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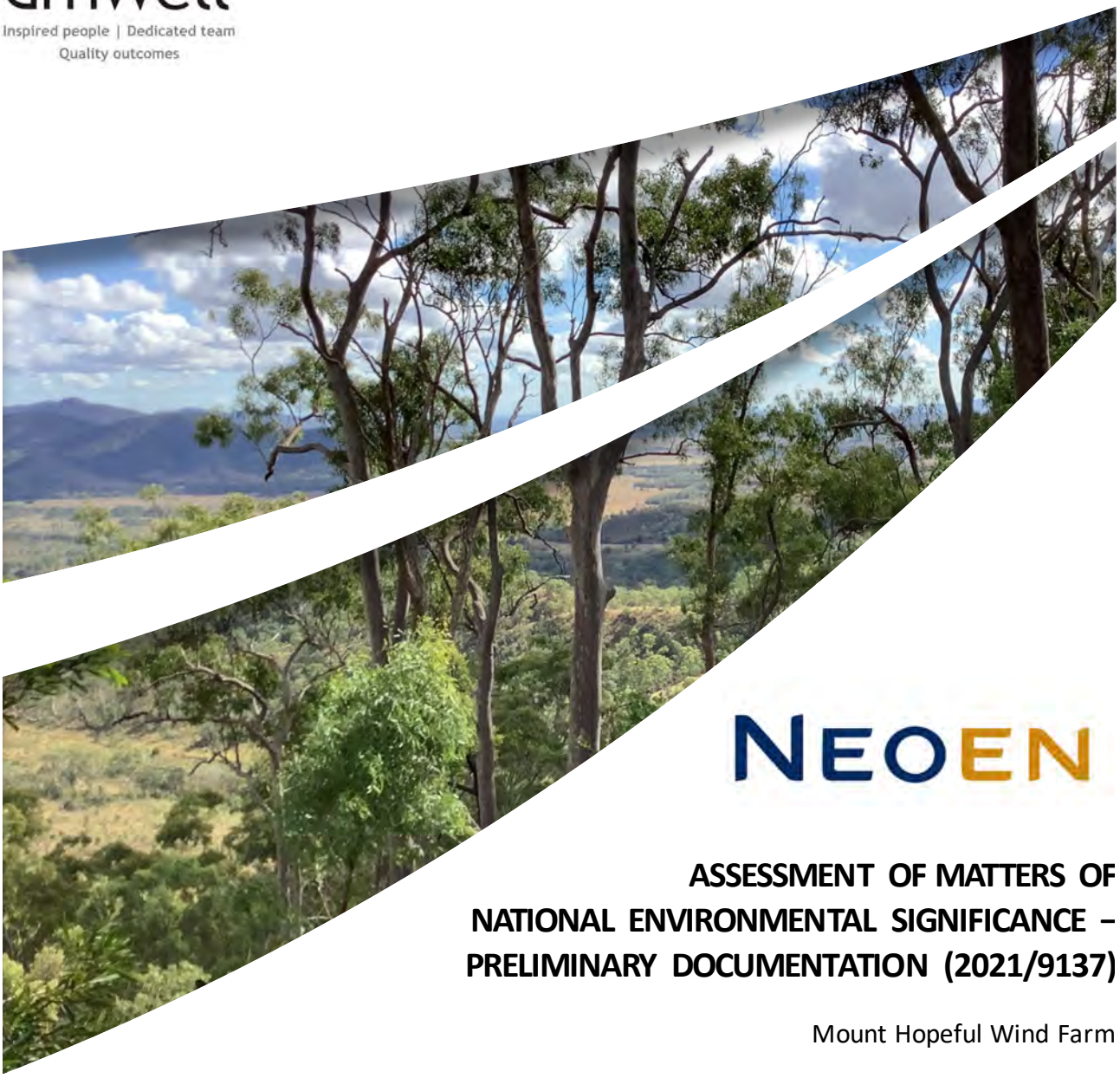

NEOEN

ASSESSMENT OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE – PRELIMINARY DOCUMENTATION (2021/9137)

Mount Hopeful Wind Farm

FINAL – ATTACHMENT B1

August 2023

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Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Neoen Australia Pty Ltd

Report No. 22753 / R03
Date: August 2023

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Abbreviations

Abbreviation	Description
ALA	Atlas of Living Australia
AGL	above ground level
BBAMP	Bird and Bat Adaptive Management Plan
BBUS	Bird and Bat Utilisation Survey
CEMP	Construction Environment Management Plan
cm	centimetres
DBH	Diameter at Breast Height
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEWHA	Department of Environment, Water, Heritage and the Arts
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPBC Offset Policy	*Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy
ESCP	Erosion and Sediment Control Plan
HQS	Habitat quality score
IBRA	Interim Biogeographic Regionalisation for Australia
kV	kilovolt
L	litre
m/km	metres/kilometres
MHQA	Modified habitat quality assessment
MNES	Matters of National Environmental Significance
MNES Guidelines	Matters of National Environmental Significance: Significant Impact Guidelines 1.1
MW	megawatt
NC Act	*Nature Conservation Act 1992* (QLD)
Neoen	Neoen Australia Pty Ltd
PMST	Protected Matters Search Tool
the Project	Mount Hopeful Wind Farm Project
Qld	Queensland
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
SPRAT	Species Profile and Threats
TEC	Threatened Ecological Community
Umwelt	Umwelt (Australia) Pty Ltd
VM Act	*Vegetation Management Act 1999* (QLD)
VMP	Vegetation Management Plan
WoNS	Weed of National Significance

1.0 Introduction

Neoen Australia Pty Ltd (Neoen) is proposing to develop the Mount Hopeful Wind Farm Project (the Project) to supply energy to the future Central Queensland Renewable Energy Zone (QREZ). The Project will comprise up to 63 wind turbine generators (WTGs), ancillary infrastructure including up to ten temporary and ten permanent wind monitoring masts, six substations, battery energy storage systems, temporary construction compound/laydown areas, concrete batching plants, high voltage overhead powerlines, as well as underground power and communication cables. The Project includes an access road corridor which would involve upgrades to approximately 30 km of existing road between the Burnett Highway at Dixalea and Glengowan Road to ensure the safe transportation of Project infrastructure. The Project is expected to have a maximum generation capacity of approximately 400 megawatts (MW). Subject to conditions, the Project was granted approval by the Queensland State Assessment and Referral Agency (SARA) on 17 June 2022 (SARA Reference 2109-24892 SDA).

Umwelt was commissioned by Neoen to undertake an ecology assessment for the Project with particular focus on Matters of National Environmental Significance (MNES) protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The original MNES assessment supported the referral of the Project in 2021 (EPBC Reference 2021/9137).

On 7 March 2022, the delegate for the Minister for the Environment determined that the Project was a controlled action requiring further assessment and approval under the EPBC Act before it can proceed. The relevant controlling provisions include:

- **Listed threatened species and communities (sections 18 and 18a).**
- **Listed migratory species (sections 20 and 20A).**

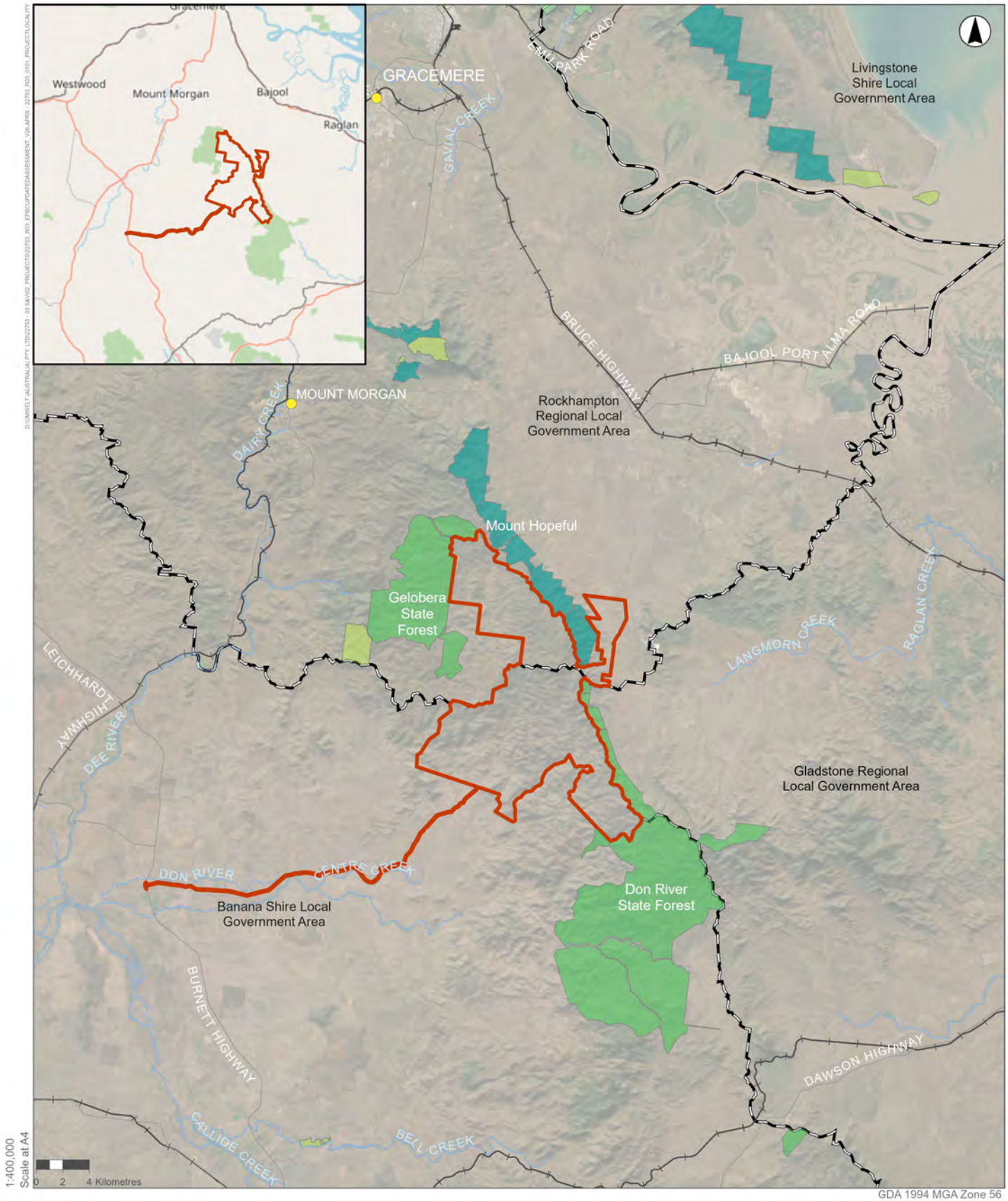
The Project will be assessed by Preliminary Documentation, with further information requested by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).
The purpose of this updated MNES assessment is to respond to DCCEEW's Request for Additional Information (RFI) (relevant to this report) and support the Preliminary Documentation assessment of the Project under the EPBC Act.

1.1 Project Locality

The Project is situated approximately 15 kilometres (km) south-east of Mount Morgan, in Central Queensland, within a largely rural and sparsely settled landscape mostly used for light grazing and livestock production. The nearest population centers are Rockhampton, located 45 km north and Gladstone, located 65 km east. The Project occurs along the Ulam Range, between Mount Hopeful on the Dee Range and Mount Alma on the Mount Alma Range. The terrain within the area varies from undulating rises to steep hills and mountain ranges surround.

Several protected areas occur in the immediate vicinity of the Project including Gelobera State Forest to the west, Ulam Range State Forest to the east and Don River State Forest to the south-east.

The Project's location in the region is depicted on **Figure 1.1**.



Legend

- Town
- Roads
- Railway
- Watercourses
- Local Government Area (LGA)
- Study Area
- Conservation Park
- National Park
- Resources Reserve
- State Forest

FIGURE 1.1

PROJECT LOCALITY

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1.2 MNES Assessment Boundaries and Definitions

The Mount Hopeful Wind Farm Project is the Proposed Action for the purpose of this assessment. The Mount Hopeful Wind Farm Project is herein referred to as 'the Project'.

For the purposes of this assessment, 3 distinct boundaries are presented, including:

- **Study Area:** represents the boundaries of the involved land parcels which encompass the infrastructure that has been designed for the proposed wind farm, including the proposed access road corridor (**Section 1.2.1**). The Study Area also represents the limit of vegetation and habitat mapped for the Project.
- **Development Corridor:** refers to spatial bounds in which all Project infrastructure will be located (**Section 1.2.3**).
- **Disturbance Footprint:** represents the maximum extent of direct impacts and the indicative location of proposed Project infrastructure (**Section 1.2.4**).

These areas are further described below and depicted in **Figure 1.2**.

1.2.1 Study Area

The Study Area refers to the boundaries of the 17 freehold land parcels which encompass the infrastructure that has been designed for the proposed wind farm, as well as the boundary of the access road corridor (inclusive of the local road reserve for Glengowan Road, Playfields Rd and McDonalds Rd and small area of one additional adjacent land parcel). The area covers approximately 16,975.8 hectares (ha) and extends approximately 25 km north-south at the longest point and 42 km east-west at the widest point (this includes approximately 30 km of access road). The Study Area represents the limit of the vegetation and habitat mapped for the Project. It should be noted however, that this boundary does not represent the spatial bounds in which all Project field surveys have been conducted (this area being larger and including areas outside of the Study Area). Lot and plans relevant to the Study Area include:

- Those relevant to the proposed wind farm:
    - 148/DS151, 2420/DT4077, 21/RN46, 30/RN72, 50/DT40144, 1933/RAG4058, 21/RN1345, 100/SP289441, 33/DT40123, 2039/RAG4056, 23/RN25, 38/DT40131, 2057/RAG4059, 24/RN34, 25/RN25, 15/RN1089 and 2345/DT4077.
- That relevant to the access road corridor:
    - 17/RAG4094.

The Study Area is within the Rockhampton Regional Council and Banana Shire Council Local Government Areas (LGA). The predominant land use in both LGAs is rural agriculture comprising mostly beef cattle grazing and farmland cropping including cotton and lucerne. Some forestry, coal mining and power generation also occur. Elevations within the Study Area ranges from approximately 120 metres (m) Australian Height Datum (AHD) to 500 m AHD, characterised by varying landforms within the Study Area that comprises peaks and valleys, with areas of lower, generally flatter topography surrounding the Study Area to the east and west.

Major highways in proximity to the Study Area include the Bruce Highway to the east, Burnett Highway to the west, and the Dawson Highway to the south. These major transport corridors link to the cities of Rockhampton and Gladstone, as well as the Port of Gladstone from which the proposed turbine components will be transported. Access to the Study Area is primarily via the Burnett Highway located to the east of the Study Area, as well as lower order roads in Banana Shire Council including McDonalds Road and Playfields Road.

1.2.2 Development Corridor

The Development Corridor is a 'buffered' version of the indicative Project layout, covering approximately 1,555.1 ha. This area represents the maximum spatial extent where disturbance may occur within the Study Area and includes areas required for temporary and permanent Project infrastructure, equipment and materials laydown, installation and access. This includes an access road corridor that is situated between the Burnett Highway at Dixalea and Glengowan Road at the southwestern extent of the Project.

The Project has not yet undergone detailed design. This will occur following a competitive tender and contract award for equipment supply and construction. The detailed design process will rely heavily on future technical assessments, including but not limited to, additional ecological field surveys. The process will give certainty to the final positioning of Project infrastructure as well as the final Disturbance Footprint. Allowing for the Disturbance Footprint to be adjusted within the Development Corridor will allow for further avoidance and management of specific on-ground constraints that are identified in future technical assessments.

1.2.3 Disturbance Footprint

The Disturbance Footprint covers approximately 883.4 ha and represents the maximum extent of clearing works and the indicative locations of Project infrastructure. It is a 'worst-case' scenario in terms of the extent of clearing works. The impact assessment on MNES values (see **Section 8.1.1** and **Appendix E** of Attachment B4) refers to clearing areas that are based on the Disturbance Footprint. As infrastructure will be micro-sited within the Development Corridor, the final clearing areas are anticipated to be lower than detailed in this assessment (described further in **Section 9.2.2** of Attachment B4).

1.3 Assessment Aim and Scope

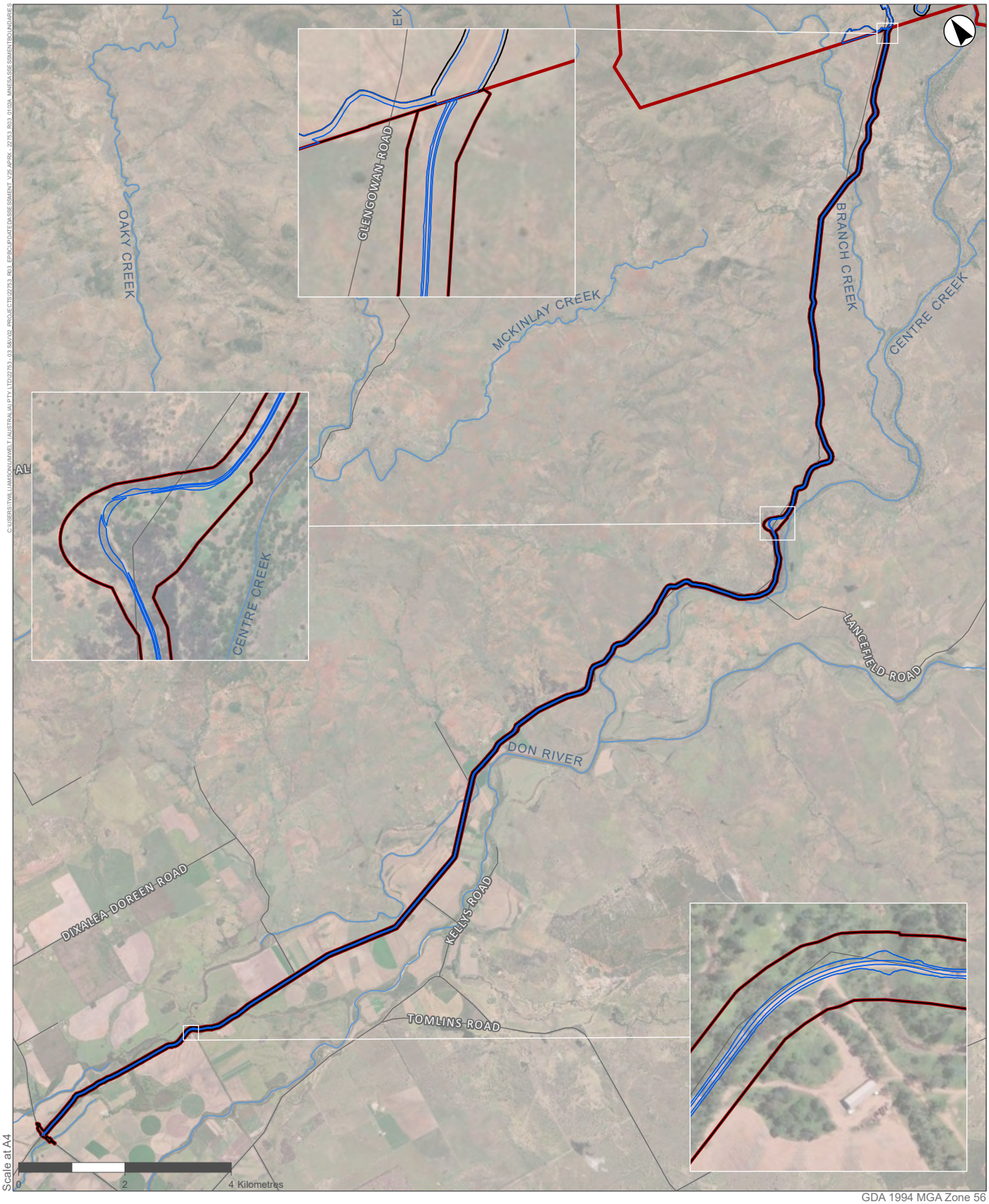
The aim of this assessment is to describe the ecological values of the Study Area protected under the EPBC Act, assess the impacts of the Project on these values, and present strategies to avoid, minimise or mitigate potential impacts.

To inform the Preliminary Documentation of the Project for assessment under the EPBC Act, this updated MNES assessment included the following tasks:

- Conduct a desktop review of available literature and previous studies in the vicinity of the Study Area, and conduct database searches for known or potentially occurring MNES.
- Undertake ecological field surveys to:
    - document condition, extent and value of vegetation communities, habitat types and other ecological values within the Study Area

- target potentially occurring threatened ecological communities (TECs), flora and fauna listed under the EPBC Act
- identify habitat resources for known and potentially occurring threatened flora, fauna and migratory species.

- Utilise field-based data in conjunction with aerial imagery and desktop data to determine the likely extent of vegetation communities, habitat types and associated MNES values across the Study Area.
- Undertake a likelihood of occurrence assessment to confirm known or potentially present MNES within the Study Area.
- Complete an impact assessment for identified or potentially occurring MNES values (as well as any additional species identified in the RFI), inclusive of recommended mitigation and management measures.
- Determine the significance of identified impacts in accordance with the Commonwealth *Matters of National Environmental Significance – Significant Impact Guidelines 1.1* (Department of the Environment 2013) and quantify the potential for any significant impacts.
- Identify potential offset requirements.



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Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Disturbance Footprint
- Development Corridor
- Study Area
- State Forest

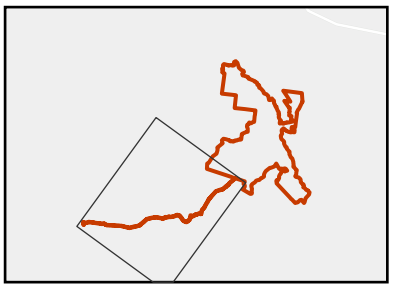
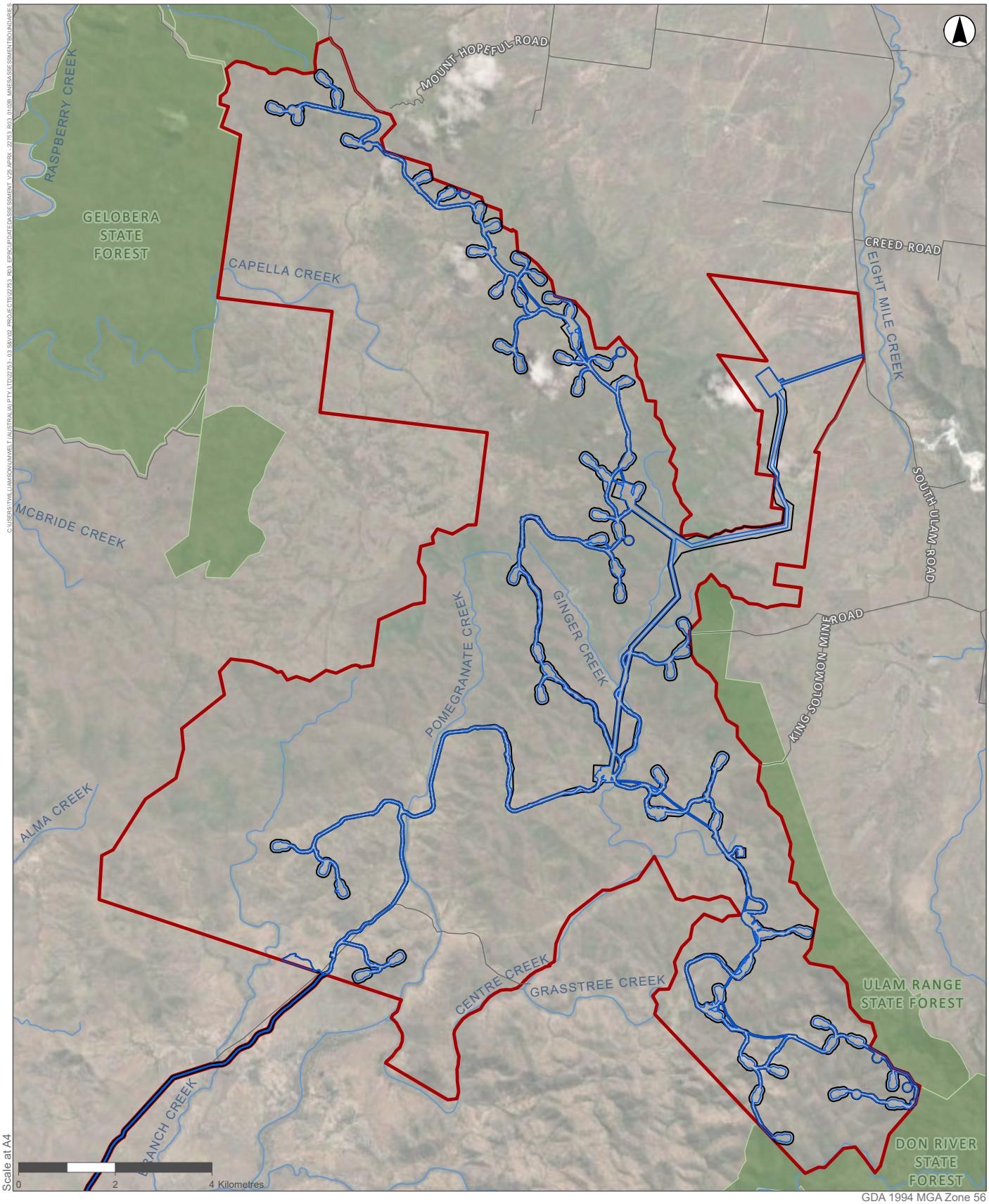


FIGURE 1.2A

MNES ASSESSMENT BOUNDARIES

Note: Data Frame is rotated

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:110,000
Scale at A4

GDA 1994 MGA Zone 56

Legend
- Roads
- Watercourse
- Disturbance Footprint
- Development Corridor
- Study Area
- State Forest

FIGURE 1.2B

MNES ASSESSMENT BOUNDARIES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

2.0 Project Description

The Project includes the construction, operation and potential decommissioning and rehabilitation of a wind farm comprising up to 63 turbines and other ancillary infrastructure, including the following:

- Up to ten permanent and ten temporary wind monitoring masts.
- Up to six substations.
- A battery energy storage system (BESS) and ancillary electrical infrastructure.
- Up to 13 km of high voltage (275 kilovolt (kV)) overhead powerlines.
- Site operational, maintenance and storage areas containing permanent site offices, workshops, warehouses, mobile offices, lunchroom, amenities and ablutions.
- Up to 175 km of gravel capped roads.
- Overhead and/or underground power and communication cables.
- Two permanent site access points.
- An access road corridor including approximately 30 km of road upgrades along McDonalds, Playfields and Glengowan Roads.
- A range of temporary infrastructure to facilitate the construction of the Project, including:
    - One construction compound.
    - A temporary worker's accommodation camp to provide for a peak construction workforce of up to approximately 450 people including a water treatment plant, sewage treatment plant and spray field.
    - Three concrete batching plants.
    - Two laydown areas.

