found foraging in, or moving across modified or degraded environments (Squatter Pigeon Workshop 2011).

Field survey results and distribution of suitable habitat

The squatter pigeon (southern) was confirmed present during the 2022 field surveys. Two individuals were recorded along two waterways (unnamed tributary of Larcom Creek and unnamed tributary of Police Creek) within the western corner of the GSDA study area. The species has been historically recorded at 35 locations within the desktop search extent (10 km buffer), the most recent record recorded in 2018. A series of low hills and rises with stony soils, woody debris and tussocky native grasses were recorded within the GSDA study area as potentially suitable breeding habitat for the subspecies. Areas of potentially suitable foraging habitat was recorded in open eucalypt woodland with grassy understorey. The distribution of predicted squatter pigeon (southern) habitat is mapped in Figure 7-2

Significance of impact assessment

The project is likely to result in a significant residual impact on squatter pigeon (southern). A significance of impact assessment of the project on squatter pigeon (southern) (vulnerable under the EPBC Act and NC Act) is provided in Table 7-5.

Table 7-5 Significance of impact on squatter pigeon (southern)

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The squatter pigeon (southern) is abundant within the region. The species has been historically recorded at 35 locations within the desktop search extent (10 km buffer) and was confirmed present within the GSDA study area, with two individuals recorded in close proximity waterways. The local population is not an important population at a national level. Important populations of the squatter pigeon (southern) have been identified in the Commonwealth approved conservation advice as all of the relatively small, isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland (Squatter Pigeon Workshop 2011). Populations in the southern parts of the subspecies range have experienced dramatic declines due to land clearing and grazing by sheep, which tends to have more significant adverse impacts on the subspecies than cattle grazing (TSSC 2015). The subspecies is still locally abundant within cattle grazing areas at the northern parts of its range (TSSC 2015). The loss of 17.31 ha of potential foraging habitat and 5.05 ha of potential

Significant residual impact criteria	Assessment
	breeding habitat (collectively representing 0.31 % of habitat within a 5 km buffer) is not expected to lead to a decline in the local squatter pigeon (southern) population and the subspecies will likely continue to persist in large numbers within the local area and surrounding region. Due to their localised and relatively temporary nature, construction and operation impacts associated with the GSDA pipeline alignment are unlikely to have any permanent impacts on the persistence of local and regional squatter pigeon (southern) populations. Increased vehicular movements during construction will increase the risk of mortality and injury of squatter pigeons; however, this will be managed through implementing speed limits and signage in areas that may support the subspecies. The project is expected to be relatively benign in terms of operational impacts with negligible noise, vibration, land disturbance and vehicular movements. Permanent speed limits and signage on internal roads and education of staff during inductions will minimise the risk of direct mortality by operational vehicles. The loss of habitat within the GSDA pipeline alignment are unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources. As such, the project is unlikely to lead to a long-term decrease in the size of a local population of the species.
Reduce the extent of occurrence of the species	**Unlikely** As detailed above, the squatter pigeon (southern) is abundant within the region. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. The project will result in a loss of 17.31 ha of potential foraging habitat and 5.05 ha of potential breeding habitat for the squatter pigeon (southern). This represents only a small percentage of the predicted habitat available within a 5 km buffer (0.31 %). Suitable foraging habitat and resources will persist in the area immediately adjacent to the GSDA pipeline alignment, and the extent and magnitude of mortality during construction is such that the subspecies will continue to persist locally. Given the relatively benign nature of the project in its operation phase, and the continued presence of suitable habitat within the local area, the project is unlikely to result in a reduction in the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon.*
Fragment an existing population	**Unlikely** Fragmentation of the existing squatter pigeon (southern) population is not expected, as the maximum width of clearing required for construction of the GSDA pipeline alignment (30 m) is narrow and linear. This is unlikely to present a permanent barrier to squatter pigeon (southern) movement. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. Habitat connectivity will be maintained among areas of habitat within and adjacent to the GSDA pipeline alignment, by maintaining ground-level substrates and vegetation, and by retaining existing unsealed tracks that provide important pathways for local squatter pigeon (southern) movement. The implementation of the Weed Management Plan is expected to maintain suitable ground-level habitat and continue to facilitate ground-level movement of the squatter pigeon (southern). Based on these considerations, the project is unlikely to fragment the existing squatter pigeon (southern) population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the subspecies' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any loss of gene transfer that would cause genetically distinct populations to form.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The project footprint is currently impacted by weed and pest species that could be harmful to the squatter pigeon (southern). The presence of these invasive species is unlikely to be exacerbated by the project, and any risks of their establishment will be managed via a site-specific CEMP and operational EMP.
Introduce disease that may cause the population to decline	**Unlikely** Recognised threats to the squatter pigeon (southern) do not include diseases. It is however, not expected that the project would result in the introduction of disease.

Significant residual impact criteria	Assessment
Interfere with the recovery of the species	**Unlikely** The project is unlikely to interfere substantially with the recovery of the species. The loss of habitat is unlikely to be significant, representing 0.31 % within a 5 km buffer. Implementation of a CEMP for the project has the potential to increase the value of local habitats through the control of weed and pest species. Local noise disturbance and mortality threats associated with the project are also expected to be low. Noting the above points relating to very limited if any effects on local populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the squatter pigeon (southern).
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Likely** The project will require the clearing of 17.31 ha of potentially suitable foraging habitat and 5.05 ha of potentially suitable breeding habitat for the squatter pigeon (southern). Although the GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared, the project will result in a loss of suitable foraging and breeding habitat. While the project is not expected to cause a long-term decline in the local population, reduce its extent of occurrence, cause adverse habitat fragmentation effects nor interfere with the recovery of the species, the loss of suitable squatter pigeon (southern) habitat within the GSDA pipeline alignment is likely to result in disruption to ecologically significant foraging and breeding locations.
Conclusion	The project is likely to result in a significant residual impact on the squatter pigeon (southern). Although the GSDA pipeline alignment has been located within areas that have been previously cleared for agricultural practices and linear infrastructure such as railways, roads, access tracks and pipelines, the project will require the clearing of 22.36 ha of suitable foraging and breeding habitat within the GSDA pipeline alignment.

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report

Figure 7-2a

Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area

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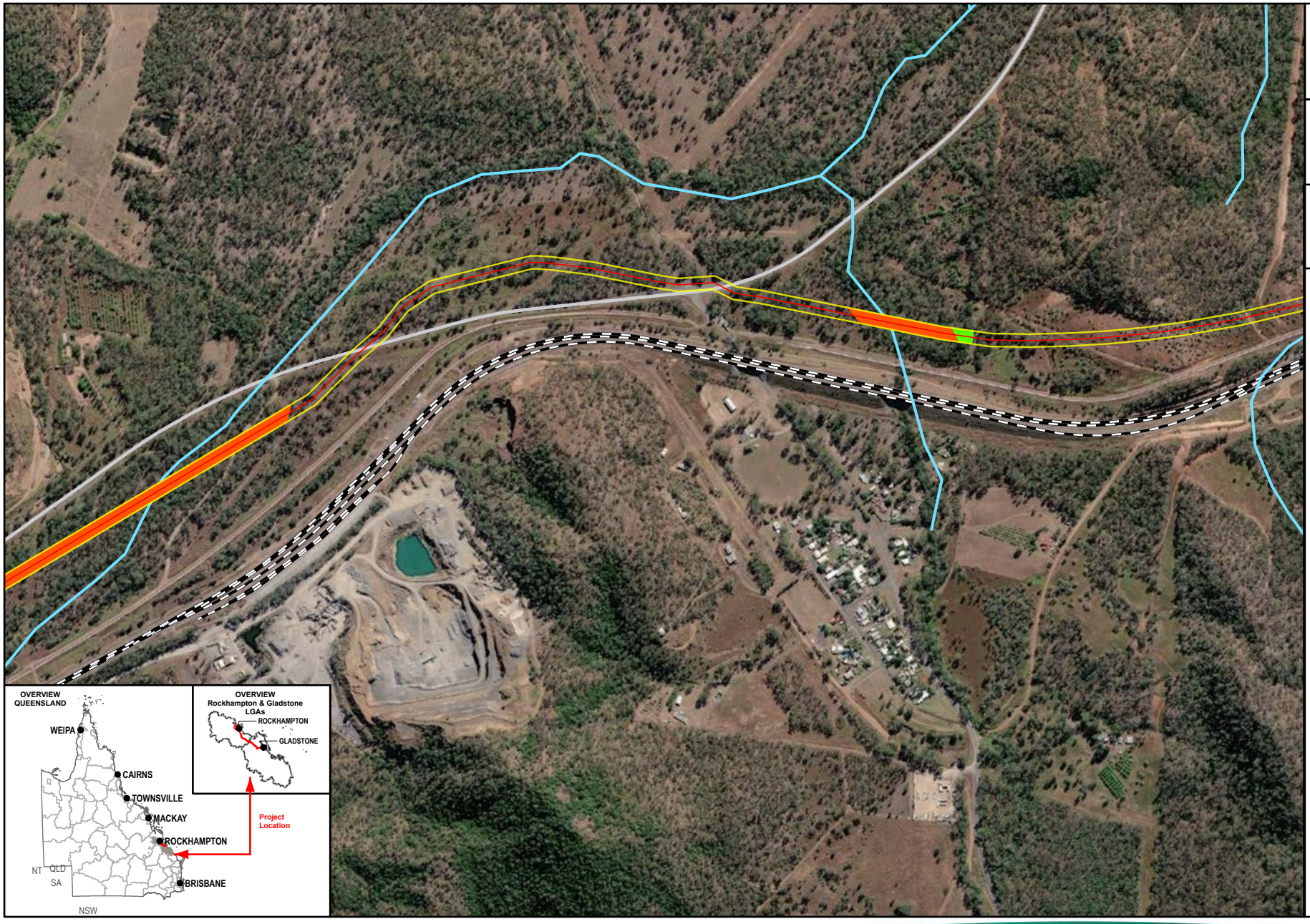

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-2b
Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area
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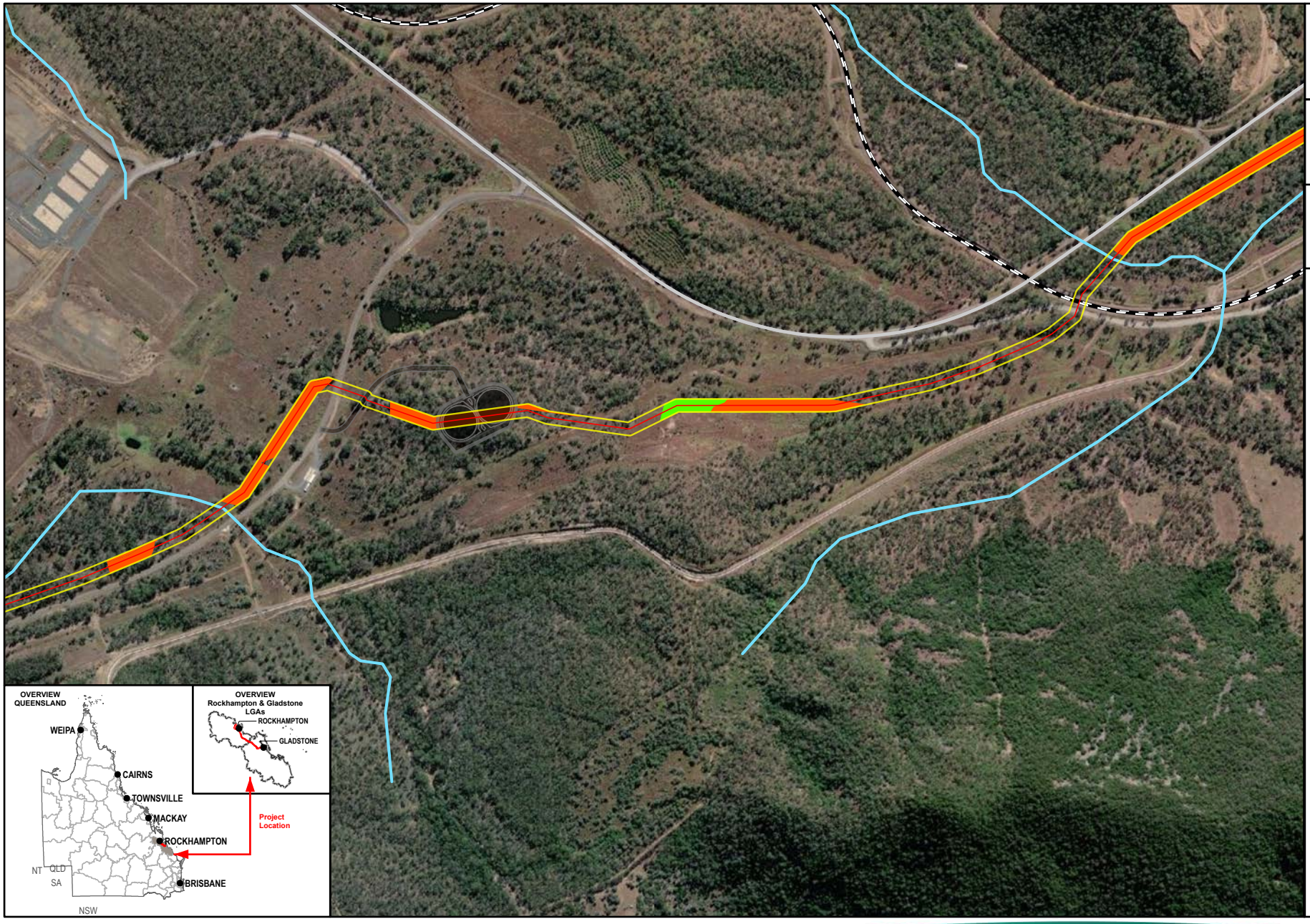

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 7-2c

Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area

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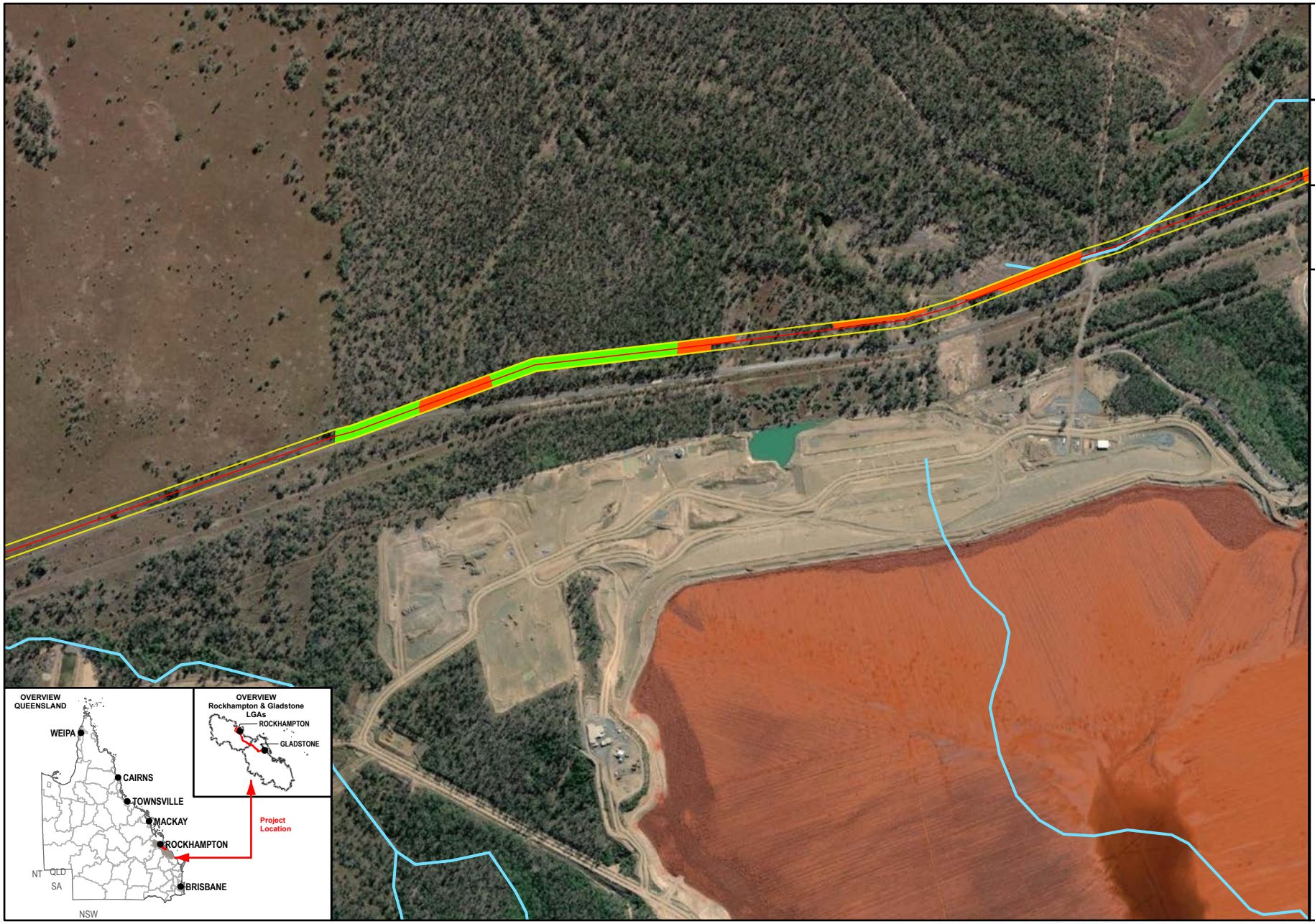

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 7-2d

Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area

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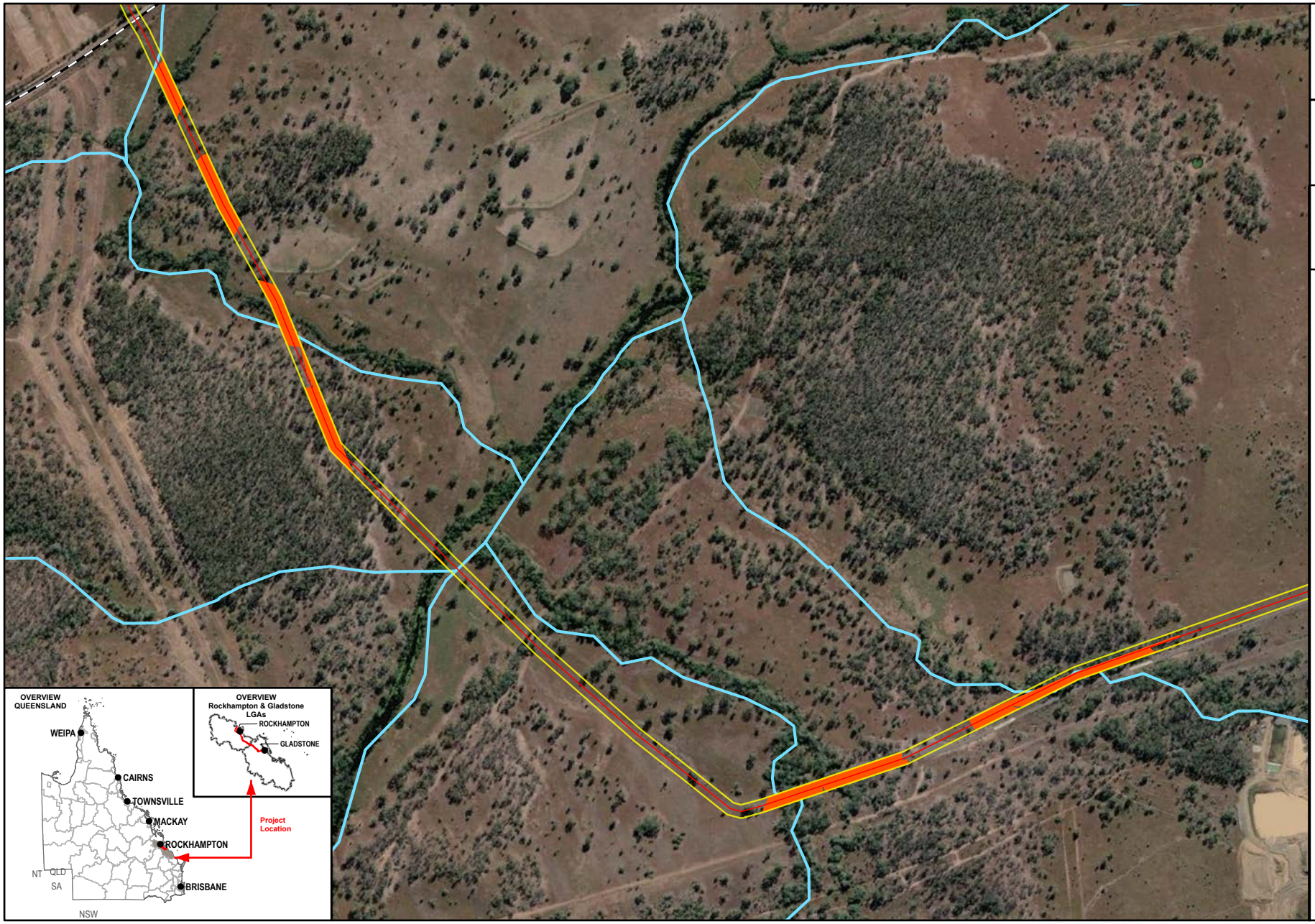

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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Figure 7-2e
Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area
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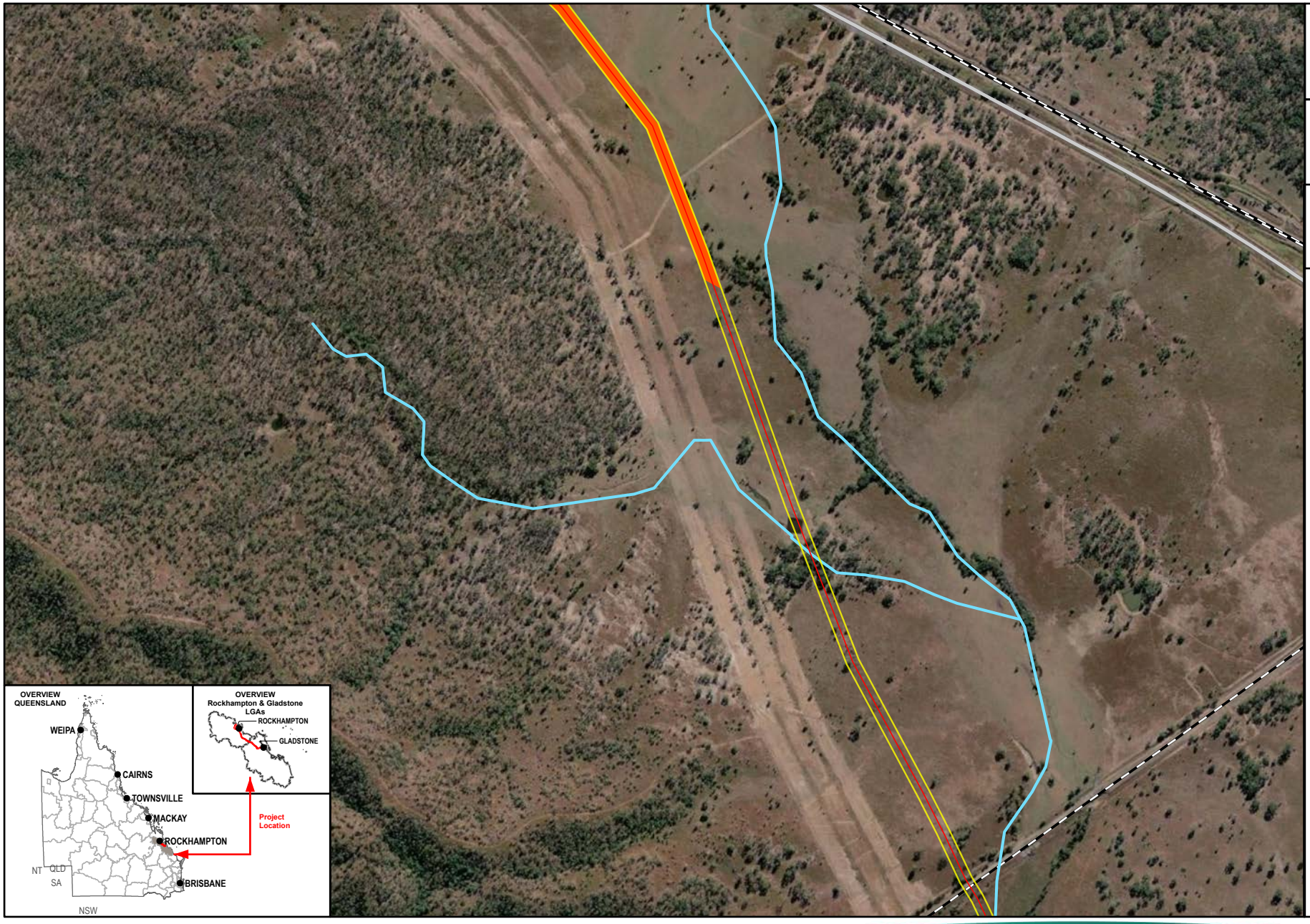

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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Figure 7-2f

Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area

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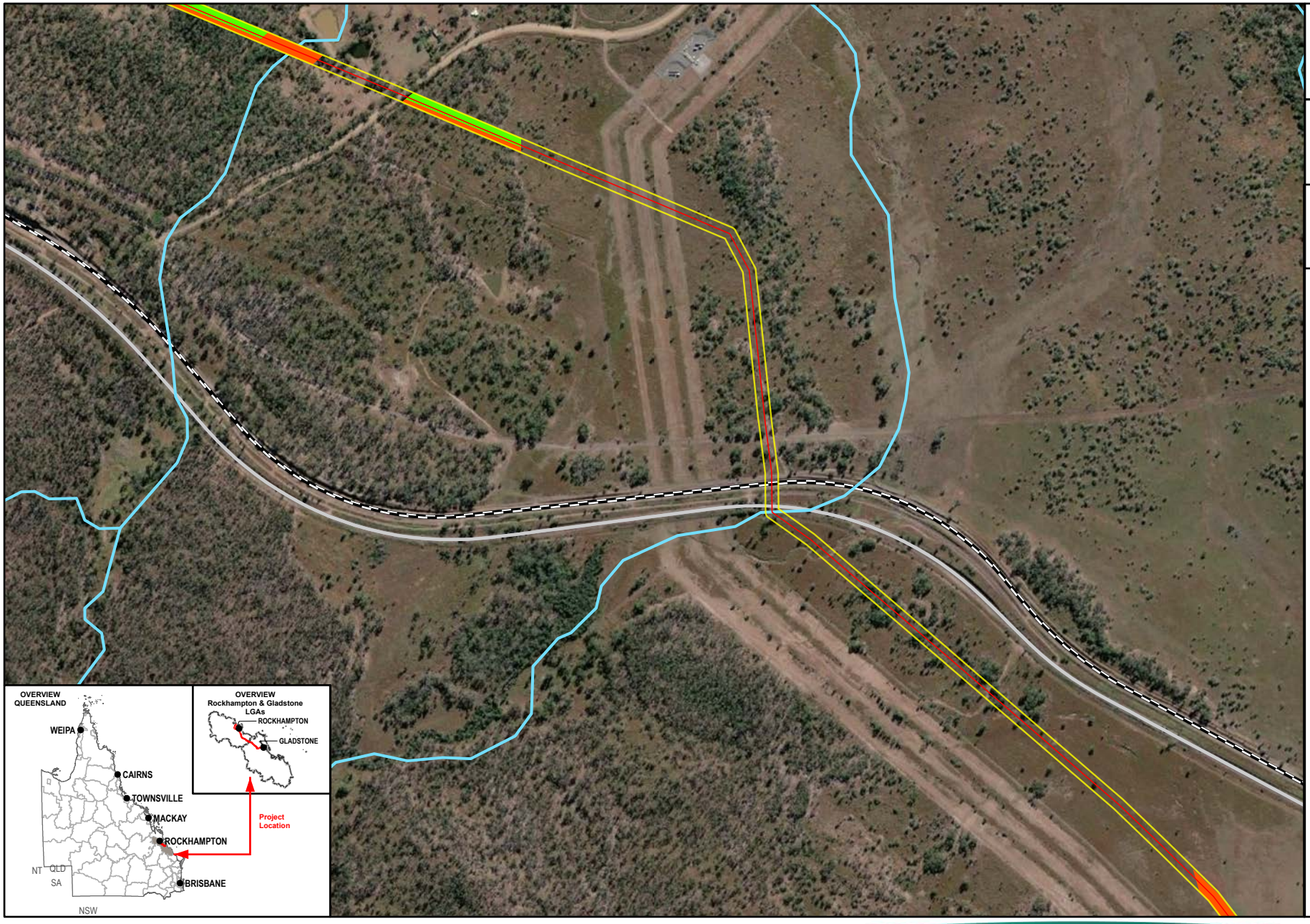

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- GSDA Pipeline Alignment
- Study Area

Predicted Squatter Pigeon (Southern) Habitat

Habitat Type

- Potential Breeding Habitat
- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

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Figure 7-2g
Distribution of Squatter Pigeon (Southern) Habitat Within the GSDA Study Area
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7.1.1.5 White-throated needletail

Conservation status and species ecology

The white-throated needletail is listed as vulnerable and migratory under the EPBC Act and vulnerable under the NC Act, but not listed as an MNES at the time of the approval. The species is almost exclusively aerial, occurring from heights of less than 1 m up to more than 1000 m above the ground (TSSC 2019). Recent research has shown that while the species is predominantly aerial, the white-throated needletail does roost on land at least occasionally, with roosts typically located in tall woodland on ridgelines and clifftops, where the birds can easily alight (Tarburton 2021). The species forages at heights up to cloud height over a range of habitat types including woodland, open forest, rainforest, heathland and partly cleared pasture and agricultural land (TSSC 2019). The species does not breed in Australia but occurs widely throughout Australia during the non-breeding period (TSSC 2019).

Field survey results and distribution of suitable habitat

The species was not recorded in field surveys but is considered likely to occur due to the presence of nearby historical records and the species' wide-ranging nature. Substantial areas of potential roosting habitat are located on ridgetops adjacent to the GSDA study area. No suitable roosting habitat occurs within or immediately adjacent to the GSDA study area. The species has the potential to forage across the entire GSDA study area at heights between 15 m and 1000 m.

Significance of impact assessment

The project is unlikely to result in a significant residual impact on the white-throated needletail. A significance of impact assessment of the project on the white-throated needletail (vulnerable under the EPBC Act and NC Act) is provided in Table 7-6.

Table 7-6 Significance of impact on the white-throated needletail

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The white-throated needletail has been historically recorded at four locations within the desktop search extent (10 km buffer), the closest record occurring approximately 100 m from the GSDA pipeline alignment near Yarwun. The species is regarded as a transient visitor to the GSDA study area, moving through the region in response to climatic conditions (e.g. bushfires, wind fronts and storm fronts). Given the species' capacity for large-scale migration and its enigmatic patterns of movement and occurrence, the concept of 'localised populations' is difficult to ascribe to this bird. The species is predominantly aerial and is generally not reliant on terrestrial habitats (DCCEEW 2022i). While the species does occasionally utilise terrestrial roosting sites, all nearby terrestrial roosting habitats are located on ridgetops away from the project and is unlikely to be directly or indirectly impacted by the construction and operation of the project.
Reduce the extent of occurrence of the species	**Unlikely** No potential habitat for the white-throated needletail will be directly or indirectly impacted by the project. The species has an extensive capacity for movement and is unlikely to experience any localised decline that would cause the species to no longer persist within the area. The project is likely to be relatively benign in its impact on the species during the operational phase.
Fragment an existing population	**Unlikely** The white-throated needletail is highly nomadic and can form large, mixed-species feeding flocks. This near-exclusively aerial, migratory species is capable of long-distance flight. The species' movements are unlikely to be restricted by the project. As such, the project is unlikely to fragment the existing population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any loss of gene transfer that would cause genetically distinct populations to form.

Significant residual impact criteria	Assessment
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** No invasive species are identified as threats to the white-throated needletail. The extent of clearing for the GSDA pipeline alignment may increase the accessibility of introduced predators including dogs, foxes and cats into the site. Pest fauna management practices will be implemented throughout the construction and operations periods and are anticipated to decrease the abundance of invasive predators, further reducing the species' vulnerability within the GSDA pipeline alignment.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not identified as a key threat to the white-throated needletail. This species' almost exclusively aerial habit means it is unlikely to have many opportunities to contract diseases that could threaten the viability of individuals and populations. The project is therefore unlikely to introduce disease that cause the species to decline.
Interfere with the recovery of the species	**Unlikely** The proposed works are considered unlikely to negatively impact the species, let alone interfere with the recovery of the species.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** The species is predominantly aerial, foraging at heights up to cloud height over a range of habitat types (TSSC 2019). The white-throated needletail is a non-breeding visitor to Australia, and breeds between October and April throughout Siberia, China, Japan and Mongolia (DCCEEW 2022i). As such, habitats within the GSDA pipeline alignment are not considered ecologically significant.
Conclusion	The project is unlikely to result in a significant residual impact on the white-throated needletail. The species is predominantly aerial. All nearby terrestrial roosting habitats are located on ridgetops away from the project and are unlikely to be directly or indirectly impacted by the construction and operation of the project.

7.1.1.6 Powerful owl

Conservation status and species ecology

The powerful owl is listed as vulnerable under the NC Act. The species occurs in a range of habitats with mature hollow-bearing trees including mountain forests and woodlands, coastal forests, woodlands, pine plantations and urban areas (Higgins 1999). Preferred habitat includes forests and woodlands with a high abundance of large trees. Mating pairs occupy a large home range (Higgins 1999). The species typically nests in large hollow-bearing trees in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (Schodde and Mason 1980; Higgins 1999). The species typically roosts in dense groves of mid-storey vegetation within closed forest, including rainforest, wet sclerophyll forest, mangrove forest, *Melaleuca*, *Acacia* and *Casuarina* in sheltered gullies typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls. The species typically does not occur within fragmented forest remnants <200 ha (Kavanagh and Stanton 2002). The species relies on the presence of mature, hollow-bearing trees for nesting sites and also to provide den sites for the hollow-dwelling arboreal mammals which form the bulk of its prey (Davey 1993; Milledge *et al*.1991; Higgins 1999). Despite the species' reliance on old growth forest, it does appear to be tolerant of some levels of selective logging, with owls persisting in areas that have been exposed to light, moderate and heavy logging. Nesting appears to be restricted to unlogged areas (Kavanagh and Peake 1993; Kavanagh and Bamkin 1995; Kavanagh 1997).

Field survey results and distribution of suitable habitat

The powerful owl was not recorded during the field surveys within the GSDA study area. Survey effort for the powerful owl included two nights of 2-3 hours of spotlighting within potentially suitable habitat in the GSDA study area. The species is considered likely to occur due to the presence of suitable habitat within and adjacent to the GSDA study area and the species has been historically recorded at 15 locations within the desktop search extent (10 km buffer), the most recent recorded in 2011 approximately 100 m from the GSDA pipeline alignment. Suitable habitat for the species was observed within a large area of remnant vegetation immediately north of Aldoga Road. This area was identified as suitable habitat for the species as it retains large, mature hollow-bearing trees, and suitable nesting and denning habitat for the arboreal mammals upon which the powerful owl preys. However, within this area, the GSDA pipeline alignment is located along an existing fence line which has been previously cleared. Therefore, low densities of suitable hollow-bearing trees occur within the GSDA pipeline alignment. The distribution of predicted powerful owl habitat is mapped in Figure 7-3.

Significance of impact assessment

The project is unlikely to result in a significant residual impact on the powerful owl. A significance of impact assessment of the project on the powerful owl (vulnerable under the NC Act) is provided in Table 7-7.

Table 7-7 Significance of impact on the powerful owl

Significant residual impact criteria	Potential to occur
A long-term decrease in the size of a local population	**Unlikely** The project is not expected to result in a long-term decrease in the size of the local powerful owl population. The project will result in loss of 2.33 ha of potential nesting habitat. This represents 0.03 % of the potential nesting habitat available within a 5 km buffer. The powerful owl has been historically recorded at 15 locations within the desktop search extent (10 km buffer), the closest record occurring approximately 100 m from the GSDA pipeline alignment near Yarwun. Given the low density at which powerful owls typically occur, and the availability of potential habitat that will remain available within their home range, the impacts of clearing on the powerful owl are anticipated to be negligible. Clearing of vegetation has the potential to cause direct injury or mortality of roosting or nesting individuals. However, this risk will be mitigated by undertaking targeted pre-clearance surveys prior to construction to identify nesting habitat and engaging suitably qualified and experienced fauna spotter-catchers to supervise all clearing of predicted breeding habitat. This will reduce the risk of individual injury or mortality during construction. This species is not considered to be at risk of vehicle strikes. The loss of vegetation within the GSDA pipeline alignment is unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources (especially noting that the species is highly mobile and has ability to disperse over relatively cleared

Significant residual impact criteria	Potential to occur
	landscapes) Overall, the species is unlikely to experience a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** The loss of woodland habitat is seen as the primary factor influencing the decline of the powerful owl (Webster *et al*. 1999, NSW Scientific Committee 2008). Due to their nesting requirements, powerful owls are reliant on large patches of remnant woodlands with trees from 100 to 500 years old (Kavanagh 1997; Loyn *et al*. 2001). The GSDA pipeline alignment is proposed to traverse a small area of remnant vegetation that retains large, mature hollow-bearing trees. In contrast, much of the remainder of areas within GSDA pipeline alignment support regrowth vegetation or younger remnant vegetation that has been fragmented by linear infrastructure such as railways, roads, access tracks and pipelines. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. The project will result in a loss of 2.33 ha of potential habitat for the powerful owl. This represents only a small percentage of the predicted habitat available within a 5 km buffer (0.03 %). Clearing along the GSDA pipeline alignment is unlikely to impact the species' ability to move nor access resources in adjacent habitats, as the proposed clearing extent is narrow (30 m) and mostly linear, and unlikely to generate edge effects or impact ecosystem structure and functioning. The nature of the project is unlikely to result in substantial indirect disturbance to the species that would inhibit the species' capacity to utilise adjacent habitat areas. The powerful owl typically maintains large territorial home ranges and occurs in low local densities. The localised impacts experienced through loss of habitat or direct collision mortality is unlikely to result in a reduction in the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon*.
Fragment an existing population	**Unlikely** Fragmentation of habitat throughout the east coast of Australia has meant the powerful owl has contracted from a single continuous population to a series of isolated residual populations (DSE 2004). While the powerful owl is reliant on large, interconnected remnants of woodland habitat, only utilising remnants larger than 200 ha (Kavanagh 1997; Kavanagh and Stanton 2002), the species can tolerate low level disturbances, persisting in disturbed woodland provided it is connected to more extensive woodland (Debus and Chafer 1994). Given the species' large home range, about 1,000 ha per pair (Schodde and Mason 1980), and ability to disperse over relatively cleared landscapes (NSW Scientific Committee 2008), the GSDA pipeline alignment is not expected to result in fragmentation of the local powerful owl population. The GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared. Within the area that is considered suitable habitat for the powerful owl, the proposed GSDA pipeline alignment follows an existing fence line which has been previously cleared and is located approximately 70 m from Aldoga Road. Habitat losses projected for the project represent 0.03% of the predicted habitat available within a 5 km buffer. As such, this represents a relatively localised impact within the context of the species' home range and is not anticipated to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any loss of gene transfer that would cause genetically distinct populations to form.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** Invasive pest species such as foxes, cats and dogs represent a potential threat to powerful owl fledglings (McNabb 1987) and are known to occur within the GSDA pipeline alignment. Implementation of the Pest Management Plan will help in limiting the impact that these species have on the local powerful owl population.

Significant residual impact criteria	Potential to occur
Introduce disease that may cause the population to decline	**Unlikely** Powerful owls are not subject to high disease risks (Debus 1997). Beak and feather disease virus, which causes psittacine beak and feather disease has been reported to occur within the species (Sarker *et al* 2015; DoE 2015). However, this has not been recorded within Queensland. Individuals have been known to have contracted botulism from ingestion of affected roadkill (CSIRO 1996). Regardless, the project is not anticipated to introduce new diseases that may cause the species to decline.
Interfere with the recovery of the species	**Unlikely** The project will remove 2.33 ha of potentially suitable habitat, equating to 0.03% of habitat available within a 5 km buffer. Adjacent remaining habitat is connected to an extensive network of suitable habitat well in excess of the 200 ha that is considered to be needed for the species. Targeted pre-clearance surveys will be undertaken by a suitably trained fauna spotter-catcher to identify and retain (where possible) trees with large hollows within the GSDA pipeline alignment. Therefore, the project is unlikely to cause a loss of habitat during the construction phase. Noting the above points relating to very limited if any effects on local populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the powerful owl.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** The project will require the clearing of 2.33 ha of potentially suitable nesting and foraging habitat for the powerful owl. While old-growth remnant woodland with mature hollow-bearing trees were identified within the GSDA study area, the GSDA pipeline alignment has been largely located along an existing fence line which has been previously cleared, and therefore, a large proportion of hollow-bearing trees will be avoided during clearing. Trees retaining large hollows within the GSDA pipeline alignment, will be identified and marked by a suitably trained fauna spotter catcher during the pre-clearance surveys. These marked trees will be retained (where possible) during the construction phase of the project to reduce the loss of potentially suitable breeding places. Provided this is undertaken, disruption to significant feeding and nesting sites is considered unlikely.
Conclusion	The project is unlikely to result in a significant residual impact on the powerful owl. The project will result in a loss (2.33 ha) of potentially suitable foraging and breeding habitat for the powerful owl; however, given the low density at which powerful owls typically occur, and the availability of potential habitat that will remain available within their home range, the impacts of clearing on the powerful owl are anticipated to be negligible. Pre-clearance surveys will be undertaken to retain (where possible) suitable nesting habitat, to further reduce the impact to potential breeding places within the GSDA pipeline alignment.

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Legend

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Figure 7-3a
Distribution of Powerful Owl Habitat Within the GSDA Study Area
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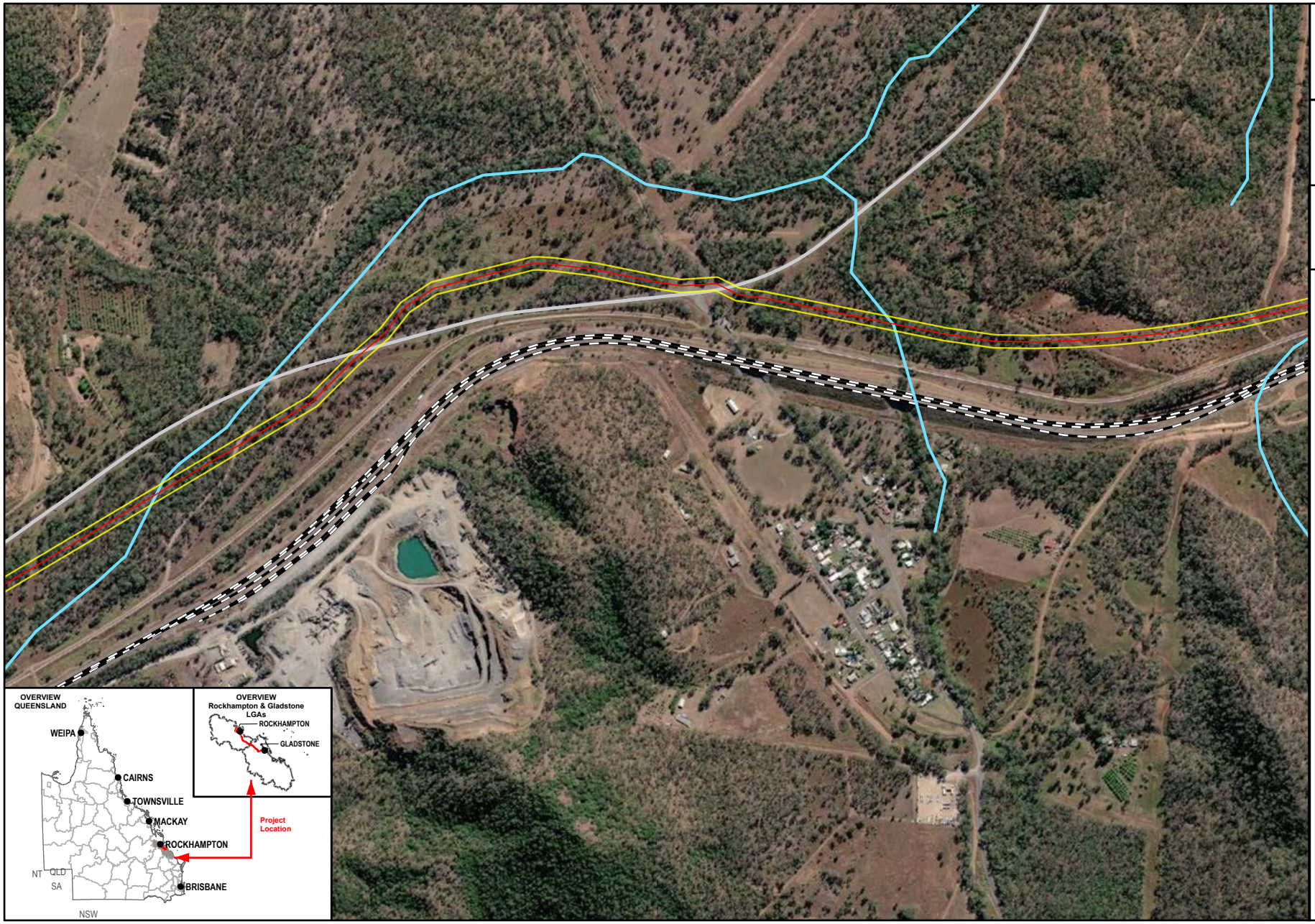

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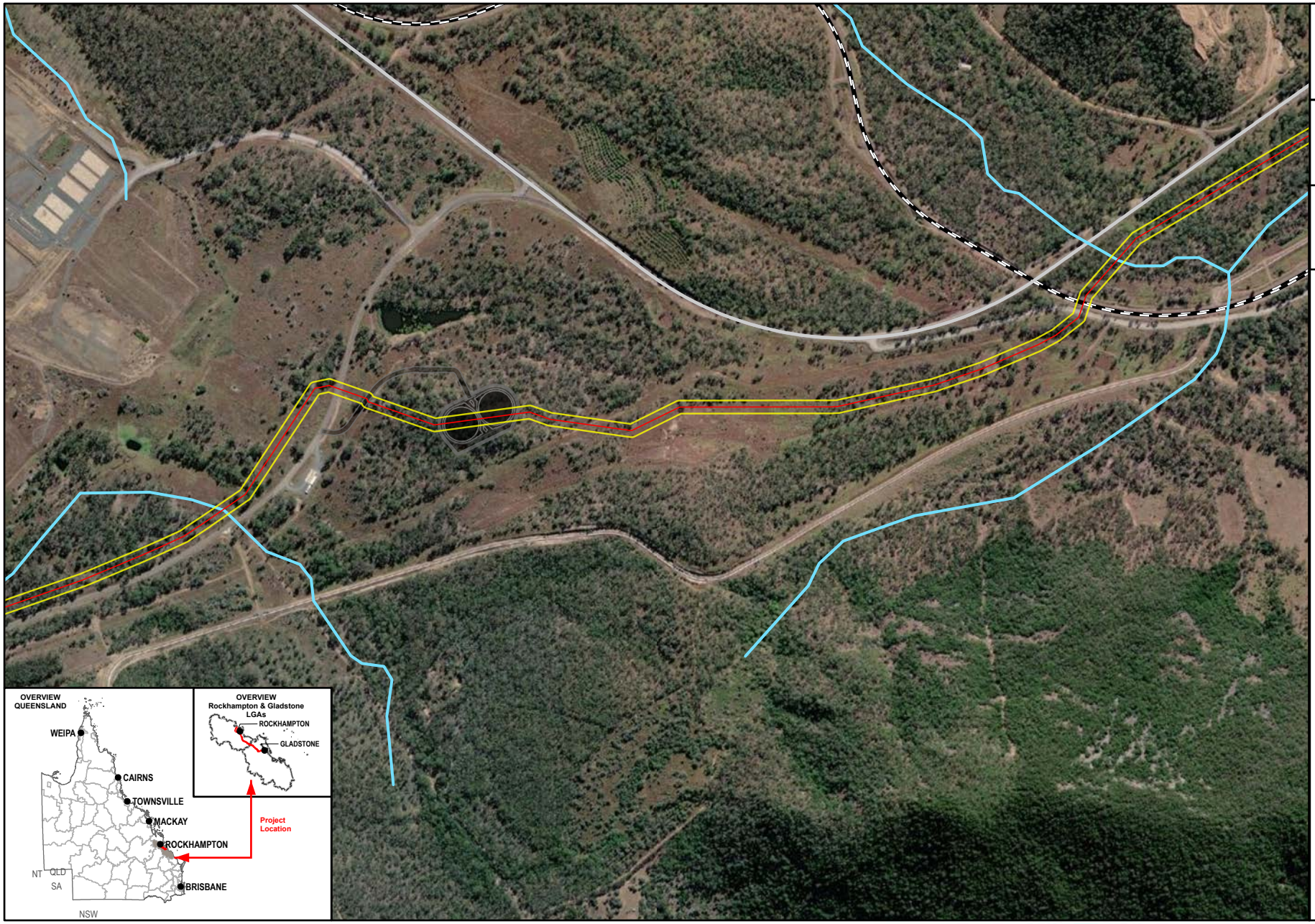
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-3b
Distribution of Powerful Owl Habitat Within the GSDA Study Area
000-G-MAP-2425 Version:3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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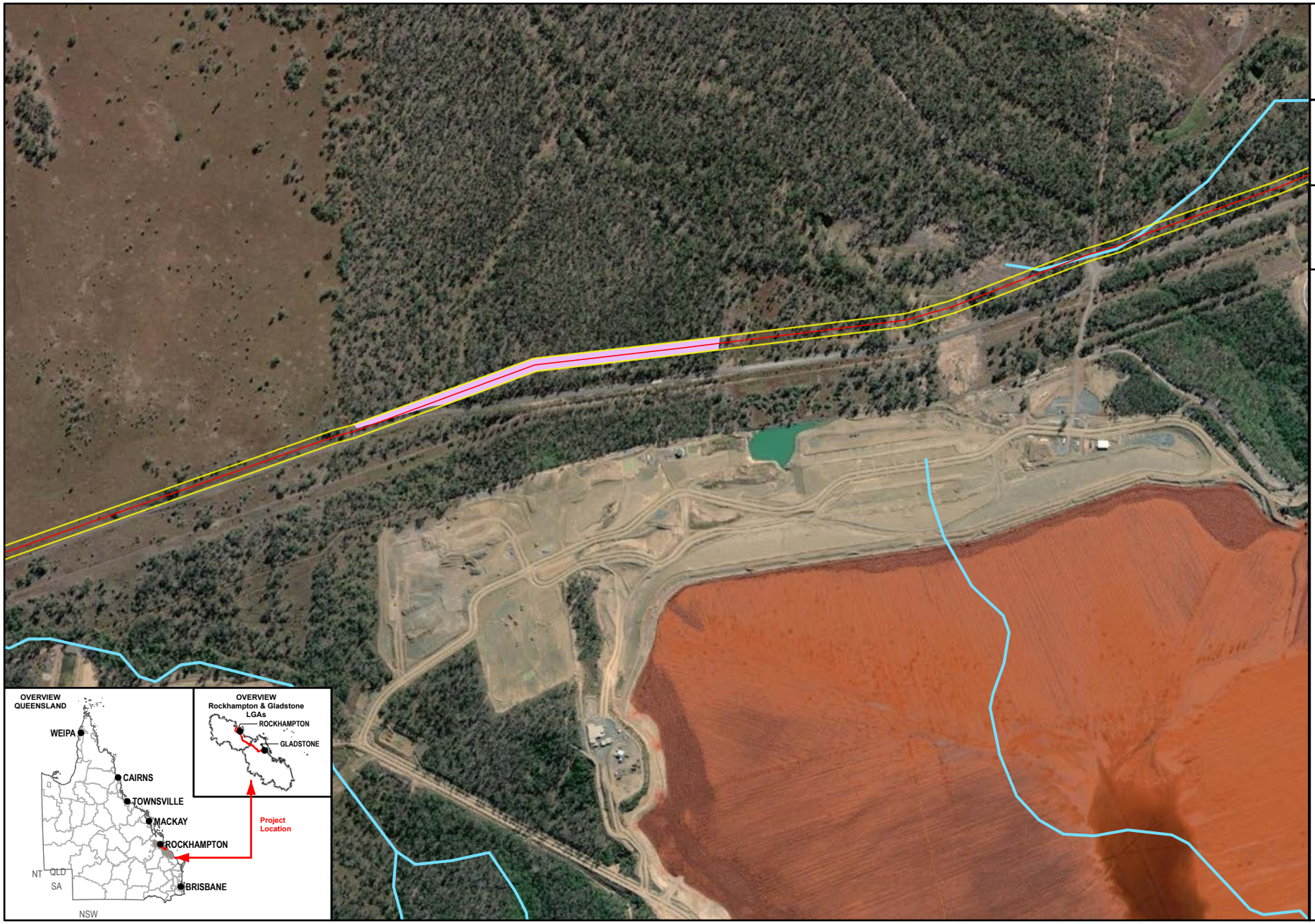
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-3c
Distribution of Powerful Owl Habitat Within the GSDA Study Area
000-G-MAP-2425 Version:3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Powerful Owl Habitat
- Waterways

Data Sources:
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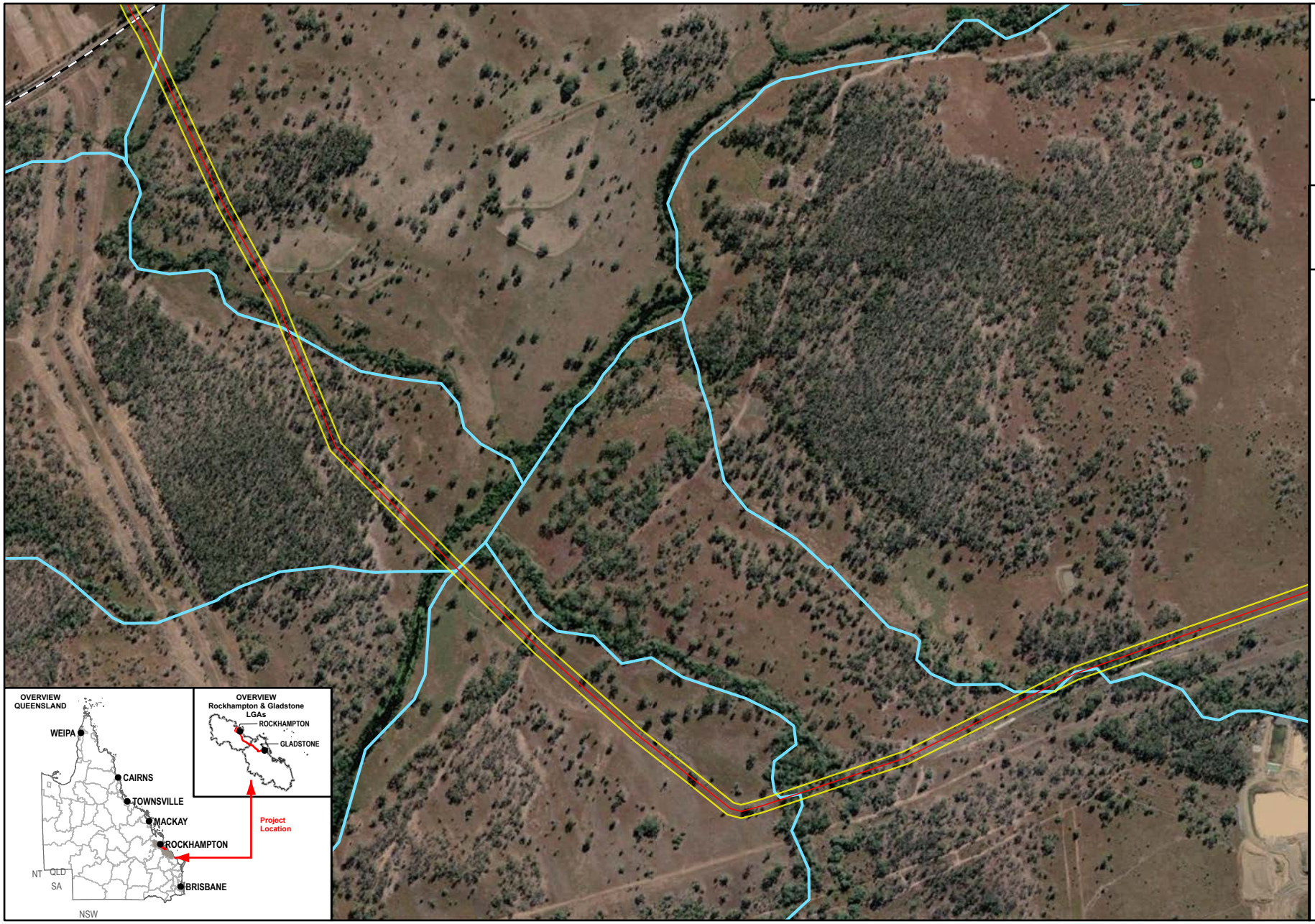
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-3d
Distribution of Powerful Owl Habitat Within the GSDA Study Area
000-G-MAP-2425 Version:3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Railways

