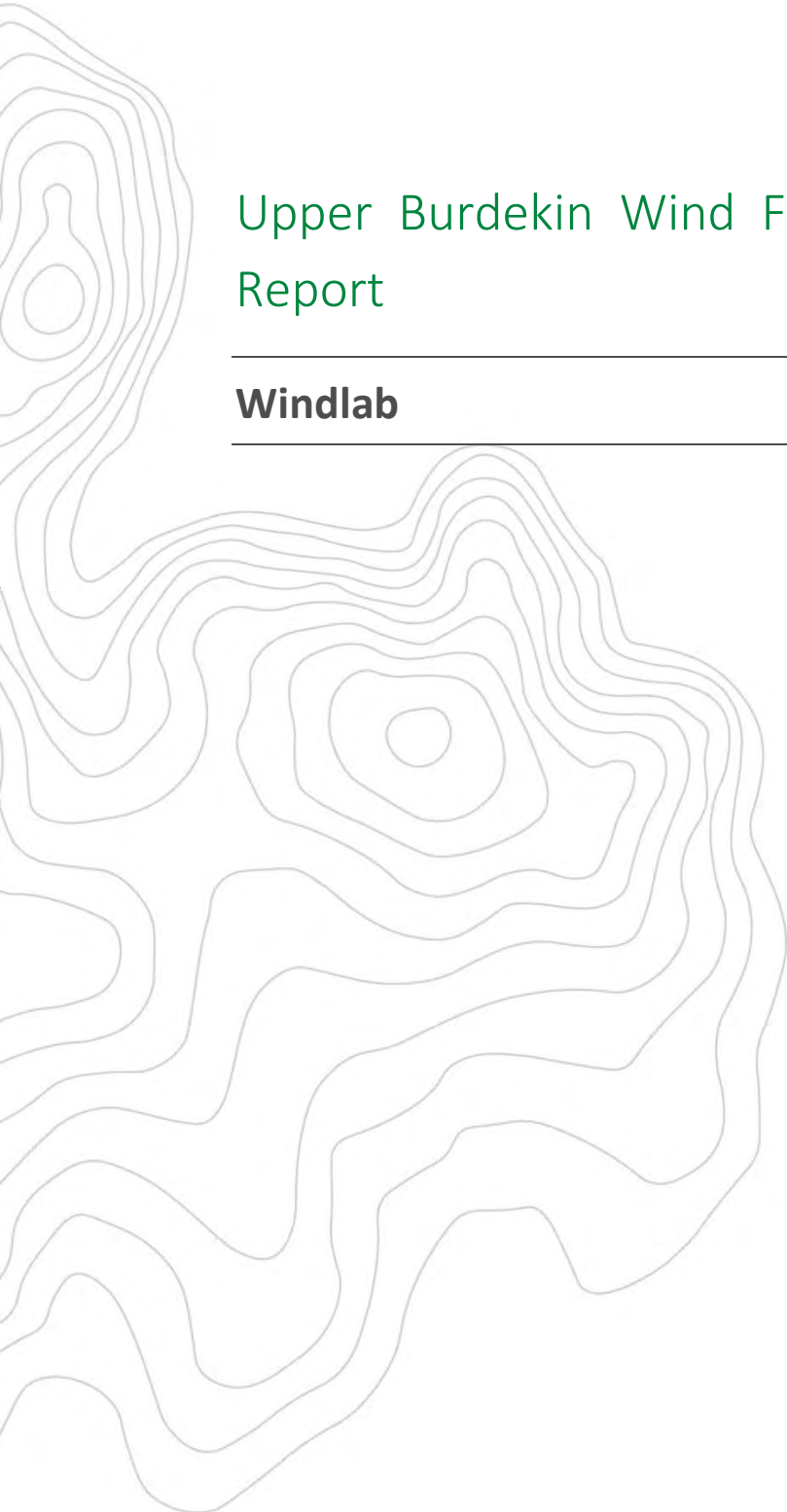


Appendix F. Ecology Report 2022



Upper Burdekin Wind Farm – 2022 Ecology Survey Report

Windlab

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Template 2.8.1

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Abbreviations

Abbreviation	Description
BBUS	Bird and Bat Utilisation Studies
BOM	Bureau of Meteorology
BOO	Best on Offer
BRSB	Bare-rumped sheath-tailed bat
DAWE	Department of Agriculture, Water and the Environment
DES	Department of Environment and Science
DoE	Department of the Environment
ELA	Eco Logical Australia Pty Ltd
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
LiDAR	Light detection and ranging
Mi	Migratory under the EPBC Act
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	<i>Nature Conservation Act 1992</i>
PER	Public Environment Report
PMST	Protected Matters Search Tool
QLUMP	Queensland Land Use Mapping Program
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
SPRAT	Species Profile and Threats
TEC	Threatened Ecological Communities
UBWF	Upper Burdekin Wind Farm
VM Act	<i>Vegetation Management Act 1999</i>

Executive Summary

This report forms the addendum to the *Upper Burdekin Wind Farm – Ecological Assessment* prepared for Windlab by Eco Logical Australia (ELA) (2020). The information presented in this addendum report details the methods and results of desktop and field surveys conducted during March and May 2022 within the disturbance footprint. The intent of these surveys was to build upon survey effort conducted in the broader Project area conducted during 2019 and 2020 surveys, and to obtain habitat quality and condition data for environmental values, specifically, threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Nature Conservation Act 1992* (NC Act).

A contemporary desktop assessment and literature review was conducted to obtain an understanding of EPBC Act and/or NC Act threatened species that may occur in the disturbance footprint that were targeted during field assessments. Habitat assessments were conducted to confirm the extent of habitat mapped within previous studies (ELA, 2020), whilst BioCondition and habitat quality data was collected in accordance with Queensland's *Guide to determining terrestrial habitat quality* (Department of Environment and Science (DES), 2020).

Field surveys revealed that a number of threatened flora and fauna species are known or have potential to occur within the disturbance footprint. These include:

Ten EPBC Act and/or NC Act threatened fauna are known to occur:

Bare-rumped sheath-tail bat, diadem leaf-nosed bat, greater large-eared horseshoe bat, koala, greater glider, Sharman's rock wallaby, red goshawk, masked owl, spectacled flying-fox, and white-throated needletail.

Two EPBC Act and/or NC Act threatened fauna species were identified as likely or having the potential occur:

Glossy black-cockatoo, and grey-headed flying-fox.

Eleven EPBC Act and/or NC Act threatened flora species were identified as likely or having potential occur:

Acacia longipedunculata, *Acacia tingoorensis*, *Commersonia reticulata*, *Corybas cerasinus*, *Corymbia leptoloma*, *Glossocardia orthochaeta*, *Homoranthus cummingii*, *Homoranthus porteri*, *Marsdenia brevifolia*, *Oenanthe javanica*, and *Solanum graniticum*.

Eight migratory and special least concern species were either known or having the potential to occur:

Likely or potential species: white-throated needletail (also vulnerable), fork tailed swift, oriental cuckoo, spectacled monarch, barn swallow, satin flycatcher, rufous fantail

Known species: short-beaked echidna.

1. Introduction

1.1. Project background

Windlab Development Pty Ltd (Windlab) is proposing the Upper Burdekin Wind Farm (UBWF) (the Project) at a site located in the Seaview Range, approximately 65 km south-west of Ingham in North Queensland. The Project has the potential to generate 400-600 MW of power and will consist of both civil and electrical works. Associated works will include a new substation to connect to the existing transmission infrastructure to the east.

The Project area encompasses a broader area of interest, within which the Project infrastructure will be sited. Ecological baseline field surveys were conducted during 2019 and 2020 within the Project area to capture the natural variability and change in species activity and/or likelihood of detection that is experienced in the Wet Tropics and Einasleigh Uplands bioregions across seasons (**Figure 1, Appendix A - Figures**). The objective of those surveys was to gain an understanding of both Matters of State Environmental Significance (MSES) and Matters of National Environmental Significance (MNES) so avoidance and mitigation measures can be implemented during the design of the Project infrastructure. Details on methods and results of these surveys are provided in *Upper Burdekin Wind Farm – Ecological Assessment* (ELA, 2020).

The Project has been referred to the Minister of the Environment (EPBC 2021/9066) and has been determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), requiring assessment by Public Environment Report (PER). PER Guidelines have been issued and include a requirement for additional ecological survey work to support the EPBC Act assessment process.

A State environmental approvals process is currently underway, including application for a State code 23 development approval and associated secondary approvals under the *Planning Act 2016*.

1.2. Survey scope

The scope of this 2022 ecological survey was to ground truth the ecological values present within the disturbance footprint of the proposed wind farm. This included understanding the likely presence of threatened species and their habitats, as well as the condition of those habitats. The disturbance footprint that was the focus of this survey is shown on Figure 1 in Appendix A, and includes all land that will be disturbed to facilitate the construction, commissioning and operation of the Project.

This 2022 survey was informed by the outcomes of previous ecological surveys as describe above. In some cases, the data collected during this survey of the disturbance footprint allowed the results of previous surveys conducted within the Project area to be refined. A description of these updates is also provided in this report.

1.3. Objectives

The objective of this scope of work is to conduct additional ecological surveys to those previously conducted in the Project area outlined in *Upper Burdekin Wind Farm – Ecological Assessment*, prepared for Windlab by Eco Logical Australia (ELA, 2020) and to determine the habitat quality and condition of values occurring in the disturbance footprint. To achieve these objectives, the following was conducted:

Compilation of desktop information to ensure contemporary information is used in the assessment.

Revision of the likelihood of occurrence from ELA, 2020 to incorporate contemporary desktop information and field survey data. A robust assessment of likelihood of occurrence was included and an assessment made on known, likely, potential or unlikely occurring EPBC Act or NC Act listed species.

Conduct additional survey effort in the disturbance footprint, as recommended in the Department of Agriculture, Water and the Environment's (DAWE) PER Guidelines, to capture the optimal habitat condition, or species and assemblages within the area. Surveys included:

Additional survey effort for relevant species in accordance with the *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2018) and relevant Commonwealth survey guidelines.

Additional ground truthing of vegetation in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner et. al., 2020).

Additional ground-truthing of threatened and migratory species habitats and details of species habitat description.

Assessment of habitat quality and condition, via Habitat Quality Assessments and BioCondition Assessments, as per *Guide to determining terrestrial habitat quality* (DES, 2020).

Bird and Bat Utilisation Studies (BBUS), as outlined in Appendix 3 of the State Code 23: Wind Farm Development (Department of Infrastructure, Local Government and Planning), were not part of this scope.

2. Methods

2.1. Desktop assessment and literature review

A desktop assessment was undertaken prior to the field assessment to identify ecological values that may occur within the disturbance footprint.

2.1.1. Database searches

To assess potential Commonwealth and State environmental matters that may occur within the disturbance footprint, the following key databases and resources were reviewed:

- EPBC Act Protected Matters Search Tool (PMST), undertaken on the 20th April 2022 with a shapefile applying a 30 km buffer around the disturbance footprint
- WildNet Records Species List, undertaken with a 30 km buffer around the disturbance area (-18.3803, 145.3612 to -19.1923, 146.1463) on the 20 April 2022 for all fauna and flora species lists and individual records of listed species
- Atlas of Living Australia (ALA) database using a 30 km buffer from the disturbance area for all threatened flora and threatened or migratory fauna species
- Regional Ecosystem (RE) mapping version 11 and 12.2 (DES, 2022)
- Department of Environment and Heritage Protection's (DEHP) Protected Plants Flora Survey Trigger mapping (DES, 2022)
- Queensland MSES report (DES, 2022)
- Vegetation Management Act (VM Act) watercourse mapping (DNRM, 2012)
- Queensland geological digital data (DNRM, 2012)
- Land-systems mapping (CSIRO, 1967)
- Queensland Land Use Mapping (QLUMP, 2018)
- Planning cadastre
- Species Profile and Threats Database (DAWE, 2022), Approved Conservation Advice, National Recovery Plans and Survey Guidelines for MNES and MSES species occurring within the disturbance area
- Aerial imagery
- LiDAR (Windlab data / ELA Memo sources).

Database search results for WildNet and PMST are provided in **Appendix B - Database searches**. Threatened species records obtained from ALA are illustrated on **Figure 2, Appendix A - Figures**.

2.1.2. Previous studies

A review of previous studies undertaken within the Project area as well as those undertaken by other proponents within 30 km of the disturbance area, for matters as identified within the PMST, were reviewed to determine threatened species records, to assist in identifying target species. These include:

- Eco Logical Australia, 2020. Upper Burdekin Wind Farm – Ecological Assessment. Prepared for Windlab Pty Ltd.
- Nature Advisory, 2022a. Bird Utilisation Survey and White-throated Needletail survey – Late wet season. Prepared for Windlab Pty Ltd.

- Nature Advisory, 2022b. Red Goshawk and Roaming Bird Survey. Prepared for Windlab Pty Ltd.
- Mt Fox Energy Park Ecological Assessment. 4 Elements Consulting (2021). *Unpublished*. Publicly available as part of the EPBC Act referral 2021/8910.
- Powerlink Kidston Connection Project, Matters of National Environmental Significance - Ecology Assessment. Powerlink Queensland. Aecom (2021). *Unpublished*. Publicly available as part of the EPBC Act referral 2021/9060.

2.1.3. Likelihood of occurrence

A likelihood of occurrence assessment was previously conducted for the whole of Project area (ELA, 2020). This likelihood of occurrence assessment was refined prior to 2022 field surveys to identify threatened flora and fauna and migratory species that may occur within the disturbance area. Species database searches were re-run prior to the survey to ensure any new species were captured in the likelihood assessment and included in the field survey effort, including checking PMST, WildNet and ALA resources. Additionally, the database searches were re-run to also exclude species which are unlikely to occur given that the Disturbance footprint does not intersect with the high-rainfall zone of the Wet-Tropics Bioregion.

An initial likelihood assessment of species potentially occurring in the disturbance footprint was conducted prior to the field assessment, based on ground-truthed mapping (ELA, 2020), database records, the known distribution and preferred habitat of each species. The criteria used to assess the likelihood of threatened species occurring within the disturbance footprint is presented in **Table 2-1**. This assessment provided a targeted list of threatened and migratory species to focus habitat assessments and field effort.

The likelihood of occurrence assessment was updated after the field survey and analysis of data, when more definitive data about the potential occurrence of on-ground values was available. The results of the likelihood assessment are presented in **Appendix C - Likelihood of Occurrence Table**.

Table 2-1: Likelihood assessment criteria of occurrence within disturbance area

Likelihood	Description
Known	Species was positively identified and recorded in the disturbance area during the field assessment; previous records of occurrence within the disturbance area.
Likely	Species was not recorded during the field survey or previously, however there are known records within the nearby surrounding area and suitable habitat exists on site.
Potential	Species was not recorded during the field survey or previously, however known records occur within the surrounding area and habitat in the disturbance area is marginal or degraded.
Unlikely	Habitat in the disturbance area might be suitable or marginal; however, species was not recorded during the field survey, and no known records of the species exist within the surrounding area.

2.2. Field survey

Field surveys were conducted by four suitably qualified ecologists over nine days in March and May 2022. Field survey methods used during the 2022 survey are outlined in the sections below. The location of survey sites from across all surveys undertaken within the Project area are illustrated on **Figure 3** and **Figure 4**. The overview of survey effort from all surveys (2019, 2020, 2022) is provided in (**Appendix A - Figures**).

2.2.1. Flora survey

The flora assessment consisted of refining RE mapping across the disturbance footprint to increase accuracy and resolve mixed polygons, where possible. Data on vegetation characteristics (floristic and structural form), ecological condition and extent of the vegetation communities was collected via three methods: BioCondition, tertiary, and quaternary assessments. Targeted searches for threatened flora species were also undertaken, and incidental observations of weed species were recorded across the disturbance footprint.

2.2.1.1. BioCondition assessments

BioCondition assessments were undertaken within the disturbance footprint in accordance with the BioCondition Manual (Eyre *et al.* 2015). BioCondition assessments involved the collection of the following 13 site-based attributes within a 100 m x 50 m nested sampling plot:

- Recruitment of woody perennial species
- Native tree species richness
- Native shrub species richness
- Native grass species richness
- Native forb species richness
- Tree canopy height
- Tree canopy cover
- Shrub canopy cover
- Native perennial grass cover
- Organic litter cover
- Number of large trees
- Coarse woody debris abundance
- Non-native plant cover

A total of 26 site condition assessments were conducted throughout the disturbance footprint.

2.2.1.2. BioCondition assessments – Best on Offer

The BioCondition method of analysis applies a comparison between measurements of specific site-based attributes and a benchmark value for each of those attributes, specific to each Regional Ecosystem (RE). Benchmark values are largely unavailable for the wide range of REs that occur in the Einasleigh Uplands and Wet Tropics Bioregions, where the disturbance footprint is situated. The development of benchmark values requires multiple samples of a RE in its reference state, to develop average or median measurements for each attribute. A reference site is defined in the “Methods for the Establishment and Survey of Reference Sites for BioCondition” (Eyre *et al.*, 2017) as an area that represents an example of a Regional Ecosystem in Functional Condition. Due to survey effort and area constraints, a single

representative ‘Best on Offer’ (BOO) site for REs without a benchmark was developed. The BOO site is established within the Project area to capture the homogeneity between sites, and better represent the local condition of the RE being analysed. In instances where a BOO site could not be established within the Project area, benchmark data was utilised from field data collected on that RE from other survey site locations. A BOO site does not necessarily represent the most functional condition of a RE (pre-European disturbance), nor is it repeated to statistically validate the result as is a benchmark which requires much greater survey effort.

A BOO site is developed in accordance with the “Methods for the Establishment and Survey of Reference Sites for BioCondition” (Eyre *et al.*, 2017). Attributes that do not require assessment at reference sites, compared to BioCondition sites, include recruitment of canopy species, non-native plant cover, and the attributes relating to landscape context.

2.2.1.3. Tertiary surveys

Tertiary surveys were used to identify vegetation communities and REs across the disturbance footprint by capturing data on the condition and species composition. Tertiary surveys were undertaken in accordance with the ‘*Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland*’ (Neldner *et al.*, 2020). At each survey point, the following information was recorded:

- RE classification
- vegetation condition (remnant, high-value regrowth, regrowth, non-remnant)
- dominant, co-dominant, sub-dominant and associated species, as well as average height and cover at each structure level (emergent, T1, T2, T3, S1, S2, ground)
- ecologically dominant layer (emergent, T1, T2, T3, S1, S2, ground)
- structure (dense, mid-dense, sparse, very sparse)
- landform
- slope class and degree
- soil texture and colour
- evidence of disturbance (for example weeds, clearing, grazing or fire) and erosion.

RE classification was determined based on the vegetation, soil and landform characteristics identified in the field, geological mapping for the region and the Regional Ecosystem Description Database (REDD). Condition status for woody vegetation was evaluated using the definitions of remnant vegetation under the VM Act.

A total of 51 tertiary surveys were conducted during the 2022 survey within the disturbance footprint. A further 55 tertiary surveys were undertaken within the Project area during 2019 and 2020 field surveys, which informed vegetation mapping within the disturbance footprint.

2.2.1.4. Quaternary surveys

Quaternary surveys were undertaken to validate the extent, classification and condition of ground-truthed vegetation communities and habitat types within the disturbance footprint. Quaternary surveys were undertaken in accordance with Neldner *et al.* (2020). At each survey point, the following information was recorded:

- RE classification

- vegetation condition (remnant, high-value regrowth, regrowth, non-remnant).
- dominant species at each structure level (emergent, T1, T2, T3, S1, S2, ground)
- ecologically dominant layer height (m) and cover (%)
- structure (dense, mid-dense, sparse, very sparse).

A total of 313 quaternary surveys were conducted during the 2022 survey within the disturbance footprint. A further 459 quaternary surveys were undertaken within the Project area in 2019 and 2020 field surveys which informed vegetation mapping within the disturbance footprint.

2.2.1.5. Threatened species searches

Targeted threatened species searches were conducted across the disturbance footprint throughout the field campaign. Based on the results of the likelihood assessment (**Appendix C**), targeted surveys focused specifically on determining the location and habitat for the species likely or potential to occur in the disturbance footprint, provided in **Table 2-2**.

Table 2-2: Summary of target threatened flora species

Flora group	Species
Trees / shrubs	<i>Acacia longipedunculata</i> , <i>Acacia tingoorensis</i> (Tingoorensis wattle), <i>Commersonia reticulata</i> , <i>Corymbia leptoloma</i> (yellowjacket), <i>Homoranthus cummingii</i> , <i>Homoranthus porteri</i> , <i>Marsdenia brevifolia</i>
Orchids and forbs	<i>Corybas cerasinus</i> (red helmet orchid), <i>Glossocardia orthochaeta</i> , <i>Oenanthe javanica</i> (water celery), <i>Solanum graniticum</i> (granite nightshade).

Targeted threatened species surveys were directed by knowledge and understanding of the targeted flora species and their potential habitat. Field teams conducted opportunistic searches in areas of potential habitat and during formal assessments such as Tertiary or BioCondition level assessments.

2.2.1.6. Threatened ecological communities

Two threatened ecological communities (TECs), Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland and Lowland tropical rainforest of the Wet Tropics were identified in the desktop assessment as having potential to occur in the disturbance footprint. Based on previous ecological assessments (ELA, 2020), both communities were determined to be unlikely. Nonetheless, the Approved Conservation Advice of each of these TECs was reviewed, and if vegetation communities that could be identified as the TECs were observed, these were assessed against the relevant diagnostic and condition criteria of the ecological community.

2.2.2. Fauna survey

The fauna survey consisted of targeted habitat assessments and searches, habitat quality assessments and a variety of passive fauna detection methods: ultrasonic and acoustic detectors, remote cameras, and drone surveys. Based on the results of the likelihood assessment (**Appendix C**), targeted surveys focused specifically on determining the presence, site usage and habitat value for the following species presented in **Table 2-3**. Reptile species were considered unlikely to occur within the development footprint (**Appendix C**), therefore no reptile specific fauna detection techniques were undertaken.