The proposed layout of the Project including the above infrastructure components is displayed on **Figure 2.1**.

The sections below provide a succinct summary of the key Project phases, focused on activities or infrastructure components relevant to the assessment of potential impacts on MNES values. For a detailed Project description, see Section 2.0 of the Preliminary Documentation.

2.1 Construction

Construction is expected to commence in the quarter 1 of 2024 (pending approval) and will occur for approximately 22–28 months. Construction is anticipated to occur Monday to Saturday, between 6:30 am and 6:30 pm, and possibly Sundays (subject to further assessment and approval), however Contractors may adopt working rosters.

Planned construction activities include:

- Vegetation clearing at proposed locations for relevant infrastructure.
- Site establishment (temporary site facilities, lay down areas, equipment and materials).
- Earthworks for access roads and wind turbine hardstands.
- Road upgrades to facilitate the safe transportation of Project infrastructure along the access road corridor.
- Excavations for wind turbine foundations.
- Construction of wind turbine foundations.
- Installation of electrical and communications cabling and equipment.
- Installation of substations, in parallel with electrical reticulation works.
- Arrival of wind turbine components to the Study Area.
- Installation of wind turbines.
- Commissioning of wind turbines.
- Reliability testing.

The turbine specifications used for the assessment are shown in **Table 2.1**. These specifications are considered to be an upper limit and are intended to provide flexibility for any innovation in turbine design between now and the time of detailed design and construction.

Table 2.1 Turbine specifications used for assessment

Feature	Maximum Specifications
Hub height	180 m
Blade length	up to 90 m
Max upper tip height	260 m Above Ground Level (AGL)

2.1.1 Construction Materials

Other than the infrastructure components, key materials required for the construction of the Project include power and fuel, concrete batching, quarry materials and water. Further information regarding these materials is provided below:

- Water of varying quality will be required for bulk earthworks and material conditioning, dust suppression, the construction workforce and ablution facilities (potable). Potable water will be obtained from the local government water reticulation network if possible or otherwise trucked to the site. Lower quality water is likely to be sourced locally from groundwater bores, surface water or offsite. During detailed design, a water sourcing strategy will be developed so that water used during the construction phase does not interfere with adjacent landowners or other stakeholders.

- Gravel or other quarry materials will be required to establish hardstand areas, access tracks, waterway crossings, erosion and sediment controls and possibly foundations. Where available these materials will be sourced from local registered quarries and / or local landowners.
- Concrete batching plant/s will likely be required to construct foundations and other infrastructure. Concrete materials will be sourced off-site.
- Generators will be required to power site offices and the switching station during construction. Either diesel or unleaded petrol will be required for generators, machinery and vehicles. Fuel storage and refuelling activities will occur only in a controlled and designated location.

2.2 Operation and Maintenance

Following the construction and commissioning of the wind farm, the amount of activity within the Study Area will decrease substantially. Many Project components are designed to be monitored and controlled remotely. As such, management of the Project will involve both on-site and off-site personnel. Offsite personnel are likely to be responsible for energy market coordination, performance and compliance monitoring, wind farm reporting and remote resets. Onsite personnel will be responsible for wind turbine and associated infrastructure maintenance, safety and environmental management and landowner liaison.

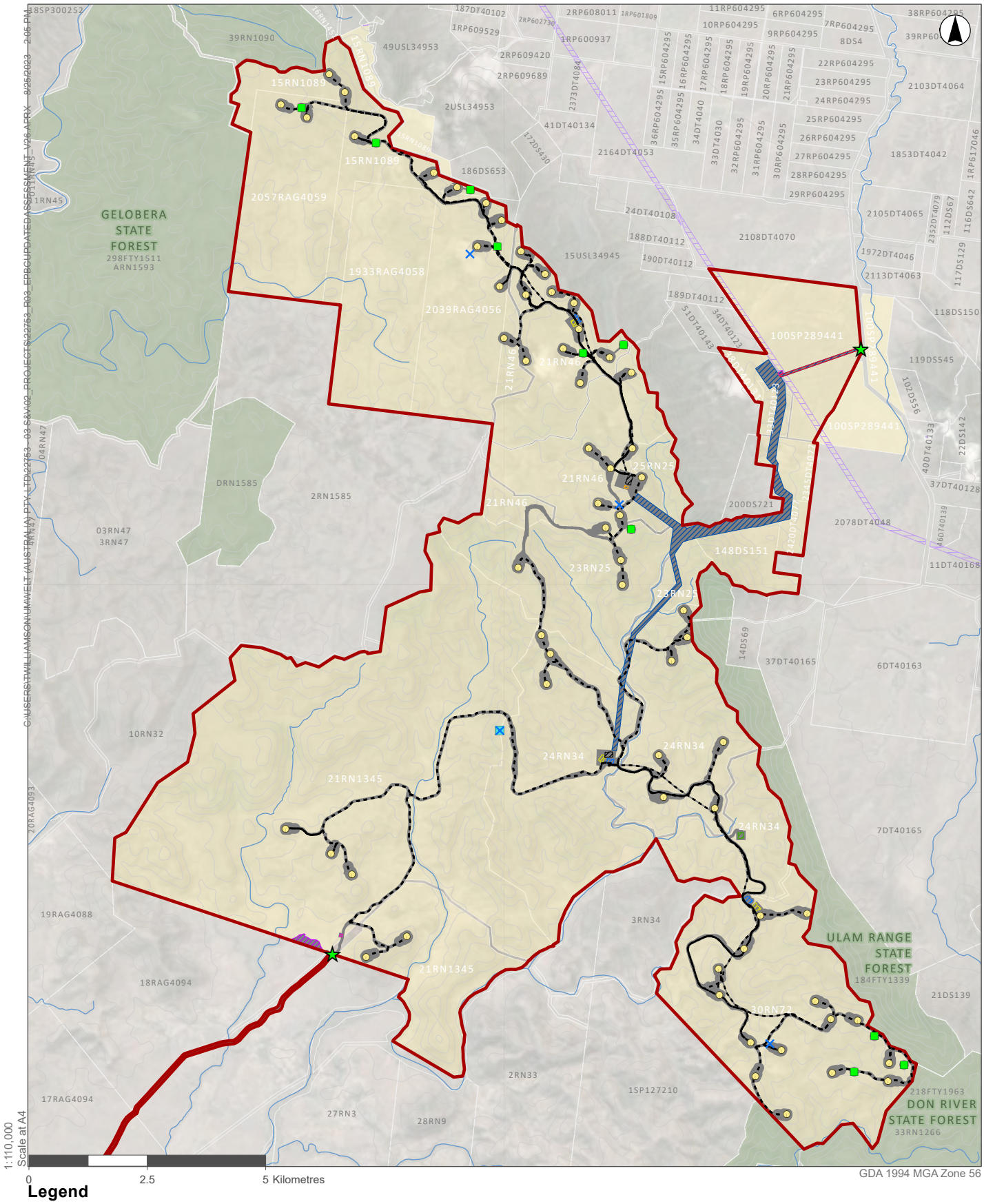
The manufacturer of the Project's final selected turbine model will be responsible for the routine maintenance of the wind turbines for a defined period following commissioning. Additional unscheduled inspections at any Project location may also be required as a result of equipment failure, damage, modifications and upgrades.

Traffic associated with the access road corridor will fluctuate during the operation and maintenance phase of the Project. Following the construction and commissioning of the wind farm, road traffic will largely be limited to on-site activities outlined above.

2.3 Decommissioning and Rehabilitation

If repowering the wind farm is not considered to be a viable option, then the Project will be decommissioned in accordance with best practice and/or in compliance with any planning conditions. Current best practice includes the removal of all above ground structures; the removal of all underground structures to at least 1 metre (m) below ground level with structures beneath this level to remain in-situ. This approach is considered less environmentally damaging than the complete removal of all above and below ground structures from the site. Areas of disturbed land will be reinstated to the original condition prior to the construction of the Project or to the condition just prior to the commencement of the decommissioning activities. Landowners will be given the option to retain the access tracks for their own purposes.

A Preliminary Decommissioning Management Plan has been prepared and will be finalised by the wind farm operator and agreed with the relevant authorities prior to any decommissioning taking account of new legislation, guidance and best practice.



Legend

- Existing Met Mast
- Contours
- Property Boundaries
- Study Area
- Easements
- Participating Properties
- Development Corridor

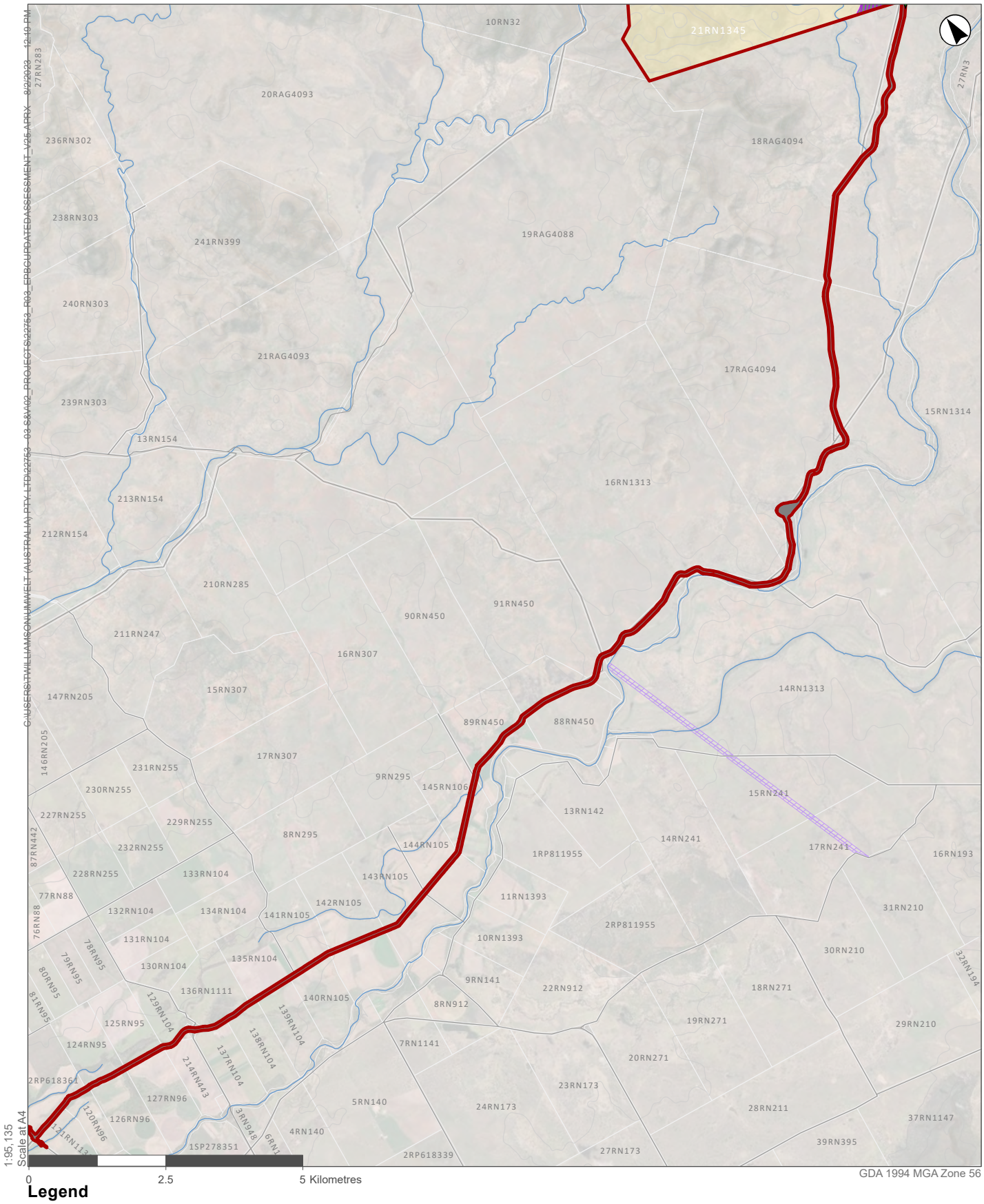
Proposed Project Infrastructure

- Permanent MET Masts
- Temporary Met Masts
- Turbines
- Site Access
- Access and Overhead / Underground Cabling
- Grid Connection Easement
- Access
- Compound
- Concrete Batching Plant
- Temporary Accomodation Camp
- Laydown
- Operation and Maintenance Area
- Site Entry
- Substation
- Transmission Infrastructure

FIGURE 2.1A

PROJECT LAYOUT

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)
NB: Layout is Indicative Only



Legend

- Existing Met Mast
- Contours
- Property Boundaries
- Study Area
- Easements
- Participating Properties
- Development Corridor

Proposed Project Infrastructure

- Permanent MET Masts
- Temporary Met Masts
- Turbines
- Site Access
- Access and Overhead / Underground Cabling
- Grid Connection Easement
- Access
- Compound
- Concrete Batching Plant
- Temporary Accomodation Camp
- Laydown
- Operation and Maintenance Area
- Site Entry
- Substation
- Transmission Infrastructure

FIGURE 2.1B

PROJECT LAYOUT

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)
NB: Layout is Indicative Only

3.0 Legislative Context

3.1 Commonwealth Legislation

3.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act is administered by the DCCEEW. Under the EPBC Act, if the Minister for the Environment determines that an action is a 'controlled action' which would have or is likely to have a significant impact on MNES or Commonwealth land, then the action may not be undertaken without prior approval from the Minster. The EPBC Act identifies nine MNES:

- World Heritage properties.
- National Heritage places.
- Ramsar Wetlands of International Significance.
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mining).
- Water resources (in relation to coal seam gas development and large coal mining development).

On 7 March 2022 the delegate for the Minister for the Environment determined that the Project was a controlled action requiring assessment and approval under the EPBC Act before it can proceed.
This determination was due to the following controlling provisions:

- **Listed threatened species and communities (sections 18 and 18a).**
- **Listed migratory species (sections 20 and 20A).**

This updated MNES assessment will supplement the requirements of the overarching Preliminary Documentation of the Project.

3.1.1.1 Matters of National Environmental Significance – Significant Impact Guidelines 1.1

The *Matters of National Environmental Significance – Significant Impact Guidelines 1.1* (Department of the Environment 2013) provide overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under the EPBC Act.

Following referral of the Project, an RFI was issued and indicated further consideration of potential significant impacts was required. In response to the RFI, this updated MNES report describes and assesses all relevant potential impacts, both direct and indirect, of the Project on relevant listed threatened species, communities and migratory species in accordance with this guideline. It also describes how avoidance, mitigation and management measures will be implemented to reduce impacts on such MNES.

3.1.2 EPBC Act Environmental Offsets Policy

The EPBC Act Environmental Offsets Policy (EPBC Offset Policy) (Department of Sustainability Environment Water Populations and Communities 2012) outlines the approach for the use of environmental offsets under the EPBC Act.

Offsets are measures that compensate for the residual significant impacts of an action on the environment, after avoidance and mitigation measures are taken. Where appropriate, offsets are considered during the assessment phase of an environmental impact assessment under the EPBC Act. The suitability of a proposed offset is considered as part of the decision to approve or not approve a Project under the EPBC Act. The EPBC Offset Policy provides guidance on how suitable offsets are determined.

The potential requirement for Commonwealth offsets as a result of residual impacts on MNES is discussed in **Section 10.0** of Attachment B4.

3.1.3 Weeds of National Significance

Under the *Australian Weeds Strategy 2017–2027* (Invasive Plants and Animals Committee 2016), 32 introduced plants are identified as Weeds of National Significance (WoNS). This list of species was developed with reference to several key criteria: invasive tendencies; impacts; potential for spread; and socioeconomic and environmental values. National management strategies and manuals have been published for all of these species. The strategies aim to:

- Prevent spread and new infestations.
- Reduce adverse impacts of existing infestations.
- Establish and maintain national commitment.
- Coordinate management at a national level.
- Increase community awareness.

WoNS that occur within the Study Area are detailed in **Section 6.3.5**. Several WoNS are recognised threats to MNES and their associated habitat. Potential impacts on MNES associated with weeds including WoNS is discussed in **Section 8.1.2.1** and **Appendix E** of Attachment B4.

4.0 Methodology

4.1 Desktop Assessment

A review of available ecological data and literature was first undertaken in 2019 to characterise the ecological values and identify the potential presence of threatened species and communities as well as migratory species within the Study Area. The objectives of this desktop assessment included:

- Review of relevant biodiversity databases, government publications and published literature relevant to the Study Area.
- Assessment of the broad conservation values of vegetation communities and habitat present in the Study Area.
- Identification of the potential presence of conservation significant species and habitat in the Study Area.

The desktop assessment inputs, and findings have been revisited throughout the course of the Project to ensure the latest information is considered in the assessment. In April 2023, this included developing a new Protected Matters Search Tool report for the Study Area and reviewing the record databases.

4.1.1 Data Sources

The desktop assessment considered data from the following resources:

- DCCEEW (2023) EPBC Protected Matters Search Tool (PMST) database.
- DCCEEW (2023b) Species Profile and Threats (SPRAT) database.
- Department of Environment and Science (DES) (2021a) Wildlife Online database.
- DES (2021b) WetlandInfo Wetland Summary Information.
- DES (2022b) Protected Plants Flora Survey Trigger Map.
- Department of Resources (DoR) (2022a) Regulated Vegetation Management Map.
- DoR (2022a)Vegetation Management Supporting Map, including Essential Habitat mapping.
- DoR (2022b) Reservoirs Map.
- DoR (2014) Queensland resources web map service.
- Queensland Herbarium (2023) Regional Ecosystem Description Database (REDD).
- Atlas of Living Australia (ALA) (2023) records database.
- Available published and unpublished reports concerning the ecology of the Study Area, including:
    - *Terrestrial Flora Assessment* (Umwelt, 2021a).
    - *Terrestrial Fauna Assessment* (Umwelt, 2021b).
    - *Bird and Bat Utilisation Assessment* (Appendix A of the Preliminary Bird and Bat Adaptive Management Plan (Attachment G of the Preliminary Documentation)).

Database searches undertaken by Umwelt designated the search area as a 10 km buffer applied to the Study Area boundary.

4.2 Field Survey Program

The data presented herein has been collected within the Study Area and neighbouring land parcels across 17 field surveys from July 2019 to July 2023 (**Table 4.1**). Due to the remoteness of the Study Area and the absence of a local weather station, field survey weather conditions have been extracted from the DES SILO weather model (Queensland Government 2023) using coordinates central to the Study Area (-23.85, 150.55). Variation in weather data results reflect the seasonality of field surveys.

Table 4.1 Field Surveys Undertaken for the Project

Field Survey	Survey Dates	Survey Length (Days)	Rainfall (mm)	Temperature (°C)	
				Min	Max
Initial Site Scoping (Flora and Fauna)	9–12 July 2019	4	0.7	6.0	24.4
Flora Survey^	6–12 August 2019	7	0	1.6	26.7
Bird and Bat Utilisation Survey	25 February–5 March 2020	10	57.1	19.5	31.8
Fauna Survey	14–23 May 2020	10	18.1	9.3	25.1
Flora Survey^	1–8 June 2020	8	0	3.9	24.3
Bird and Bat Utilisation Survey	3– 11 November 2020	9	0.6	14.7	32.4
Fauna Survey	3–13 November 2020	11	0.6	14.7	32.4
Flora Survey^	7–11 November 2020	5	0.0	14.7	28.6
Flora Survey^	20–24 January 2021	4	0.6	18.3	32.5
Fauna Survey	30 September–6 October 2021	7	23.5	10.2	32.4
Bird and Bat Utilisation Survey	8–15 October 2021	8	1.8	14.5	31.3
Bird and Bat Utilisation Survey	14–21 February 2022	8	6.1	18.9	32.9
BioCondition and Habitat Quality Assessment	24–28 October 2022	5	37.4	17.1	33.7
Targeted *Cycas megacarpa* Population Survey	24–28 October 2022	5	37.4	17.1	33.7
Flora and Fauna Survey	15–16 February 2023	2	2.7	21	30.8
BioCondition and Habitat Quality Assessment	5–10 June 2023	6	3.2	12.2	27.5
BioCondition and Habitat Quality Assessment	26 June–2 July 2023	7	0	5.7	31.2

^ *Opportunistic fauna surveys also undertaken.*

The methods employed during the above field surveys are discussed in **Section 4.2.1** and **Section 4.2.2**.

4.2.1 Terrestrial Flora

4.2.1.1 Vegetation Communities

Vegetation was classified and mapped in accordance with the *Methodology for surveying and mapping regional ecosystems and vegetation communities in Qld, Version 5.1* (Neldner *et al.* 2020). Quaternary level surveys were undertaken at 448 sites to describe dominant species and characterise vegetation structure. Dominant species and percentage cover for each vegetation layer was recorded and any exotic species were noted. Detailed vegetation data was also recorded from seven secondary level survey sites, which involved the collection of data within a 50 m x 10 m plot. Locations of quaternary and secondary survey sites are depicted in **Figure 4.1**.

Using land zone information and dominant species data, each vegetation community was classified to a specific Regional Ecosystem (RE) in accordance with the Queensland Herbarium REDD. The spatial extent of vegetation was identified in the field and satellite imagery was also consulted to confirm vegetation boundaries for larger polygons.

4.2.1.2 Threatened Ecological Communities

The field validation of TECs identified as potentially occurring in the desktop assessment was undertaken via a two-step process. The first step involved the identification of analogous REs. Where an analogous REs was located, the vegetation composition and structure were evaluated against TEC condition thresholds and key diagnostic characteristics to determine if the community meets the TEC requirements. Condition thresholds and key diagnostic criteria used in the assessment reflect those detailed in the TECs' respective Conservation or Listing Advice.

4.2.1.3 Threatened Flora

Searches for threatened flora species identified as potentially occurring in the desktop assessment were completed throughout all field surveys in areas of suitable habitat. Searches generally comprised opportunistic and random walking meanders. Threatened species targeted included:

- *Cycas megacarpa.*
- *Cossinia australiana.*
- *Decaspermum struckoilicum.*
- *Samadera bidwillii.*

If a threatened flora species was found during these searches a number of details were recorded including the location, population size and spatial extent, habit and aspect. Photographs were taken and if deemed necessary, voucher samples for submission to the Queensland Herbarium were also collected.

Specimens of any plant taxa that could not be identified in the field were collected, pressed and dried in accordance with the requirements of the Queensland Herbarium (Queensland Herbarium & Bean 2016). Dried specimens were then identified through reference books and keys and through comparison with named species.

As the presence of *Cycas megacarpa* was determined early in the field survey program, a specific methodology was adopted. Further detail on the targeted survey approach for *Cycas megacarpa* is outlined below.

Targeted *Cycas megacarpa* Surveys

Targeted and opportunistc searches for *Cycas megacarpa*, listed as Endangered under the EPBC Act, were undertaken throughout the survey program to assess the extent of its occurrence and relative densities within the Study Area. In October 2022, a targeted *Cycas megacarpa* field survey was conducted across the Development Corridor to increase the understanding of presence and abundance in this area. Approximately 4,138.6 ha within the Study Area was surveyed, including part of targeted surveys. Within the Development Corridor, approximately 1,069.6 ha was surveyed which equates to 68.3% of the area.

All surveys employed one of the following survey methods to record the present of *Cycas megacarpa*:

- Individual point counts (single individuals recorded with a GPS unit).
- Visual point density estimate within a 0.25 ha area, or direct density assessment within a 0.25 ha plot (50 x 50 m, center point marked with a GPS and all individuals recorded). Each plot was assigned one of five density categories:
    - Scattered: 1–2 individuals.
    - Low: 3–10 individuals.
    - Moderate: 11–25 individuals.
    - High: 26–40 individuals.
    - Very high: >40 individuals.