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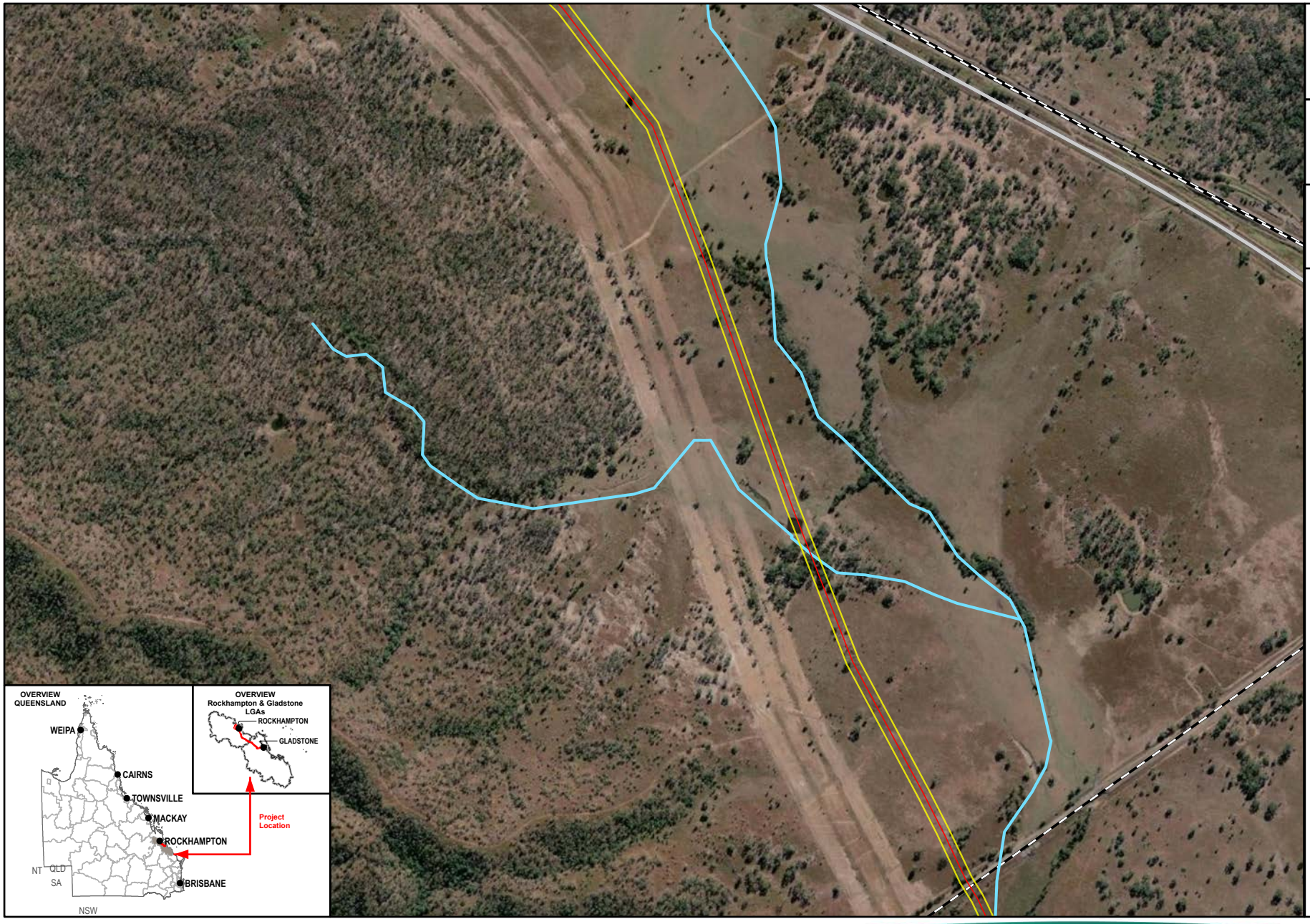
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-3e
Distribution of Powerful Owl Habitat Within the GSDA Study Area
000-G-MAP-2425 Version:3 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

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Figure 7-3f
Distribution of Powerful Owl Habitat Within the GSDA Study Area
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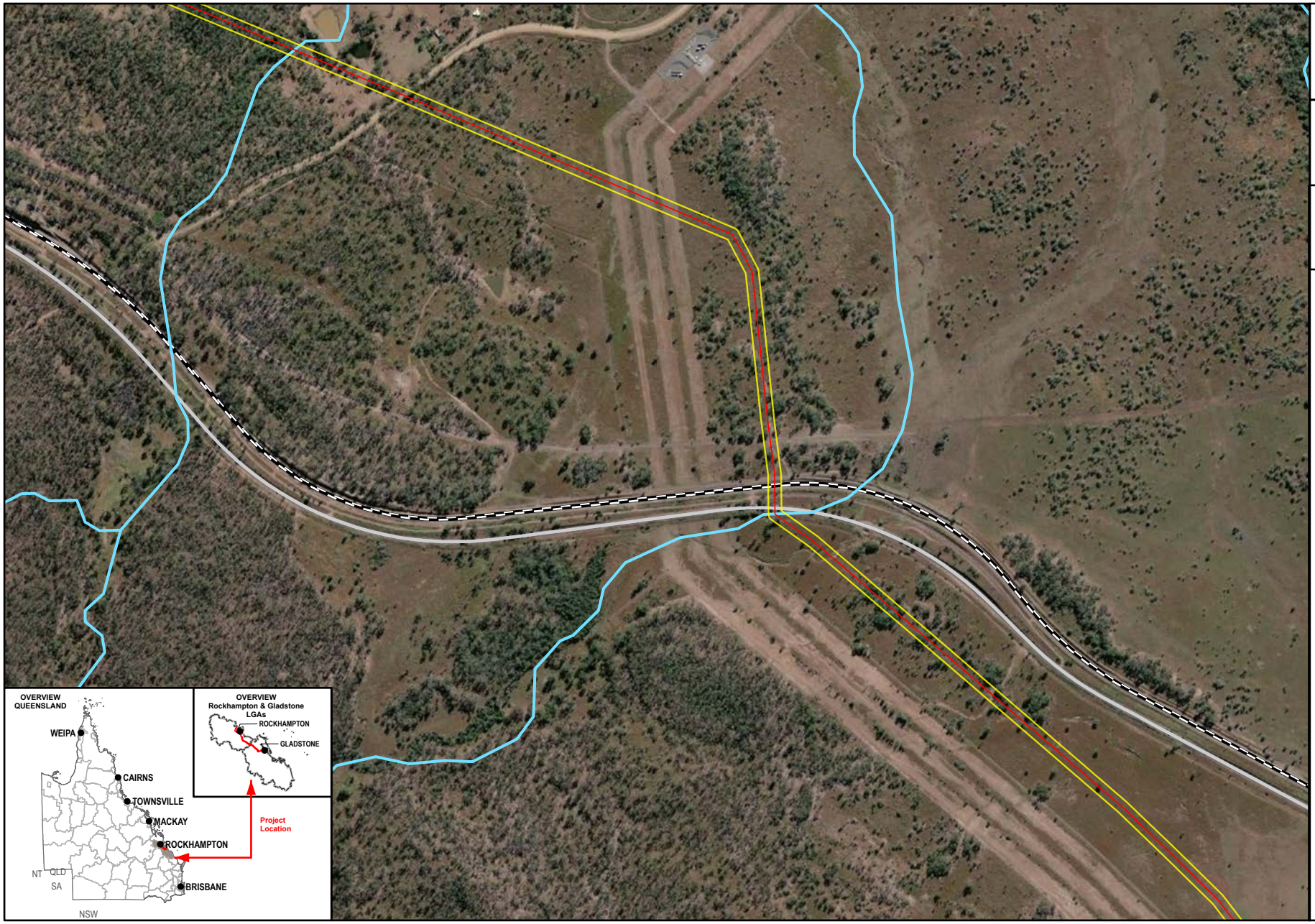

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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-3g
Distribution of Powerful Owl Habitat Within the GSDA Study Area
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7.1.1.7 Greater glider (southern and central)

Conservation status and species ecology

The greater glider (southern and central) is listed as endangered under the EPBC Act and NC Act, but was not listed as an MNES at the time of the approval. The species is restricted to tall eucalypt forests and woodlands with relatively old trees and an abundance of hollow-bearing trees (DCCEEW 2022a). The species has a specialist folivorous diet, mostly comprising of eucalypt leaves (Eyre *et al.* 2022) and displays seasonal food preferences. As a result, the species requires access to forests with a diversity of eucalypt species to provide a consistent food source throughout the year (DCCEEW 2022a). The species has been most frequently recorded feeding on trees including *Corymbia citriodora*, *C. intermedia*, *Eucalyptus fibrosa*, *E. moluccana* and *E. portuensis*, with *C. citriodora* and *E. tereticornis* being important species in greater glider habitat (Eyre *et al.* 2022).

During the day, the species dens in tree hollows, with particular preference for large hollows (diameter >10 cm) in mature trees (DCCEEW 2022a). Both live and standing dead hollow-bearing trees provide suitable denning habitat for the species; however, they are known to prefer live hollow-bearing trees (DCCEEW 2022a). The availability of mature, hollow-bearing trees is a limiting factor on greater glider occurrence and density. In southern Queensland, the species requires at least 2 to 4 live den trees within 2 ha of suitable habitat, whereas in NSW, the species has been found to be absent from forests with fewer than six hollow-bearing trees per ha (DCCEEW 2022a). The greater glider (southern and central) has also been recorded in regrowth forests, where hollow-bearing trees occur in sufficient densities (DCCEEW 2022a).

The species has a relatively small home range, typically 1 – 4 ha (DCCEEW 2022a). Studies revealed that the occupation of a small (< 3 ha) home range is consistent throughout the species Australian geographic range (Eyre *et al.* 2022). Given the species' limited capacity for dispersal, and reluctance to cross vegetation gaps, it is sensitive to habitat fragmentation (DCCEEW 2022a). However, small or fragmented habitat patches that area connected to larger habitat patches can facilitate dispersal of the species and/or enable recolonization.

Field survey results and distribution of suitable habitat

The greater glider (southern and central) was not recorded during the field surveys within the GSDA study area. Survey effort for the greater glider (southern and central) included two nights of 2-3 hours of spotlighting and faecal pellet searches at 12 locations within potentially suitable habitat in the GSDA study area. Suitable habitat is widely distributed within the region and the species has been historically recorded at 30 locations within the desktop search extent (10 km buffer), the most recent recorded in 2014 approximately 100 m from the GSDA pipeline alignment. Many of these records have been historically recorded in riparian habitats, in close proximity to drainage lines and watercourses.

Suitable foraging habitat was recorded in eucalypt woodland areas retaining preferred tree species at numerous locations along the GSDA pipeline alignment, especially along waterways and drainage lines. Potentially suitable denning habitat was recorded within remnant and regrowth woodland habitats where hollow-bearing trees persisted in the GSDA study area A large proportion of these habitats were highly fragmented or disconnected from large remnant patches and hollow-bearing trees occurred in low numbers. Within remnant vegetation, immediately north of Aldoga Road, suitable foraging and denning habitat was recorded. This woodland retains large, mature eucalypt trees supporting high densities of suitable hollows (diameter > 10 cm) and is connected to large patches of remnant woodland. Within this woodland area, the GSDA pipeline alignment follows an existing fence line which has been largely cleared, and therefore retains low abundance of suitable hollow-bearing trees for the species.

The distribution of predicted greater glider (southern and central) habitat is mapped in Figure 7-4.

Significance of impact assessment

The project is likely to result in a significant residual impact on the greater glider (southern and central). A significance of impact assessment of the project on the greater glider (southern and central) (endangered under the EPBC Act and NC Act) is provided in Table 7-8.

Table 7-8 Significance of impact on the greater glider (southern and central)

Significant residual impact criteria	Potential to occur
A long-term decrease in the size of a local population	**Unlikely** The greater glider (southern and central) was not recorded within the GSDA study area during the field surveys. The greater glider (southern and central) has been historically recorded at 30 locations within the desktop search extent (10 km buffer), the closest record occurring approximately 100 m from the GSDA pipeline alignment near Yarwun. At a national level, all populations of the greater glider (southern and central) are considered important populations (DCCEEW 2022a). The project will result in the clearing of 20.09 ha of predicted foraging habitat and 5.28 ha of predicted denning habitat for the species, representing 0.22% of habitat available within a 5 km buffer. The GSDA pipeline alignment largely supports regrowth vegetation (retaining few hollow-bearing trees) and open landscapes that have been previously cleared for agricultural practices. The remaining areas support remnant vegetation, providing suitable foraging and denning habitat for the greater glider (southern and central). Clearing has the potential to cause direct mortality and injury of individuals. This risk will be mitigated by the employment of a fauna spotter-catcher during clearing to check hollows in large fallen trees and relocate any encountered individuals. Sequential clearing will also be adopted to allow species to self-disperse and tree felling will occur towards cleared areas, rather than towards standing vegetation. The project is not considered likely to lead to a long-term decrease in the size of the greater glider (southern and central) local population. Considering the greater glider (southern and central) has been recorded extensively within the surrounding landscape, the local population of the species is anticipated to remain largely unaffected due to the availability of habitat within the surrounding landscape. The loss of vegetation within the GSDA pipeline alignment is unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources. 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 project will result in a loss of 20.09 ha of predicted foraging habitat and 5.28 ha of predicted denning habitat for the greater glider (southern and central). Suitable denning habitat within the GSDA pipeline alignment is located within a large area of remnant vegetation immediately north of Aldoga Road. Within this area, the GSDA pipeline alignment is expected to follow an existing fence line which has been previously cleared. Therefore, low densities of suitable denning habitat occur within the GSDA pipeline alignment, with high densities of suitable denning habitat located in woodland immediately adjacent to the GSDA pipeline alignment. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. Clearing along the GSDA pipeline alignment is unlikely to impact the species' ability to move nor access resources in adjacent habitats, as the proposed clearing extent is narrow (30 m) and mostly linear, and unlikely to generate edge effects or impact ecosystem structure and functioning. Given the minimal loss of 25.37 ha of suitable (foraging and denning) habitat, negligible impact of local and landscape connectivity, and low levels of disturbance during the operation phase, it is unlikely to have any significant indirect impact on the species. While there will be a localised loss of habitat for the greater glider (southern and central) (including ecological significant locations), this will not have a bearing on the species' extent of occurrence. Accordingly, the project is unlikely to reduce the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon*.

Significant residual impact criteria	Potential to occur
Fragment an existing population	**Unlikely** Greater gliders have been recorded gliding up to 100 m (Menkhorst and Knight 2011), but it is more widely accepted that their typical maximum gliding distance is 60 m (Weston 2003), and an average glide length is typically 25 to 35 m (with a launch height of 20 to 25 m) (Australian Museum Business Service 2001). The ability to glide at these distances enables gliders to traverse relatively open habitat providing that the distance between trees does not exceed the species' gliding capability (references within Ball and Goldingay 2008). Even when the distance between trees exceeds the maximum gliding distance, some glider species will glide some of the distance and then move across the ground to the next tree for the remaining short distance (van der Ree *et al*. 2003). The maximum width of clearing required for construction of the GSDA pipeline alignment (i.e. 30 m) is not considered to exceed the volplane distance of the species. As such, habitat loss within the GSDA pipeline alignment is not expected to impact connectivity between greater glider (southern and central) habitat retained on either side of the corridor as the habitat losses will be localised and is unlikely to create large gaps that present new barriers to greater glider (southern and central) movement. Connectivity to extensive areas of suitable habitat will persist in the surrounding landscape allowing opportunities for movement. Furthermore, large areas of remnant habitat are located within Mount Stowe State Forest, Calliope Conservation Park and Mount Larcom. Therefore, the GSDA pipeline alignment is unlikely to fragment an existing greater glider (southern and central) population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally and regionally is unlikely to be limited by any localised clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any form of genetic isolation at a population level.
Result in invasive species that are harmful to a endangered species becoming established in the endangered species' habitat	**Unlikely** The project is unlikely to result in the introduction or spread of invasive species beyond current levels. The implementation of a Weed and Pest Management Plan will further reduce potential impacts of invasive species. As such, the project is not expected to result in invasive species that are harmful to the greater glider (southern and central) becoming established in the species' habitat.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not a known threat to the species; however, greater glider habitat is susceptible to *Phytophthora cinnamomi* due the soil fungus's ability to infect eucalypt species. Clearance of vegetation will engage standard hygiene protocols to limit the potential for introduction or spread of phytophthora throughout the GSDA pipeline alignment (i.e. beginning works with clean vehicles and undertaking clearing works during dry conditions). Considering the implementation of strict biosecurity protocols, the project is unlikely to introduce a disease that may cause the species to decline.
Interfere with the recovery of the species	**Unlikely** The project is unlikely to interfere with the recovery of the species. The greater glider (southern and central) has been widely recorded within region, with large, contiguous patches of suitable habitat located adjacent to the project. Although the project will remove 20.09 ha of predicted foraging habitat and 5.28 ha of predicted denning habitat, equating to 0.22 % of habitat available within a 5 km buffer, the remaining habitat is connected to an extensive network of suitable habitat to facilitate dispersal of the species and enable recolonization. The impacts of the GSDA pipeline alignment are expected to be relatively benign, as the maximum corridor width (30 m) is well below the species maximum volplane distance) and is unlikely to produce fragmentation or habitat isolation. The risk of individual mortality or injury during construction will be addressed via the mitigation measures in the CEMP and the use sequential clearing and an experienced fauna spotter-catcher during clearing. Noting the above points relating to very limited if any effects on local populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the greater glider (southern and central).

Significant residual impact criteria	Potential to occur
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Likely** The project will require the clearing of 25.37 ha of potentially suitable foraging and denning habitat for the greater glider (southern and central). Although the GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared, the project will result in a loss of this species' preferred feed and den tree species, including *Corymbia citriodora*, *Eucalyptus moluccana*, *E. tereticornis* and *E. crebra.* Four tree species have been identified as frequently used foraging trees (Eyre *et al.* 2022), two of which were recorded within the GSDA study area, including *C. citriodora* and *E. moluccana.* In some months, the species has also been identified to favour *E. tereticornis* and *E. crebra* (Eyre *et al.* 2022), which were both observed throughout the GSDA study area. A study undertaken by Smith *et al.* 2007, found that greater gliders within the Brigalow Belt bioregion preferred certain tree species, including *E. fibrosa, E. moluccana* and *C. citriodora*, for denning and foraging. While the project is not expected to cause a long-term decline in the local population, reduce its extent of occurrence, cause adverse habitat fragmentation effects nor interfere with the recovery of the species, the loss of suitable greater glider (southern and central) habitat within the GSDA pipeline alignment is likely to result in disruption to ecologically significant foraging and breeding locations.
Conclusion	A conservative assessment has identified that the project is likely to result in a significant residual impact on the greater glider (southern and central). Although the GSDA pipeline alignment has been located within areas that have been previously cleared for agricultural practices and linear infrastructure such as railways, roads, access tracks and pipelines, the project will require the clearing of 25.37 ha of woodland areas retaining preferred food trees and suitable denning habitat within the GSDA pipeline alignment.

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Greater Glider Habitat

Habitant Type

- Potential Foraging Habitat
- Potential Denning Habitat
- Waterways
- Main Roads
- Railways

Data Sources:

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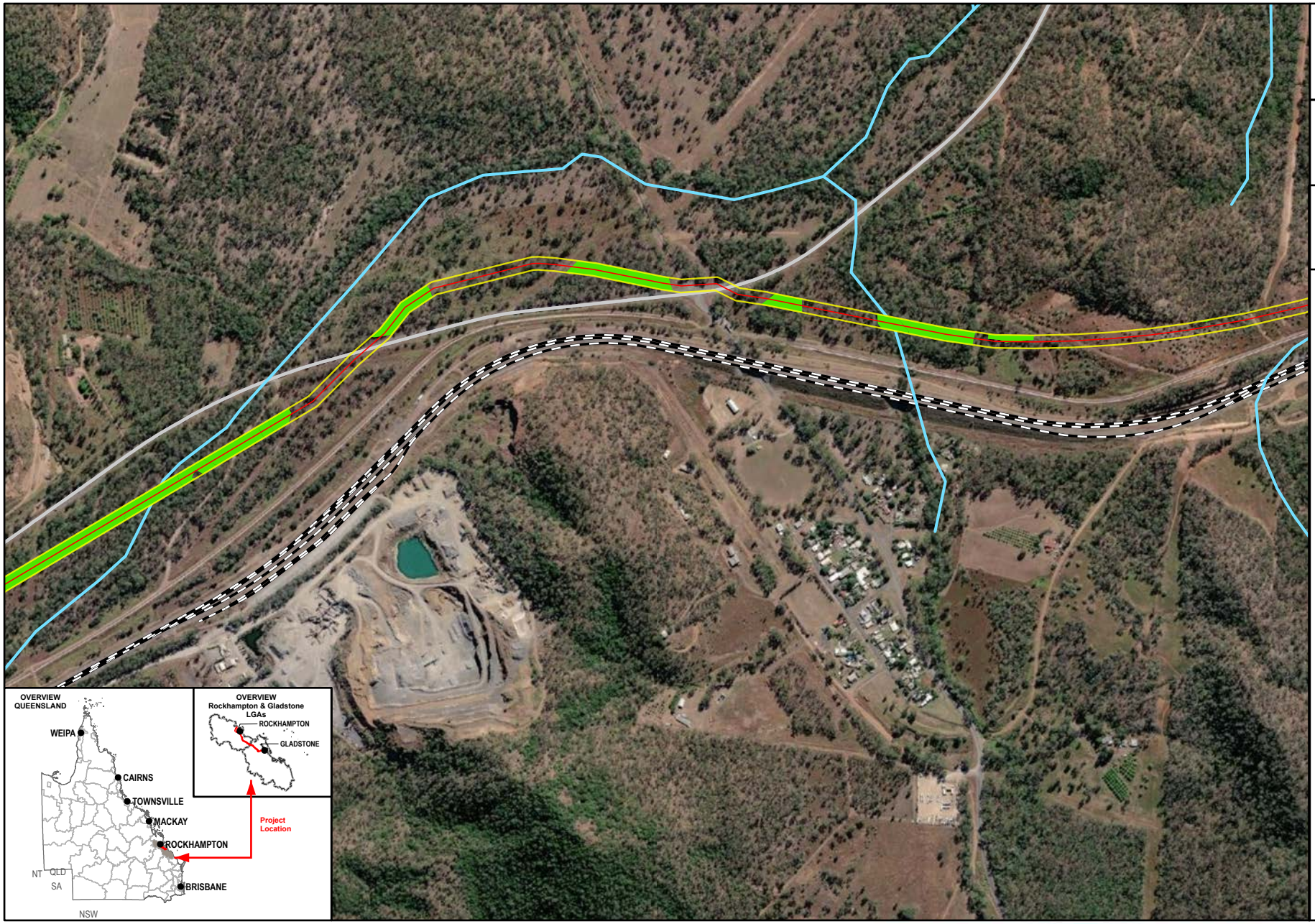
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-4a
Distribution of Great Glider Habitat Within the GSDA Study Area

000-G-MAP-2426 Version:4 Date:19/09/2022



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Predicted Greater Glider Habitat

Habitant Type

- Potential Foraging Habitat
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Distribution of Great Glider Habitat Within the GSDA Study Area
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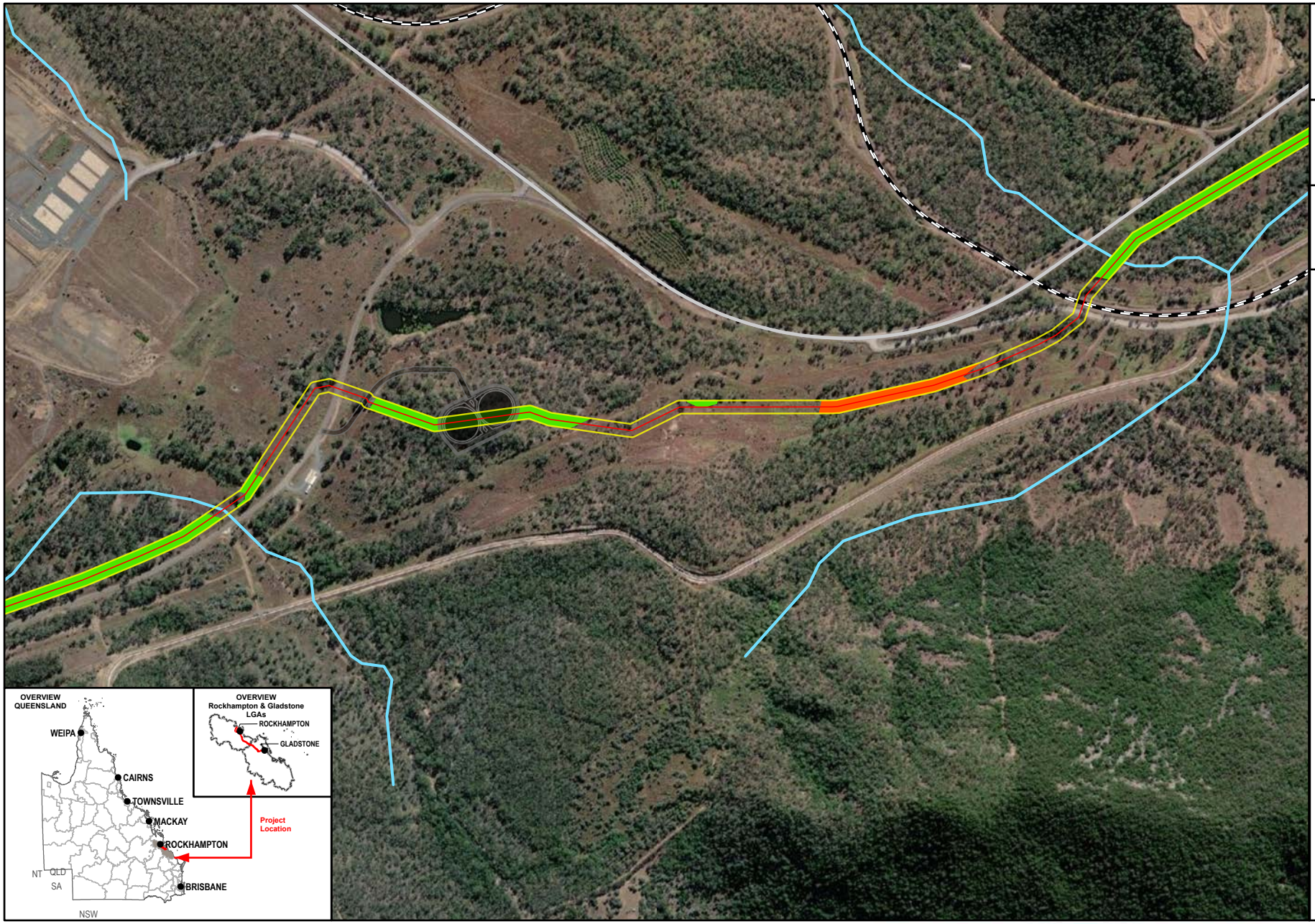

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Predicted Greater Glider Habitat

Habitant Type

- Potential Foraging Habitat
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- Aldoga Reservoirs Layout
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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-4c
Distribution of Great Glider Habitat Within the GSDA Study Area

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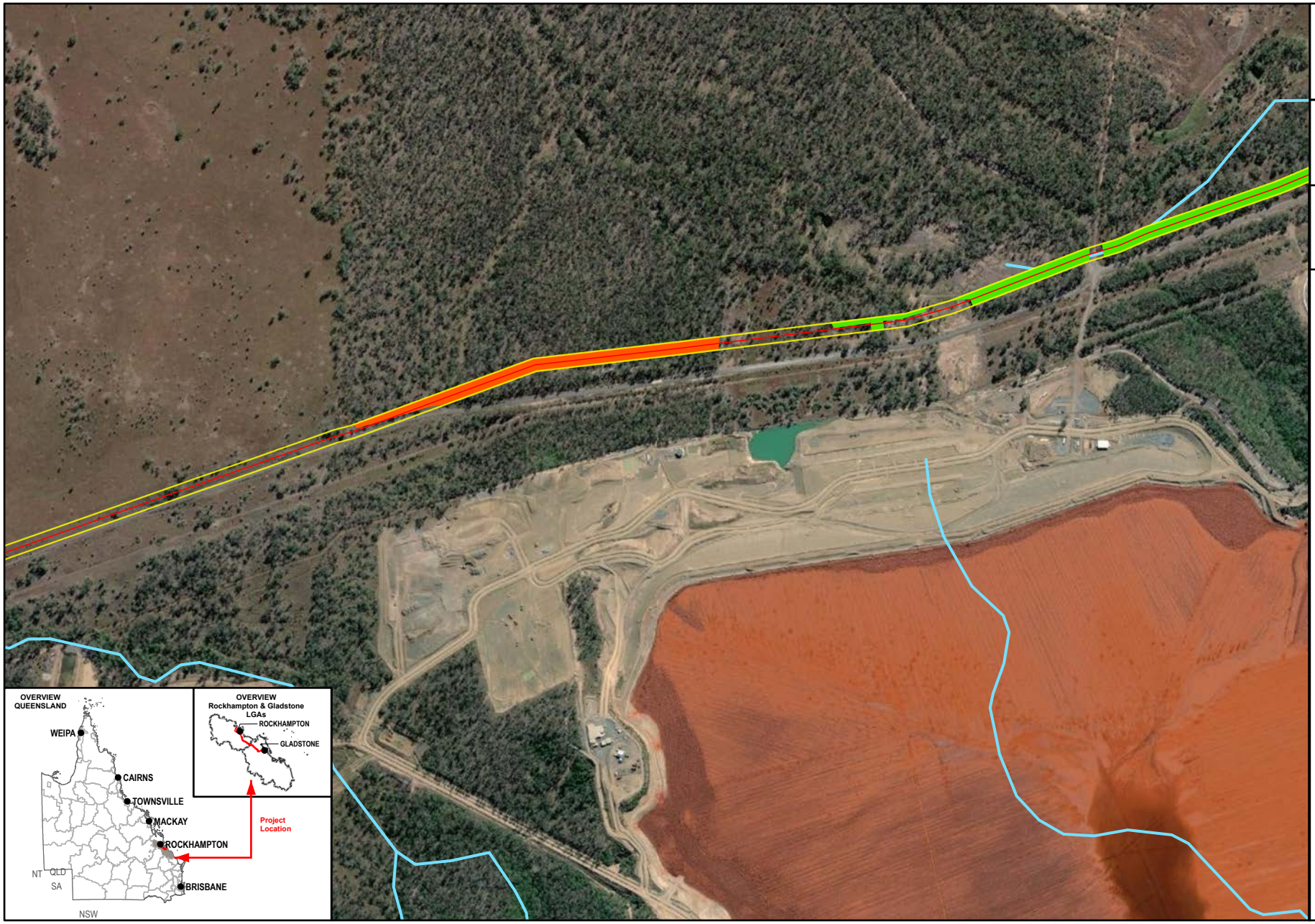

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Greater Glider Habitat

Habitant Type

- Potential Foraging Habitat
- Potential Denning Habitat
- Waterways

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Distribution of Great Glider Habitat Within the GSDA Study Area
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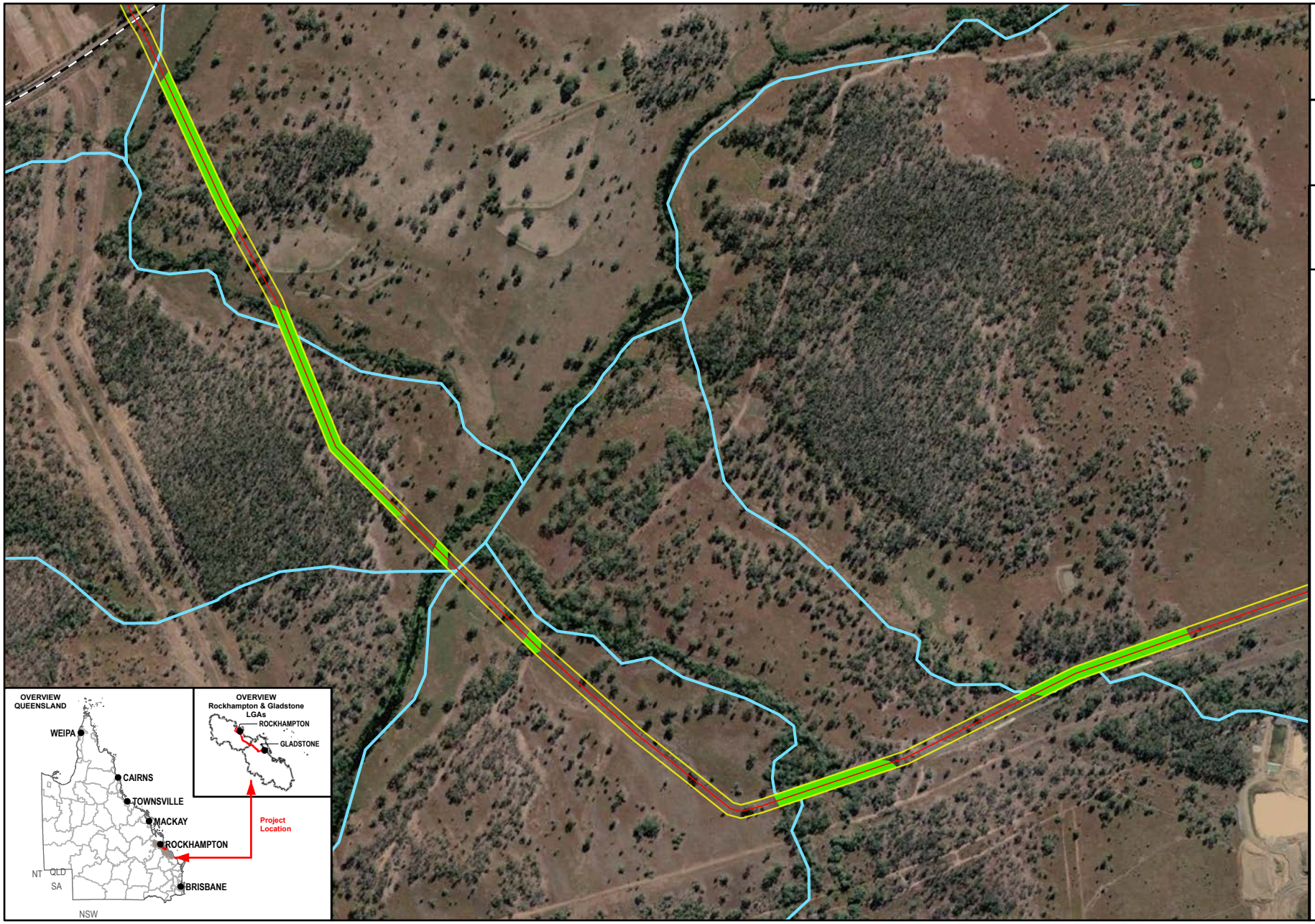

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Greater Glider Habitat

Habitant Type

- Potential Foraging Habitat
- Waterways
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-4e
Distribution of Great Glider Habitat Within the GSDA Study Area
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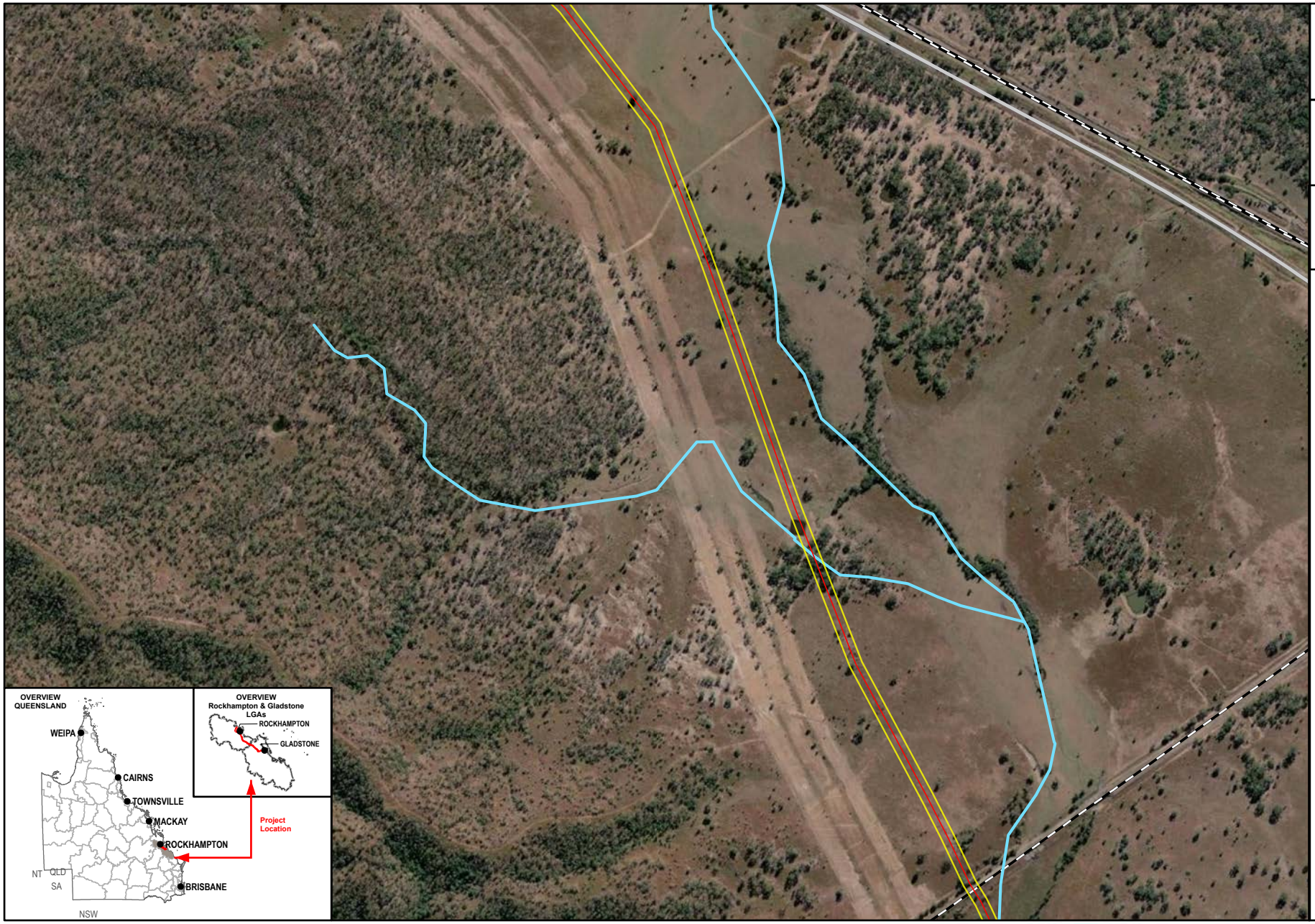

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Legend

- GSDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

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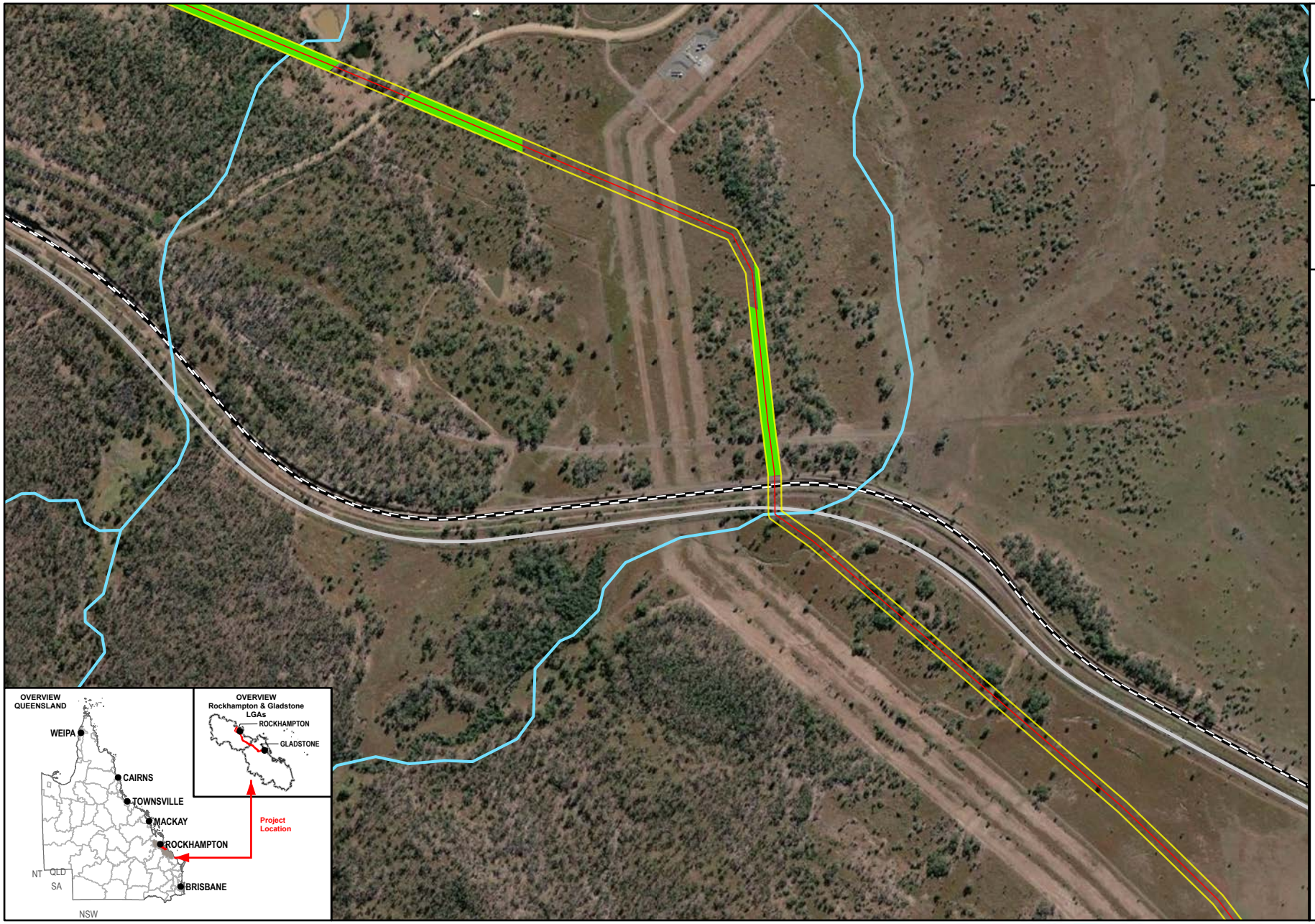

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Legend

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- Study Area

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Habitant Type

- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

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7.1.1.8 Yellow-bellied glider (south-eastern)

Conservation status and species ecology

The yellow-bellied glider (south-eastern) (*Petaurus australis australis*) is listed as vulnerable under the EPBC Act and NC Act but was not listed as an MNES at the time of the approval. The subspecies occurs in eucalypt-dominated forest and woodland (DAWE 2022a). The subspecies can occur in dry and wet sclerophyll, with abundance highly dependent on forest age and floristics. The subspecies prefers large tracts of mature, old growth forest that are able to provide suitable habitat for foraging and denning requirements. These requirements include floristic diversity, high proportion of winter-flowering and smooth-barked gums to provide year-round foraging resources. The subspecies is nocturnal, during the day yellow-bellied glider (south-eastern) dens in hollow-bearing trees, usually over one meter in diameter, primarily, living hollow-bearing smooth-barked eucalypts are used (DAWE 2022a). The subspecies occurs in family groups of between two to six individuals, covering a home range of approximately 50-65 ha, large home-ranges are required to maintain subpopulation viability (DAWE 2022a).

Field survey results and distribution of suitable habitat

No yellow-bellied glider (south-eastern) individuals or V-shaped incisions on smooth-barked eucalypts were recorded during the field surveys within the GSDA study area. Survey effort for the yellow-bellied glider (south-eastern) included two nights of 2-3 hours of spotlighting within potentially suitable habitat in the GSDA study area. Suitable habitat was recorded within the GSDA study area, and the species has been historically recorded at 15 locations within the desktop search extent (10 km buffer), the closest record located approximately 100 m from the GSDA pipeline alignment. Many of these records have been historically recorded in riparian habitats, in close proximity to drainage lines and watercourses.

Suitable foraging habitat was recorded in eucalypt woodland areas retaining preferred tree species at numerous locations along the GSDA pipeline alignment, especially along waterways and drainage lines. Potentially suitable denning habitat was recorded within remnant and regrowth woodland habitats where hollow-bearing tree persisted in the GSDA study area. A large proportion of these habitats were highly fragmented or disconnected from large remnant patches and hollow-bearing trees occurred in low numbers. Within remnant vegetation, immediately north of Aldoga Road, suitable foraging and denning habitat was recorded. This woodland retains large, mature eucalypt trees supporting high densities of suitable hollows, and is connected to large patches of remnant woodland (> 200 ha^2). Within this woodland area, the GSDA pipeline alignment follows an existing fence line which has been previously cleared, and therefore retains low densities of suitable hollow-bearing trees for the species. The distribution of predicted yellow-bellied glider (south-eastern) habitat is mapped in Figure 7-5.

Significance of impact assessment

The project is likely to result in a significant residual impact on the yellow-bellied glider (south-eastern). A significance of impact assessment of the project on the yellow-bellied glider (south-eastern) (vulnerable under the EPBC Act and NC Act) is provided in Table 7-9.

Table 7-9 Significance of impact on the yellow-bellied glider (south-eastern)

Significant residual impact criteria	Potential to occur
A long-term decrease in the size of a local population	**Unlikely** The yellow-bellied glider (south-eastern) has been historically recorded at 15 locations within the desktop search extent (10 km buffer), the closest record located approximately 100 m from the GSDA pipeline alignment near Yarwun. Due to a lack of population information, all local yellow-bellied glider (south-eastern) population are considered important populations (DAWE 2022a). The project will result in the clearing of 18.86 ha of predicted foraging habitat and 5.28 ha of predicted denning habitat for the species, representing 0.21% of habitat available within a 5 km buffer. The species is reliant on smooth-barked eucalypts for foraging given its tendency to acquire sap by incising directly into the bark. Mature smooth-barked eucalypt trees are moderately abundant within the GSDA pipeline alignment; however, low amounts of suitable denning habitat were recorded. The GSDA pipeline alignment largely supports regrowth vegetation (retaining few hollow-bearing trees) and open landscapes that have been previously cleared for agricultural practices. The remaining areas support remnant vegetation, providing suitable foraging and denning habitat for the yellow-bellied glider (south-eastern). Clearing has the potential to cause direct mortality and injury of individuals.

Significant residual impact criteria	Potential to occur
	This risk will be mitigated by the employment of a fauna spotter-catcher during clearing to check hollows in large fallen trees and relocate any encountered individuals. Sequential clearing will also be adopted to allow species to self-disperse and tree felling will occur towards cleared areas, rather than towards standing vegetation. The project is not considered likely to lead to a long-term decrease in the size of the yellow-bellied glider (south-eastern) local population. Considering the species has a large capacity for movement and can periodically move to access areas of foraging habitat, the species' local population is anticipated to remain largely unaffected due to the availability of habitat within the surrounding landscape. The loss of vegetation within the GSDA pipeline alignment is unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources. 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 is reliant on access to smooth-barked hollow-bearing trees (i.e. *Eucalyptus tereticornis* and *Corymbia citriodora*) for denning and foraging. As mentioned above, mature smooth-barked eucalypt trees are moderately abundant within the GSDA pipeline alignment, with low densities of suitable denning habitat. High densities of suitable denning sites were observed in mature woodland immediately adjacent to the GSDA pipeline alignment. The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. Clearing along the GSDA pipeline alignment is unlikely to impact the species as the proposed clearing extent is narrow (30 m) and mostly linear, and unlikely to generate edge effects or impact ecosystem structure and functioning. Given the minimal loss of 18.86 ha of suitable foraging habitat and 5.28 ha of suitable denning habitat, negligible impact of local and landscape connectivity, and low levels of disturbance during the operation phase, it is unlikely to have any significant indirect impact on the species. While there will be a localised loss of habitat for the yellow-bellied glider (south-eastern) (including ecological significant locations), this won't have a bearing on the species' extent of occurrence. Accordingly, the project is unlikely to reduce the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon*.
Fragment an existing population	**Unlikely** Linear impacts along the GSDA pipeline alignment is not considered to exceed the species' volplane distance and are unlikely to cause any fragmentation in the species habitat, as yellow-bellied gliders (southern) has been recorded to glide to a maximum distance of 140 m (DAWE 2022a). Connectivity to extensive areas of suitable habitat will persist in the surrounding landscape allowing opportunities for movement. Furthermore, large areas of remnant habitat are located within Mount Stowe State Forest, Calliope Conservation Park and Mount Larcom. Therefore, the GSDA pipeline alignment is unlikely to fragment an existing yellow-bellied glider (south-eastern) population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA pipeline alignment. As a result, the project is unlikely to cause any form of genetic isolation at a population level.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The predation by European red foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) are listed as a threat to the yellow-bellied glider (south-eastern). It has been shown that European red foxes are able to climb trees where to can predate on living gliders, with feral cats likely eating the subspecies through scavenging (DAWE 2022a). The project is not considered likely to increase the incidence of any invasive species (particularly European red foxes and feral cats) that could threaten the yellow-bellied glider (south-eastern), especially noting mitigation measures in place to manage invasive species.

Significant residual impact criteria	Potential to occur
Introduce disease that may cause the population to decline	**Unlikely** The yellow-bellied glider (south-eastern) is potentially susceptible to adverse impact from *Phytophthora cinnamomi* due the soil fungus's ability to infect *Eucalyptus* species. Biosecurity requirements (e.g. weed and seed declarations) will be implemented throughout the project, and thus, this risk has been assessed as low.
Interfere with the recovery of the species	**Unlikely** The project is unlikely to interfere substantially with the recovery of the species. The yellow-bellied glider (south-eastern) has been widely recorded within region, with large, contiguous patches of suitable habitat located adjacent to the project. Although the project will remove 18.86 ha of predicted foraging habitat and 5.28 ha of denning habitat, equating to 0.21 % of habitat available within a 5 km buffer, the remaining habitat is connected to an extensive network of suitable habitat. The impacts of the GSDA pipeline alignment are expected to be relatively benign, as the maximum corridor width (30 m) is well below the species maximum volplane distance (> 100 m) and is unlikely to produce fragmentation or habitat isolation. The risk of individual mortality or injury during construction will be addressed via the mitigation measures in the CEMP and the use of sequential clearing and an experienced fauna spotter-catcher during clearing. Noting the above points relating to very limited if any effects on local populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the yellow-bellied greater glider (south-eastern).
Cause disruptions to ecologically significant locations of a species	**Likely** The project will require the clearing of 24.14 ha of potentially suitable foraging and denning habitat for the yellow-bellied glider (south-eastern). Although the GSDA pipeline alignment has largely been placed within or adjacent to areas that have been previously cleared, the project will result in a loss of species preferred trees species, including *Corymbia citriodora, Eucalyptus moluccana* and *E. tereticornis*, for foraging and denning. While the project is not expected to cause a long-term decline in the local population, reduce its extent of occurrence, cause adverse habitat fragmentation effects nor interfere with the recovery of the species, the loss of suitable yellow-bellied glider (south-eastern) habitat within the GSDA pipeline alignment is likely to result in disruption to ecologically significant foraging and breeding locations.
Conclusion	A conservative assessment has identified that the project is likely to result in a significant residual impact on the yellow-bellied glider (south-eastern). Although the GSDA pipeline alignment has been located within areas that have been previously cleared for agricultural practices and linear infrastructure such as railways, roads, access tracks and pipelines, the project will require the clearing of 24.14 ha of woodland areas retaining preferred food trees and suitable denning habitat within the GSDA pipeline alignment.