Table 2-3: Summary of target threatened, migratory or special least concern fauna species

Fauna group	Species
Mammals	Diadem leaf-nosed bat (<i>Hipposideros diadema reginae</i>), greater glider (northern) (<i>Petauroides minor</i>), Sharman's rock-wallaby (<i>Petrogale sharmani</i>), koala (<i>Phascolarctos cinereus</i>), spectacled flying-fox (<i>Pteropus conspicillatus</i>), grey-headed flying-fox (<i>Pteropus poliocephalus</i>), greater large-eared horseshoe bat (<i>Rhinolophus robertsi</i>), bare-rumped sheath-tailed bat (<i>Saccolaimus saccolaimus nudicluniatu</i>), short-beaked echidna (<i>Tachyglossus aculeatus</i>).
Birds	Glossy black-cockatoo (<i>Calyptorhynchus lathami erebus</i>), red goshawk (<i>Erythroriorchis radiatus</i>), white-throated needletail (<i>Hirundapus caudacutus</i>), masked owl (northern) (<i>Tyto novaehollandiae kimberli</i>).
Migratory birds	Fork-tailed swift (<i>Apus pacificus</i>), oriental cuckoo (<i>Cuculus optatus</i>), barn swallow (<i>Hirundo rustica</i>), spectacled monarch (<i>Monarcha trivirgatus</i>), satin flycatcher (<i>Myiagra cyanoleuca</i>), rufous fantail (<i>Rhipidura rufifrons</i>).
Amphibians	Magnificent brood frog (<i>Pseudophryne covacevichae</i>)

A range of survey locations and techniques were employed to target these threatened species, as detailed in the following sections. Whilst the methods focussed on the target species, other vertebrate fauna species were also recorded incidentally by the field teams. For example, pest species were recorded across the disturbance footprint to understand their impact on threatened species and habitat condition. Findings from previous studies undertaken in the Project area also informed the placement of field survey techniques.

2.2.2.1. Site selection

The intent of these surveys was to build upon survey effort previously undertaken within the Project area. In particular, survey effort was focused on assessing habitat values and potential species occurrences in the disturbance area, especially where site-specific data was not able to be collected during previous surveys. The location of fauna survey sites was selected to allow for sampling of habitat for each threatened or migratory fauna species (target species) having potential to occur, as identified in the desktop assessment (**Appendix C**). Survey locations, as well as those undertaken during previous studies within the Project area are displayed in **Appendix A, Figure 3**. In conjunction with previous survey effort undertaken within the Project area, survey sites were established in locations that were compliant with species specific survey guidelines and required survey effort for each of the target species, as detailed in **Appendix D**.

2.2.2.2. Targeted habitat assessments

Targeted habitat assessments were conducted for species identified in the desktop assessment as potentially occurring in the disturbance area and for those with specialist habitat requirements. For these species, specific details of habitat features are required to understand their potential occurrence in the disturbance area. Data collected on habitat features specific to each species was guided by relevant National Recovery Plans, Commonwealth Listing Advice and Survey Guidelines (specific references are provided in Appendix D - Survey effort) and knowledge from suitably qualified ecologists who have experience in the region and with the species. Targeted species and their associated microhabitat features include:

Mammals

- greater glider (hollow-bearing trees, size of hollows, tree species)

- koala (food tree species, canopy connectivity)
- Sharman’s rock-wallaby (density and structure of rocks, boulders and crevices)
- spectacled flying fox and grey-headed flying fox (fruiting and flowering flora species, evidence of camps)

Micro-bats

- bare-rumped sheath-tailed bat (abundance and suitable size hollows, intact Eucalyptus woodland)
- diadem leaf-nosed bat (suitable cave roost sites – high and domed)
- greater large-eared horseshoe bat (complex vegetation with intact understory and presence of basal hollows)

Birds

- glossy black-cockatoo (food tree species, frequency of hollows)
- masked owl (hollow-bearing trees, size of hollows, prey abundance)
- red goshawk (tall trees within 1 km to a permanent water source, prey abundance)

2.2.2.3. Fauna detection methods

Active and passive fauna survey methods were used to expand upon survey effort conducted during 2019 and 2020 surveys in the Project area (ELA, 2020) and further determine the presence of threatened or migratory fauna species, as follows:

Active methods:

- opportunistic bird surveys
- active searches, including scat and track searches, den and roost site searches
- drone surveys
- spotlighting and call playback.

Passive methods:

- ultrasonic and acoustic call detectors
- baited remote cameras

Each of these methods is described in further detail below. Survey site locations for all survey methods are shown in **Figure 3** and **Figure 4, Appendix A - Figures**. Overall survey effort per method is presented in **Appendix D - Survey effort**.

2.2.2.4. Diurnal active searches

Diurnal active searches were conducted throughout the disturbance footprint for potential threatened species habitat during habitat assessments.

Active searching included searching to directly observe threatened species or find indirect evidence of species’ presence, such as roost signs, scats, scratches, tracks or nests.

Active diurnal searches for marsupial species scats were conducted near potential den sites, in rocky areas, under target trees, and along creek lines. Active diurnal searches for signs of Sharman’s rock-wallaby specifically focused on scats, smooth worn rock ledges, and tracks in sandy substrate on rock

ledges / cliff lines. Diurnal active searches for koala focussed on direct sightings of the species or evidence of scratches on trees or scats. Searches for roost sites of flying foxes were conducted across the disturbance footprint. Birds were opportunistically observed throughout the day within different habitats. Red goshawk nests were actively searched for in tall trees along watercourses or emergent trees throughout woodlands.

Drone surveys targeted red goshawk nests and Sharman’s rock-wallaby habitat (**Figure 3, Figure 4 and Figure 15**). A DJI Mavic Air 2 drone was operated by an ecologist using the DJI Fly application (Version 1.1.6). The drone was flown along riparian zones and over the tree canopy in suitable red goshawk habitat to inspect trees for potential red goshawk nests. Drone flights were also conducted over potential Sharman’s rock-wallaby habitat to identify boulder stacks that may represent core habitat for the species.

2.2.2.5. Spotlighting and call playback

Spotlighting and call playback surveys targeted nocturnal threatened species such as koalas, greater glider, masked owl and Sharman’s rock-wallaby. As flower blooms were infrequent during the study period, spectacled flying fox or grey-headed flying fox were not specifically targeted. Spotlighting included two survey methods by two ecologists: slow driving transects to allow for maximum coverage whilst detecting nocturnal species, and slow walking transects. Spotlighting was complimented with intermittent call playback for target species known to respond (koala and masked owl). Spotlighting effort was limited during the 2022 survey due to weather conditions and reduced survey time.

2.2.2.6. Ultrasonic and acoustic detectors

Ultrasonic bat detection devices (Anabat Swifts and SM3 devices) were used to determine species presences within the disturbance footprint and surrounding region. Unattended bat recorders were placed in the vicinity of rocky outcrops or in foraging sites such as vegetation corridors, flyways, over watercourses and adjacent to artificial waterbodies (dams) in representative potential, likely and known habitat. A time delay was programmed into each ultrasonic device such that the Anabats recorded calls from 5 pm to 5 am the next morning.

Acoustic recording devices (Wildlife Acoustics Song Meter SM3 and SM4) were used to detect the presence of koala, masked owl, red goshawk and magnificent brood frog within the disturbance footprint and surrounding region. These were placed in representative potential, likely and known habitat for these species. Acoustic recording devices were programmed to record all day and night to target both diurnal (Red goshawk) and nocturnal species (koala, masked owl and magnificent brood frog).

2.2.2.7. Remote cameras

Remote cameras were deployed across the disturbance footprint and surrounding region to detect the presence of threatened fauna. Locations included areas of known or potential habitat, such as adjacent waterbodies, along ledges in rocky outcrops, near hollow bearing trees, burrows or at the base of fallen logs. To increase the likelihood of attracting fauna, each camera was aimed a bait station containing universal bait (a mixture of peanut butter, oats, honey and sardines). Remote camera locations are displayed in **Appendix A, Figure 3**.

Cameras were fixed to trees or other habitat features and were directed towards a bait station positioned approximately 2-8 m away on the ground, often amongst boulders or at suspected den sites. Bait stations were baited with a universal bait.

Each camera was programmed to take up to three images each trigger event with a one second delay between triggers. Cameras were set to run 24 hours per day. All photographs were downloaded from the cameras and analysed by a suitably qualified ecologist.

2.2.3. Assessment of condition and habitat quality

2.2.3.1. Habitat quality assessment

Habitat quality assessments were undertaken in accordance with the Guide to Determining Terrestrial Habitat Quality (version 1.3) (DES, 2020). Habitat quality assessments were undertaken for species known and likely to occur within the disturbance footprint, and conducted in representative areas of potential species habitat and included the following assessments:

- Landscape-scale attributes – describes the surrounding landscape of the subject area, and the influence this has on the vegetation quality.
- Site-based attributes – provides an indication of the general vegetation condition of an area
- Species habitat attributes – determines the ability of an area to support a particular fauna species based on that species' specific habitat requirements.

These assessment methodologies are discussed in detail in the sections below.

2.2.3.2. Landscape-scale attributes

The landscape surrounding the disturbance footprint is assessed at the Bioregion scale as either fragmented, or intact, as per the BioCondition Assessment Manual (Eyre *et al.*, 2015). A fragmented landscape has sharp or high contrast edge boundaries and includes the Wet tropics Bioregion (7). An intact landscape is characterised by low contrast edge boundaries and includes the Einasleigh Uplands Bioregion (9). The attributes measured to assess the landscape context to species habitat quality differs according to whether the landscape is fragmented or intact.

A fragmented landscape is assessed by measuring the following four landscape-scale attributes:

- size of patch
- context
- connectivity
- ecological corridors

An intact landscape is assessed by measuring the single landscape-scale attribute of:

- distance to permanent water

The assessment of landscape-scale attributes was undertaken in a desktop setting as per the Guide to Determining Terrestrial Habitat Quality, which refers to the methodology described in the BioCondition Assessment Manual (Eyre *et al.*, 2015). A landscape-scale attribute numerical score out of 20 was generated for each fragmented and intact landscapes.

2.2.3.3. Site-based attribute assessments

Site-based attribute assessment was undertaken as per the Guide to Determining Terrestrial Habitat Quality (2020), which refers to the methodology described in the BioCondition Assessment Manual (Eyre *et. al.*, 2015). Refer to **Section 2.2.1.1**.

The analysis and development of RE representative BOO sites was undertaken in accordance with the “Methods for the Establishment and Survey of Reference Sites for BioCondition” (Eyre *et al.*, 2017) or detailed within **Section 2.2.1.2**. Data derived using this method was used in conjunction with the BioCondition Assessment Manual (Eyre *et. al.*, 2015). Refer to **Section 2.2.1.2**.

2.2.3.4. Species habitat attribute assessments

Species habitat quality attributes are designed to assess the capacity of a habitat area to support a species for all or part of its life. Specifics for each species are not provided in State guidelines, therefore, species specific habitat requirements were researched using available literature and the knowledge of experienced, suitably qualified ecologists for each potentially occurring threatened species (as determined by the desktop assessment). Terrestrial habitat quality assessments were conducted concurrently at each site-based attribute assessment site for each relevant species (**Appendix A, Figure 3**). These assessments were conducted for species assessed as potentially occurring, as per **Appendix C** and on-site habitat suitability assessments (refer to **Section 2.2.2**).

For each species, three measurable habitat attributes are assessed against a series of species-specific environmental indicators. Each environmental indicator is assigned a score from 0-5, where 0 represents the lowest quality and/or availability, and 5 represents the highest quality and/or availability. Each score in the five-point rating scale is assigned a specific measure of the indicator (**Table 2-4**). The rating-scale for field-based indicators is used strictly as a guide to assist ecologists assign the most appropriate score. The ecological requirements of a species habitat attribute cannot routinely fit into pre-determined categories. Scores assigned to a species habitat attribute in the field is made at the discretion of the ecologists undertaking the survey. To bolster habitat quality interpretation and analysis in instances where it is difficult to measure habitat using the described method, usually because species requirements are poorly defined in literature or the species is a generalist, an additional “over all” score was collected.

Measured species habitat attributes include:

- Quality and availability of food and habitat required for foraging
- Quality and availability of habitat required for shelter and breeding
- Quality and availability of habitat required for mobility

Additionally, for each species the habitat is assessed for the absence of threats. Threatening processes are informed through species literature resources, such as conservation advice and recovery plan publications, and further assessed in the field as reasonably practicable. Each identified threat is assessed against the scope and severity threat matrix, provided in the *Guide to determining terrestrial habitat quality* (DES, 2020). The threat matrix results in a single overall score which represents the magnitude of the most threatening factor identified to occur within or in proximity to the matter area.

Threats were assessed on the following four principles:

- Scope of threats regarding what percentage of the population or habitat within the matter area will be affected over the next 10 years or 3 generations
- Low scores reflect higher percentage (80-100%) of population or habitat being destroyed while high scores are assigned where a smaller portion (1-19%) of habitat or population is slightly degraded or negligibly affected
- Severity of threat assesses what percentage for the population, or its habitat will be affected by the threat.
- Low scores being allocated when 80-100% of the population or its habitat will be affected, and high scores being allocated when the threat is negligible and will affect only a small proportion (1-5%) of a species habitat or population.

Species habitat attributes, environmental indicators, and literature supported justification for inclusion are presented below.

Table 2-4: Summary of species habitat attributes and field indicators

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Birds			
Masked owl (<i>Tyto novaehollandiae</i>)			
Quality and availability of food and habitat required for foraging	Ground vegetation community	Score 0 - cleared OR dense tall shrub layer OR dense thickets of weed species	In northern Australia the masked owl is known to occupy habitats including riparian forest, rainforest, open forest, <i>Melaleuca</i> swamps and the edges of mangroves, as well as along the margins of sugar cane fields (Higgins 1999; Nielsen 1996; Storr 1977, 1980). Foraging behaviour has been recorded to take place in open woodland, taking small-medium sized mammals as prey (Garnett & Crowley 2000). Ground vegetation community cover is an important indicator for the quality and availability of habitat to support adequate populations of prey species, and also the hunting capability of the bird. Where ground vegetation was considered to be supportive of prey species, containing native grasses and woody debris for shelter/breeding/foraging, with a low/minimal shrub layer to optimise hunting capability, a high score of 5 was assigned. Where ground cover was too thick and considered to hinder hunting capability, or derived of exotic species, a low score of 0 was assigned.
		Score 1 - sparse ground cover OR dense low-medium shrub layer	
		Score 2 - ground cover of exotic grasses, litter, small woody debris, with an intermediate shrub layer but infrequent large shrubs	
		Score 3 - ground cover of minimal litter, exotic grasses but more abundant native grasses, medium sized woody debris, and moderate abundance of medium sized shrubs	
		Score 4 - ground cover of some native grasses and some exotic grasses, some litter, woody debris and moderate abundance of low shrubs	
		Score 5 - ground cover of native grass and minimal exotic grass, woody debris including frequent hollow logs, and sparse low shrubs	
Quality and availability of habitat required for shelter and breeding	Same as above	Score 0 - no large trees/no hollows	The masked owl utilises large hollows in large trees for breeding within patches of closed forest (Garnett & Crowley 2000). Quality and availability of habitat required for shelter and breeding was scored according to both the availability and suitability of nesting
	Hollow bearing tree availability	Score 1 - sparse mature trees and sparse small-medium hollows available (5-15cm diameter)	

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
		Score 2 - scattered large trees, and abundant small-medium sized hollows (5-15cm diameter)	sites, as well as the suitability of the area to support sufficient hunting (ground vegetation community).
		Score 3 - scattered large trees, and abundant medium sized hollows (diameter 15-30cm)	
		Score 4 - Abundant large mature trees, most with at least one suitable large hollow (diameter >30cm)	
		Score 5 - Abundant large mature trees, most with multiple large hollows (diameter >30cm)	
Quality and availability of habitat required for mobility	Patch size (connectivity)	Score 0 - <155 ha	The southern subspecies has been recorded to occupy a core area of 155 ha, with a home range of 1017 - 1178 ha out of breeding season. Due to an absence of literature specific to the northern subspecies, a patch size of 155 ha was used to score this indicator. Patch size scoring increments were developed conservatively by adding the approximate minimum core area size of 150 ha, to each increasing score value. Where the habitat patch size was less than 155 ha a low score of 0 was assigned. Larger patches received higher scores.
		Score 1 - 155 - 300 ha	
		Score 2 - 300 - 450 ha	
		Score 3 - 450 - 500 ha	
		Score 4 - 500 - 650 ha	
		Score 5 - > 650 ha	
Absence of threats	Broad scale environmental change	Scope and severity of all species-specific threats.	Broad scale environmental change is the most plausible explanation for current low population densities of the masked owl. Altered fire regimes, grazing by livestock feral animals, and native vegetation displacement by exotic flora (particularly introduced pasture grasses) are the key threatening processes leading to habitat change (Woinarski, Risler & Kean 2004). Habitat clearing has likely reduced the availability of suitable nesting hollows, thereby increasing competition with more aggressive and successful species such as the brushtail possum (Schodde & Mason 1980). The broad-scale decline of small-medium sized mammals across northern Australia may also have
	Competition for breeding space and food		

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
			reduced the availability of prey for the masked owl, thereby increasing competition with similar predatory bird species, particularly larger owls (Garnett & Crowley 2000; Schodde & Mason 1980; Woinarsk, Risler & Kean 2004). Threats were assessed in the field as reasonably practicable and graded accordingly against the threat scope and severity matrix, where a single overall score was assigned.

Red goshawk (*Erythrotriorchis radiatus*)

Quality and availability of food and habitat required for foraging	Availability of Prey species	Score 0 - No prey species or supportive habitat present.	The red goshawk is considered to prefer foraging/hunting habitat characteristic of an open understorey below a canopy of large, widely spaced trees (DERM, 2012). Ground vegetation community cover is an important indicator for the quality and availability of habitat to support adequate populations of prey species (birds), and also the hunting capability of the bird. In winter in eastern Australia, the species moves from nest sites in the mountain ranges to coastal plains, where it is associated with permanent wetlands and where it often feeds on waterbirds (Garnett et al., 2011). The red goshawk is known to hunt within a home range of between 120 and 200 km ² in open forests and gallery forests (Czechura & Hobson, 2000). Occasional records of individuals hundreds of kilometres from the known breeding range suggest juvenile dispersal from their natal territories may be extensive (Debus & Czechura, 1988). They are also believed to rarely breed in areas of fragmented native vegetation (Aumann & BakerGabb, 1991; Czechura, 2001).
		Score 1 - Low quality prey species present and in low abundance.	
		Score 2 - Occasional suitable prey species present and in low abundance.	
		Score 3 - Moderate prey diversity and moderate abundance of prey bird species	
		Score 4 - High prey diversity but moderate abundance present and of preferred prey species such as kookaburras, lorikeets and cockatoos present	
	Score 5 - High prey diversity and abundance present and of preferred prey species such as kookaburras, lorikeets and cockatoos present		
	Distance to permanent water	Score 0 - >5 km Score 1 - 4 - 5 km	

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator	
	Patch size (connectivity)	Score 2 - 3 - 4 km	Based on the above, patch size, proximity to permanent water, and availability of prey were used as indicators of quality and availability of food and habitat required for foraging.	
		Score 3 - 2 - 3 km		
		Score 4 - 1 - 2 km		
		Score 5 - <1 km		
		Score 0 - <120 km ² of suitable foraging habitat (forested)	As a general guide to habitat scoring of red goshawk, ideal habitat was considered to be well connected (>200 km ²) with large, tall trees (with regular emergent or T1 greater than 31 m) that make up an open very sparse canopy (10 - 30%), contain a low very sparse understory, and occur within 1 km of permanent water (preferably a river, or large wetland).	
		Score 1 - 120 - 200 km ²		
		Score 2 - 200 - 300 km ²		
		Score 3 - 300 - 400 km ²		
		Score 4 - 400 - 500 km ²		
		Score 5 - > 500 km ² of suitable foraging habitat (forested)		
Quality and availability of habitat required for shelter and breeding	distance to permanent water	See above	The red goshawk is known to nest in the tallest trees (mean = 31 m) within 1 km of water, and birds are also thought to occupy the same breeding territory each year (DERM, 2012). Distance to permanent water and the availability of tall nesting trees were used as indicators to measure the quality and availability of habitat required for shelter and breeding.	
		Availability of tall nesting trees		Score 0 - no large trees (>25 m tall)
				Score 1 - sparse large trees (<5 per ha)
				Score 2 - 5 - 15 large trees per ha

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
		Score 3 - 15 - 20 large trees per ha	
		Score 4 - 20 - 30 tall trees per ha, some emergent trees present	
		Score 5 - abundant (>30) tall trees (>25m) per ha and emergent trees	
Quality and availability of habitat required for mobility	Availability of tall nesting trees Patch size (connectivity)	See above.	Species habitat mobility requirements are not fundamentally different. Therefore, some of the same field-based indicators for <i>Quality and availability of food and habitat required for foraging/breeding</i> were also utilised to score and assess <i>Quality and availability of habitat required for mobility</i> .
Absence of threats	Habitat fragmentation and degradation Direct disturbance and loss of nesting sites Changes in prey availability	Score 0 - Evidence of complete habitat structural clearing Score 1 - Evidence of heavy selective structural clearing (ie. selective large trees) Score 2 - evidence of light selective structural clearing (ie. selective large trees) Score 3 - evidence of understory clearing, largely connected vegetation Score 4 - evidence of some historical clearing, mostly intact connected vegetation Score 5 - no evidence of vegetation clearing, large vegetation tract	The primary threatening process to the red goshawk is considered to be widespread vegetation clearing for agriculture, particularly of lowland and riverine forests (Baker-Gabb 1988). Northern Qld populations are considered to be at risk of ongoing decline as these populations are the scarce where lowland forests have been cleared for agriculture or for urban development (Czechura et al., 2011). Other causes of decline have been attributed to forestry, where tall suitable nesting trees are targeted for clearing. Fire regimes are a potential threatening process where infrequent or too frequent burning can result in unsuitable vegetation to support healthy populations of prey species. Threats were assessed in the field as reasonably practicable and graded accordingly against the threat scope and severity matrix, where a single overall score is assigned.
Mammals			