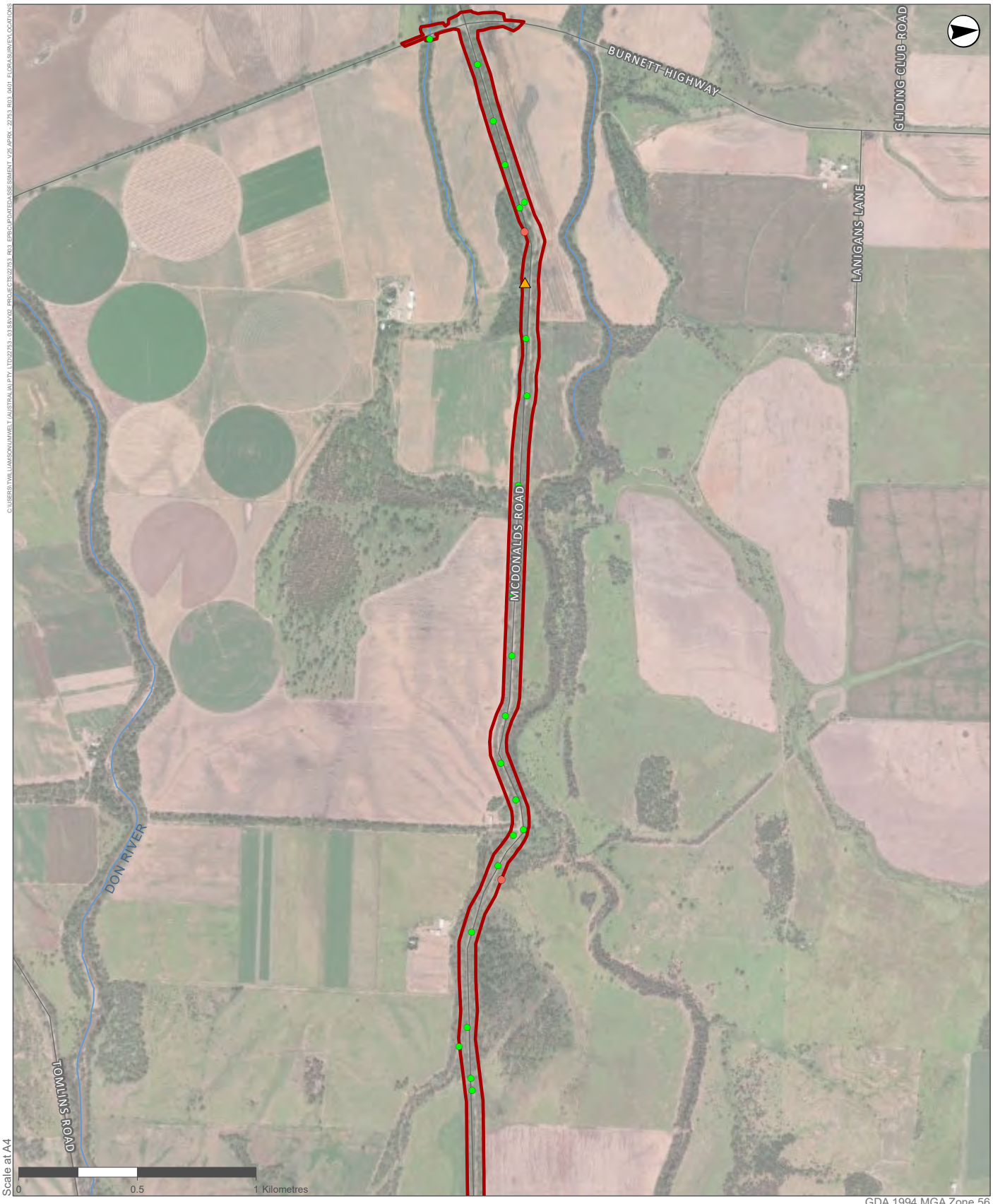
For all surveys the age class structure (e.g., development class) was recorded for each individual using the following classification:

- Juvenile (<50 cm).
- Sub-adult (0.5–1 m).
- Adult (>1–5 m).
- Large adult (>5 m).

Using this approach, estimations of population size and impacts to individuals were able to be determined..

4.2.1.4 Nomenclature

Taxonomic nomenclature used for the description of floral species is according to Census of the Queensland Flora (Brown & Bostock 2019). Exotic flora and fauna species are signified in text by an asterisk (*).



1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Field Survey Locations

- Quaternary Sites
- Secondary Sites
- Biocondition Sites

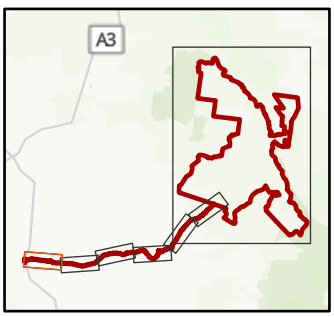


FIGURE 4.1A

FLORA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Field Survey Locations

- Quaternary Sites
- Secondary Sites
- Biocondition Sites

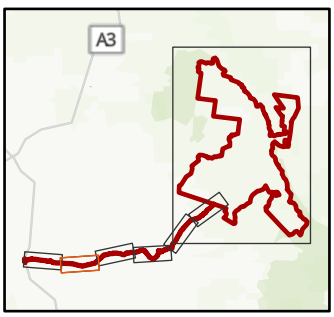


FIGURE 4.1B

FLORA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Field Survey Locations

- Quaternary Sites
- Secondary Sites
- Biocondition Sites

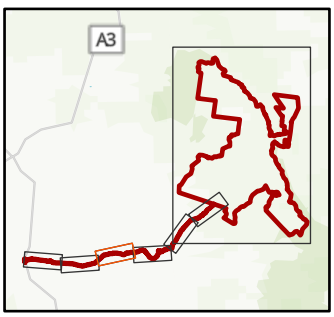
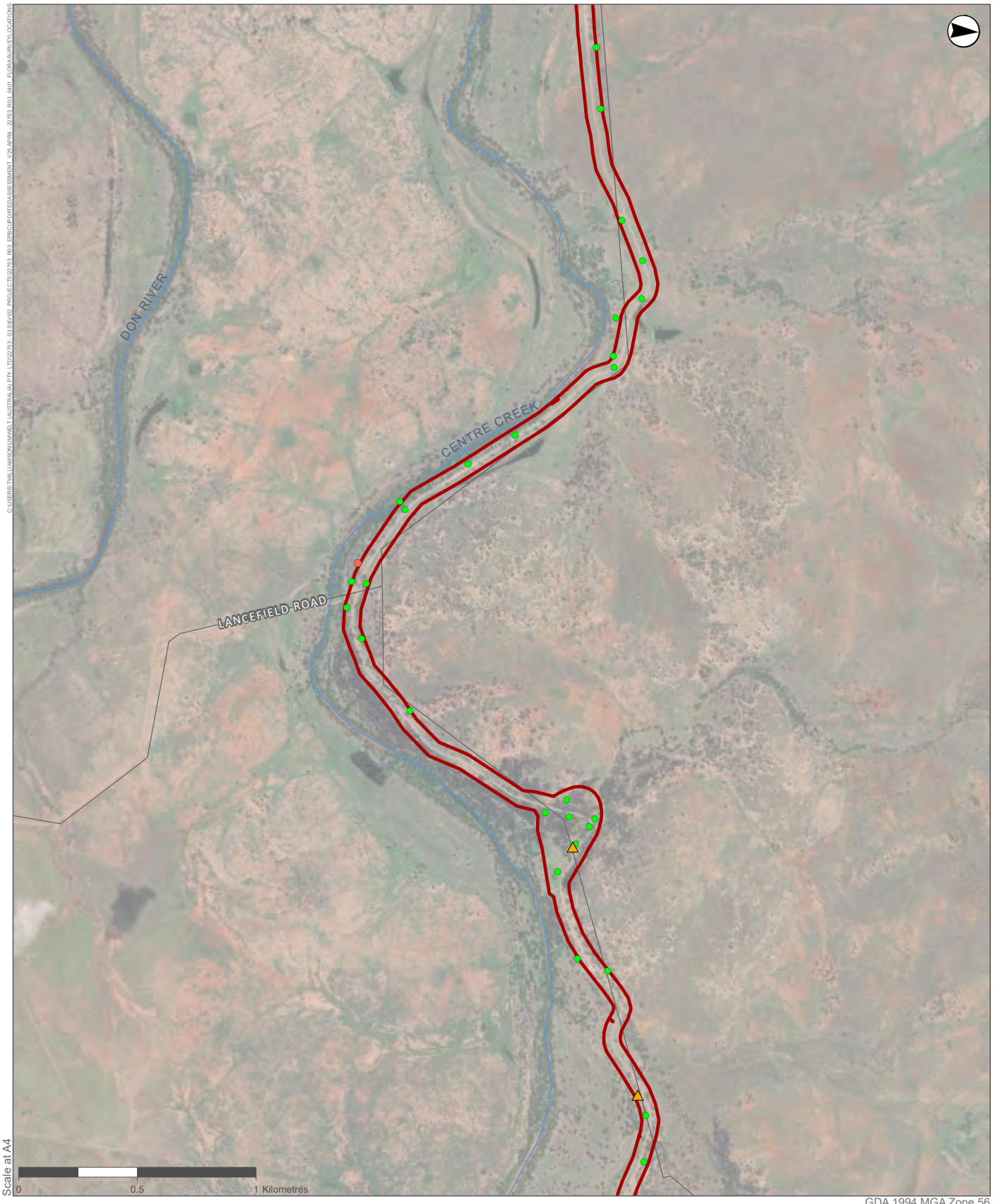


FIGURE 4.1C

FLORA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Field Survey Locations

- Quaternary Sites
- Secondary Sites
- Biocondition Sites

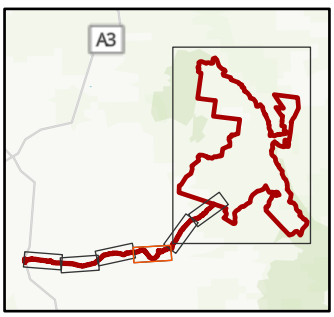


FIGURE 4.1D

FLORA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Field Survey Locations

- Quaternary Sites
- Secondary Sites
- Biocondition Sites

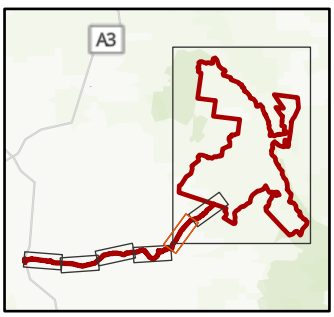
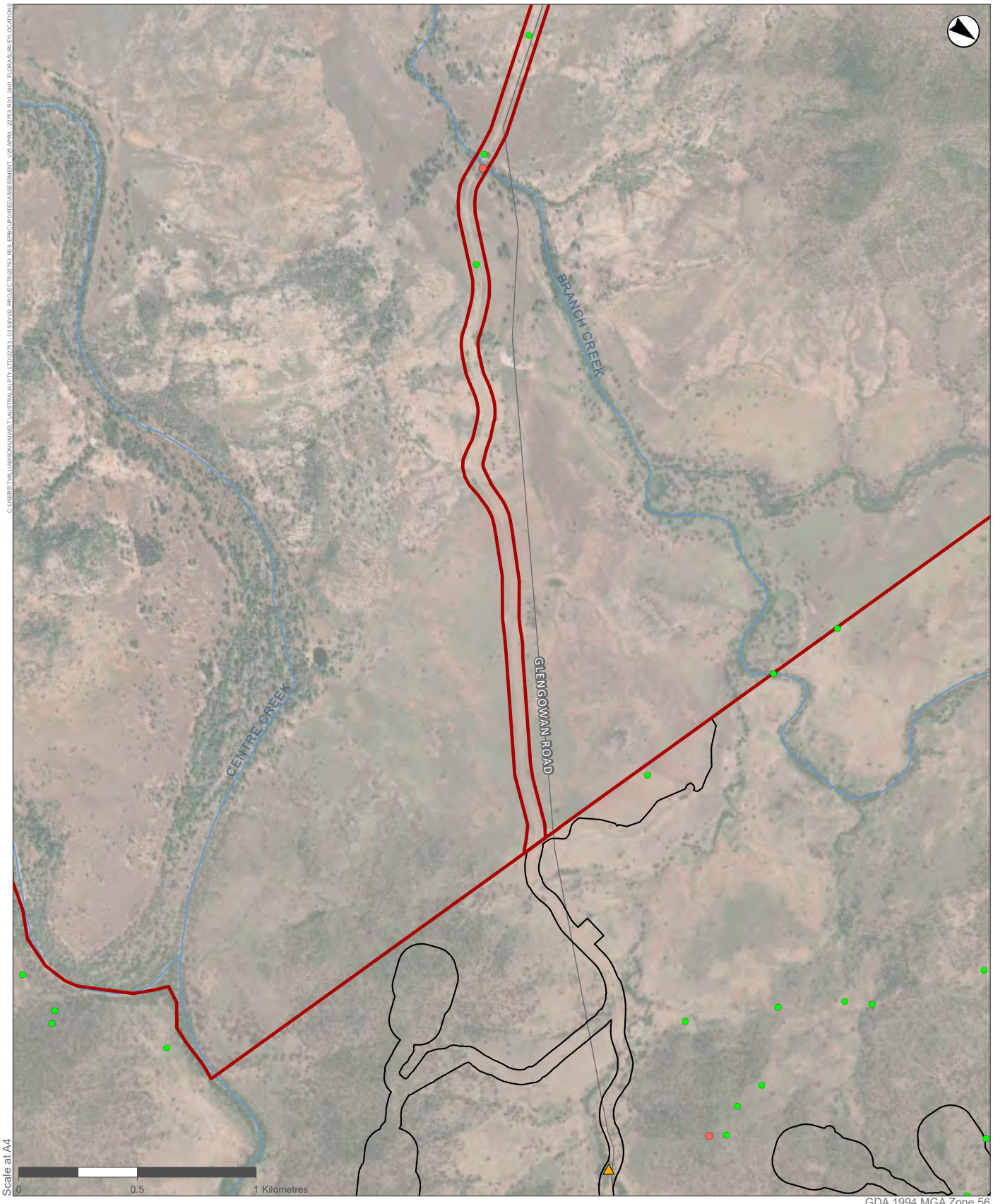


FIGURE 4.1E

FLORA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Field Survey Locations

- Quaternary Sites
- Secondary Sites
- Biocondition Sites

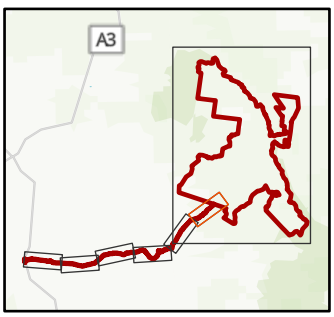
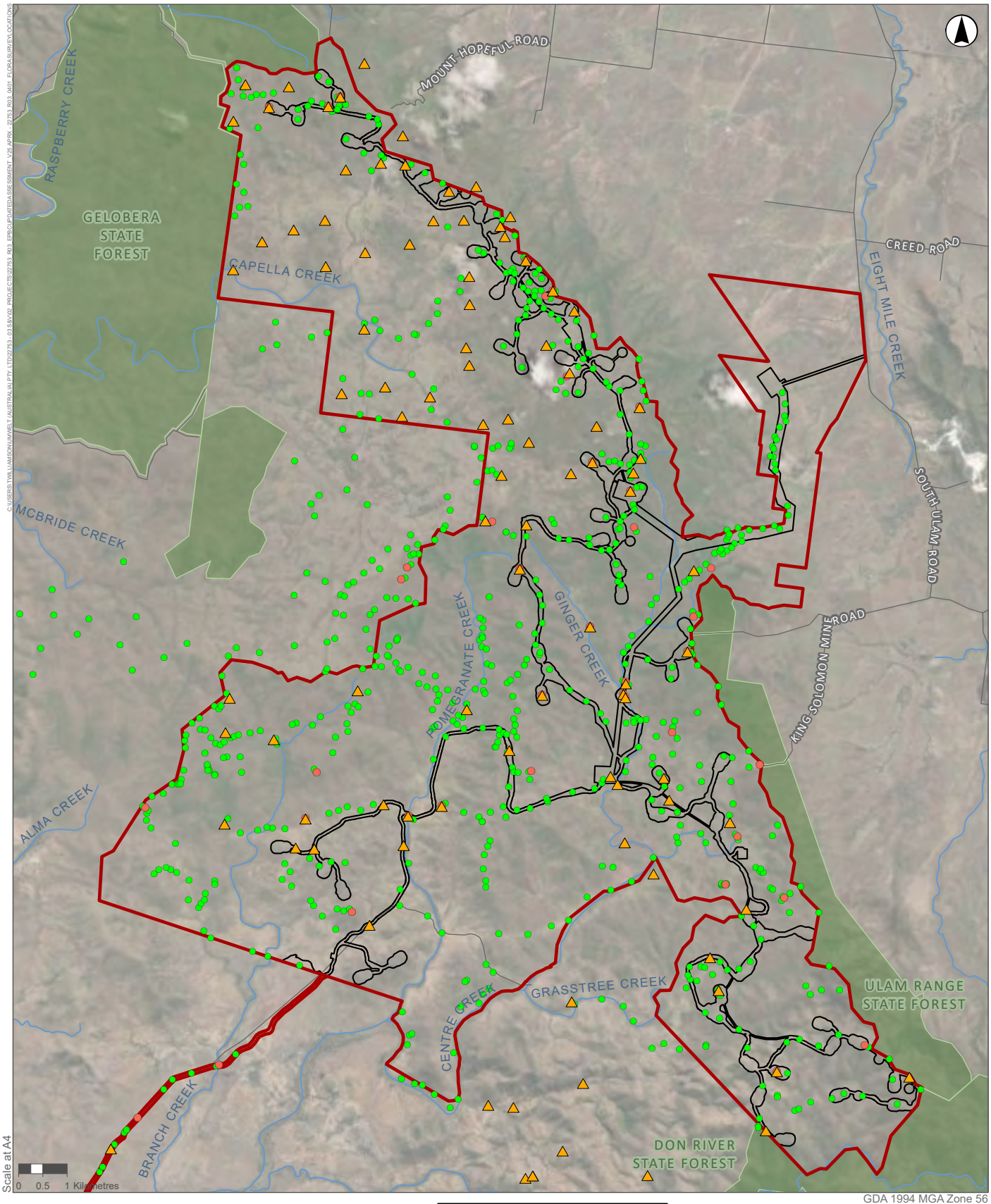


FIGURE 4.1F

FLORA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:110,000
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Field Survey Locations

- Quaternary Sites
- Secondary Sites
- Biocondition Sites

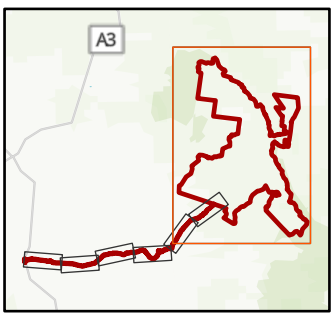


FIGURE 4.1G

FLORA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

4.2.2 Terrestrial Fauna

Fauna surveys were conducted within representative locations of all fauna habitat types. The adopted methodology followed recommendations outlined in Queensland survey guidelines, *Terrestrial Fauna Survey Guidelines for Queensland, Version 3* (Eyre *et al.* 2018). Specific methods employed are detailed in **Table 4.2** below.

Due to the location of the Study Area, terrain difficulties, ethical requirements and remote access, intensive trapping methodologies were limited to a few locations and remote sampling techniques were instead adopted, including the use of cameras and acoustic monitoring devices.

Survey effort outlined in **Table 4.2** covers the full field survey program which was conducted across an area larger than the Study Area, including areas directly adjacent as well as land parcels to the west. Fauna survey locations are displayed on **Figure 4.2**.

Table 4.2 Fauna Survey Techniques

Technique	Description	Survey Effort
Bird Survey (General)	Roaming/meandering bird surveys using both visual and auditory identification was conducted within all habitat types. Active birding was also completed at farm dams and watercourses where accessible.	115 person-hours
Bird Survey (Vantage Point)	High points within the landscape with clear vantage of proposed turbines and adjacent valleys were surveyed for birds. All birds heard and observed were recorded along with flight heights and behaviours. Vantage point surveys were undertaken to characterise bird assemblages within the Study Area. The presence of threatened and migratory bird species was a key focus, including the white-throated needletail, fork-tailed swift, red goshawk and squatter pigeon (southern). Further information regarding the methodology employed during these surveys is provided in **Section 4.2.2.1** below.	225 person-hours
Spotlighting and Call Playback	Spotlighting was undertaken on foot targeting grey-headed flying fox, ghost bat, greater and koala habitat, including areas of vine thicket and eucalypt woodland. Spotlighting was also undertaken from the passenger window of a slow-moving vehicle. Call playback surveys were also undertaken targeting nocturnal bird species as well as koala within eucalypt woodland on hills and slopes.	62 person-hours 6 hours
Elliott Trapping	Type A aluminium Elliot traps targeting small mammals and reptiles were placed at approximately 10 m intervals along two transects. Traps were baited with a mixture of rolled oats, peanut butter, honey and vanilla essence, and checked each morning to identify and release captured fauna.	320 trap nights
Pitfall Trapping	Pitfall trapping was undertaken using 20 litre (L) buckets dug into the ground until the top of the bucket was flush with the surface of the ground. Three buckets were used at each site separated by approximately 10 m. A drift fence, approximately 30 cm high, was erected between each bucket to direct small animals towards the pitfall traps.	27 trap nights

Technique	Description	Survey Effort
Active Searches	Active diurnal searches were conducted within all habitat types to identify the present of fauna or signs of fauna activity including scats and scratches. Searches included scanning the trees and ground, searching beneath microhabitat such as rocks, fallen timber and peeling bark, digging through leaf litter and soil at tree bases and flushing birds from areas with a dense or grassy ground cover. Grass tussocks were gently disturbed to potentially flush ground-dwelling birds such as the threatened squatter pigeon (southern). Disturbance to microhabitat features and reptiles was kept to a minimum. Active searches were also completed opportunistically at Habitat Assessment and SAT sites.	58 person-hours
Camera Trapping	Camera traps were deployed in strategic positions including fauna corridors and watering points such as dams and creek lines to record visitation by nocturnal and diurnal animals. Camera traps comprised baited set-ups using honey oat mix and/or sardines as an attractant.	490 trap nights
Acoustic Bat Call Detection	Anabat Swift devices were deployed in representative microbat foraging and dispersal habitat including natural flyways, along watercourses and at BBUS vantage locations to record the presence of microbats. Data recorded on the bat recorders were analysed by a qualified specialist, Greg Ford of Balance! Environmental. The format and content of the analysis summary reports comply with nationally accepted standards for the interpretation and reporting of Anabat data. Anabat Swift devices were used in surveying for ghost bat.	111 nights
Harp Trapping	Single and double-bank harp traps were positioned in natural flyways associated with a creek line in locations of eucalypt woodlands to target microbat species. This method was used to target various microbat species including ghost bat.	14 trap nights
Koala SAT	Targeted searches for koala presence through identification of scats and scratched within all accessible broad habitat types (Phillips & Callaghan 2011).	20 sites
Fauna Habitat Assessment	Fauna habitat values were characterised using a comprehensive habitat assessment methodology within all accessible broad habitat types capturing variation in condition, vegetation types and disturbances. The presence and abundance of specific habitat resources was also assessed, including but not limited to: • Koala food and shelter trees. • Hollow bearing trees and stags. • Fallen logs, woody debris and leaf litter. • Rocky features such as surface rocks, boulders, crevices, overhangs and caves. • Proximity to water. These assessments were used to inform habitat modelling for each of the potentially occurring or known MNES.	269 sites
Incidental Observations	All fauna observed incidentally throughout the Study Area were recorded, including while traveling to and between vantage point sites. For each record the following were noted; species, location of the observation recorded, abundance, flight behaviour, flight height and flight direction.	Throughout all survey periods

4.2.2.1 Bird and Bat Utilisation Surveys

Umwelt ecologists conducted an extensive bird and bat utilisation survey (BBUS) program for the Project. Bird utilisation surveys were initially conducted in 2019 during winter (9 to 12 July 2019 and 7 to 12 August 2019) to establish vantage point locations and begin collecting a baseline avifaunal data set. A total of 16 vantage survey points were selected on the ridgelines and peaks of the Study Area based on the degree of visibility of surrounding areas (**Figure 4.3**).

Following initial surveys in 2019, four replicate surveys were conducted to capture seasonal variation in birds present within the Study Area. These surveys were conducted during the following periods:

- Autumn 2020 (23 February to 5 March 2020).
- Late spring 2020 (5 to 12 November 2020).
- Spring 2021 (8 to 15 October 2021).
- Summer 2022 (14 to 21 February 2022).

The timing of these surveys coincided with the seasonal migration of EPBC Act listed birds, including white-throated needletail (*Hirundapus caudacutus*) and fork-tailed swift (*Apus pacificus*).

During each survey event generally 13 of the 16 vantage points were selected for sampling. Each vantage point was surveyed for one hour during three sampling windows per day:

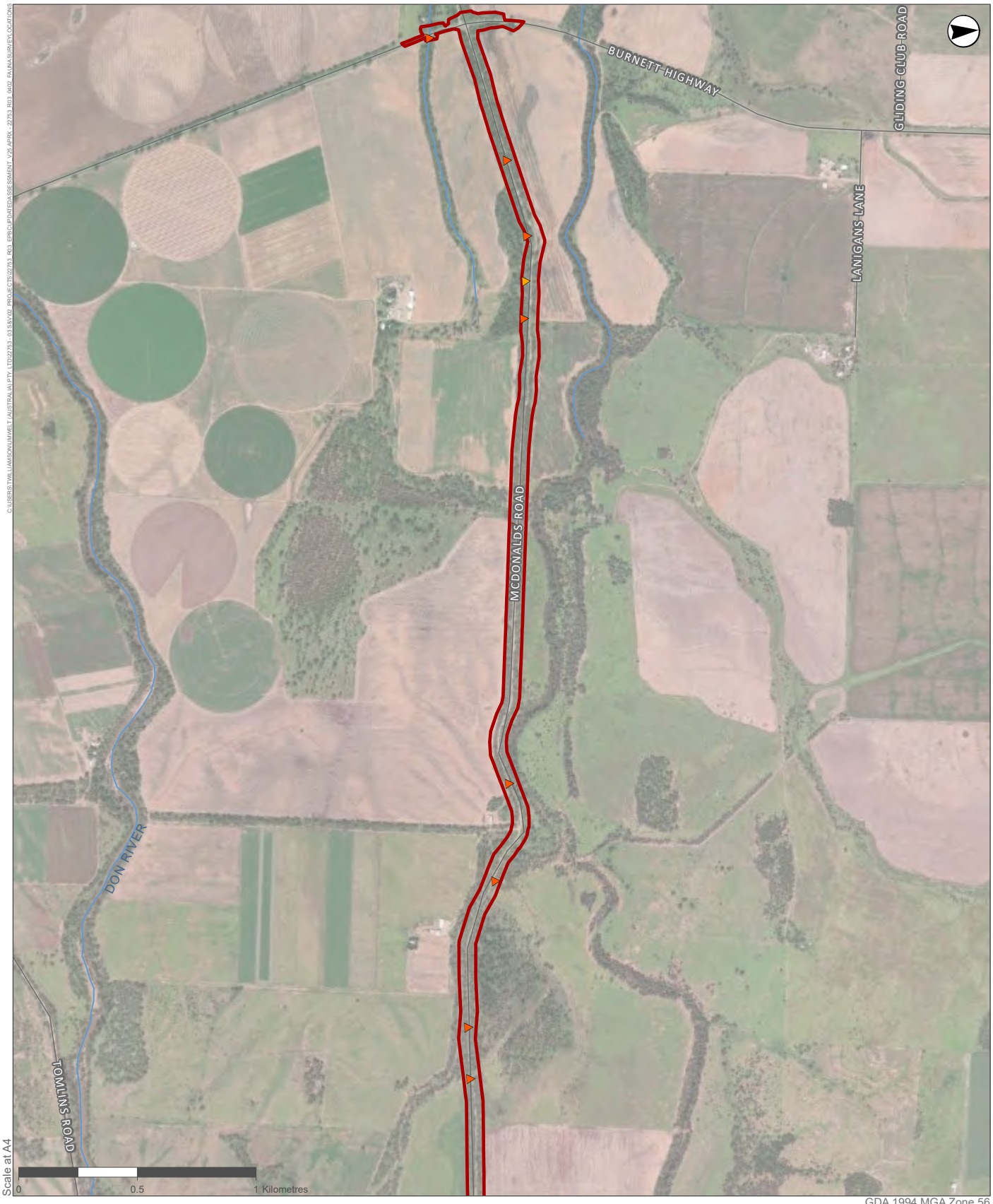
- Morning (between 6.00 am and 10.00 am).
- Midday (between 10.00 am and 2.00 pm).
- Afternoon (between 2.00 pm and 6.00 pm).