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Yellow-bellied Glider (South-eastern) Habitat

Habitat Type

- Potential Denning Habitat
- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 7-5a
Distribution of Yellow-bellied Glider (South-eastern) Habitat Within the GSDA Study Area

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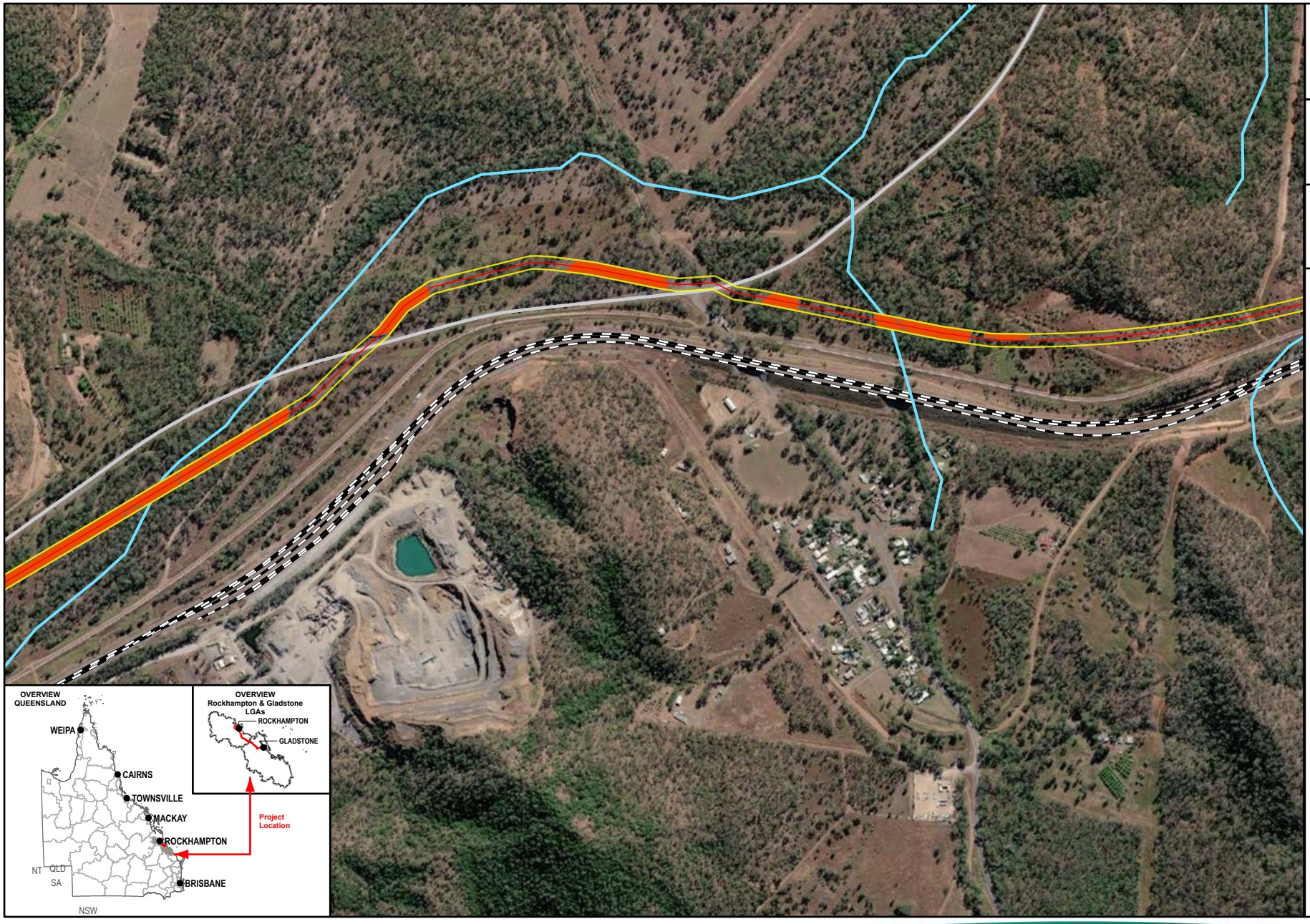

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Legend

- GSDA Pipeline Alignment
- Study Area

Predicted Yellow-bellied Glider (South-eastern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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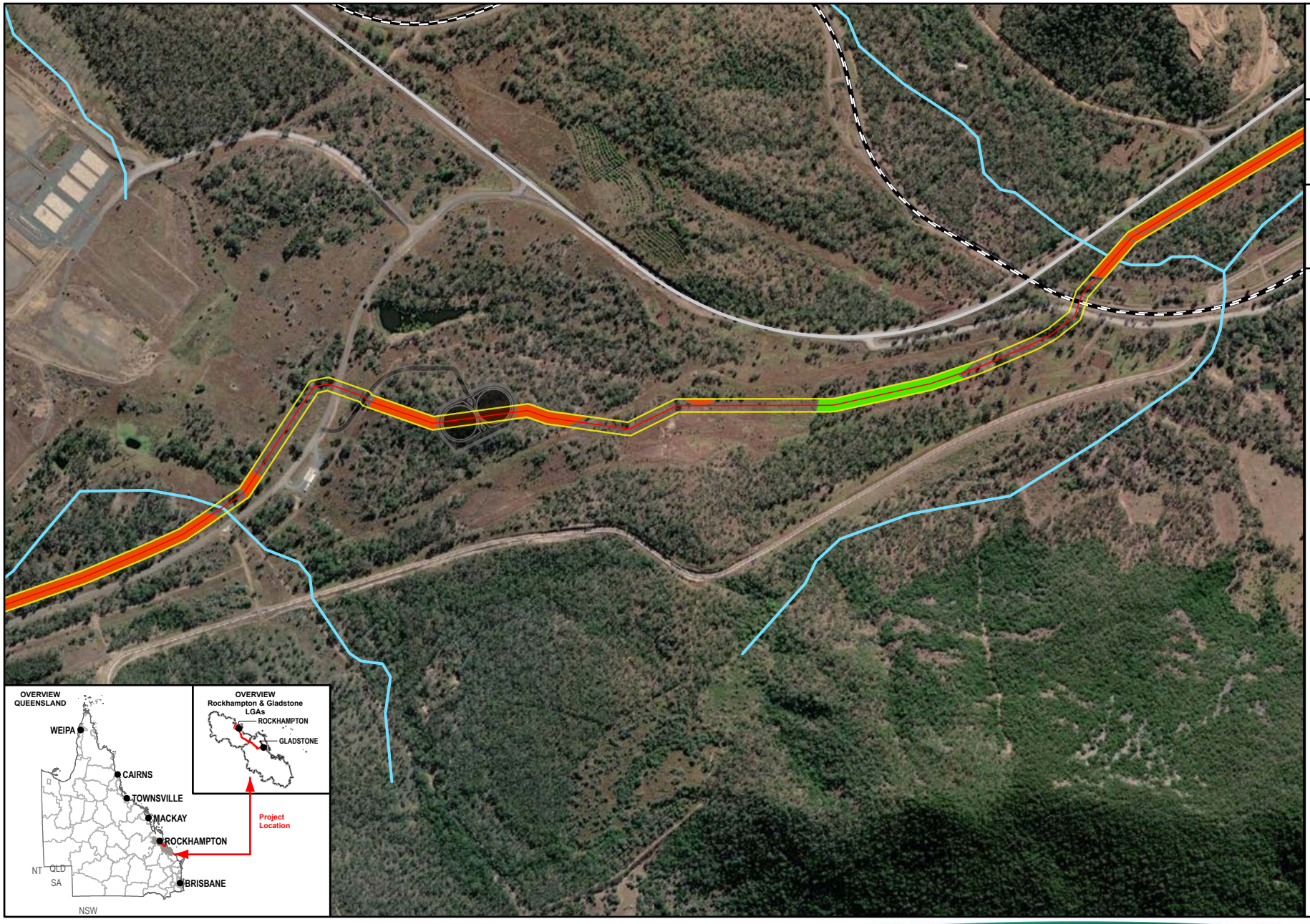

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- GSDA Pipeline Alignment
- Study Area

Predicted Yellow-bellied Glider (South-eastern) Habitat

Habitat Type

- Potential Denning Habitat
- Potential Foraging Habitat
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
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Figure 7-5c
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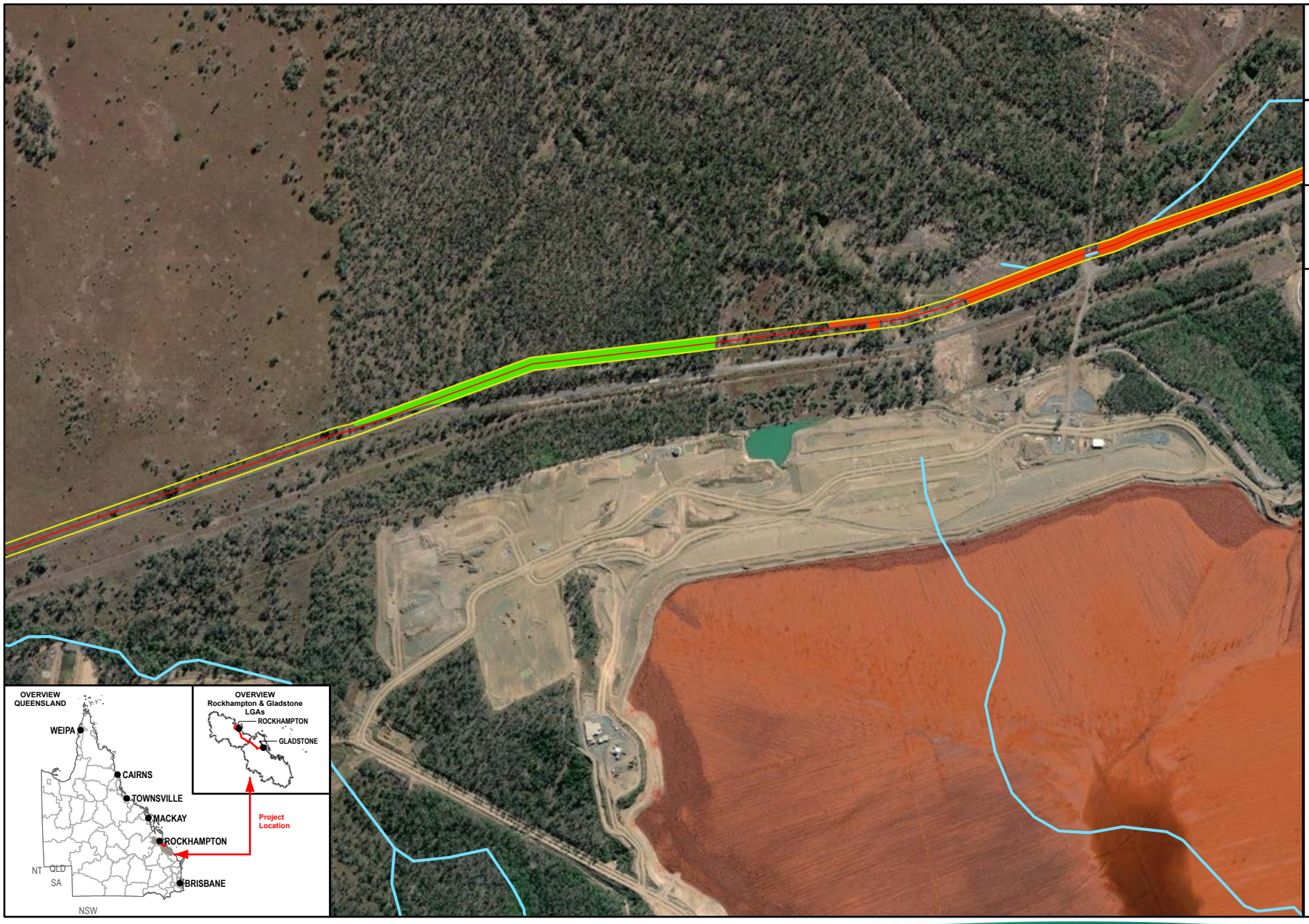

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Legend

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- Study Area

Predicted Yellow-bellied Glider (South-eastern) Habitat

Habitat Type

- Potential Denning Habitat
- Potential Foraging Habitat
- Waterways

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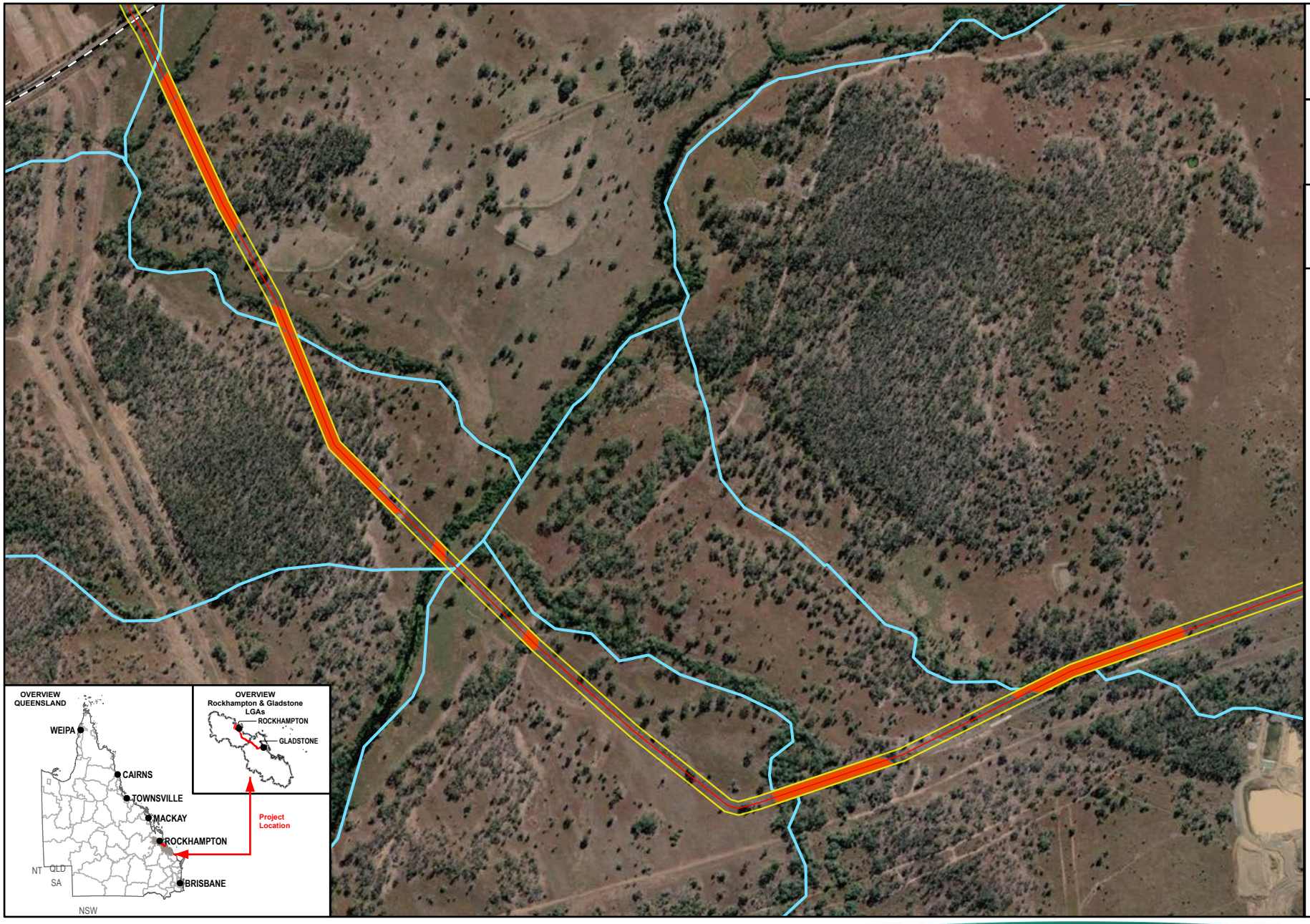

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Predicted Yellow-bellied Glider (South-eastern) Habitat

Habitat Type

- Potential Foraging Habitat
- Waterways
- Railways

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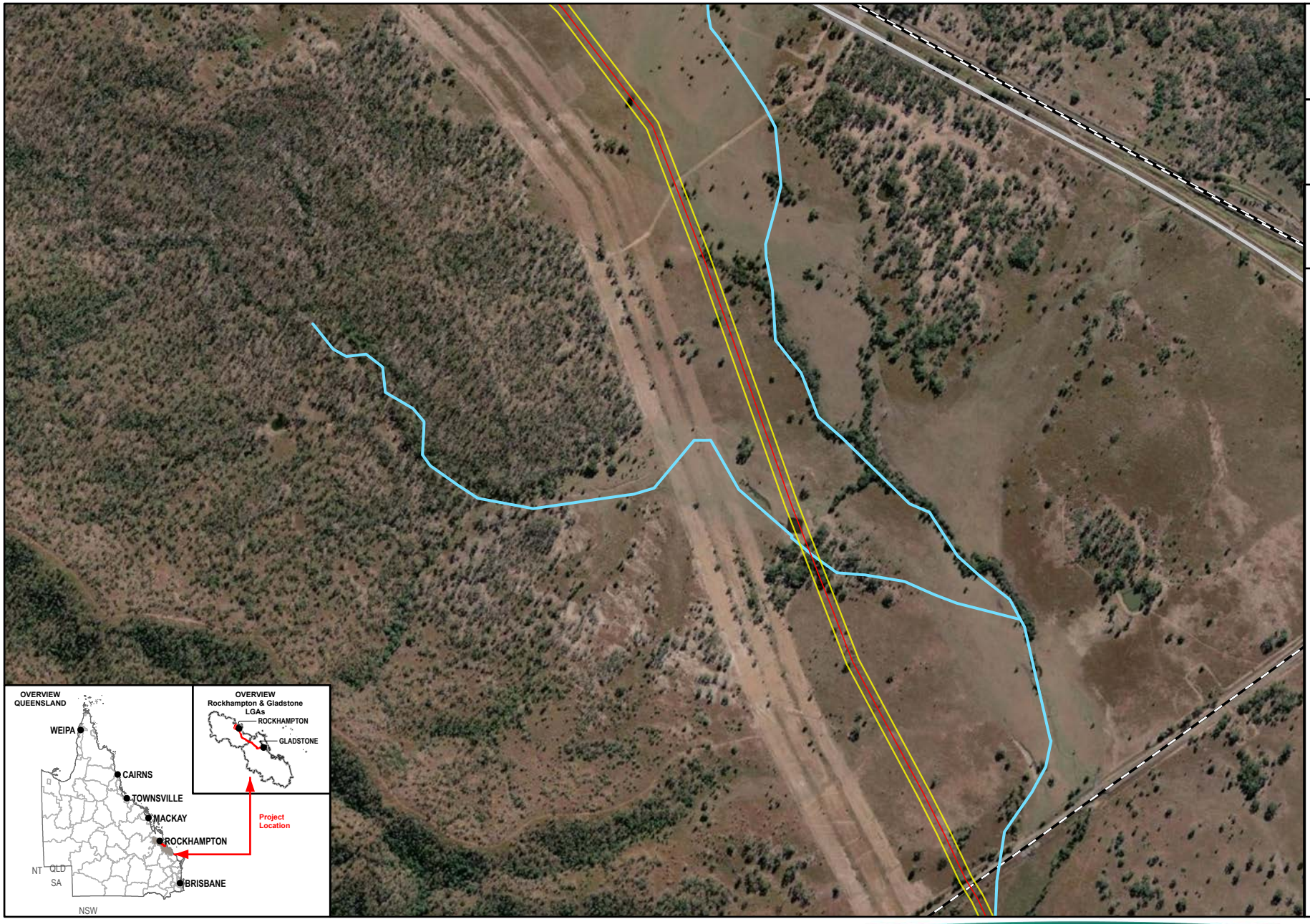

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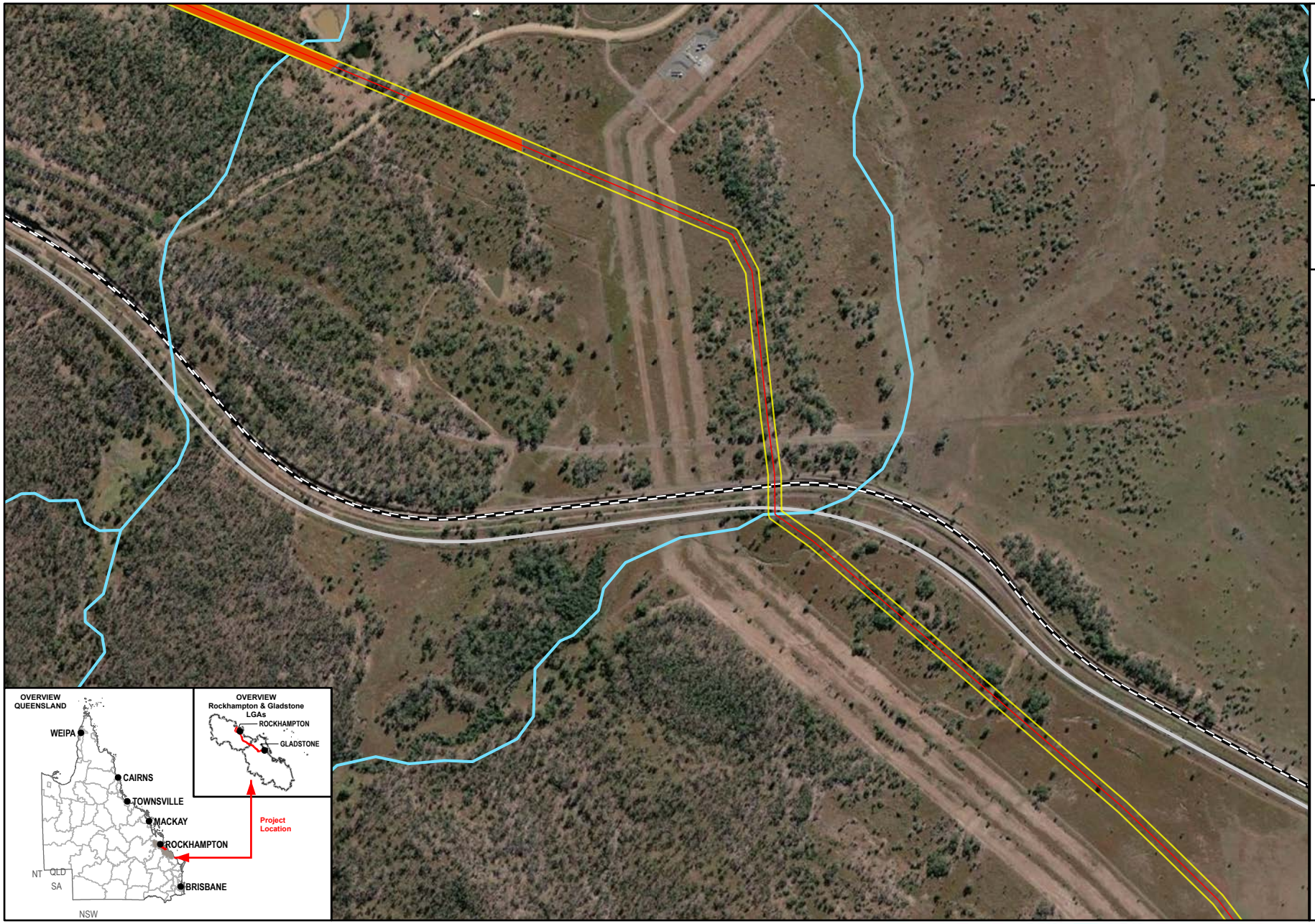

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Distribution of Yellow-bellied Glider (South-eastern) Habitat Within the GSDA Study Area

000-G-MAP-2427 Version:3 Date:19/09/2022

7.1.1.9 Koala

Conservation status and species ecology

The koala is listed as endangered under the EPBC Act and NC Act, but was not listed as an MNES at the time of the approval. The koala occurs in Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia. The species' occurrence is discontinuous across its distribution with several subpopulations separated by cleared lands and unsuitable habitat (DAWE 2022a). They are a wide-ranging species, typically occurring in forests and woodlands dominated by *Eucalyptus* species (DAWE 2022a). The species occurs in coastal and inland habitats – in Queensland this spans north Queensland to the Herberton area, westwards into semi-arid parts of central Queensland, and south into New South Wales (DAWE 2022a). The koala's range is restricted by food, habitat and environmental requirements, resulting in highly variable home range sizes. In Queensland and New South Wales, home ranges vary from 3 to 500 ha (DAWE 2022a), with home range increasing as trees become more widely spaced (DAWE 2022a; Youngentob 2021). Males typically have larger home ranges than females, and in general, home ranges are larger in semi-arid woodlands than in mesic coastal forests (DAWE 2022a). Since European colonisation, the koala's distribution and population size has declined significantly as a result of vegetation clearance and climate change drivers (DAWE 2022a).

In Queensland, koala inhabit moist coastal forests, southern and central western subhumid woodlands and eucalypt woodlands adjacent to waterbodies in semi-arid western parts of the state (Youngentob 2021). The species' occurrence is patchy, fragmented and often occurs in low-density populations across a number of bioregions including north to Einasleigh Uplands and Wet Tropics, Desert Uplands, Central Mackay Coast, Mitchell Grass Downs, Mulga Lands, Brigalow Belt North, Brigalow Belt South, and South Eastern Queensland where they are most frequently sighted (DAWE 2022a; Youngentob 2021).

The koala is an obligate folivore and its highly specialised diet Is defined by the availability and palatability of a limited variety of *Eucalyptus, Corymbia* and *Angophora* species (Youngentob 2021). Primary food species differ across the species' range – koalas have been recorded to feed on more than 120 species of *Eucalyptus, Corymbia* and *Angophora* species. The koala is a relatively sedentary species, with movement increasing during the breeding period (September to February) (DAWE 2022a).

In the assessment of habitat quantity and quality, the National Recovery Plan for the Koala (DAWE 2022b) highlights the importance of considering landscape patch size, form and spatial configuration within the context of the wider landscape, which can vary among landscapes and varies regionally (DAWE 2022b). Research has shown that koalas move very differently through different landscapes, depending on the level of habitat connectivity that has been retained (DAWE 2022b). In contiguous landscapes with high connectivity, koalas move slowly between koala habitat trees along vegetated watercourses, roadsides and other areas of functional connectivity. This increases their energetic efficiency and reduces their susceptibility to predation (DAWE 2020b). In more fragmented landscapes, koalas follow more direct movement pathways and demonstrate an increased willingness to cross open areas at ground level to move between isolated patches of vegetation (DAWE 2022b) albeit their safety is at risk and the open and exposed landscape proves to be a hostile environment (DAWE 2022b). In the context of a contiguous landscape, where high levels of linear habitat connectivity are retained along watercourses, vegetated roadsides and fence lines and where dog attacks on livestock have been reported by local landholders, large open paddocks are expected to receive low levels of utilisation by koalas.

Field survey results and distribution of suitable habitat

Koala scratches (on smooth-barked trees) and faecal pellets were recorded during the Arup (2008) field surveys within the GSDA study area. No individuals or traces were recorded during the 2022 field surveys. Survey effort for the koala included two nights of 2-3 hours of spotlighting and faecal pellet searches at 12 locations within potentially suitable habitat in the GSDA study area. Historical records for the species have been recorded at nine locations within the desktop search extent (10 km buffer), the closest record approximately 2 km from the GSDA pipeline alignment. Many of these records have been historically recorded along fringing riparian vegetation and woodland habitats, including tributaries adjoining Larcom Creek and within woodland adjacent to The Narrows Road.

Potential habitat for this species was widespread within all the GSDA study area, particularly within woodland habitats retaining koala food trees (i.e. *Melaleuca*, *Eucalyptus, Corymbia* and *Acacia* species) and fringing riparian vegetation. The distribution of predicted koala habitat was based on criteria detailed in Appendix F and is mapped

in Figure 7-6. Habitat assessments undertaken within the GSDA study area involved taking representative photos of the vegetation and general habitat. Nine habitat assessment sites within the GSDA study area were selected to illustrate suitable habitat for the koala, as well as presenting photos of areas that do not represent suitable habitat due to the lack of koala food and shelter trees. Each survey photo reference number refers to the photo that was taken at that habitat assessment site and is presented in Appendix G. Of those nine habitat assessment site photos, six photos (i.e. photo number 1, 2, 3, 5, 7 and 9) represent suitable koala habitat.

Significance of impact assessment

The project is likely to result in a significant residual impact on the koala. A significance of impact assessment of the project on the koala (endangered under the EPBC Act and NC Act) is provided in Table 7-10.

Table 7-10 Significance of impact on the koala

Significant residual impact criteria	Potential to occur
A long-term decrease in the size of a local population	**Unlikely** The koala population within the GSDA study area is considered an important population in the accordance with the Commonwealth approved conservation advice. The koala has been historically recorded at nine locations within the desktop search extent (10 km buffer), the closest record approximately 2 km from the GSDA pipeline alignment. Koala scratches and faecal pellets were recorded during the Arup (2008) field surveys within the GSDA study area; however, no individuals or evidence of presence was recorded during the 2022 field surveys. Based on the ecological field surveys and species ecology, koalas are predicted to occur at low densities within the GSDA pipeline alignment. The project is anticipated to result in the loss of 35.92 ha of suitable koala habitat. This represents 0.42 % of regional habitat (i.e. available within a 5 km buffer). The maximum width of clearing required for construction of the GSDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. The GSDA pipeline alignment largely supports regrowth vegetation and open landscapes that have been previously cleared for agricultural practices and linear infrastructure such as railways, roads, access tracks and pipelines. The remaining areas support remnant vegetation retaining suitable koala food trees (i.e. *Melaleuca*, *Eucalyptus*, *Corymbia* and *Acacia* species) in woodland and fringing riparian habitats. Relatively large areas of suitable habitat will persist in the surrounding landscape allowing opportunities for movement, including woodland habitats, riparian corridors and large areas of remnant habitat located within Mount Stowe State Forest, Calliope Conservation Park and Mount Larcom. Construction and operation impacts associated with the project are unlikely to have permanent impacts on the persistence of local and regional koala populations. Based on the scarcity of historical records and lack of koala traces in field surveys, koalas are likely to occur in low local densities. While the loss of 35.92 ha of suitable habitat will reduce the local availability of koala food and shelter trees, this is unlikely to lead to excessive competition for resources, given the low koala densities. The local loss of resources is therefore likely to be absorbed within remaining habitat in areas adjacent to the GSDA pipeline alignment. Therefore, the local koala population is not expected to experience a significant reduction in foraging and breeding success due to any increase in competition for resources.
Reduce the extent of occurrence of the species	**Unlikely** The project is anticipated to result in the loss of 35.92 ha of suitable koala habitat. This represents 0.42 % of regional habitat (i.e. available within a 5 km buffer). A maximum width of 30 m will be cleared for construction of the GSDA pipeline alignment, with 20 m to be rehabilitated after the pipeline has been installed and buried. The GSDA pipeline alignment has been largely placed in landscapes that have been previously cleared (open grass paddocks and regrowth vegetation) and has largely avoided areas retaining intact and fragmented remnant vegetation. Much of the surrounding landscape is similar to the landscape present within the GSDA pipeline alignment, such as cleared open landscapes, riparian corridors, and regrowth and remnant vegetation. Extensive areas of remnant habitat occur within Mount Stowe State Forest, Calliope Conservation Park and Mount Larcom, which interconnect with suitable koala habitat present within and adjacent to the GSDA pipeline alignment. The project is unlikely to disrupt connectivity to the extent that movement between remnant patches will be disrupted. As such, the project is unlikely to reduce the extent of occurrence of the species, especially noting the definition of extent of occurrence per the Queensland *Significant Residual Impact Guideline* (DEHP 2014b): *Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon*.

Significant residual impact criteria	Potential to occur
Fragment an existing population	**Unlikely** A maximum width of 30 m will be cleared for construction of the GSDA pipeline alignment, with 20 m to be rehabilitated after the pipeline has been installed and buried. The GSDA pipeline alignment has been largely placed in landscapes that have been previously cleared and in areas that retain regrowth vegetation. Much of the GSDA pipeline alignment has also been located adjacent to existing linear infrastructure including railways, roads, access tracks and pipelines, to reduce further fragmentation. Habitat loss within the GSDA pipeline alignment is not expected to impact connectivity with surrounding koala habitat as the habitat losses will be localised and is not considered to create large gaps to disrupt koala movement. Large areas of suitable koala habitat will persist within woodland and riparian corridor habitats immediately adjacent to the GSDA pipeline alignment, as well as extensive areas of remnant habitat located within Mount Stowe State Forest, Calliope Conservation Park and Mount Larcom. Therefore, the project is unlikely to fragment an existing koala population. It is noted that the local koala population in the landscape is likely to be very low, noting the low number of historic records and no contemporary records from 2022 field surveys.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally and regionally is unlikely to be limited by any localised land clearing necessary to construct the GSDA alignment. As a result, the project is not considered to cause any form of genetic isolation at a population level.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** Invasive species including wild dogs already occur throughout the area. Predatory species are attracted to prey opportunities presented by cleared corridors or prey moving away from disturbance areas. While new infrastructure has the potential to increase the risk of wild dog attack on koala by facilitating regional movement of dogs, these threats are already present within the receiving environment and are not likely to be exacerbated by the project. Feral animal control measures will be implemented throughout the duration of the project and have been designed to mitigate such risks. There is also potential for the spread of invasive weeds during the construction and operation phase. This potential will be addressed within the EMP and could provide the opportunity to enhance the quality of the environment utilised by the koala by providing mitigation measures to combat introduced species. The eradication of ground-covering weeds could enhance local koala movement. If mitigation measures are implemented correctly, the project is unlikely to result in the introduction of invasive species that are harmful to the koala.
Introduce disease that may cause the population to decline	**Unlikely** The project is not anticipated to introduce new diseases that may cause the species to decline. Stress may lead to an increase in the expression of chlamydia in koalas; however, the implementation of mitigation measure such as sequential clearing, site speed limits, use of experienced spotter-catchers during clearing and the requirement to allow koalas to self-disperse will reduce disturbance-related stress and risk of disease. Additionally, the species is susceptible to *Phytophthora cinnamomi* due the soil fungus's ability to infect *Eucalyptus* species. Biosecurity requirements (e.g. weed and seed declarations) will be implemented for the project, and thus, this risk has been assessed as low.
Interfere with the recovery of the species	**Unlikely** The project is expected to be relatively benign with no substantial long-term increase in mortality or any substantial barrier effects due to loss of habitat connectivity. All impacts are expected to be localised. Impacts along the GSDA pipeline alignment are expected to be consistent with existing levels of impact from habitat fragmentation and exposure to road noise and traffic. The risk of koala mortality of injury will be managed by the mitigation measures contained within the CEMP, and an experienced and suitably qualified fauna spotter-catcher will be employed during all clearing works. Accordingly, the project is unlikely to substantially interfere with the recovery of the species.

Significant residual impact criteria	Potential to occur
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Likely** The project will require the clearing of 35.92 ha of potentially suitable foraging and breeding habitat for the koala. Although the GSDA pipeline alignment has been largely placed within or adjacent to areas that have been previously cleared, the project will result in a loss of koala food and shelter trees (i.e. *Melaleuca*, *Eucalyptus, Corymbia* and *Acacia* species). While the project is not expected to cause a long-term decline in the local population, reduce its extent of occurrence, cause adverse habitat fragmentation effects nor interfere with the recovery of the species, the loss of suitable koala habitat within the GSDA pipeline alignment is likely to result in disruption to ecologically significant locations.
Conclusion	The project is likely to result in a significant residual impact on the koala. Although the GSDA pipeline alignment has been largely placed within or adjacent to areas that have been previously cleared, the project will require the clearing of 35.92 ha of suitable foraging habitat (i.e. *Melaleuca*, *Eucalyptus* and *Corymbia* species) and breeding habitat.

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Legend

- GSDA Pipeline Alignment
- Study Area
- Survey Photo Reference Number
- Predicted Koala Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
(Datum GDA2020)

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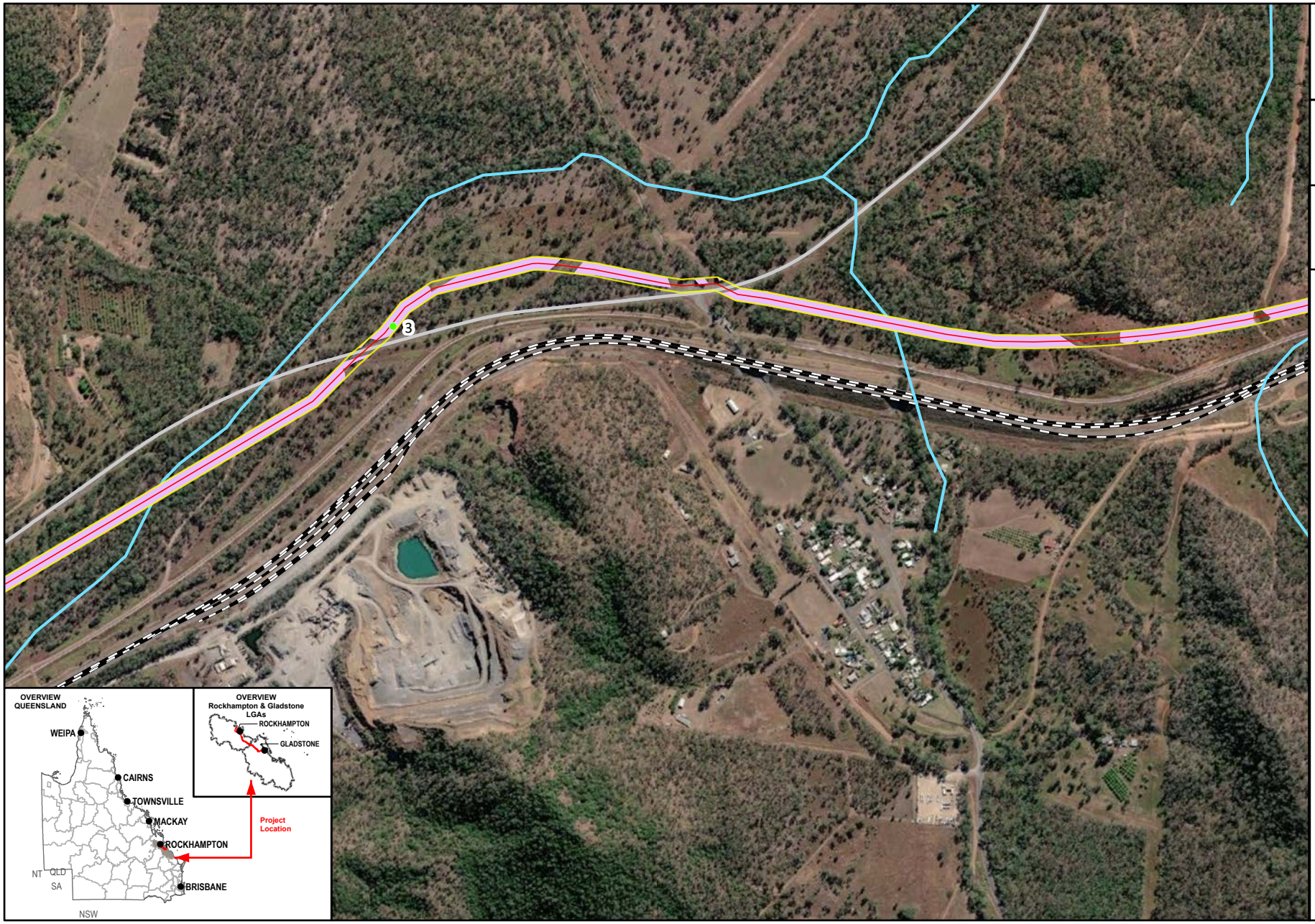
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-6a
Distribution of Koala Habitat Within the GSDA Study Area

000-G-MAP-2428 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Survey Photo Reference Number
- Predicted Koala Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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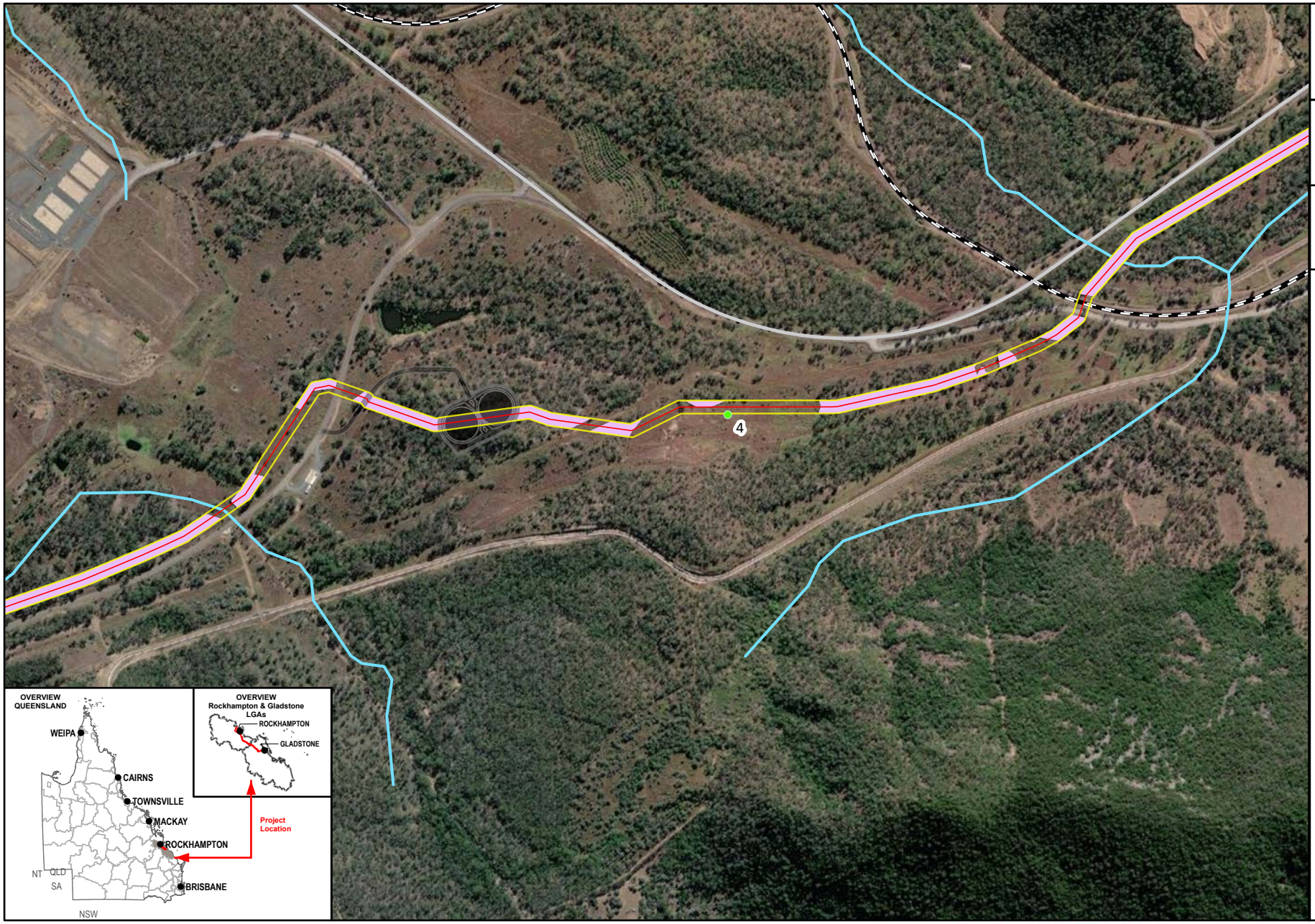
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-6b
Distribution of Koala Habitat Within the GSDA Study Area

000-G-MAP-2428 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Survey Photo Reference Number
- Predicted Koala Habitat
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
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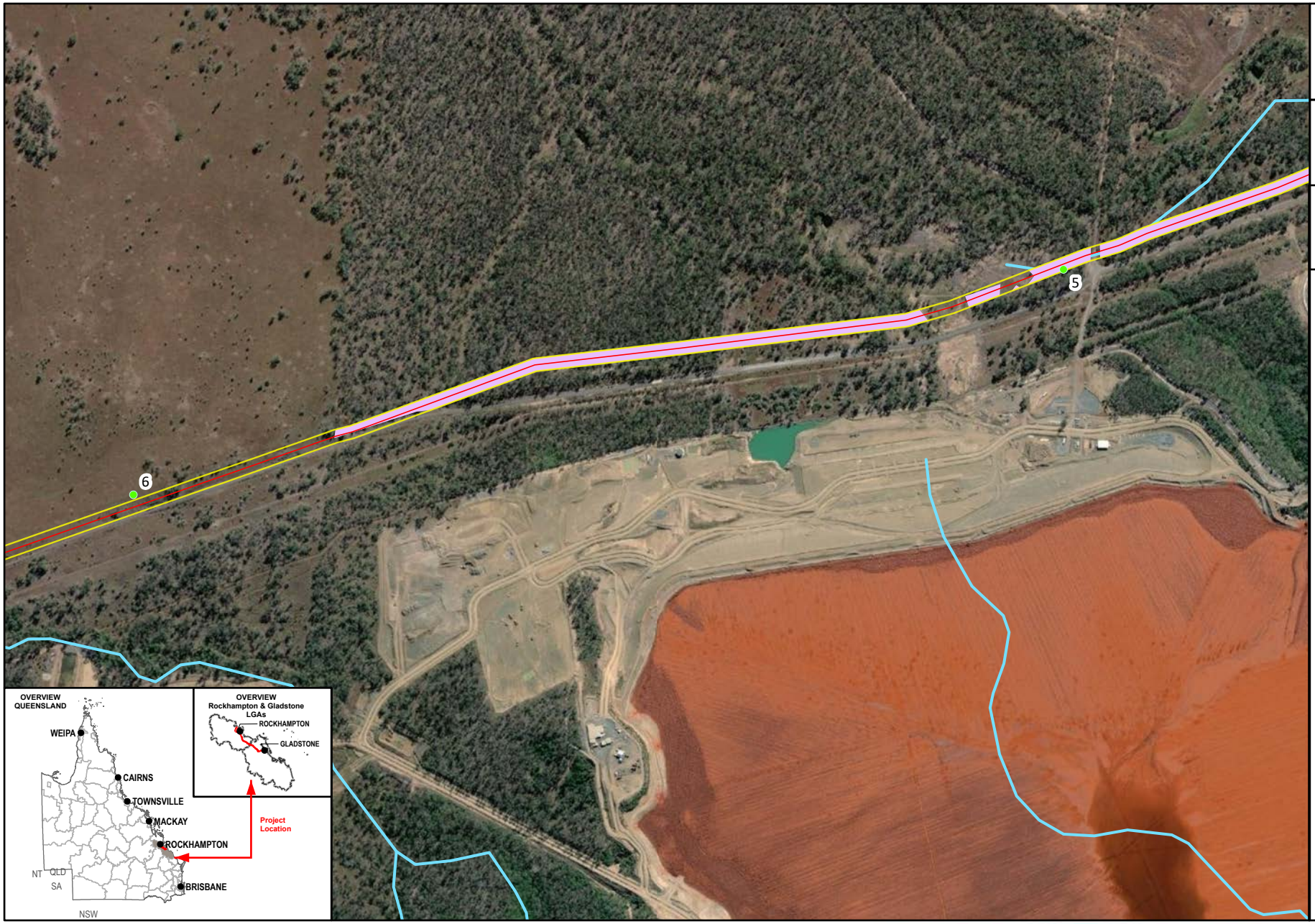
Figure 7-6c
Distribution of Koala Habitat Within the GSDA Study Area

000-G-MAP-2428 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Survey Photo Reference Number
- Predicted Koala Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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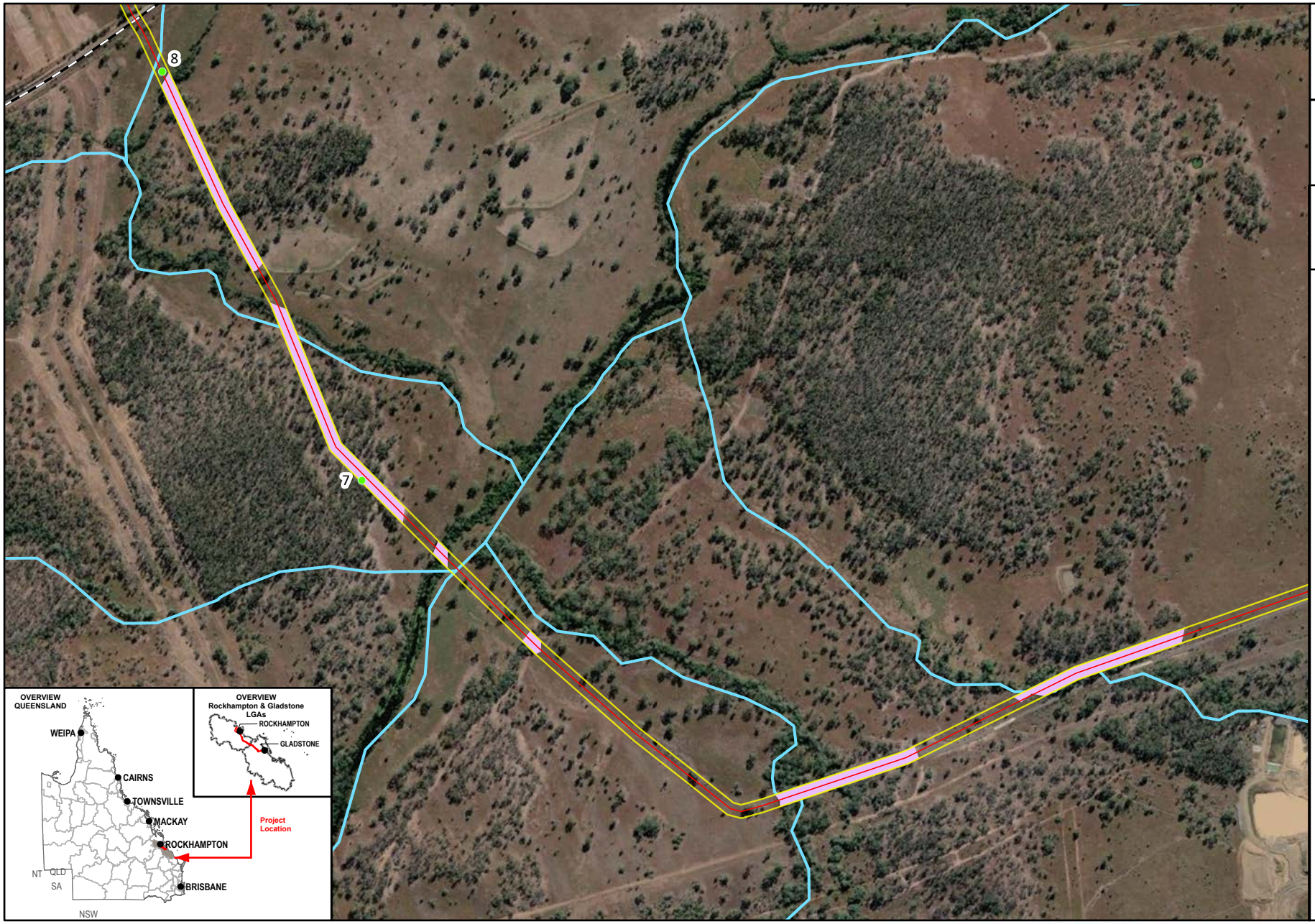
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-6d
Distribution of Koala Habitat Within the GSDA Study Area

000-G-MAP-2428 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Survey Photo Reference Number
- Predicted Koala Habitat
- Waterways
- Railways

Data Sources:
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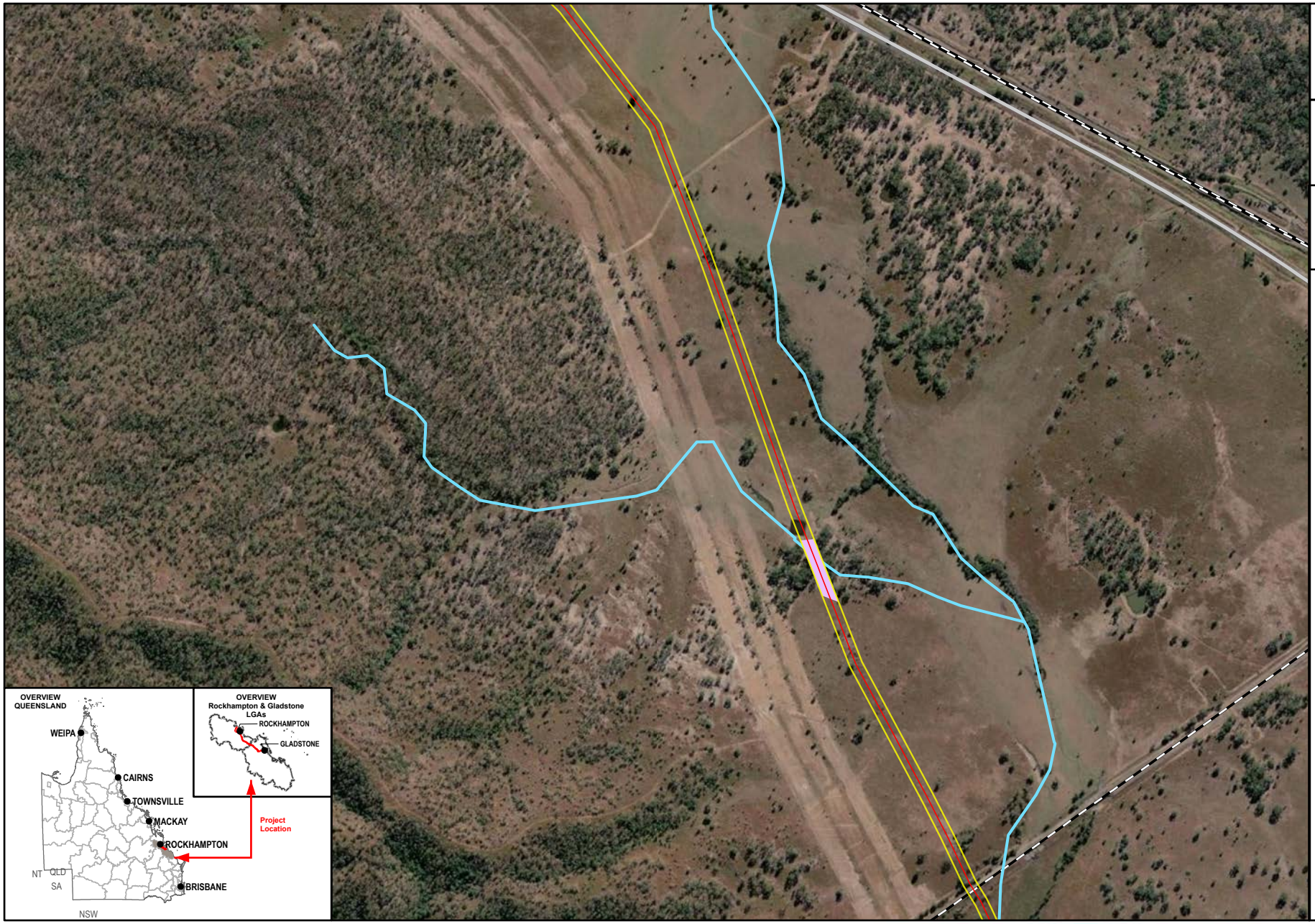
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-6e
Distribution of Koala Habitat Within the GSDA Study Area

000-G-MAP-2428 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Koala Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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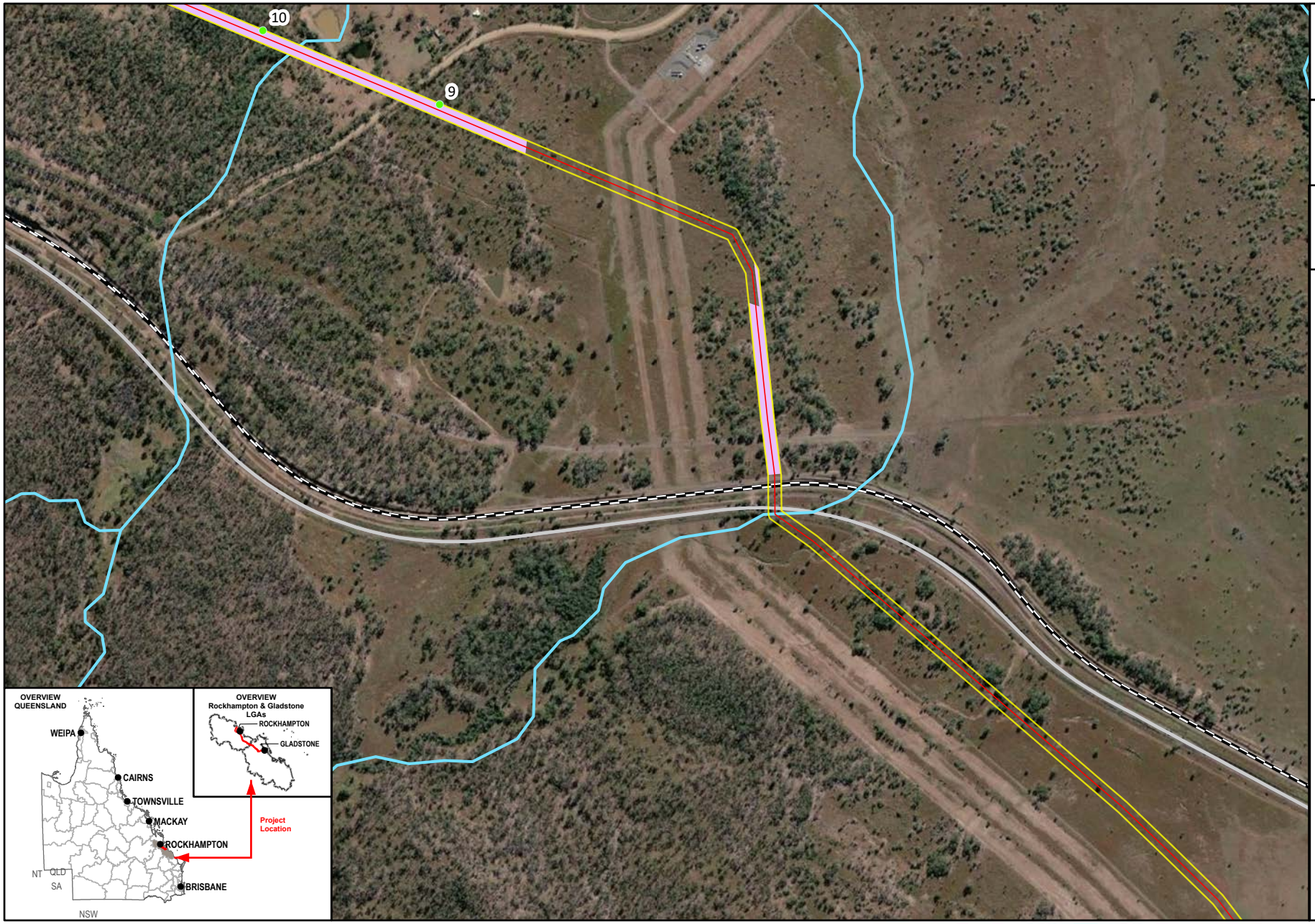
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-6f
Distribution of Koala Habitat Within the GSDA Study Area

000-G-MAP-2428 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
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- Survey Photo Reference Number
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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-6g
Distribution of Koala Habitat Within the GSDA Study Area

000-G-MAP-2428 Version:4 Date:19/09/2022

7.1.1.10 Grey-headed flying-fox

Conservation status and species ecology

The grey-headed flying-fox is listed as vulnerable under the EPBC Act and is not listed under the NC Act. The species was listed as an MNES at the time of the approval. The grey-headed flying-fox is one of the largest bats in the world (DAWE 2021) and Australia's only endemic flying-fox and occurs on the east coast of Australia from Ingham in Queensland to Adelainde in South Australia (DCCEEW 2022j). The species selectively forages for food where it is readily available, and hence, only utilises a small proportion of its range at any given time. A small number of local areas can support a continued presence of the species (DAWE 2021). Typically, patterns of occurrence and relative abundance for the species fluctuate between seasons and years in line with food availability (DCCEEW 2022j).