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Greater glider (<i>Petauroides minor</i>)			
Quality and availability of food and habitat required for foraging	Food tree abundance	Score 0 - 0 food trees present	The species is primarily a folivore, consuming eucalypt leaves with a preference for young foliage, and occasionally also consuming flowers. A higher richness in potential food species (<i>Eucalyptus</i> and <i>Corymbia</i> species) received a higher score.
		Score 1 - 1 to 10 % of total veg is comprised of food or den trees	
		Score 2 - 11 to 25 % of total veg is comprised of food or den trees	
		Score 3 - 25 to 50 % of total veg is comprised of food or den trees	
		Score 4 - 51 to 75 % of total veg is comprised of food or den trees	
		Score 5 - >75 % of total veg is comprised of food or den trees	
	Food tree average DBH (quality)	Score 0 - no food trees present	In a study conducted on greater glider in proximity to the area, of the 56 known den sites, all were hollows in trees and 28.5% were <i>E. acmenoides</i> (now <i>E. portuensis</i>), 25% in <i>E. citriodora</i> , 14% in <i>E. tereticornis</i> , 12.5% in <i>E. intermedia</i> , 12.5% in <i>E. crebra</i> and 7.2% in dead trees of undetermined species (Comport et al, 1996). Published research from central Queensland of a similar species (<i>Petauroides volans</i>) showed preferred food tree DBH averages between 30-70 cm. Scores were scaled accordingly (Smith et. al. 2007). Having a diet primarily of eucalypt leaves, areas with abundant, diverse, mature (remnant) eucalypt (75% canopy cover) provide higher quality food resources for the species compared to sparse canopies with a low abundance of food trees. As a general guide to assessing the quality of habitat, habitat which was characteristic of the above was considered to be optimum and would be assigned the highest score of 5.
		Score 1 - dbh < 20 cm	
		Score 2 - dbh 20 - 30 cm	
		Score 3 - dbh 30 - 40 cm	
		Score 4 - dbh 40 - 50 cm	
Score 5 - average dbh > 50 cm			

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Quality and availability of habitat required for shelter and breeding	Availability of hollows with an entrance size of >6cm diameter per ha (Den quality)	Score 0 - no hollows present Score 1 - dbh < 30 cm Score 2 - dbh 30 - 40 cm Score 3 - dbh 40 - 50 cm Score 4 - dbh 50 - 60 cm Score 5 - average dbh > 60 cm	The species is a hollow specialist that utilises hollows during the day for breeding and shelter. The species prefers large, well-connected, old growth forests. A minimum entrance size of 6cm is required, higher scores were awarded to areas with a higher hollow count, with a minimum of 4/ha and a minimum entrance size of 6cm. Published research shows that preferred den tree average DBH is >50 cm (in central QLD). This class size is most likely to contain older, mature growth trees or stags with suitable hollows compared to trees in smaller size classes, therefore scores were scaled accordingly.
	Den abundance	Score 0 - less than 2 hollows per ha Score 1 - 2 to 5 hollows per ha Score 2 - 6 to 10 hollows per ha Score 3 - 10 to 15 hollows per ha Score 4 - 15 to 20 hollows per ha Score 5 - greater than 20 hollows per ha"	
Quality and availability of habitat required for mobility	Patch size	Score 0 - smaller than 160 ha Score 1 - 160 to 260 ha Score 2 - 260 to 360 ha Score 3 - 360 to 460 ha Score 4 - 460 to 560 ha	It is recognised that the species will not persist in isolated patches of less than 160 ha (Smith et. al. 2007). As species is likely to use the same habitat for shelter and breeding, patches less than 160 ha will be assigned the lowest score (0), while larger patches will reflect higher scoring. Home range estimates from the Paluma Range study suggested that home ranges were 1.3 to 4.2 ha for males and from 0.9 to 1.7 ha for females (Comport et al. 1996).

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
	Position in the landscape	<p>Score 5 - Greater than 560 ha</p> <p>Score 0 - patch is greater than 200 m from suitable GG habitat, or is only connected by non-native vegetation</p> <p>Score 1 - Fragmented patch, limited hollows or food trees connecting patches</p> <p>Score 2 - High value regrowth or fire damaged patches, some hollows but disjointed connectivity</p> <p>Score 3 - Remnant vegetation connected to site but some fragmentation in proximity, mixture of suitable food trees and or moderate hollows present</p> <p>Score 4 - Large tracts of remnant vegetation connected to site, mixture of suitable food trees and abundant hollows</p> <p>Score 5 - Large tracts of remnant vegetation connected to site, dominated by preferred food trees dominant and abundant hollows</p>	<p>The species is sensitive to fragmentation and does not disperse easily across non-native vegetation. Position in the landscape refers to proximity of the area to suitable habitat. To maintain viable populations, they appear to require large areas of continuous habitat (at least 160 km² in Queensland). Larger, well-connected patches to other suitable habitat received the highest scores.</p>
Absence of threats	<p>Habitat clearing (specifically old growth trees with den sites)</p> <p>Habitat fragmentation</p> <p>Inappropriate fire regimes</p>	Scope and severity of all species-specific threats.	<p>Common threats can include but are not restricted to clearing of mature growth, habitat fragmentation and inappropriate fire regimes. Threats were assessed in the field as reasonably practicable and graded accordingly against the threat scope and severity matrix, where a single overall score is assigned.</p>
Koala (<i>Phascolarctos cinereus</i>)			

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Quality and availability of food and habitat required for foraging	Food tree abundance (% of treed biomass)	Score 0 - 0%	Assesses of the proportion (% canopy cover) of food tree within the canopy from genera <i>Angophora</i> , <i>Eucalyptus</i> , <i>Corymbia</i> , <i>Lophostemon</i> and <i>Melaleuca</i> in which the species is known to forage. This provides an assessment on the availability of food resources, with a higher score (5) awarded to higher percentage cover (>75%).
		Score 1 - 1-10 %	
		Score 2 - 11 - 25 %	
		Score 3 - 25 - 35 %	
		Score 4 - 35 - 50 %	
	Score 5 - > 50 %	Assesses the quality and connectiveness of the canopy that provides food and shelter for the species. Highly connect canopies and those unaffected by drought or clearing were awarded highest scores (5), whilst impacted canopies by clearing and drought (dieback) were assigned lower scores.	
	Canopy quality (crown cover %)	Score 0 - none or very sparse canopy cover with no food trees present	Evidence suggests that a breeding population of koalas will not persist in patches smaller than 50 ha (McAlphine et al 2007). Patches below 50 ha were assigned a score of 0, whilst large contiguous patches >500 ha were assigned the highest score (5).
		Score 1 - sparse or dead canopy cover with signs of regeneration with only 1 food tree species present	Koala contract towards vegetation with reliable leaf moisture during times of drought and severe heat. Dry season refugia is scored according the moisture content of the direct environment and the likelihood of the T1 canopy to maintain adequate leaf moisture. In wetter areas such as riparian zones, leaf moisture is more reliable and therefore the habitat is assigned a higher score in this category.
		Score 2 - sparse healthy canopy cover with 1 food tree species present	
		Score 3 - moderate, healthy canopy cover with emerging trees and 1 or more koala food trees or 1 food tree that accounts for more than 50% of total vegetation	
Score 4 - mid-dense, healthy canopy cover with emerging trees and 2 or more koala food trees or 1 food tree that accounts for more than 50% of total vegetation			
Score 5 - dense, healthy canopy cover with emerging trees and 2 or more koala food trees or 1 food tree that accounts for more than 50% of total vegetation			

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
	Patch size (ha)	<p>Score 0 - less than 50 ha</p> <p>Score 1 - 50 to 200 ha</p> <p>Score 2 - 200 to 400 ha contiguous habitat</p> <p>Score 3 - 400 to 500 ha contiguous habitat</p> <p>Score 4 - 500 to 1000 ha contiguous habitat</p> <p>Score 5 - Greater than 100 ha contiguous habitat</p>	
	Dry season refugia	<p>Score 0 - cleared</p> <p>Score 1 - dry habitat, with sparse canopy cover and leaves are unlikely to retain moisture in severe heat or drought conditions</p> <p>Score 2 - dry habitat with moderate canopy cover that is unlikely to retain moisture in drought conditions</p> <p>Score 3 - regrowth floodplain habitat</p> <p>Score 4 - high value regrowth riparian vegetation patches less than 500ha or remnant floodplain</p> <p>Score 5 - well connected, remnant riparian vegetation or patches larger than 500 ha</p>	

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Quality and availability of habitat required for shelter and breeding	As above.	As above.	Species shelter, breeding and food requirements are not fundamentally different. Therefore, the same field-based indicators for <i>Quality and availability of food and habitat required for foraging</i> were also utilised to score and assess <i>Quality and availability of habitat required for shelter and breeding</i>
Quality and availability of habitat required for mobility	As above. Patch isolation (connectivity)	As above. Score 0 - patch is isolated by cleared ground greater than 200m from closest koala habitat Score 1 - patch is isolated by cleared ground greater than 100 m from closest koala habitat Score 2 - patch is isolated by cleared ground greater than 75 to 100 m from closest koala habitat Score 3 - patch is isolated by cleared ground greater than 50 to 75 m from closest koala habitat Score 4 - patch is isolated by cleared ground greater than 25 to 50 m from closest koala habitat Score 5 - patch is isolated by isolated by cleared ground less than 25 m from closest koala habitat	Patch size isolation assesses the degree of connectivity between patches. Koalas are reluctant to transverse cleared areas greater than 200 m, as such patches that are separated by >200 m were assigned the lowest score. Patches that were closer together were awarded higher scores accordingly.
Absence of threats	Predation by wild dog or cat Poor fire regimes Habitat clearing and fragmentation	Scope and severity of all species-specific threats.	Common threats can include but are not restricted to habitat clearing, habitat fragmentation, inappropriate fire regimes, drought, extreme temperatures, predation by dogs and vehicle strike. Threats were assessed in the field as reasonably

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
	Vehicle strike		practicable and graded accordingly against the threat scope and severity matrix, where a single overall score was assigned.
	Drought and extreme heat		

Sharman's rock wallaby (*Petrogale sharmani*)

Quality and availability of food and habitat required for foraging	Suitable foraging habitat	<p>Score 0 - No native grass present. Non-native herbivores high density.</p> <p>Score 1 - <10% native ground cover. Non-native herbivores moderate to high density.</p> <p>Score 2 - 10-30% native ground cover. Non-native herbivores moderate to high density.</p> <p>Score 3 - 30-50% native ground cover. Non-native herbivores moderate density.</p> <p>Score 4 - 50-70% native ground cover comprising of 3 or more species. Non-native herbivores low.</p> <p>Score 5 - >70% native ground cover comprising of 3 or more species. Non-native herbivores low or absent.</p>	Sharman's rock wallaby is known to forage on native grasses in the open woodlands that surround their rocky shelters (TSSC, 2016). Suitable foraging habitat is characteristic of an area made up of more than 70% native ground cover and comprised of three species or more. The presence of non-native herbivores, such as cattle, is low or entirely absent. Habitat of this description was considered preferred and assigned the highest score of 5. Suitability of habitat for foraging was scored between 0 and 5 according to this preferred habitat as a benchmark.
Quality and availability of habitat required for shelter and breeding	Availability of rocky outcrops	<p>Score 0 - No rock outcrops or boulder piles presents - foraging habitat only i.e site within 1 km to shelter habitat</p> <p>Score 1 - Supporting stepping stone habitat of isolated boulder piles or boulders scattered throughout foraging habitat but unlikely to be complex enough for shelter</p> <p>Score 2 - Low lying rocky outcrops or scattered boulder piles with limited complexity</p>	Sharman's rock wallaby occurs in a variety of rocky habitats amongst grassy woodlands or open forests, including rocky outcrops, boulder piles, gorges, cliff lines, and rocky slopes (TSSC, 2016). The species uses these rocky refuges as shelter during the day, emerging at dusk to forage (TSSC, 2016). The quality and availability of habitat required for shelter and foraging was scored according to the size and complexity of the rocky outcrop.

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
		<p>Score 3 - Boulders or rocky outcrops presents, but scattered in the landscape and smaller discrete complex stacked rock clusters present</p> <p>Score 4 - Rocky outcrop bigger than 100m² and connected to other shelter and foraging habitat</p> <p>Score 5 - Rocky outcrop bigger than 150m² in a well connected environment to other rocky outcrops or boulder piles OR distinct complex granite stacked rock clusters present</p>	
Quality and availability of habitat required for mobility	<p>Same as above</p> <p>Patch size</p>	<p>Same as above.</p> <p>Score 0 - <2 km² of suitable foraging habitat (forested)</p> <p>Score 1 – 2 – 10 km²</p> <p>Score 2 – 10 – 30 km²</p> <p>Score 3 – 30 – 60 km²</p> <p>Score 4 – 60 – 120 km²</p> <p>Score 5 - > 120km² of suitable foraging habitat (forested)</p>	<p>Patch size isolation assesses the degree of connectivity between patches. Where suitable shelter (rocky outcrops and caves) as well as foraging habitat (grassy woodlands or open forests) persists, species dispersal is possible. Without shelter, the species would be vulnerable to predation by exotic species such as dogs, cats, and foxes (TSSC, 2016).</p>
Absence of threats	<p>Predation by wild dogs and cats</p> <p>Habitat clearing and degradation</p>	Scope and severity of all species-specific threats	<p>The species limited range and specific habitat requirements, makes it particularly vulnerable to the presence of threats. Likely threatening processes include habitat degradation as a result of livestock grazing and non-native pasture species, as well as predation by feral species such as dogs, cats, and foxes. The species is believed to be disadvantaged from both the absence and the over-use of fire regimes. Threats were assessed in the field as reasonably practicable and graded accordingly against the</p>

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
	Poor fire regimes	<p>Score 0 - evidence of >1 high-heat recent fires, with scarring reaching tree canopy height and resulting in death of vegetation at multiple levels, and a notable absence of ground and shrub layer vegetation, and thinning of canopy cover (severe fire scars)</p> <p>Score 1 - evidence of a single high-heat recent fire, with scarring reaching tree canopy height and resulting in some death of vegetation at multiple levels (severe fire scars)</p> <p>Score 2 - evidence of recent fire, with scarring appearing at multiple vegetation levels and a notable loss in ground cover vegetation (intermediate severity fire scars)</p> <p>Score 3 - evidence of recent fire, with scarring appearing low in shrub canopy and affected vegetation is in a stage of regrowth and recovery (low severity fire scars)</p> <p>Score 4 - some evidence of non-recent fire, but appearing well aged and vegetation is seemingly recovered</p> <p>Score 5 - Preferred fire regime evident of a low intensity, patchy fires that maintain food resources in unburnt patches and provide a pulse of high quality food in burnt patches</p>	threat scope and severity matrix, where a single overall score was assigned.
Spectacled flying-fox (<i>Pteropus conspicillatus</i>) / Grey-headed flying-fox (<i>P. poliocephalus</i>)			

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Quality and availability of food and habitat required for foraging	Suitability of foraging habitat	<p>Score 0 - No flowering or fruiting species present.</p> <p>Score 1 - >1 species of Eucalyptus, Corymbia or Melaleuca sp. present in open forest or woodlands</p> <p>Score 2 - >2 species of Eucalyptus, Corymbia or Melaleuca sp. present in open forest or woodlands</p> <p>Score 3 - >3 species of Eucalyptus, Corymbia or Melaleuca sp. present in open forest or woodlands</p> <p>Score 4 - A mixture of Eucalyptus, Corymbia, Melaleuca species with either Ficus sp, Burdekin plum or other fruiting trees present in open forest or woodlands</p> <p>Score 5 - Numerous rainforest species OR >5 species of Eucalyptus, Corymbia or Melaleuca in tall open forests.</p>	<p>The species mostly occurs in rainforest environments, where it lives colonially in ‘camps’ (TSSC, 2019). The species is known to forage well away from camps in a variety of different habitat types, and consumes rainforest fruits, riparian zone flowers, as well as Melaleuca, eucalypt, and mangrove flowers and fruit (TSSC, 2019). Suitability of foraging habitat was assigned a score based on the diversity and abundance of favourable tree species. A high score of 5 was assigned where numerous and especially favourable food tree species were present, such as the <i>Pleiogynium timorense</i> (Burdekin plum).</p>
Quality and availability of habitat required for shelter and breeding	Availability of roosting sites	<p>Score 0 - Unlikely to provide roosting habitat</p> <p>Score 1 - Open woodlands within 16 km of rainforest, however, low probability of providing tree structure suitable for camps</p> <p>Score 2 - Open woodlands within 7 km of rainforest, however, low probability of providing tree structure suitable for camps</p> <p>Score 3 - Tall open forests outside 16 km of known rainforest, but could be used as seasonal roosting habitat</p> <p>Score 4 - Well shaded roosting locations within 7-16 km to rainforest</p>	<p>Occupation of camps is highly seasonal, and the species can share camps with other <i>Pteropus</i> species (TSSC, 2019). Camp movements are dependent upon seasonal fruiting and flowering of food plants (Richards 1990b). The quality and availability of roosting sites was scored according to the distance to nearby rainforest, and the presence of large trees creating well shaded roosting habitat.</p>

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
		Score 5 - Well shaded roosting locations such as riparian zones or other dense vegetation within 7 km of rainforest	
Quality and availability of habitat required for mobility	Suitability of foraging habitat	As above	Flying-fox species are highly mobile, and individuals are known to travel as far as 50 km in a single night to forage (TSSC, 2019). <i>Pteropus</i> species can disperse widely from camps following foraging resources, roosting in suitable habitat where available. Therefore, the species habitat mobility requirements are not fundamentally different from the above resources. The same field-based indicators used to score quality and availability of habitat required or shelter and breeding, and quality and availability of food and habitat required for foraging, were used to score the quality and availability of habitat required for mobility. Mobility can be directly impeded through entanglement, resulting in mortality, with human constructs such as power lines and barb-wired fences. Where human construct was observed, the quality and availability of habitat required for mobility was reduced.
	Availability of roosting sites.	As above.	
	Human construct	Score 0 - Present of barbwire fences, power lines or fruit tree netting	
		Score 1 - Present of barbwire fences, power lines or fruit tree netting within 1 km	
		Score 2 - Present of power lines or fruit tree netting within 5km	
		Score 3 - Present of fruit tree netting within 8 km	
		Score 4 - Limited human made infrastructure within 10 km	
		Score 5 - No infrastructure within 10 km	
Absence of threats	Human construct	As above.	The species is vulnerable to a wide range of threatening processes such as habitat loss and fragmentation, poor fire regimes, disease, and illegal culling. In particular, <i>Pteropus</i> species are frequently entangled in human-made obstacles such as barb wired fences and powerlines, which most often results in mortality (TSSC, 2019). The presence of such obstacles, and without the aid of deterrents (such as reflective bat plates),
	Vegetation clearing and degradation	Score 0 - Evidence of complete vegetation clearing	
		Score 1 - Evidence of selective large tree clearing	

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
	Poor fire regimes	<p>Score 2 - Absence of any understory due to clearing i.e. lack of habitat complexity</p> <p>Score 3 - Evidence of some structural clearing (e.g. thinning of a structural layer such as shrubs or mid-story)</p> <p>Score 4 - Some evidence of historical selective clearing</p> <p>Score 5 - No evidence of vegetation clearing</p> <p>Scope and severity of all species-specific threats</p>	presents a direct threat to the species. Threats were assessed in the field as reasonably practicable and graded accordingly against the threat scope and severity matrix, where a single overall score was assigned.
Mammals, micro-bats			
Bare-rumped sheath-tailed bat (<i>Saccolaimus saccolaimus nudicluniatatus</i>)			
Quality and availability of food and habitat required for foraging	Suitable eucalyptus open forest	<p>Score 0 - cleared OR dense thickets of exotic vegetation</p> <p>Score 1 - Sparse shrub/ground cover layer, less than 10 % canopy cover of T1</p> <p>Score 2 - Sparse shrub/ground cover layer, suitable canopy cover between 10% and 30%</p> <p>Score 3 - Marginally suitable Eucalyptus/Corymbia woodland</p> <p>Score 4 - Intact open Eucalyptus/Corymbia woodland, however a noticeable thinning of large trees</p>	There is an absence of scientific literature pertaining to the ecology of the bare-rumped sheath-tailed bat. The species has been recorded mostly in eucalypt forests and woodlands, generally in near-coastal areas. In Queensland, it is known to be associated with coastal lowland rainforests, and more open forests dominated by Eucalyptus or Corymbia species interspersed with coastal lowland rainforest.