Vantage points were surveyed twice during each sampling window such that individual surveys were undertaken on six occasions at each vantage point. At each vantage point, a single observer recorded the following information for each observation:

- Species and abundance.
- Observation type (visual or aural).
- Distance and direction from the observer (to the nearest 10 m and 10° respectively).
- Approximate height AGL of the observed bird/s (to the nearest 10 m).
- Direction of flight (to the nearest 10°).
- Flight pattern (i.e. not flying, local movement, directional flight, circling, swooping, varied, other).
- Behaviour (i.e. flight, foraging, perching, mating, aggressive interactions, hollow inspection, nesting, on station).

Bat utilisation surveys were undertaken in July 2019 (winter), February to March 2020 (autumn), November 2020 (spring), October 2021 (spring) and February 2022 (summer). Microbat (microchiropteran) echolocation calls were sampled using Anabat Swift recording devices at each vantage point location. Devices were placed approximately 2 m AGL facing a cleared area or flyway and left for between two to five nights. In addition, two Anabat Swift devices were deployed on the meteorological mast at approximately 50 m AGL, for a combined total of three nights.

The likelihood that bat species detected in the Study Area fly at-risk (i.e. at RSA height) was inferred based on calls detected from the elevated Anabat Swift device and on literature relevant to the flight behaviour of recorded species.



Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Fauna Survey Locations

- Fauna Habitat Assessment (9)
- Spotlighting Sights

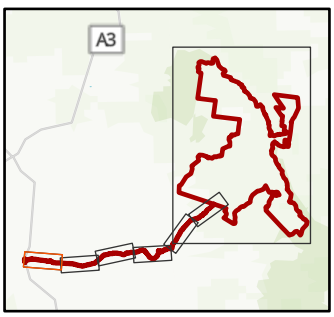


FIGURE 4.2A

FAUNA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Fauna Survey Locations

- Fauna Habitat Assessment (6)
- Spotlighting Sights

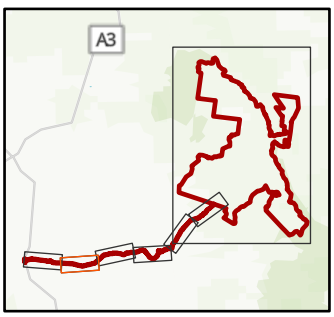


FIGURE 4.2B

FAUNA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Fauna Survey Locations

- Fauna Habitat Assessment (6)
- Spotlighting Sights

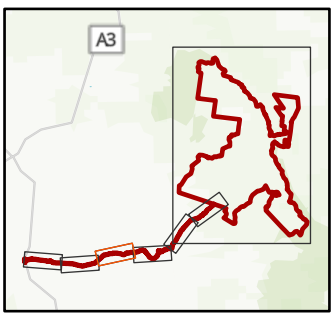


FIGURE 4.2C

FAUNA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Fauna Survey Locations

- Fauna Habitat Assessment (14)
- Spotlighting Sights

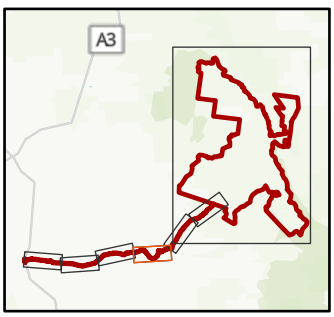


FIGURE 4.2D

FAUNA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Fauna Survey Locations

- Fauna Habitat Assessment (8)
- Spotlighting Sights

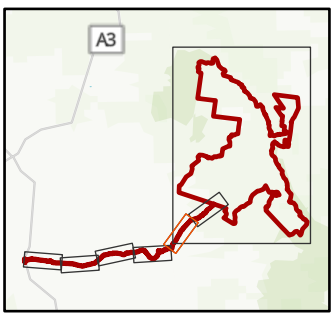
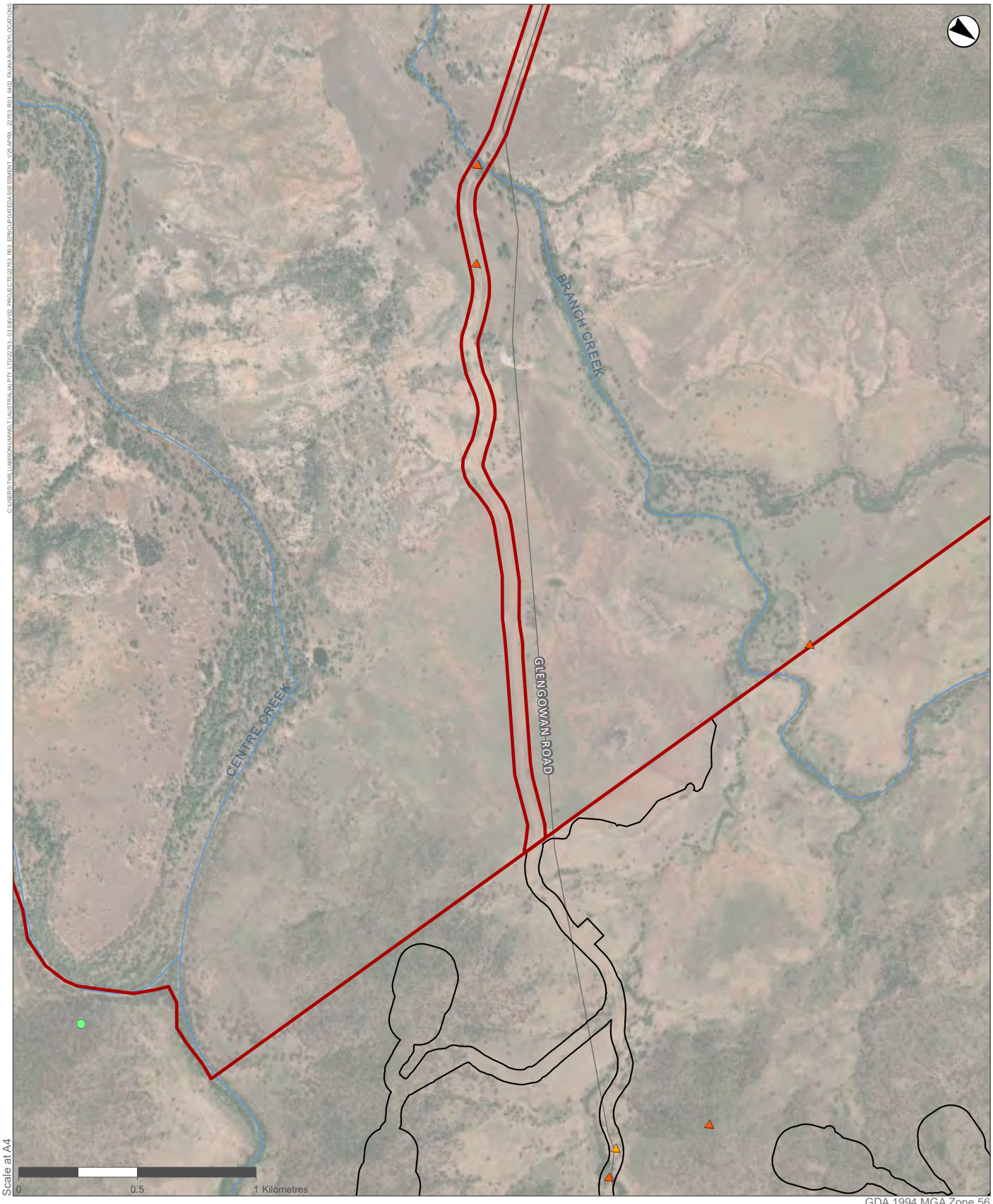


FIGURE 4.2E

FAUNA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Fauna Survey Locations

- Koala SAT (1)
- Fauna Habitat Assessment (5)
- Spotlighting Sights

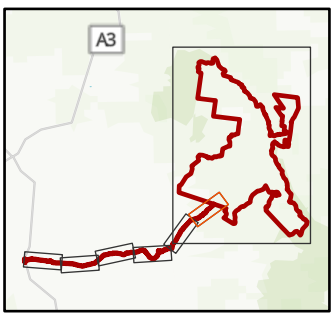
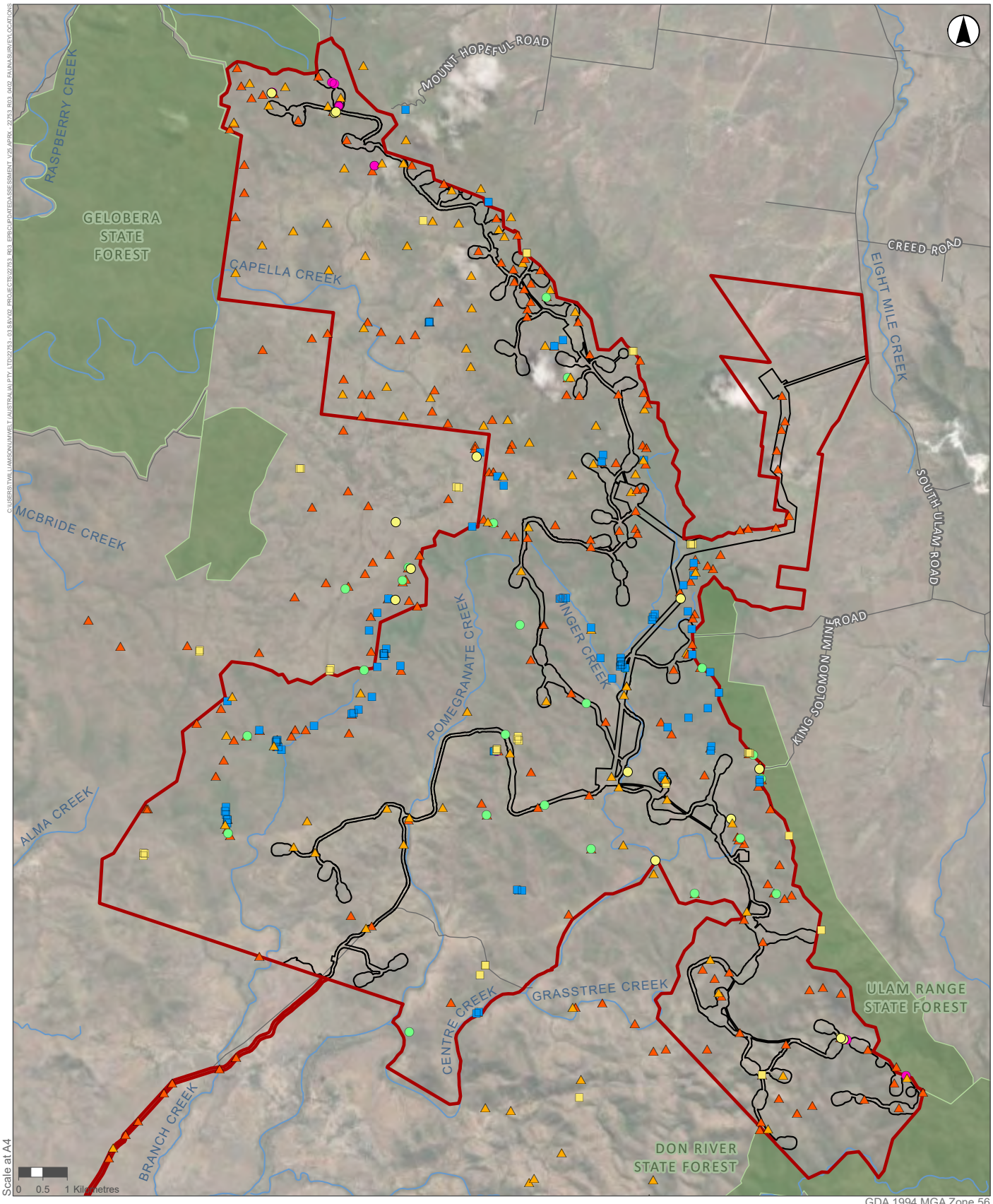


FIGURE 4.2F

FAUNA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:110,000
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest

Fauna Survey Locations

- Anabat (39)
- Camera (83)
- Harp Trapping (14)
- Koala SAT (26)
- Fauna Habitat Assessment (232)
- Fauna Habitat Quality Assessment (16)
- Spotlighting Sights

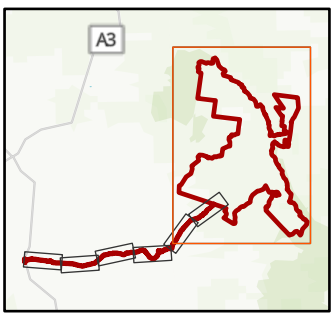
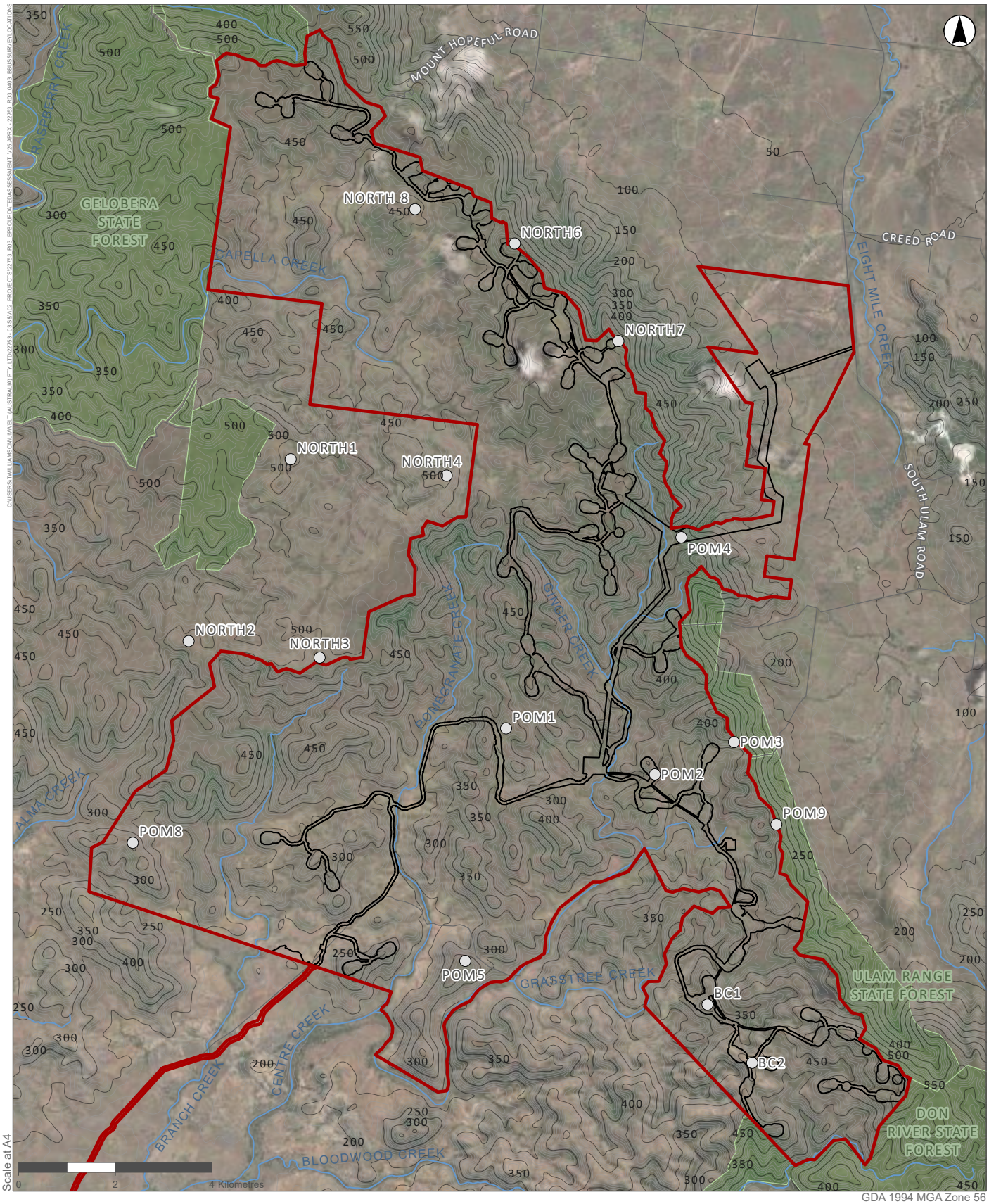


FIGURE 4.2G

FAUNA SURVEY LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Vantage Point Sites
- Roads
- Contours (10m)
- Contours (50m)
- Watercourse
- Study Area
- Development Corridor
- State Forest

FIGURE 4.3

BBUS LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

4.2.3 MNES Survey Effort and Adequacy

The preliminary desktop assessment identified a number of threatened and/or migratory species listed under the EPBC Act as potentially occurring within the Study Area (see **Section 5.2** and **Section 5.3**). Some of these species were the subject of targeted survey effort within representative habitat types:

- Northern quoll (*Dasyurus hallucatus*).
- Collared delma (*Delma torquata*).
- Squatter pigeon (southern) (*Geophaps scripta scripta*).
- Greater glider (southern and central) (*Petauroides volans*).
- Yellow-bellied glider (south-eastern) (*Petaurus australis australis*).
- Koala (*Phascolarctos cinereus*).
- Migratory birds, including the white-throated needletail (*Hirundapus caudacutus*) and fork-tailed swift (*Apus pacificus*).
- Flora species including *Cycas megacarpa*, *Cossinia australiana*, *Decaspermum struckoilicum* and *Samadera bidwillii*.

Species not targeted during the field survey program were those found to have no records in the desktop search extent, no suitable habitat within the Study Area or do not have a distribution that overlays the Study Area. Whilst these species were not targeted, other survey techniques employed for the target species above are likely to have been suitable at detecting presence, particularly for the migratory or threatened bird species such as the red goshawk (*Erythrotriorchis radiatus*).

Survey techniques employed to target fauna species listed under the EPBC Act were determined based on the DCCEEW survey guidelines for Australia threatened fauna, referral guidelines and SPRAT where appropriate. Surveys were undertaken in accordance with the following resources:

- *Survey Guidelines for Australia's Threatened Mammals* (Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) 2011a).
- *Survey Guidelines for Australia's Threatened Bats* (Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010a).
- *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010b).
- *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPaC 2011b).
- *EPBC Act referral guideline for the endangered northern quoll* (Department of the Environment 2016).
- *A Review of Koala Habitat Assessment Criteria and Methods* (Australian National University 2021) .
- *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (Department of the Environment 2015a).
- *Targeted Species Survey Guidelines – Ghost Bat* (Hourigan 2011).
- Species-specific guidelines, where available.

In lieu of Commonwealth survey guidelines, survey techniques employed to target EPBC Act listed flora species reflect those endorsed by the Queensland government including opportunistic searches in suitable habitat.

Table 4.3 below outlines the survey effort and adequacy of the field survey program for the targeted MNES. Survey effort and adequacy has also been documented for select species that were not considered likely to occur, but are included in the Project's RFI, including the red goshawk (*Erythrotriorchis radiatus*), ghost bat (*Macroderma gigas*) and grey-headed flying-fox (*Pteropus poliocephalus*).