The species maintains one intermixing population throughout Australia. The grey-headed flying-fox requires foraging habitat and roosting sites, with it being a canopy-feeding frugivore and nectarivore, with the species diet supplemented with leaves DCCEEW 2022j; DAWE 2021). The species roosts in camps in areas ranging from continuous forests to patches of vegetation as small as 1 ha. Typically, camps are associated with water sources, in vegetation communities including rainforest, Melaleuca, mangroves and riparian vegetation (DCCEEW 2022j). The grey-headed flying-fox forages in canopy vegetation in a variety of habitats ranging from rainforests, open forest, open and closed woodlands and vegetation dominated by *Melaleuca* and *Banksia* species (DAWE 2021; DCCEEW 2022j). Major foraging sources for the species include blossoms from genus *Eucalyptus, Corymbia, Angophora, Melaleuca, Banksia* and *Syzygium* spp (DAWE 2021). Few of the grey-headed flying-fox foraging species flower in winter, or flower reliably in winter. As such, the species is subject to recurrent food shortages during winter and spring, with foraging resources typically restricted to coastal lowlands of south-east Queensland and northern New South Wales. As a result, the species continually migrates throughout its range to access food resources that are patchily distributed and seasonally available (DAWE 2021; DCCEEW 2022j).

Important winter and spring foraging habitat includes woodlands with *Eucalyptus tereticornis, E. albens, E. crebra, E. fibrosa, E. melliodora, E. paniculata, E. pilularis, E. robusta, E. seeana, E. sideroxylon, E. siderophloia, Banksia integrifolia, Castanospermum australe, Corymbia citriodora, C. eximia, C. maculata* (south from Nowra), *Grevillea robusta* and *Melaleuca quinquenervia or Syncarpia glomulifera* (DAWE 2021).

Grey-headed flying-foxes roost in groups of various sizes on exposed limbs of large trees (DCCEEW 2022j). The species typically utilise the same roosting site for longs periods of time (DCCEEW 2022j). The species commutes daily to foraging sites, which are usually within 15 km of the roosting site but can travel up to 40 km at night-time to different feeding areas as food resources change (DAWE 2021; DCCEEW 2022j).

Grey-headed flying-fox seasonally breed during a single event each year. Mating of grey-headed flying-foxes occurs in early autumn followed by the larger roosting camps tending to disperse in pursuit of available food resources (DAWE 2021; DCCEEW 2022j). Males and females segregate in October, when females give birth. Females give birth to their young following six months of gestation. As most adult grey-headed flying-foxes conceive one young annually, there is a low maximum rate of population growth. Females have a high tendency for aborting or abandoning their young in response to environmental stress such as a lack of food or high temperatures (DAWE 2021; DCCEEW 2022j).

Field survey results and distribution of suitable habitat

No grey-headed flying-fox nor any flying-fox camps were recorded during the field surveys within the GSDA study area. Survey effort for the grey-headed flying-fox included two nights of 2-3 hours of spotlighting within potentially suitable habitat in the GSDA study area. Suitable habitat was recorded within the GSDA study area, and the species has been historically recorded at eight locations within the desktop search extent, the most recent record recorded in 2014. The closest record is approximately 3 km east of the southern extent of the GSDA pipeline alignment, within coastal habitat. Suitable foraging habitat was recorded in eucalypt woodland areas retaining important winter and spring foraging tree species, including *Eucalyptus tereticornis, E. crebra, Corymbia citriodora* and *Melaleuca quinquenervia*. The distribution of predicted grey-headed flying-fox habitat is mapped in Figure 7-7.

Significance of impact assessment

The project is likely to result in a significant impact on the grey-headed flying-fox. As the species is not listed under the NC Act, a significance of impact assessment on the grey-headed flying-fox (vulnerable under the EPBC Act) was undertaken in accordance with the Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013) and is provided in Table 7-11.

Table 7-11 Significance of impact on the grey-headed flying-fox

Significant impact criteria	Assessment
Lead to a long-term decrease in the size of an important population of the species	**Unlikely** The grey-headed flying-fox population is a single, interbreeding population and therefore not considered an important population under the definition outlined in the Commonwealth *Significant impact guidelines 1.1* (DoE 2013). The project will result in the loss of 35.92 ha of potential foraging habitat for the species, most of which would constitute habitat critical to the survival of the species due to the local abundance of key food tree species (i.e. *Eucalyptus tereticornis, E. crebra, Corymbia citriodora* and *Melaleuca quinquenervia*). This habitat is not within 20 km of the nearest nationally important flying-fox camp (i.e. the range in which the species typically forages), the nearest nationally important flying-fox camp is approximately 230 km south east of the GSDA pipeline alignment. Therefore, the project is unlikely to lead to a long-term population decrease.A
Reduce the area of occupancy of an important population	**Unlikely** As detailed above, the local population is unlikely to represent an important population as the nearest nationally important camp is >200 km distant. The project will result in the loss of 35.92 ha of habitat, most of which would constitute habitat critical to the survival of the species. However, the loss of habitat, noting its narrow and linear configuration, and recognising the mobility of the grey-headed flying-fox, is not considered likely to reduce the area of occupancy of the species.
Fragment an existing important population into two or more populations	**Unlikely** The grey-headed flying-fox has an extensive range with the capacity to move large distances between camps at a national level. The loss of habitat attributed to the project will have localised impact that unlikely pose any barrier to movement. As such, impacts attributed to the project is unlikely to fragment the population into two or more populations.
Adversely affect habitat critical to the survival of a species	**Likely** The *National Recovery Plan for the grey-headed flying-fox* (DAWE 2021) identifies habitat critical to the survival of the species as habitats associated with winter and spring flowering food tree species that are in limited supply across the species' range, due to historical land clearing, predominantly in coastal areas. The project will result in the loss of 35.92 ha of foraging habitat, likely to be habitat critical to the survival of the species due to the abundance of important winter and spring foraging tree species (i.e. *Eucalyptus tereticornis, E. crebra, Corymbia citriodora* and *Melaleuca quinquenervia*). Based on the extent of the impact, this is likely to represent a significant adverse impact on habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	**Unlikely** The project is unlikely to disrupt the breeding cycle of an important population or an important grey-headed flying-fox camp. The project will have no direct impact on roosting habitat. The nearest camp is located approximately 20 km to the south along Leixlip Creek in Calliope.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely** The project will result in the loss of 35.92 ha of potential foraging habitat, representing habitat critical to the survival of the species. The nearest nationally important flying-fox camp is located approximately 228 km southeast of the GSDA pipeline alignment. As suitable foraging habitat is not within 20 km of a nationally important flying-fox camp, the habitat is unlikely to represent habitat utilised by the camp on a regular basis. However, it is within the species' foraging range (i.e. within 40 km of a camp) and may be important for supporting individuals at the camp, particularly during the winter and spring resource bottlenecks.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely** No invasive species are listed among the key threats to the grey-headed flying-fox in the Commonwealth approved conservation advice for the species. The project is unlikely to introduce or encourage the spread of any invasive species that could adversely affect the species.

Significant impact criteria	Assessment
Introduce disease that may cause the species to decline	**Unlikely** The grey-headed flying-fox is susceptible to Lyssavirus. While this is generally stable in the population, exposure to significant ecological stress can cause an increase in the incidence of Lyssavirus that can cause local declines in the species (DAWE 2021). The project will have no direct impact on camps or roosting sites, where there would typically be increased capacity for external impacts to cause adverse stress to an extent required to induce an increase in Lyssavirus.
Interfere substantially with the recovery of the species	**Unlikely** The project is unlikely to interfere substantially with the recovery of the species. Large, continuous patches of suitable foraging habitat for the grey-headed flying-fox is located adjacent to the GSDA pipeline alignment. Although, the project will result in the loss of 35.92 ha of potential foraging habitat, representing habitat critical to the survival of the species, the remaining habitat is connected to an extensive network of suitable habitat. The risk of individual mortality or injury during construction will be addressed via the mitigation measures in the EMP and the use sequential clearing and an experienced fauna spotter-catcher during clearing.
Conclusion	A conservative assessment has identified that the project is likely to result in a significant impact on the grey-headed flying-fox. Although the GSDA pipeline alignment has been largely placed within or adjacent to areas that have been previously cleared, the project will require the clearing of 35.92 ha of suitable foraging habitat, likely to be habitat critical to the survival of the species due to the abundance of important winter and spring foraging tree species (i.e. *Eucalyptus tereticornis, E. crebra, Corymbia citriodora* and *Melaleuca quinquenervia*).

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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Grey-headed Flying-fox Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-7a
Distribution of Grey-headed Flying-fox Habitat Within the GSDA Study Area

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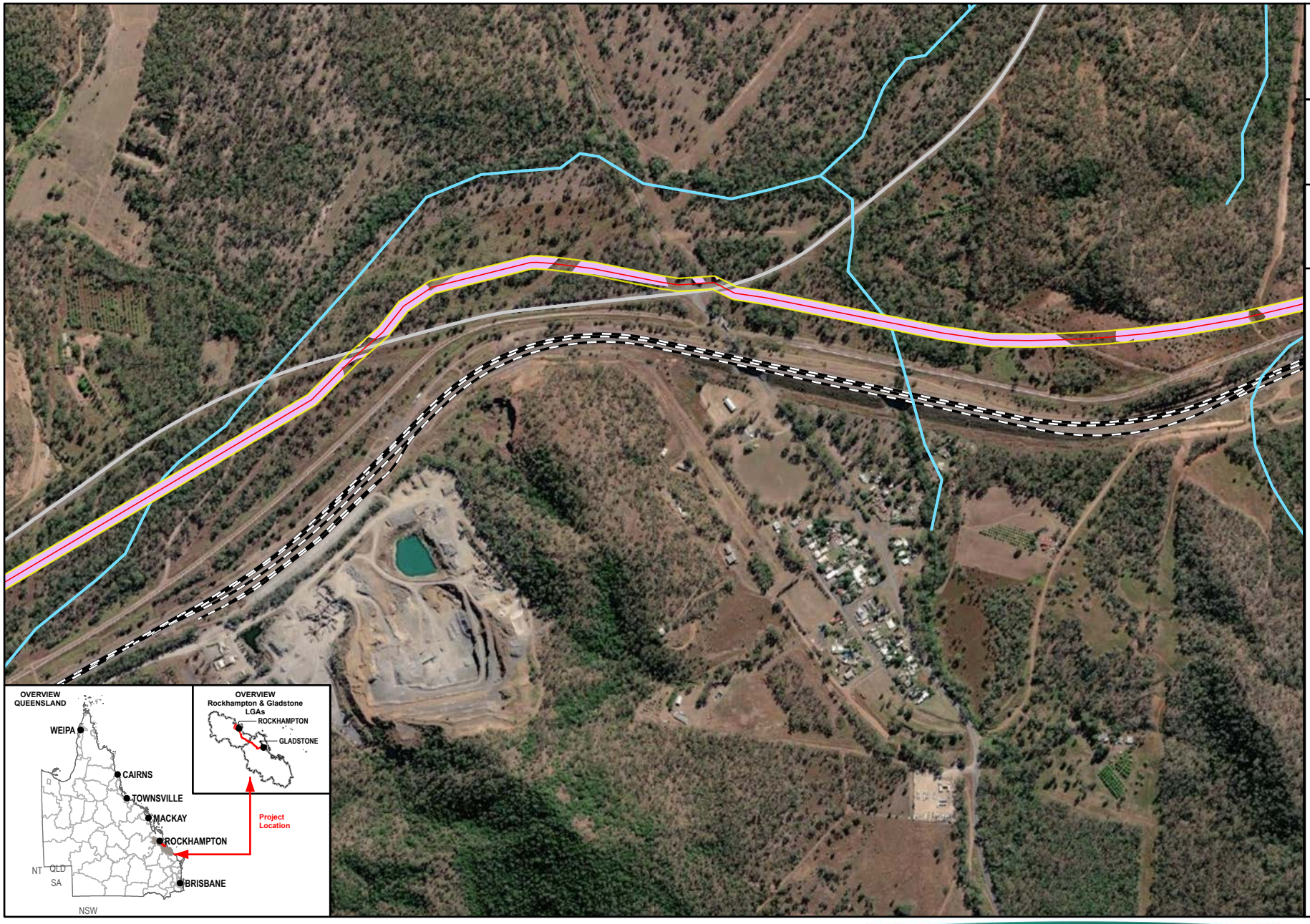

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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Grey-headed Flying-fox Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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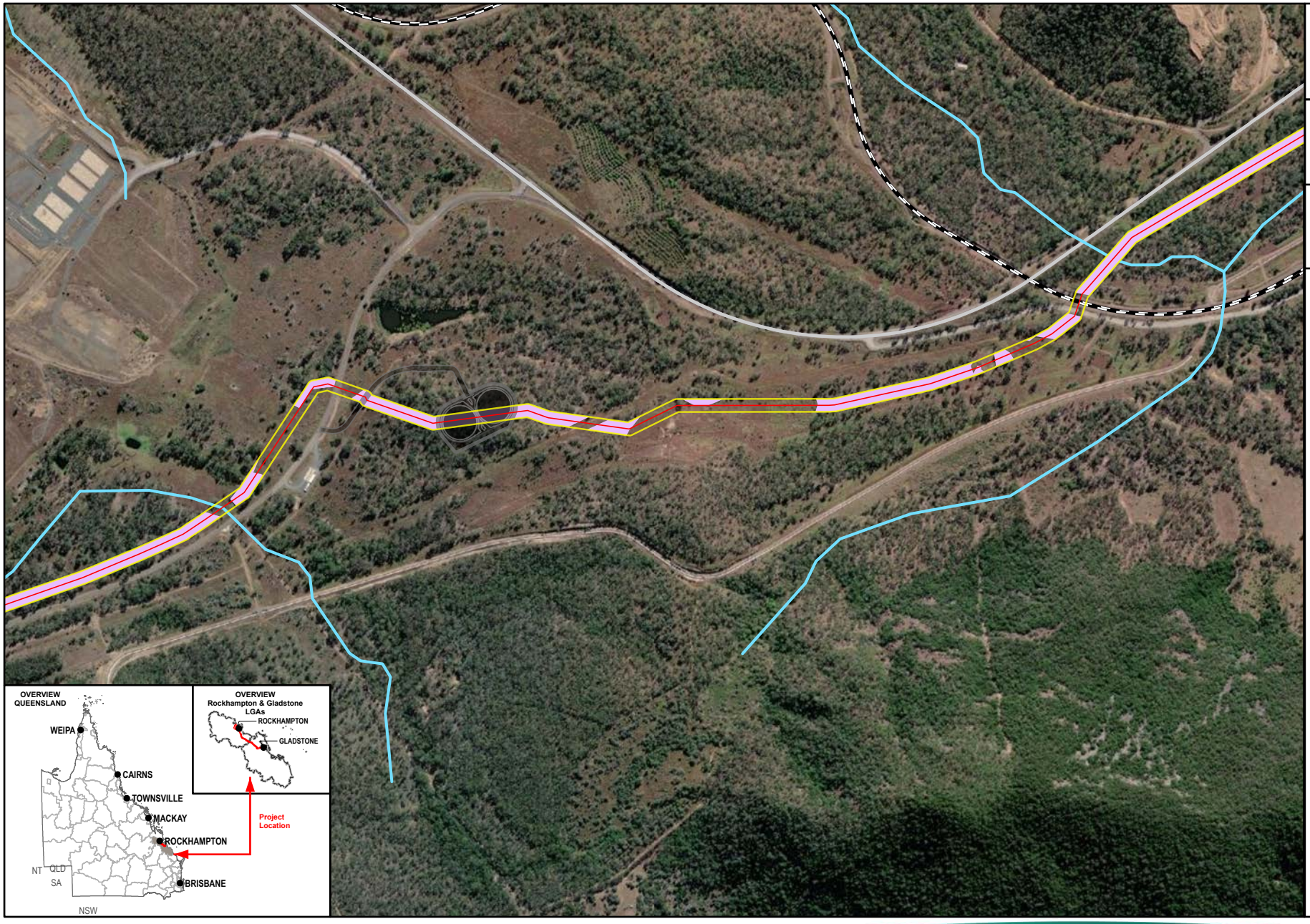
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-7b
Distribution of Grey-headed Flying-fox Habitat Within the GSDA Study Area

000-G-MAP-2430 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Grey-headed Flying-fox Habitat
- Aldoga Reservoirs Layout
- Waterways
- Main Roads
- Railways

Data Sources:
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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-7c
Distribution of Grey-headed Flying-fox Habitat Within the GSDA Study Area

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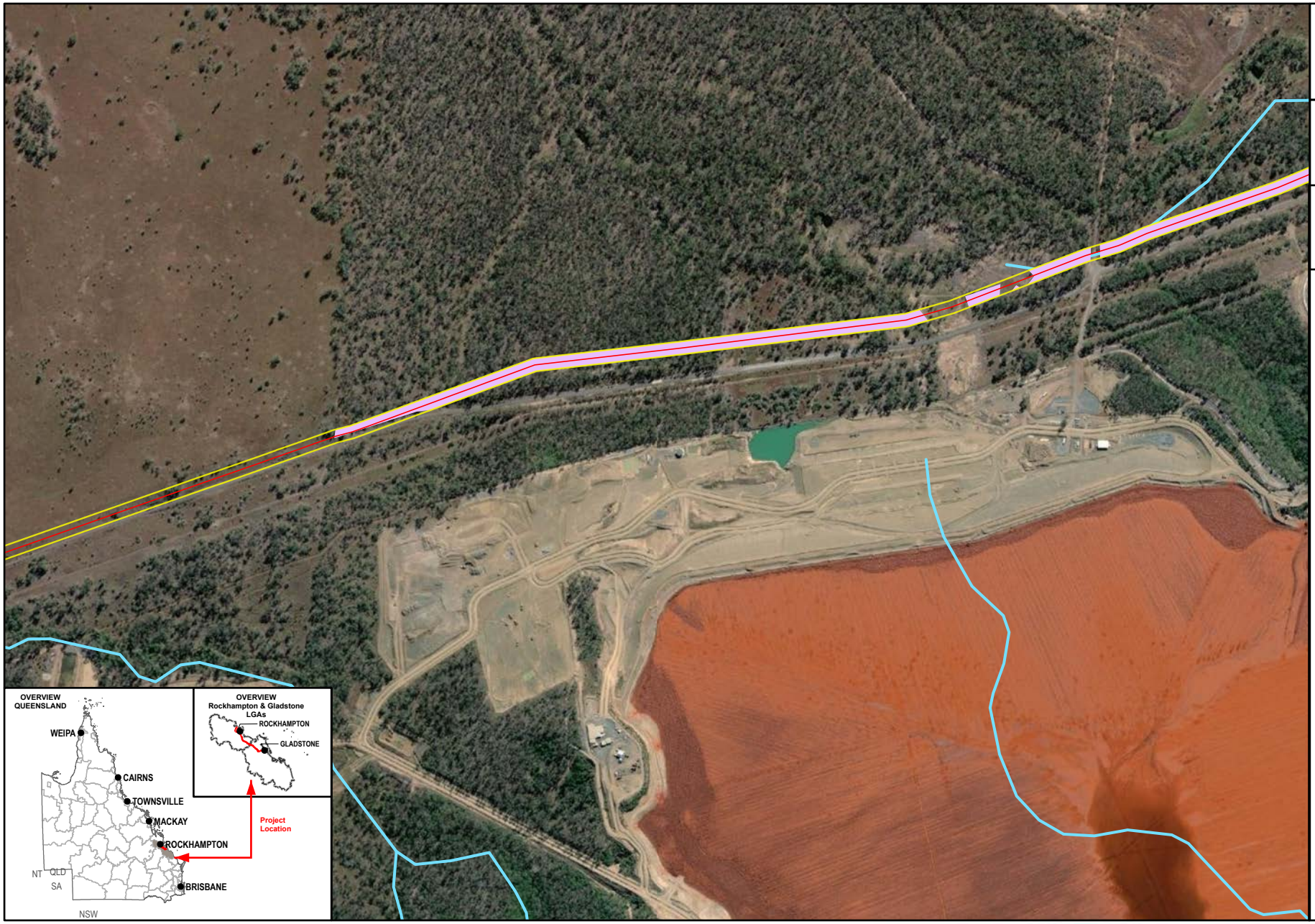

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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Grey-headed Flying-fox Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-7d
Distribution of Grey-headed Flying-fox Habitat Within the GSDA Study Area

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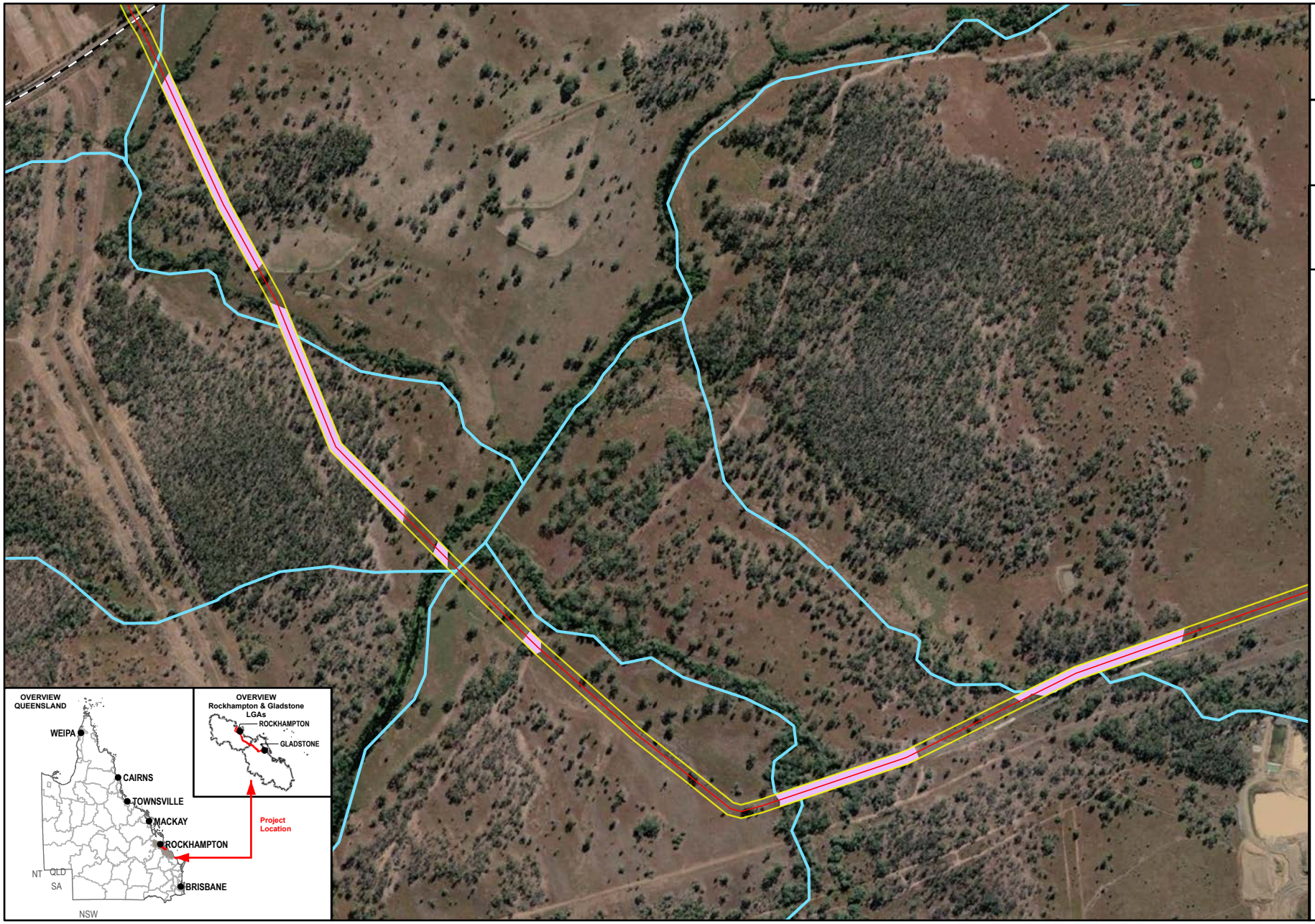

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Legend

- GSDA Pipeline Alignment
- Study Area
- Predicted Grey-headed Flying-fox Habitat
- Waterways
- Railways

Data Sources:
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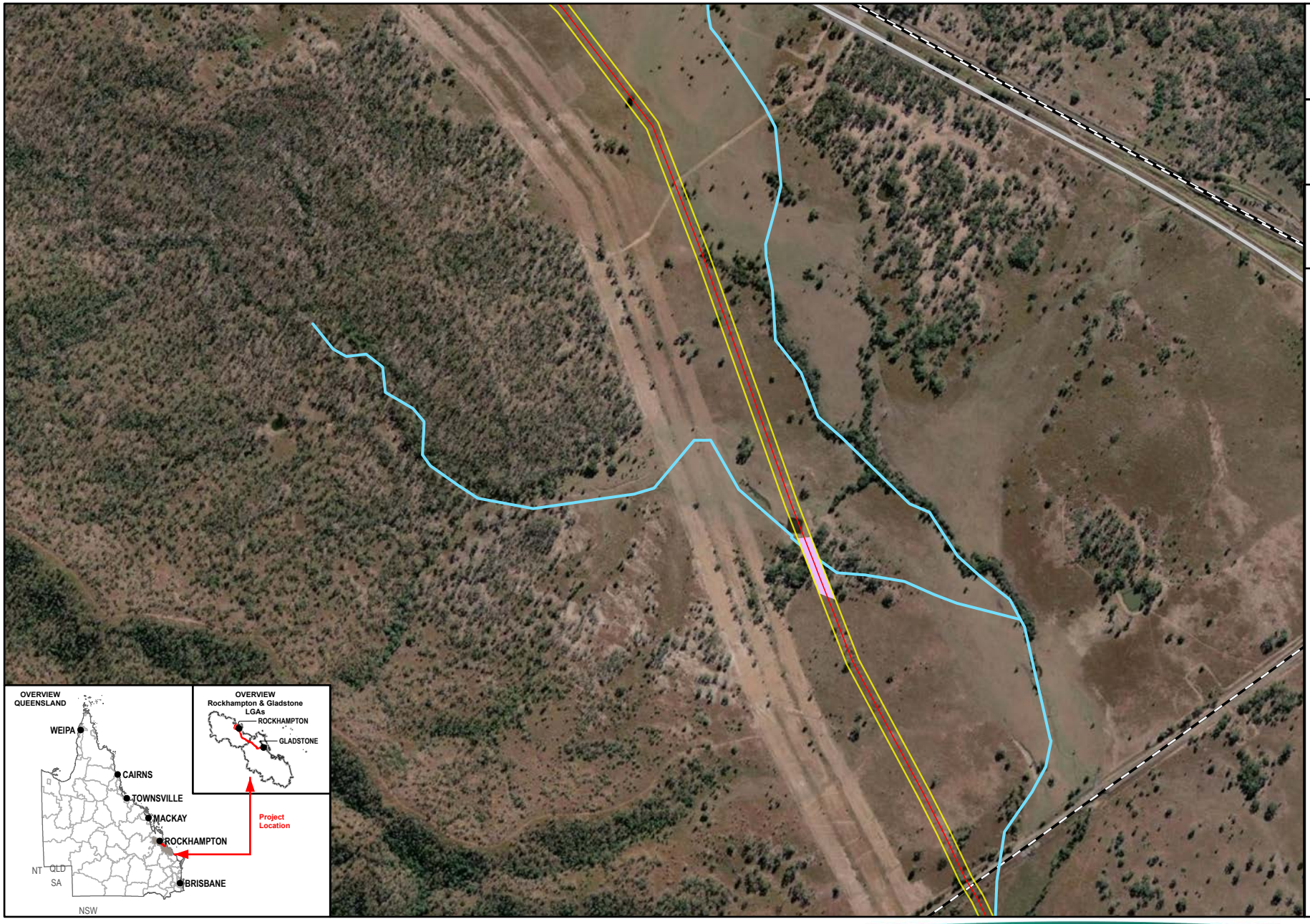
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-7e
Distribution of Grey-headed Flying-fox Habitat Within the GSDA Study Area

000-G-MAP-2430 Version:4 Date:19/09/2022



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Legend

- GSDA Pipeline Alignment
- Study Area
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- Waterways
- Main Roads
- Railways

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-7f
Distribution of Grey-headed Flying-fox Habitat Within the GSDA Study Area

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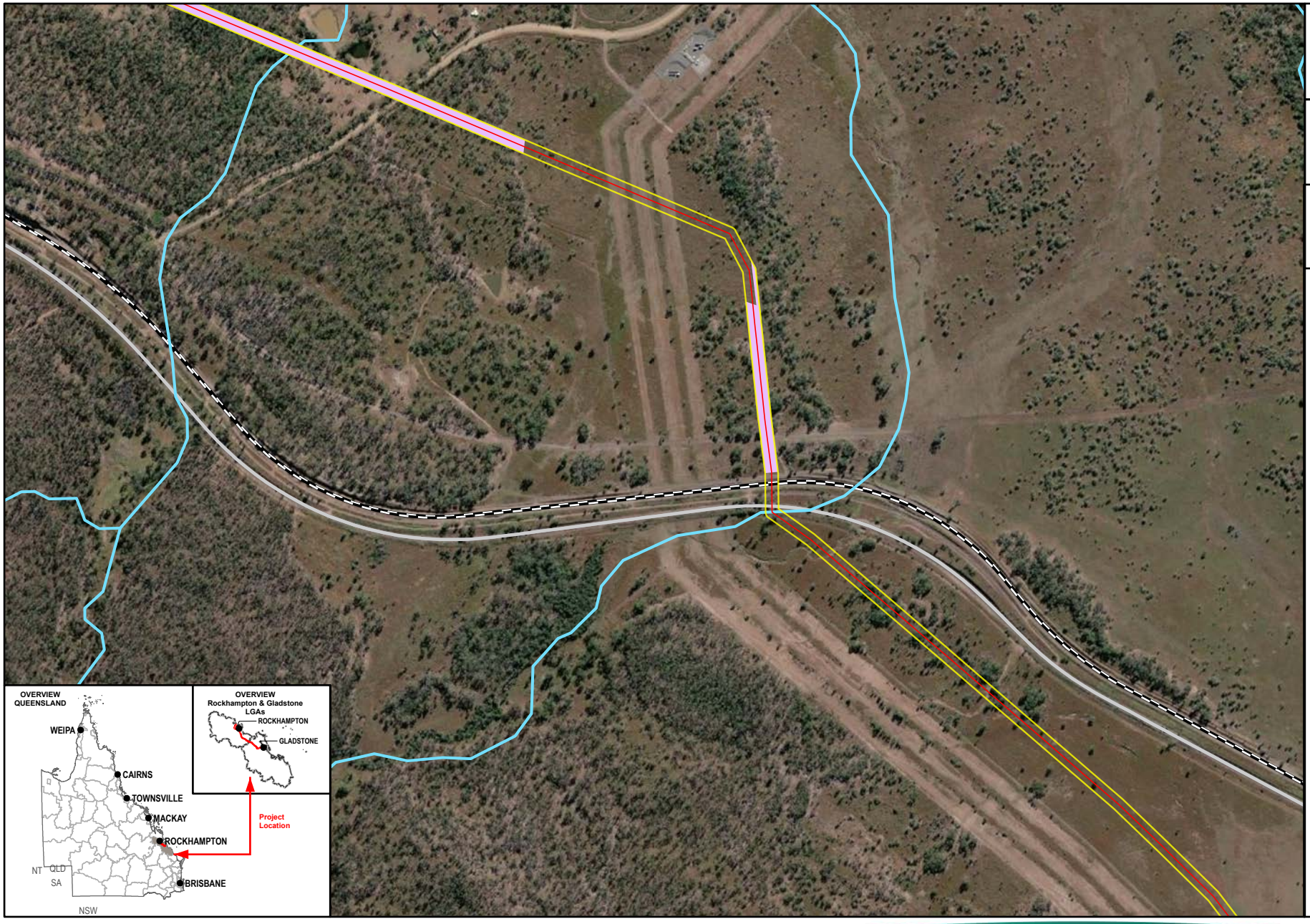

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- GSDA Pipeline Alignment
- Study Area
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- Waterways
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Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-7g
Distribution of Grey-headed Flying-fox Habitat Within the GSDA Study Area

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7.1.2 Significant Residual Impact on MSES values

The following MSES values, listed in the *Significant Residual Impact Guideline 2014* (DEHP 2014b), have been identified as having the potential to be impacted by the project. Note that potential impacts on MSES conservation significant species and their habitat have been assessed above in Section 7.1.1. A summary of the significant residual impact assessments are provided in Table 7-12.

Table 7-12 Summary of the GSDA significant residual impact assessments

Value	Is the residual impact significant?
Regulated vegetation	Likely
Connectivity areas	Unlikely
Wetlands and watercourses	Unlikely
Waterway providing for fish passage	Unlikely

7.1.2.1 Regulated vegetation

The project is likely to have a significant impact on regulated vegetation within the GSDA pipeline alignment. A significant residual impact assessment is provided in Table 7-13.

Table 7-13 Significant residual impact assessment – regulated vegetation

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
Significant residual impact criteria		
For clearing for linear infrastructure: – Greater than 25 m wide in a grassland (structural category) regional ecosystem; or – Greater than 20 m wide in a sparse (structural category) regional ecosystem; or – Greater than 10 m wide in a dense to mid-dense (structural category) regional ecosystem.	For clearing for linear infrastructure: – Greater than 25 m wide in a grassland (structural category) regional ecosystem; or – Greater than 20 m wide in a sparse (structural category) regional ecosystem; or – Greater than 10 m wide in a dense to mid-dense (structural category) regional ecosystem.	For clearing for linear infrastructure: – Greater than 25 m wide in a grassland (structural category) regional ecosystem; or – Greater than 20 m wide in a sparse (structural category) regional ecosystem; or – Greater than 10 m wide in a dense to mid-dense (structural category) regional ecosystem.
	Clearing within 50 m of the defining bank.	Clearing within 5 m of the defining bank.
Assessment		
Significant – Clearing greater than 10 m wide in a dense (structural category) endangered regional ecosystem and greater than 20 m wide in a sparse (structural category) of concern regional ecosystem is proposed to occur. – Disturbance within 10 m to 30 m will be rehabilitated, leaving 10 m permanently cleared.	**Not significant** No wetlands are mapped as intersecting the GSDA pipeline alignment	**Significant** – Clearing greater than 10 m wide in a dense (structural category) regional ecosystem and greater than 20 m wide in a sparse (structural category) regional ecosystem that are within the defined distance of a watercourse is proposed to occur. Clearing within 5 m of the defining bank will also occur. – Disturbance within 10 m to 30 m will be rehabilitated, leaving 10 m permanently cleared. The disturbance within 5 m of a bank will be rehabilitated after construction as the pipeline is proposed to be buried under watercourses and associated bank vegetation.

7.1.2.2 Connectivity areas

To identify and quantify any significant impact on connectivity within the GSDA pipeline alignment, the Landscape Fragmentation Tool (LFC) was used. The LFC tool performs a desktop assessment of proposed impacts on connectivity areas containing remnant vegetation and determines whether the prescribed activity will be significant with respect to the Queensland Environmental Offset Framework.

The following significant residual impact criteria for the significant residual impact test for connectivity as listed in the *Significant Residual Impact Guideline 2014* (DEHP 2014b), have been assessed and the project is unlikely to have a significant impact on connectivity within the GSDA pipeline alignment. A significant residual impact assessment of connectivity is provided in Table 7-14.

Table 7-14 Significant residual impact assessment – connectivity

Significant residual impact criteria	Assessment
Change in core remnant ecosystem extent at the local scale	Unlikely
Loss or fragmentation of core remnant ecosystem at the site scale	Unlikely

7.1.2.3 Wetlands and watercourses

The following significant residual impact criteria for wetlands and watercourses as listed in the *Significant Residual Impact Guideline 2014* (DEHP 2014b), have been assessed and the project is unlikely to have a significant impact on wetlands and watercourses within the GSDA pipeline alignment. A significant residual impact assessment is provided in Table 7-15.

Table 7-15 Significant residual impact assessment – wetlands and watercourses

Significant residual impact criteria	Assessment
Areas of the wetland or watercourse being destroyed or artificially modified;	**Unlikely** There are no HES wetlands that intersect the GSDA pipeline alignment, therefore no MSES wetlands will be permanently destroyed or artificially modified as a result of the project. There are five moderate and nine low risk ephemeral waterways that intersect with the GSDA pipeline alignment a. Where works occur in ephemeral habitats, additional controls for the protection of habitat and flow will be implemented. These measures will include scheduling works during the dry season to avoid increased mobilisation or erosion and sedimentation and avoid key fish migration and spawning periods. Works in wetted waterways will be undertaken in accordance with the DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), and any approval conditions, to avoid impacts to flow and fauna movement within the wetland. Within ephemeral watercourses that are dry during construction, the pipelines will be constructed via trenching. There will be a temporary modification of the dry creek bed and banks during construction to clear vegetation within the pipeline trenching footprint which will cause a temporary disturbance. However, it is expected that after construction, the watercourse beds and banks within the footprint will be rehabilitated back to their natural state with no residual impact. Larcom Creek is the only high-risk waterway within the GSDA pipeline alignment. This site contains a permanent waterbody and therefore this pipeline crossing is expected to be constructed via thrust boring and have no impact upon the waterway.
A measurable change in water quality of the wetland or watercourse—for example a change in the level of the physical and/or chemical characteristics of the water, including salinity, pollutants, or nutrients in the wetland or watercourse, to a level that exceeds the water quality guidelines for the waters; or	**Unlikely** The GSDA pipeline alignment has been positioned to avoid impacts on MSES wetlands and water courses where possible. Within ephemeral watercourses and wetlands that are dry during construction, the pipelines will be constructed via trenching. There will be a temporary modification of the dry creek bed and banks during construction to clear vegetation within the pipeline trenching footprint which will cause a temporary disturbance. However, it is expected that after construction, the watercourse beds and banks within the footprint will be rehabilitated back to their natural state with no residual impact.

Significant residual impact criteria	Assessment
	For the high-risk waterway, Larcom Creek, the pipeline will be constructed via trenchless methods and is not expected to have any impact upon water quality. The water quality of watercourses that intersect the GSDA pipeline alignment are therefore unlikely to undergo a measurable change. A CEMP, including erosion and sediment control will be implemented to minimise impacts to water quality during construction.
The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected; or	**Unlikely** The habitats or lifecycles of native species that are dependent on the waterway are unlikely to be seriously affected by the project. The GSDA pipeline alignment has been positioned to avoid impacts to HES wetlands and high ecological waterways where possible. Within ephemeral watercourses and wetlands that are dry during construction, the pipelines will be constructed via trenching. There will be a temporary modification of the dry creek bed and banks during construction to clear vegetation within the pipeline trenching footprint which will cause a temporary disturbance. However, it is expected that after construction, the watercourse beds and banks within the footprint will be rehabilitated back to their natural state with no residual impact. For the high-risk waterway, Larcom Creek, the pipeline will be constructed via thrust boring. Where works occur in wetted habitats, additional controls for the protection of habitat and flow including short duration of works outside of key migration or breeding periods will occur, these works will be localised and unlikely to disrupt the lifecycles of native species.
A substantial and measurable change in the hydrological regime or recharge zones of the wetland, e.g. a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland; or	**Unlikely** No wetlands intersect the GSDA pipeline alignment. No downstream wetlands have the potential to be impacted by the project as the project is unlikely to interfere with hydrological regime or recharge zone of downstream wetlands.
An invasive species that is harmful to the environmental values of the wetland being established (or an existing invasive species being spread) in the wetland.	**Unlikely** No wetlands intersect the GSDA pipeline alignment. No downstream wetlands have the potential to be impacted by the project due to the nature of the proposed works. Site-specific Weed and Pest Management Plan in accordance with relevant legislation and plans will be implemented that outlines protocols to prevent the introduction of weed and pest species into the construction area and minimise the spread of declared weeds and pests within the project footprint.

7.1.2.4 Waterway providing for fish passage

The following significant residual impact criteria for waterways providing for fish passage as listed in the *Significant Residual Impact Guideline 2014* (DEHP 2014b), have been assessed and the project is unlikely to have a significant impact on waterway providing for fish passage within the GSDA pipeline alignment. A significant residual impact assessment is provided in Table 7-16.

Table 7-16 Significant residual impact assessment – waterway providing for fish passage

Significant residual impact criteria	Assessment
Result in the mortality or injury of fish; or	**Unlikely** It is considered unlikely that the proposed pipeline works will result in the mortality or injury of fish. Construction will occur during the dry season within ephemeral waterways thereby avoiding injury and mortality. For the high-risk waterway, Larcom Creek, the pipeline will be constructed via thrust boring, avoiding potential injury or morality impacts to the fish community. Construction will be conducted within 180 days (DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018)), complying with approval conditions for the protection of waterways providing for fish passage. If construction is required within a waterway supporting aquatic fauna, then fauna salvage will occur in accordance with DAF Fish Salvage Guidelines. A CEMP will be implemented to protect habitat quality downstream of construction.

Significant residual impact criteria	Assessment
Result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage such as through the depletion of fishes' energy reserves, stranding, increased predation risks, entrapment or confined schooling behaviour in fish; or	**Unlikely** It is considered unlikely that the proposed pipeline works will result in conditions that substantially increases the risks to the health, wellbeing and productivity of fish seeking passage. Key mitigation measures include construction during the dry season and the use of thrust boring at the high-risk waterway, Larcom Creek. Capture and relocation of fish in wetted waterways will also be undertaken in accordance with DAF Fish Salvage Guidelines where required. A CEMP will be implemented for the protection of habitat quality within and downstream of the construction footprints.
Reduce the extent, frequency or duration of fish passage previously found at a site; or	**Unlikely** It is considered unlikely that the proposed pipeline works will reduce the extent, frequency or duration of fish passage within the GSDA pipeline alignment. The location of the pipeline has been located to avoid and reduce impacts to permanent waterways. Construction will primarily occur within dry ephemeral waterways and no impacts to fish passage will occur. The only high-risk waterway within the GSDA pipeline alignment is Larcom Creek and thrust boring methods of construction will be used to further avoid direct impacts to fish, fish movement and habitat quality. Where works occur in wetted habitats, additional controls for the protection of habitat and flow including short duration of works outside of key migration or breeding periods will occur, these works will be localised and unlikely to disrupt the passage of fish. Works in wetted waterways will be undertaken in accordance with the DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), or any approval conditions and will allow for continued or facilitated movements.
Substantially modify, destroy or fragment areas of fish habitat (including, but not limited to in-stream vegetation, snags and woody debris, substrate, bank or riffle formations) necessary for the breeding and/or survival of fish; or	**Unlikely** It is considered unlikely that the proposed pipeline works will substantially modify, destroy or fragment areas of fish habitat within the GSDA pipeline alignment. The location of the pipeline has been located to avoid and reduce impacts to permanent waterways. Open trench construction methods will primarily occur within dry ephemeral waterways in which there will be a temporary modification of the dry creek bed and banks which will cause a temporary disturbance. However, it is expected that after construction, the watercourse beds and banks, along with other fish habitats within the footprint will be rehabilitated back to their natural state with no residual impact. For Larcom Creek, the high-risk mapped waterway under the WWBW spatial layer that will contain water at the time of construction, thrust boring will be used to further avoid direct impacts to fish habitat. Where works occur in wetted habitats, additional controls for the protection of habitat will include the implementation of a CEMP and fauna salvage in accordance with DAF guidelines. The works will be localised and unlikely to substantially modify, destroy or fragment area of fish habitat.
Result in a substantial and measurable change in the hydrological regime of the waterway, for example, a substantial change to the volume, depth, timing, duration and frequency of flows; or	**Unlikely** It is considered unlikely that the proposed pipeline works will substantially or measurably change the hydrological regime of the waterways within the GSDA pipeline alignment. Construction will primarily occur within dry ephemeral waterways and not impact upon the hydrological regime of these waterways. Waterways mapped as high and major risk under the WWBW spatial layer that contain water at the time of construction will utilise trenchless construction methods if possible and avoid impacts to the hydrological regime of the waterways. Where construction occurs in wetted habitats, works will be undertaken in accordance with the DAF's 'ADR for operational work that is constructing or raising waterway barrier works' (DAF 2018), or any approval conditions and will allow for continued flow through or around the construction footprint and is therefore unlikely to impact upon the hydrological regime of the waterway.

Significant residual impact criteria	Assessment
Lead to significant changes in water quality parameters such as temperature, dissolved oxygen, Ph and conductivity that provide cues for movement in local fish species.	**Unlikely** It is considered unlikely that the proposed pipeline works will lead to significant changes in water quality parameters within the GSDA pipeline alignment. The location of the pipeline has been located to avoid and reduce impacts to permanent waterways. Construction will primarily occur within dry ephemeral waterways and not impact upon the water quality within these waterways. For Larcom Creek, the high-risk mapped waterway under the WWBW spatial layer that will contain water at the time of construction, thrust boring will be used and will avoid impacts to water quality within the waterways. During any works that may occur in wetted waterways, a WQMP, as per the CEMP, will be developed to identify the potential for water quality degradation and allow for adaptive management if required. Therefore, works within the project are unlikely to impact upon water quality parameters and thereby not disrupt environmental cues for movement of local fish species.

7.2 SGIC SDA

7.2.1 Significance of impact on threatened communities

One TEC was confirmed present in the SGIC SDA pipeline alignment that was identified as a controlling provision and considered in deciding the EPBC Approval, namely the Brigalow (*Acacia harpophylla* dominant and co-dominant) (endangered under the EPBC Act). The potential for the project to significantly impact on this community was assessed against the criteria for endangered and critically endangered TECs in the EPBC Significant Impact Guidelines 1.1 (DoE 2013). The assessment found that the project is likely to have a significant impact on the community. Justification for this finding is included in the significance of impact assessment provided in Table 7-17. The Poplar Box Grassy Woodland on Alluvial Plains TEC was also confirmed present in the SGIC SDA pipeline alignment; however, it was not listed at the time of the approval and a significant impact assessment is not required for this community.

Table 7-17 EPBC Act significant impact assessment – Brigalow (Acacia harpophylla dominant and co-dominant) TEC

Significant impacts criteria	Assessment
Reduce the extent of an ecological community	**Unlikely** One patch of the TEC was confirmed present in the SGIC SDA pipeline alignment. This patch will be directly impacted, with a total of 1.52 ha of the TEC patch to be cleared for the project. Whilst the area of the impacted patch will be reduced by 12.7%, the majority of the patch will be retained and the extent of occurrence of the community in the local area is unlikely to change as a result of the project. Based on the definition of extent provided by the IUCN (TSSC 2017), no reduction in the extent of the TEC is expected.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	**Likely** The SGIC SDA pipeline alignment crosses the TEC patch for a distance of approximately 507 m. The proposed clearing width of 30 m will represent a break in connectivity within this patch and also lead to greater vulnerability from edge effects. Furthermore, clearing for roads or transmission lines is cited in the Significant Impact Guidelines 1.1 (DoE, 2013) as an impact that would result in fragmentation and is likely to have a significant impact on a TEC. A pipeline corridor that is kept clear of vegetation is likely to have similar impact to a transmission line. Management measures will be implemented to reduce clearing for the pipeline and associated access track to the minimum extent practicable. Nevertheless, the project is likely to result in fragmentation of this community.
Adversely affect habitat critical to the survival of an ecological community	**Likely** Clearing 1.52 ha of the TEC patch will be required to accommodate the pipeline and associated maintenance track. This represents 12.7% of the patch. As per the listing advice, all confirmed TEC patches are considered areas critical to the survival of the ecological community. As such, clearing for the project is likely to adversely affect habitat critical to the survival of the TEC.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	**Unlikely** The landscape is not proposed to be altered in a way that will impact the abiotic features necessary to support the TEC. Surface water flows are not expected to be significantly impeded by the project.
Cause a substantial change in the species composition of an occurrence of an ecological community.	**Unlikely** No significant change in the species composition is expected. The introduction of a weed control program through the CEMP is likely to result in the overall reduction of invasive species across the project footprint. Equipment and personnel will be subject to weed hygiene requirements and are unlikely to contribute to the introduction of additional invasive species to the site.

Significant impacts criteria	Assessment
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community	**Unlikely** The introduction of a weed control program through the CEMP is likely to reduce existing weed levels within the project footprint. Equipment and personnel will be subject to weed hygiene conditions and are unlikely to contribute to the introduction of additional invasive species to the site.
Interfere with the recovery of an ecological community	**Unlikely** The nominated TEC patch occurs in a landscape that is subjected to ongoing cattle grazing. It is also unlikely that recovery actions would be initiated by landowners. Nevertheless, further fragmentation of the patch will be detrimental to any future recovery actions should they occur.
Conclusion	The project is likely to result in a significant impact on the Brigalow (Acacia harpophylla dominant and co-dominant) TEC. The project will result in clearing 1.52 ha of the TEC patch, which is likely to result in fragmentation of the community and adversely affect habitat critical to the survival of the TEC. Biosecurity and hygiene measures will be incorporated in the project's CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.

7.2.2 Significant Impact on MNES and MSES species

This section assesses the significance of the SGIC SDA impacts on MNES and MSES that have been confirmed present or are considered likely to occur within the SGIC SDA study area. The significance of impact assessment has been undertaken in accordance with the Queensland *Significant Residual Impact Guideline* (DEHP 2014b) and Commonwealth *Significant Impact Guidelines 1.1* (DoE 2013). A summary of outcomes of the MNES and MSES significant impact assessment are presented in Table 7-18.

Table 7-18 Summary of residual significant impact assessment on MSES

Species	Significant impact	EPBC Approval	Assessed as MSES	Assessed as MNES
Flora				
Samadera bidwillii	Unlikely	✓	✓	
Fauna				
Curlew sandpiper	Unlikely		✓	
Green turtle	Unlikely		✓	
Estuarine crocodile	Unlikely		✓	
Ornamental snake	Unlikely	✓	✓	
Yellow chat (Dawson)	Unlikely	✓	✓	
Squatter pigeon (southern)	Likely	✓	✓	
Grey snake	Unlikely		✓	
White-throated needletail	Unlikely		✓	
Powerful owl	Unlikely		✓	
Platypus	Unlikely		✓	
Greater glider (southern and central)	Likely		✓	
Yellow-bellied glider (south-eastern)	Likely		✓	
Koala	Likely		✓	
Grey-headed flying-fox	Likely	✓		✓
Australian painted snipe	Unlikely	✓	✓	

7.2.2.1 *Samadera bidwillii*

Conservation status and species ecology

Samadera bidwillii is listed as a vulnerable under both the NC Act and the EPBC Act and was listed as an MNES at the time of the approval. It is a small shrub or tree that grows up to 6 m in height. Its leaves are stiff and leathery and up to 9 cm in length and 6 to 12 mm wide. Flowering occurs from November to March. Inflorescences occur in axillary clusters of 1 to 4; sepals are 0.75 mm to 1 mm long and petals are up to 2.5 mm long. The fruit is a drupe (up to 1 cm long) with short hairs (DotE, 2015). Fruiting typically occurs from February to April but only a small proportion of plants produce viable seed in any one season. Plants often resprout from rootstock following disturbance.

S. bidwillii typically inhabits lowland rainforest or rainforest margins and can also be found in other forest types including open forest and woodland and habitats adjacent to temporary and permanent watercourses (DotE, 2015).

Significance of impact assessment

The project is unlikely to result in a significant residual impact on *Samadera bidwillii*. A significance of impact assessment of the project on *Samadera bidwillii* (vulnerable under the EPBC Act and NC Act) is provided in Table 7-19.

Table 7-19 Significance of impact on **Samadera bidwillii**

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** Although this species is considered likely to occur based on the species distribution and habitat present, no individuals have been confirmed present in the SGIC SDA pipeline alignment during successive on-ground survey efforts by various consultants. As such the project is unlikely to result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the SGIC SDA pipeline alignment. Therefore, the project is unlikely to result in a reduction in the extent of occurrence of the species.
Fragment an existing population	**Unlikely** No population has been recorded historically or during recent survey efforts within the SGIC SDA pipeline alignment. Therefore, no fragmentation of an existing population is expected to occur.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The project is unlikely to impact any local occurrences or their supporting habitats and opportunities for breeding and dispersal are not expected to be impeded by the project. As such, the project is unlikely to result in the isolation of habitats for the species or the formation of genetically distinct populations.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** The project is unlikely to result in an invasive species becoming established within the SGIC SDA pipeline alignment. Strict biosecurity measures will be incorporated in the Project CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not considered to be a key threat to *S. bidwillii*; however, hygiene management measures will be utilised during the construction phase to limit the introduction of organic matter into the SGIC SDA pipeline alignment.
Interfere with the recovery of the species	**Unlikely** No population has been recorded historically or during recent survey efforts within the SGIC SDA pipeline alignment. Therefore, no interference with the recovery of the species has been identified.

Significant residual impact criteria	Assessment
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** No population has been recorded historically or during recent survey efforts within the SGIC SDA pipeline alignment. Therefore, the project footprint is not considered to be ecologically significant for this species.
Conclusion	The project is unlikely to result in a significant residual impact on *Samadera bidwillii.* No individuals or population have been recorded historically or during recent surveys efforts within the GSDA pipeline alignment. Biosecurity and hygiene measures will be incorporated in the project's CEMP to limit the introduction of weeds and other organic matter from outside of the project footprint.

7.2.2.2 Curlew sandpiper

Conservation status and species ecology

The curlew sandpiper is listed as critically endangered and migratory under the EPBC Act and critically endangered under the NC Act. The species was not listed at the time of the approval. During the non-breeding period and breeding season for non-breeding birds, the species occurs within suitable habitats along the coast and inland Australia (DoE 2015a). In Australia, the species occurs on intertidal mudflats in sheltered coastal areas, including estuaries, and non-tidal swamps, including lakes and lagoons near the coast (DoE 2015a). The species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects in tidal and non-tidal habitats, such as mudflats, sandy shores, flooded paddocks and inundated saltflats (DoE 2015a). The curlew sandpiper roosts around coastal or near-coastal lagoons and other wetlands on open substrates. The species has been recorded roosting in mangroves (DoE 2015a). The breeding range of the curlew sandpiper is restricted to the Arctic of northern Siberia. The species departs breeding grounds in July and August, stops over in northern Australia and then continues the direct route to south-east Australia in late August and September. The species' return to breeding grounds begins in March (DoE 2015a).

Field survey results and distribution of suitable habitat

The curlew sandpiper was not recorded during the field surveys within the SGIC SDA study area. The species is considered likely to occur due to the presence of suitable habitat and the species has been historically recorded at 13 locations within the desktop search extent (10 km buffer). The closest record is approximately 1.7 km west from the SGIC SDA pipeline alignment, near Marmor. Suitable habitat for the species was observed in areas where the SGIC SDA pipeline alignment intersects tidal (i.e. mangroves, saltmarshes and mudflats) and non-tidal habitats (i.e. seasonal wetlands). The distribution of predicted curlew sandpiper habitat is mapped in Figure 7-8.