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
		Score 5 - Intact open Eucalyptus/Corymbia woodland with large mature trees	
Quality and availability of habitat required for shelter and breeding	Hollow-bearing tree availability	<p>Score 0 - Tree layer is not ecologically dominant OR majority of T1 layer is less than 20 cm DBH</p> <p>Score 1 - Spare large trees / hollow possibility</p> <p>Score 2 - Marginally suitable trees, hollows sparse and marginally suitable</p> <p>Score 3 - Moderate abundance of suitable trees, hollows becoming abundant but still marginally suitable</p> <p>Score 4 - Moderate abundance of suitable hollowing Eucalyptus spp. trees</p> <p>Score 5 - Abundance of large preferable hollowing Eucalyptus spp. OR abundant or moderately abundant hollowing <i>E. platyphylla</i></p>	All known roosting records are from deep tree hollows in the following species: <i>Eucalyptus platyphylla</i> (poplar gum), <i>Eucalyptus minata</i> (Darwin woollybutt) and <i>E. tetradonta</i> (Darwin stringybark) (DoE, 2022b). Hollows in these tree species have also been used as maternity roosts. <i>E. platyphylla</i> occurs intermittently throughout the study area. In habitat where <i>E. platyphylla</i> occurs with observable hollows a high score of 5 was assigned. Where other hollowing eucalyptus trees occur in similar habitat, an intermediate score was assigned between 2 - 4, and where no hollow bearing trees were available a low score of 0 was assigned.
Quality and availability of habitat required for mobility	Suitable eucalyptus open forest	Same as above.	Limited information is available about the dispersal / movement patterns of the species. It is suspected that the BRSB occurs at low population densities, and can travel large distances (DoE, 2022b). The species is highly mobile given it utilises forested communities and roosts in hollows. Species mobility was therefore scored according to the general suitability of the habitat as well as the degree of pressure from clearing processes that could directly impede mobility and dispersal.
	Habitat loss and fragmentation	<p>Score 0 - Evidence of complete vegetation clearing</p> <p>Score 1 - Evidence of selective large tree clearing</p> <p>Score 2 - Absence of any understory due to clearing i.e. lack of habitat complexity</p>	

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
	Poor fore regimes	<p>Score 3 - Evidence of some structural clearing (e.g. thinning of a structural layer such as shrubs or mid-story)</p> <p>Score 4 - Some evidence of historical selective clearing</p> <p>Score 5 - No evidence of vegetation clearing</p> <p>Score 0 - evidence of >1 high-heat recent fires, with scarring reaching tree canopy height and resulting in death of vegetation at multiple levels, and a notable absence of ground and shrub layer vegetation, and thinning of canopy cover (severe fire scars)</p> <p>Score 1 - evidence of a single high-heat recent fire, with scarring reaching tree canopy height and resulting in some death of vegetation at multiple levels (severe fire scars)</p> <p>Score 2 - evidence of recent fire, with scarring appearing at multiple vegetation levels and a notable loss in ground cover vegetation (intermediate severity fire scars)</p> <p>Score 3 - evidence of recent fire, with scarring appearing low in shrub canopy and affected vegetation is in a stage of regrowth and recovery (low severity fire scars)</p> <p>Score 4 - some evidence of non-recent fire, but appearing well aged and vegetation is seemingly recovered</p> <p>Score 5 - no evidence of recent fire and managed fuel load</p>	

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Absence of threats	Habitat loss and fragmentation Poor fire regimes	Same as above.	The bare-rumped sheath-tailed bat utilises hollowing <i>Eucalyptus</i> tree species, which are often subject to clearing and competition for space with other hollow breeding species (DoE, 2022b). It is also unlikely this species utilises caves and human dwellings for roosting, making it more vulnerable to loss of roosting sites due to land clearing. The reduction of understory vegetation from over grazing and fire regimes are also likely threatening processes altering suitable habitat (DoE, 2022b). Threats were assessed in the field as reasonably practicable and graded accordingly against the threat scope and severity matrix, where a single overall score was assigned.

Greater large-eared horseshoe bat (*Rhinolophus robertsi*) / diadem leaf-nosed bat (*Hipposideros diadema reginae*)

Quality and availability of food and habitat required for foraging	Vegetation complexity and clustered understory	<p>Score 0 - cleared OR dense thickets of weeds</p> <p>Score 1 - Sparse understory and midstory, distinct lack of vegetation complexity</p> <p>Score 2 - Intermediate density of understory and midstory, upper canopy incomplete</p> <p>Score 3 - Intermediate density of understory and midstory, canopy mostly intact will sparse tall trees</p> <p>Score 4 - Well developed clustered understory and midstory, upper canopy intact with large, tall trees</p> <p>Score 5 - Complex vegetation community: complete with intact understory, midstory and canopy OR intact open forest</p>	The species is found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, <i>Melaleuca</i> forest with rainforest understorey, open savannah woodland and tall riparian woodland of <i>Melaleuca</i> , <i>E. tereticornis</i> (forest red gum) and <i>E. tessellaris</i> (Moreton Bay ash) (Hourigan C., 2011; DoE, 2022). The species is known to forage in a variety of vegetation types including open forest, <i>Acacia</i> dominated rainforest ridges, clustered understory amongst rainforest, gullies, and creek lines. Areas characteristic of the above habitat descriptions were assigned a score of 5.
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Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
Quality and availability of habitat required for shelter and breeding	Same as above	Same as above.	The species is believed to roost mainly in basal hollows of large trees, as well as dense vegetation, rockpiles, and areas beneath creek banks (<i>Hourigan C., 2011; DoE, 2022</i>). <i>Rhinolophus robserti</i> has been recorded to take advantage of disused underground mines, although not an obligate cave dweller (<i>DoE, 2022</i>), whereas <i>H. reginae</i> roosts throughout the year in caves and disused mines, preferring those with large chambers, high domed ceilings and multiple entrances (<i>Hourigan, C., 2011</i>). The species has been recorded to roost colonially, which is likely dependant on the availability of suitable cave systems (<i>Hourigan C., 2011</i>) As roosting sites can be variable and difficult to identify, the <i>quality and suitability of habitat required for foraging</i> is also indicative of the <i>quality and availability of habitat required for shelter and breeding</i> and was utilised to score this attribute.
	Availability of roosting sites	<p>Score 0 - Tree layer is not ecologically dominant and no rock stacks OR majority of T1 layer is less than 20 cm DBH</p> <p>Score 1 – Sparse potential roost sites (trees and small rock stacks)</p> <p>Score 2 - Abundance of marginally suitable hollows in tree AND/OR marginally suitable rock stacks (cave roost sites)</p> <p>Score 3 - Moderate abundance of tee hollows AND/OR occasional large rock stacks with crevices for potential cave roosts</p> <p>Score 4 - Abundant variety of hollows, some basal and some upper canopy AND/OR intermittent large granite rock stacks forming small but permanent roost sites</p> <p>Score 5 - Abundant basal hollows (lower half of tree trunk) AND/OR large granite rock stacks forming cave systems suitable for permanent colony roost sites</p>	
Quality and availability of habitat required for mobility	Vegetation complexity and clustered understory	Same as above.	The home range for the species is not well known, however based on records of occurrence and connectedness is it possible that the species can occupy a minimum area of 8159 km ² . Species mobility and dispersal through the landscape is likely to be correlated with vegetation complexity providing suitable coverage from predation as well as food and roosting resources. Intact habitat, where little impact for clearing occurs, was considered to provide suitable habitat for mobility and dispersal.
	Availability of roosting sites	Same as above.	
	Habitat clearing	Same as above.	

Species and habitat attribute	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
<p>Score 0 - Evidence of complete vegetation clearing</p> <p>Score 1 - Evidence of selective large tree clearing</p> <p>Score 2 - Absence of any understory due to clearing i.e. lack of habitat complexity</p> <p>Score 3 - Evidence of some structural clearing (e.g. thinning of a structural layer such as shrubs or mid-story)</p> <p>Score 4 - Some evidence of historical selective clearing</p> <p>Score 5 - No evidence of vegetation clearing</p>			
<p>Absence of threats</p>	<p>Habitat clearing – loss of roost sites and loss of complex understory</p> <p>Over grazing and weed invasion</p> <p>Poor fire regimes</p>	<p>Scope and severity of all species-specific threats.</p> <p>Score 0 - evidence of >1 high-heat recent fires, with scarring reaching tree canopy height and resulting in death of vegetation at multiple levels, and a notable absence of ground and shrub layer vegetation, and thinning of canopy cover (severe fire scars)</p> <p>Score 1 - evidence of a single high-heat recent fire, with scarring reaching tree canopy height and resulting in some death of vegetation at multiple levels (severe fire scars)</p>	<p>The primary threatening process to the species is considered to be the continued loss of suitable foraging and roosting habitat due to land clearing and habitat change. In particular the loss of vegetation understory from over grazing and poor fire regimes may reduce the quality and suitability of habitat. Threats were assessed in the field as reasonably practicable and graded accordingly against the threat scope and severity matrix, where a single overall score was assigned.</p>

Species and habitat attribute	and	habitat	Field based indicator	Field based indicator scoring	Justification of inclusion of field indicator
				Score 2 - evidence of recent fire, with scarring appearing at multiple vegetation levels and a notable loss in ground cover vegetation (intermediate severity fire scars)	
				Score 3 - evidence of recent fire, with scarring appearing low in shrub canopy and affected vegetation is in a stage of regrowth and recovery (low severity fire scars)	
				Score 4 - some evidence of non-recent fire, but appearing well aged and vegetation is seemingly recovered	
				Score 5 - no evidence of recent fire and managed fuel load	

2.2.3.5. Species habitat attribute scoring

Species habitat attributes were assessed and scored for the entire matter area. The species habitat attributes and their respective weightings are presented in **Table 2-5** and was conducted in accordance with the Guide to Determining Terrestrial Habitat Quality (2020). In the case where multiple indicators were used to determine species habitat attribute scores, indicators were averaged and then multiplied by 5 to achieve a score out of 25 for each attribute.

Table 2-5: Species habitat attributes and their weightings

Species habitat attribute	Weighting (%)
Quality and availability of food and habitat required for foraging	25
Quality and availability of habitat required for shelter and breeding	25
Quality and availability of habitat required for mobility	25
Absence of threats	25

2.2.3.6. Habitat quality scoring

Habitat quality scoring was undertaken in accordance with the method described in the Guide to Determining Terrestrial Habitat Quality (2020) to generate a BioCondition score and a species habitat score for MNES (matter area) present within the disturbance footprint. The following calculations were performed to generate the overall BioCondition score for each matter area:

- Where multiple field survey sites were established within one assessment unit, BioCondition scores were averaged to generate an overall score for the assessment unit. Assessment units are defined at RE type and condition (e.g. 9.12.19, remnant).
- An area weighted BioCondition score was calculated for each assessment unit within a matter area by multiplying the BioCondition score by the area (ha) of the assessment unit and dividing by the total area (ha) of the matter area.
- The overall BioCondition score for the matter area is then calculated by summing the area weighted BioCondition scores for each assessment unit within the matter area. This value is converted to a score out of ten by multiplying the matter area BioCondition score by ten.

The following calculations were performed to generate the overall species habitat score for each matter area:

- Where multiple field species habitat attributes were undertaken within a single matter area, the scores were averaged to generate an overall score for the matter area.
- This value was converted to a score out of ten by multiplying the matter area species habitat score by ten.

As the disturbance footprint contains State and Commonwealth values, generation of scores were in line with guidance provided in the Offsets Area Guide with attributes including species stocking rates. This methodology combines BioCondition scores (site and landscape attributes) with habitat quality for fauna species, or threats and role of site location scores for flora and TECs. Final habitat / TEC quality score is out of ten. Scoring of species stocking rates as per the quality guide and calculator spreadsheet provided by the DAWE is shown in Table 2-6 and Table 2-7 below.

Table 2-6: Species stocking rate scoring

Species Stocking Rate (SSR)		Scoring			
Presence detected on or adjacent to site (neighbouring property with connecting habitat)	Score	0	5	10	
		No	Yes - adjacent	Yes - on site	
Species usage of the site (habitat type & evidenced usage)	Score	0	5	10	15
		Not habitat	Dispersal	Foraging	Breeding
Approximate density (per ha)	Score	0	10	20	30
Role/importance of species population on site (scored from supplementary Table 2-7)	Score	0	5	10	15
		0	5 - 15	20 - 35	40 - 45

Table 2-7: Species stocking rate supplementary table

SSR Supplementary Table		Scoring	
Key source population for breeding	Score	0	10
		No	Yes/ Possibly
Key source population for dispersal	Score	0	5
		No	Yes/ Possibly
Necessary for maintaining genetic diversity	Score	0	15
		No	Yes/ Possibly
Near the limit of the species range	Score	0	15
		No	Yes

2.2.4. Data analysis

2.2.4.1. Vegetation mapping

Flora data was analysed against State vegetation mapping (remnant RE mapping version 11 and 12.2). Where necessary, vegetation community and habitat boundaries were refined and/or verified using spatial data collected in the field to produce final ground-truthed mapping. Polygons were generally mapped at 1:10,000 scale. Areas of un-mapped vegetation which met the definition of a RE (as per the REDD), or areas which could not be surveyed due to physical access constraints (extreme topography, or boggy conditions), were mapped and attributed using field data or a combination of field data and extrapolation using available satellite imagery.

Some REs mapped by the State were not surveyed due to access and/or time constraints. To overcome this limitation, a process for validation and quantitative assessment was undertaken in the form of confidence ratings to further understand the spatial and attribute accuracy for each vegetation community polygon. This method is part of the *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland* (Neldner et. al. 2019), whereby a confidence rating of A, B or C is given for spatial and attribute accuracy, as follows:

- spatial accuracy of boundaries is defined as the spatial or positional accuracy of the polygon boundary line, with confidence ratings as follows:
 - A = high confidence in accuracy of polygon boundary
 - B = moderate confidence in accuracy of polygon boundary
 - C = low confidence in accuracy of polygon boundary
- attribute accuracy of the polygon regional ecosystem attribute, which includes the regional ecosystem and the proportions of mixed polygons, with confidence ratings as follows:
 - A = high confidence in accuracy of polygon attributes
 - B = moderate confidence in accuracy of polygon attributes
 - C = low confidence in accuracy of polygon attributes.

Certain REs can intrinsically have a low spatial accuracy due to gentle environmental gradients, whereby the boundary between two REs gradually changes across, say, one hundred metres. The presence of field data generally indicated a high confidence in attribute accuracy, depending on the size of the polygon. In this instance, the confidence scoring was primarily utilised to denote ELA’s confidence in the spatial and attribute accuracy. This method also allowed for moderate “B” accuracy to be applied in areas not ground-truthed, which were considered analogous with other surveyed areas based on our understanding of the broader Project area, and the relevant consistency of State mapping. Vegetation mapping was updated and refined within the development footprint and Project area, where further data was obtained following surveys.

2.2.4.2. Habitat mapping

Habitat mapping within the disturbance footprint was undertaken with the guidance of multiple data inputs including habitat assessments collected during the present field survey, previous studies field data, species records (ALA and survey records), slope and elevation data, LiDAR modelling, geology, ground-truthed vegetation, modelled habitat and Queensland Regional Ecosystem mapping. Habitat mapping was updated within the development footprint and Project area, where further data was obtained following surveys.

2.2.4.3. Flora field samples

Samples were collected for flora specimens that could not be accurately identified in the field. Samples were inspected further using a microscope and relevant plant keys to identify the species.

2.2.4.4. Bioacoustic data analysis

Ultrasonic bat calls were analysed by qualified specialist, Greg Ford of Balance! Environmental. The format and content of the analysis summary reports complies with nationally accepted standards for the interpretation and reporting of Anabat data (Reardon, 2003). Bat activity was calculated using calls identified to a “definite” and “probable” confidence level. Only species or species groups that have been identified to a definite or probable level have been included within this report.

Analysis of acoustic data recorded during the survey period was undertaken with the use of Kaleidoscope Pro software (Wildlife Acoustics version 5.3.3). Recordings were scanned using signal detection parameters specific to the vocalisation of each target fauna species (koala, red goshawk and masked owl) and detected signals were reviewed by an ecologist for presence at each site. Search parameters used for each species are presented below in **Table 2-8**.

Table 2-8 Kaleidoscope Pro search parameters for target species

Species	Frequency range (Hz)	Detection range (s)	Max. inter-syllable gap
koala	10 – 2,800	0.1 – 25	0.5
masked owl	1,500 – 5,512	0.65 - 2	0.35
red goshawk	860 – 7,300	0.1 - 5	0.35
magnificent brood frog	1,400 – 3,200	0.03 – 0.2	0.35

2.2.5. Survey limitations

Results are intrinsically limited to the snapshot in time the field surveys offered to collect data on presence of species. However, survey limitations are largely reduced by taking into account previous studies undertaken within the Project area, those within the vicinity of the Project area and available desktop data. Nonetheless, the survey did experience limitations due to poor weather conditions including heavy rain and thunderstorms, which resulted in a reduced survey effort (three days shorter than planned). This resulted in a reduced quantity of data that was able to be collected during the field survey. Specifically, the full range of REs known to occur within the disturbance footprint were not surveyed for BioCondition nor were habitat assessments conducted. Particularly vegetation located on land zones 3 and 11 were under-surveyed because of the reduced survey time. Despite this limitation, it is considered that the survey effort conducted within the disturbance footprint and surrounding project area was sufficiently detailed such as to inform assessment of habitat values within these areas, such that a precautionary assessment of impacts in these areas could be undertaken.

Spotlight survey effort was also limited due to the onset of poor weather conditions part way through the survey, making road conditions unsuitable to travel at night. Furthermore, the spectacled flying-fox was not able to be targeted during spotlight surveys due to the absence of favourable tree species in flower – which would otherwise be targeted habitat.

Three remote devices (remote cameras, and an Anabat Swift), used to target Sharman’s rock-wallaby and threatened micro-bat species were unable to be collected due to poor access as a result of the rains and thus data from these devices has not be included in the results of this report. Nonetheless, the species that the devices targeted have already been confirmed in the Project area, therefore, species habitat was included in the disturbance footprint. Further detail regarding the absence of specific data and surrogate analysis where appropriate is discussed in **Section 3**.

BioCondition analysis was limited by the absence of listed benchmark values for the full range of REs that occur within the disturbance footprint. Ideally, a reference site specific to each RE would be established. This would include up to three sampled sites to find a median benchmark value, which would result in a more robust BioCondition analysis. Due to survey effort weather constraints, some BOO surveys to determine surrogate benchmark values are limited to a single representative site or data from a different, although functionally relevant, RE was used as a substitute.

3. Results

3.1. Survey timing and conditions

The survey was undertaken across two survey periods, with 3 days conducted in March, and six days in May 2022. The weather leading up to the and at the time of the survey are presented in **Table 3-1**. Rainfall conditions over a two-year period (January 2020 – May 2022) which encompasses all ecology surveys undertaken to date is illustrated in Figure 3-1. This demonstrates good seasonal (rainfall) variability over the suite of surveys, with the most recent work undertaken directly post a significant wet period and therefore providing a robust wet season survey.

Long-term climate data statistics which include both mean month rainfall and mean maximum and minimum temperature is illustrated in **Figure 3-2**. Weather and climate data was collected from the closest station with complete records. Rainfall data was located at Michael Creek Alert (Station #32186) approximately 5 km east of the disturbance footprint (BOM, 2022a), climate data from Mount Surprise Township (Station #030036) west 130 km (Bom, 2022b), and wind data from Townsville Aero (Station #032040) 110 km South (BOM, 2022c).

Survey conditions were comparable in terms of temperature of those to be expected during Wet tropics and Einasleigh Uplands surveys during this period. Rainfall in December, January, February, and March 2022 around the disturbance footprint received well below average rainfall, with 68 mm, 181 mm, 90 mm, and 57 mm respectively. Late rainfall during April and May far exceeded normal conditions with 231 mm, 173 mm respectively.