Table 4.3 Survey Guideline Requirements and Effort Undertaken for each MNES

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
squatter pigeon (southern) (*Geophaps scripta scripta*)	In lieu of species-specific guidance, surveys were undertaken in consideration of the *Survey guidelines for Australia's threatened birds* (DEWHA 2010) and *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al.* 2018).	• Area searches for the species in representative habitat or transect surveys. Recommended effort is 15 hours over 3 days within an area of 50 ha. Or six x 5–10 minute searches within an area of 1 ha. Longer surveys may be required in complex habitats. • Flushing surveys. Recommended effort is 10 hours over 3 days within an area of 50 ha. • Surveys to be undertaken during peak bird activity.	• 269 habitat assessments. • 65 habitat quality assessments. • 115 hours of diurnal bird surveys primarily over Spring and Summer in areas of representative habitat. • Three of the four BBUS were conducted during summer and spring, while the fourth BBUS occurred in late Summer/early autumn, equating to 206 hours of vantage point surveys in the summer and spring months. • Tracks, watercourses and water bodies (farm dams) were particularly monitored whilst surveying to detect the squatter pigeon (southern).	**Guidelines Met** A number of recommended survey methods were employed during peak activity periods to detect these bird species. The combination of diurnal bird surveys, vantage point surveys and incidental records across the field program provide adequate survey effort.
red goshawk (*Erythrotriorchis radiatus*)	In lieu of species-specific guidance, surveys were undertaken in consideration of the *Survey guidelines for Australia's threatened birds* (DEWHA 2010) and *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al.* 2018).	• Area searches for the species in representative habitat or transect surveys. Recommended effort is 15 hours over 3 days within an area of 50 ha. Or six x 5–10 minute searches within an area of 1 ha. Longer surveys may be required in complex habitats. • Flushing surveys. Recommended effort is 10 hours over 3 days within an area of 50 ha. • Surveys to be undertaken during peak bird activity.	• 269 habitat assessments, including nest searches in riparian woodlands. • 115 hours of diurnal bird surveys primarily over spring and summer in areas of representative habitat. • Three of the four BBUS were conducted during summer and spring, while the fourth BBUS occurred in late summer/early autumn, equating to 206 hours of vantage point surveys in the Summer and Spring months.	**Guidelines Met** A number of recommended survey methods were employed during peak activity periods to detect these bird species. The combination of diurnal bird surveys, vantage point surveys and incidental records across the field program provide adequate survey effort.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
northern quoll (*Dasyurus hallucatus*)	The *EPBC Act Referral Guideline for the Endangered Northern Quoll* (Department of the Environment 2016) and *Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011a).	• If the Project will occur within the modelled distribution of the species and suitable habitat is likely to occur, initially undertake a reconnaissance survey using remote cameras and latrine searches. • If habitat critical to the survival of the species is present and may be impacted, undertake targeted surveys applying a refined and more targeted use of remote cameras and other supplementary techniques. • Transects of baited cameras, spaced 100 m apart for four nights is recommended. Remote cameras can be used at any time of the year but preferably when northern quolls are likely to be active and more detectable, i.e. before male die-off. • In Queensland, camera trapping is recommended over cage trapping (Eyre *et al.* 2018).	• 269 habitat assessments, noting the presence of potential denning features including large hollow logs and complex boulder piles. • 81 habitat quality assessments. • Reconnaissance survey undertaken in July 2019 using remote cameras in areas of representative habitat. • Targeted placement of remote cameras undertaken in May – June 2020 and November 2020 in locations of identified potential habitat, baited using a combination of chicken coupled with a bolus of rolled oats, peanut butter, honey and vanilla essence, for a total of 490 trap nights. • Elliot trapping program undertaken in May – June 2020 in locations of representative identified potential habitat, baited using rolled oats, peanut butter, honey and vanilla essence, for a total of 320 trap nights.	**Guidelines Met** Significant survey effort has been undertaken using methods recommended by the referral guidelines for Queensland, comprising both a reconnaissance and targeted survey. Habitat assessments were conducted throughout the field survey program to identify potential areas of habitat critical to the survival of the species.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
greater glider (southern and central) (*Petauroides volans*)	In lieu of species-specific guidance, surveys were undertaken in consideration of *Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011a) and *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al.* 2018).	• Arboreal mammal survey methods identified by DSEWPaC (2011a) include: o diurnal searches for the presence of potentially suitable habitat resources for nest or den sites as well as signs of the species' presence, such as scratches on tree trunks and scats beneath trees o stag watching o spotlight surveys in suitable vegetation types o call detection and/or call playback surveys for vocal species, in addition to playback of the calls of owl predators that are known to induce a call response o Elliot A and cage trapping. • As per (Eyre *et al.* 2018), spotlighting transects are the most effective method. • Where possible, survey effort should target habitat known to be suitable for listed species.	• 269 habitat assessments which included searches for suitable hollows in trees and stags. • 81 habitat quality assessments. • 62 hours of spotlighting across May–June 2020, November 2020 and October 2021. Spotlighting occurred on foot and from vehicles within locations of identified potential habitat (i.e., *Eucalyptus moluccana* woodland). • 6 hours of call playback to ascertain the presence of predator owls and other glider species including yellow-bellied glider (south-eastern) (*Petaurus australis australis*), squirrel glider (*P. norfolcensis*) and sugar glider (*P. breviceps*) which may influence the presence/abundance of greater gliders.	**Guidelines Met** Three recommended methods have been employed to detect greater glider. The presence and abundance of hollow-bearing trees was assessed at each habitat assessment site. Spotlighting, which is reported to be the most effective method at detecting arboreal mammals, has also been conducted extensively during the field survey program. Habitat surveyed was suitable and representative.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
yellow-bellied glider (south-eastern) (*Petaurus australis australis*)	In lieu of species-specific guidance, surveys were undertaken in consideration of *Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011a) and *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al.* 2018).	• Arboreal mammal survey methods identified by DSEWPaC (2011a) include: o diurnal searches for the presence of potentially suitable habitat resources for nest or den sites as well as signs of the species' presence, such as scratches on tree trunks and scats beneath trees o stag watching o spotlight surveys in suitable vegetation types o call detection and/or call playback surveys for vocal species, in addition to playback of the calls of owl predators that are known to induce a call response o Elliot A and cage trapping. • As per (Eyre *et al.* 2018), spotlighting transects are the most effective method. • Where possible, survey effort should target habitat known to be suitable for listed species.	• 269 habitat assessments which included searches for suitable hollows in trees and stags. • 81 habitat quality assessments. • 62 hours of spotlighting across May–June 2020, November 2020 and October 2021. Spotlighting occurred on foot and from vehicles within locations of identified potential habitat (i.e., *Eucalyptus moluccana* woodland). • 6 hours of call playback to ascertain the presence of predator owls and other glider species including greater glider (southern and central) (*Petauroides volans*), squirrel glider (*Petaurus norfolcensis*) and sugar glider (*Petaurus breviceps*) which may influence the presence/abundance of yellow-bellied glider (south-eastern).	**Guidelines Met** Three recommended methods have been employed to detect yellow-bellied glider. The presence and abundance of hollow-bearing trees was assessed at each habitat assessment site. Spotlighting, which is reported to be the most effective method at detecting arboreal mammals, has also been conducted extensively during the field survey program. Habitat surveyed was suitable and representative.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
koala (*Phascolarctos cinereus*)	*A Review of Koala Habitat Assessment Criteria and* Methods (Australian National University 2021) and *Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011a).	• No effort standards are prescribed for koala surveys. • Direct observation methods include transect and point surveys, spotlighting, camera traps, thermal detection drones, mark-resight and recapture, and detection dogs. Surveys should be undertaken between August and January, when koala activity is generally at a peak, and resident breeding females with back-young are most easily observed. • Indirect methods include observation of scratchings, call playback, passive acoustics, landscape nutrition quality surveys, Spot Assessment Technique (SAT) and other scat search methods. Indirect methods are reported to be often the most effective for gathering presence/absence data due to the difficulty in observing koalas and the variable density of koalas across the landscape.	• 269 habitat assessments. • 81 habitat quality assessments. • 20 Spot Assessment Technique (SAT) sites were completed in May–June 2020 and November 2020 within areas of potential habitat, equating to 600 trees searched. • 62 hours of spotlighting across May–June 2020, November 2020 and October 2021 on foot and from vehicles within locations of identified potential habitat.	**Guidelines Met** As recommended, the field program employed both direct and indirect methods, including within the months when activity is generally highest. Significant spotlighting effort was undertaken in areas of representative habitat. Habitat assessments supplemented survey effort.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
ghost bat (*Macroderma gigas*)	*Targeted Species Survey Guidelines – Ghost Bat* (Hourigan 2011)	• Active acoustic detection coupled with spotlighting to rule out observations of similar species such as the yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*) and barn owl (*Tyto alba*). A minimum of 8 detector hours over a minimum of 4 nights. • Harp trapping or mist netting within flyways such as vehicle tracks, walking tracks, watercourses and gullies in a wide variety of habitat types. A minimum of 8 trap nights over a minimum of 4 nights. • In areas of potential roosting habitat, conduct roost searches by investigating gorges, gullies, fissures, rocky outcrops, overhangs and cliff lines. Recommended effort is 2 hours per survey day.	• 269 habitat assessments, including roost searches in steep and rocky terrain. When potential roosts were detected, ecologists investigated on foot or with a drone. • Harp trapping was conducted at 5 flyway locations for a total of 14 trap nights. • 62 hours of spotlighting across May–June 2020, November 2020 and October 2021 on foot and from vehicles within locations of identified potential foraging habitat. • Unattended Anabat bat call detectors were deployed in a range of habitat types including woodlands and watercourses for a total of 111 nights.	**Guidelines Partially Met** Multiple methods were employed to detect the ghost bat including roost searches, unattended bat recorders, spotlighting and harp trapping. Harp trapping effort exceeds what is recommended. Although unattended bat recorders are not the preferred method of acoustic detection according to the State Guideline, this method is recommended by Bat Call WA Pty Ltd (2022).
grey-headed flying-fox (*Pteropus poliocephalus*)	In lieu of species-specific guidance, surveys were conducted in consideration of the *Survey guidelines for Australia's threatened bats* (DEWHA 2010) and *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre *et al.* 2018).	• Prior to survey conduct a database search of active and historical flying-fox roosting sites. • Diurnal surveys for active flying-fox camps should be undertaken to determine the potential presence of unrecorded roosting sites. Signs of flying-fox presence such as audible calls, odour and droppings should be examined. Dusk surveys can also be conducted to detect roost sites.	• 269 habitat assessments were undertaken noting signs of bat activity, food plants and habitat suitability. • 7 secondary plots and 341 quaternary plots were completed to determine floristic characteristics and vegetation communities. • 60 hours of spotlighting on foot and by vehicle covering a range of habitat types.	**Guidelines Met** A review of fly-fox roosting sites (both current and historic) was undertaken to determine the proximity of these sites in relation to the Study Area. Although survey effort is not specified, through the use of both indirect and direct methods in areas of representative habitat, overall effort is considered sufficient.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
		• Surveys of vegetation communities and food plants by a qualified botanist. • Night-time, walking transect surveys in search of feeding and flying bats.		
Migratory birds	*Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (Department of the Environment 2015)	For oriental cuckoo (*Cuculus optatus*), black-faced monarch (*Monarcha melanopsis*), satin flycatcher (*Myiagra cyanoleuca*), spectacled monarch (*Symposiachrus trivirgatus*) and rufous fantail (*Rhipidura rufifrons*) during migration, it is recommended that surveys be undertaken over standardised timed periods. Surveys and assessments should also consider habitat (and specific locations) that is suitable and important for migration passage. While there are no standard survey techniques for white-throated needletail (*Hirundapus caudacutus*) and fork-tailed swift (*Apus pacificus*), they should be counted by an experienced person from elevated viewpoints (if present) during summer. If white-throated needletails are known to occur, observations should be made as late as possible in the evening of birds coming into roost in tall trees along ridgetops.	• 269 habitat assessments. • 115 hours of diurnal bird surveys in areas of potential habitat. • Three of the four BBUS were conducted during summer and spring, while the fourth BBUS occurred in late summer/early autumn, equating to 206 hours of vantage point surveys in the summer and spring months.	**Guidelines Met** The combination of habitat assessments, diurnal bird surveys, BBUS and incidental sightings provide adequate survey effort to detect migratory species. BBUS surveys were conducted within suitable seasonal timeframes. Vantage points were strategically and appropriately located.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
collared delma (*Delma torquata*)	In lieu of species-specific guidance, surveys were undertaken in consideration of the *Draft referral guidelines for the nationally listed Brigalow Belt reptiles* (DSEWPaC 2011c) and *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPaC 2011b)	• Undertake diurnal hand searches in appropriate habitats. o Search microhabitats, such as carefully turning woody debris and rocks and raking through leaf litter. o Survey over a minimum of 1.5 person hours per ha for habitats of average complexity. o Survey over a minimum of 3 days. • Undertake pitfall trapping during late spring to summer. o A series of pitfall trap lines comprising six 4–10 L buckets and funnel traps spread along a 15 m fence would be an appropriate trap design. • As general rule surveys should only be undertaken from late September through to late March when weather conditions are warm, not too dry and maximum temperatures are greater than 25°C on most survey days. • Optimal survey times vary between species, but generally are early morning (within 4 hours of sunrise) and late afternoon to early evening for diurnal species, and into late warm nights for nocturnal species.	• 269 habitat assessments, noting the presence of key microhabitat features. • 65 habitat quality assessments. • 58 hours of diurnal active searches completed in May–June 2020 and November 2020 in locations of identified potential habitat. • Pitfall trapping undertaken at two sites in May–June 2020 in locations of identified potential habitat, for a total of 27 trap nights. As pitfall trapping is considered less effective than active diurnal searches in locating the species (Porter 1998), only active searches were undertaken in November 2020. Each pitfall site constituted one trap line of three 20 L buckets spread along a fence approximately 20 m long and 30 cm high. Soil hardness inhibited efforts to include more buckets in the trap line.	**Guidelines Met** Recommended methods were employed to maximise the detection of the species including diurnal active searches and pitfall trapping in the recommended seasonal period. Habitat assessments supplement this effort overall. Effort is considered adequate.

Species	Relevant Guidelines	Recommended Methodology	Effort Undertaken	Survey Adequacy
Cycas megacarpa	There are no Commonwealth-approved species-specific survey guidelines	• *Cycas megacarpa* is easily distinguished from other cycad species by its large glaucous seeds as well as its green leaves with moderate broad leaflets (DCCEEW 2022). • Fruiting cones are produced between May and February. Seeds become ripe from March onwards and drop from the tree.	• Opportunistic searches for *Cycas megacarpa* were undertaken throughout the survey program, including during the fruiting period, to assess the extent of its occurrence and relative densities within the Study Area. • In October 2022, a targeted *Cycas megacarpa* field survey was conducted across the Development Corridor to increase the understanding of presence and abundance in this area. • Survey methods utilised for all *Cycas megacarpa* assessments include individual point counts, visual counts within a 25 m radius, visual counts within a 50 m x 50 m plot, and detailed counts within a 50 m x 10 m plot.	**Effort Considered Adequate** Although there is no guideline specifying appropriate survey techniques or effort for *Cycas megacarpa*, survey effort undertaken is considered significant and includes surveys within the species' fruiting period.
Cossinia australiana, *Decaspermum struckoilicum* and *Samadera bidwillii*	There are no Commonwealth-approved species-specific survey guidelines	• Flowering of *Cossinia australiana* has been recorded from October to January, with fruiting recorded in February. • Flowering of *Decaspermum struckoilicum* has been recorded in October and November and fruiting from November to February. • *Samadera bidwillii* flowers from December to March and fruits from February to May.	• Targeted searches for the species were completed throughout the field survey program, including during the flowering and fruiting periods for each species. • Searches generally comprised opportunistic and random walking meanders in areas of suitable habitat. • Searches were undertaken across all survey days throughout the program including at the 7 secondary plots and 341 quaternary plots.	**Effort Considered Adequate** Although there are no guidelines specifying appropriate survey techniques or effort for the listed species, survey effort undertaken is considered sufficient and included sampling within the species' fruiting period. It is considered reasonable that any populations present within the Study Area would be detected given the effort undertaken.

4.2.4 Survey Limitations

This assessment has been completed using a combination of field-validated data, desktop information and reasonably extrapolated field survey results. As such, the results are subject to the level of accuracy and detail associated with this information.

Land access was a key limitation throughout the field survey program, and particularly affected surveys that required the use of remote locations such as vantage points. Terrain was difficult with tracks generally highly eroded, overgrown, or poorly established, resulting in limited safe access into more remote areas. Potential safety issues as a result of inclement weather also occasionally limited access.

4.2.4.1 Flora

As described above, land access was a key constraint. Eucalypt woodland community types were well sampled; however, the semi-evergreen vine thicket communities were less represented due to the thick vegetation and steep slopes. This lack of coverage has been considered when undertaking the likelihood of occurrence assessment (**Section 7.0** of Attachment B2).

The flora survey undertaken between 6–12 August 2019 was undertaken in late winter after a long period of extended drought. There was a noticeable lack of species diversity in the ground layer (e.g. grasses and herbs). The following surveys were undertaken in seasons that provided a good representation of grass and herb species.

While the flora field survey method quantitatively measured *Cycas megacarpa* across the Development Corridor, the site coverage was not systematic (i.e. parallel line searches) and whilst extensive, did not cover the full extent of the habitat available. For this reason, the actual numbers recorded from density plots or species record points, represent the lower bound estimate of the population size within the Study Area . However, the application of density information was used to project the upper limit of *Cycas megacarpa* individuals using a combination of habitat extent mapping (as verified in the field) and spatial interpolation methods.

4.2.4.2 Fauna

Patterns of faunal activity and estimates of relative abundance or presence-absence of species, varies temporally in response to the time of day (e.g. day versus night), seasonal changes (e.g., spring versus winter) as well as between years (e.g. rainy year versus drought year) (Eyre *et al.* 2018).

The COVID-19 pandemic caused delays in the survey schedule due to Government regulated travel restriction and commercial fight availability from March to June 2020. These delays pushed the fauna survey from late in the Autumn fauna survey window and into early winter. These surveys were subsequently undertaken during a cooler, drier period.

Restricted access including the safe access of steep slopes meant that many ecological trapping methods (e.g. harp traps, Elliot traps and pitfall traps) were unable to be deployed intensively across the Study Area. Greater survey effort involving the use of remote sampling techniques (e.g. cameras) and targeted spotlighting surveys were conducted to account for this method shortfall.

4.3 Likelihood of Occurrence Assessment

The likelihood of occurrence of MNES species and communities was assessed based on results of field surveys (**Section 7.0** of Attachment B2), a review of publicly available records, known habitat preferences and the broad habitats within the Study Area determined using the Project's vegetation mapping. MNES were assigned to one of the categories outlined in **Table 4.4**.

Table 4.4 Likelihood of Occurrence Assessment Criteria

Category	Description
Known	This category includes all species which have been confirmed via field surveys within the Study Area.
High	The species has been previously recorded in the Study Area or in the immediate vicinity, and details on presence are reliable. The Study Area contains preferred habitat resources which may support a population of the species.
Moderate	The species is known from the broader area (desktop search extent / 10 km) and some of the preferred habitat is present within the Study Area. Aerial foragers and other migratory birds that may overfly the Study Area are also included in this category.
Low	The Study Area supports some suitable habitat, often marginal. The species may disperse through the Project Area infrequently and is unlikely to depend on the habitat for survival.
Unlikely	The Study Area offers limited to no potential habitat for the species, is outside its known range and/or is lacking broader habitat requirements.

4.4 MNES Habitat Modelling

Following the completion of the likelihood of occurrence assessment and the mapping of vegetation communities and habitat, mapping for the MNES values known or having the potential to occur within the Study Area was undertaken. In response to the RFI, habitat modelling was also undertaken for three species considered to have a low likelihood of occurrence.

'Modelling criteria' developed were primarily based on habitat requirements as specified by SPRAT. As required, other publicly available datasets were also reviewed to inform the modelling rules including relevant species recovery plans (where available), referral guidelines, approved conservation advice and listing advice, management plans and peer-reviewed journal articles. Habitat assessments collected during the field surveys, species records (public and survey records), and Project vegetation mapping were the primary inputs used to map the potential habitat according to the modelling criteria. For some habitats or habitat features (i.e. hilly rocky areas and dense vegetation), mapping delineation was completed manually using additional mapping datasets including watercourse and 10-metre contours in conjunction with high-quality Queensland Globe aerial imagery.

Although REs form the basis of the fauna habitat types discussed in this assessment, the presence and abundance of required habitat resources as determined through field surveys was considered foremost when assessing if suitable for a particular MNES. Per MNES, habitat modelling criteria and mapping justification are provided under the *Occurrence and Potential Habitat within the Study Area* section in **Appendix E** of Attachment B4.

4.4.1 *Cycas megacarpa*

Using *Cycas megacarpa* presence/absence and abundance field data, an estimation of the distribution and density of *Cycas megacarpa* within the Study Area was undertaken using a spatial interpolation model. Interpolation models can be used to predict values for cells in a raster from a limited number of sample data points. The underlying assumption that makes interpolation a viable option is that spatially distributed objects are spatially correlated, thereby assuming that things that are close together tend to have similar characteristics.

The interpolation selected for this analysis was the Inverse Distance Weighted method (IDW). IDW is a method of interpolation that estimates cell values by averaging the values of sample data points in the vicinity of each processing cell. The closer a data point is to the centre of the cell being estimated, the more influence, or weight, it has in the averaging process. This method assumes that the variable being mapped decreases in influence with distance from its sampled location.

The interpolation was conducted using ESRI GIS mapping software ArcGIS Pro. To provide a visual aid, the resultant output was categorised and styled into density categories, comprising High (25–50 plants per 0.25 ha), Moderate (10–25 plants per 0.25 ha), Low (0.5 -10 plants per 0.25 ha), Absent (0–0.5 plants per 0.25 ha). The output was analysed against locations of actual counts and habitat extent mapping. To enhance the accuracy of the model, and where available, the IDW outputs were clipped to known habitat (confirmed and suspected) areas.

Noting that a targeted *Cycas megacarpa* field survey was completed across the Development Corridor in October 2022, calculated densities are expected to be most accurate in this area as a result of greater number of sample data points relative to the surrounding Study Area.

4.5 Significant Impact Assessment

The potential significance of Project-related impacts on MNES were assessed in accordance with *Matters of National Environmental Significance – Significant Impact Guidelines 1.1* (Department of the Environment 2013) (**Section 10.0** of Attachment B4). Results of the likelihood of occurrence assessment were considered when assessing potential impacts, with the majority of the values assessed determined to have a moderate, high or known likelihood of occurrence. Three aerial fauna species considered to have a low likelihood of occurrence but identified on the RFI as being at risk of potential operational impacts, were also assessed. Species not listed under the EPBC Act at the time of the Project's referral in 2021 are however excluded.

Key terms used within significant impact criteria for listed TECs, threatened species and migratory species are defined by DEWHA (2013) as follows:

Habitat critical to the survival of a species or ecological community refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal.
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- To maintain genetic diversity and long-term evolutionary development. Or,
- For the reintroduction of populations or recovery of the species or ecological community.

Important population of a species refers to a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans and/or that are:

- Key source populations either for breeding or dispersal.
- Populations that are necessary for maintaining genetic diversity, and/or Populations that are near the limit of the species range.

Important habitat for a migratory species refers to habitat that is**:**

- Utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species. And/or
- Of critical importance to the species at particular life-cycle stages. And/or
- Utilised by a migratory species which is at the limit of the species range. And/or
- Within an area where the species is declining.

Other Commonwealth guidelines used to support the assessment of impacts on MNES include:

- *EPBC Act Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (DSEWPaC 2011c).
- *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (Department of the Environment 2015a).
- *Appendix A: Supporting information for each of the 14 migratory listed birds* (Department of the Environment 2015b).
- *EPBC Act referral guideline for the endangered northern quoll Dasyurus hallucatus* (Department of the Environment 2016).

Additional Commonwealth resources such as threat abatement plans, recovery plans and approved conservation advice statements have been referred to in the impact assessments (**Appendix E** of Attachment B4). These include:

- *Threat abatement plan for predation by feral cats* (Department of the Environment 2015c).
- *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads* (DSEWPaC 2011d).
- *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)* (Department of the Environment and Energy 2017).
- *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi* (Department of the Environment 2014).
- *Threat abatement plan for predation by the European red fox* (Department of the Environment Water Heritage and the Arts 2008a).

- *National Recovery Plan for the Koala Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territory)* (Department of Agriculture Water and the Environment 2022a).
- *National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus* (Department of Environment and Water 2021).
- *National Multi-species Recovery Plan for the cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi and Macrozamia platyrhachis* (Queensland Herbarium 2007).
- *A review of ghost bat ecology, threats and survey requirements* (Bat Call WA Pty Ltd 2021).
- *Conservation Advice for Erythrotriorchis radiatus (red goshawk)* (DCCEEW 2023a).
- *Conservation Advice for Delma torquata (collared delma)* (Department of the Environment Water Heritage and the Arts 2008b).
- *Conservation Advice Geophaps scripta scripta (squatter pigeon (southern))* (Threatened Species Scientific Committee 2015).
- *Conservation Advice Hirundapus caudacutus (white-throated needletail)* (Threatened Species Scientific Committee 2019).
- *Conservation Advice Macroderma gigas (ghost bat)* (Threatened Species Scientific Committee 2016).
- *Conservation Advice Petauroides volans (greater glider)* (Department of Climate Change Energy the Environment and Water 2022a).
- *Conservation Advice for Phascolarctos cinereus (combined populations in Queensland, New South Wales and the Australian Capital Territory)* (Department of Agriculture Water and the Environment 2022b).

4.6 Habitat Quality Assessments

The *Offsets Assessment Guide* spreadsheet (Australian Government 2012a) and *How to use the Offsets Assessment* document *Guide* (Australian Government 2012b) provides the support framework to assess offset requirements for an MNES via the scoring of habitat quality.

To support any Commonwealth offsets that may be required for the Project, field surveys conducted in 2022 and 2023 included habitat quality assessments within both the Development Corridor (impact area) and potential offset properties (offset area) in accordance with the Queensland *Guide to determining terrestrial habitat quality* (Eyre *et al.*, 2020). Habitat quality assessments conducted were specific to species that were considered to be at risk of significant impacts as a result of the Project including *Cycas megacarpa,* northern quoll, greater glider (southern and central), yellow-bellied glider (south-eastern), koala and collared delma. Detailed discussion of the methodology used to assess habitat quality is discussed in Section 5.2.3 of the Offset Management Strategy (Attachment K of the Preliminary Documentation).

Prior to the habitat quality assessment surveys, the matter unit (MU) and assessment unit (AU) were delineated and mapped to inform field surveys and ensure adequate sampling replication throughout the proposed offset areas. Delineation of units were consistent with the impact site, following the below approach:

- Matter Unit – being the habitat utilisation type of the target MNES Matter, i.e. northern quoll denning and refuge habitat.
- Assessment unit – Condition types mapped within the mapped area of the matter unit. i.e. remnant vegetation in northern quoll denning and refuge habitat.

A total of 105 habitat quality assessments were completed throughout the impact area and offset area. **Table 4.5** presents the number of habitat quality assessments conducted within the impact and offset areas for each matter unit.

Table 4.5 Summary of the HQA field surveys conducted throughout the impact and offset areas

Matter	Matter Unit	Impact	Offset
Cycas megacarpa	Mapped habitat	12	46
Northern quoll	Denning and refuge	2	17
Greater glider (southern and central)	Forging and dispersal	8	15
	Potential/ future breeding and denning	4	17
	Likely/ current breeding and denning	10	25
Yellow-bellied glider (south-eastern)	Breeding and denning	8	24
	Foraging and dispersal	6	21
Koala	Climate refugia	3	10
	Breeding, foraging and dispersal	22	50
Collared delma	Breeding and foraging	12	38

4.6.1 Field Survey Methodology

The key indicators for determining habitat quality at the impact and proposed offset property are:

- **Site condition:** This is the condition of a site in relation to the ecological requirements of a threatened species or ecological community. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features.
- **Site context:** This is the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a threatened species or ecological community.
- **Species stocking rate:** This is the usage and/or density of a species at a particular site.

The collection of field data associated with the above habitat quality attributes, followed the methodology outlined in the Queensland *Guide to determining terrestrial habitat quality (version 1.2*), except where departures were necessary to address requirements of the Offset Policy and DCCEEW modified habitat quality scoring approach. Departures include the development and assessment of species-specific habitat attributes, varied buffers for relevant species context assessments and species stocking rate (replacing habitat index scoring).

Species specific habitat attributes relevant to site condition scoring include:

- The *quality and availability of food and foraging habitat*, this attribute forms a component of the site condition scoring assessment. This attribute is not relevant to *Cycas megacarpa*.
- The *quality and availability of shelter*, this attribute forms a component of the site condition scoring assessment. The attribute extends to the quality and availability of breeding habitat, noting the overlap between shelter and breeding requirements for the impacted MNES. This attribute is not relevant to *Cycas megacarpa*.
- As well as the above, specific field assessment and justification were developed for site condition attributes, comprising:
    - **Species mobility capacity**: this attribute considered the quality and availability of habitat for mobility, and incorporated site-specific field data as well as other measures. The attribute was tailored to each impacted MNES. Further detail on how this attribute was applied to the final scoring process is provided in Section 5 of Attachment K (Offsets Management Strategy).
    - **Threat to species**: this attribute was tailored to each impacted MNES and incorporated field verified data specific to the offset property. Further detail on how this attribute was applied to the final scoring process is provided in Section 5 of Attachment K (Offsets Management Strategy).

4.6.2 Habitat Quality Scoring

The habitat quality of the impact and potential offset areas were calculated as per the modified habitat quality assessment designed for the Offsets Assessment Guide (*Environmental Protection and Biodiversity Conservation 1999*). This method evaluates the site condition, site context and species stocking rate to provide a habitat quality score (HQS) out of 10, each of which have a set of sub-attributes which are further discussed in the below sections.

4.6.2.1 Site Condition and Site Context

The site condition and site context attributes each contribute 30 % weighting to the final habitat quality score. The relevant sub-attributes and associated maximum scores are provided in Table 5.3 of the Offset Management Strategy (Attachment K of the Preliminary Documentation).

Scoring for the vegetation components of site condition was completed in accordance with the BioCondition survey methodology (Eyre et al. 2015). Whereas tailored data collection and scoring approaches for Site Condition sub-attributes: 'Quality and Availability of Food and Foraging Habitat' and 'Quality and Availability of Shelter'; and Site Context sub-attributes: 'Threats to species' and 'Species mobility capacity' were consistent with approaches set out in the modified habitat quality assessment (MHQA) scoring spreadsheet as provided by DCCEEW. Further detail on species specific habitat quality sub-attributes.

Species specific habitat quality attributes, relevant to the scoring of site condition and site context for threatened fauna species, are detailed in Section 5 of the Offset Management Strategy (Attachment K of the Preliminary Documentation).

4.6.2.2 Species Stocking Rate

The species stocking rate is the third component and contributes 40% to the final habitat quality score. Species stocking rate sub-attributes measure the presence, usage and importance of the population to give an indication of the site's carrying capacity and significance to each species' overall survival. Four attributes were assessed to provide a maximum score of 70. Different species stocking rate approaches exist for threatened fauna and threatened flora. These are presented in Section 5 of the Offset Management Strategy (Attachment K of the Preliminary Documentation).