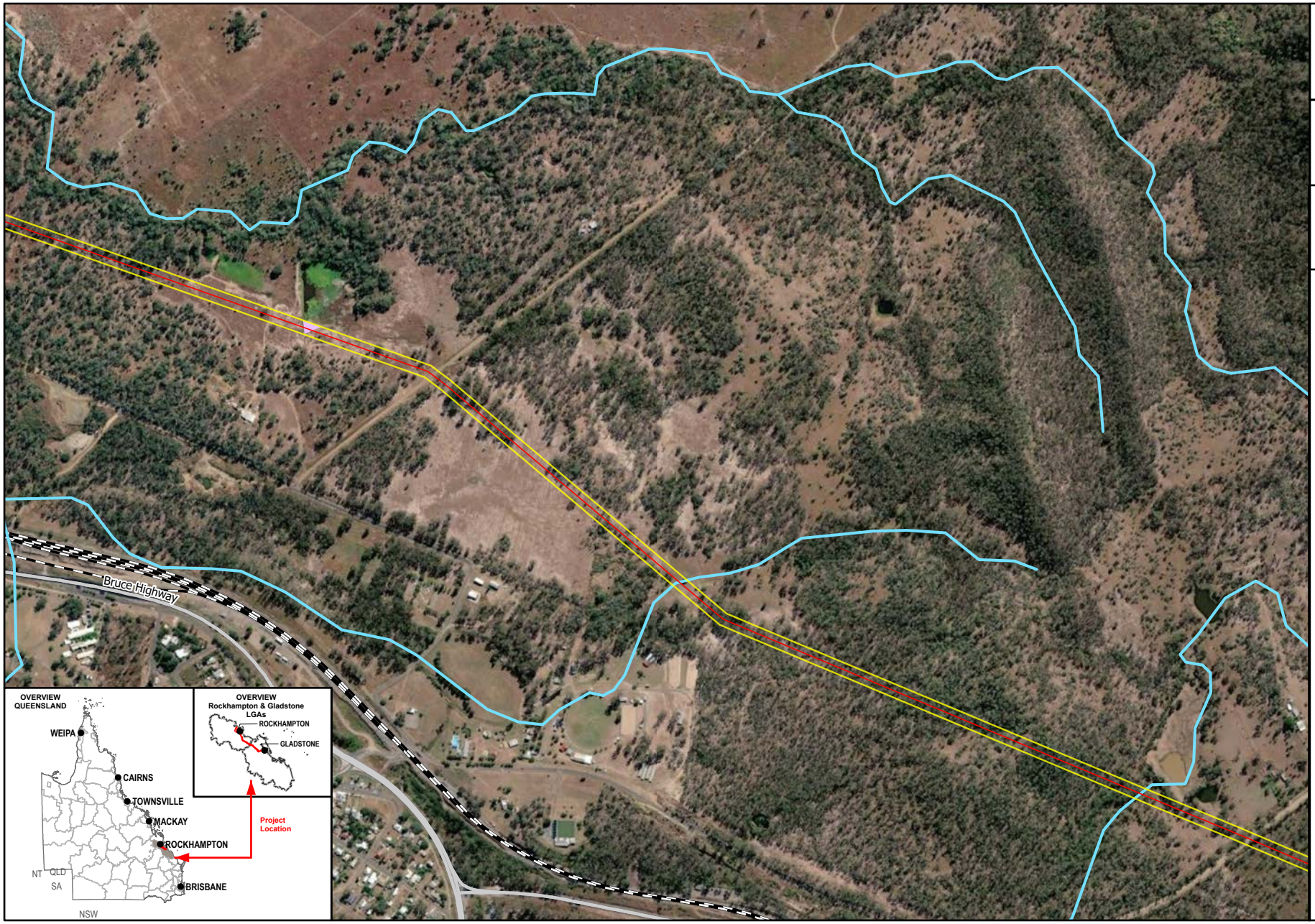
Significance of impact assessment

The project is unlikely to result in a significant residual impact on the curlew sandpiper. A significance of impact assessment of the project on the curlew sandpiper (critically endangered and migratory under the EPBC Act and critically endangered under the NC Act) is provided in Table 7-20.

Table 7-20 Significance of impact on the curlew sandpiper

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The curlew sandpiper is not considered to have a limited geographic distribution as the species is known to move locally, regionally, and globally. The species has been historically recorded at 13 locations within the desktop search extent (10 km buffer). The project will result in the clearing of 1.64 ha of predicted habitat for the species, representing 0.29% of habitat available within a 5 km buffer. Given the scarcity of records within the local landscape and the species' is highly mobile, the loss of suitable habitat within the SGIC SDA pipeline alignment is unlikely to (1) limit movement of resident or transient individuals; nor (2) affect the availability of resident or transient individuals to acquire key resources (especially noting that the dearth of historical records indicates that adjacent habitats are unlikely to be at carrying capacity and the species does not breed within Australia). The project is unlikely to lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	**Unlikely** Occurrence of the species within the SGIC SDA pipeline alignment has not been recorded. The closest record is approximately 1.7 km west from the SGIC SDA pipeline alignment, near Marmor. The maximum width of clearing required for construction of the SGIC SDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. Clearing along the SGIC SDA pipeline alignment is unlikely to impact the species as the proposed clearing extent is narrow and mostly linear, and unlikely to impact intertidal systems within and adjacent to the SGIC SDA pipeline alignment. The project will result in a loss of 1.64 ha of predicted habitat for the curlew sandpiper. Given the minimal loss of habitat, negligible impact of local and landscape connectivity, and low levels of disturbance during the operation phase, it is unlikely to have any significant indirect impact on the species. Accordingly, the project is unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	**Unlikely** A maximum width of 30 m will be cleared for construction of the SGIC SDA pipeline alignment, with 20 m to be rehabilitated after the pipeline has been installed and buried. As the SGIC SDA pipeline alignment is narrow and linear and the curlew sandpiper is highly mobile, the project is unlikely to fragment the curlew sandpiper population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** The species' breeding grounds do not occur within Australia. The species' capacity to move locally, regionally, and globally is unlikely to be limited by any localised land clearing necessary to construct the SGIC SDA pipeline alignment. As a result, the project is unlikely to cause any loss of gene transfer that would cause genetically distinct populations to form.
Result in invasive species that are harmful to a (critically) endangered species becoming established in the (critically) endangered species' habitat	**Unlikely** Numerous invasive weeds and pasture grasses are currently well established within the SGIC SDA pipeline alignment. Implementation of a site-specific Weed and Pest Management Plan will reduce the risk of further weed spread. Therefore, the project is unlikely to result in the establishment of novel invasive species affecting curlew sandpiper foraging habitat.
Introduce disease that may cause the population to decline	**Unlikely** Disease is not listed as a potential threat to the species (DoE 2015a). The project is unlikely to introduce a disease that may cause the species to decline.
Interfere with the recovery of the species	**Unlikely** No impacts on the lifecycle are predicted to occur and the species does not breed in Australia. No impacts on the long-term persistence of the species in the local landscape is anticipated, and no reduction in population size is expected such that no genetic diversity will be lost for the species. Noting the above points relating to very limited if any effects on local populations (e.g. declines), extent of occurrence, fragmentation, invasive species, and disease, the project is not considered likely to interfere with the recovery of the glossy black-cockatoo.

Significant residual impact criteria	Assessment
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** The project will result in a loss of 1.64 ha of potentially suitable foraging habitat for the curlew sandpiper. While the species is known to mainly occur within intertidal mudflats (DCCEEW 2022), only a small proportion of habitat loss contains tidal wetlands (i.e. mudflats and saltmarshes) and fringing mangrove vegetation along tidal waterways. A large proportion of habitat loss contains large seasonal wetlands retaining pastural grasses, which is not considered as an ecological significant location of the species. While disturbance to species' may be experienced during construction, this disturbance will be short-term such that no impact on the lifecycle of this species is anticipated. Furthermore, any disturbance during construction will be highly localised and therefore unlikely to impact ecologically significant locations of a species. This conclusion is based on the small extent of the proposed impact. Similarly, owing to the narrow clearing extent, food resources in the local landscape for the species' is unlikely to be substantially reduced and movement patterns are not anticipated to be impacted as there will be no functional disruption in habitat connectivity. The project is unlikely to disrupt the species breeding cycle, as the species breeding range is restricted to the Arctic of northern Siberia (DoE 2015a).
Conclusion	The project is unlikely to result in a significant residual impact on the curlew sandpiper. The project will result in a loss (1.64 ha) of potentially suitable foraging habitat for the curlew sandpiper; however, due to the narrow clearing extent, food resources in the local landscape for the species' is unlikely to be substantially reduced and movement patterns are not anticipated to be impacted as there will be no functional disruption in habitat connectivity. Furthermore, the project is unlikely to impact the species' breeding cycle, as its breeding range is restricted to the Arctic of northern Siberia (DoE 2015a).



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8a
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022

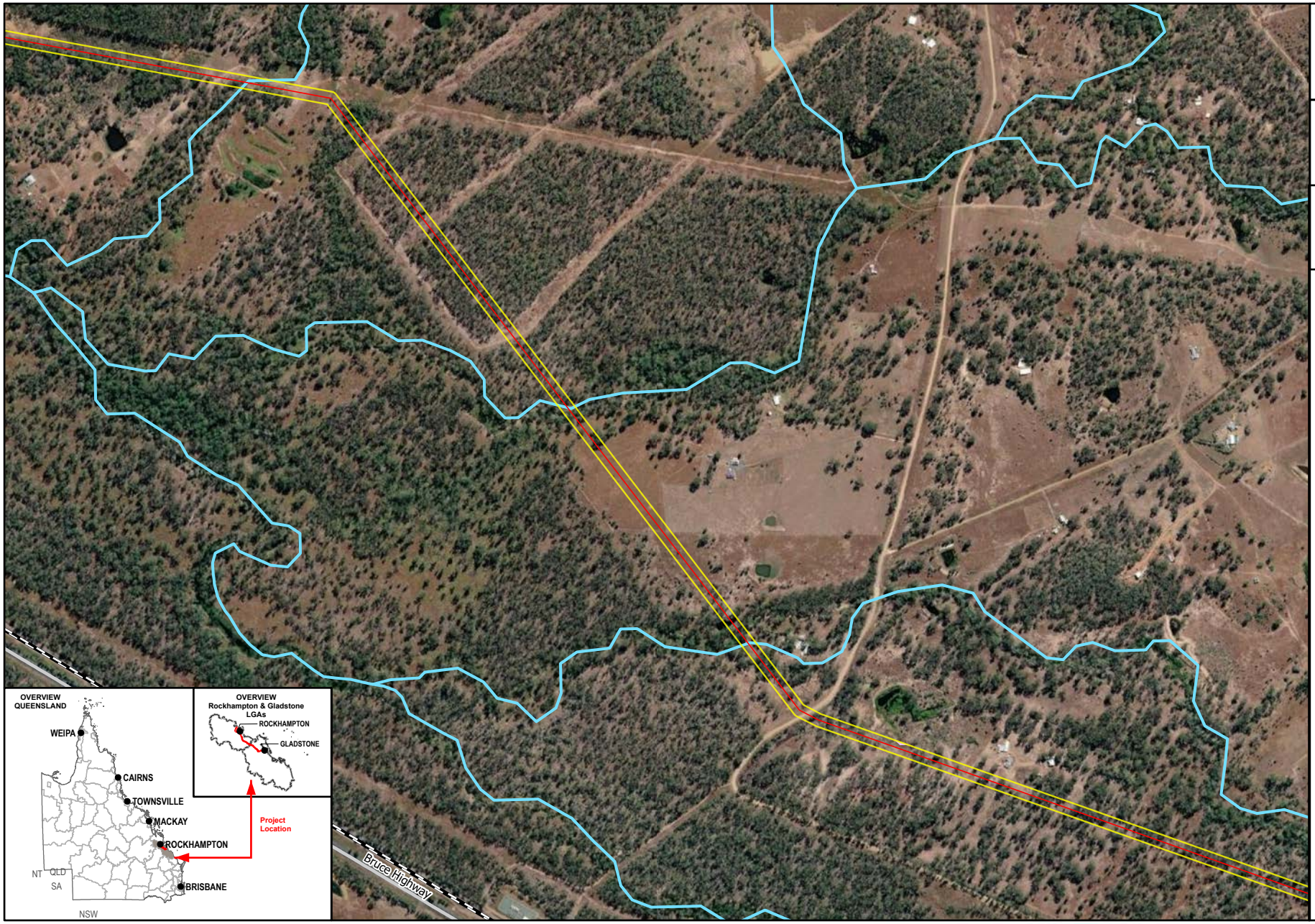

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Figure 7-8b
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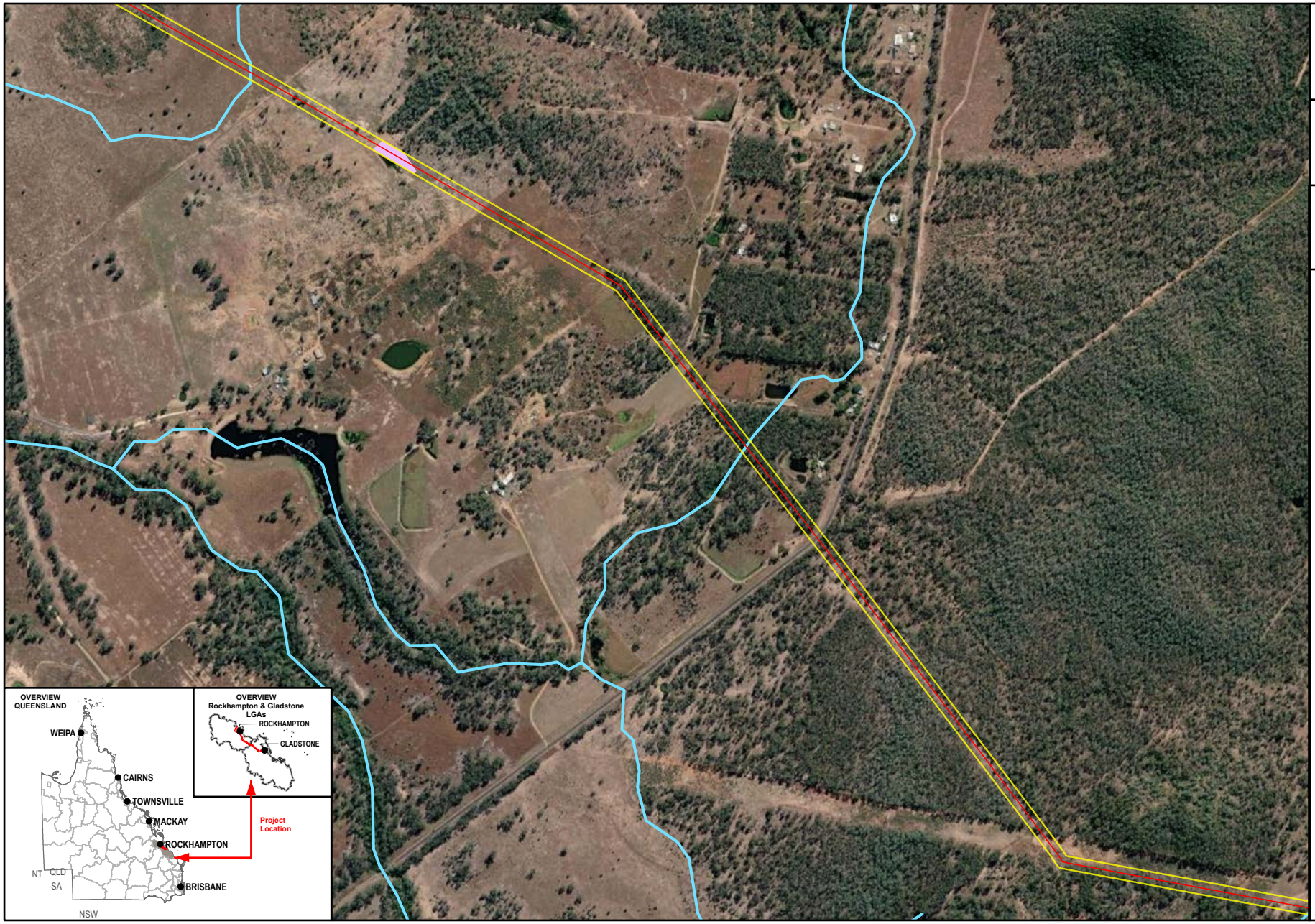
000-G-MAP-2429 Version:3 Date:19/09/2022



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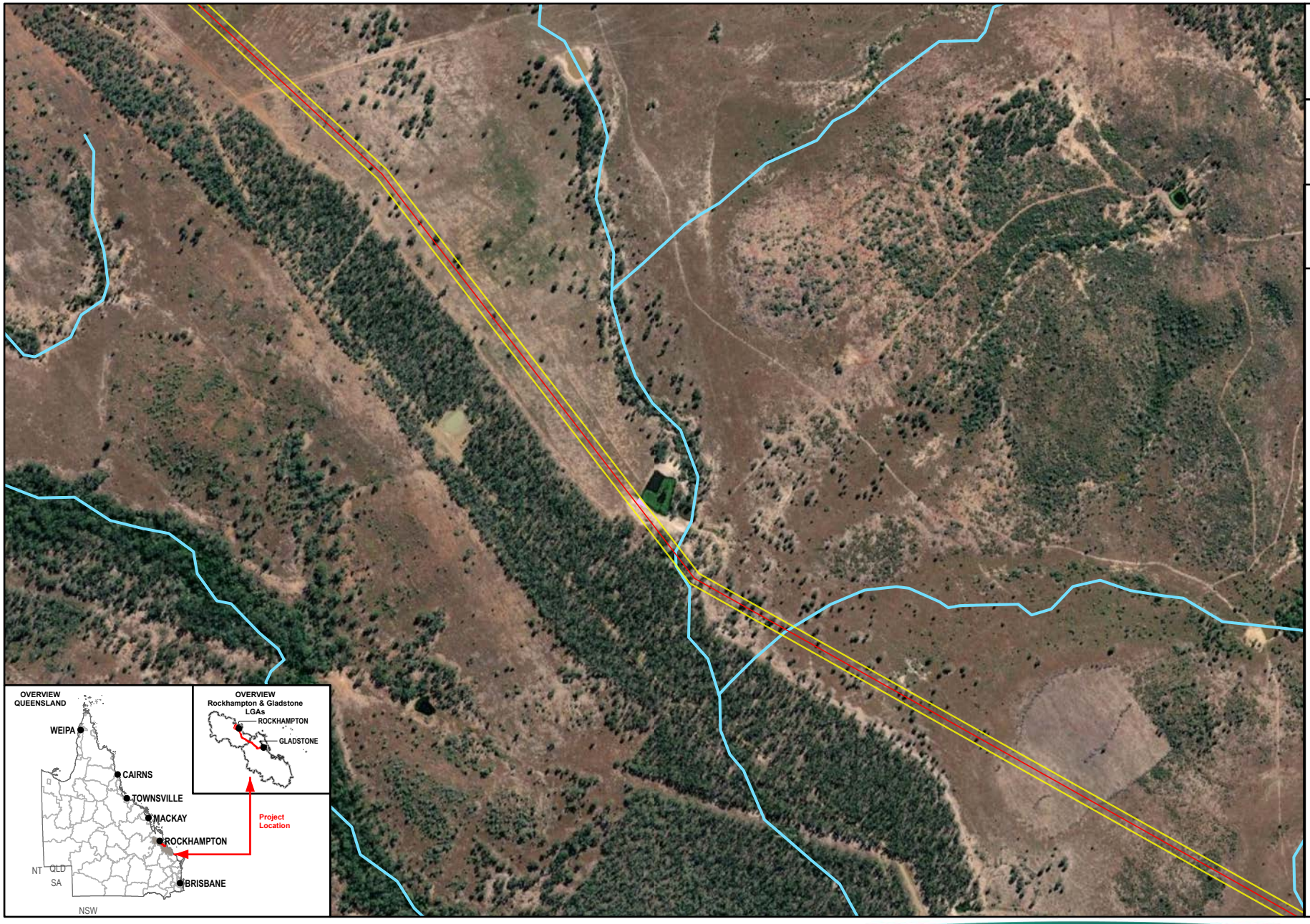

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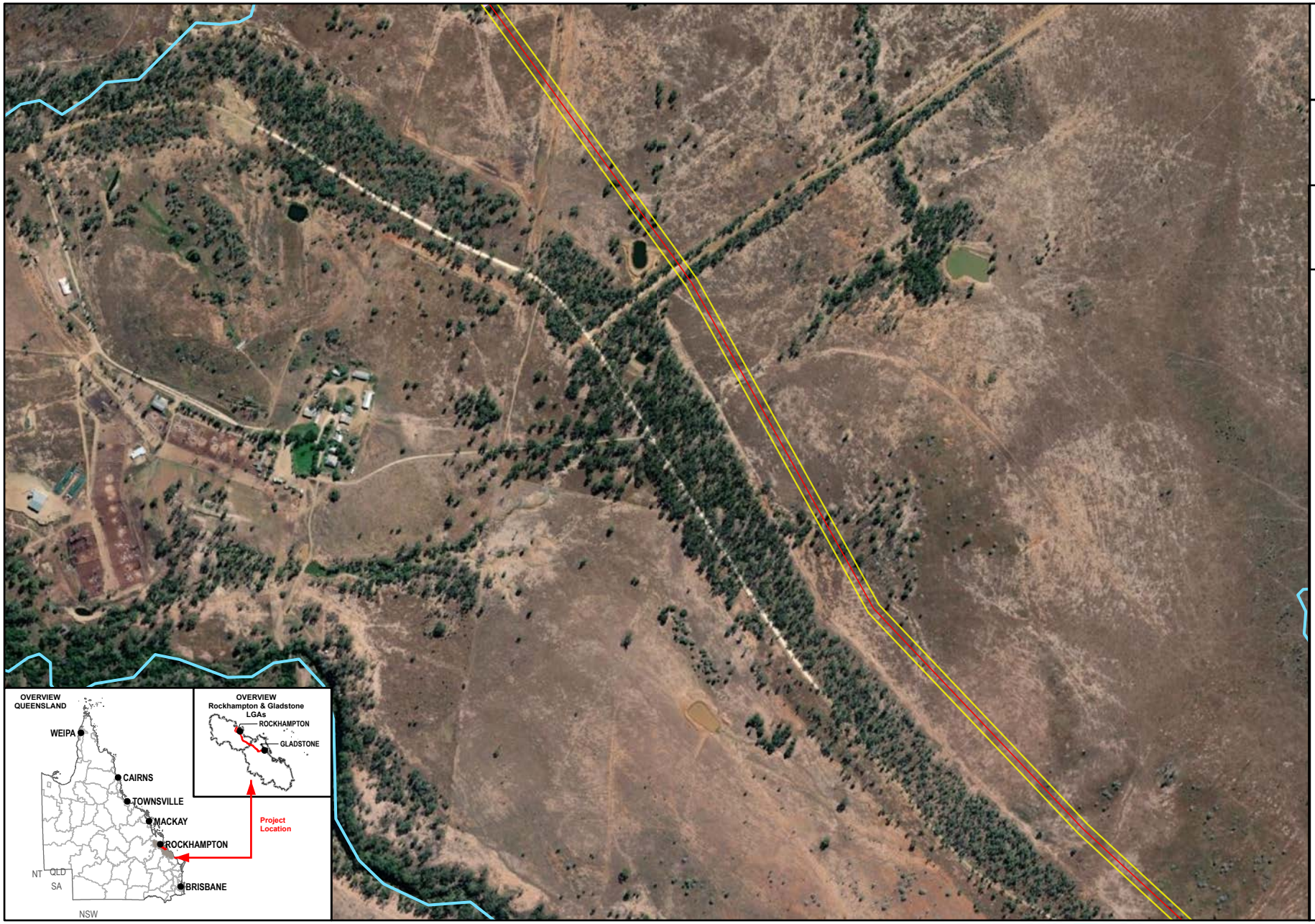

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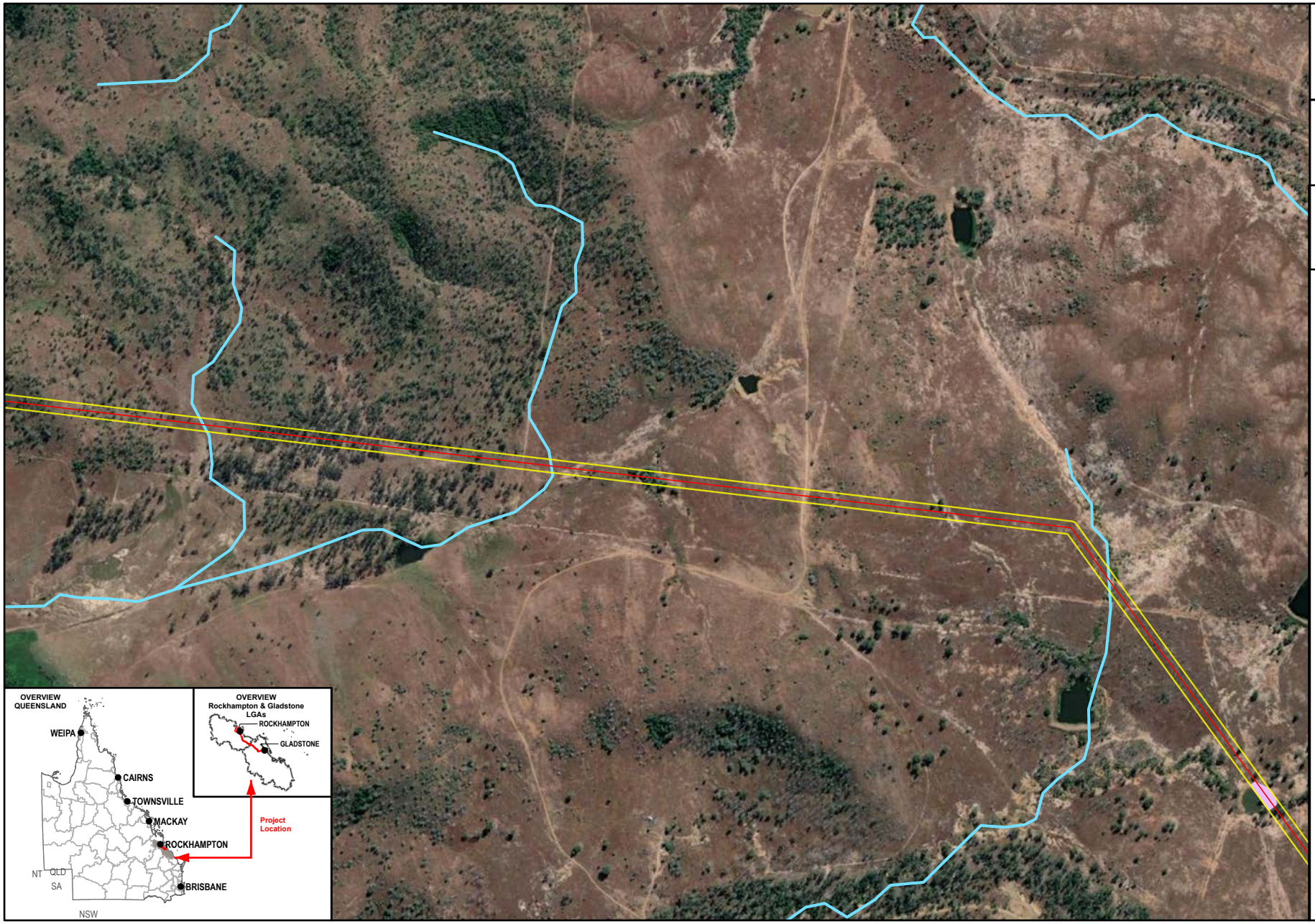
Figure 7-8e
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
(Datum GDA2020)

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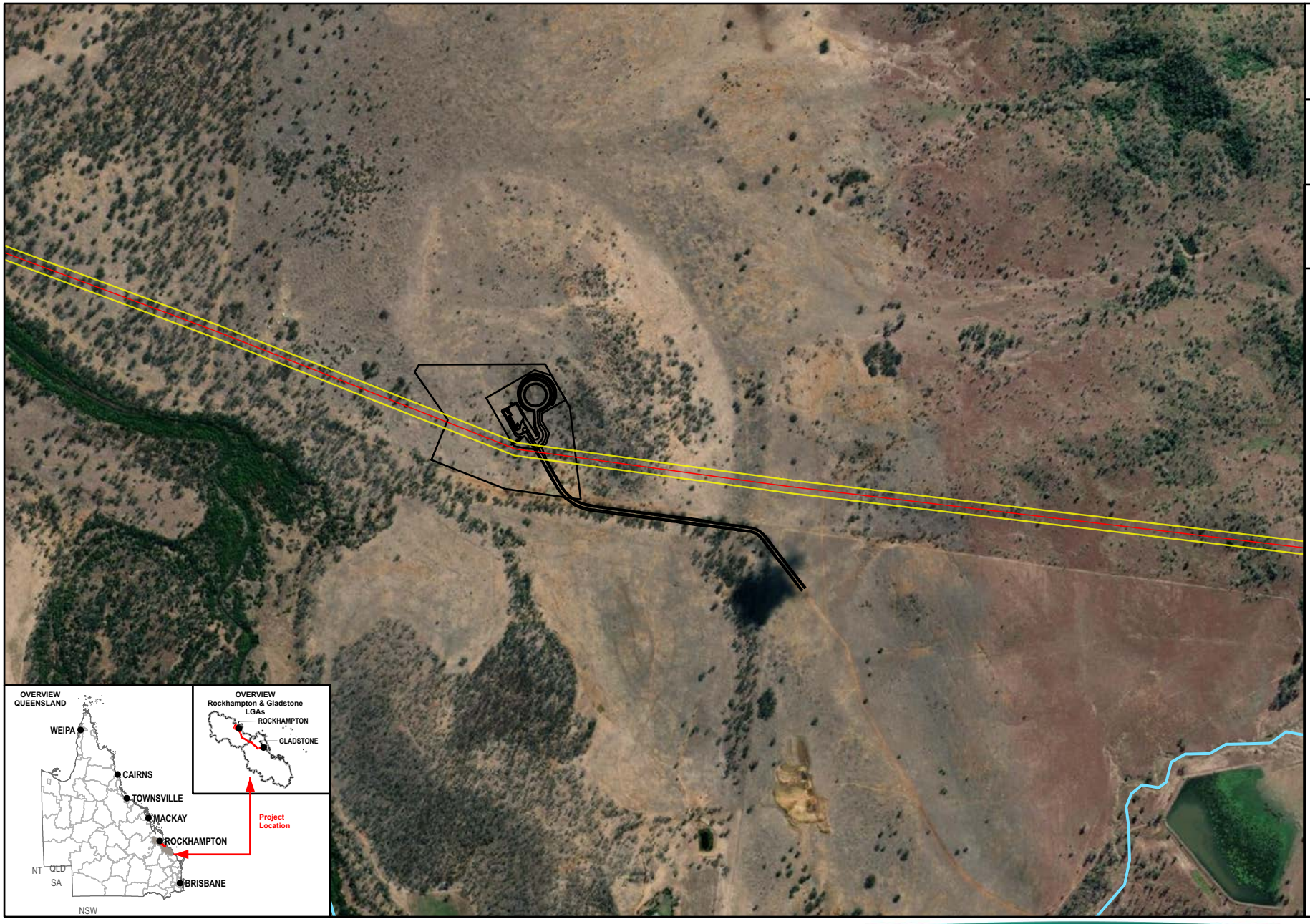
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8f
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Raglan Pump Station and Reservoir Layout
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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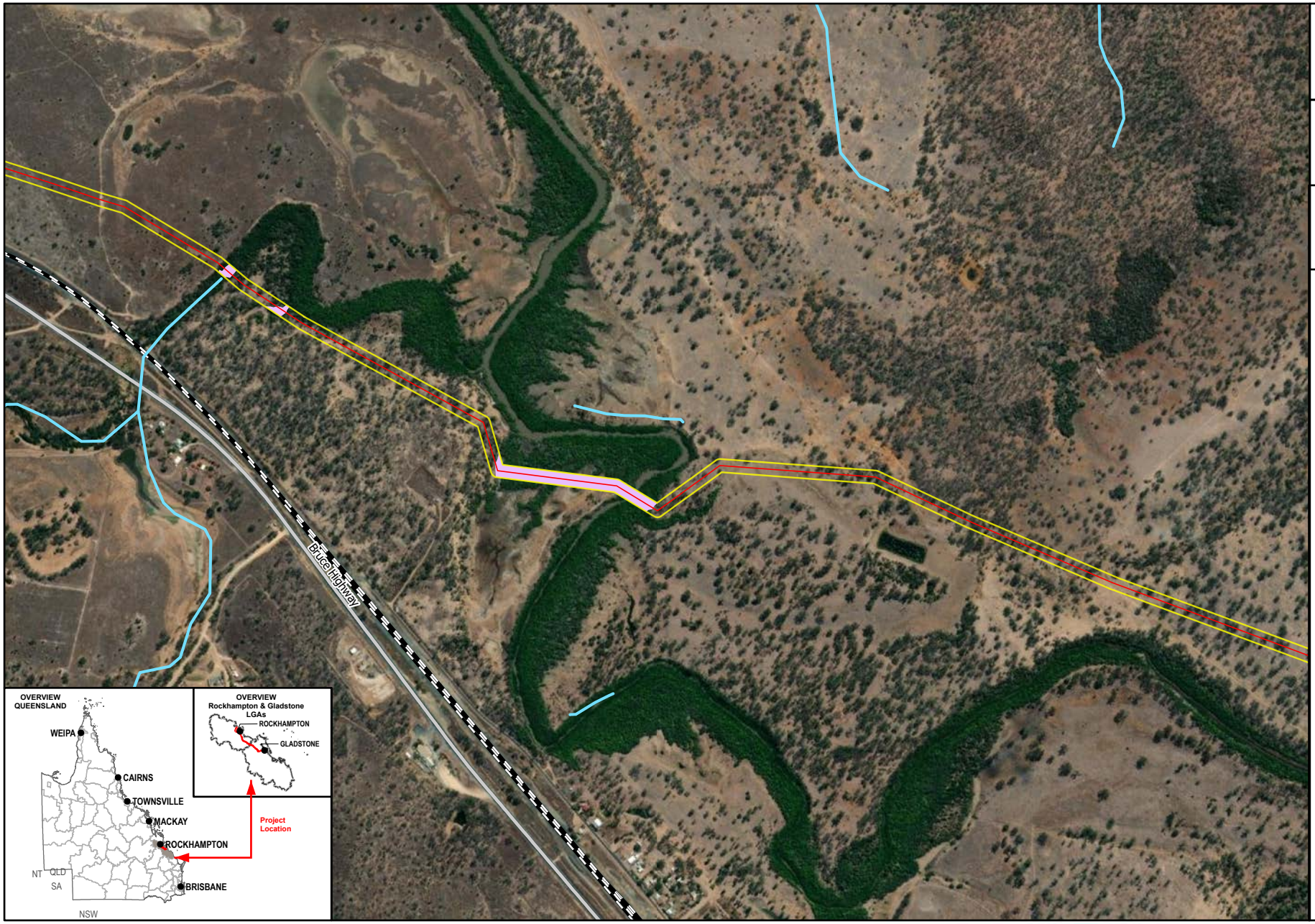
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8g
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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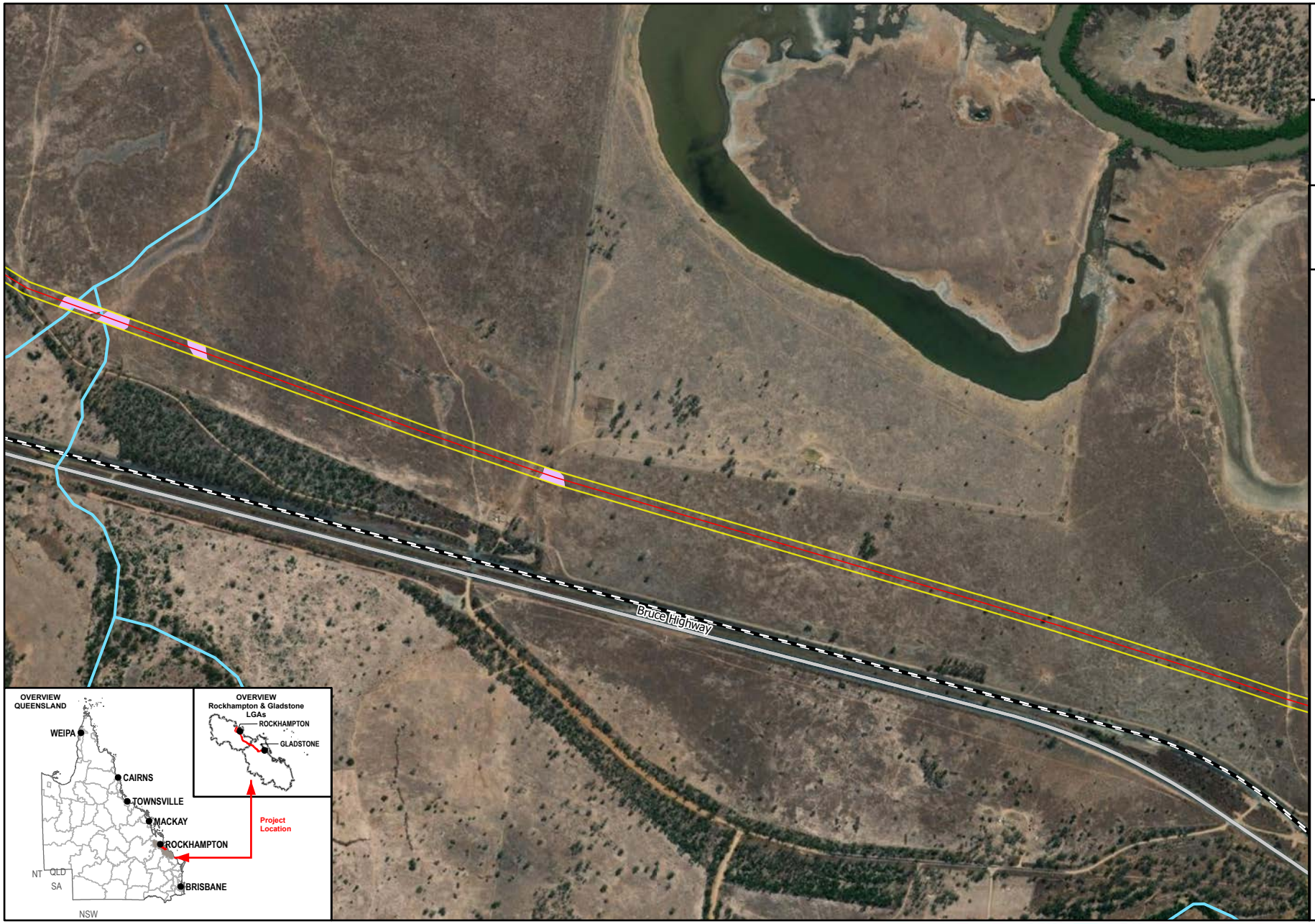
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8h
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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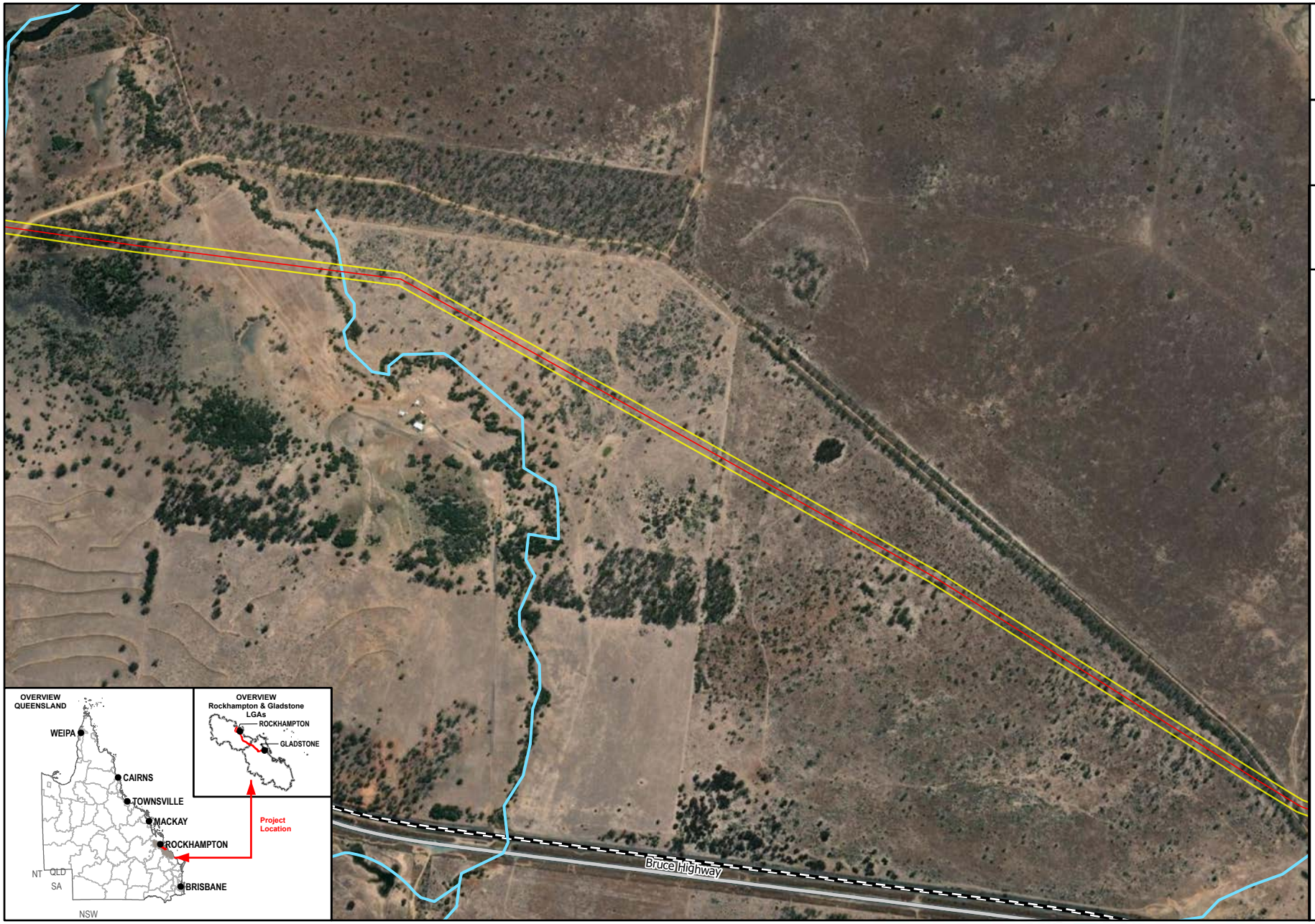
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8i
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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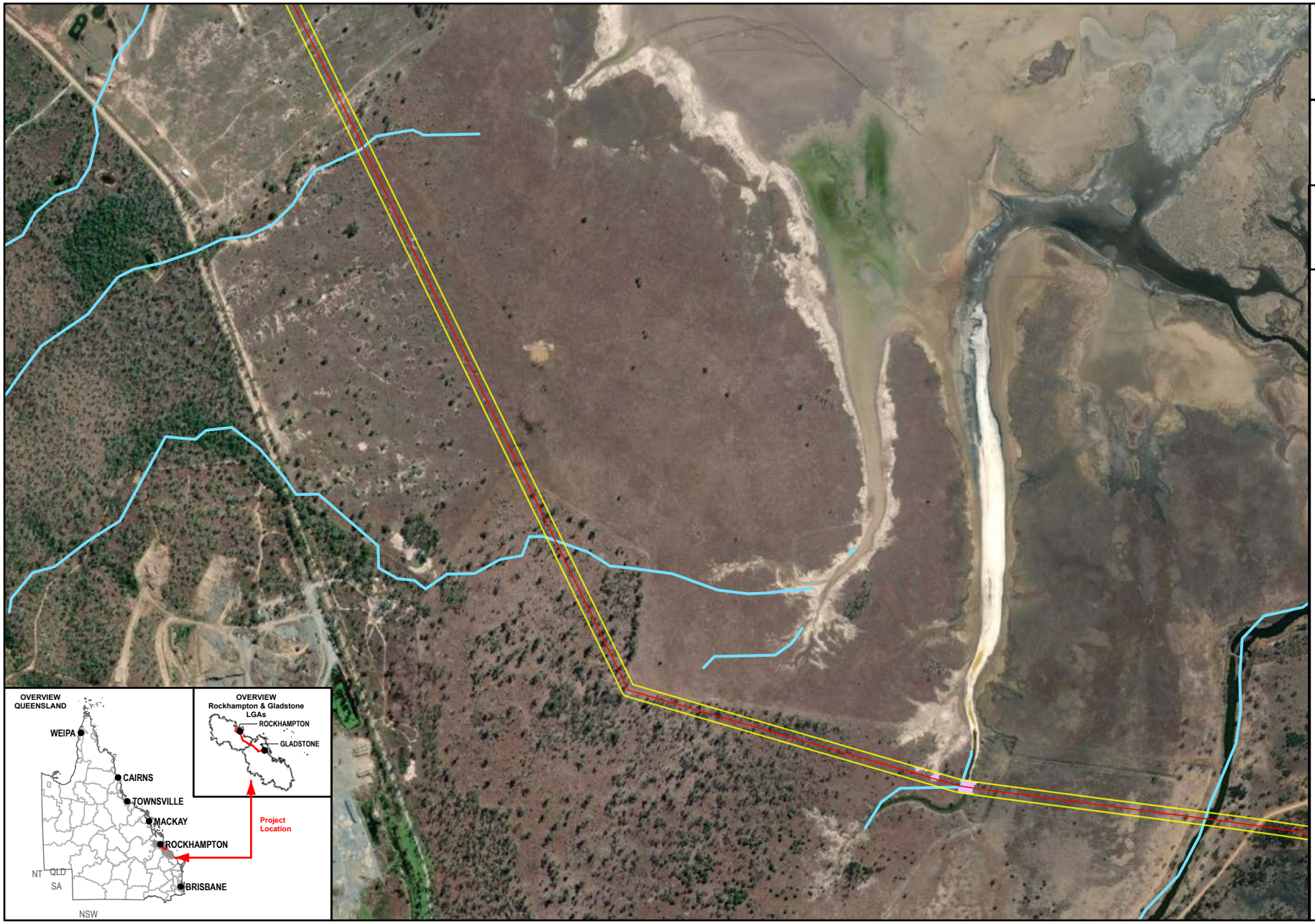
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8j
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways

Data Sources:
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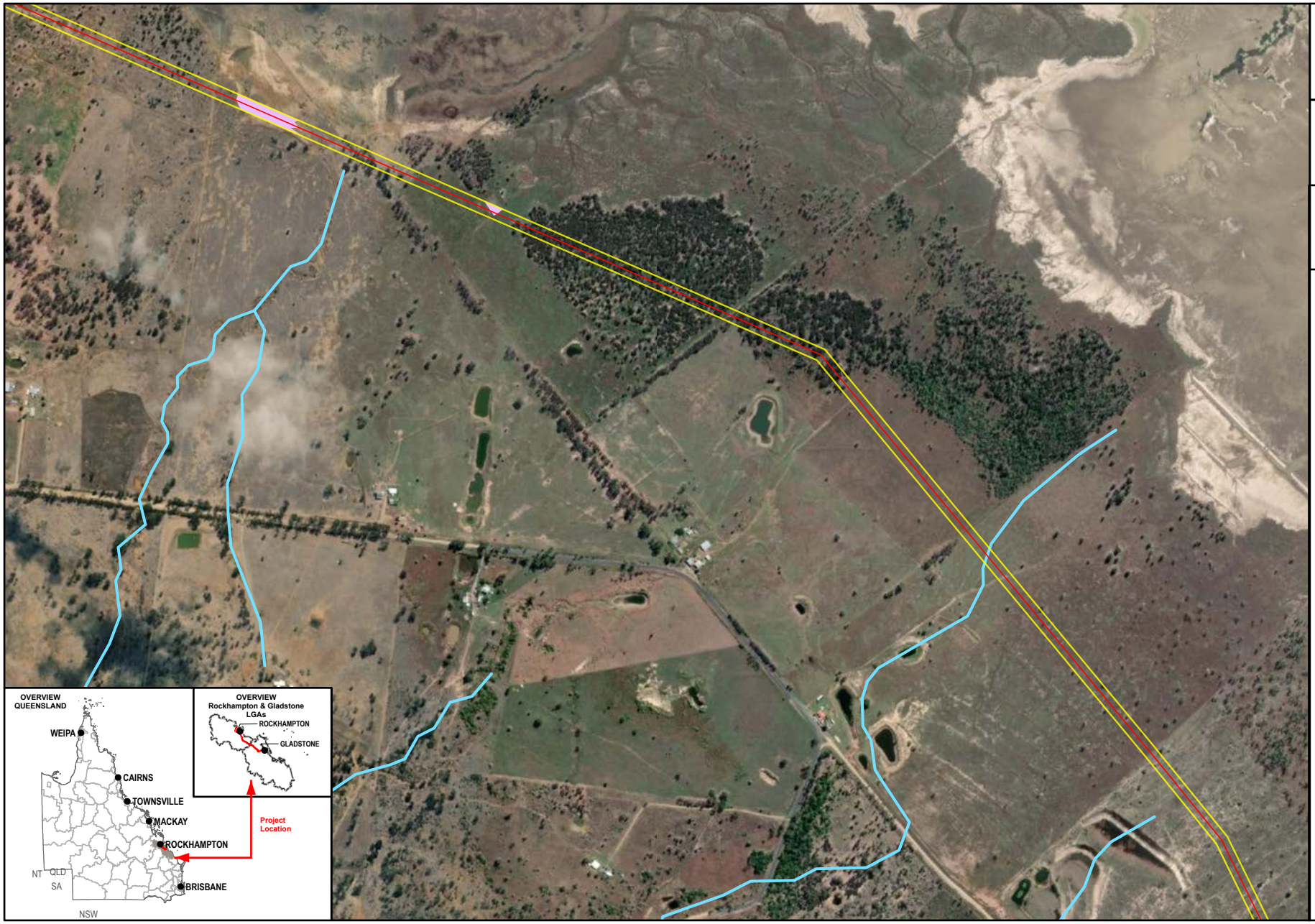
Fitzroy to Gladstone Pipeline Baseline Terrestrial and Aquatic Ecology Technical Report

Figure 7-8k

Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area

000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways

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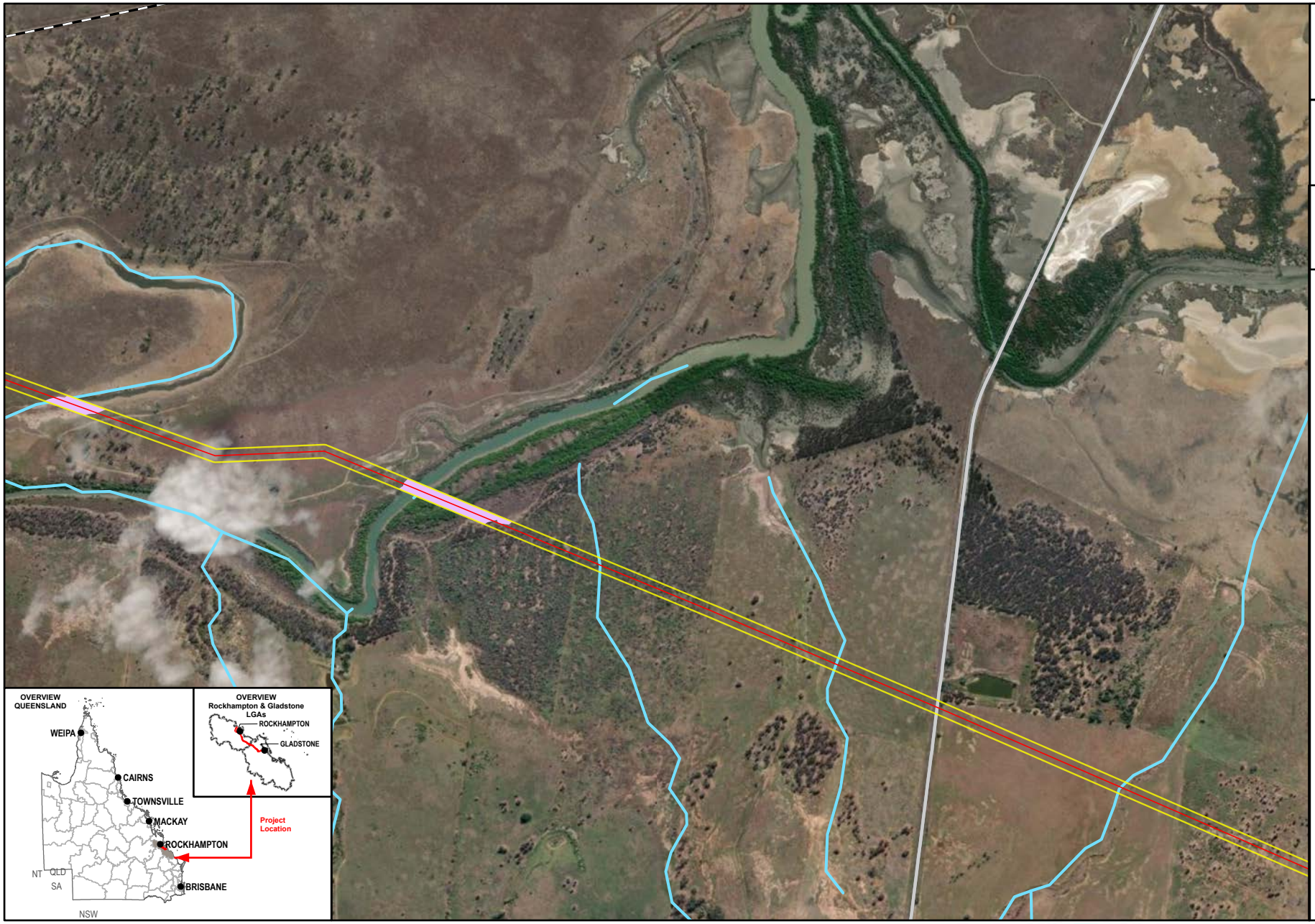
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8l
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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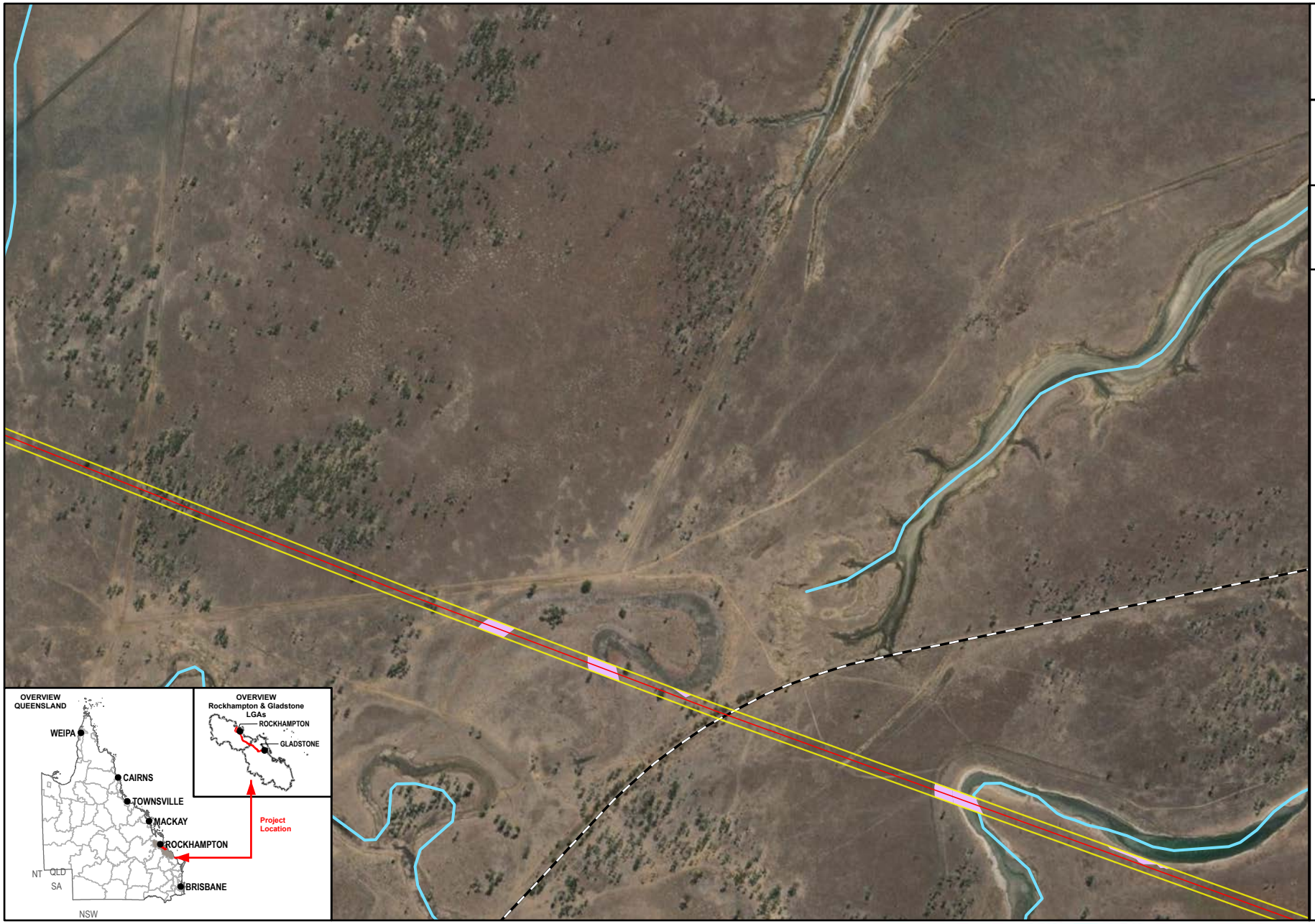
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8m
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Railways