Table 3-1 : Survey conditions preceding and during the field surveys

Date	Temperature (°C)		Total Rainfall (mm)	Max Wind Gust (km/h)
	Minimum	Maximum		
Feb-22	20.9	32.3	90	54
Mar-22	17.6	37.2	57	57
26 th March 2022	24.8	31.3	0	41
27 th March 2022	22.4	32.7	1	31
28 th March 2022	23.7	32.7	1	31
Apr-22	18.1	33.5	231	54
4 th May 2022	20.6	29.1	0	30
5 th May 2022	21.5	29.3	0	24
6 th May 2022	21.7	29.8	0	28
7 th May 2022	22	28.3	0	33
8 th May 2022	23	26.7	8	39
9 th May 2022	21	26.4	13	41

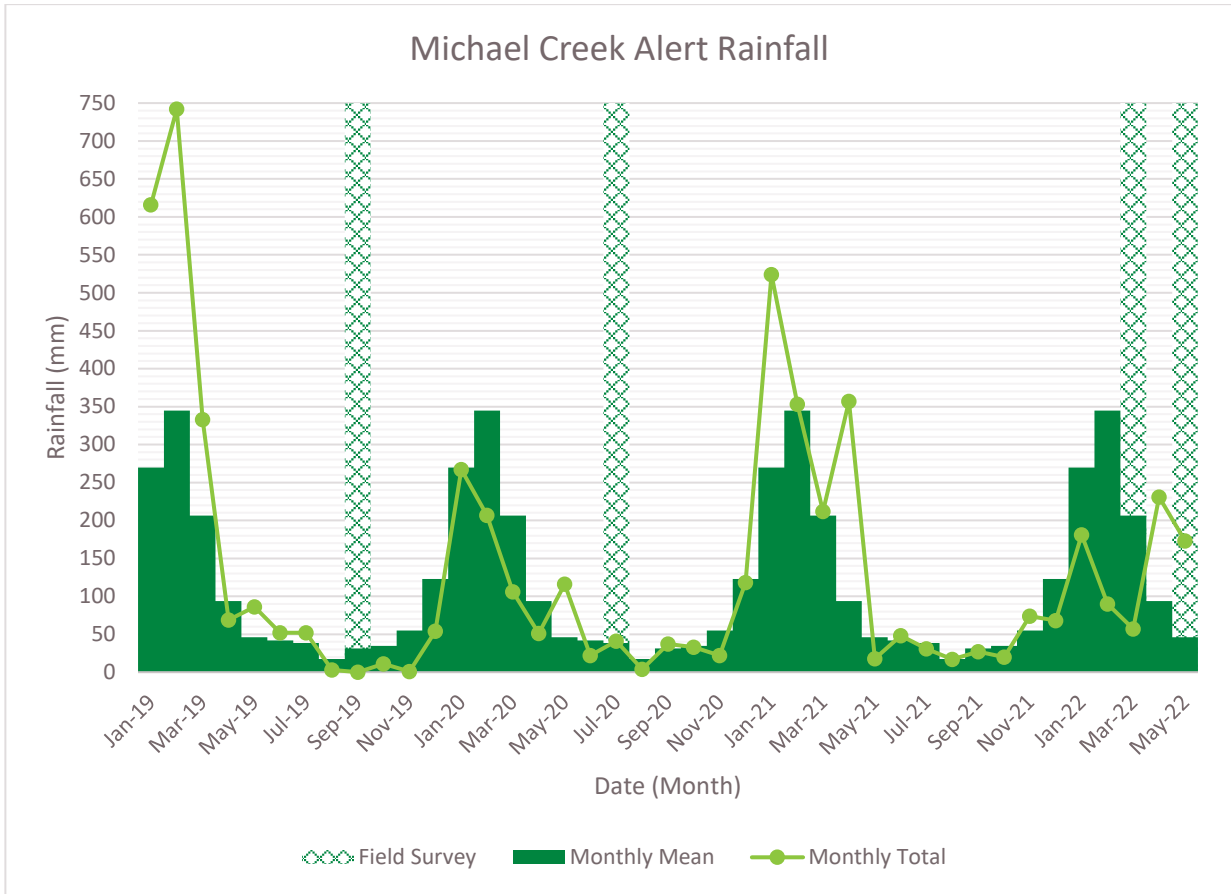


Figure 3-1: Total and mean monthly rainfall (mm) during the complete survey period (May 2019 – May 2022), recorded at Michael Creek Alert weather station

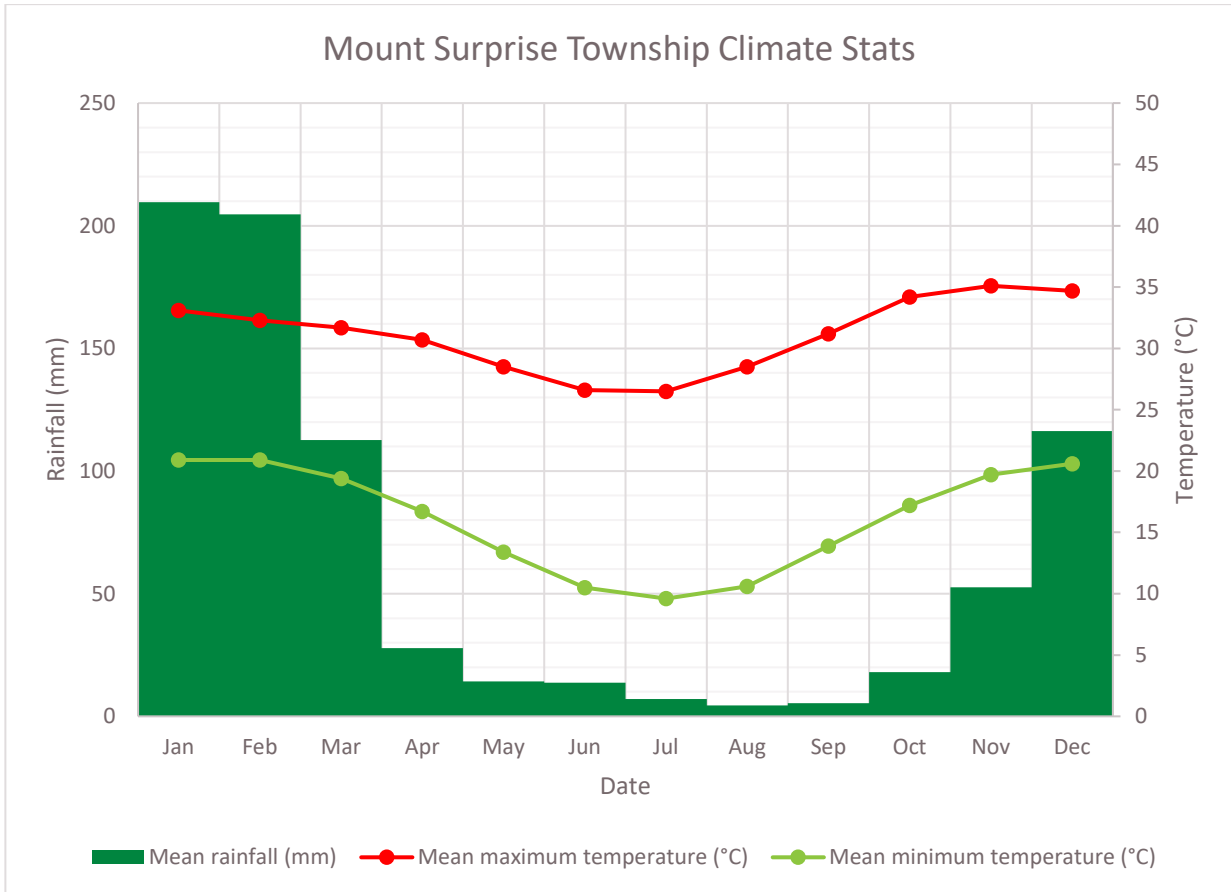


Figure 3-2: Long-term mean monthly maximum and minimum temperature (degrees Celsius) and rainfall (mm) recorded at Mount Surprise Township weather station

3.2. Previous studies

A number of recent assessments have been undertaken in the Upper Burdekin region. These studies were reviewed to assist with informing target species based upon confirmed records of EPBC Act and/or NC Act species in the surrounding area. Threatened species observed during previous studies, within or in proximity to the disturbance footprint, are listed in **Table 3-2**.

Table 3-2: Threatened species summary of previous studies within proximity to the disturbance footprint

Species detected	EPBC Act / NC Act Status	Previous Study
Bare-rumped sheath-tailed bat (<i>Saccolaimus saccolaimus nudicluniatus</i>)	Vulnerable / Endangered	Eco Logical Australia, 2020. Upper Burdekin Wind Farm – Ecological Assessment.
<i>Commersonia reticulata</i>	NA / Vulnerable	Prepared for Windlab Pty Ltd.
Diadem leaf-nosed bat (<i>Hipposideros diadema reginae</i>)	- / Near threatened	
Northern greater glider (<i>Petauroides minor</i>)	Vulnerable / Vulnerable	
Greater large-eared horseshoe bat (<i>Rhinolophus robertsi</i>)	Vulnerable / Endangered	
Koala (<i>Phascolarctos cinereus</i>)	Endangered / Endangered	

Species detected	EPBC Act / NC Act Status	Previous Study
Masked owl (northern) (<i>Tyto novaehollandiae kimberli</i>)	Vulnerable / Vulnerable	
Red goshawk (<i>Erythrotriorchis radiatus</i>)	Vulnerable / Endangered	
Sharman's rock-wallaby (<i>Petrogale sharmani</i>)	Vulnerable / Vulnerable	
Spectacled flying fox (<i>Pteropus conspicillatus</i>)	Endangered / Endangered	
Bare-rumped sheath-tailed bat (<i>Saccolaimus saccolaimus nudicluniatu</i> s)	Vulnerable / Endangered	Mt Fox Energy Park Ecological Assessment. 4 Elements Consulting (2021). Unpublished. Publicly available as part of the EPBC Act referral 2021/8910.
<i>Corymbia leptoloma</i>	Vulnerable / Vulnerable	
Northern greater glider (<i>Petauroides minor</i>)	Vulnerable / Vulnerable	
Greater large-eared horseshoe bat (<i>Rhinolophus robertsi</i>)	Vulnerable / Endangered	
White-throated needletail (<i>Hirundapus caudacutus</i>)	Vulnerable / Vulnerable	Nature Advisory, 2022a. Bird Utilisation Survey and White-throated Needletail survey – Late wet season. Prepared for Windlab Pty Ltd.
Migratory species including fork-tailed swift, oriental cuckoo, rufous fantail and satin flycatcher	Migratory / Special Least Concern	
Potential nest of red goshawk (<i>Erythrotriorchis radiatus</i>)	Vulnerable / Endangered	Nature Advisory, 2022b. Red Goshawk and Roaming Bird Survey. Prepared for Windlab Pty Ltd.
Migratory species including fork-tailed swift, oriental cuckoo, rufous fantail and spectacled monarch	Migratory / Special Least Concern	
Sharman's rock wallaby (<i>Petrogale sharmani</i>)	Vulnerable / Vulnerable	Powerlink Kidston Connection Project, Matters of National Environmental Significance - Ecology Assessment. Powerlink Queensland. Aecom (2021). Unpublished. Publicly available as part of the EPBC Act referral 2021/9060.
Greater glider (<i>Petauroides volans</i>)	Vulnerable / Vulnerable	
Evidence of Koala (<i>Phascolarctos cinereus</i>)	Endangered / Endangered	

3.3. Overall survey effort

Survey effort during this event expanded upon that previously conducted for the broader Project area, however, with a particular focus on the environment within the disturbance footprint. For context, the number of flora survey sites for each data collection method are outlined conducted across all survey efforts are provided in **Table 3-3** and visually represented in **Appendix A, Figure 4**. Fauna survey effort is provided in **Table 3-4** and is presented in **Appendix A, Figure 3**.

Table 3-3: Flora survey effort

Survey type	September/October 2019	July 2020	March/April 2022	Total number of sites
Quaternary sites	316	172	313	801
Tertiary sites	52	6	83	141
BioCondition sites	N/A	N/A	26	26

Table 3-4: Fauna survey effort

Survey method	September/October 2019	July 2020	March/April 2022	Total effort
Ultrasonic detector	10 sites	15 sites	1 site	26 sites
	300 recording nights	74 recording nights	14 recording nights	388 recording nights
Acoustic detector	4 sites	4 sites	2 sites	10 sites
	76 recording nights	46 recording nights	56 recording nights	178 recording nights
Remote camera	45 sites	33 sites	5 Sites	83 sites
	596 trap nights	451 trap nights	136 trap nights	1,183 trap nights
Spotlighting and call playback	10 nights	5 nights	3 nights	18 nights
	70 hours	15 hours	5 hours	90 hours
Harp traps and mist netting	N/A	4 sites	N/A	4 sites
		15 harp trap nights		15 harp trap nights
		5 mist net nights		5 mist net nights
Bird surveys	Area searches over 12 days	Area searches 60 hours over 14 days. 20 Bird Utilisation Surveys	Area searches over 24 hours over 6 days.	Area searches over 32 days 20 Bird Utilisation Surveys
Diurnal searches	active Area searches 96 hours over 12 days	Area searches 112 hours over 14 days	Area searches over 9 days	Area searches over 35 days
Drone surveys	Not conducted in 2019	2.95 hours flight time over 21.22 km	3.2 hours flight time over 23.49 km	6.15 hours flight time over 44.71 km
General assessments	habitat 81 assessments	13 assessments	N/A	94 assessments
Targeted assessments	habitat 301 assessments	69 assessments	124	494 assessments
Habitat assessments	quality N/A	N/A	136	136

3.4. Flora

3.4.1. Vegetation communities

The disturbance footprint was found to be comprised predominantly of remnant vegetation, and of Least Concern REs disturbance footprint, with limited presence of Of Concern REs (refer to **Figure 5** and **6, Appendix A - Figures**) Non-remnant areas include vehicle access tracks, fences, and a state road. The field surveys confirmed 30 REs, which occur across 6 land zones (3, 5, 7, 8, 11, 12) and 2 bioregions (Wet Tropics and Einasleigh Uplands). A summary of REs ground-truthed within the disturbance footprint, including VM Act status classification as per the REDD and a description of the vegetation community observed in the field is provided in **Table 3-5**.

Table 3-5: Description of vegetation communities

RE	REDD Description	Field Description	VM Act status
7.12.24a	<i>Eucalyptus portuensis</i> , <i>Corymbia intermedia</i> , <i>E. drepanophylla</i> , <i>E. platyphylla</i> , <i>E. tereticornis</i> , <i>C. tessellaris</i> , <i>Lophostemon suaveolens</i> , <i>Syncarpia glomulifera</i> open forest to woodland. Foothills, of the wet and moist rainfall zones.	Community of mid-density canopy cover containing <i>Corymbia intermedia</i> and <i>Eucalyptus portuensis</i> . With a sparse mid-layer consisting of <i>Lophostemon suaveolens</i> and <i>Allocasuarina torulosa</i> . The sparse shrub layer often consisted of <i>Acacia flavescens</i> , <i>Alphitonia excelsa</i> , <i>Denhamia disperma</i> , <i>Lantana camara</i> and juvenile canopy species. A dense ground layer consisted of mostly native <i>Imperata cylindrica</i> , <i>Mnesithea rottboellioides</i> , and <i>Themeda triandra</i>	Least Concern
7.12.29a	<i>Corymbia intermedia</i> , <i>Eucalyptus tereticornis</i> , <i>E. drepanophylla</i> open forest to low open forest and woodland with <i>Allocasuarina torulosa</i> , <i>A. littoralis</i> , <i>Lophostemon suaveolens</i> , <i>Acacia cincinnata</i> , <i>A. flavescens</i> , <i>Banksia aquilonia</i> and <i>Xanthorrhoea johnsonii</i> . Uplands, on granite and rhyolite.	Open forest with a medium to dense canopy consisting of <i>Corymbia intermedia</i> , <i>Eucalyptus tereticornis</i> . Most areas have a sparse <i>Lophostemon suaveolens</i> mid-layer and either no shrub layer or a sparse distribution of <i>Alstonia muelleriana</i> , <i>Lophostemon suaveolens</i> and, <i>Lantana camara</i> . The ground layer consists of mostly native <i>Themeda triandra</i> with some exotic <i>Imperata cylindrica</i> .	Least Concern
7.12.29b	<i>Corymbia intermedia</i> , <i>Allocasuarina torulosa</i> , <i>Lophostemon suaveolens</i> open forest and woodland. Uplands, of the moist rainfall zone, on granite and rhyolite.	Open forest dominated by mid-dense canopy of <i>Corymbia intermedia</i> with scattered <i>Eucalyptus portuensis</i> and a sparse mid-layer of <i>Allocasuarina littoralis</i> , <i>Allocasuarina torulosa</i> , and <i>Lophostemon suaveolens</i> . A mixture of sparsely distributed shrubs consistent of <i>Xanthorrhoea johnsonii</i> , <i>Lophostemon suaveolens</i> , and <i>Alstonia muelleriana</i> . The main ground cover is a medium density <i>Themeda triandra</i> , <i>Imperata cylindrica</i> , <i>Gahnia aspera</i> , and <i>Heteropogon triticeus</i> mix.	Least Concern

RE	REDD Description	Field Description	VM Act status
7.12.30a	<i>Corymbia citriodora</i> , <i>Eucalyptus portuensis</i> , <i>C. intermedia</i> , <i>Syncarpia glomulifera</i> woodland to low woodland to open forest with <i>Callitris intratropica</i> , <i>Acacia calyculata</i> and <i>Xanthorrhoea johnsonii</i> . Uplands and highlands, of the moist and dry rainfall zones.	Medium density open forest community dominated by <i>Corymbia citriodora</i> , <i>Eucalyptus portuensis</i> with scattered <i>Corymbia intermedia</i> , <i>Alphitonia excelsa</i> through the lower canopy. The shrub layer is a mixture medium coverage of <i>Acacia calyculata</i> , <i>Acacia flavescens</i> , <i>Persoonia falcata</i> and juvenile canopy species. The ground cover has a medium density that is mostly native dominated by <i>Mnesithea rottboellioides</i> , <i>Heteropogon triticeus</i> , <i>Themeda triandra</i> .	Least Concern
7.12.34	<i>Eucalyptus portuensis</i> (white mahogany) and/or <i>E. drepanophylla</i> (ironbark), +/- <i>C. intermedia</i> (pink bloodwood) +/- <i>C. citriodora</i> (lemon-scented gum), +/- <i>E. granitica</i> (granite ironbark) open woodland to open forest. Uplands on granite, of the dry rainfall zone.	The canopy ranges from very sparse to medium density around the project area, dominated by <i>Eucalyptus portuensis</i> and <i>Corymbia intermedia</i> . A sparse mid-layer of <i>Allocasuarina littoralis</i> , <i>Allocasuarina torulosa</i> , and <i>Lophostemon suaveolens</i> is often found. The shrub layer is often absent or sparse containing mainly <i>Acacia flavescens</i> , <i>Xanthorrhoea johnsonii</i> , <i>Melaleuca viridiflora</i> , and juvenile canopy species. The ground cover ranges from absent to dense predominantly dominated by <i>Themeda triandra</i> , <i>Pteridium esculentum</i> , <i>Mnesithea rottboellioides</i> and <i>Heteropogon triticeus</i> .	Least Concern
7.12.35	<i>Eucalyptus portuensis</i> (white mahogany), <i>E. tereticornis</i> (forest red gum), <i>Corymbia intermedia</i> (pink bloodwood) woodland. Extensive dissected granites and rhyolites in the Kirrama - Oak Hills area.	A medium density canopy dominated by <i>Corymbia intermedia</i> , <i>Eucalyptus tereticornis</i> , and <i>Eucalyptus portuensis</i> . The shrub layer is sparse and consist of mainly juvenile canopy species, <i>Acacia flavescens</i> , and <i>Allocasuarina sp.</i> With a dense ground layer of <i>Mnesithea rottboellioides</i> , <i>Themeda triandra</i> , <i>Imperative cylindrica</i> , <i>Heteropogon triticeus</i> , and a diverse native mix.	Of Concern
7.12.65	Rock pavements or areas of skeletal soil, on granite and rhyolite, mostly of dry western or southern areas, often with shrublands to closed forests of <i>Acacia</i> spp. (wattles) and/or <i>Lophostemon suaveolens</i> (swamp mahogany) and/or <i>Allocasuarina littoralis</i> (black sheoak) and/or <i>Eucalyptus lockyeri</i> subsp. <i>exuta</i> .	A sparse upper canopy of <i>Eucalyptus portuensis</i> and <i>Corymbia abergiana</i> occasionally occurs. The shrub layer varies between moderately dense to very dense with <i>Acacia leptostachya</i> . Other shrub species which occur include <i>Sannantha augusta</i> and <i>Alphitonia excelsa</i> . The ground community occurs amongst and in between rock pavements and includes species <i>Xanthorrhoea johnsonii</i> , <i>Themeda triandra</i> , and <i>Entolasia stricta</i> .	Least Concern
7.12.65b	Rock pavement communities of the dry rainfall zone with <i>Acacia leptostachya</i> , <i>Eucalyptus lockyeri</i> subsp. <i>exuta</i> , <i>Lophostemon confertus</i> , <i>L. suaveolens</i> , <i>Persoonia falcata</i> , <i>Ficus rubiginosa</i> and <i>Allocasuarina inophloia</i> . Far northern areas including Adeline Creek.	Shrub layer community of medium dense <i>Acacia leptostachya</i> and <i>Sannantha augusta</i> with emergent <i>Eucalyptus exserta</i> . A medium density ground layer with a mix of native species including <i>Xanthorrhoea johnsonii</i> , <i>Themeda triandra</i> and <i>Entolasia stricta</i> and exotic grass <i>Melinis repens</i> .	Least Concern

RE	REDD Description	Field Description	VM Act status
7.12.65c	Low woodland and shrubland complex with <i>Lophostemon suaveolens</i> , <i>Corymbia citriodora</i> , <i>Eucalyptus lockyeri</i> subsp. <i>exuta</i> , <i>E. granitica</i> , <i>E. drepanophylla</i> and <i>E. portuensis</i> . Shrubs often occur in clumps or groves either as an understorey or scattered shrubland communities within the type and include <i>Lophostemon suaveolens</i> , <i>L. confertus</i> , <i>Acacia leptostachya</i> , <i>Allocasuarina inophloia</i> and <i>Melaleuca viridiflora</i> . Dry rainfall zone areas of abundant surface rock and shallow or skeletal soils.	Woodland community with a sparse canopy comprised of a mixture of <i>Corymbia intermedia</i> , <i>Eucalyptus portuensis</i> , and <i>Lophostemon suaveolens</i> . The sparse mid-layer mainly dominated by <i>Melaleuca viridiflora</i> and <i>Corymbia intermedia</i> , and <i>Acacia leptostachya</i> . The shrub layer is a mixture of <i>Xanthorrhoea johnsonii</i> , <i>Acacia leptostachya</i> , and <i>Lophostemon suaveolens</i> . The ground later is dominated by <i>Themeda triandra</i> with some <i>Heteropogon contortus</i> , <i>Arundinella nepalensis</i> , and <i>Velleia pubescens</i> .	Least Concern
7.3.26a	<i>Casuarina cunninghamiana</i> , <i>Eucalyptus tereticornis</i> , <i>Lophostemon suaveolens</i> , <i>Melaleuca leucadendra</i> , <i>M. fluviatilis</i> , <i>Buckinghamia celsissima</i> , <i>Mallotus philippensis</i> woodland and forest with an understorey of <i>Melaleuca viminalis</i> and <i>Bursaria tenuifolia</i> . Fringing forests of larger streams. Riverine wetland or fringing riverine wetland.	The canopy is sparse and comprised of <i>Casuarina cunninghamiana</i> , and <i>Lophostemon suaveolens</i> . The shrub layer consists of mainly <i>Melaleuca viminalis</i> with some <i>Lophostemon suaveolens</i> and <i>Pandanus spiralis</i> . Where present the ground layer varied from <i>Ischaemum australe</i> dominate to <i>Imperata cylindrica</i> , <i>Lomandra</i> with the occasional sedge species.	Of concern
7.5.1a	<i>Eucalyptus tereticornis</i> (forest red gum), <i>Corymbia intermedia</i> (pink bloodwood) and <i>E. reducta</i> (Queensland stringybark) woodland to open forest of uplands. Weathered soils of a remnant surface.	Open woodland with a medium density canopy community containing <i>Corymbia intermedia</i> , <i>Eucalyptus portuensis</i> , <i>Allocasuarina torulosa</i> and <i>Corymbia citriodora</i> . A sparse mid-layer with scattered canopy species and <i>Acacia flavescens</i> . The shrub layer was sparse dominated by <i>Eustrephus latifolius</i> , <i>Acacia flavescens</i> and <i>Lantana camara</i> . The ground layer is a dense main native mix of <i>Themeda triandra</i> , <i>Imperata cylindrica</i> and <i>Hardenbergia violacea</i> .	Of concern
7.5.2	<i>Eucalyptus portuensis</i> +/- <i>Corymbia intermedia</i> , open forest to woodland of uplands on weathered soils of a remnant surface	The canopy is dominated by a sparse layer of <i>Eucalyptus portuensis</i> . A medium to dense mid-layer of <i>Acacia flavescens</i> , <i>Syncarpia glomulifera</i> , <i>Lophostemon suaveolens</i> are common with the shrub layer been comprised of both mid-layer and juvenile canopy species. The ground layer is dense dominated by <i>Entolasia stricta</i> , <i>Imperata cylindrica</i> , and <i>Breynia oblongifolia</i> .	Of Concern
7.5.2a	<i>Eucalyptus portuensis</i> , <i>Corymbia intermedia</i> , <i>E. tereticornis</i> , <i>Lophostemon suaveolens</i> , <i>Syncarpia glomulifera</i> open forest and woodland. Laterite.	A sparse open canopy dominated by <i>Eucalyptus portuensis</i> , <i>Corymbia intermedia</i> and <i>Eucalyptus tereticornis</i> . The mid-layer consists of <i>Acacia flavescens</i> and <i>Corymbia intermedia</i> with a medium dense shrub layer consisting of juvenile canopy species and <i>Lophostemon suaveolens</i> . The ground layer is medium dense dominated by <i>Entolasia stricta</i> and <i>Imperata cylindrica</i> .	Of Concern