5.0 Protected Matters Search Tool Results

Results from the recent PMST database search are outlined in **Table 5.1**. As identified in the PMST search results, three MNES may occur within the search extent:

- Listed Threatened Ecological Communities.
- Listed Threatened Species.
- Listed Migratory Species.

The results of the PMST database search are summarised below (**Section 5.1** to **Section 5.3**). The raw PMST database report is provided in **Appendix A** of Attachment B4.

Table 5.1 PMST Database Search Results

Matter of National Environmental Significance	Potential Presence in Search Extent
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Importance	None
Great Barrier Reef Marine Park	None
Commonwealth Marine Area	None
Listed Threatened Ecological Communities	5
Listed Threatened Species	45
Listed Migratory Species	17

5.1 Threatened Ecological Communities

A total of five TECs were identified in the PMST results as 'known to occur', 'may occur' or 'likely to occur' in the search extent. These TECs, as well as the analogous REs which may constitute these TECs are presented in **Table 5.2**.

Table 5.2 Threatened Ecological Communities Identified from the PMST Database

Threatened Ecological Community	EPBC Act Status	Corresponding Regional Ecosystems within Brigalow Belt Bioregion[1]
Brigalow (*Acacia harpophylla* dominant and codominant)	Endangered	11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.11.14, 11.12.21
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	11.3.3, 11.3.15, 11.3.16, 11.3.28, 11.3.37
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	11.3.2, 11.3.17, 11.4.7, 11.4.12

Threatened Ecological Community	EPBC Act Status	Corresponding Regional Ecosystems within Brigalow Belt Bioregion[1]
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	11.3.11, 11.4.1, 11.8.13, 11.11.18, 11.2.3, 11.9.4
Weeping Myall Woodlands	Endangered	11.3.2, 11.3.28

[1] These REs can form part of or align with the TECs if the key diagnostic characteristics and condition thresholds specified as part of the Commonwealth conservation or listing advice are also met.

5.2 Threatened Species

A total of 16 threatened flora species and 29 threatened fauna species were identified in the PMST results as 'known to occur', 'may occur' or 'likely to occur' in the search extent. These species are presented in **Table 5.3**.

Table 5.3 Threatened Species Identified from the PMST Database

Common Name	Scientific Name	EPBC Act Status[1]	NC Act Status
Threatened Flora			
hairy-joint grass	*Arthraxon hispidus*	Vulnerable	Vulnerable
three-leaved bosistoa	*Bosistoa transversa*	Vulnerable	Least Concern
miniature moss-orchid	*Bulbophyllum globuliforme*	Vulnerable	Near Threatened
ooline	*Cadellia pentastylis*	Vulnerable	Vulnerable
cossinia	*Cossinia australiana*	Endangered	Endangered
wedge-leaf tuckeroo	*Cupaniopsis shirleyana*	Vulnerable	Vulnerable
-	*Cycas megacarpa*	Endangered	Endangered
-	*Cycas ophiolitica*	Endangered	Endangered
-	*Decaspermum struckoilicum*	Endangered	Critically Endangered
king blue-grass	*Dichanthium queenslandicum*	Endangered	Vulnerable
bluegrass	*Dichanthium setosum*	Vulnerable	Least Concern
black ironbox	*Eucalyptus raveretiana*	Vulnerable	Least Concern
-	*Marsdenia brevifolia*	Vulnerable	Vulnerable
quassia	*Samadera bidwillii*	Vulnerable	Vulnerable
-	*Solanum dissectum*	Endangered	Endangered
-	*Solanum johnsonianum*	Endangered	Endangered
Threatened Fauna			
Birds			
curlew sandpiper	*Calidris ferruginea*	Critically Endangered, Migratory	Critically Endangered
greater sand plover	*Charadrius leschenaultii*	Vulnerable, Migratory	Vulnerable

Common Name	Scientific Name	EPBC Act Status[1]	NC Act Status
Coxen's fig-parrot	*Cyclopsitta diophthalma coxeni*	Endangered	Endangered
red goshawk	*Erythrotriorchis radiatus*	Endangered	Endangered
grey falcon	*Falco hypoleucos*	Vulnerable	Vulnerable
squatter pigeon (southern)	*Geophaps scripta scripta*	Vulnerable	Vulnerable
painted honeyeater	*Grantiella picta*	Vulnerable	Vulnerable
white-throated needletail	*Hirundapus caudacutus*	Vulnerable, Migratory	Vulnerable
star finch (eastern)	*Neochmia ruficauda ruficauda*	Endangered	Endangered
eastern curlew	*Numenius madagascariensis*	Critically Endangered, Migratory	Endangered
southern black-throated finch	*Poephila cincta cincta*	Endangered	Endangered
diamond firetail	*Stagonopleura guttata*	Vulnerable	Vulnerable
Australian painted snipe	*Rostratula australis*	Endangered	Endangered
black-breasted button-quail	*Turnix melanogaster*	Vulnerable	Vulnerable
Mammals			
large-eared pied bat	*Chalinolobus dwyeri*	Vulnerable	Vulnerable
northern quoll	*Dasyurus hallucatus*	Endangered	Least Concern
ghost bat	*Macroderma gigas*	Vulnerable	Endangered
Corben's long-eared bat	*Nyctophilus corbeni*	Vulnerable	Vulnerable
greater glider (southern and central)	*Petauroides volans*	Vulnerable	Vulnerable
yellow-bellied glider (south-eastern)	*Petaurus australis australis*	Vulnerable	Vulnerable
koala	*Phascolarctos cinereus*	Endangered	Endangered
grey-headed flying-fox	*Pteropus poliocephalus*	Vulnerable	Least Concern
Reptiles			
collared delma	*Delma torquata*	Vulnerable	Vulnerable
ornamental snake	*Denisonia maculata*	Vulnerable	Vulnerable
yakka skink	*Egernia rugosa*	Vulnerable	Vulnerable
southern snapping turtle	*Elseya albagula*	Critically Endangered	Critically Endangered
Dunmall's snake	*Furina dunmalli*	Vulnerable	Vulnerable
grey snake	*Hemiaspis damelii*	Endangered	Endangered
Fitzroy River turtle	*Rheodytes leukops*	Vulnerable	Vulnerable

[1] *The EPBC Act statuses listed in this table are current as of the Project's referral (i.e. 2021). It is noted that some listings have changed in 2022, however they are not relevant to this assessment.*

5.3 Migratory Species

Excluding species also listed threatened, a total of 13 migratory fauna species were identified in the PMST results as 'known to occur', 'may occur' or 'likely to occur' in the search extent. These species are presented in **Table 5.4**.

Table 5.4 Migratory Species Identified from the PMST Database

Common Name	Scientific Name	EPBC Act Status	NC Act Status
Marine Birds			
fork-tailed swift	*Apus pacificus*	Migratory	Special Least Concern
Marine Species			
salt-water crocodile	*Crocodylus porosus*	Migratory	Vulnerable
Terrestrial Species			
oriental cuckoo	*Cuculus optatus*	Migratory	Special Least Concern
black-faced monarch	*Monarcha melanopsis*	Migratory	Special Least Concern
spectacled monarch	*Symposiachrus trivirgatus*	Migratory	Special Least Concern
yellow wagtail	*Motacilla flava*	Migratory	Special Least Concern
satin flycatcher	*Myiagra cyanoleuca*	Migratory	Special Least Concern
rufous fantail	*Rhipidura rufifrons*	Migratory	Special Least Concern
Wetlands Species			
common sandpiper	*Actitis hypoleucos*	Migratory	Special Least Concern
sharp-tailed sandpiper	*Calidris acuminata*	Migratory	Special Least Concern
pectoral sandpiper	*Calidris melanotos*	Migratory	Special Least Concern
Latham's snipe	*Gallinago hardwickii*	Migratory	Special Least Concern
osprey	*Pandion haliaetus*	Migratory	Special Least Concern

6.0 Description of Ecological Values

6.1 Bioregion and Subregions

The Study Area is located within the Brigalow Belt South Interim Biogeographic Regionalisation for Australia (IBRA) bioregion. This bioregion is predominantly characterised by mixed eucalypt woodland with areas of brigalow (*Acacia harpophylla*) scrubs and open Mitchell grasslands, with cattle grazing being the major land use (Bastin & ACRIS Management Committee 2008).

The Study Area is located across three subregions of the Brigalow Belt bioregion:

- The Mount Morgan Ranges subregion covers much of the mountainous parts of the Study Area.
- The Marlborough Plains subregion covers only the north-eastern corner of the Study Area.
- The Callide Creek Downs subregion covers only the western extent of the access road corridor.

The Mount Morgan Ranges subregion is a rugged and hilly region formed on the Paleozoic rocks of the coastal ranges. The vegetation is dominated by narrow-leaved ironbark (*Eucalyptus crebra*), with red bloodwood (*Corymbia erythrophloia*) and lemon-scented gum (*Corymbia citriodora*) on the rugged slopes, silver-leaved ironbark (*Eucalyptus melanophloia*) on erosional lower slopes, gum-topped box (*Eucalyptus moluccana*) on the colluvial slopes and forest red gum (*Eucalyptus tereticornis*) and Moreton Bay ash (*Corymbia tessellaris*) on the alluvial soils (Sattler & Williams 1999).

The Marlborough Plains subregion is an undulating hilly province with complex geology. The subregion is dominated by alluvial plains and colluvial slopes, usually with a woodland of poplar gum (*Eucalyptus platyphylla*), ghost gum (*Corymbia dallachiana*), forest red gum (*Eucalyptus tereticornis*) and tea tree (*Melaleuca* spp.). Low rises have *E. crebra* and hillier areas with open forest or woodland of *Corymbia citriodora*, *Corymbia* spp. and *Eucalyptus crebra* (Sattler & Williams 1999).

The Callide Creek Downs subregion is an undulating river valley dominated by lower catena Tertiary deposits, with extensive areas of outcrop of underlying argillaceous rocks and smaller areas of low dissected tablelands of upper catena Tertiary deposits. Brigalow (*Acacia harpophylla*) communities are dominant, with areas of soft-wood scrub. Shrubby woodlands dominated by narrow-leaved ironbark (*Eucalyptus crebra*) occur on the dissected tablelands and the alluvial areas are dominated by forest red gum (*Eucalyptus tereticornis*) (Sattler & Williams 1999).

6.2 Vegetation Communities

The Study Area occurs within a rural landscape that is sparsely settled and mostly used for light grazing and livestock production. Large areas of the Study Area have been historically cleared and were found to support remnant and regrowth eucalypt communities as well as areas of cleared land during the field survey program. The dominant regrowth and remnant vegetation communities across the Study Area are eucalypt woodland and forest dominated by *Eucalyptus crebra*, *Corymbia citriodora* and *Eucalyptus acmenoides*. On the lower colluvial slopes, *Eucalyptus moluccana* and *Eucalyptus tereticornis* are present with the creek lines supporting *Melaleuca fluviatilis* and *Casuarina cunninghamiana*. Woodlands associated with alluvial plains within the access road corridor are typically dominated by *Eucalyptus tereticornis, Eucalyptus coolabah,* and *Eucalyptus populnea.* Alluvial woodlands associated with the wind farm area are typically dominated by *Eucalyptus tereticornis, Corymbia tessellaris* and occasionally *Casuarina cunninghamiana*. Vine thicket communities are also scattered throughout the Study Area , often centered around steep terrain with narrow drainage features.

A full list of the vegetation communities' ground-truthed during the field survey program is provided in **Table 6.1** below.

Table 6.1 Ground-truthed Vegetation Communities

RE ID	RE Description	Area (ha) within the Study Area		Area (ha) within the Disturbance Footprint	
		Remnant	Regrowth	Remnant	Regrowth
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	10.0	2.9	0.8	0.2
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	3.1	-	0.3	-
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	87.9	63.1	6.0	0.9
11.3.4a	*Corymbia tessellaris* woodland. On alluvial sandridges to elevated levees and level terraces	4.4	1.8	0.3	0.1
11.3.25	*Eucalyptus tereticornis or E. camaldulensis* woodland fringing drainage lines	34.7	12.2	0.2	0.2
11.3.25b	*Melaleuca leucadendra* and/or *M. fluviatilis*, *Nauclea orientalis* open forest.	176.4	64.4	3.1	1.4
11.11.3	*Corymbia citriodora*, *Eucalyptus crebra*, *E. acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	1,482.8	1,620.9	128.0	117.5

RE ID	RE Description	Area (ha) within the Study Area		Area (ha) within the Disturbance Footprint	
		Remnant	Regrowth	Remnant	Regrowth
11.11.3c	*Eucalyptus moluccana* woodland on lower slopes in association with *E. crebra* +/- *Corymbia citriodora* +/- *Eucalyptus* spp.	255.0	-	23.8	-
11.11.4	*Eucalyptus crebra* woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	15.1	851.6	6.0	2.5
11.11.4a	*Eucalyptus tereticornis* dominated woodland.	44.1	117.6	6.8	7.3
11.11.4b	*Corymbia trachyphloia* or *Eucalyptus acmenoides*, *E. crebra* woodland +/- *Acacia leiocalyx*.	679.5	125.1	44.5	2.1
11.11.4c	*Eucalyptus moluccana* dominated woodland.	129.0	29.1	35.3	5.0
11.11.4d	*Lophostemon* spp. with shrubs on coastal rocky short steep hills	-	21.9	-	-
11.11.5	Microphyll vine forest +/- *Araucaria cunninghamii* on old sedimentary rocks	13.5	70.2	-	0.2
11.11.5a	Vine thicket, usually with no *Araucaria cunninghamii* emergents.	50.7	-	8.4	-
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics	46.8	955.3	10.9	82.0
11.12.1	*Eucalyptus crebra* woodland on igneous rocks	519.4	1,592.0	-	47.2
11.12.4	Semi-evergreen vine thicket and microphyll vine forest on igneous rocks	280.1	-	-	-
11.12.6	*Corymbia citriodora* open forest on igneous rocks (granite)	3,450.4	467.4	72.5	25.3
11.12.6a	*Eucalyptus crebra* +/- *Corymbia citriodora* and woodland to open forest on gently undulating lower slopes of hills	26.1	-	1.1	-

6.2.1 Threatened Ecological Communities

No TECs were confirmed within the Study Area as part of the field survey program. Two REs (RE 11.3.2 and 11.3.3), analogous to Poplar Box, Weeping Myall and Coolibah TECs, were identified in the State vegetation mapping and confirmed during field surveys. However, the condition of these vegetation communities did not meet TEC status when assessed against the condition thresholds and diagnostic criteria.

6.3 Terrestrial Habitat Values

Terrestrial habitat assessed during the field survey program can be broadly grouped into seven types, as summarised in **Table 6.2** and shown on **Figure 6.1**.

Table 6.2 Terrestrial Habitat Types within the Study Area

Habitat Type	Habitat Description	Associated REs	Area (ha) within Study Area[1]	Area (ha) within Disturbance Footprint[1]
Mixed eucalypt woodland on steep slopes	Mixed eucalypt woodland on steep slopes and crests, commonly with *Corymbia citriodora* and/or *Eucalyptus crebra* +\- *E. acmenoides*, *E. tereticornis*	11.11.3, 11.11.4, 11.11.4a, 11.11.4b, 11.11.4d, 11.12.6, 11.12.6a	9,016.8	413.7
***Eucalyptus crebra* woodland**	*Eucalyptus crebra* +\- *Corymbia erythrophloia* woodland on slopes and crests	11.11.15, 11.12.1	3,113.5	140.2
***Eucalyptus moluccana* woodland**	*Eucalyptus moluccana* woodland on slopes and crests	11.11.3c, 11.11.4c	413.1	64.0
Semi-evergreen vine thicket	Vine thicket on upper slopes and gullies with various floristics including *Euroschinus falcatus* var. *falcatus*, *Brachychiton australis*, *Flindersia* spp., *Ficus* sp., *Jasminum* sp., *Alyxia* sp., etc.	11.11.5 11.11.5a 11.12.4	414.5	8.6
Riparian *Melaleuca* woodland	*Melaleuca fluviatilis* woodland +\- *Eucalyptus tereticornis* fringing a watercourse	11.3.25b	240.8	4.5
Alluvial eucalypt woodland	*Eucalyptus tereticornis* +\- *E. coolabah, E. populnea* or *Corymbia tessellaris* woodland on alluvial soils sometimes with *Casuarina cunninghamiana* as dominant	11.3.2, 11.3.3, 11.3.4, 11.3.4a, 11.3.25	220.0	9.0
Non-remnant pasture	Areas containing pasture comprising native and non-native grasses, scattered native trees and various infrastructure including tracks and dams	-	3,545.0	243.3

[1] *Areas reported are inclusive of regrowth where present.*

1:22,500 Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest
- Regrowth Vegetation

Terrestrial Habitat Types

- Alluvial eucalypt woodland
- Non-remnant pasture

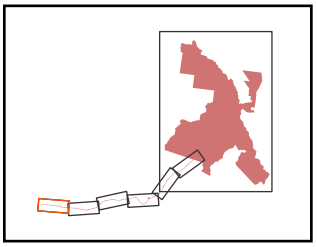


FIGURE 6.1A

TERRESTRIAL HABITAT TYPES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest
- Regrowth Vegetation

Terrestrial Habitat Types

- Alluvial eucalypt woodland
- Non-remnant pasture

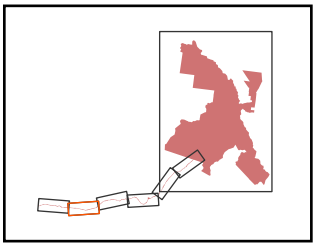


FIGURE 6.1B

TERRESTRIAL HABITAT TYPES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest
- Regrowth Vegetation

Terrestrial Habitat Types

- Alluvial eucalypt woodland
- Non-remnant pasture

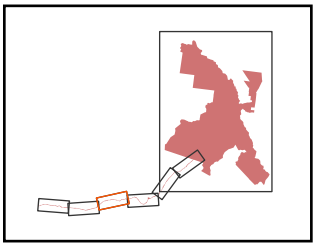


FIGURE 6.1C

TERRESTRIAL HABITAT TYPES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest
- Regrowth Vegetation

Terrestrial Habitat Types

- Alluvial eucalypt woodland
- Non-remnant pasture

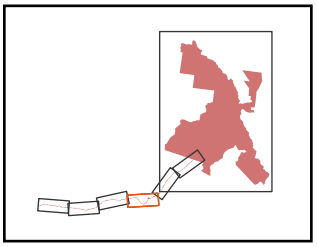


FIGURE 6.1D

TERRESTRIAL HABITAT TYPES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest
- Regrowth Vegetation

Terrestrial Habitat Types

- Alluvial eucalypt woodland
- Non-remnant pasture

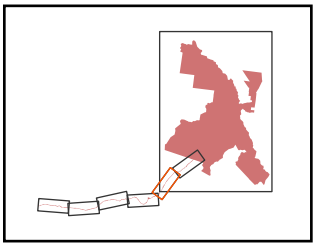
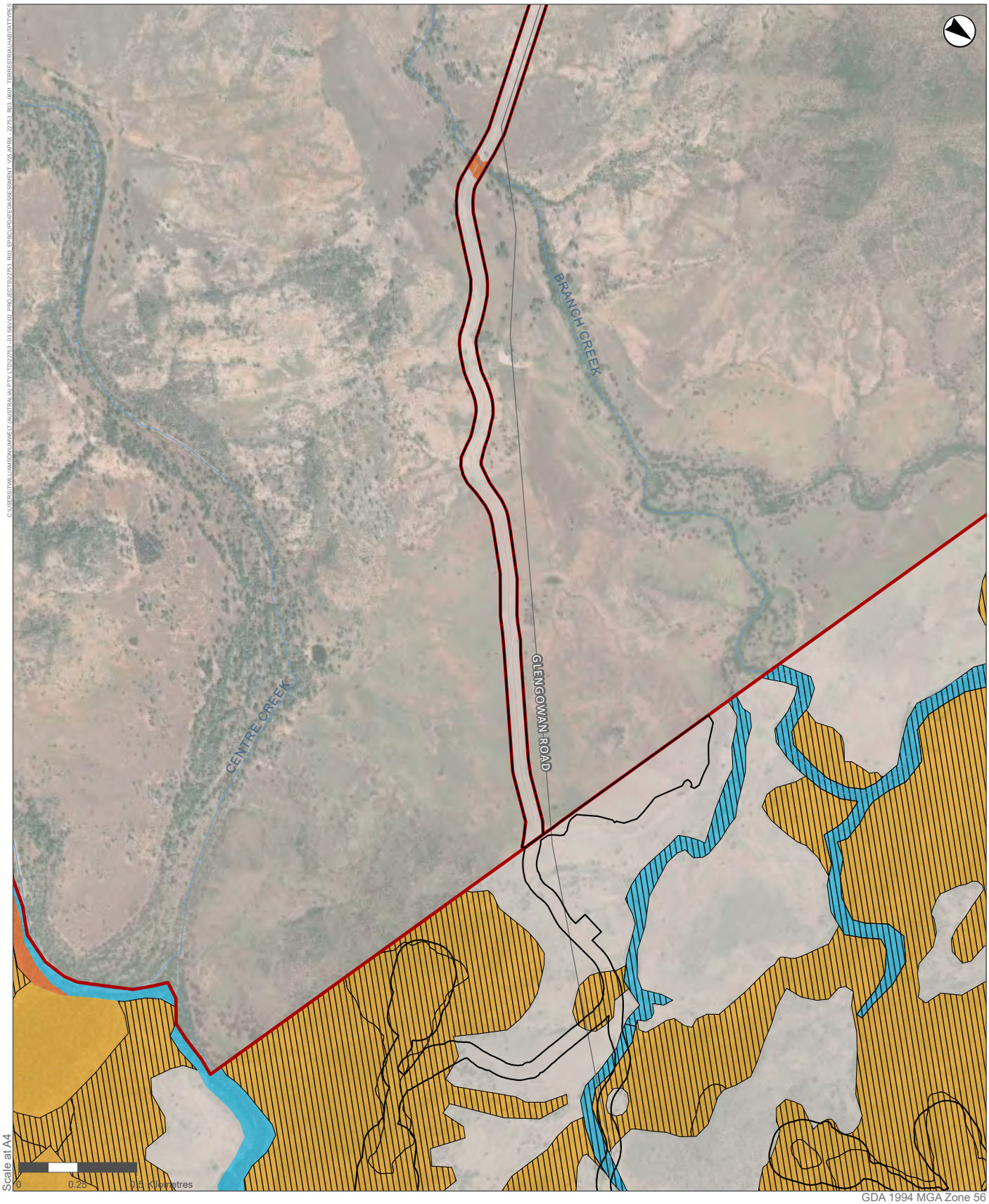


FIGURE 6.1E

TERRESTRIAL HABITAT TYPES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:22,500
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest
- Regrowth Vegetation

Terrestrial Habitat Types

- Alluvial eucalypt woodland
- *Eucalyptus crebra* woodland
- Riparian Melaleuca woodland
- Non-remnant pasture

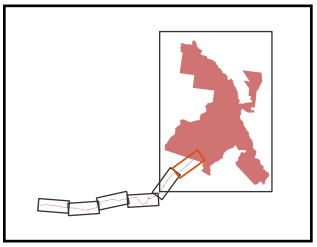
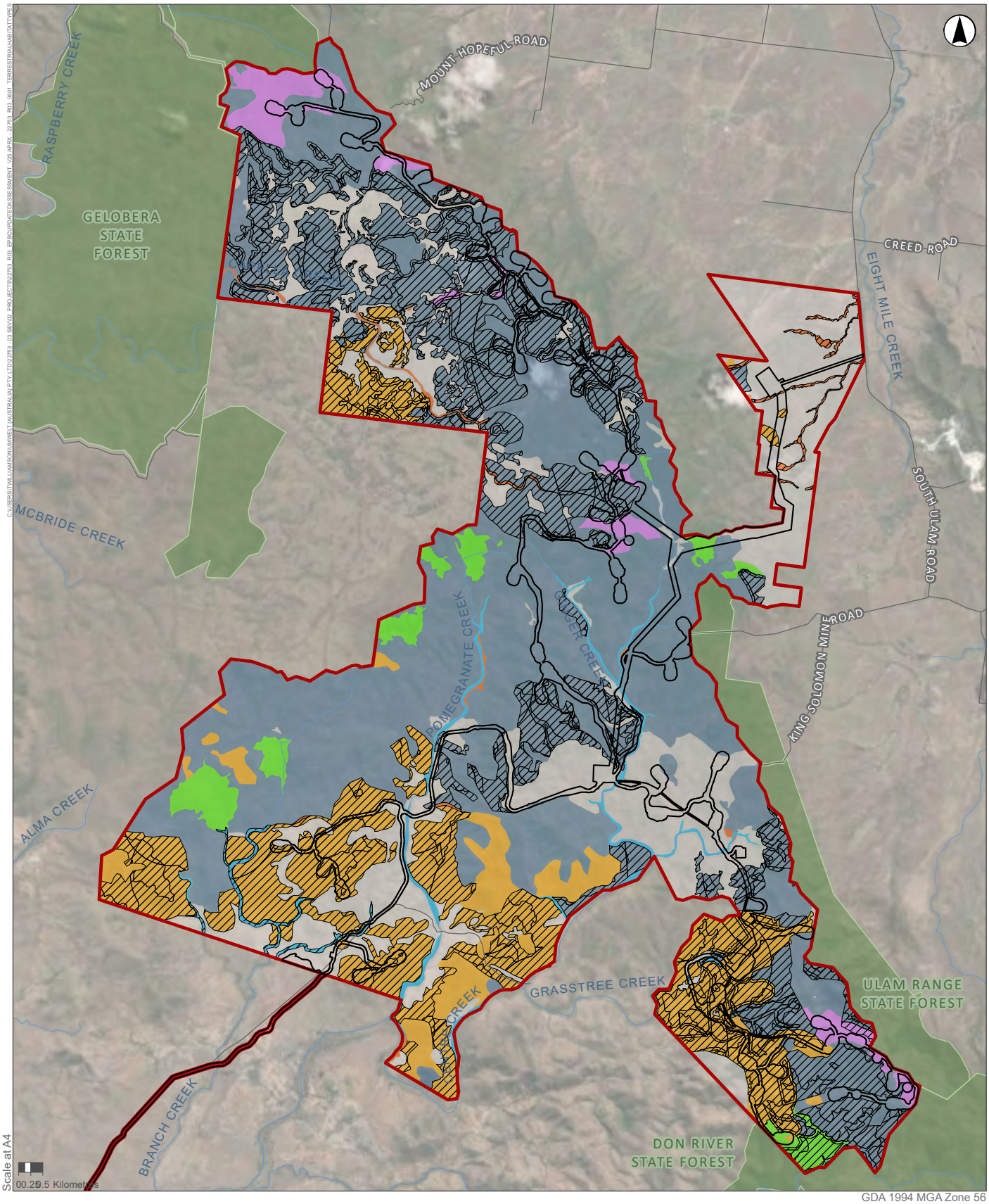


FIGURE 6.1F

TERRESTRIAL HABITAT TYPES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Watercourse
- Study Area
- Development Corridor
- State Forest
- Regrowth Vegetation

Terrestrial Habitat Types

- Alluvial eucalypt woodland
- *Eucalyptus crebra* woodland
- *Eucalyptus moluccana* woodland
- Mixed eucalypt woodland on steep slopes
- Riparian Melaleuca woodland
- Semi-evergreen vine thicket
- Non-remnant pasture

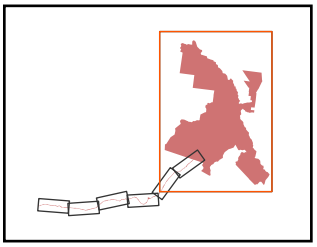


FIGURE 6.1G

TERRESTRIAL HABITAT TYPES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

6.4 Species Diversity

Field surveys identified 219 flora species from 59 families and 134 genera. The most represented plant families were Poaceae (32 species), Myrtaceae (26 species), Fabaceae (16 species), Asteraceae (13 species) and Mimosaceae (10 species). Of the flora species recorded, 32 are introduced representing 15.5% of the total flora recorded (see **Section 6.3.5**).