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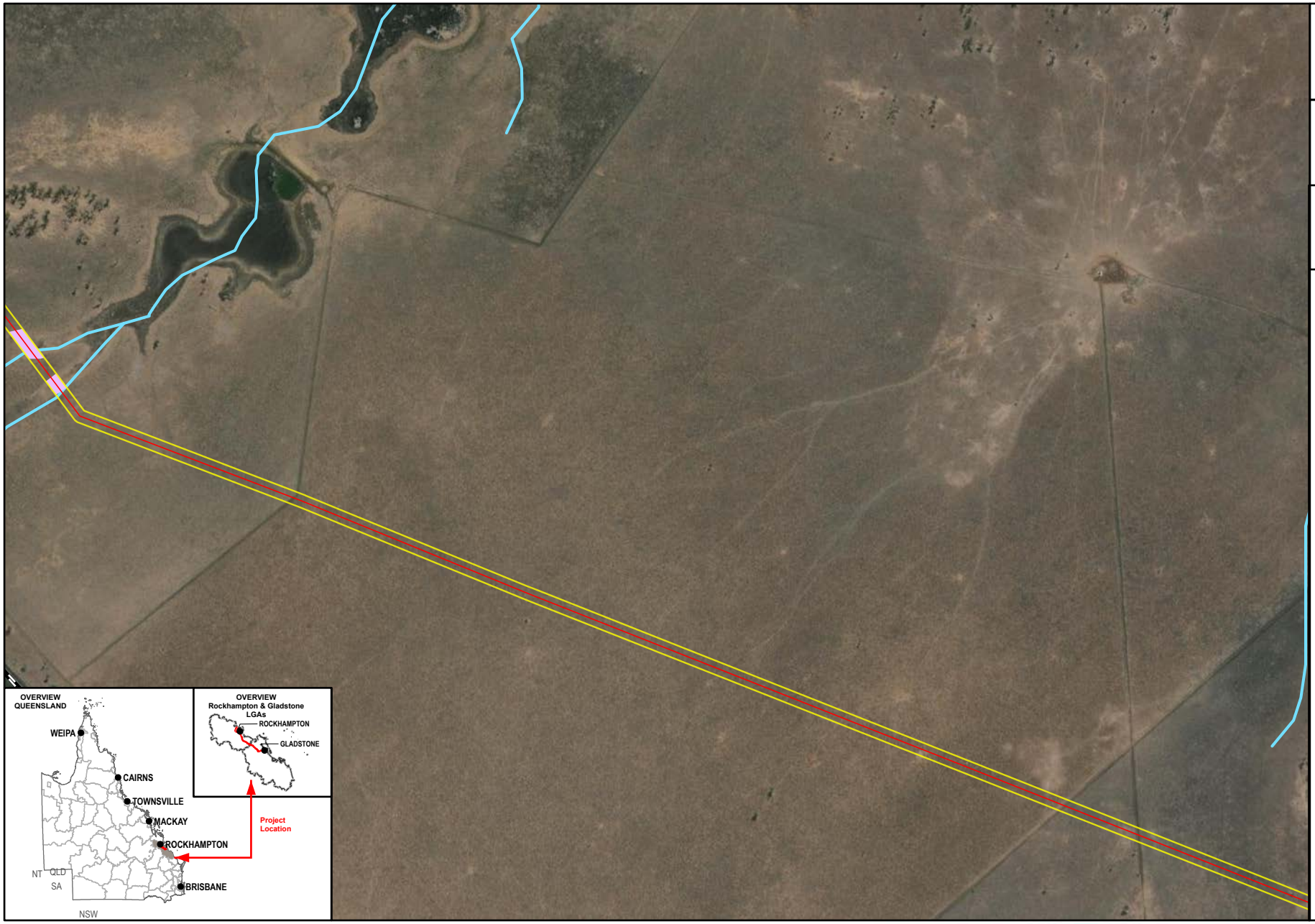
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8n
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Railways

Data Sources:
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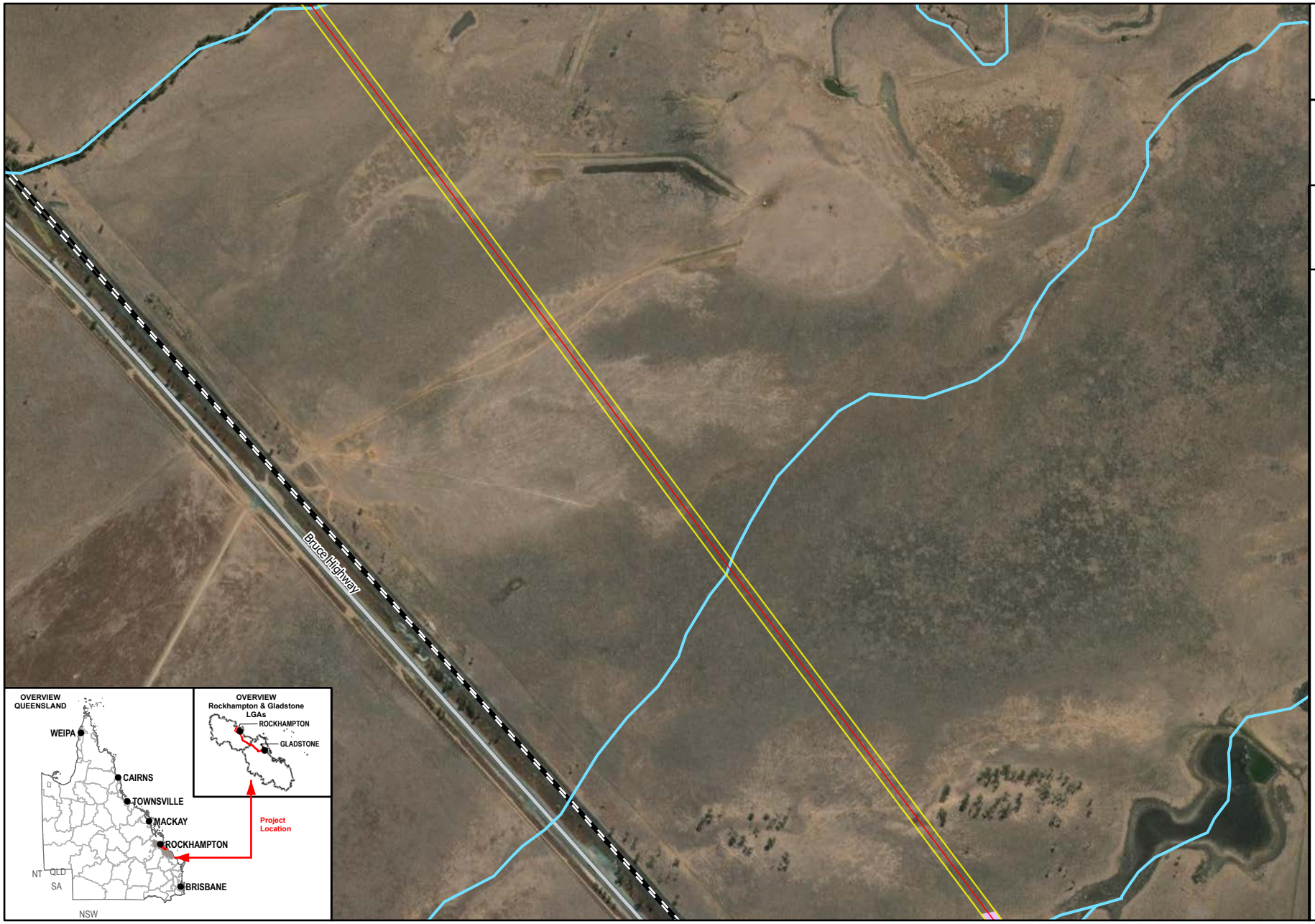
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8o
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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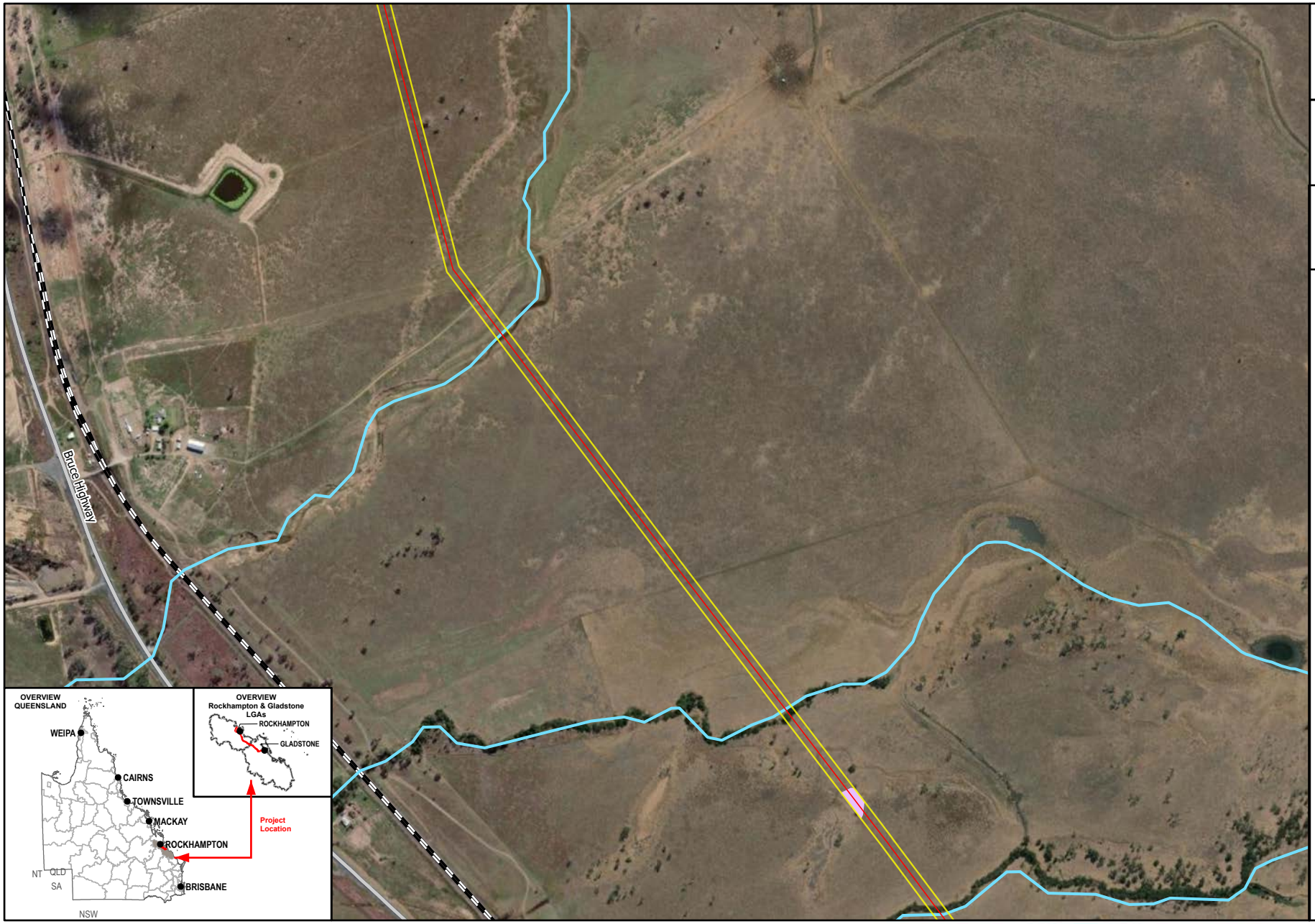
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8p
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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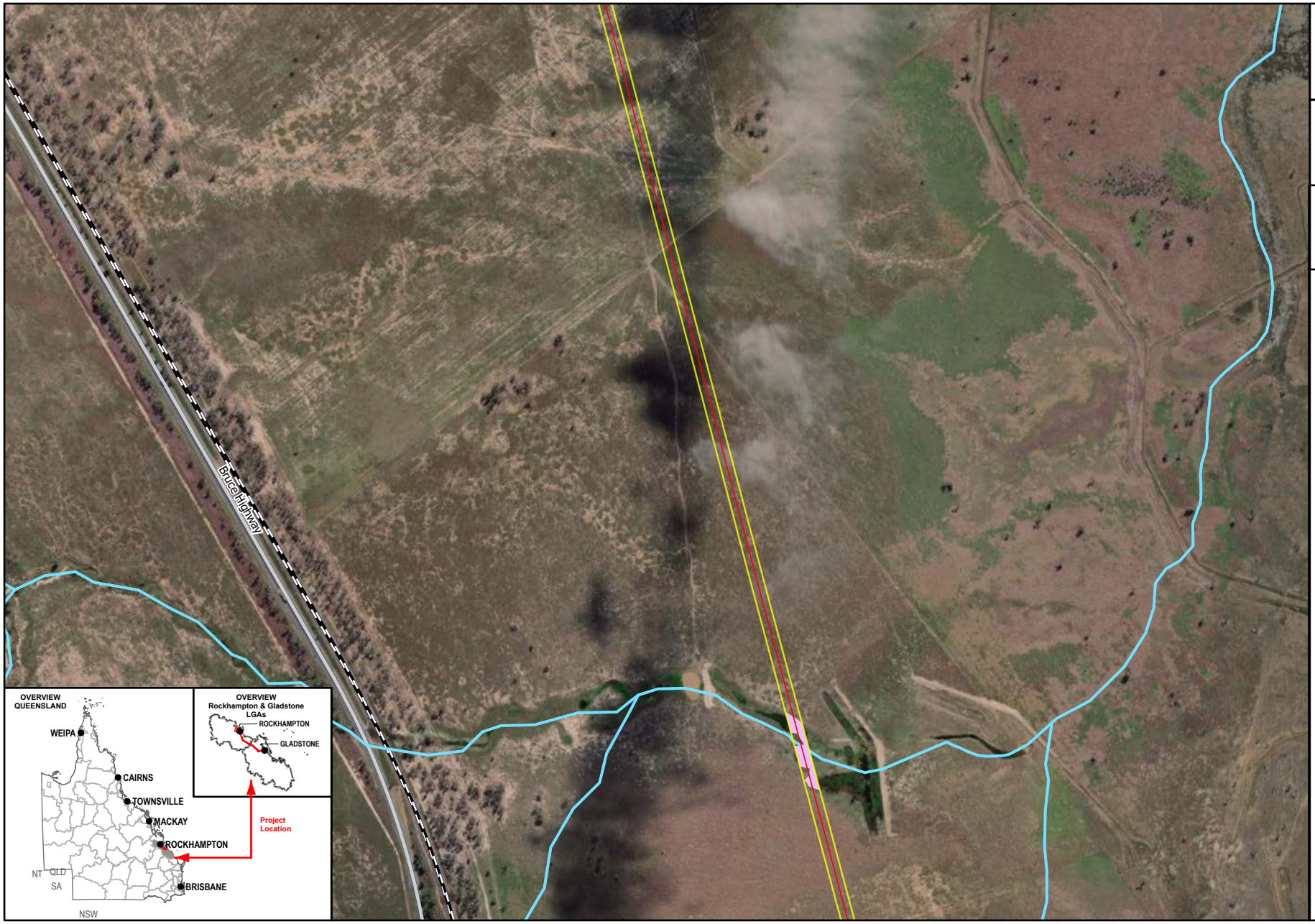
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8q
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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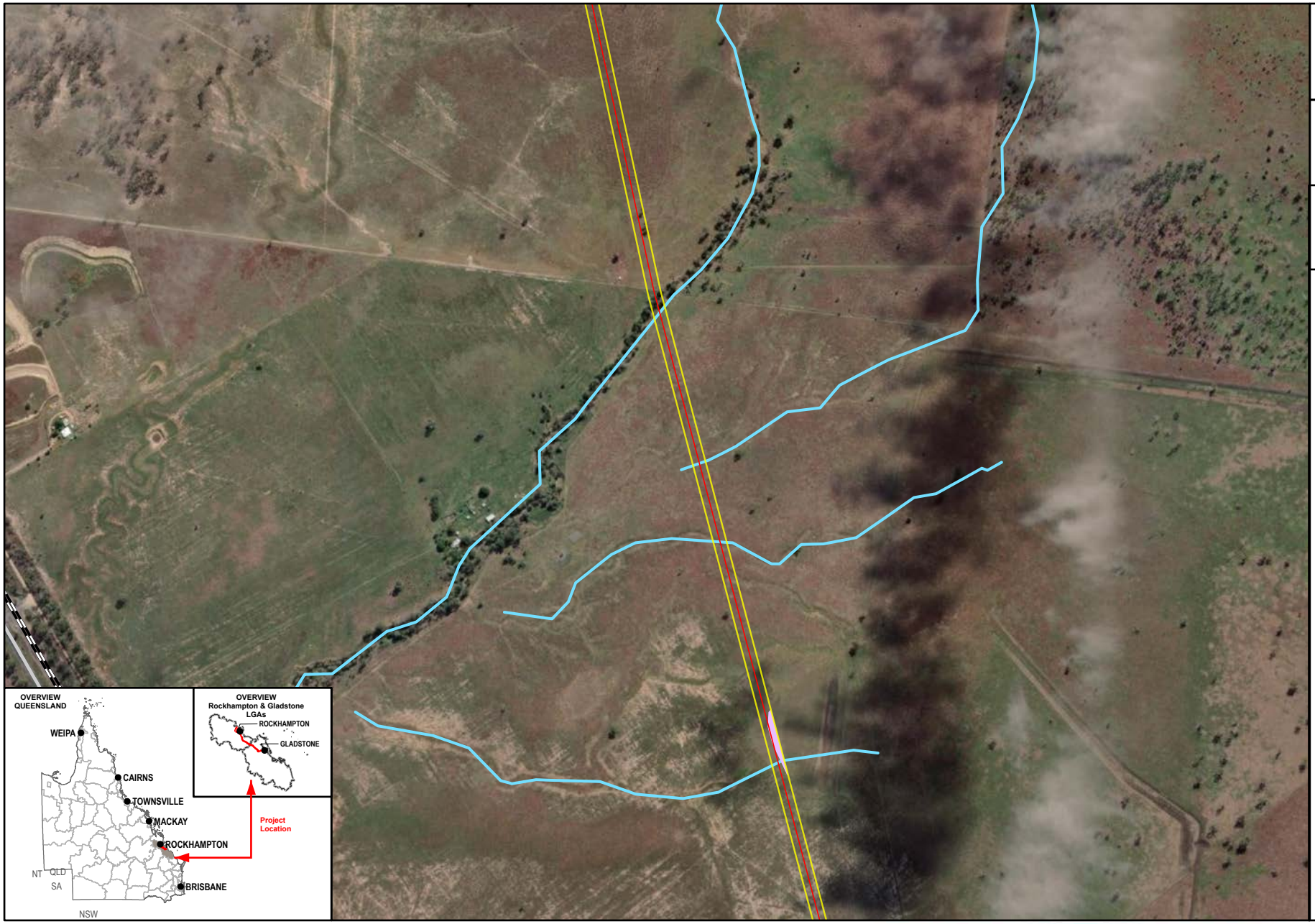
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8r
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Curlew Sandpiper Habitat
- Waterways
- Main Roads
- Railways

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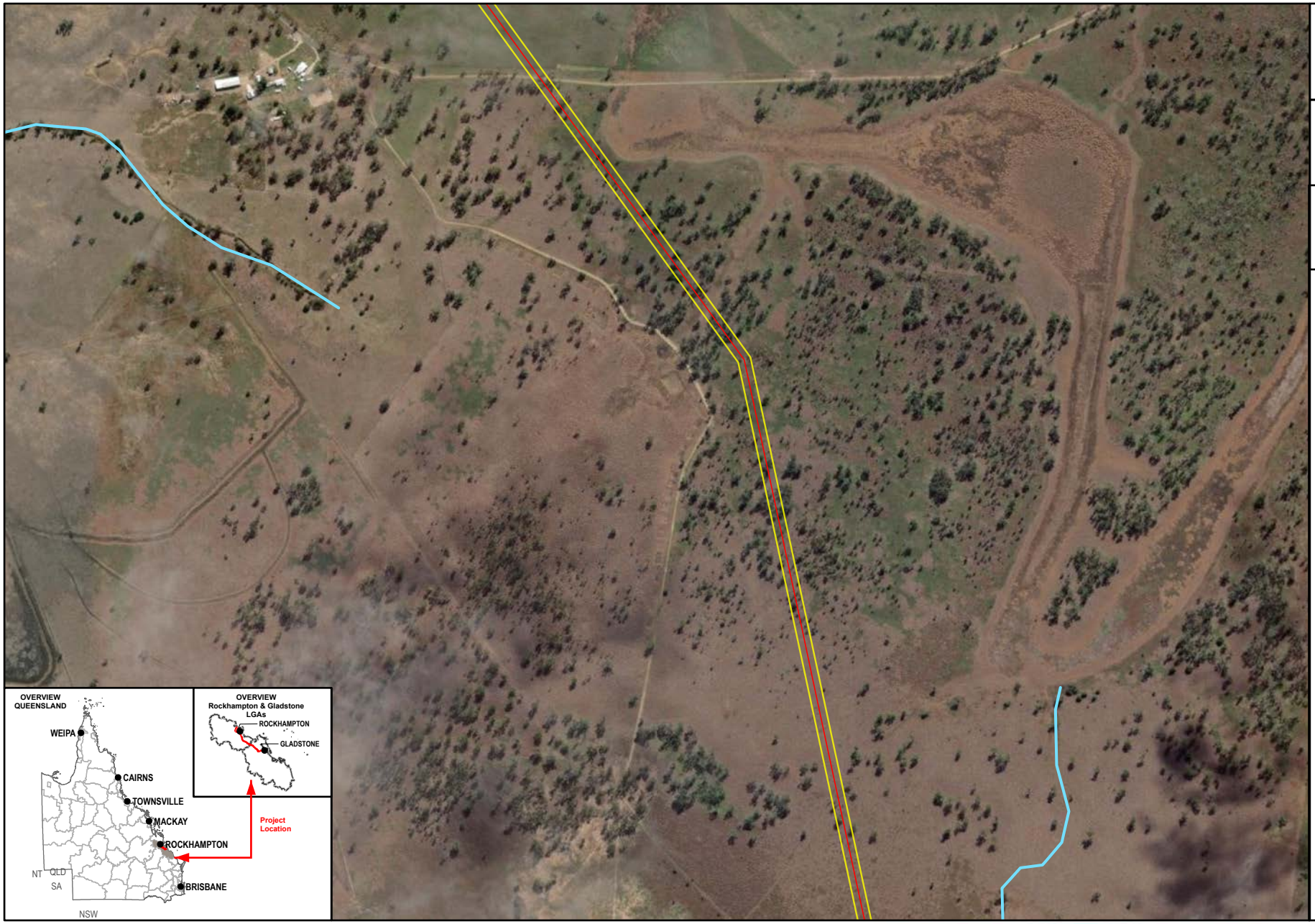
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8s
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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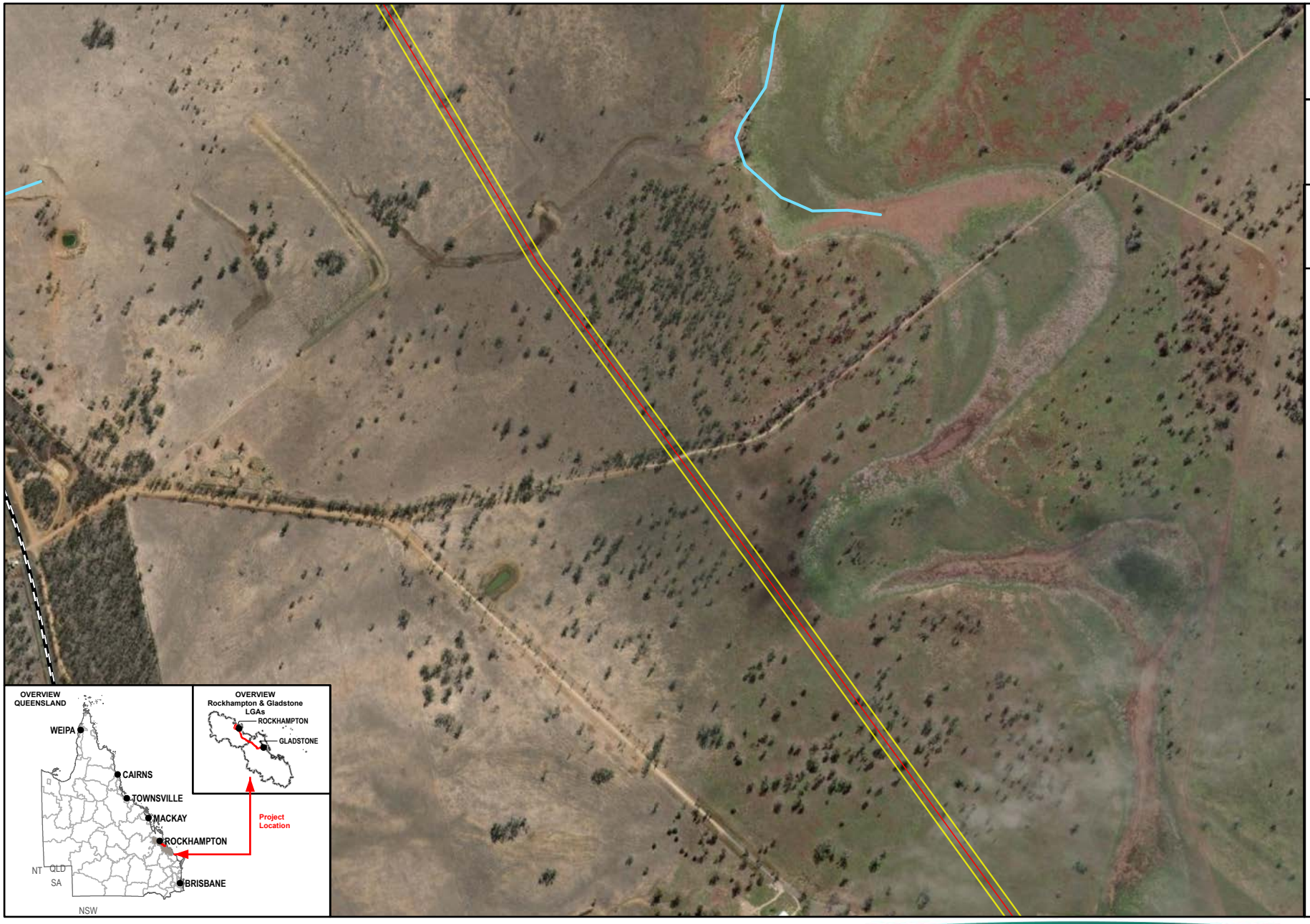
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8t
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
000-G-MAP-2429 Version:3 Date:19/09/2022



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- Railways

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Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-8u
Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
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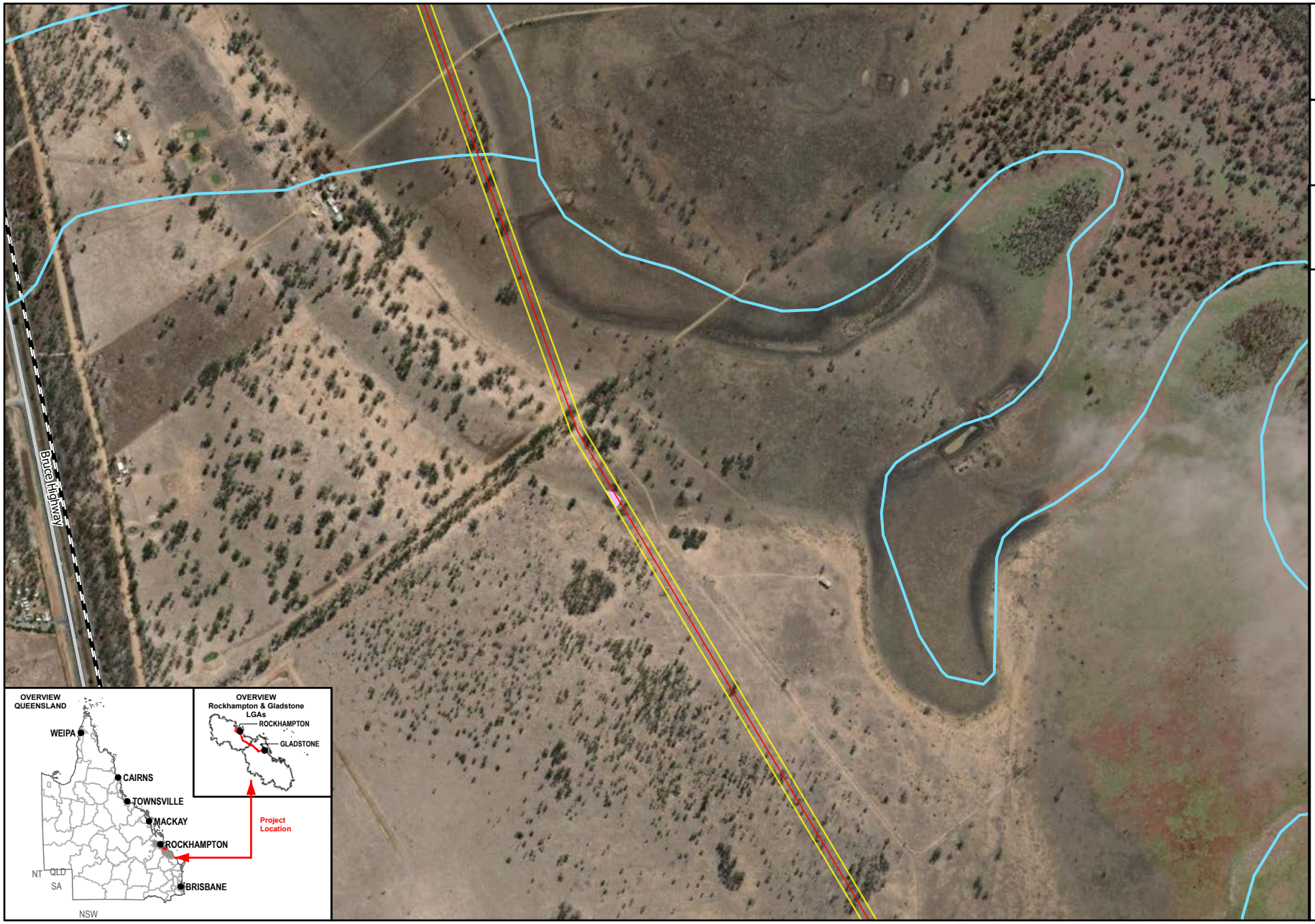

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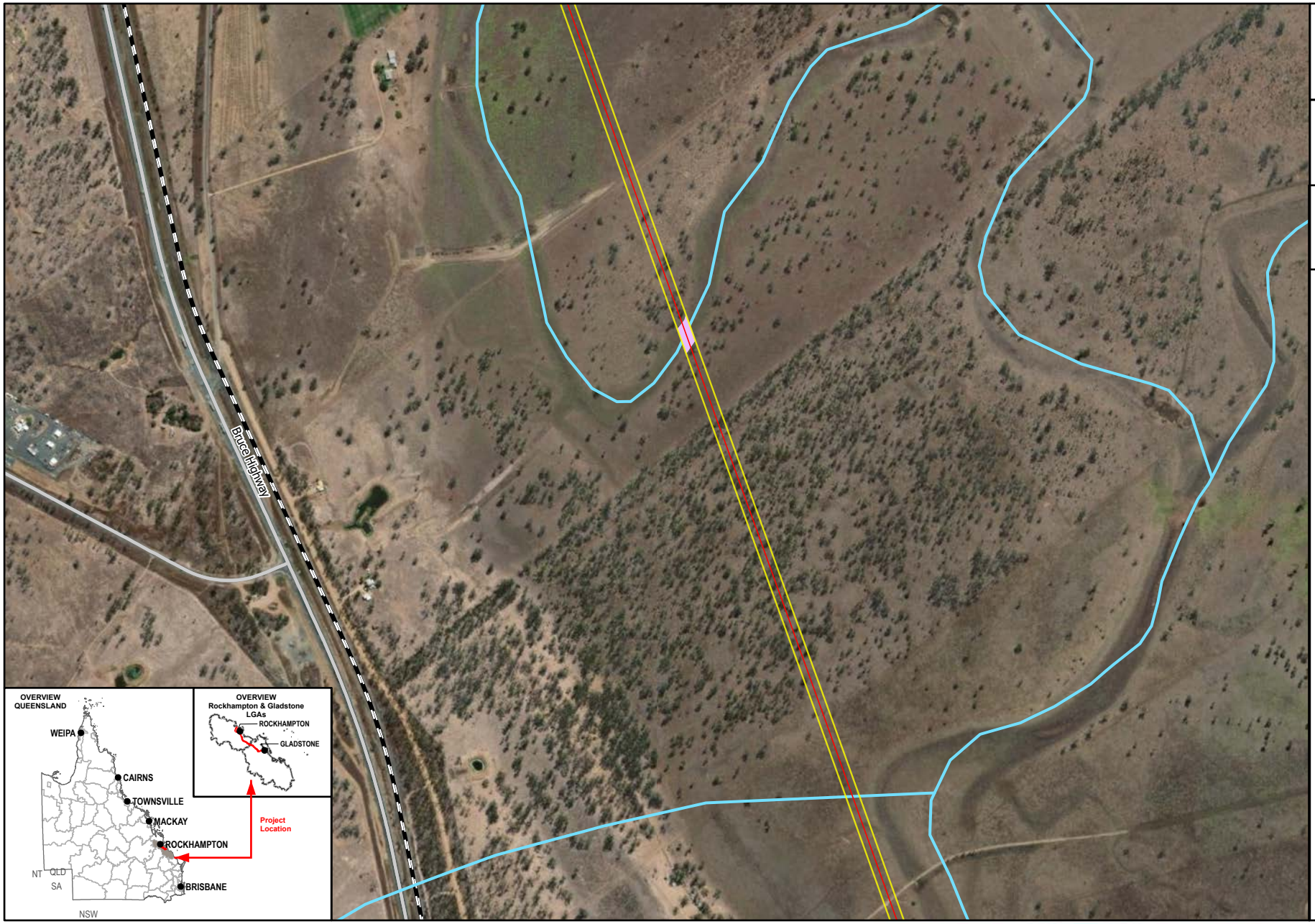

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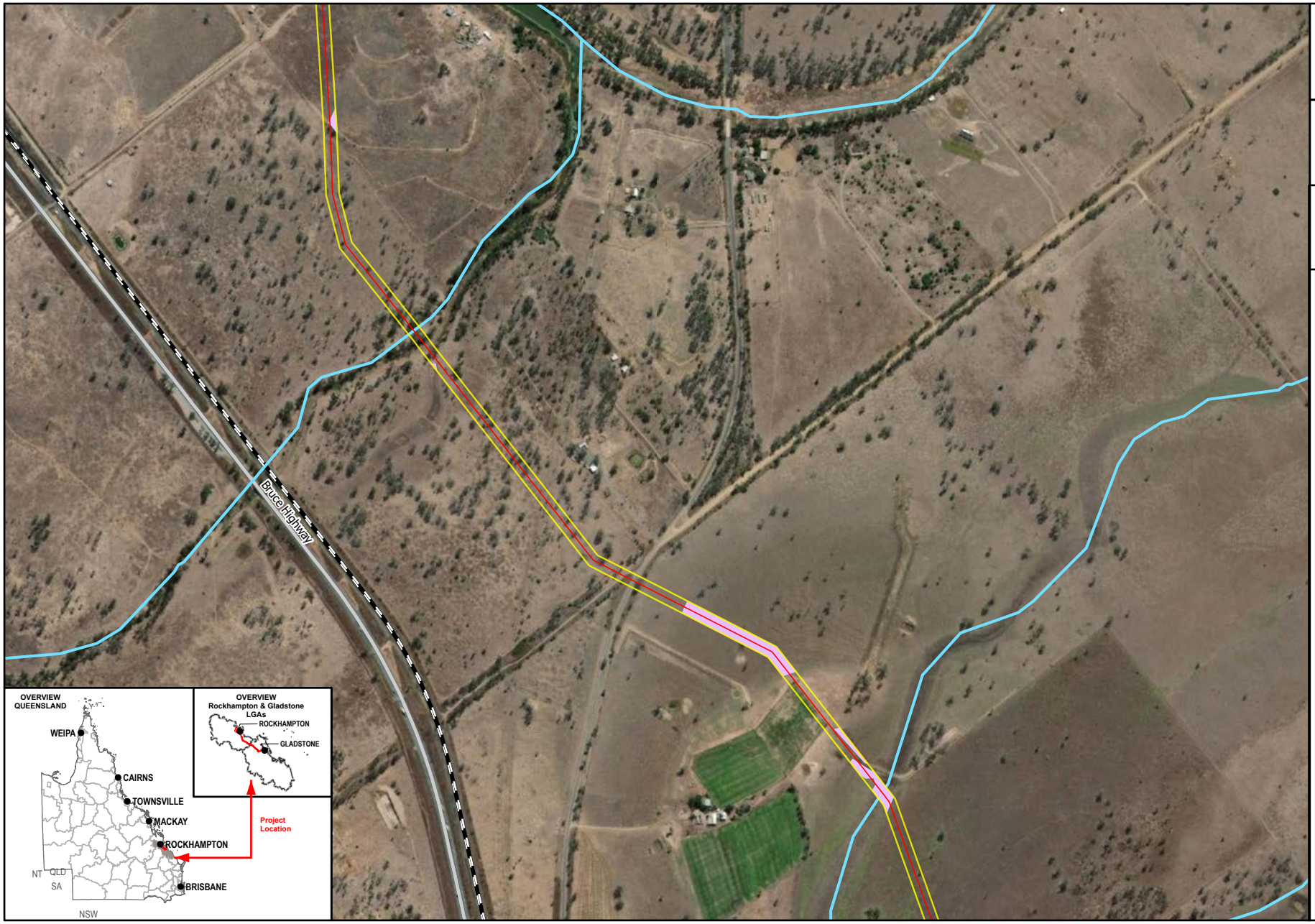

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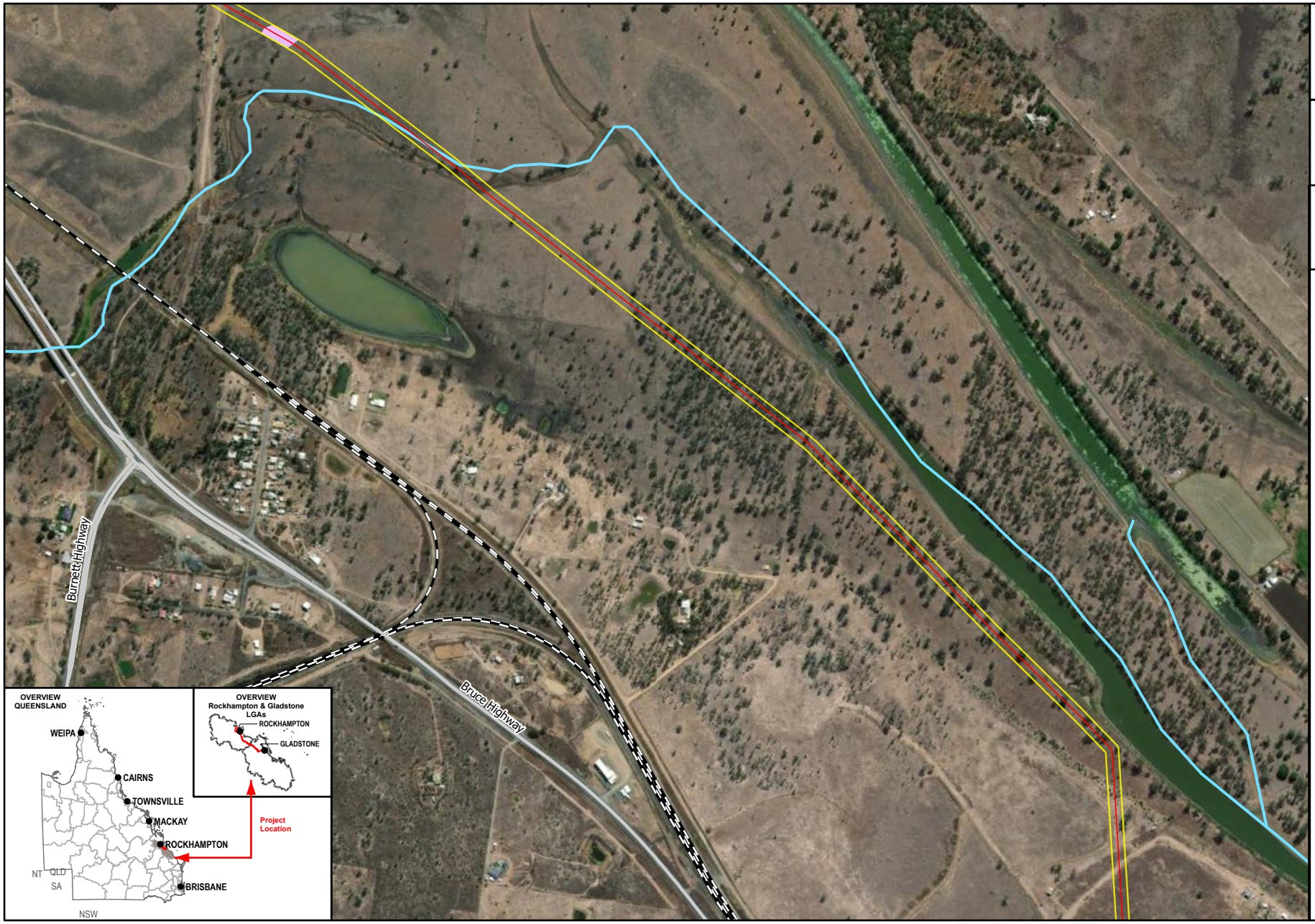

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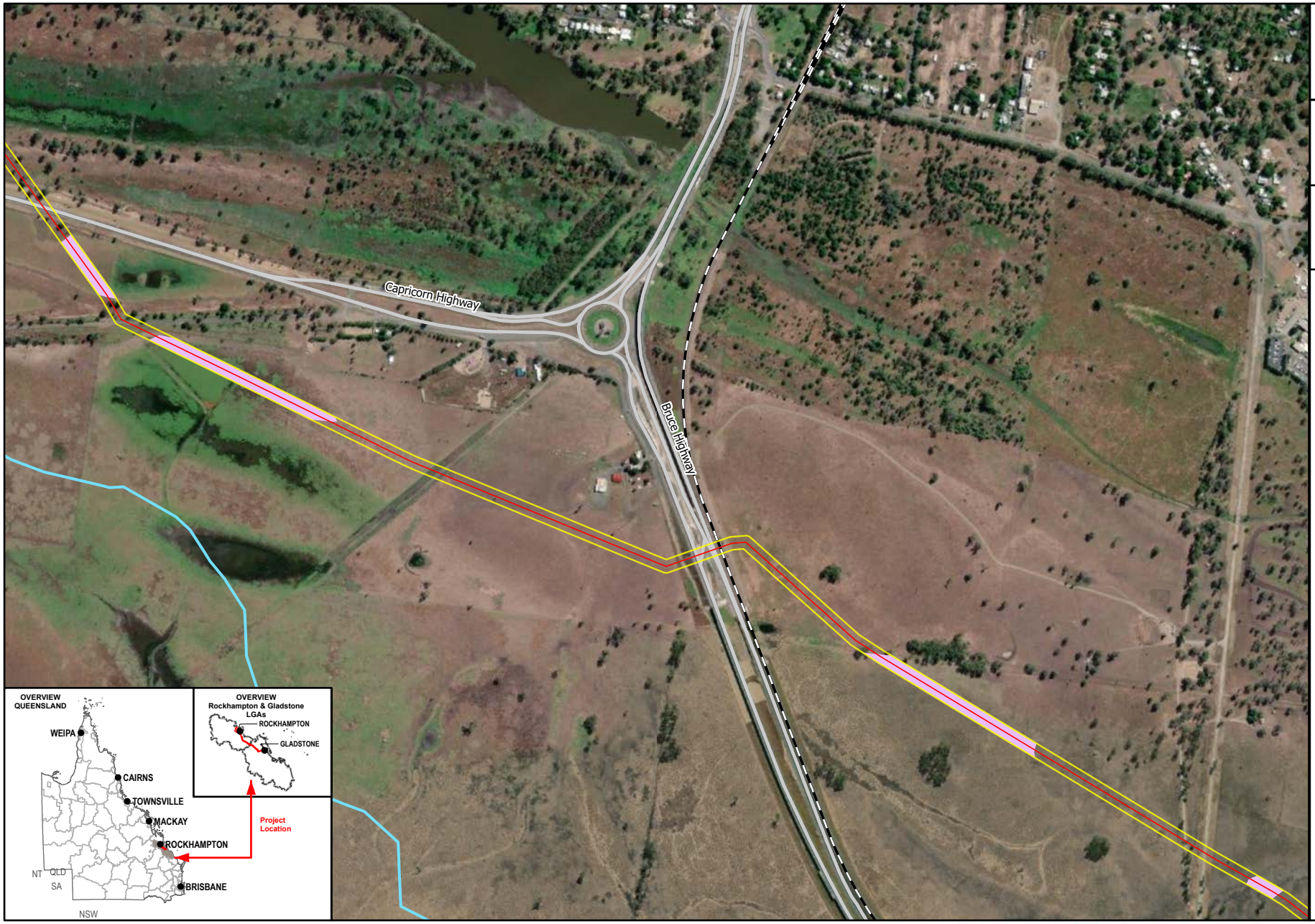

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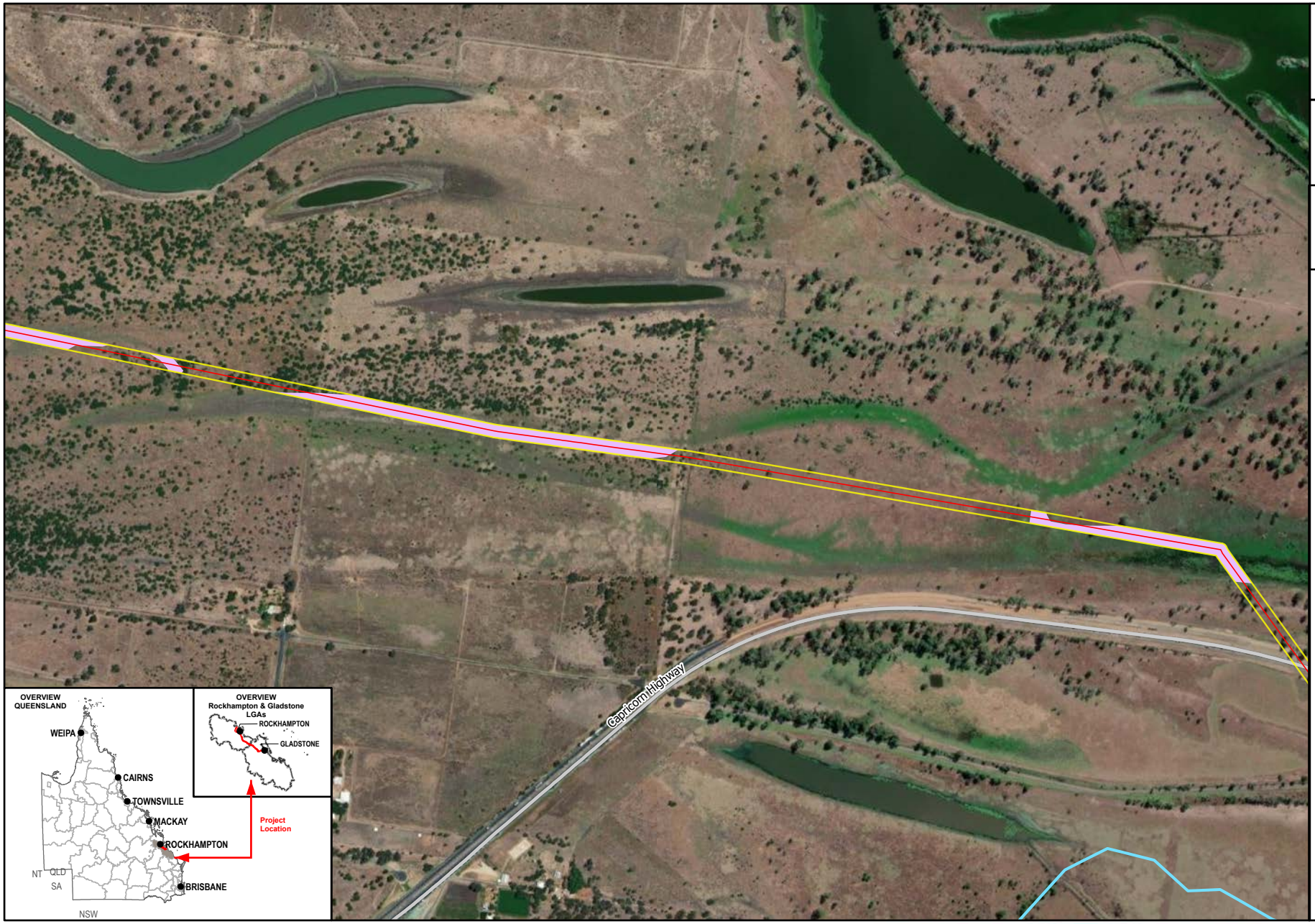

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Distribution of Curlew Sandpiper Habitat Within the SGIC SDA Study Area
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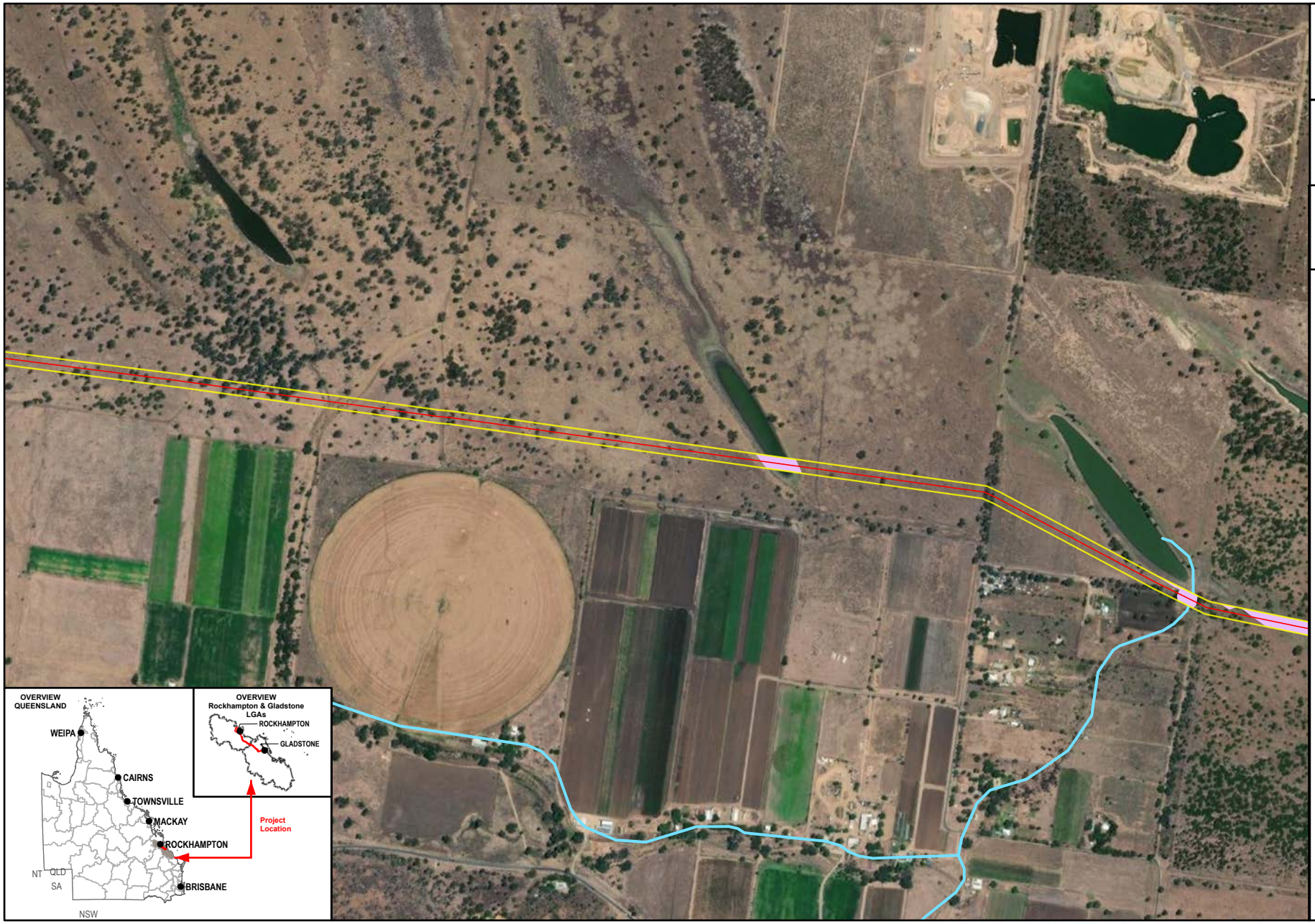

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7.2.2.3 Ornamental snake

Conservation status and species ecology

The ornamental snake is listed as vulnerable under the EPBC Act and NC Act and was listed as an MNES at the time of the approval. The ornamental snake is a cryptic nocturnal species that feeds almost exclusively on frogs (DCCEEW 2022g). The species is more active during the summer months but may be encountered throughout the year. Activity peaks generally correlate to heavy rains when frogs congregate to breed, and later when young frogs emerge (DCCEEW 2022g). Important populations occur in remnant vegetation near gilgai mounds and depressions (DSEWPaC 2011).

Across its distribution, the species occurs sparsely, and the population size is unknown. It occurs in woodlands and shrublands, preferably brigalow, in low lying areas where deep-cracking clays are abundant. The species is reliant on the cracking clay substrate and can persist in areas of regrowth and non-remnant vegetation provided cracking clay soils and gilgais persist (DoE 2014). Ornamental snakes utilise high specialised habitat and can transition from highly abundant to absent within a few hundred metres should topography or soil type change (DCCEEW 2022g).

Field survey results and distribution of suitable habitat

The ornamental snake was confirmed present during the Arup (2008) field surveys. Two individuals were recorded in a vegetated area adjoining a seasonal wetland near Casuarina Road, Midgee. Both individuals were located under large ground logs within an area retaining large hollow-bearing Eucalyptus coolabah trees and cracking clays. The species was not recorded during the 2022 field surveys. Survey effort for the ornamental snake included active searches at 11 locations and one night of spotlighting within the SGIC SDA study area. The species has been historically recorded at 24 locations within the desktop search extent, the most recent record recorded in 2003. Suitable habitat for the species was recorded within vegetated areas retaining E. coolabah (Plate 7-1) or Acacia harpophylla with large ground logs and cracking clays (Plate 7-1) on alluvial plains, associated with gilgais or adjoining wetlands. The distribution of predicted ornamental snake habitat is mapped in Figure 7-9.

Plate 7-1 Eucalyptus coolabah woodland with large ground logs and cracking clays (Casuarina Road, Midgee).

Significance of impact assessment

The project is unlikely to result in a significant residual impact on ornamental snake. A significance of impact assessment of the project on ornamental snake (vulnerable under the EPBC Act and NC Act) is provided in Table 7-21.