RE	REDD Description	Field Description	VM Act status
7.5.2c	<i>Eucalyptus portuensis</i> +/- <i>Corymbia intermedia</i> +/- <i>Corymbia clarksoniana</i> +/- <i>Eucalyptus tereticornis</i> +/- <i>Lophostemon suaveolens</i> tall open forest to woodland with a mid-layer of <i>Acacia flavescens</i> , <i>Allocasuarina torulosa</i> , and a grassy ground layer. Weathered soils of a remnant surface.	A community dominated solely by a sparse canopy of <i>Eucalyptus portuensis</i> , with a mid-layer community of medium density <i>Acacia flavescens</i> , <i>Syncarpia glomulifera</i> , and <i>Lophostemon suaveolens</i> . A sparse shrub layer with <i>Lophostemon suaveolens</i> , <i>Acacia flavescens</i> , and <i>Persoonia falcata</i> is present. The ground layer is mostly native consisting of <i>Entolasia stricta</i> , <i>Imperata cylindrica</i> , and <i>Breynia oblongifolia</i> .	Of Concern
7.5.3	<i>Eucalyptus portuensis</i> (white mahogany), <i>Corymbia citriodora</i> (lemon scented gum), and <i>E. drepanophylla</i> (ironbark), woodland to open forest of uplands. Weathered soils of a remnant surface.	Open forest community containing a moderately dense upper canopy of <i>Eucalyptus portuensis</i> , <i>Corymbia citriodora</i> , and <i>Eucalyptus crebra</i> . A sparse sub-canopy is present with recruiting canopy species. The shrub layer is absent, and the ground layer is moderately dense and species diverse. Native grass species <i>Themada triandra</i> and <i>Heteropogon contortus</i> were the most abundant in the ground layer.	Of Concern
7.5.4a	<i>Corymbia intermedia</i> +/- <i>Eucalyptus tereticornis</i> woodland and open forest with <i>Allocasuarina torulosa</i> , <i>A. littoralis</i> , <i>Lophostemon suaveolens</i> , <i>Acacia flavescens</i> , <i>Banksia aquilonia</i> and <i>Xanthorrhoea johnsonii</i> . Weathered soils and laterite of a remnant surface.	A dense canopy woodland with <i>Corymbia intermedia</i> and scattered <i>Eucalyptus tereticornis</i> . The mid-layer is dominated by <i>Allocasuarina torulosa</i> with a shrub layer contain juvenile canopy species and <i>Acacia flavescens</i> . The ground layer is sparse with <i>Entolasia stricta</i> and <i>Imperata cylindrica</i>	Of Concern
7.5.4f	<i>Corymbia intermedia</i> , <i>Allocasuarina torulosa</i> , <i>Lophostemon suaveolens</i> open forest and woodland. Deep weathered soils of basalt origin.	Open woodlands with a medium <i>Corymbia intermedia</i> , <i>Allocasuarina torulosa</i> , <i>Lophostemon suaveolens</i> . A sparse shrub layer containing <i>Acacia flavescens</i> , <i>Allocasuarina sp.</i> , and <i>Syncarpia glomulifera</i> . The ground layer was dominated by <i>Themada triandra</i> and <i>Imperata cylindrica</i> .	Of Concern
7.8.18a / b	<i>Corymbia intermedia</i> , <i>Eucalyptus tereticornis</i> , <i>E. granitica</i> open forest to woodland with <i>Allocasuarina torulosa</i> , <i>A. littoralis</i> , <i>Lophostemon suaveolens</i> , <i>Acacia cincinnata</i> , <i>A. flavescens</i> , <i>Banksia aquilonia</i> and <i>Xanthorrhoea johnsonii</i> . Basalt.	State mapped. No ground truthed data available. BioCondition score derived from Assessment Unit grouping (Table 3-7)	Of Concern

RE	REDD Description	Field Description	VM Act status
9.11.2a	Woodland to open woodland of <i>Eucalyptus crebra</i> (narrow-leaved ironbark) +/- <i>Corymbia dallachiana</i> (Dallachy's gum) +/- <i>C. erythrophloia</i> (red bloodwood) +/- <i>C. clarksoniana</i> (Clarkson's bloodwood) +/- <i>Eucalyptus</i> spp. +/- <i>Corymbia</i> spp. An open to mid-dense sub-canopy layer can occur and include canopy species, <i>Bursaria incana</i> (prickly pine), <i>Hakea</i> spp., and <i>Acacia</i> spp. The shrub layer is sparse to open and can include canopy species, <i>Denhamia cunninghamii</i> (yellowberry bush), <i>Grewia retusifolia</i> , <i>Erythroxylum australe</i> (cocaine tree), <i>Carissa</i> spp., <i>Hakea</i> spp. and <i>Acacia</i> spp. The ground layer is grassy and dominated by <i>Heteropogon contortus</i> (black speargrass), <i>Themeda triandra</i> (kangaroo grass) and <i>H. triticeus</i> (giant speargrass). Occurs on metamorphic hills and rises.	Emergent <i>Eucalyptus crebra</i> and <i>Corymbia dallachiana</i> with a mixed canopy of medium density <i>Eucalyptus crebra</i> and <i>Corymbia dallachiana</i> with intermittent <i>Corymbia clarksoniana</i> . A sparse to medium density sub-canopy of <i>Corymbia erythrophloia</i> and a mix of canopy species. The ground layer is absent to sparse consisting of <i>Heteropogon contortus</i> and <i>Themeda triandra</i> .	Least Concern
9.11.4a	Open forest to open woodland of <i>Eucalyptus granitica</i> , <i>Corymbia clarksoniana</i> (Clarkson's bloodwood) and/or <i>C. intermedia</i> (pink bloodwood), <i>C. citriodora</i> subsp. <i>citriodora</i> (lemon-scented gum) +/- <i>E. portuensis</i> (white mahogany) +/- <i>C. dallachiana</i> (Dallachy's gum) +/- <i>E. tereticornis</i> (bluegum). Other ironbark species may also occur, namely <i>E. crebra</i> , <i>E. drepanophylla</i> (grey ironbark) in the south and <i>E. cullenii</i> (Cullen's ironbark) in the north. An open sub-canopy can occur and include canopy species, <i>Erythrophleum chlorostachys</i> (Cooktown ironwood) and <i>Grevillea glauca</i> (bushman's clothes peg). The mid-dense shrub layer includes <i>Acacia flavescens</i> (yellow wattle), <i>Grevillea glauca</i> , <i>Petalostigma</i> spp., <i>Bursaria incana</i> (prickly pine) and <i>Denhamia cunninghamii</i> (yellowberry bush). <i>Xanthorrhoea johnsonii</i> (grass-tree) may also occur in a lower shrub layer. The mid-dense ground layer is grassy and dominated by <i>Heteropogon contortus</i> (black speargrass) and <i>Themeda triandra</i> (kangaroo grass). Occurs on metamorphic hills.	Open woodland dominated by medium density canopy comprised of <i>Corymbia citriodora</i> and <i>Eucalyptus crebra</i> . With a shrub layer consisting of multiple mixed layers of <i>Cajanus reticulatus</i> , <i>Indigofera pratensis</i> , <i>Persoonia falcata</i> and juvenile canopy species. Ranging from sparse to dense the ground coverage is a mix of <i>Heteropogon contortus</i> , <i>Grewia retusifolia</i> , <i>Breynia oblongata</i> and high amounts of exotic <i>Wynn cassia</i> and <i>Melinis repens</i> .	Least Concern

RE	REDD Description	Field Description	VM Act status
9.12.19	<i>Eucalyptus crebra</i> or <i>E. granitica</i> +/- <i>Corymbia citriodora</i> subsp. <i>citriodora</i> +/- <i>E. portuensis</i> mixed woodland on igneous hills	A medium density canopy cover dominated by <i>Eucalyptus crebra</i> with a mixture of <i>Corymbia leichhardtii</i> , <i>Erythrina vespertilio</i> , <i>Corymbia citriodora</i> , <i>Eucalyptus exserta</i> , and <i>Corymbia trachyphloia</i> . A sparse mid-layer containing <i>Denhamia disperma</i> , <i>Bursaria incana</i> , and a mix of canopy species. With a shrub layer sparse to medium density mainly consisting of scattered <i>Petalostigma pubescens</i> and <i>Melaleuca viridiflora</i> with some <i>Bursaria incana</i> , <i>Breynia oblongifolia</i> , <i>Acacia flavescens</i> , <i>Pittosporum spinescens</i> , and <i>Grewia retusifolia</i> . The ground layer is medium to dense with a diverse community dominated by <i>Aristida calycina</i> , <i>Heteropogon contortus</i> , <i>Themeda triandra</i> , and <i>Melinis repens</i> .	Least Concern
9.12.1a	Woodland to low open woodland of <i>Eucalyptus crebra</i> (narrow-leaved ironbark) +/- <i>Corymbia dallachiana</i> (Dallachy's gum) +/- <i>C. erythrophloia</i> (red bloodwood) +/- <i>C. clarksoniana</i> (Clarkson's bloodwood) +/- <i>Corymbia</i> spp. <i>E. exilipes</i> (fine-leaved ironbark) or <i>E. granitica</i> (granite ironbark) can sometimes occur as a dominant. An open sub-canopy can occur with canopy species as well as <i>Geijera salicifolia</i> (wilga), <i>Petalostigma pubescens</i> (quinine), <i>Denhamia cunninghamii</i> (yellowberry bush), <i>Bursaria incana</i> (prickly pine) and <i>Acacia</i> spp. An open shrub layer usually includes canopy and sub-canopy species and <i>Carissa lanceolata</i> (currantbush). The sparse to dense ground layer is dominated by <i>Heteropogon contortus</i> (black speargrass) and <i>Themeda triandra</i> (kangaroo grass). Occurs on a variety of landforms from undulating plains to steep hills.	Open woodland mixed community of medium to dense canopy of <i>Eucalyptus crebra</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus persistens</i> , <i>Corymbia dallachiana</i> , and <i>Corymbia intermedia</i> . A sparse mid-layer of <i>Corymbia clarksoniana</i> with the occasional <i>Ficus rubiginosa</i> . A sparse shrub layer of <i>Bursaria incana</i> , <i>Acacia disparrima</i> , <i>Acacia flavescens</i> , <i>Lantana camara</i> , <i>Ficus platypoda</i> , and <i>Acacia decora</i> . The ground layer ranges from sparse to dense dominated by <i>Heteropogon triticeus</i> , <i>Themeda triandra</i> , and <i>Heteropogon contortus</i> .	Least Concern
9.12.1e	Grassland with isolated emergent trees of <i>Eucalyptus crebra</i> (sens. lat.) (narrow-leaved ironbark) +/- clumps of shrubs of <i>Acacia decora</i> and/or <i>A. leptostachya</i> (slender wattle) and/or <i>Jacksonia thesioides</i> and/or <i>Allocasuarina inophloia</i> (stringybark sheoak). Occurs on granite hills.	A scattered emergent layer of <i>Eucalyptus crebra</i> , <i>Corymbia dallachiana</i> , and <i>Corymbia erythrophloia</i> . The shrub layer is clumped under emergent trees often containing <i>Lantana camara</i> , <i>Alphitonia excelsa</i> , and <i>Breynia oblongifolia</i> . With a medium to dense ground layer dominated by <i>Heteropogon contortus</i> , <i>Heteropogon triticeus</i> , and <i>Indigofera hirsuta</i> .	Least Concern

RE	REDD Description	Field Description	VM Act status
9.12.2	<i>Eucalyptus portuensis</i> , <i>Corymbia citriodora</i> subsp. <i>citriodora</i> , <i>E. granitica</i> or <i>E. crebra</i> , <i>C. intermedia</i> or <i>C. clarksoniana</i> mixed woodland on steep hills and ranges on igneous hills close to Wet Tropics boundary	Sparse canopy cover containing a mixed community of <i>Corymbia citriodora</i> , <i>Eucalyptus crebra</i> , <i>Corymbia clarksoniana</i> , <i>Eucalyptus portuensis</i> , and <i>Corymbia intermedia</i> . Occasional with a sparse mid-layer of mixed canopy species and a sparse shrub layer of <i>Acacia flavescens</i> , <i>Jasminum simplicifolium</i> , and <i>Petalostigma pubescens</i> . The ground cover was dense heavily dominated by <i>Themeda triandra</i> and <i>Heteropogon triticeus</i> .	Least Concern
9.12.22	<i>Eucalyptus drepanophylla</i> , <i>Corymbia clarksoniana</i> or <i>C. intermedia</i> and <i>C. dallachiana</i> woodland on steep rugged igneous ranges	Medium density canopy with <i>Corymbia dallachiana</i> , <i>Eucalyptus crebra</i> , and <i>Corymbia erythrophloia</i> on steep slopes. A sparse mid-layer of <i>Bursaria incana</i> , <i>Petalostigma pubescens</i> , and <i>Denhamia disperma</i> . The shrub layer is a mixture scattered <i>Persoonia falcata</i> , <i>Breynia oblongifolia</i> , and <i>Petalostigma pubescens</i> . The exotic species <i>Vachellia bidwillii</i> was sometimes present. A dense ground layer dominated by native grasses <i>Themeda triandra</i> , <i>Heteropogon triticeus</i> and a mixture of native forb species.	Least Concern
9.3.1	<i>Eucalyptus camaldulensis</i> and/or <i>E. tereticornis</i> +/- <i>Melaleuca</i> spp. +/- <i>Casuarina cunninghamiana</i> fringing woodland on channels and levees	A sparse <i>Eucalyptus tereticornis</i> emergent layer with medium canopy cover comprised of <i>Casuarina cunninghamiana</i> , <i>Corymbia tessellaris</i> and <i>Corymbia clarksoniana</i> . A sparse mid-layer is often found containing <i>Lophostemon suaveolens</i> , <i>Lophostemon grandiflora</i> , juvenile canopy species with the occasional <i>Melaleuca leucadendra</i> . The shrub layer was absent or small patches of juvenile canopy species with <i>Lantana camara</i> and <i>Melaleuca trichostachya</i> . A dense ground layer was often dominated by <i>Heteropogon contortus</i> , <i>Indigofera sp.</i> , and <i>Themeda triandra</i> .	Least Concern
9.3.13	<i>Melaleuca</i> spp., <i>Eucalyptus camaldulensis</i> and <i>Casuarina cunninghamiana</i> fringing open forest on streams and channels	Mixed open forest with sparse to dense canopy community of <i>Melaleuca</i> spp., <i>Allocasuarina torulosa</i> , and <i>Casuarina cunninghamiana</i> . The shrub layer contains <i>Pleiogynium timorense</i> and juvenile canopy species. The ground layer is dense with <i>Heteropogon contortus</i> and <i>Themeda triandra</i> .	Least Concern

RE	REDD Description	Field Description	VM Act status
9.5.5a	Mixed woodland to open forest of <i>Eucalyptus crebra</i> (narrow-leaved ironbark), <i>Corymbia clarksoniana</i> (Clarkson's bloodwood) and <i>C. citriodora</i> subsp. <i>citriodora</i> (lemon-scented gum) +/- <i>E. portuensis</i> (white mahogany) with a generally open sub-canopy of canopy species +/- <i>Callitris intratropica</i> (cypress pine) and <i>Acacia</i> spp. The open shrub layer often contains juvenile canopy species, <i>Petalostigma pubescens</i> (quinine), <i>Acacia flavescens</i> (powder puff wattle) and other <i>Acacia</i> spp. <i>Themeda triandra</i> (kangaroo grass) is the dominant species in a dense grassy ground layer. Occurs on Tertiary plateaus and remnants.	Mixed open woodland community with a medium to sparse canopy cover containing <i>Eucalyptus crebra</i> , <i>Corymbia clarksoniana</i> , and <i>Corymbia citriodora</i> with Emergent <i>Corymbia intermedia</i> . The shrub layer contains <i>Allocasuarina torulosa</i> , <i>Eucalyptus portuensis</i> , and <i>Acacia flavescens</i> . The ground layer is dominated by <i>Themeda triandra</i> , <i>Entolasia stricta</i> , and <i>Lomandra longifolia</i> .	Least Concern
9.7.3b	Woodland of <i>Eucalyptus portuensis</i> (white mahogany) +/- <i>Corymbia trachyphloia</i> (brown bloodwood) +/- <i>C. citriodora</i> subsp. <i>citriodora</i> (lemon-scented gum) +/- <i>C. clarksoniana</i> (Clarkson's bloodwood) +/- <i>C. intermedia</i> (pink bloodwood) +/- <i>E. crebra</i> (narrow-leaved ironbark) +/- <i>E. howittiana</i> (Howit's box). A sparse sub-canopy can contain canopy species +/- <i>Grevillea glauca</i> (bushman's clothes peg). A sparse to mid-dense shrub layer is often present and includes canopy species, <i>Acacia</i> spp. (wattle), <i>Grevillea</i> spp. +/- <i>Pultenaea</i> spp. There is a mid-dense grassy cover of <i>Themeda triandra</i> (kangaroo grass). Occurs on lateritised weathering profiles overlying land zone 11 or 12 geologies and on lateritised edges of granite breakaways and Tertiary plateaus in subregion 6	Woodland dominated by a sparse canopy of <i>Eucalyptus portuensis</i> with <i>Eucalyptus crebra</i> and <i>Corymbia trachyphloia</i> . A very sparse low mid-layer of <i>Acacia flavescens</i> , <i>Acacia leptostachya</i> and <i>Corymbia citriodora</i> . The shrub layer is dominated by juvenile canopy species, <i>Hibiscus meraukensis</i> and <i>Acacia flavescens</i> . The ground layer is medium to sparse with <i>Themeda triandra</i> , <i>Entolasia stricta</i> , and <i>Indigofera pratensis</i>	Least concern
9.8.4a	Woodland to open woodland of <i>Eucalyptus crebra</i> (narrow-leaved ironbark) or <i>E. granitica</i> (granite ironbark) +/- <i>Corymbia intermedia</i> (pink bloodwood) +/- <i>C. dallachiana</i> (Dallachy's gum) +/- <i>C. tessellaris</i> (Moreton Bay ash). Scattered canopy species and <i>Lophostemon suaveolens</i> (swamp mahogany) can sometimes occur in the sub-canopy. The shrub layer is absent to sparse. The ground layer is dense and grassy and is dominated by <i>Themeda triandra</i> (kangaroo grass) and <i>Heteropogon contortus</i> (black speargrass). Occurs on basalt plains and rocky basalt plains and hills with varying depths of soil.	A sparse canopy of <i>Corymbia tessellaris</i> and <i>Eucalyptus crebra</i> , often found with a sparse mid-layer comprises the juvenile canopy species. A sparse shrub layer also is dominated by juvenile canopy species with <i>Lantana camara</i> and <i>grevillea parallela</i> mixed in. The ground layer is dense with a mix of <i>Heteropogon contortus</i> , <i>Themeda quadrivalvis</i> , <i>Heteropogon triticeus</i> , and the occasional native and exotic forbs species.	Least Concern

RE	REDD Description	Field Description	VM Act status
Non-remnant	Non-remnant	Existing access tracks or cleared areas	N/A

3.4.2. Threatened flora

A total of eleven threatened flora species were assessed as being likely or having the potential to occur within the disturbance footprint (Appendix C - Likelihood of Occurrence Table). No threatened flora species were detected within the disturbance footprint during field surveys, however, one species, *Commersonia reticulata*, was detected within approximately 200 m of a proposed access track and 350 m of proposed turbine (27N). Approximately 50 individuals were observed growing on a small rock pavement. Additionally, there are three areas of Protected Plant Flora Survey High Risk Trigger Area (version 8.0) that intersect the disturbance footprint, indicating presence of threatened flora species or species habitat (**Appendix A, Figure 9**). Habitat for potentially occurring flora species are illustrated on **Figures 10 and 11 (Appendix A)**.

Flora results of the likelihood of occurrence assessment, and description of species habitat as it occurred within the disturbance footprint, are summarised in Table 3-6 below. Overall, threatened flora species habitat was found to be in good condition (class 1) across the disturbance footprint, as reflected by the BioCondition Class Scores (1 to 4), where a score of 1 reflects functional biodiversity condition and a score of 4 reflects dysfunctional biodiversity condition.