A total of 197 fauna species from 84 families and 147 genera were also identified during the field survey program, comprising 134 birds, 39 mammals, 18 reptiles and 6 amphibians. Of the species recorded, 6 are introduced, representing 3.1% of the total fauna recorded.

The full species list is provided in **Appendix B** of Attachment B4.

6.4.1 Threatened Flora

One threatened flora species was recorded during the field survey program: *Cycas megacarpa* (Endangered under the EPBC Act). The species was commonly recorded across all vegetation communities within the Study Area including within eucalypt woodland on steep slopes, alluvial eucalypt woodland and non-remnant cleared areas. Record locations are depicted in **Figure 6.2**.

6.4.2 Threatened Fauna

Five threatened fauna species were recorded within the Study Area during surveys, as outlined in **Table 6.3**. Species record locations are depicted in **Figure 6.3**.

Table 6.3 Threatened Fauna Recorded within the Study Area

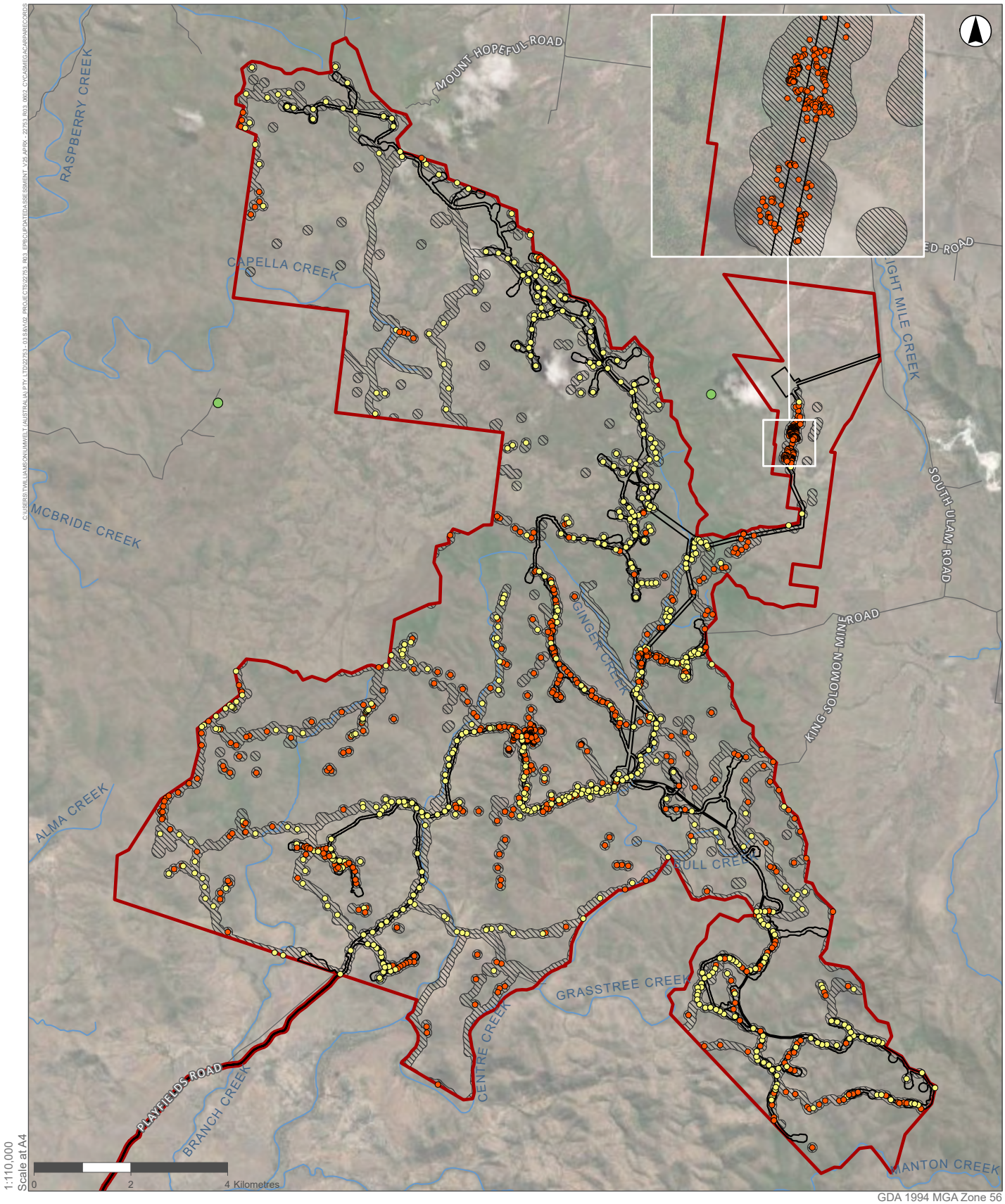
Common Name	Scientific Name	EPBC Act Status	Notes
northern quoll	*Dasyurus hallucatus*	Endangered	Recorded on two camera traps in the central portion of the Study Area, both from a narrow tract of riparian *Melaleuca* woodland surrounded by dense, rocky eucalypt woodland on steep slopes.
squatter pigeon (southern)	*Geophaps scripta scripta*	Vulnerable	Recorded on 78 occasions occupying a range of habitat types, most commonly along access tracks in non-remnant areas.
white-throated needletail	*Hirundapus caudacutus*	Vulnerable, Migratory	Recorded on 30 occasions flying over a diversity of habitat types, both incidentally and during bird and bat utilisation surveys (BBUS).
greater glider (central and southern)	*Petauroides volans*	Vulnerable	Recorded three times during spotlight surveys. Two records were from gum-topped box (*Eucalyptus moluccana*) woodland adjacent to the Study Area's western boundary. The third record was from *E. moluccana* woodland in the north-western portion of the Study Area.
yellow-bellied glider (south-eastern)	*Petaurus australis australis*	Vulnerable	Recorded four times during spotlighting surveys. All records occur in the far northern extent of the Study Area where the sub-species was recorded utilising *E. moluccana* woodland.

6.4.3 Migratory Fauna

Excluding the white-throated needletail (*Hirundapus caudacutus*) which is also listed threatened, two migratory species were recorded within the Study Area during surveys, as outlined in **Table 6.4.** Species record locations are depicted in **Figure 6.3**.

Table 6.4 Migratory Fauna Recorded within the Study Area

Common Name	Scientific Name	EPBC Act Status	Notes
rufous fantail	*Rhipidura rufifrons*	Migratory	Recorded twice from vine thicket habitat, once in the south-east and once in the north-west of the Study Area.
spectacled monarch	*Symposiarchus trivirgatus*	Migratory	Recorded twice from vine thicket habitat, once in the central portion and once in the north-east of the Study Area.



Legend

- Roads
- Watercourse
- Disturbance Footprint
- Study Area
- Field Survey Extent
- *Cycas megacarpa* Record (ALA)

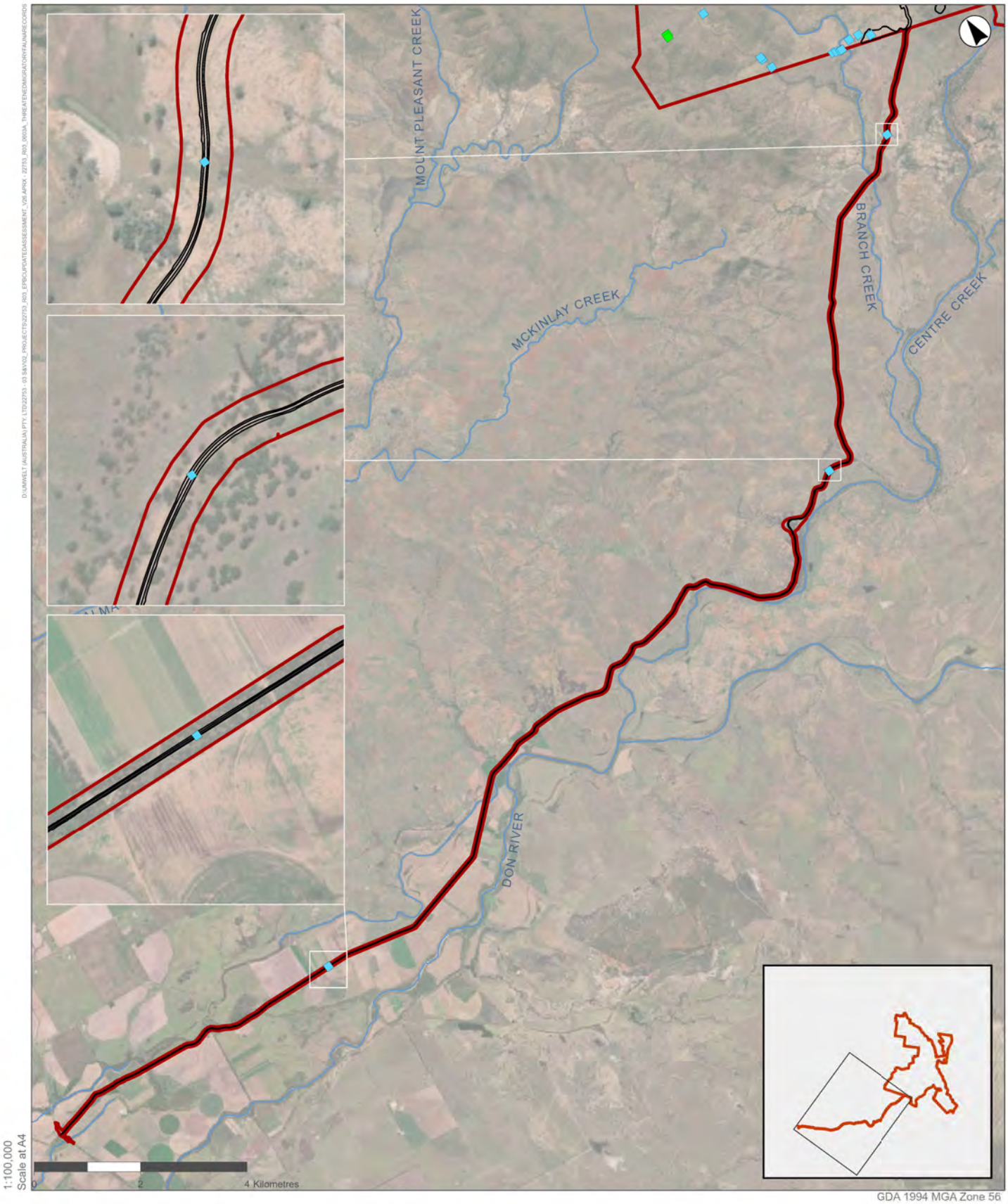
***Cycas megacarpa* Records (Umwelt)**

- Yes
- No

FIGURE 6.2

CYCAS MEGACARPA RECORDS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



1:100,000
Scale at A4

GDA 1994 MGA Zone 56

Legend

- Roads
- Watercourse
- Study Area
- Disturbance Footprint

Threatened Fauna (Umwelt)

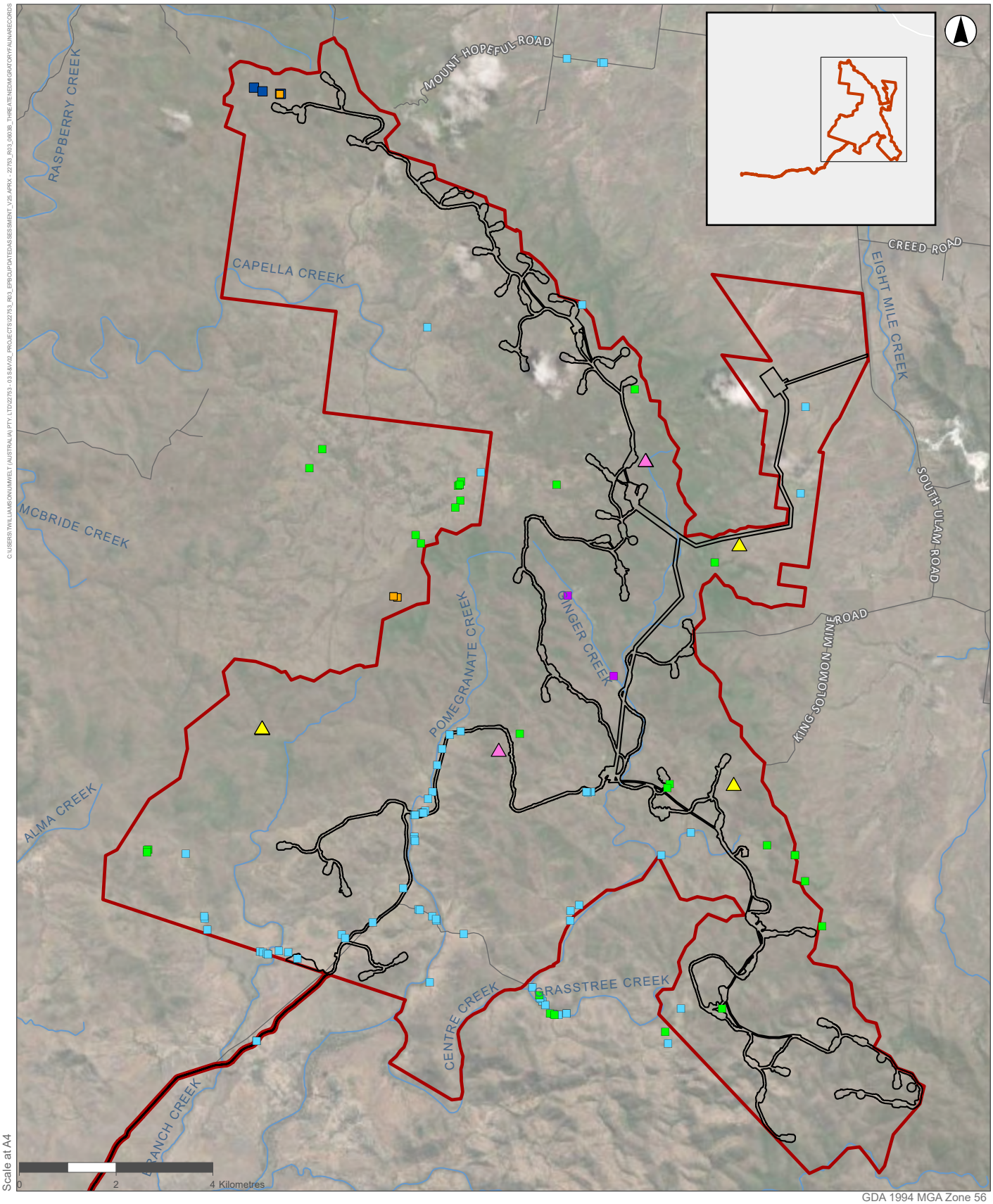
- Squatter pigeon (southern) (*Geophaps scripta scripta*)
- White-throated needletail (*Hirundapus caudacutus*)
- Greater glider (*Petauroides volans*)
- Yellow-bellied glider (*Petaurus australis australis*)

FIGURE 6.3A

THREATENED AND MIGRATORY FAUNA RECORD LOCATIONS

Note: Data Frame is rotated

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Watercourse
- Study Area
- Disturbance Footprint

Threatened Fauna (Umwelt)

- Squatter pigeon (southern) (*Geophaps scripta scripta*)
- White-throated needletail (*Hirundapus caudacutus*)
- Northern quoll (*Dasyurus hallucatus*)
- Greater glider (*Petauroides volans*)
- Yellow-bellied glider (*Petaurus australis australis*)
- Greater glider (*Petauroides volans*)

Migratory Fauna (Umwelt)

- Spectacled monarch (*Symposiachrus trivirgatus*)
- Rufous fantail (*Rhipidura rufifrons*)

FIGURE 6.3A

THREATENED AND MIGRATORY FAUNA RECORD LOCATIONS

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

6.4.4 Birds and Bats

A total of 148 bird species were recorded within the Study Area during the BBUS field program; 88 were recorded during vantage point surveys while the remaining 60 were heard or observed incidentally during travel between vantage points or during other surveys within the Study Area.

A total of 18 bat species were recorded within the Study Area across the field survey program, either acoustically recorded by Anabat devices or caught via harp trapping. Nine of the 18 species were recorded during each BBUS. None of the bat species recorded during the field survey program are listed under the NC Act or EPBC Act.

The full list of bird and bat species identified during the field survey program is provided in **Appendix B** of Attachment B4.

6.4.4.1 At-Risk Species

During the BBUS program, birds were observed flying between 0–1,500 m AGL, including flights within the RSA. A total of 24 bird species were observed flying within the RSA, placing them at risk of turbine blade strike. Of these, one species is listed as threatened/migratory under the EPBC Act (the white-throated needletail). Further discussion of at-risk species is provided in the *Bird and Bat Utilisation Assessment* (Appendix A of the Preliminary Bird and Bat Adaptive Management Plan (Attachment G of the Preliminary Documentation)).

6.4.5 Introduced Species

Thirty-two introduced flora species were identified during the survey program. Of these, five species are identified as WoNS:

- Lantana (*Lantana camara**).
- Prickly pear (*Opuntia stricta**).
- Velvety pear (*Opuntia tomentosa**).
- Rubber vine (*Cryptostegia grandiflora**).
- Parthenium (*Parthenium hysterophorus**).

Five introduced fauna species were identified during the field survey program:

- Wild dog (*Canis familiaris**).
- Cane toad (*Rhinella marina**).
- Cat (*Felis catus**).
- Horse (*Equus caballus**).
- Pig (*Sus scrofa**).

EPBC Act 'key threatening processes' are processes which threaten the survival, abundance or evolutionary development of a native species or ecological community (DAWE 2021). Key threatening processes are linked to three of the above introduced species and include:

- The biological effects, including lethal toxic ingestion, caused by cane toads.
- Predation by feral cats.
- Predation, habitat degradation, competition and disease transmission by feral pigs.

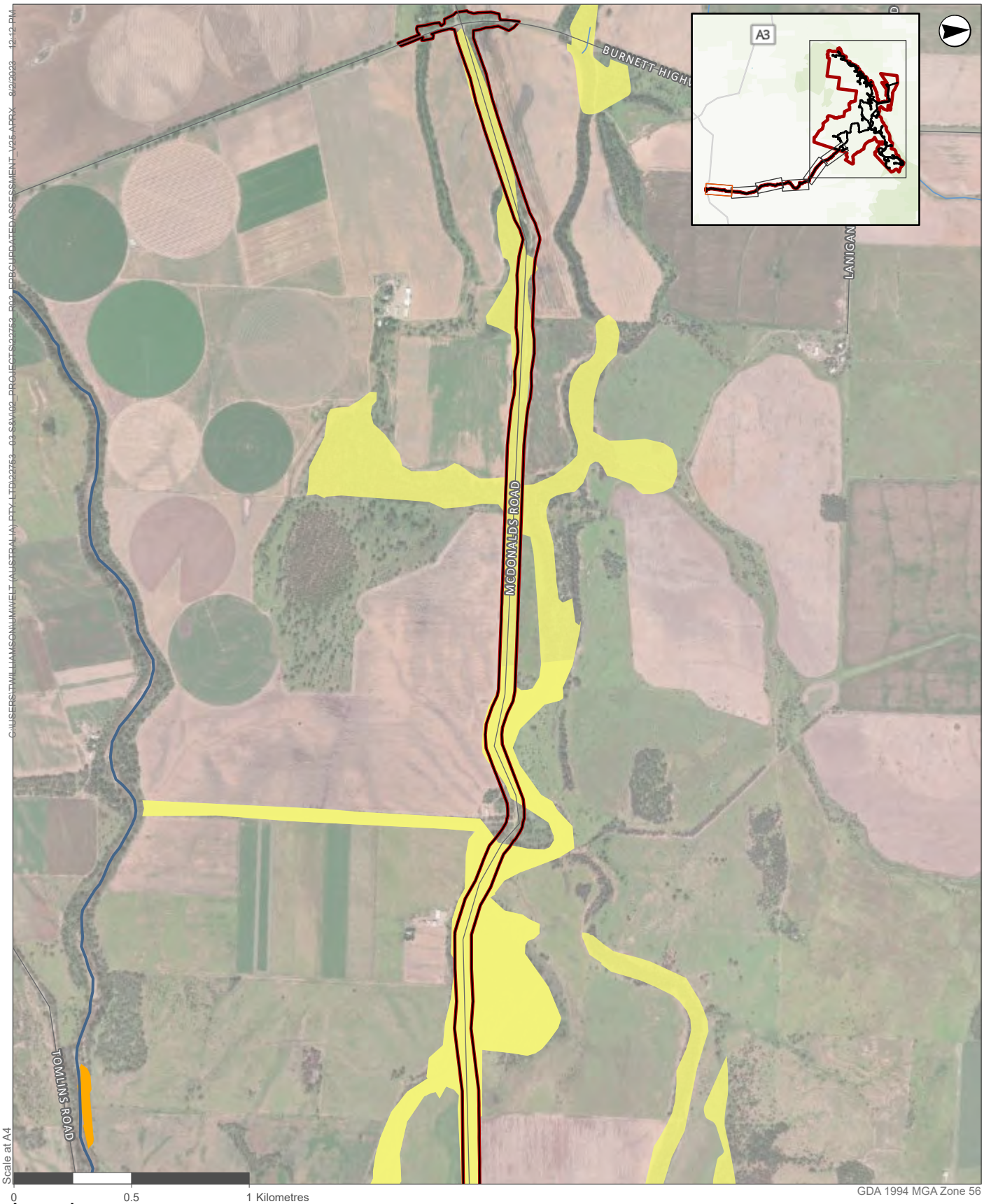
6.5 Wetlands and Watercourses

The aquatic ecological values assessed during field surveys relate to the ephemeral creek systems of the Study Area (depicted in **Figure 6.4**). These creeks include many watercourses comprising stream order four, three, two and one watercourses. Given the highly ephemeral nature of watercourses in the Study Area they were generally dry at the time of field surveys, with small pools persisting after rain where the channel substrate comprised bedrock. The longest major watercourse within the Study Area is Centre Creek, a stream order four watercourse situated along the southern boundary and intersected by the access road corridor. The access road corridor runs parallel to Centre Creek which runs in a westerly direction as a tributary of the Don River, a stream order six watercourse. The access road corridor intersects several smaller drainage features with a stream order of one to four. There are no wetlands mapped within the Study Area.

In-stream aquatic habitat included rocky substrates, varying in complexity from pebbles/stones to large boulders upon bedrock. All watercourses supported in-stream snags such as fallen branches, logs, trees and shrubs. Stream banks comprised grasses consistent with the adjacent woodlands, although riparian ground-cover species such as spiny-headed matrush (*Lomandra longifolia*) were also present. Watercourses showed evidence of disturbance, often associated with cattle impacts such as the presence of weeds (e.g. *Lantana camara** and *Cryptostegia grandiflora**) and ground disturbance.

Fringing riparian vegetation was generally uniform throughout the Study Area, often dominated by *Melaleuca fluviatilis* and/or *Casuarina cunninghamiana*, although vine thicket habitat types which formed a dense canopy was also present. Eucalypts also featured along watercourses, predominately stream order three and stream order four watercourses, with dominant species including *Eucalyptus tereticornis* and *Corymbia tessellaris*.

During brief periods of inundation, the aquatic environment within the Study Area may support marginal assemblages of aquatic fauna species such as native fish and freshwater crustaceans. No aquatic flora species were recorded within the Study Area. However, numerous macrophyte species were recorded in and around the watercourses. These species were represented within alluvial woodlands dominated by *Eucalyptus tereticornis*, *Melaleuca fluviatilis* and *Casuarina cunninghamiana*.