Table 7-21 Significance of impact on ornamental snake

Significant residual impact criteria	Assessment
A long-term decrease in the size of a local population	**Unlikely** The ornamental snake has been historically recorded at 11 locations within the desktop search extent (10 km buffer). The project will result in the clearing of 8.77 ha of predicted habitat for the species, representing 0.10% of habitat available within a 5 km buffer. The species inhabits woodland habitats retaining *E. coolabah* or *A. harpophylla* with logs and coarse ground litter on heavier, cracking clay soils, particularly in association with waterbodies or gilgais (DoE 2022a). The SGIC SDA pipeline alignment intersects vegetated areas with large *E. coolabah* trees, retaining large ground logs and cracking clays. Although these areas were recognised as suitable habitat for the species, the ground has been modified with pasture grasses and the areas are subject to cattle grazing and trampling. The SGIC SDA pipeline alignment also intersects brigalow woodland retaining seasonally inundated habitats (i.e. gilgais). These areas have been largely cleared for agricultural purposes, with remaining brigalow occurring as fragmented, isolated and modified remnants within the SGIC SDA study area and broader landscape. Suitable ground-level microhabitats such as cracking clays, ground logs, woody debris and rocks were recorded as low densities within remnant brigalow areas, and very sparse to absent within regrowth brigalow areas. Due to the lack of suitable ground-level microhabitats within areas retaining brigalow, these habitats are considered suboptimal habitat for the species. The projects impact is not anticipated to correspond to a regional level or a long-term decrease as the impacted area equates to only 0.10% of suitable habitat available within a 5 km buffer. The impact is considered unlikely to lead to a long-term decrease in the size of the local ornamental snake population.
Reduce the extent of occurrence of the species	**Unlikely** Two individuals were recorded approximately 500 m east of the SGIC SDA pipeline alignment near Casuarina Road, Midgee, during the Arup (2008) field surveys. The SGIC SDA pipeline alignment intersects 8.77 ha of predicted habitat for the ornamental snake, representing 0.10% of suitable habitat for the species at a local scale (5 km buffer). The surrounding landscape has been largely cleared and heavily altered by intensive agriculture, and cattle grazing and trampling, with a small proportion of potentially suitable habitat occurring within the SGIC SDA pipeline alignment. A maximum width of 30 m will be cleared for construction of the SGIC SDA pipeline alignment. Suitable ground-level microhabitats such as ground logs, woody debris and rocks are to be retained during the construction works and to be placed on the SGIC SDA pipeline alignment after the pipeline has been installed and buried. Accordingly, the project is unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	**Unlikely** While the SGIC SDA pipeline alignment may support an existing ornamental snake population, the magnitude of impact is unlikely to present a permanent barrier to movement. The maximum width of clearing required for construction of the SGIC SDA pipeline alignment is 30 m. Once the pipeline has been installed and buried, a maximum width of 10 m will be permanently cleared with the remaining 20 m to be rehabilitated. Construction activities will be planned to minimise the period of time the trench is open and the length of open trench. Where the trench remains open overnight or for extended length, the ends of the trench left open will be ramped to a gentle include (< 50%) to allow fauna to escape and sawdust filled hessian bags (shelter sites) will be placed at regular intervals. If mitigation measures are implemented correctly, the project is unlikely to fragment the existing local population.
Result in genetically distinct populations forming as a result of habitat isolation	**Unlikely** As detailed above, the species' capacity to move locally post-construction is unlikely be limited by any localised land clearing necessary to construct the SGIC SDA pipeline alignment. As a result, the project is unlikely to cause any form of genetic isolation at a population level.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	**Unlikely** As this species feeds almost exclusively on frogs, the ornamental snake is considered to be at risk from lethal ingestion of cane toads (DoE 2022a). Cane toads are already known to occur within the SGIC SDA study area, and the construction or operation of the project is unlikely to exacerbate the risks. The project is therefore expected to have negligible impact on the species due to the influence of cane toads or other pest species.
Introduce disease that may cause the population to decline	**Unlikely** There are no known diseases that could be introduced by the construction or operation of the project.

Significant residual impact criteria	Assessment
Interfere with the recovery of the species	**Unlikely** The project is unlikely to interfere substantially with the recovery of the species. The impacts of the SGIC SDA pipeline alignment are expected to be relatively benign, as the project is expected to remove 8.77 ha of suboptimal habitat due to the moderately low abundance of ground-level microhabitats within brigalow habitats occurring within the SGIC SDA study area. Suitable ground-level microhabitats such as ground logs, woody debris and rocks are to be retained during the construction works and to be placed on the SGIC SDA pipeline alignment after the pipeline has been installed and buried. The risk of individual mortality or injury during construction will be addressed via the mitigation measures in the CEMP and the use of an experienced fauna spotter-catcher during clearing and grading.
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	**Unlikely** Due to the operational and logistic constraints associated with undertaking construction during the wet season, works will take place in dry season months (where practicable) and therefore avoid the species' peak period of breeding and foraging activity (i.e. the wet season). The *Draft referral guidelines for the nationally listed brigalow belt reptiles* (DSEWPaC 2011) indicates that a loss of more than 2 ha of important habitat risks a significant impact. Important habitat is considered to be any gilgais or mounds within areas of known habitat and connecting habitat that links gilgais (DSEWPaC 2011). The SGIC SDA pipeline alignment is estimated to impact 8.77 ha of potential habitat. Potentially suitable habitat for the species is considered suboptimal due to the moderately low abundance of ground-level microhabitats and the overall condition of the habitat. Vegetated areas containing large *E. coolabah* trees retained suitable shelter habitat (i.e. ground logs and shallow cracking clays); however, the ground has been modified with pasture grasses and has been subject to cattle grazing and trampling. Vegetated areas containing *A. harpophylla* retained gilgais; however, the ground had been exposed to high levels of disturbance caused by cattle trampling and feral pig rooting. A large proportion of these areas had been previously cleared, retaining regrowth (2 – 3 m tall) vegetation. Therefore, the loss of suitable ornamental snake habitat within the SGIC SDA pipeline alignment is unlikely to result in disruption to ecologically significant locations.
Conclusion	The project is unlikely to result in a significant residual impact on the ornamental snake. The project will result in a loss (8.77 ha) of potentially suitable habitat for the ornamental snake; however, suitable habitat identified within the SGIC SDA pipeline alignment is considered suboptimal due to the low abundance of ground-level microhabitats and the low condition of the habitat caused by cattle grazing and trampling throughout the area. An experienced fauna spotter-catcher is to be present during clearing and grading, and to undertake open trench inspections along the SGIC SDA pipeline alignment and relocate any encountered individuals.

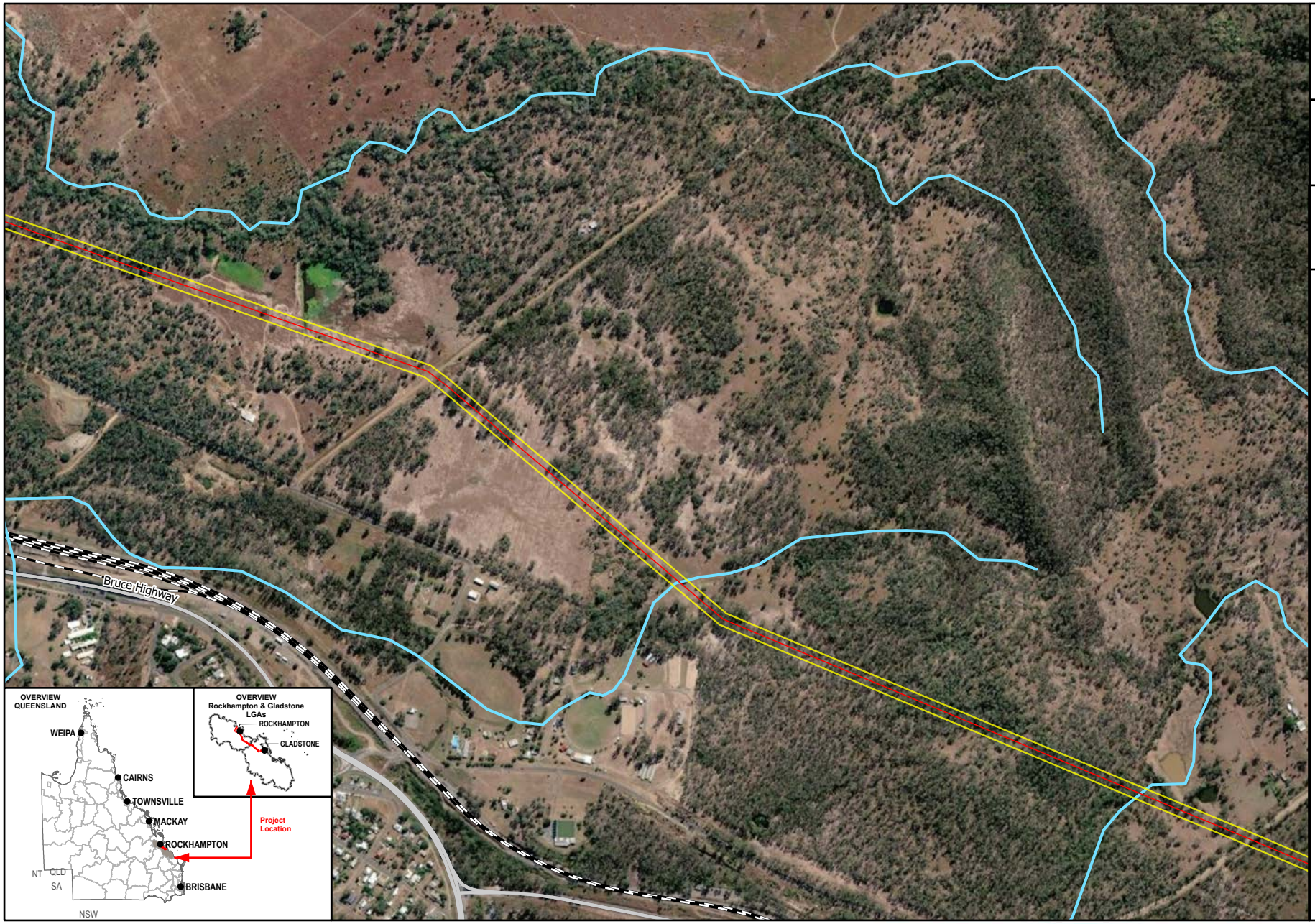

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Figure 7-9a
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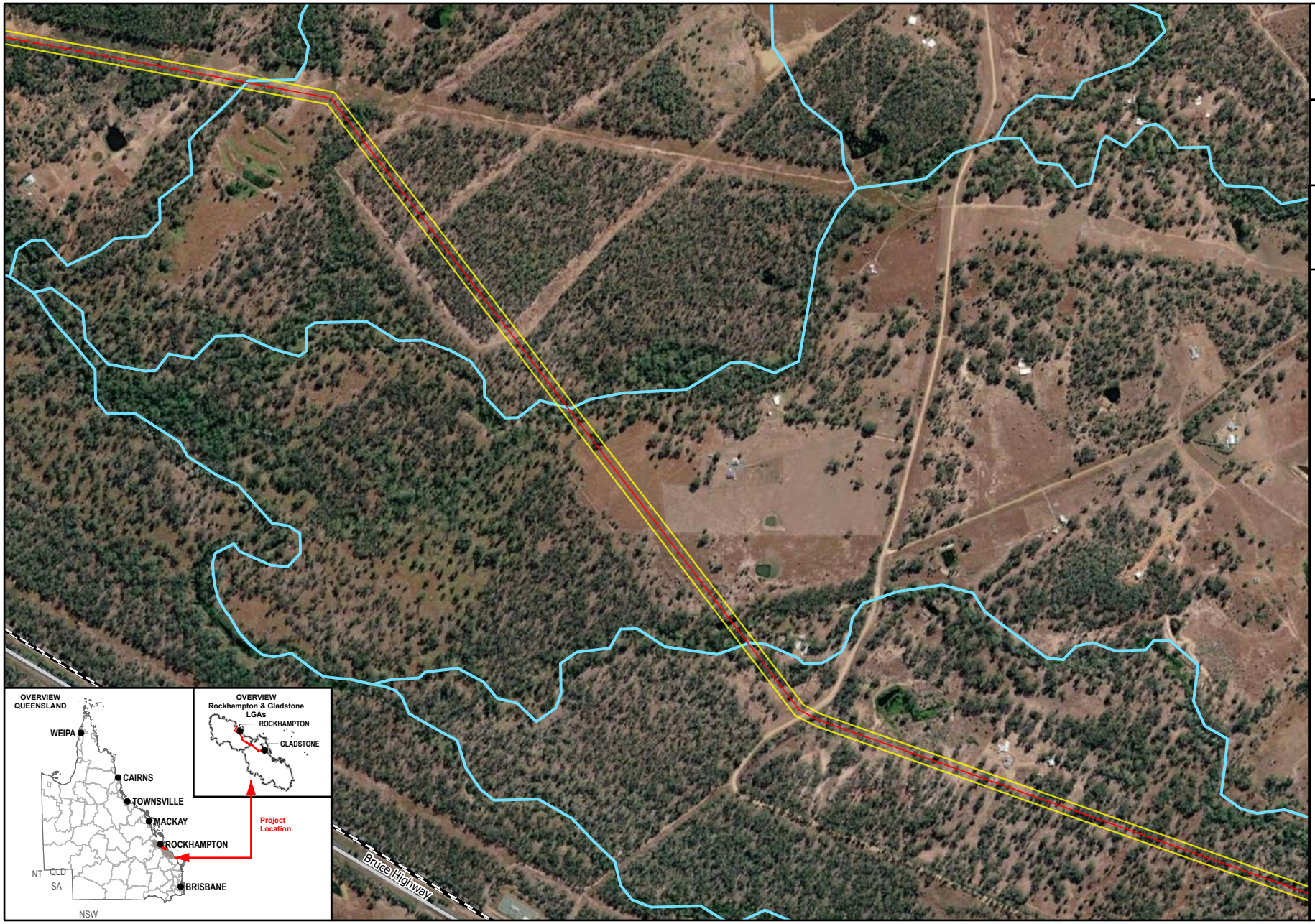

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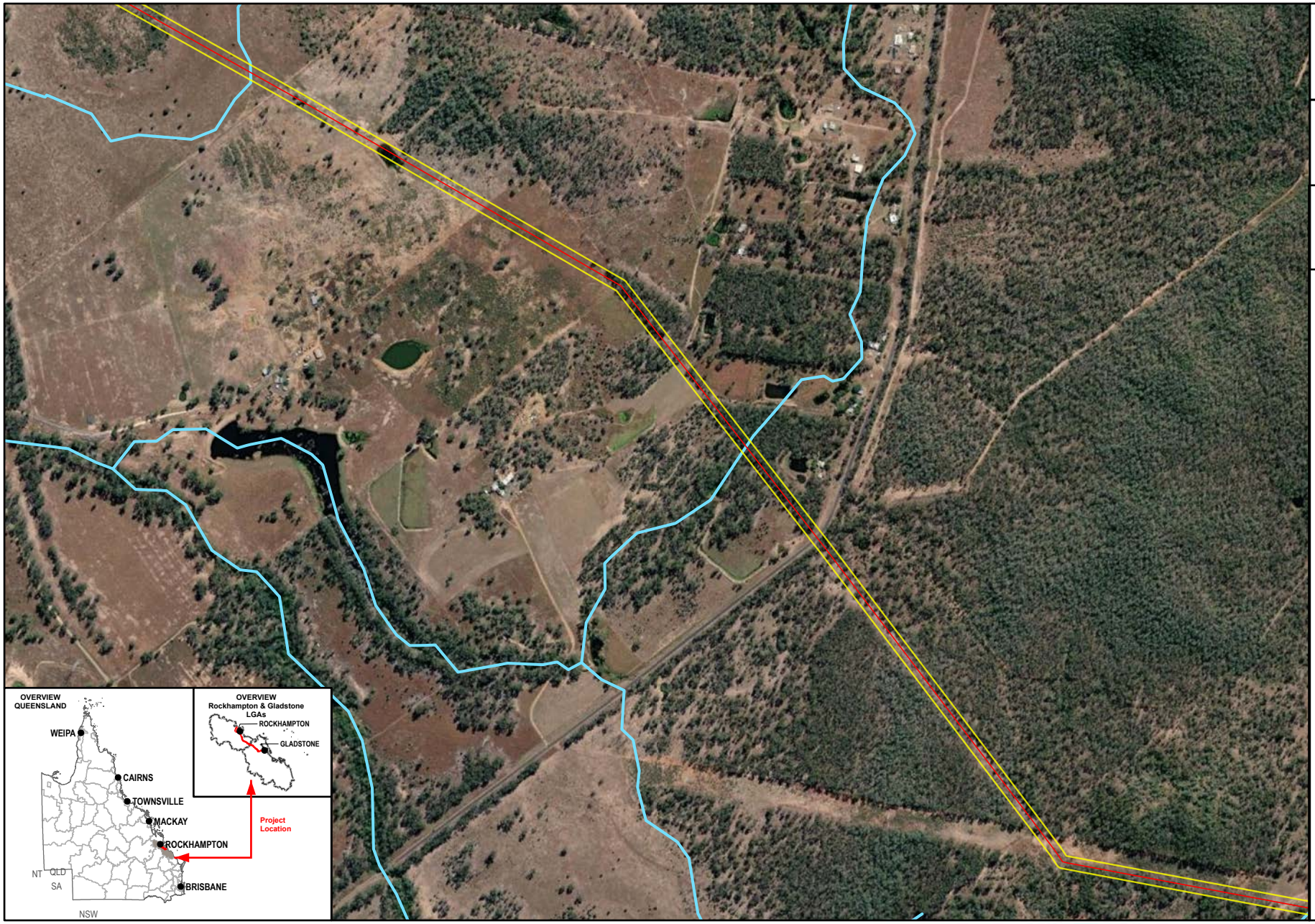

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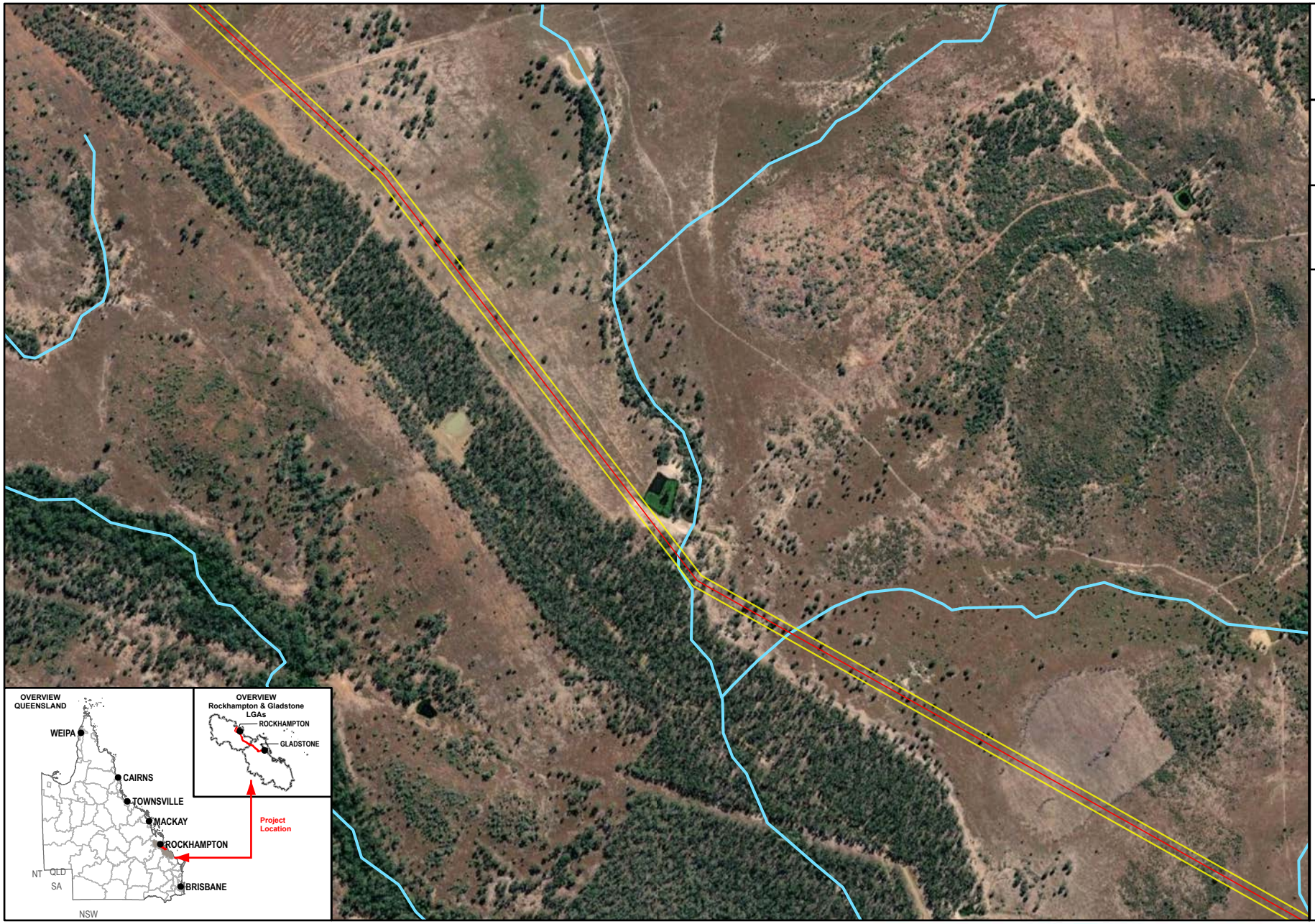

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Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
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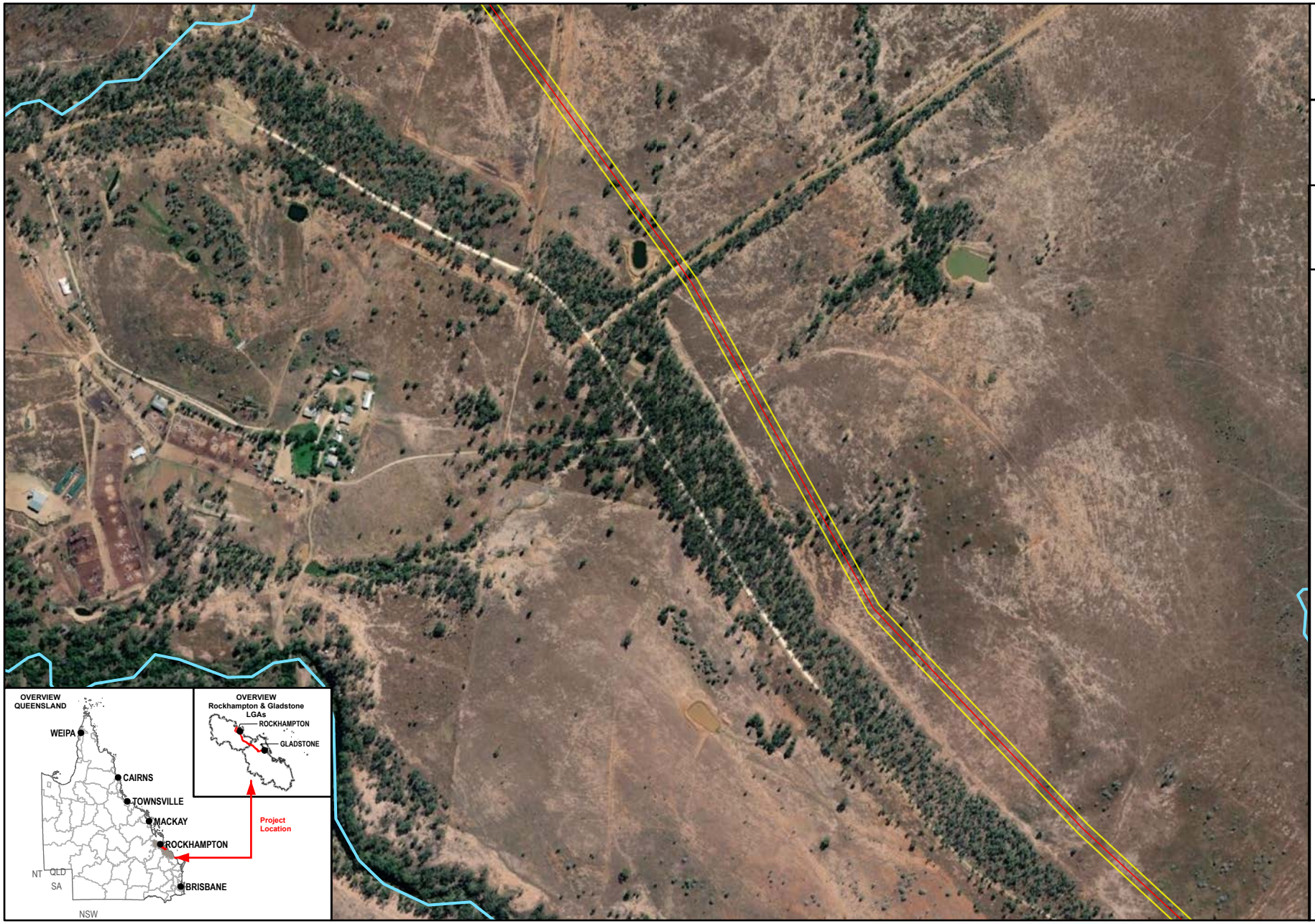
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9d
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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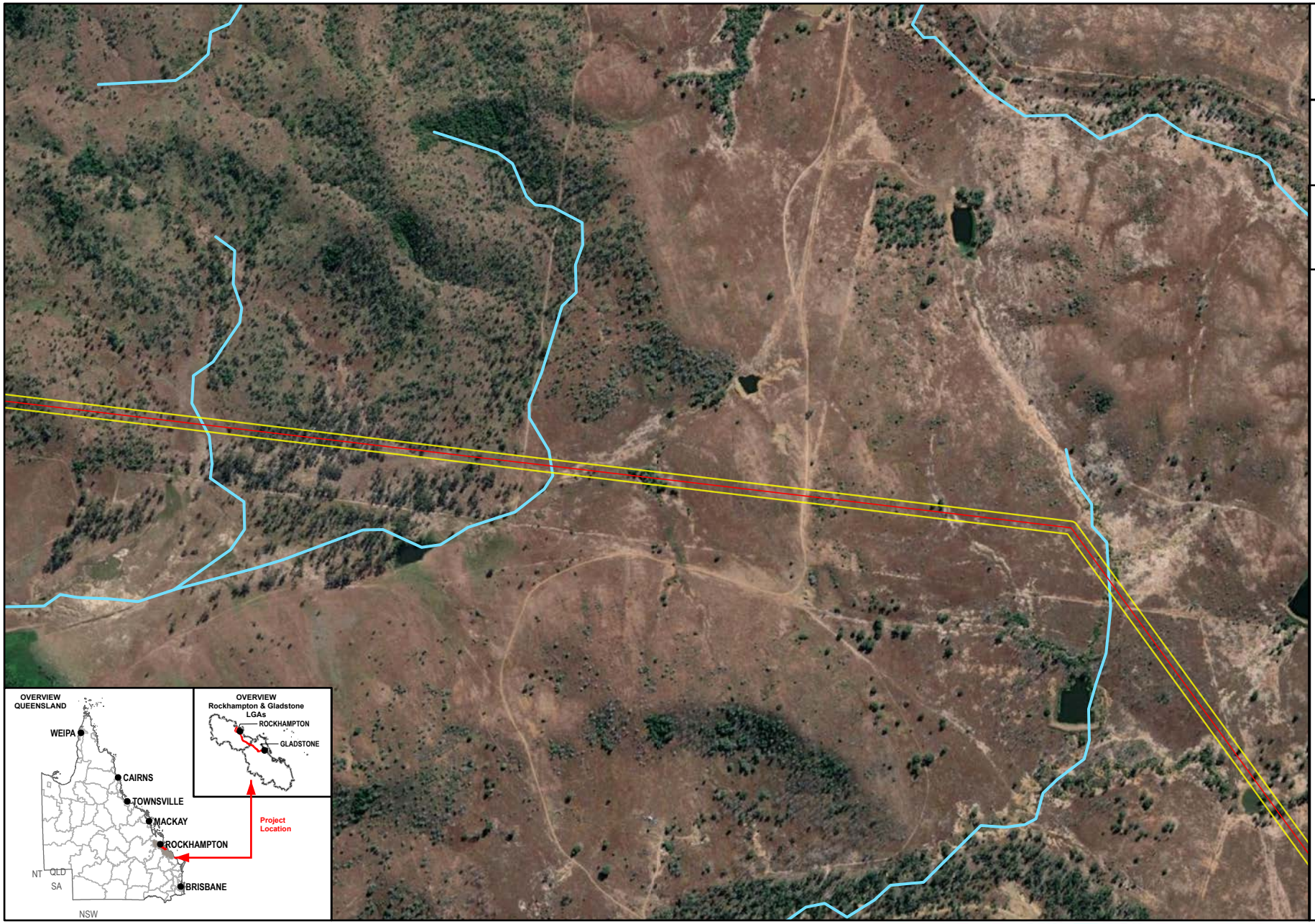
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9e
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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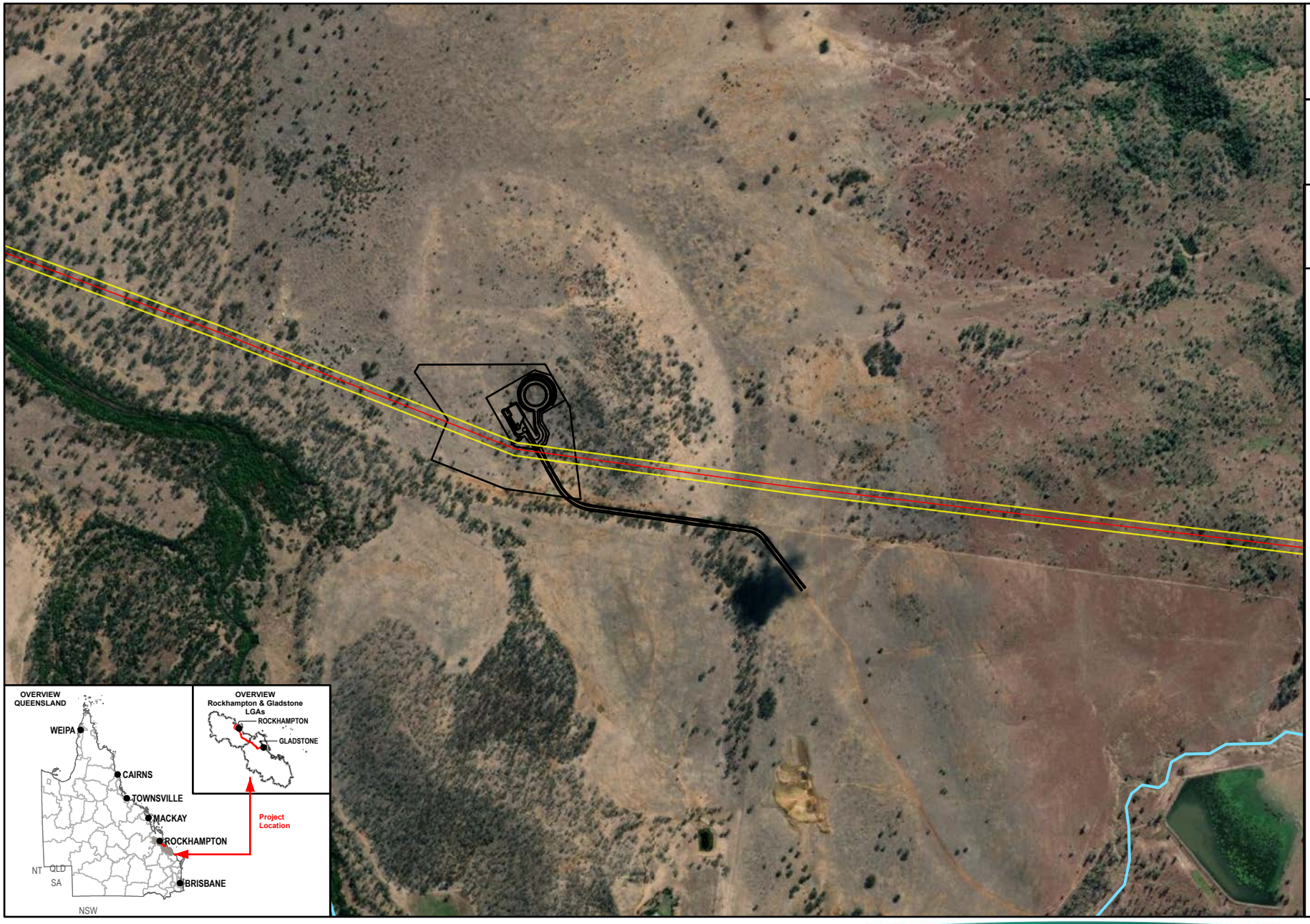
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9f
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Raglan Pump Station and Reservoir Layout
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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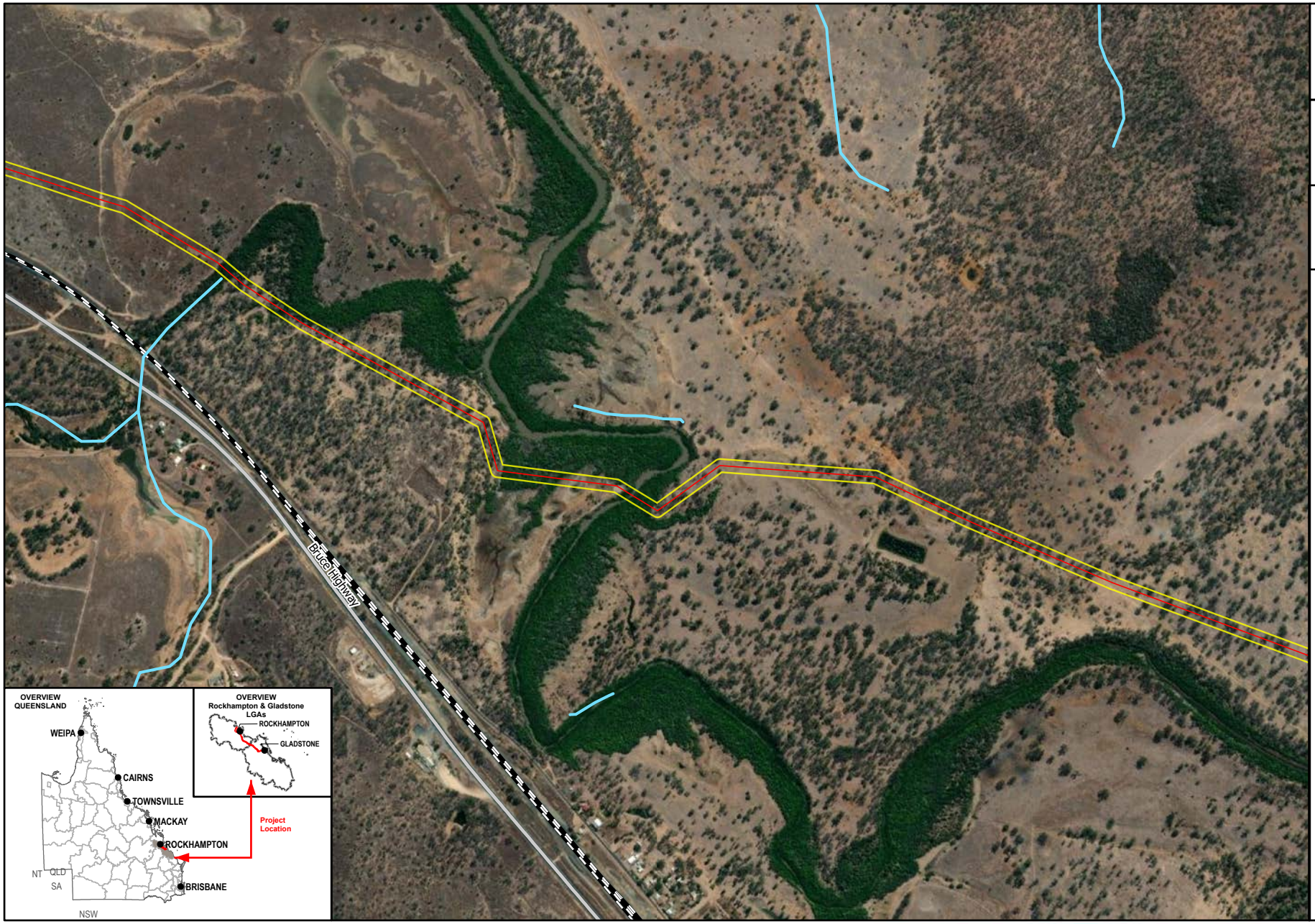
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9g
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
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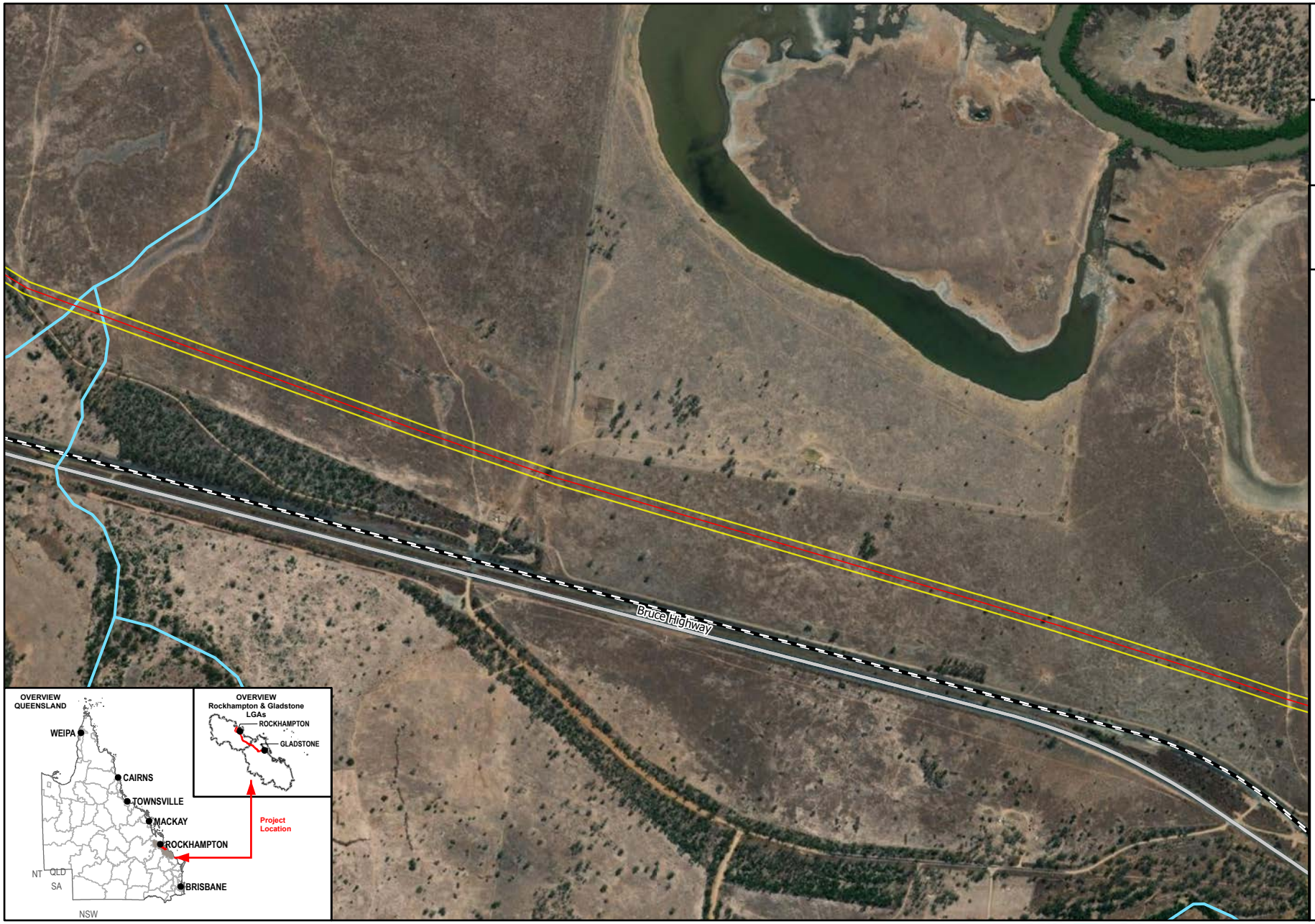
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9h
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
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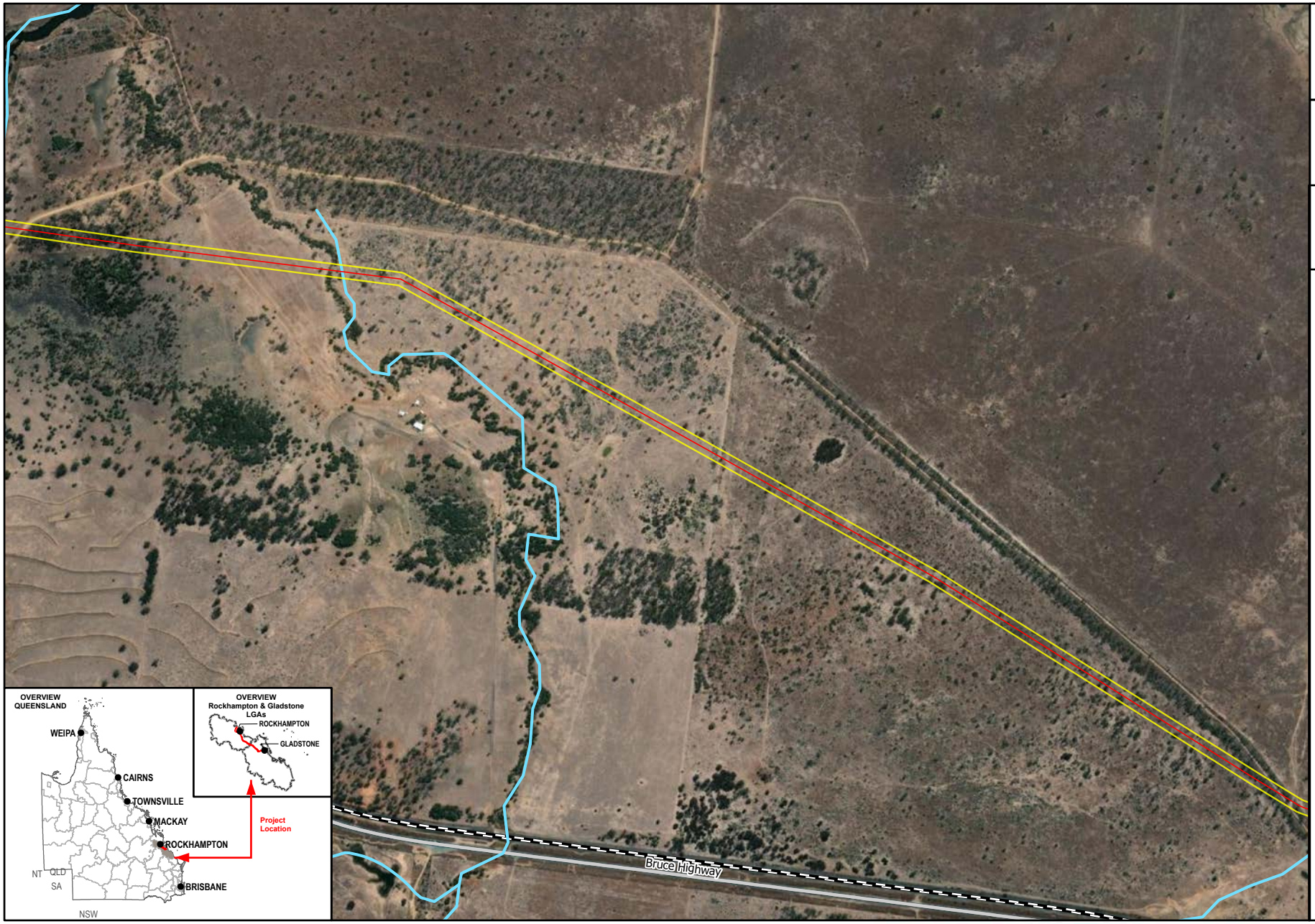
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9i
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
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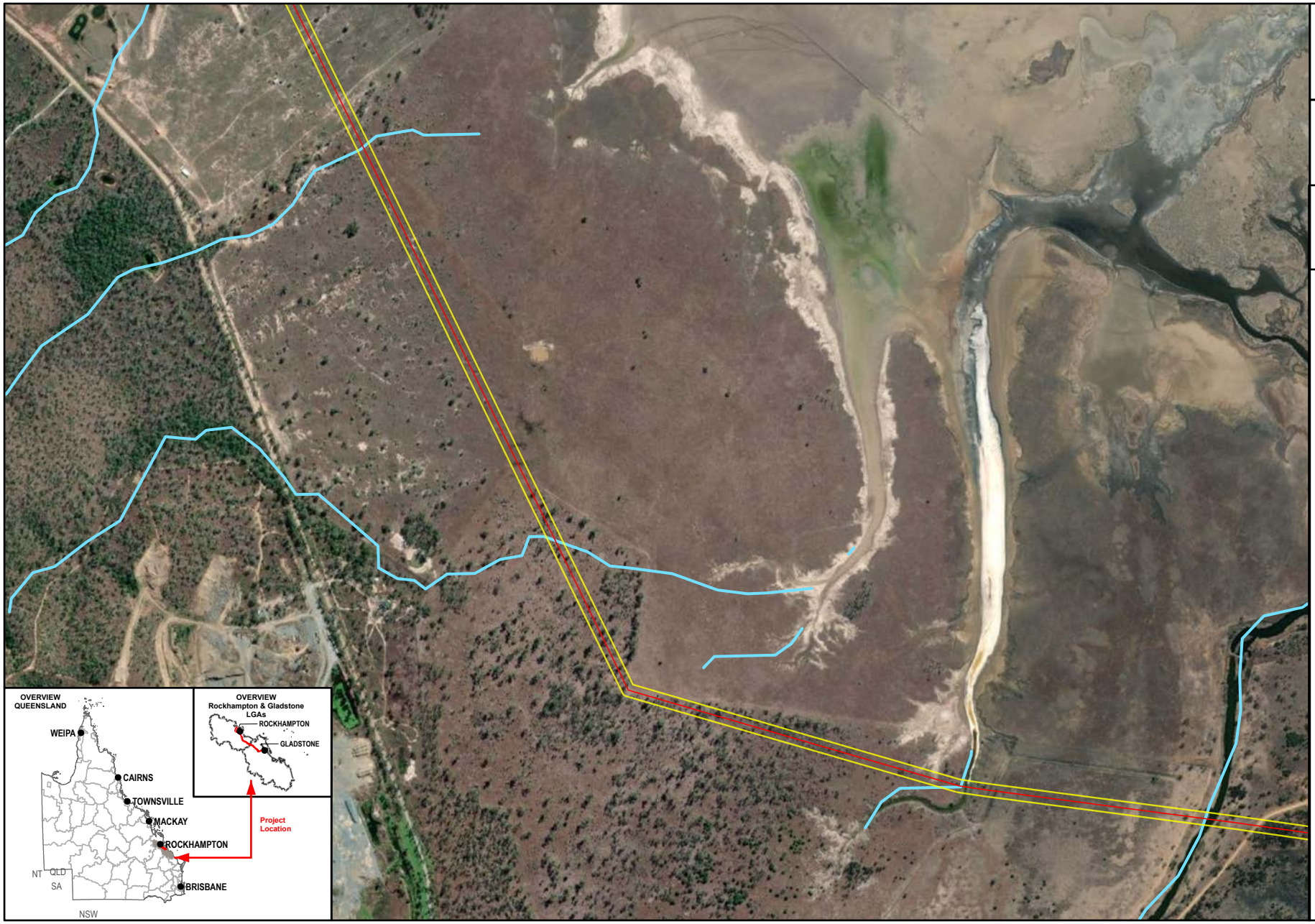
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9j
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways

Data Sources:
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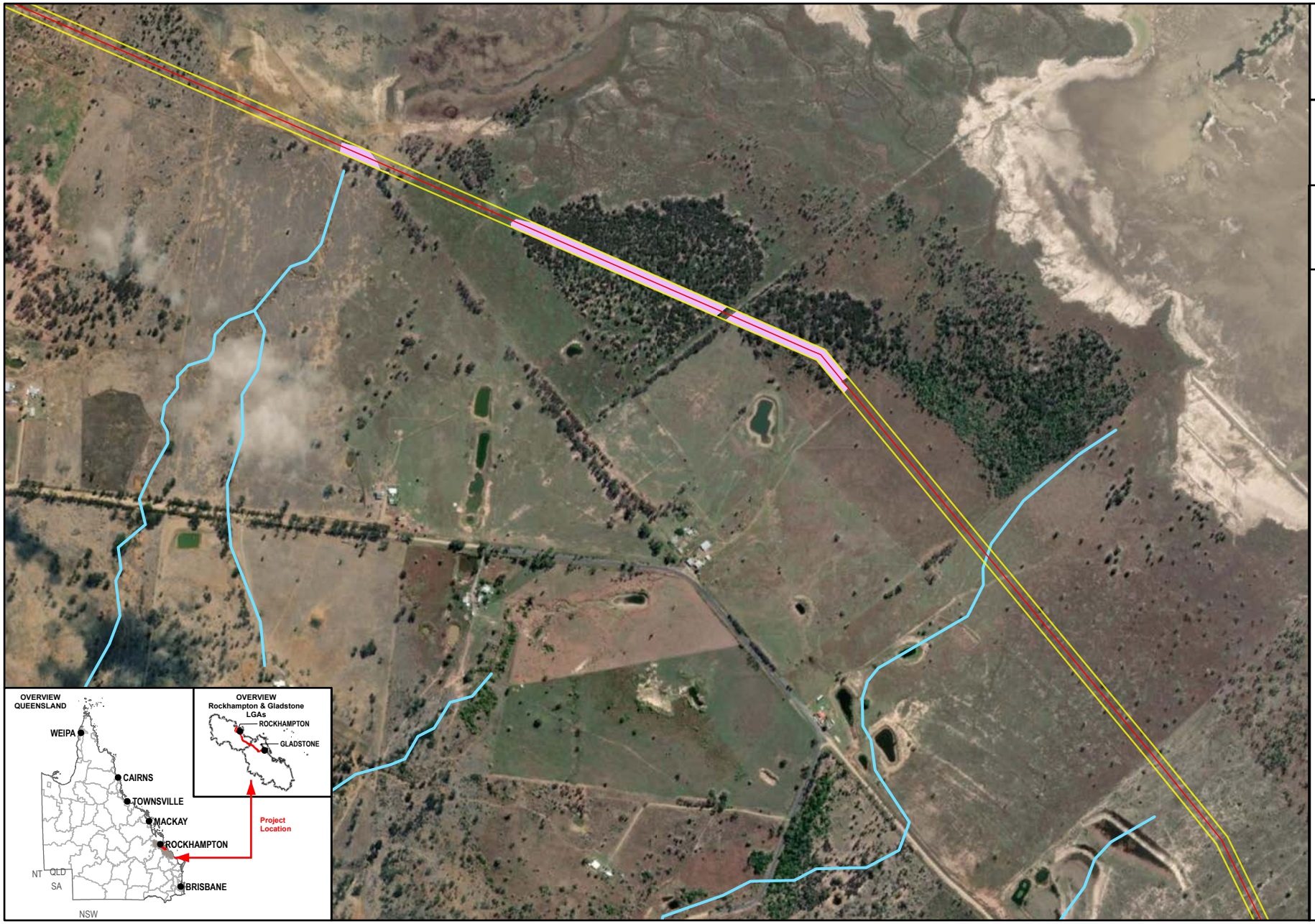
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9k
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Ornamental Snake Habitat
- Waterways

Data Sources:
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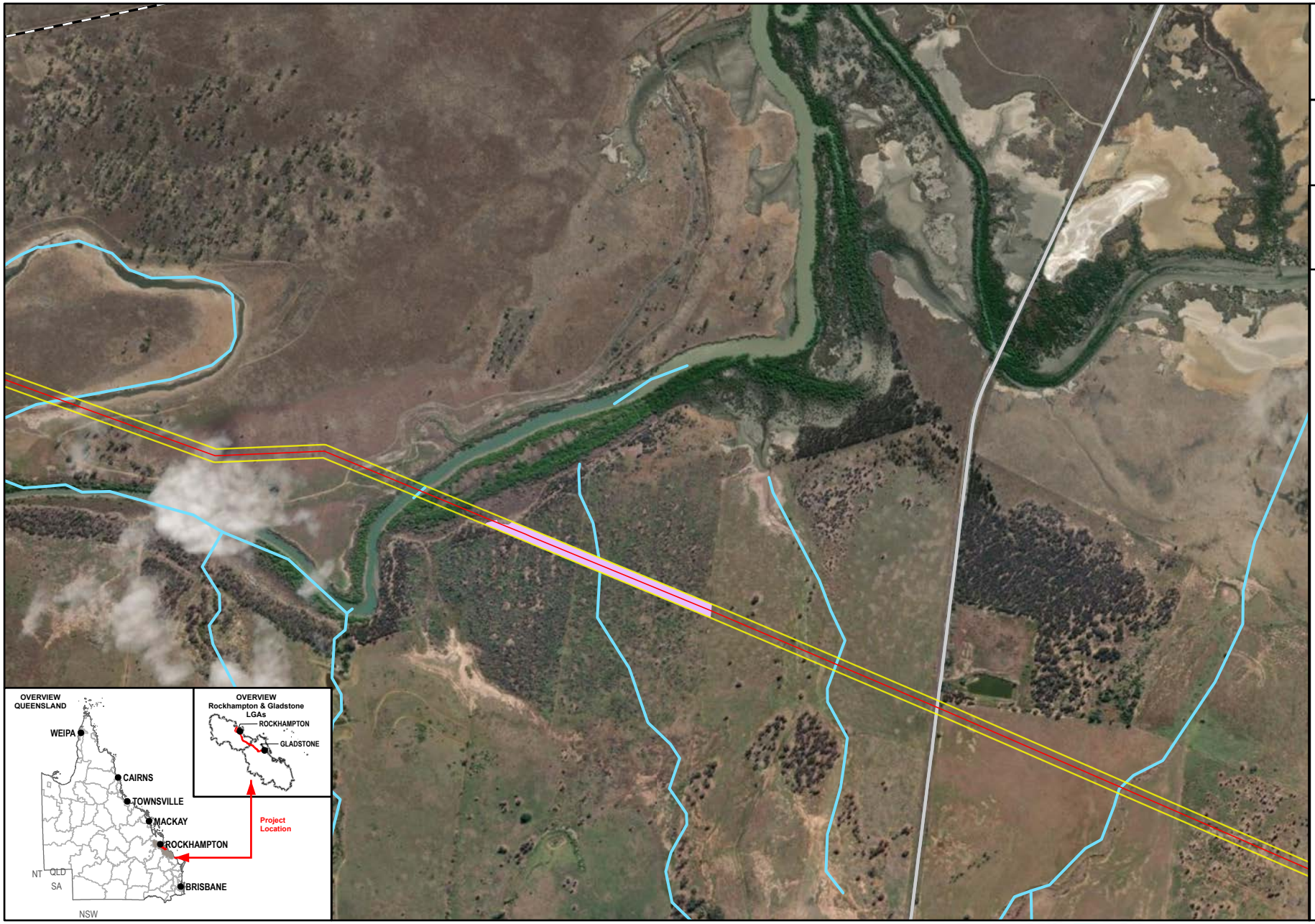
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9l
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Ornamental Snake Habitat
- Waterways
- Main Roads
- Railways