Table 3-6: Habitat description and BioCondition score for potentially occurring threatened flora species

Species	Likelihood of occurrence	NC Act listing	EPBC Act listing	Description of species habitat occurring within project impact area	BioCondition Score (class)
<i>Acacia longipedunculata</i>	Potential	NT	-	The species has potential to occur in habitats characterised by woodland to open forest in dry rainfall zones on granite uplands. Suitable woodland habitat within the disturbance footprint often contained a canopy of mixed <i>Eucalyptus</i> and <i>Corymbia</i> species such as <i>E. portuensis</i> , <i>C. citriodora</i> , and <i>C. intermedia</i> . A diverse shrub layer is typically present and includes other common <i>Acacia</i> species such as <i>A. calyculata</i> and <i>A. flavescens</i> . The ground layer is dominated by native grasses <i>Themeda triandra</i> and <i>Heteropogon triticeus</i> . Habitat of this character was in good condition, often with low weed invasion and low grazing pressure. Some areas had experienced recent high-heat fires, which could affect the suitability of the habitat.	1
<i>Acacia tingoorensis</i> (Tingoorensis wattle)	Likely	V	-	The species has potential to occur in habitats characterised by woodland to open forest in dry rainfall zones on granite uplands. Suitable woodland habitat within the disturbance footprint often contained a canopy of mixed <i>Eucalyptus</i> and <i>Corymbia</i> species such as <i>E. portuensis</i> , <i>C. citriodora</i> , and <i>C. intermedia</i> . A species diverse shrub layer is typically present and includes other common <i>Acacia</i> species <i>A. calyculata</i> and <i>A. flavescens</i> . The ground layer is dominated by native grasses <i>Themeda triandra</i> and <i>Heteropogon triticeus</i> . Habitat of this character was in good condition, often with low weed invasion and low grazing pressure.	1
<i>Commersonia reticulata</i>	Likely	V	-	The species was observed in two locations during previous studies (ELA, 2020; ELA, 2022), however, outside of the disturbance footprint. In both locations, the species was observed growing in clusters on rock pavements. Habitat for the species within the disturbance footprint consists granite rock pavement communities, which were typically dominated by a shrub layer of mixed densities depending on the area. These areas occur as discrete rock pavements, as well as bare areas observed in other vegetation community types. Common dominant shrub species included <i>Acacia leptostachya</i> , <i>Melaleuca viridiflora</i> , and <i>Sannantha augusta</i> . Potential habitat also occurred in mixed open woodland often dominated by yellow jacket. Suitable woodland communities occurred in granite hills and ranges, and occasionally included distinct areas of rock pavements in which the species may occur. In these suitable rock pave communities the ground layer is highly variable growing amongst and in-between granite. Ground composition was dominated by native grasses <i>Themeda triandra</i> and <i>Heteropogon triticeus</i> . Habitat of this character was in good condition, often with low weed invasion and low grazing pressure.	1
<i>Corybas cerasinus</i> (Red helmet orchid)	Potential	NT	-	Species habitat is characterised by moist to wet open forest, often dominated by <i>Corymbia intermedia</i> , <i>Eucalyptus portuensis</i> , and <i>E. tereticornis</i> . The mid-layer is typically sparse with common species <i>Lophostemon suaveolens</i> and <i>Alstonia muelleriana</i> . The ground layer, where this species occurs, was dense and dominated by native grass species	1

Species	Likelihood of occurrence	NC Act listing	EPBC Act listing	Description of species habitat occurring within project impact area	BioCondition Score (class)
				<i>Themeda triandra</i> and <i>Imperata cylindrica</i> . The species is small and occurs low in the ground layer, making detection difficult. Overall, the species habitat is in good condition, reflected by the BioCondition score.	
<i>Corymbia leptoloma</i> (yellow jacket)	Potential	V	V	Species habitat is variable occurring in wet rainfall zones, across mixed open woodlands on uplands and granite rock pavement communities. Habitat was typically dominated by a mixed <i>Eucalyptus</i> and <i>Corymbia</i> canopy, including <i>E. portuensis</i> , <i>Lophostemon suaveolens</i> , and <i>C. intermedia</i> - know co-occurrence canopy species. A mixed shrub layer occurs with species such as <i>Acacia flavescens</i> and <i>Melaleuca viridiflora</i> . The ground layer is variable across potential habitat, however, typically includes the common native grass species <i>Themeda triandra</i> . Species habitat was widespread across the disturbance footprint, and in good condition as reflected by the BioCondition class score.	1
<i>Glossocardia orthochaeta</i>	Potential	E	-	Species habitat occurs on steep rocky granite country with boulder stacks and open granite pavements. The species grows on soils of granitic lithosols. The species is most likely to be found on granite rock pavements in partially shaded areas in proximity to minor creeks, potentially on the ecotone between vine thicket and open grassy woodlands. Suitable habitat in the disturbance footprint occurs as rock pavements.	1
<i>Homoranthus cummingii</i> / <i>Homoranthus porteri</i>	Potential	CR V	- V	Species habitat is variable occurring in wet and dry rainfall zones, across mixed open woodlands on uplands amongst granite rock pavement communities. Habitat was typically dominated by a mixed <i>Eucalyptus</i> and <i>Corymbia</i> canopy, including <i>E. portuensis</i> , <i>C. intermedia</i> , <i>E. tereticornis</i> , and <i>Lophostemon suaveolens</i> . A mixed shrub layer occurs with species such as <i>Acacia flavescens</i> and <i>Melaleuca viridiflora</i> . The ground layer is sparse to moderately dense with native grass species <i>Themeda triandra</i> and <i>Imperata cylindrica</i> . The species has the potential to occur in this habitat where soils are shallow on exposed slope ridges and on the edges of rock pavements. The species habitat was widespread across the disturbance footprint, and in good condition as reflected by the BioCondition class score. Some areas of the species habitat was affected by fire, which could limit species detectability.	1
<i>Marsdenia brevifolia</i>	Potential	V	V	Species habitat was limited to a distinct habitat type characterised by very open <i>Eucalyptus</i> woodland communities on basalt plains. The canopy and mid-layer are both very sparse and dominated by <i>E. crebra</i> and <i>Corymbia tessellaris</i> . The ground layer was dense with native grass species <i>Heteropogon contortus</i> , and <i>Heteropogon triticeus</i> . Species habitat was in good condition as reflected by the BioCondition class score, however, evidence of high-heat fires was observed which could limit species detectability and occurrence. Further, <i>Themeda quadrivalvis</i> was observed in low densities in some areas, which is an exotic grass that can outcompete native ground covers.	2
<i>Oenanthe javanica</i> (water celery)	Potential	NT	-	Species habitat occurs in wet vegetation fringing riverine systems, channels, and levees across the disturbance footprint. The habitat is characterised by an open woodland canopy of <i>Eucalyptus tereticornis</i> , <i>Casuarina cunninghamiana</i> , <i>Corymbia tessellaris</i> , and <i>Lophostemon suaveolens</i> . The mid layer is variable across the species habitat and can include <i>Melaleuca viminalis</i> , <i>Pandanus spiralis</i> , and <i>Melaleuca trichostachya</i> . The ground layer is	N/A – see survey limitations

Species	Likelihood of occurrence	NC Act listing	EPBC Act listing	Description of species habitat occurring within project impact area	BioCondition Score (class)
				often dense with native grass and sedge, and species diverse in wet areas. Native grasses often include <i>Imperata cylindrica</i> , <i>Heteropogon contortus</i> , and <i>Themeda triandra</i> . Species habitat condition was not measured according to BioCondition due to survey limitations (see Section 2.2.5). Overall, the habitat was mostly absent of weed invasion, impacts from burning, or grazing pressure.	
<i>Solanum graniticum</i> (granite nightshade)	Potential	E	E	Species habitat occurs on granite uplands in mixed open woodland communities of <i>Eucalyptus</i> and <i>Corymbia</i> species. Typical dominant species include <i>E. crebra</i> , <i>E. tereticornis</i> , <i>E. persistens</i> , and <i>C. intermedia</i> . There is a distinctively sparse to absent shrub layer, however, can include <i>Bursaria incana</i> , <i>Acacia disparrima</i> , and <i>Acacia flavescens</i> . The ground layer occurs in variable density and is predominantly made up of native grass species <i>Heteropogon triticeus</i> , <i>Themeda triandra</i> , and <i>Heteropogon contortus</i> . Species habitat was in good condition, as reflected by the BioCondition class score. Habitat was largely absent of heavy weed invasion, and pressure from grazing. Some areas with species habitat were heavily burnt, which could impact species presence and detectability.	1

3.4.3. BioCondition scores

A total of 16 assessment units (AU) were analysed from a total of 26 BioCondition surveys (**Table 3-7**). BioCondition scores were further categorised into functionality classifications, as defined below and by the BioCondition manual (Erye *et al.* 2015):

- BioCondition class 1: >0.80 (Functional biodiversity condition);
- BioCondition class 2: >0.60 to 0.80 (Nearing functional biodiversity condition);
- BioCondition class 3: 0.40 to 0.59 (Nearing dysfunctional biodiversity condition); and
- BioCondition class 4: <0.40 (Dysfunctional biodiversity condition).

BioCondition classifications for each assessment unit were equally split between class 1 and class 2 which in both cases represents a vegetation community in a functional biodiversity condition. Vegetation across the disturbance footprint overall is therefore in good condition, mostly absent of structural clearing and weeds which would otherwise be reflected in a poor BioCondition score and classification. Vegetation communities on basalt, or lateritic derived soils were subject to some exotic species occurrence.

As described in the survey limitations (**Section 2.2.5**), due to large amounts of rainfall, parts of the disturbance footprint could not be accessed which resulted in some assessment units (AUs), namely those on land zone 3 and 11 not able to be surveyed. These areas comprise of a relatively small (combined area of 52 ha) portion of the disturbance footprint. Additionally, where REs formed a similar vegetation community or ecological function, such as those specified as 'a', 'b', etc., these were grouped, where relevant into the same AU (**Table 3-7**).

Table 3-7: BioCondition analysis summary and results

AU	RE	Condition	Area (ha)	No. of BioCondition sites established	BioCondition score	BioCondition class
AU1	7.12.24a, 7.12.29a, 7.12.29b	Remnant	17.39	2	0.8	1
AU2	7.5.1b	Remnant	3.10	1	0.7	2
AU3	7.12.30a	Remnant	18.44	1	0.9	1
AU4	7.12.34	Remnant	41.06	3	0.8	2
AU5	7.12.35	Remnant	1.66	1	0.9	1
AU6	7.12.65, 7.12.65b, 7.12.65c	Remnant	9.90	1	1.0	1
AU7	7.5.2, 7.5.2a, 7.5.2c, 7.5.3	Remnant	13.75	1	0.8	1
AU8	7.5.4a, 7.5.4f, 7.8.18a, 7.8.18b	Remnant	14.95	1	0.8	1
AU9	9.12.1a	Remnant	57.70	2	0.8	1
AU10	9.12.19	Remnant	45.90	3	0.6	2
AU11	9.12.2	Remnant	225.99	1	0.7	2
AU12	9.12.22	Remnant	6.92	1	0.8	1
AU13	9.12.4c	Remnant	0.00*	1	0.8	2
AU14	9.5.5a	Remnant	12.19	3	0.7	2
AU15	9.7.3b	Remnant	6.69	1	0.7	2
AU16	9.8.4a	Remnant	23.12	3	0.7	2

*was surveyed prior to a change in disturbance footprint – this RE has since been excluded as the impact area has been reduced.

3.4.4. Threatened ecological communities

Based on the vegetation assessed in the surrounding Project area, no TECs were observed, nor have potential to occur in the disturbance footprint.

3.5. Habitat values

Eight broad habitat types were identified in the disturbance footprint. These habitats provide a range of resources for native fauna species, including threatened and migratory species. These broad habitat types include:

- Riparian forest
- Very open woodland on metamorphics and low hills
- Open woodland to open forest on granite and tertiary surfaces
- Woodland on lateritised surface
- Open forest to woodlands on uplands
- Open woodland on basalt plains
- Rock pavements
- Open forest with *Allocasuarina* spp. dominant or co-dominant in the canopy

Five additional broad habitat types were identified during within the broader Project area. However, these areas were found not to exist within the disturbance footprint. These broad habitat types are:

- Floodplain
- Tussock grassland
- Simple or notophyll vine forest (rainforest)
- Vine thicket
- Melaleuca swamps


A vegetation description and microhabitat features available for fauna species associated with each habitat type are described in **Table 3-8** and shown in **Figure 7**.


Table 3-8: Broad habitat types present within the disturbance footprint



Broad habitat type	Description	REs	Representative photo
Riparian forest	<p>Vegetation description</p> <p>Tall forest (20-25 m) fringing major watercourses, on narrow alluvial flats and benches constrained by steep banks. Dominant species include <i>Casuarina cunninghamiana</i>, <i>Casuarina cristata</i>, <i>Melaleuca leucadendra</i>, <i>Corymbia tessellaris</i>, <i>Lophostemon grandifloras</i>, and <i>Lophostemon suaveolans</i>. <i>Eucalyptus tereticornis</i> occurred as an occasional emergent species. There may be a fringing shrub layer of <i>Melaleuca viminalis</i> and a ground layer of predominantly <i>Lomandra hystrix</i> and <i>L. longifolia</i>.</p> <p>This habitat type was infrequent throughout the disturbance footprint.</p> <p>Microhabitat features</p> <p>Whilst this habitat type was infrequent throughout the disturbance footprint, it provides foraging and shelter habitat features.</p> <p>Within larger creeks, large stretches of these riparian forests were often dominated by <i>Melaleuca spp.</i>, or <i>Casuarina spp.</i>, and therefore, hollow-bearing trees suitable for sheltering greater glider or micro-bat species were infrequently observed. However, these tree species provide seasonal foraging resources for flying-fox species when in flower, in particular the threatened spectacled flying-fox.</p> <p>Creeks within this habitat type within the disturbance footprint were mostly dry at the time of the survey, despite recent rain. Water in these creeks would frequently return with rainfall and in turn support the growth of tall and mature riparian vegetation. The Eucalypts growing in proximity to these creeks provide good quality refuge and foraging habitat for koala during the dry season and the emergent <i>E. tereticornis</i> provide potential habitat for nesting red goshawk.</p> <p>Flowering <i>Eucalyptus</i> and <i>Melaleuca spp.</i> provide food resources for foraging flying fox species, including threatened species.</p>	<p>7.3.26a</p> <p>9.3.1</p> <p>9.3.13</p>	


Broad habitat type	Description	REs	Representative photo
Open woodland on basalt plains	<p>Vegetation description</p> <p>Very open woodland dominated by <i>Eucalyptus crebra</i> or other ironbark species, often with scattered <i>Corymbia dallachiana</i> and <i>Corymbia tessellaris</i>. the shrub layer is absent, and a ground layer is made up of native grass species <i>Heteropogon contortus</i> and <i>Themeda triandra</i>. Where fire regimes have recently taken place there is an obvious thickening of exotic forb cover, namely Wynn cassia (<i>Chamaecrista rotundifolia</i>). This particularly occurred on basalt plains (RE 9.8.4a).</p> <p>Microhabitat features</p> <p><i>E. crebra</i> occurred with infrequent small hollows, providing potential roosts for microbats which prefer open woodland, such as the threatened bare-rumped sheath-tailed bat. <i>Eucalyptus crebra</i> provides food for koala, and where medium hollows occur, provides habitat for other arboreal mammals – potentially greater glider where suitable riparian vegetation is adjacent.</p>	9.8.4a	
Very open woodland on metamorphic and low hills	<p>Vegetation description</p> <p>Open woodland dominated by <i>Eucalyptus crebra</i> or other ironbark, and occasionally <i>C. citriodora</i> or <i>E. portuensis</i>. A shrub layer ranged from mid-dense or very sparse and comprised mostly of <i>Acacia spp.</i> The ground layer was often native, comprising of both grasses and forb species. Some exotics were sparsely occurring throughout.</p> <p>Microhabitat features</p> <p>Where hollow-bearing trees occurred and where tree species richness was 2 or more species provides foraging and shelter areas for greater glider, although vast areas, often dominated by ironbark species contained smaller, infrequent hollow-bearing trees were largely unsuitable for the species.</p> <p>The range of native ground species, where in proximity to granite shelter sites, providing foraging habitat for Sharman’s rock-wallaby.</p> <p>Given the dominance of eucalypt species in this habitat type, this habitat provides suitable areas for koala.</p>	9.11.2a 9.11.4a	


Broad habitat type	Description	REs	Representative photo
Open woodland to open forest on granite or tertiary surfaces	<p>Vegetation description</p> <p>Open woodland to open forest of sparse structure with mixtures of <i>Eucalyptus</i> and <i>Corymbia</i> species. The dominant canopy varies between <i>Corymbia citriodora</i> var. <i>citriodora</i>, <i>Eucalyptus crebra</i>, <i>Eucalyptus shirleyi</i>, <i>Eucalyptus portuensis</i>, <i>Eucalyptus exserta</i>, and <i>Eucalyptus tereticornis</i>.</p> <p>Open woodland to open forest of sparse structure with mixtures of <i>Corymbia citriodora</i> var. <i>citriodora</i>, <i>Eucalyptus portuensis</i>, <i>Corymbia clarksoniana</i> and/or <i>Corymbia intermedia</i>, <i>Eucalyptus tereticornis</i> and mixed woodlands of <i>Eucalyptus crebra</i> with other <i>Corymbia</i> and <i>Eucalyptus</i> species.</p> <p>A shrub layer typically occurs in these woodlands and often includes <i>Acacia</i> and <i>Melaleuca</i> species. Ground cover is open, with predominantly native grasses including <i>Themeda triandra</i>, <i>Aristida calycina</i>, and <i>Heteropogon</i> spp. Large boulders and boulder stacks are common throughout this land zone, and occasionally form steep rugged ranges and granite stacked cliff faces alongside valleys (such as in RE 9.12.22).</p> <p>Microhabitat features</p> <p>Boulders provide shelter for various mammals and reptile species. Areas with greater complexity of stacked boulders, with various crevices provide denning and shelter habitat for Sharman’s rock-wallaby. Stacked granite cliff faces, or jump-ups provide an abundance of caves and crevices suitable to Sharman’s rock wallaby. Additionally, this habitat provides suitable roost sites for micro-bat species such as the greater large-eared horseshoe bat, and the leaf-nosed diadem bat, which are known to roost colonially where suitable habitat, such as caves, exists. <i>Corymbia</i> and <i>Eucalyptus</i> species provide food trees for koala and greater glider. Large hollows were infrequent, but where present and located within proximity to riparian vegetation, provide suitable den sites for greater glider. Scattered fruiting species as well as such as <i>Ficus rubiginosa</i> and <i>Pleiogynum timorense</i> provide favourable foraging opportunities for frugivorous species such as spectacled flying fox.</p> <p>Open woodlands provide potential habitat for the vulnerable <i>Commersonia reticulata</i>.</p>	<p>7.12.30a</p> <p>7.12.34</p> <p>7.12.35</p> <p>9.12.19</p> <p>9.12.1a</p> <p>9.12.1e</p> <p>9.12.2</p> <p>9.12.22</p> <p>9.5.5a</p>	


Broad habitat type	Description	REs	Representative photo
Woodland on lateritised surface	<p>Vegetation description</p> <p>Woodland community dominated by <i>Corymbia citriodora</i>, and a mixture of infrequent <i>Eucalyptus portuensis</i>, <i>Eucalyptus crebra</i>, and <i>Corymbia trachypholia</i>. The shrub layer is absent to sparse and includes <i>Persoonia falcata</i>, <i>Xanthorrhoea johnsonii</i>, and recruiting canopy species. The ground layer is moderately dense with native grass species <i>Arundinella nepalensis</i>, <i>Heteropogon contortus</i>, and <i>Themeda triandra</i>.</p> <p>Microhabitat features</p> <p>The dominant canopy of <i>C. citriodora</i>, a favourable fodder species, provides suitable habitat to koala. This vegetation community was located on undulating plains, away from direct permanent water sources and is therefore unlikely to provide refuge habitat in drought conditions. Small to medium hollows were infrequent, however, could provide suitable habitat to the bare-rumped sheath-tailed bat which utilises <i>Eucalyptus</i> / <i>Corymbia</i> open woodlands. The absence of large hollows, and infrequent large trees means this habitat is unlikely to support greater glider. When in flower this community could provide suitable foraging habitat for the flying-fox species.</p>	9.7.3b	


Broad habitat type	Description	REs	Representative photo
Open forest to woodlands on uplands	<p>Vegetation description</p> <p>Open forest to tall open forest and woodland of <i>Eucalyptus portuensis</i>, <i>Corymbia intermedia</i>, <i>Eucalyptus portuensis</i>, and / or <i>Eucalyptus tereticornis</i>. <i>Allocasuarina</i> species occur in some areas of land zone 5 (such as 7.5.2a), and often occupy both the upper and sub-canopy. The variable shrub layer can include species <i>Acacia flavescens</i>, <i>A. calyculata</i>, <i>Lophostemon suaveolens</i>, <i>Melaleuca viridiflora</i>, and <i>Xanthorrhoea johnsoii</i>. The ground cover is variable with density of cover but is typically dense and moist with litter. Where ground cover is dense, it is mostly made up native grass species <i>Themeda triandra</i>, <i>Heteropogon triticeus</i>, and <i>Impertea cylindirca</i>. Infrequent rocky outcrops also support vine forest species such as <i>Ficus rubiginosa</i>, <i>Denhamia cunninghamii</i> and <i>Pleiogynium timorense</i>.</p> <p>Microhabitat features</p> <p>Tall forest and woodland areas provide foraging and breeding habitat (where within 1 km of a permanent water source) for red goshawk and foraging and denning habitat for masked owl. Where <i>Allocasuarina</i> occurs it provides habitat for glossy black-cockatoo. Dense understory of <i>Allocasuarina</i> provides flyways and foraging opportunities for greater large-eared horseshoe bat. <i>Eucalyptus</i> and <i>Corymbia</i> species provide food and shelter for koala, as well as the spectacled flying-fox, and denning opportunities for greater glider where large hollows are abundant, especially in <i>E. tereticornis</i>. Boulders provide shelter for various mammals and reptile species. Thick grass cover provides habitat for common small mammals such as bandicoots.</p>	<p>7.5.1a 7.5.2 7.5.2a 7.5.2c 7.5.3 7.5.4a 7.5.4f 7.12.24a 7.12.29a 7.12.29b</p>	