Legend

- Roads
- Development Corridor
- Study Area
- State Forest
- Reservoirs (DoR)

Stream Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream or Higher

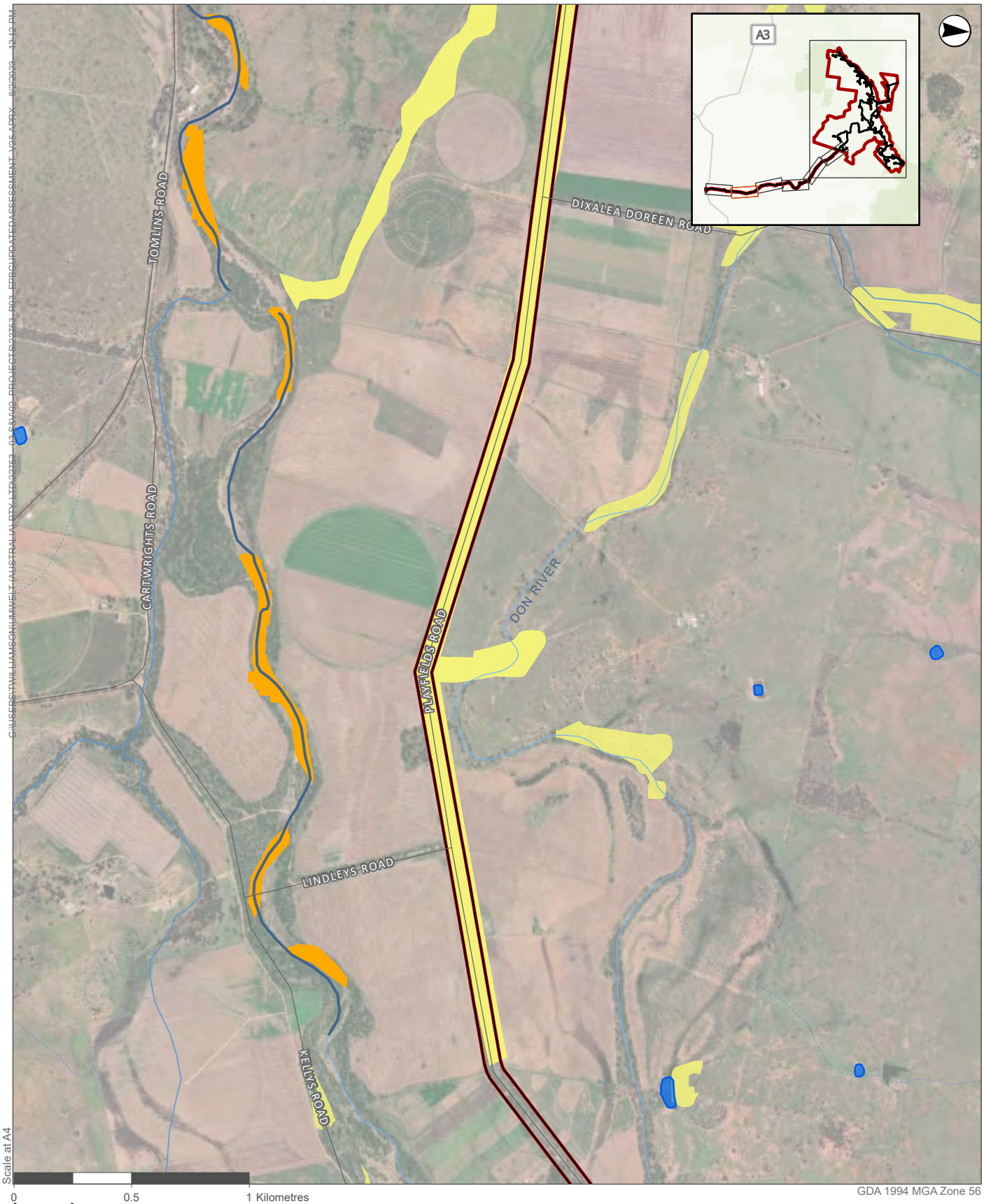
Queensland Wetland Areas (DES)

- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Riverine

FIGURE 6.4A

WETLANDS AND WATERCOURSES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Development Corridor
- Study Area
- State Forest
- Reservoirs (DoR)

Stream Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream or Higher

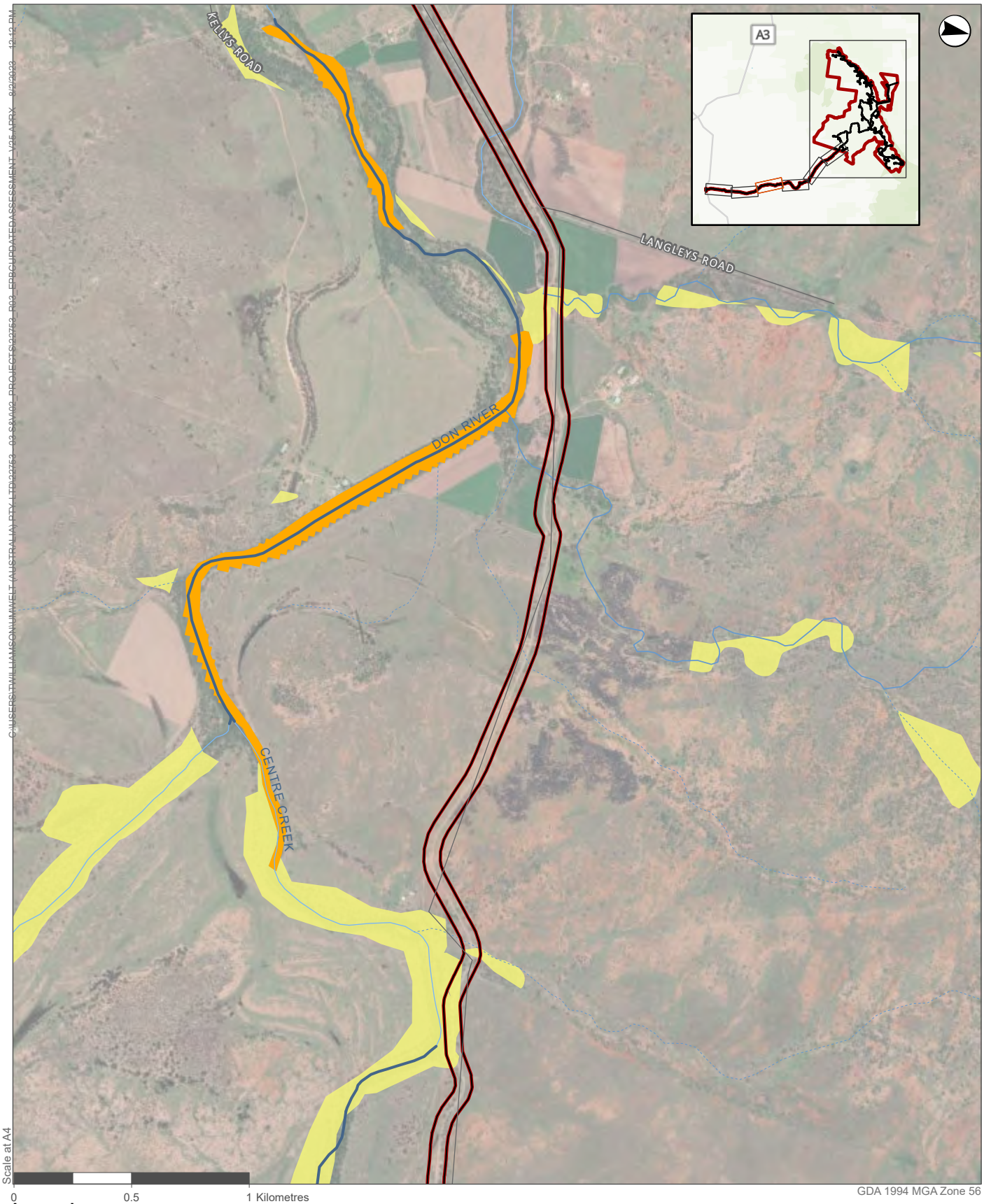
Queensland Wetland Areas (DES)

- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Riverine

FIGURE 6.4B

WETLANDS AND WATERCOURSES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Development Corridor
- Study Area
- State Forest
- Reservoirs (DoR)

Stream Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream or Higher

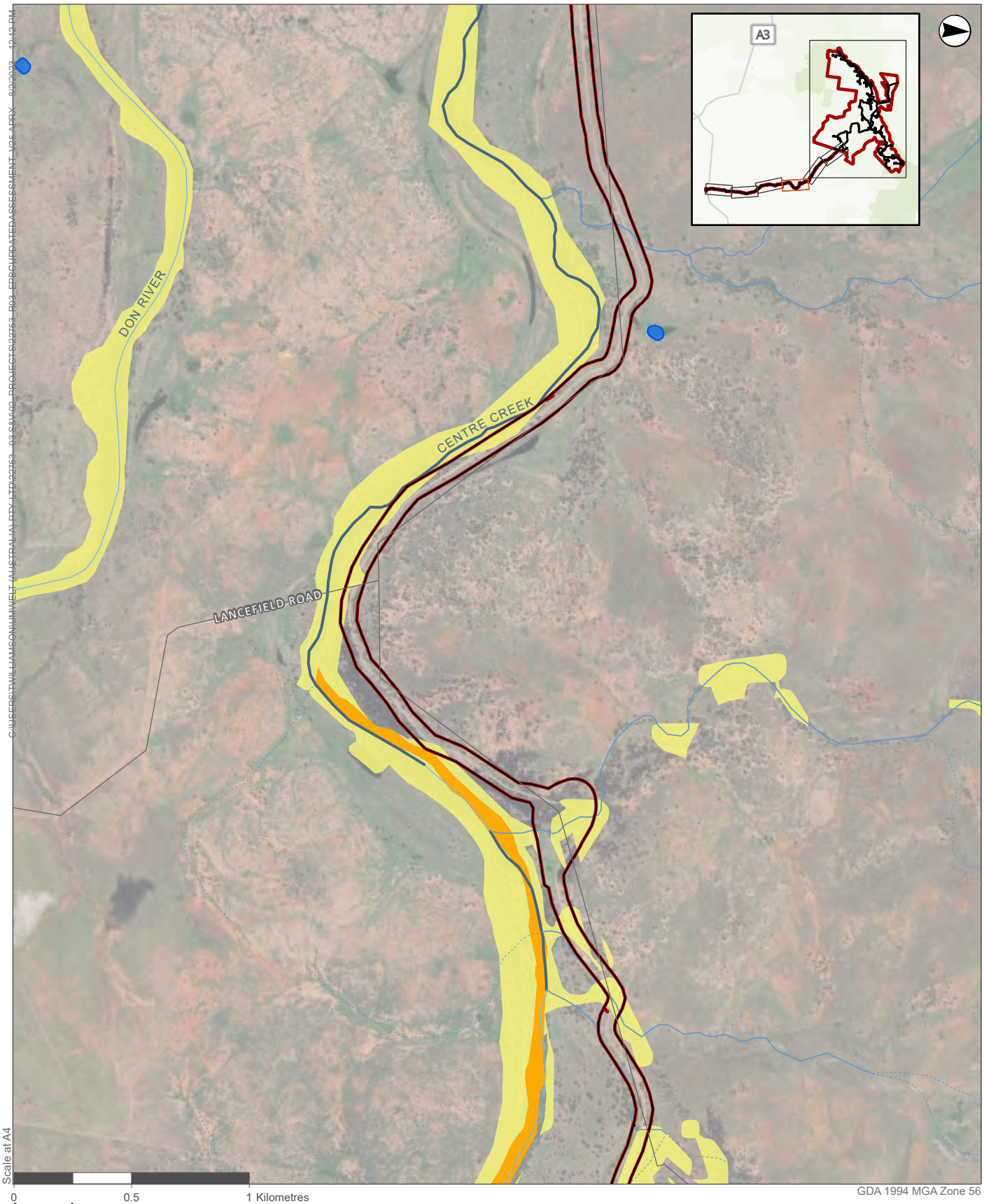
Queensland Wetland Areas (DES)

- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Riverine

FIGURE 6.4C

WETLANDS AND WATERCOURSES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Development Corridor
- Study Area
- State Forest
- Reservoirs (DoR)

Stream Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream or Higher

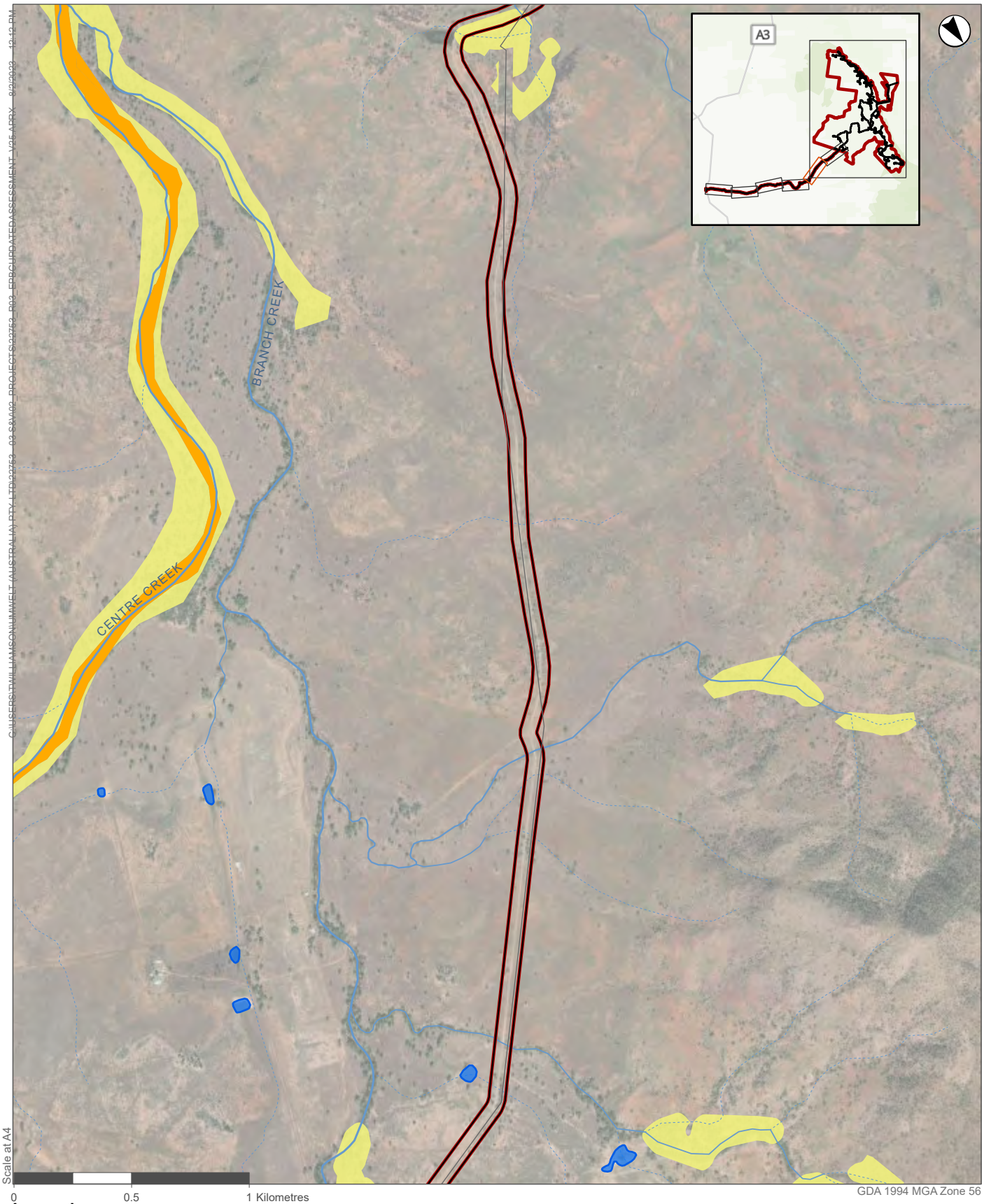
Queensland Wetland Areas (DES)

- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Riverine

FIGURE 6.4D

WETLANDS AND WATERCOURSES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Development Corridor
- Study Area
- State Forest
- Reservoirs (DoR)

Stream Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream or Higher

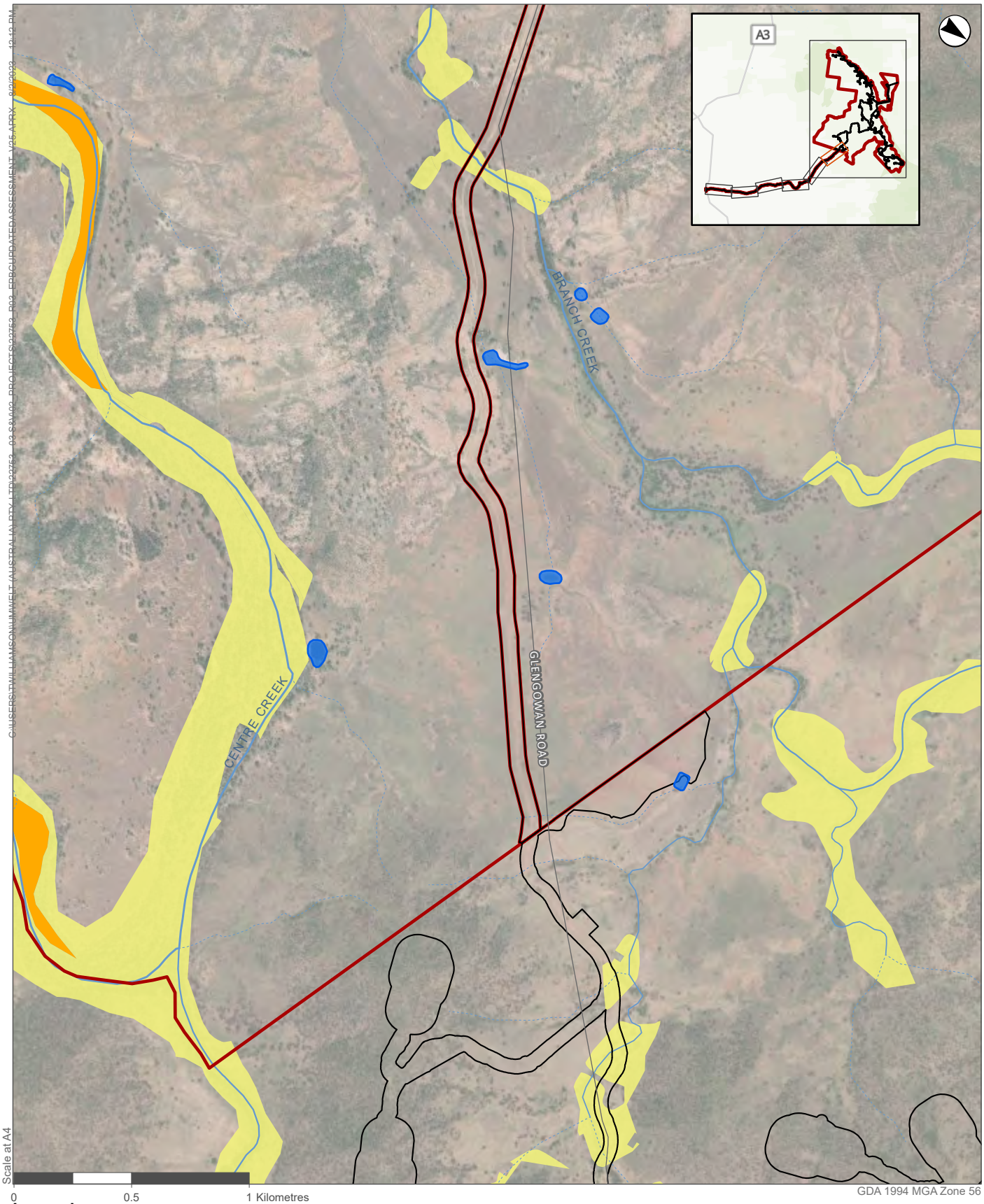
Queensland Wetland Areas (DES)

- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Riverine

FIGURE 6.4E

WETLANDS AND WATERCOURSES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Development Corridor
- Study Area
- State Forest
- Reservoirs (DoR)

Stream Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream or Higher

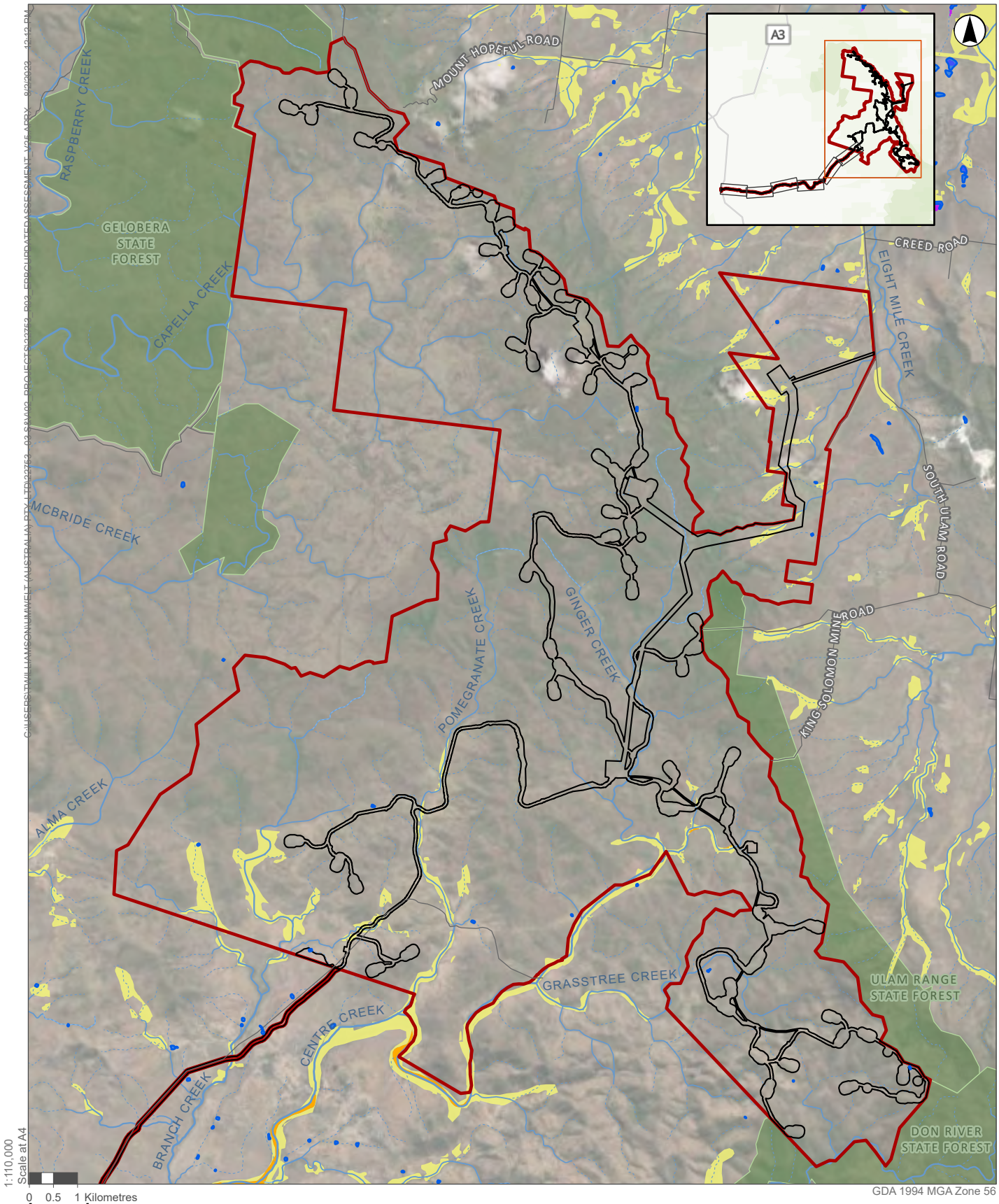
Queensland Wetland Areas (DES)

- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Riverine

FIGURE 6.4F

WETLANDS AND WATERCOURSES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)



Legend

- Roads
- Development Corridor
- Study Area
- State Forest
- Reservoirs (DoR)

Stream Order

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream or Higher

Queensland Wetland Areas (DES)

- Artificial/ highly modified wetlands (dams, ring tanks, irrigation channel
- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Riverine

FIGURE 6.4G

WETLANDS AND WATERCOURSES

Image Source: ESRI Basemap (2022) **Data source:** Department of Resources (2022)

6.6 Habitat Quality Assessment Results

The results of the habitat quality assessments are summarised below in **Table 6.5**, with raw data, detailing the Assessment Unit and Matter Unit of each value along with the matter proportion is provided in **Appendix D** of Attachment B4. The habitat quality assessment results are discussed in further detail in the Offset Management Strategy (Attachment K of the Preliminary Documentation).

Table 6.5 Habitat Quality Assessment Results Table

Species	Matter Unit / Habitat Utilisation	Impact				Offset			
		Cnd^	Cxt^	SSR^	HQS^	Cnd^	Cxt^	SSR^	HQS^
Maximum Score		**3**	**3**	**4**	**10**	**3**	**3**	**4**	**10**
Cycas megacarpa	Habitat	1.9	2.3	3.2	**7.4**	2.0	2.4	3.2	**7.6**
Northern quoll	Denning and refuge	1.3	1.6	2.1	**5.0**	2.0	2.2	2.5	**6.7**
Greater glider (southern and central)	Potential/ future breeding and denning	1.7	2.1	2.1	**5.9**	2.1	2.1	2.6	**6.8**
	Likely/ current breeding and denning	2.2	2.0	2.7	**6.9**	2.2	2.2	3.0	**7.4**
	Foraging and dispersal	1.9	1.5	1.9	**5.3**	1.8	1.9	1.6	**5.3**
Yellow-bellied glider (south-eastern)	Breeding and denning	2.3	1.8	2.6	**6.6**	2.0	2.0	2.1	**6.2**
	Foraging and dispersal	1.8	1.7	2.0	**5.4**	1.9	1.9	1.7	**5.6**
Koala	Climate refugia	1.9	2.1	2.0	**6.0**	2.0	2.2	2.1	**6.3**
	Breeding, foraging and dispersal	2.3	2.0	2.0	**6.3**	2.1	2.2	1.7	**6.0**
Collared delma	Breeding and foraging	1.8	1.8	2.5	**6.2**	2.0	2.3	2.3	**6.6**

^ Cnd: Site Condition Score, Cxt: Site Context Score, SSR: Species Stocking Rate, HQS: Habitat Quality Score.

umwelt
Environmental & Social
Consultants

Umwelt (Australia) Pty Limited

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au