Data Sources:
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Fitzroy to Gladstone Pipeline
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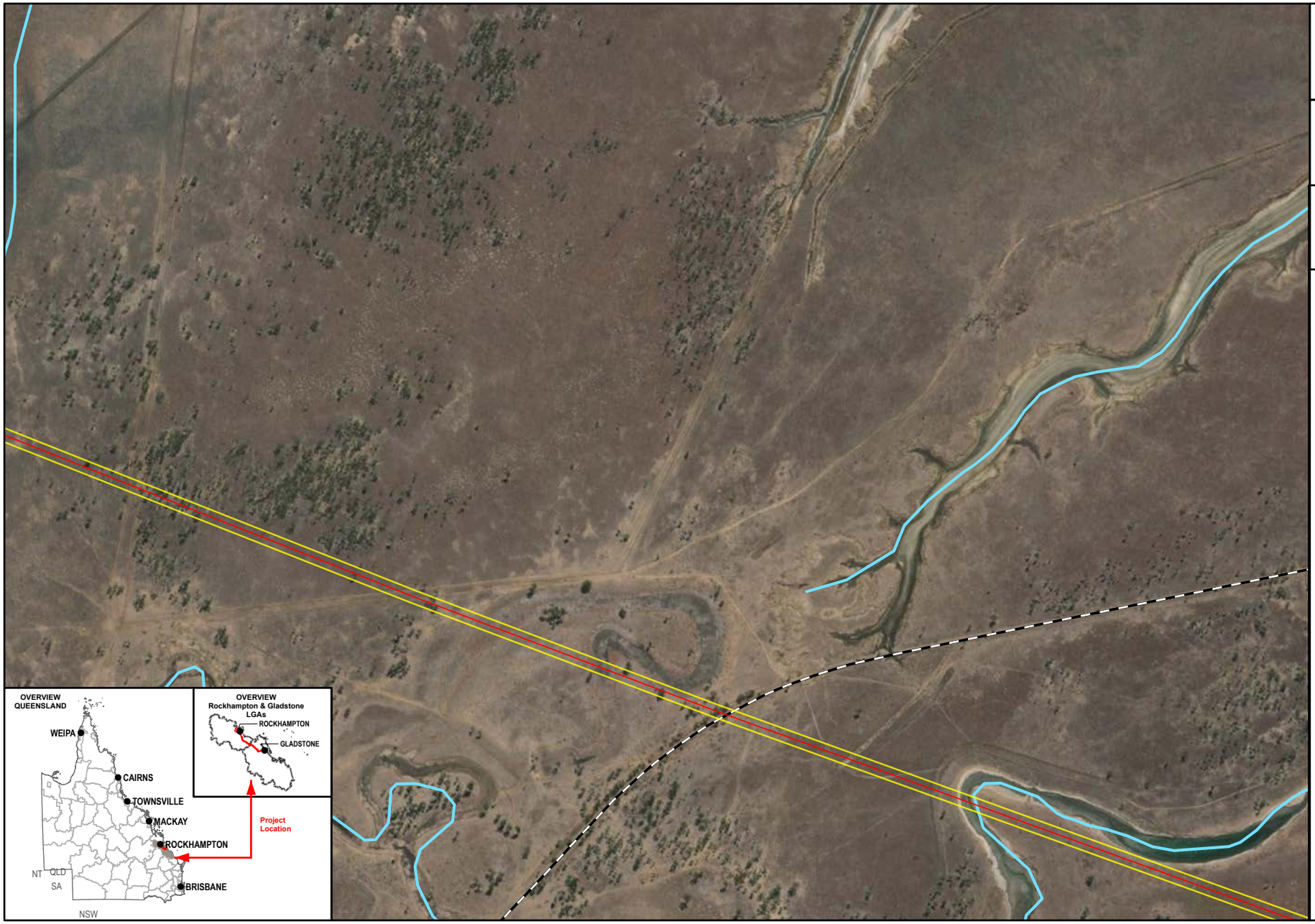
Figure 7-9m
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Railways

Data Sources:
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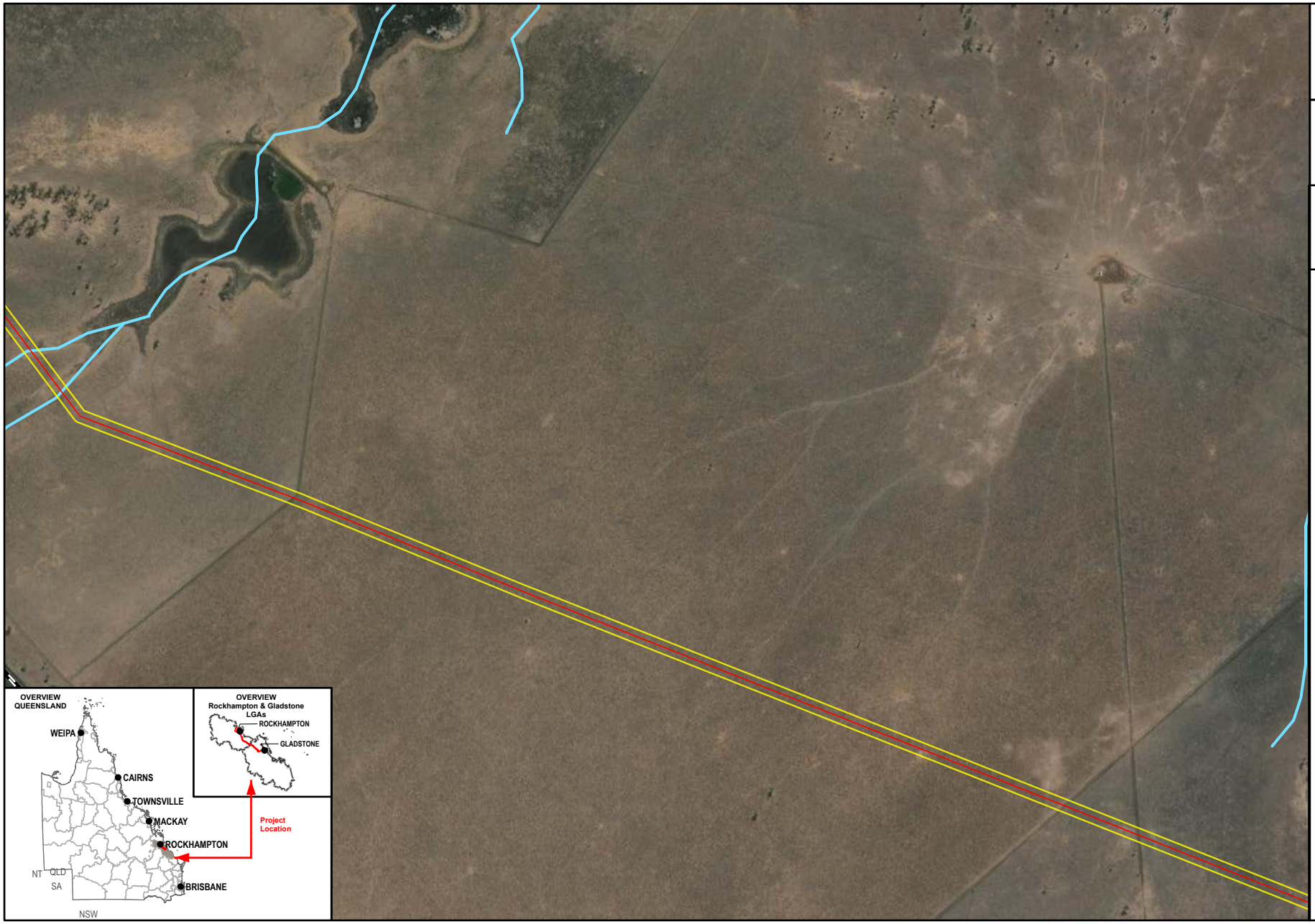
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9n
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Railways

Data Sources:
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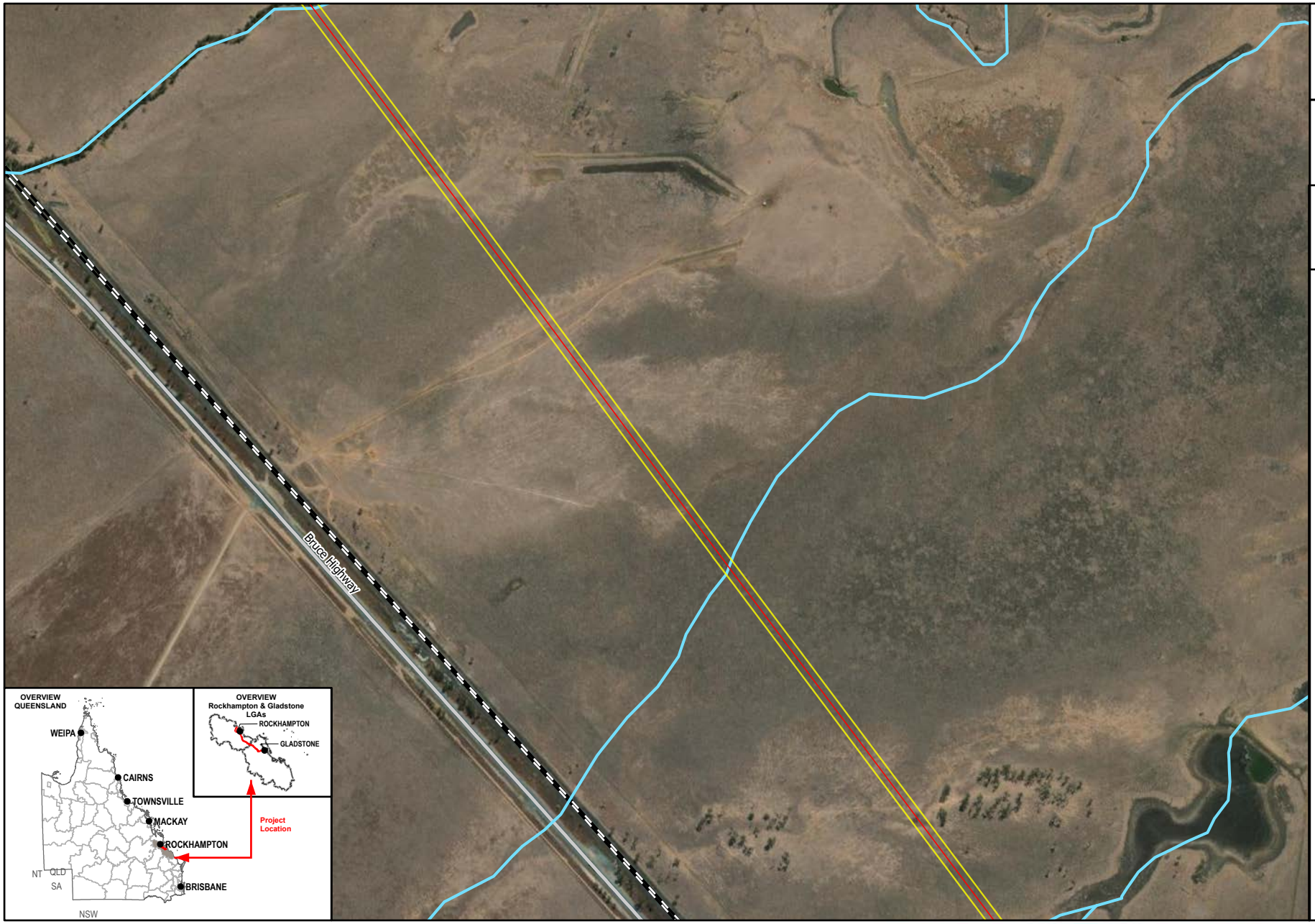
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9o
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
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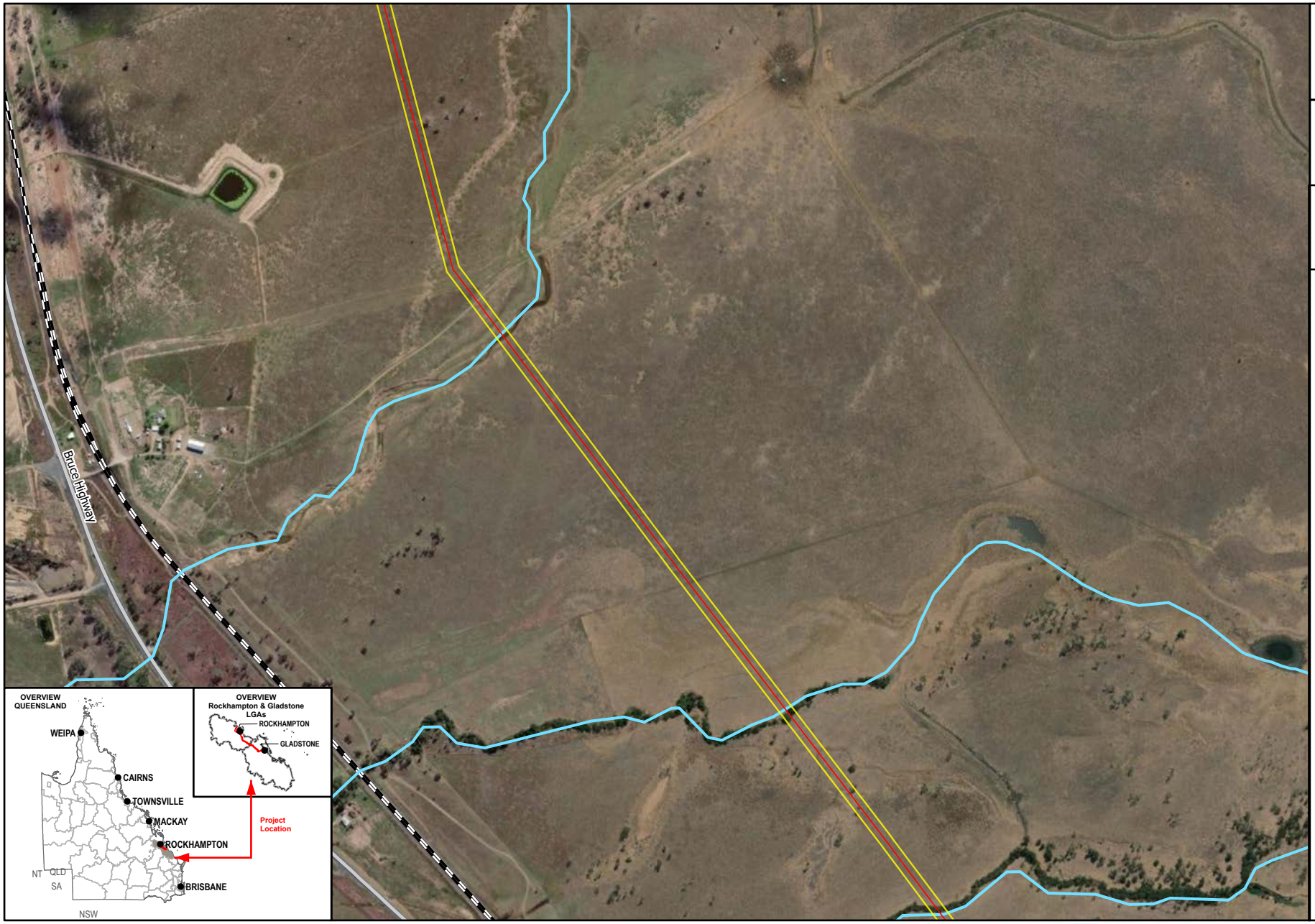
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9p
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
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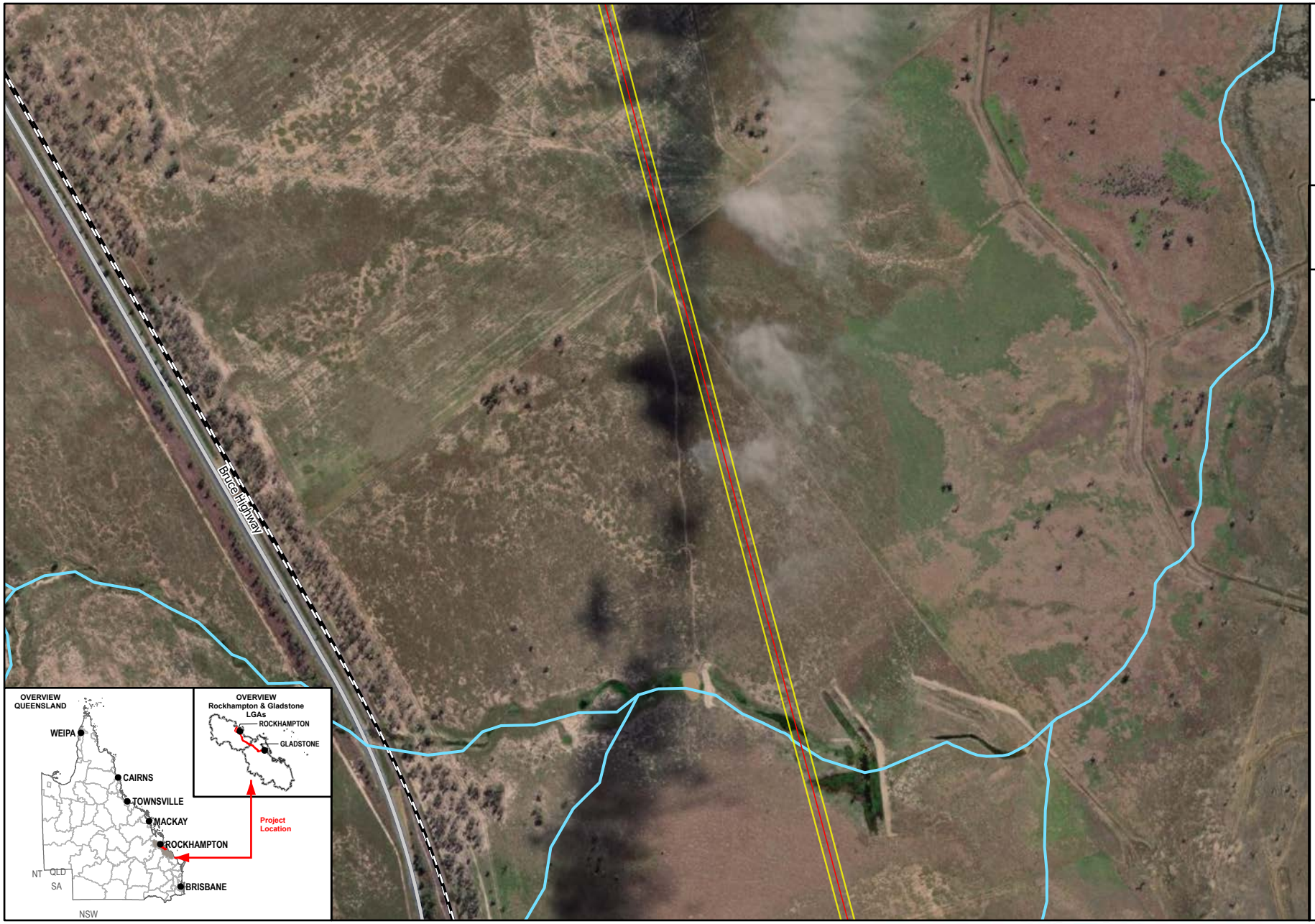
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9q
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

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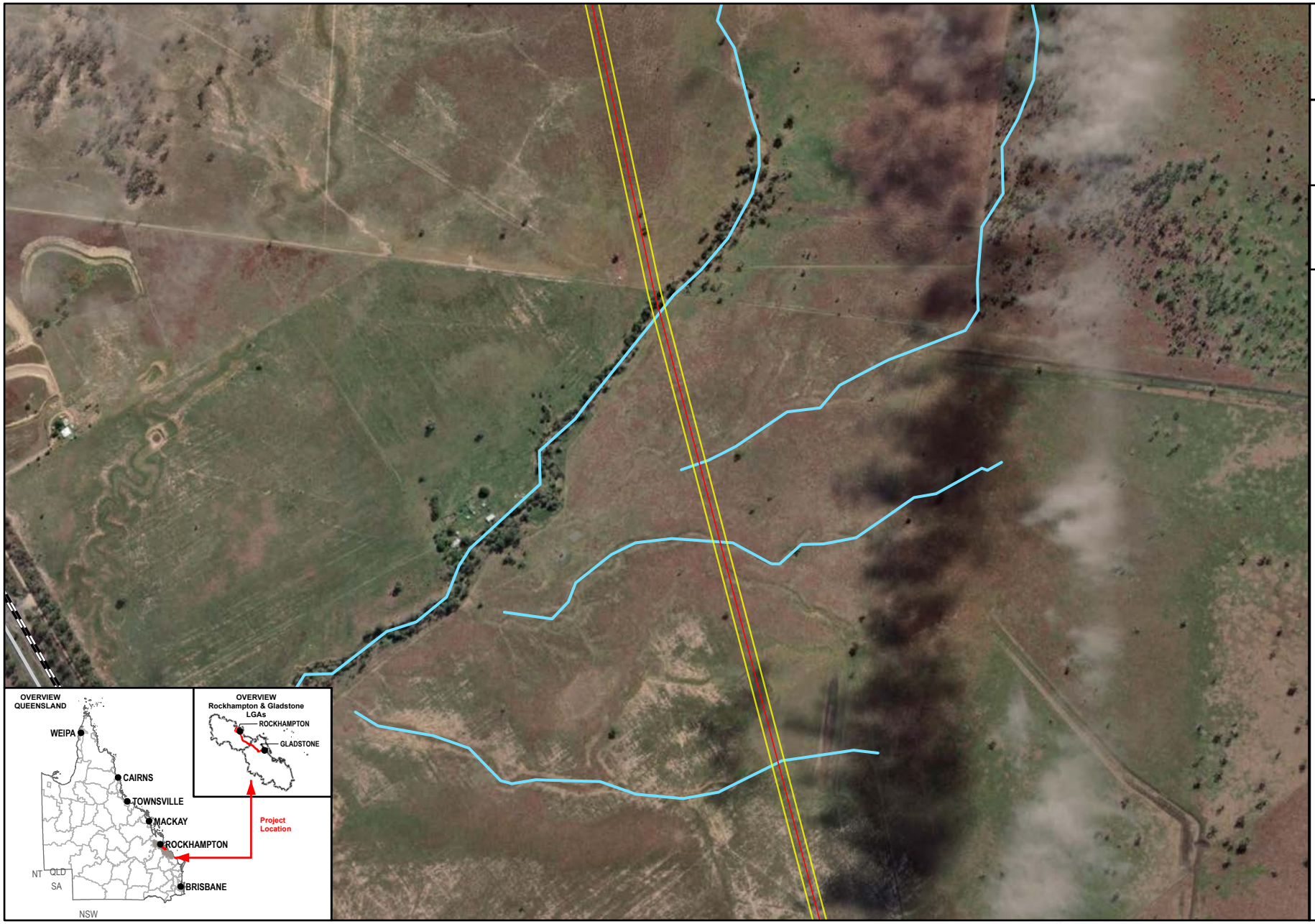
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9r
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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- SGIC SDA Pipeline Alignment
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- Waterways
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- Railways

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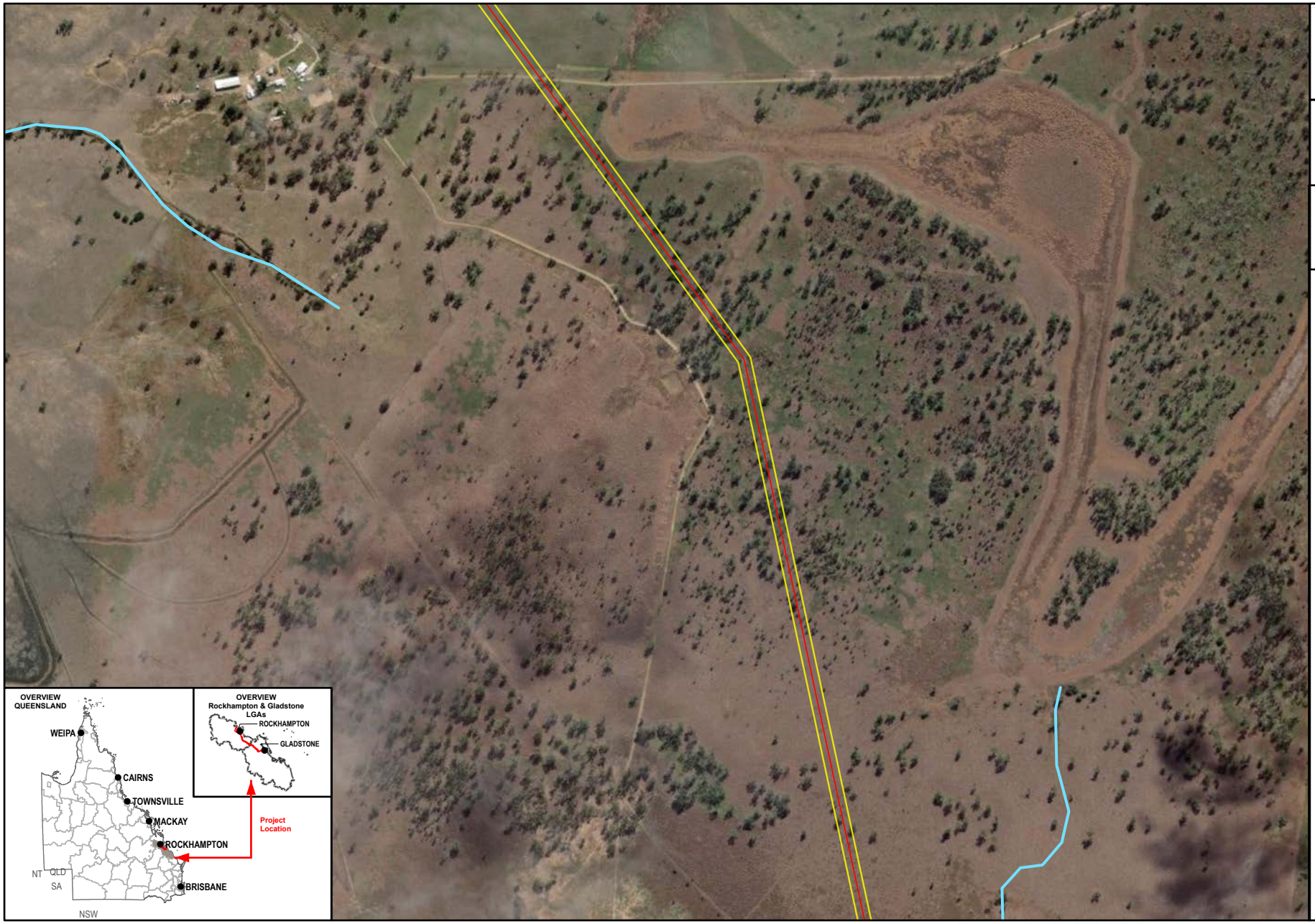
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9s
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways

Data Sources:
1. Base Layers (Roads, waterway, locality, LGA etc) @ QSpatial, 2021
2.Imagery @ Esri, Maxar, GeoEye, Earthstar Geographics, CNES-Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECTION UTM Zone 56
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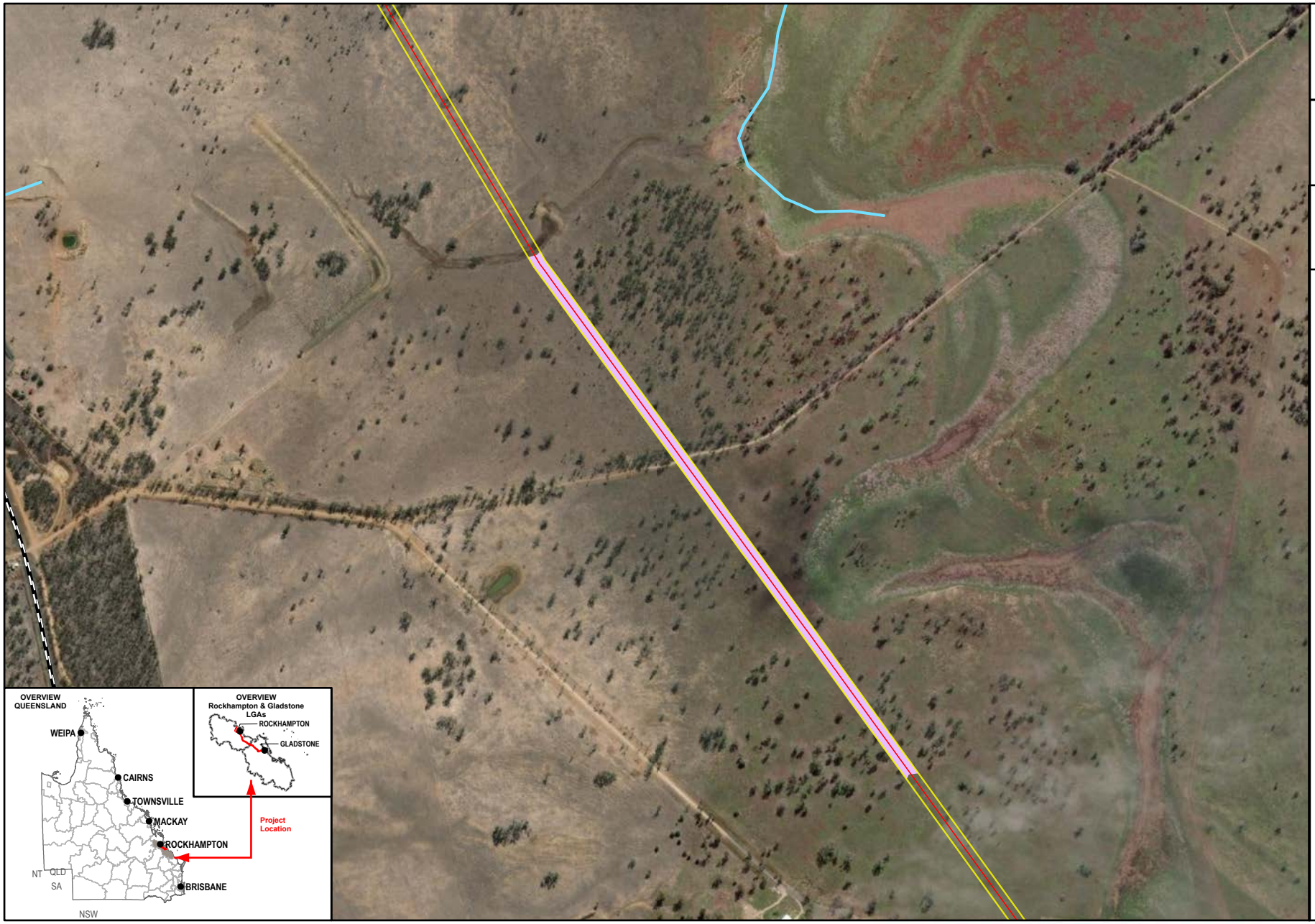
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9t
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Predicted Ornamental Snake Habitat
- Waterways
- Railways

Data Sources:
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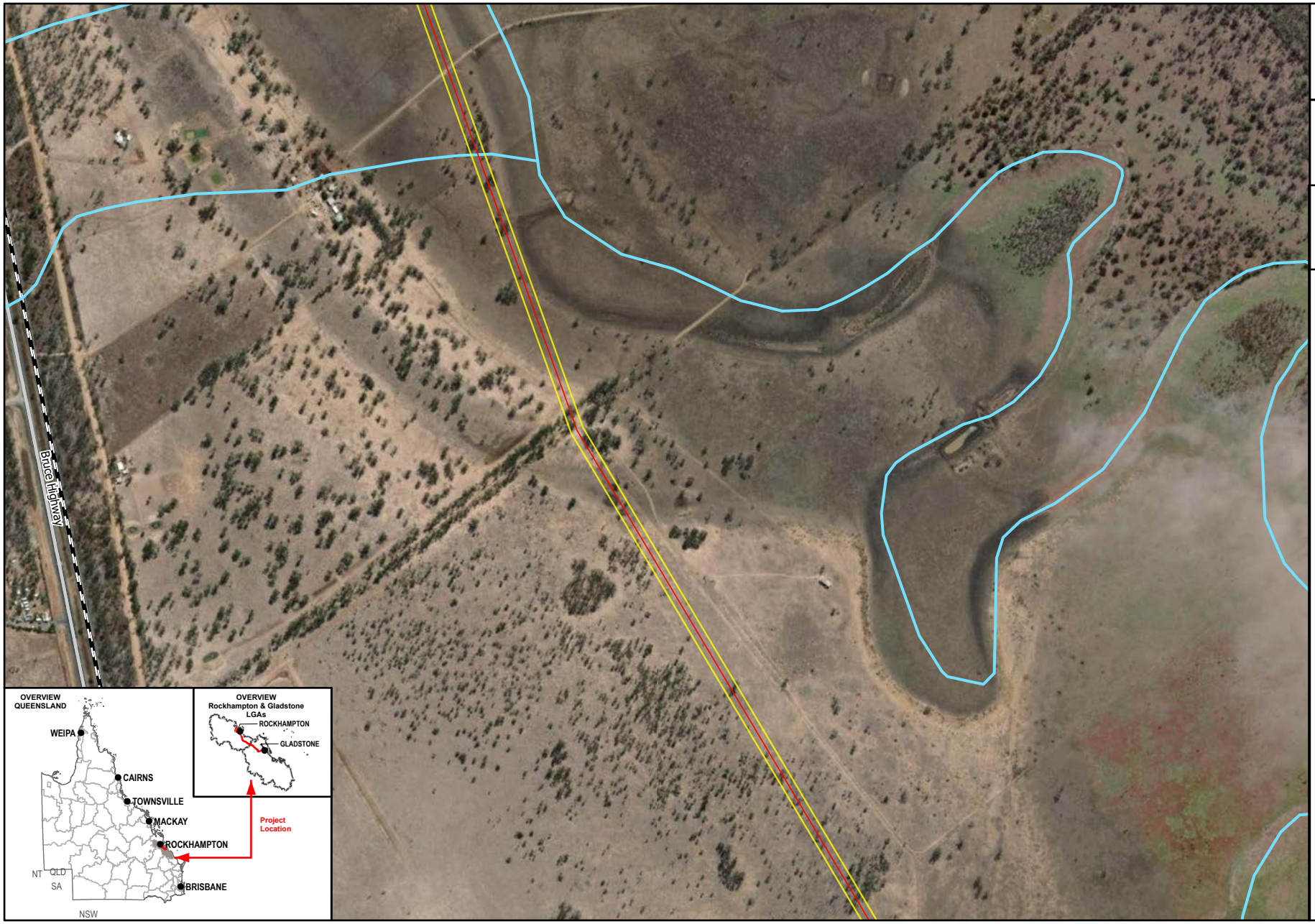
Fitzroy to Gladstone Pipeline
Baseline Terrestrial and Aquatic Ecology Technical Report
Figure 7-9u
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

Data Sources:
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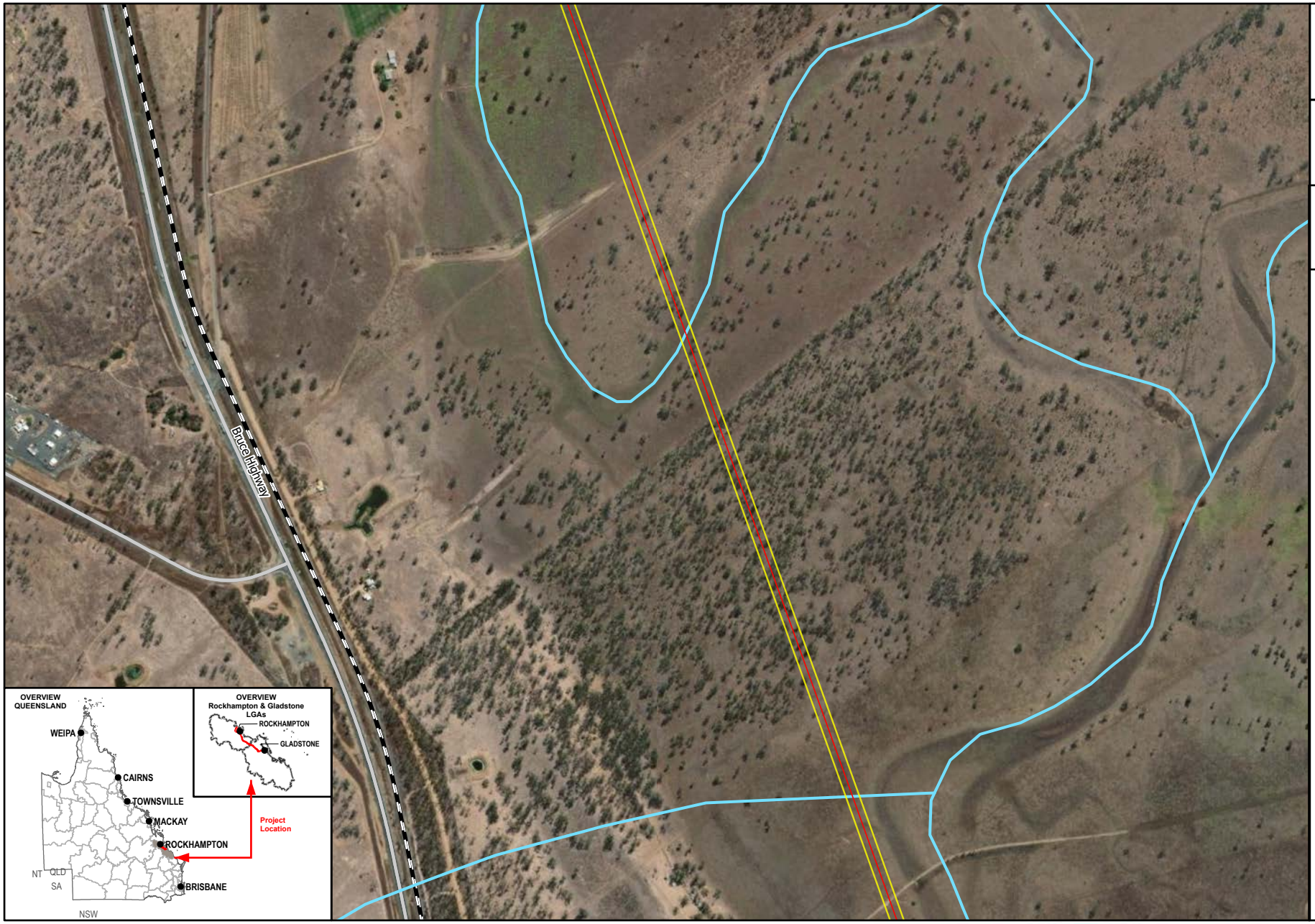
Figure 7-9v
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

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Figure 7-9w
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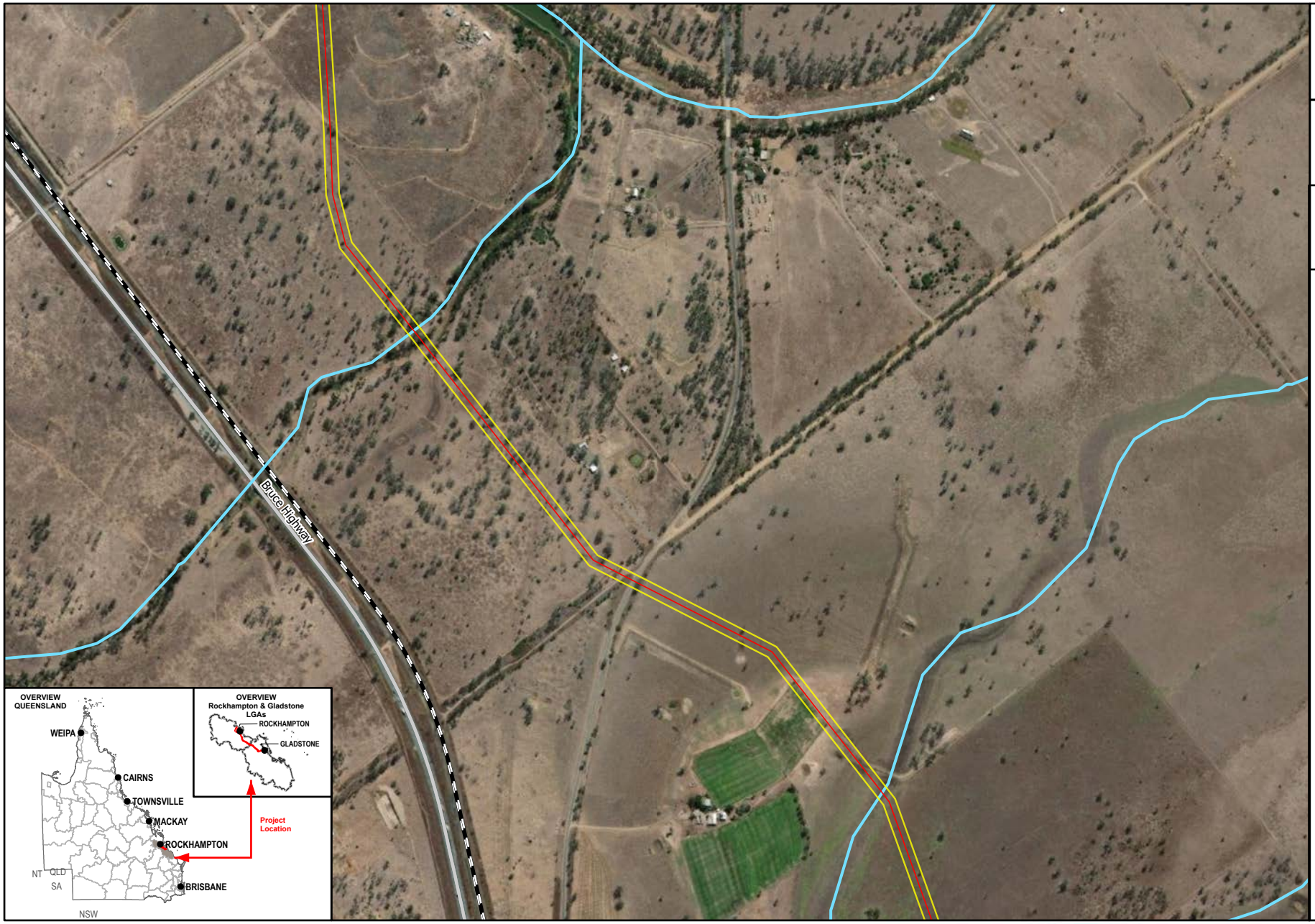

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Legend

- SGIC SDA Pipeline Alignment
- Study Area
- Waterways
- Main Roads
- Railways

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Figure 7-9x
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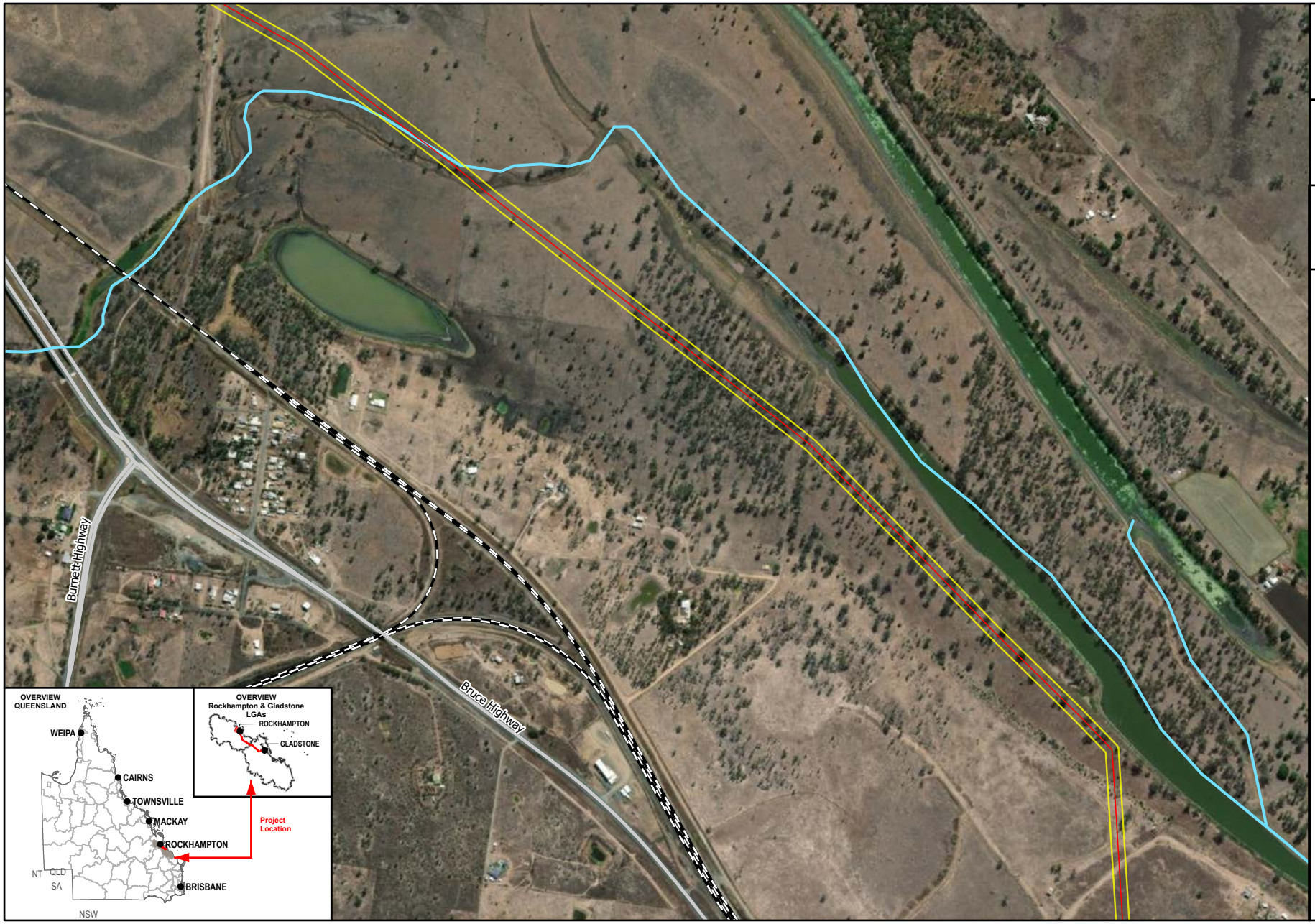
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

- SGIC SDA Pipeline Alignment
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- Waterways
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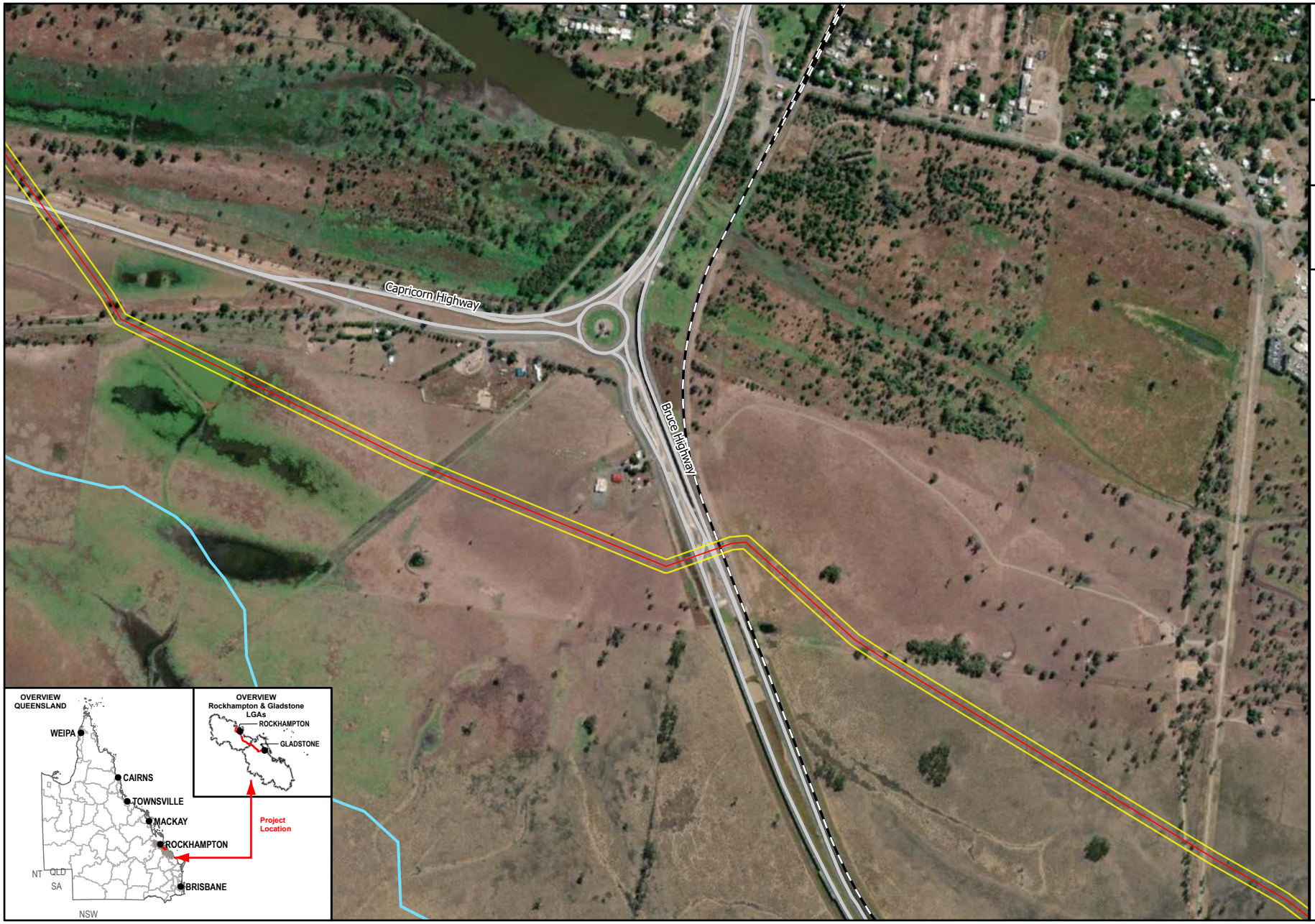
Figure 7-9y
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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Legend

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- Railways

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Figure 7-9z
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022

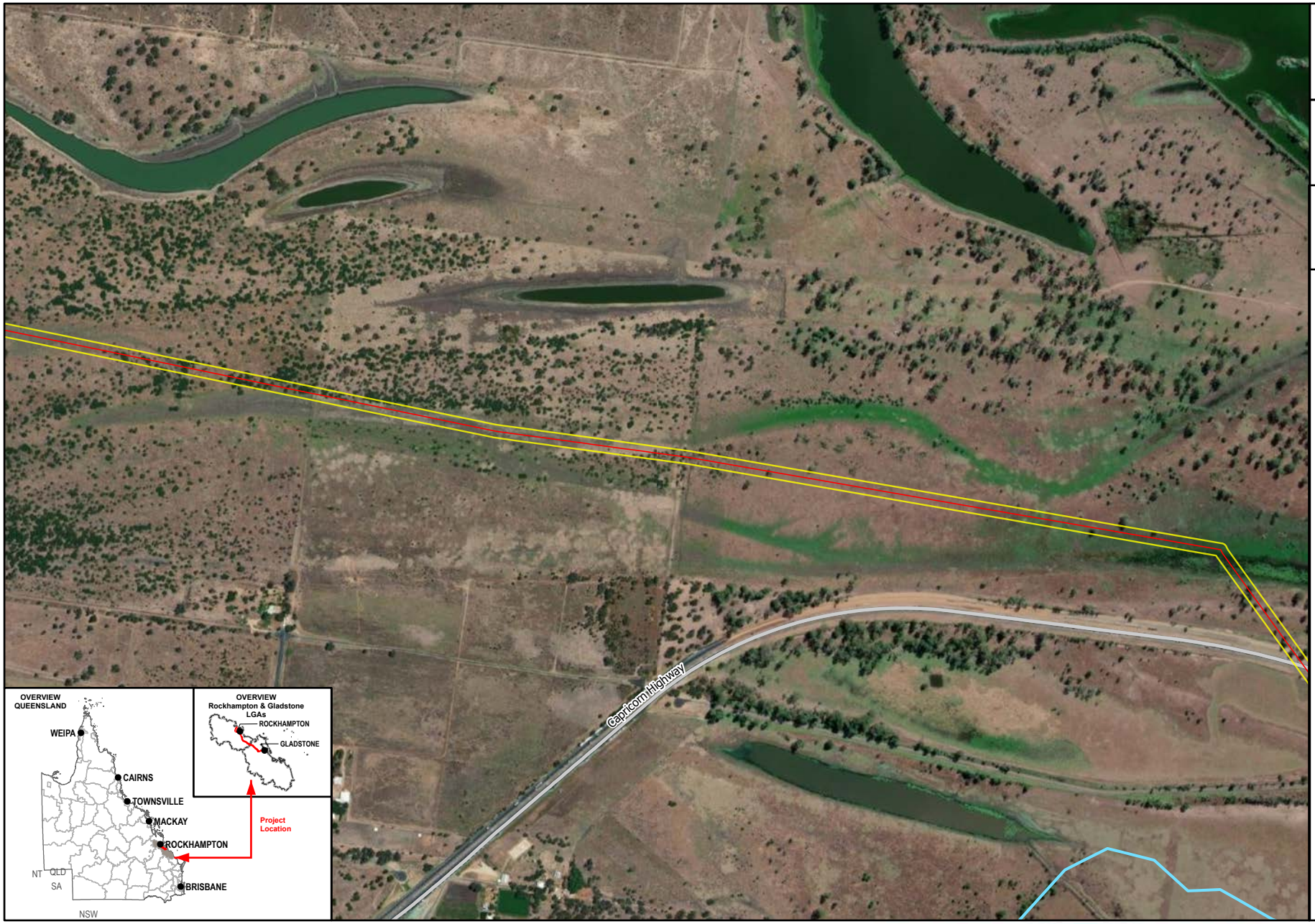

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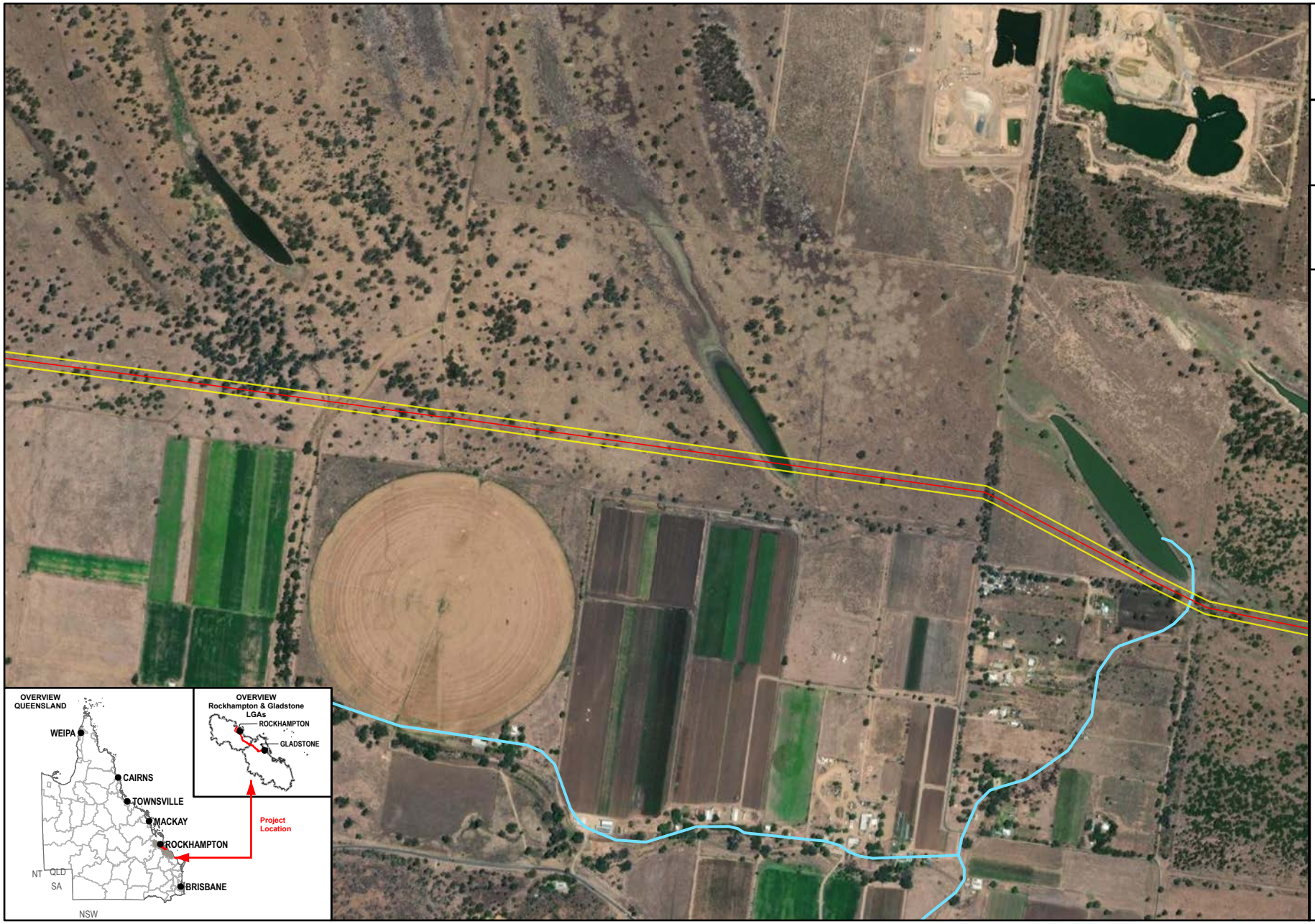
Figure 7-9a1
Distribution of Ornamental Snake Habitat Within the SGIC SDA Study Area
000-G-MAP-2431 Version:4 Date:19/09/2022



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