Broad habitat type	Description	REs	Representative photo
Rock pavements	<p>Vegetation description</p> <p>Sparse shrubby and grassy vegetation around the margins of pavements, with a low tree and shrub cover of <i>Eucalyptus portuensis</i>, <i>C. intermedia</i>, <i>Lophostemon suaveolens</i>, <i>Allocasuarina littoralis</i>, and <i>Acacia</i> spp. (<i>A. leptostachya</i>, <i>A. viridiflora</i>, <i>A. flavescens</i>). Grasses include <i>Themeda triandra</i>, <i>Arundinella nepalensis</i> and <i>Aristida</i> sp.</p> <p>Microhabitat features</p> <p>Rocks provide shelter and basking habitat for various mammals and reptile species. Areas with greater complexity of stacked boulders, with deep and abundant crevices provide potential habitat for Sharman’s rock-wallaby. <i>Allocasuarina littoralis</i> provides potential foraging habitat for the glossy black-cockatoo. Where large hollowing <i>Eucalyptus</i> and <i>Corymbia</i> species occur within or fringing rock pavement vegetation, habitat is also suitable for breeding.</p>	7.12.65 7.12.65b 7.12.65c	
Open forest with <i>Allocasuarina</i> spp. dominant or co-dominant in the canopy	<p>Vegetation description</p> <p>Open forest comprising <i>Allocasuarina littoralis</i>, with a mixture of <i>Corymbia intermedia</i>, <i>Eucalyptus crebra</i>, and <i>Eucalyptus portuensis</i>. The shrub layer is dominated by <i>Acacia species flavescens and torulosa</i>. The ground layer moderately dense with a variety of native grass species such as is <i>Themeda triandra</i>, <i>Imperata cylindrica</i>, <i>Heteropogon triticeus</i>, and <i>Entolasia stricta</i>.</p> <p>Microhabitat features</p> <p>Forest she-oaks (<i>Allocasuarina torulosa</i>, <i>A. littoralis</i>) fruit provide food resources for glossy-black-cockatoo. Where hollow-bearing <i>Eucalyptus</i> and <i>Corymbia</i> trees are present, they provide suitable breeding habitat for the glossy-black-cockatoo as well as denning habitat for an array of arboreal mammals and bird species, including the threatened greater glider and masked owl.</p>	7.8.18a 7.8.18b	

Broad habitat type	Description	REs	Representative photo
Floodplain	<p>Vegetation description</p> <p>Open woodland dominated by <i>Eucalyptus platyphylla</i> with associated <i>Corymbia</i> spp. Mid-layer and ground layer was sparse, observed on clay soils with low drainage. This vegetation community commonly occurred in the surrounds of riparian forest and drainage lines (particularly 9.3.1).</p> <p>Microhabitat features</p> <p>The dominant eucalyptus canopy provides suitable habitat to a diversity of threatened species. <i>Eucalyptus platyphylla</i> is a large tree growing up to 20m tall, and often producing medium to large size hollows. The bare-rumped sheath-tail bat is known to have a preference for tree hollows in <i>E. platyphylla</i> for roost sites. Both koala and greater glider will utilise this habitat given the palatability of the eucalyptus foliage, the retention of moisture in the canopy being on a floodplain, and the abundance of suitable sized hollows. Masked owl may also utilise this habitat for both foraging and nesting, as the grassy understory is suitable for hunting and the presence of suitable hollows within proximity to riparian forest.</p>	9.3.6	
Tussock grassland	<p>Vegetation description</p> <p>Grassland to very open grassland of <i>Iseilema</i> spp. (flinders grass) with a mixture of other grass species such as <i>Dichanthium</i> spp., <i>Bothriochloa</i> spp., <i>Heteropogon contortus</i> and <i>Aristida</i> spp. Tussock grasslands were found to occur on undulating basalt plains amongst open woodland and vine-thicket communities. This vegetation is confined to very small area in the far south-east of the wider Project area and does not occur within the Disturbance footprint.</p> <p>Microhabitat features</p> <p>Tussock grassland habitat is often situated amongst and in-between areas of open woodland. This habitat provides important foraging resources for threatened species Sharman's rock wallaby, which seek shelter in the nearby granite boulder stacks. \</p>	9.8.13	Site was not accessible.

Broad habitat type	Description	REs	Representative photo
Simple notophyll vine forest	<p>Vegetation description</p> <p>Species-rich rainforest with well-developed structure, dominated by <i>Archontophoenix alexandrae</i>, <i>Elaeocarpus</i> spp., <i>Buckinghamia celsissima</i>, <i>Cardwellia sublimis</i> and <i>Syzygium</i> spp. The ground layer is comprised of tree and vine seedlings.</p> <p>Microhabitat features</p> <p>Fruiting trees providing potential foraging habitat for southern cassowary and a range of closed forest dwelling birds, frogs, reptiles and mammals. A rocky stream of fresh water provides a water source for fauna species.</p>	7.12.2e 7.12.16a	

Broad habitat type	Description	REs	Representative photo
Vine thicket	<p>Vegetation description</p> <p>Dense low (5-10 m) species-rich vine thicket with tall emergent trees in fire-protected gullies near major watercourses (Michael Creek, Four-Mile Creek).</p> <p>Microhabitat features</p> <p>The dense vegetation and rock crevices provide shelter for various small mammals and reptiles. Fruiting flora species provide foraging habitat for flying foxes and insect prey for microbats, including the threatened spectacled flying fox and diadem leaf-nosed bat.</p>	<p>9.11.9</p> <p>9.8.7</p> <p>9.8.7x</p>	

Broad habitat type	Description	REs	Representative photo
Melaleuca swamps	<p>Vegetation description</p> <p><i>Melaleuca</i> spp. dominated vegetated swamps with sedge dominated ground layers. <i>Melaleuca quinquenervia</i> and <i>M. viridiflora</i> are common, with <i>Acacia</i> spp., <i>Banksia aquilonia</i>, <i>Melastoma malabathricum</i> and <i>Xanthorrhoea johnsonii</i> in a sparse shrub layer, and <i>Ischaemum australe</i>, <i>Rhynchospora corymbosa</i>, <i>R. brownii</i>, <i>Blechnum parrisiae</i>, <i>Cyperus exaltatus</i> and <i>Schoenoplectiella mucronata</i> in the ground layer.</p> <p>Microhabitat features</p> <p>Permanent water affords good frog habitat. Dominance of <i>Melaleuca</i> spp. provides feeding resource for arboreal mammals (sugar glider, squirrel glider), flying foxes (e.g. spectacled, little red), microbats (including diadem leaf-nosed bat) various bird species.</p>	7.3.8x	

3.6. Fauna

3.6.1. Threatened fauna

A total of 13 threatened fauna species were assessed as being likely or having the potential to occur within the disturbance footprint (Appendix C - Likelihood of Occurrence Table). Of these, five threatened fauna species were confirmed to occur within or in close proximity to the disturbance footprint, and given their mobile nature were included as 'known', including: koala, greater glider, Sharman's rock wallaby, red goshawk, and masked owl. Each species and its specific habitat within the disturbance footprint are discussed below in Table 3-9. Species records are presented in Appendix A - Figures (**Figure 12 to Figure 17**). The magnificent brood frog was assessed as potentially occurring and has been described in a separate memo.

Table 3-9: Habitat description and habitat quality score for threatened fauna species potentially occurring in the disturbance footprint

Species	EPBC Act / NC Act	Likelihood of occurrence	Description of species occurring within disturbance footprint	Habitat quality score (1 to 10)
Koala	Endangered / Endangered	Known	<p>No direct observations were made during this survey event, however, this is not unusual as diurnal surveys typically yield low results for the species. Spotlighting surveys during the survey event were prevented due to poor weather conditions. Koala was observed on 20 occasions during previous studies (ELA, 2020) within the wider Project area. Given the location of these previous observations and the mobile nature of this species, it is considered to occur within the disturbance footprint.</p> <p>When observed previously, koalas were utilising <i>Eucalyptus tereticornis</i>, <i>E. crebra</i>, <i>E. moluccana</i>, and <i>Corymbia citriodora</i> trees, which are all known food trees for the species. Habitat in the disturbance footprint includes all <i>Eucalyptus</i> communities, including riparian forest, open forest to woodlands on uplands, open woodland to open forest on granite or Tertiary surfaces and very open woodland on metamorphics and basalt plains and low hills.</p> <p>Riparian forest and open forest habitat in moist areas provide refuge habitat for koala which is suitable during times of stress, such as drought or extreme heat events as they typically have higher canopy cover which regulates the temperature. Furthermore, close proximity to watercourses means that riparian forest habitat has a higher moisture content in leaves.</p> <p>Dry habitat types such as open or very open woodlands dominated by ironbarks, such as <i>E. crebra</i>. provide foraging and dispersal habitat for koala, however, these represent marginal habitat only.</p>	8
Greater glider	Vulnerable / Endangered	Known	<p>No direct observations were made during this survey event. However, greater glider was observed on 22 occasions during previous studies (ELA, 2020) within the wider Project area. Given the location of these previous observations and the mobile nature of this species, it is considered to occur within the disturbance footprint..</p> <p>The species was observed utilising <i>E. tereticornis</i>, <i>E. portuensis</i>, <i>E. moluccana</i>, <i>C. intermedia</i>, <i>C. citriodora</i>, and <i>C. tessellaris</i>. The species was also observed in <i>E. crebra</i> which is not a typical food or den tree species, however, it was in woodland with surrounding mixed food species. Habitat types in which the species was observed include riparian forest, open woodland to open forest on granite or Tertiary surfaces and very open woodland on basalt plains and low hills. The species has potential to occur in any habitat type that includes <i>Eucalyptus</i> spp. or <i>Corymbia</i> spp. and contains abundant hollows for denning (minimum of 2 – 4 hollows per ha). Due to the species' reliance on tree hollows, dry eucalypt habitat dominated by ironbarks such as <i>E. crebra</i> have been excluded where they did not contain suitable hollows.</p>	8

Species	EPBC Act / NC Act	Likelihood of occurrence	Description of species occurring within disturbance footprint	Habitat quality score (1 to 10)
Spectacled flying-fox	Endangered / Endangered	Known	<p>No direct observations were made during this survey event. However, Spectacled flying-fox was observed during previous field surveys foraging in Burdekin plum (<i>Pleiogynium timorense</i>) and fig (<i>Ficus</i> spp.) trees disturbance footprint within the wider project area. The species is highly mobile and moves throughout its range in response to availability of foraging resources. As such, the species has potential to occur anywhere in the disturbance footprint that suitable trees are fruiting (e.g. Burdekin plum or fig trees) or flowering (e.g. <i>Melaleuca</i> spp., <i>Eucalyptus</i> spp. or <i>Corymbia</i> spp). Such foraging resources are widely available, including being scattered throughout the disturbance area. Given the location of previous observations, the presence of suitable habitat, and the mobile nature of this species, it is considered to occur within the disturbance footprint.</p> <p>No camps of the species were observed within the disturbance footprint or surrounding project area. The species prefers to roost within 6.5 km and 16 km from rainforests (Richards 1990; Shilton et al. 2008). There is a small patch of rainforest within the project area, however, no sign of a camp was recorded during surveys.</p> <p>Based on the above, foraging habitat was mapped throughout the project impact area where food resources fruiting (e.g. Burdekin plum or fig trees) or flowering (e.g. <i>Melaleuca</i> spp., <i>Eucalyptus</i> spp. or <i>Corymbia</i> spp).</p>	6
Grey-headed flying fox	Vulnerable / Least concern	Potential	<p>No direct observations were made during this survey event. The Ecological requirements of the Grey-headed flying-fox are not distinctly different from that of the Spectacled flying-fox (above). Pteropus species are known to commonly co-occur and share roosts, therefore, where the one species is known to occur it is considered likely for another species to also occur. However, grey-headed flying-fox are now considered infrequent visitors to far-northern habitats. A review of the national flying-fox monitoring viewer revealed that low numbers (<499 individuals) were observed at the Ingham camp during the last monitoring event in 2020 and for most of the preceding 8 years. The species is therefore considered to have the potential to occur.</p>	6
Sharman's rock-wallaby	Vulnerable / Vulnerable	Known	<p>Sharman's rock-wallaby was observed during this survey event within the wider Project area. Remote cameras and direct observation captured the species in the Project area and surrounds, as well as within 200 m of the Disturbance footprint in granite rock stack habitat. In 2019, field surveys detected the species within the Disturbance footprint itself, however, records are scattered throughout the Project area and surrounds. The species was also observed on numerous occasions during previous surveys (ELA, 2020) in proximity to rocks, across a variety of habitat types ranging from eucalypt woodlands with scattered boulders, likely providing steppingstone habitat, to complex rocky structures likely providing long-term shelter habitat, along rocky creek lines and in areas of vine thicket.</p>	8

Species	EPBC Act / NC Act	Likelihood of occurrence	Description of species occurring within disturbance footprint	Habitat quality score (1 to 10)
			<p>Within the disturbance footprint, habitat suitability ranged in likely usage from shelter habitat (more complex rocky areas) throughout to foraging and dispersal (scattered occurrence of rocks or isolated boulder piles interspersed in open woodlands). Foraging and dispersal habitat was observed throughout the disturbance footprint. With these habitats defined as areas within 1 km of potential shelter habitat, where steppingstone habitat was present (smaller rocky structures, isolated boulder stacks) and comprised of open woodlands to open forest with a native grassy ground layer in which the species likely feeds.</p> <p>Key shelter habitat which provides denning opportunity occurs in RE 9.12.22 as complex granite rock stacks occurs within the Disturbance footprint. Within the wider project area, there are large area of likely species shelter habitat. These areas comprise extensive rocky outcrops or abundant granite boulders. Figs sheltering within the rocky crevices were often an indicator of suitable complexity.</p>	
Red goshawk	Vulnerable / Endangered	Known	<p>No direct observations were made during this survey event. However, Red goshawk was recorded once in the wider project area during previous surveys (ELA, 2020). The species was recorded in the open forest to woodland on uplands habitat type, flying low over open forest dominated by <i>Corymbia intermedia</i>. A potential red goshawk nest was observed on a separate occasion in the wider project area (Nature Advisory, 2022b).</p> <p>Suitable species nesting habitat and foraging habitat is present both within the wider project area and the disturbance area, as defined below.</p> <p><u>Nesting habitat</u></p> <p>Red goshawk is known to nest within 1 km of permanent water and nests are usually constructed in emergent trees (mean tree height 31 m), thus suitable nesting habitat within the disturbance area includes all riparian forest, open forest and woodland habitat types with tall trees, within 1 km of permanent water. It should be noted that no nests have been observed in the disturbance area.</p> <p><u>Foraging habitat</u></p> <p>In north Queensland, the species prefers to forage over intact mosaics of native vegetation, including riparian vegetation, open forest and woodland, mainly in rugged terrain (DERM, 2012). As such, foraging habitat within the disturbance footprint includes all vegetated habitat types.</p>	7

Species	EPBC Act / NC Act	Likelihood of occurrence	Description of species occurring within disturbance footprint	Habitat quality score (1 to 10)
Glossy black - cockatoo	NA / Vulnerable	Potential	The species was not recorded during the 2022 or previous field surveys; however, suitable habitat occurs in both the disturbance area and the wider project area and the species is known to occur in Paluma ranges (approx. 38 km from the Project impact area). The species almost exclusively forages on <i>Allocasuarina</i> seeds (Birdlife Australia, 2022). Suitable habitat types for the species in the disturbance footprint include open forest with <i>Allocasuarina</i> spp. dominant or co-dominant in the canopy and portions of open forest to woodlands on uplands where an <i>Allocasuarina</i> understorey occurs.	8
White-throated needletail	Vulnerable, Migratory, Marine / Vulnerable	Known	<p>This species was not recorded during this survey event. However it was recorded during the during BUS in 2022, with a total count of 176 individuals (Nature Advisory, 2022) including at sites within the disturbance footprint.</p> <p>The species is highly mobile, migratory and almost exclusively aerial when in Australia (TSSC, 2019a). The species forages over a variety of habitat types and as such is likely to occur over any part of the disturbance area and surrounds during September to April. As this species is predominantly aerial while in Australia, habitat quality data was not collected, nor habitat mapped for the species.</p>	-
Masked owl (northern)	Vulnerable / Vulnerable	Known	<p>This species is still undergoing acoustic analysis, and therefore it is not yet known if the species was captured during this survey event. Masked owl was observed during previous surveys (ELA, 2020) within the wider Project area. Given the location of these previous observations and the mobile nature of this species, it is considered to occur within the disturbance footprint.</p> <p>The species forages over area of moist forest, woodlands and timbered watercourses. Nests are located in large tree hollows in patches of closed forest. Suitable habitat types for the species in the disturbance footprint includes riparian forest, open forest to woodlands on uplands and open woodland to open forest on granite or tertiary surfaces. Nesting habitat is limited to these habitat types to the extent that they contain suitable large tree hollows.</p>	8
Greater large-eared horseshoe bat	Vulnerable / Endangered	Known	<p>This species was not detected from ultrasonic recording devices during this survey event. The species was observed during previous surveys (ELA 2020) within the wider Project area. Given the mobile nature of this species and the location of these previous observations, as well as the presence of suitable habitat within the Disturbance footprint, the species is considered to occur within the Disturbance footprint.</p> <p>This species is distributed throughout most of the Wet Tropics bioregion, Cape York Peninsula and the Einasleigh Uplands bioregion, inhabiting rainforests, riparian forests, eucalypt open forests and woodlands. The species forages in open forest</p>	7

Species	EPBC Act / NC Act	Likelihood of occurrence	Description of species occurring within disturbance footprint	Habitat quality score (1 to 10)
			and woodland, preferring areas of thicker vegetation. Suitable habitat types for the species in the disturbance area include riparian forest and open woodland to open forest on granite or tertiary surfaces and open forest to woodlands on uplands.	
Bare-rumped sheath-tailed bat	Vulnerable / Endangered	Known	<p>The species was not detected in the Disturbance footprint from ultrasonic recording devices during this survey event. The genus was detected in the Project area surrounds and was determined to belong to either <i>Saccolaimus saccolaimus</i> or <i>S. flaviventris</i>. This species was observed during previous surveys (ELA 2020) within eucalypt forests in the wider Project area. Given the mobile nature of this species and the location of confirmed previous observations, as well as the presence of suitable habitat within the Disturbance footprint, the species is considered to occur within the Disturbance footprint.</p> <p>The species utilises lowland areas, typically in a range of woodland, forest and open environments. Habitat adjacent to roosts include: Poplar Gum (<i>Eucalyptus platyphylla</i>), Carbeen (<i>Corymbia tessellaris</i>) and Ghost Gum (<i>E. papuana</i>) woodlands at Ayr; Darwin Stringybark woodland (<i>E. tetradonta</i>) with Clarkson's Bloodwood (<i>Corymbia clarksoniana</i>) and Carbeen, and gallery forest and rainforest at Iron Range; and at riverine vine forest with adjacent open forest/woodland at Coen. It may also forage at the edge of such habitat. Anecdotal evidence indicates that the species roosts in tree hollows, with deep tree hollows being used as maternity roosts.</p> <p>Suitable habitat types for the species in the disturbance area include riparian forest and open forest to woodlands on uplands, with roosting habitat potentially limited to areas with suitable tree hollows.</p>	7
Diadem leaf-nosed bat	NA / Near threatened	Known	<p>The species was not detected in the Disturbance footprint from ultrasonic recording devices during this survey event, it was however detected in the Project area surrounds. The species was observed during previous surveys (ELA 2020) within open forests of <i>C. intermedia</i> and <i>E. portuensis</i> in the wider Project area. Given the location of these previous observations and the mobile nature of this species, it is highly probable that the species occurs within the Disturbance footprint. However, a record has not been physically captured within the Disturbance footprint, therefore, the species is considered likely to occur within the disturbance footprint.</p> <p>The species typically forages along the edge of vegetation or in vegetation gaps adjacent to open space, within 2.5 km of their roost site. The species primarily roosts in caves and abandoned mines. Such features have been avoided by project design and as such are unlikely to occur in the disturbance footprint. However, suitable foraging habitat does occur in the disturbance footprint and includes the habitat types riparian forest, open woodland to open forest on granite or tertiary surfaces, open forest to woodlands on uplands where <i>Allocasuarina</i> is present and open forest with <i>Allocasuarina</i> spp. dominant or co-dominant in the canopy.</p>	7

3.6.2. Migratory and/or special least concern fauna

Of the nineteen species identified in the desktop assessments, eight migratory or special least concern under the EPBC Act and/or NC Act were assessed as potentially occurring within the disturbance footprint (**Appendix C**). Out of these species, short-beaked echidna (*Tachyglossus aculeatus*) was confirmed within the disturbance footprint. Four other migratory species, white-throated needletail, fork-tailed swift, rufous fantail and satin flycatcher are likely to occur, given suitable presence of habitat and sightings within the broader Project area. The remainder of the eight species are potential occurrences (**Appendix A - Figures, Figure 13**).

Table 3-10: Summary of potentially occurring migratory or special least concern species

Species	EPBC Act listing / NC Act status	Likelihood of occurrence	Description of species habitat occurring within project impact area
Short-beaked echidna	- / SLC	Known	The species was not detected during this survey event. The species was observed during previous surveys in 2019 and 2020 in various habitats within the Project area, and less than 150 m from the Disturbance footprint. The species is found throughout Australia in a variety of different habitats including forests, woodlands, grassland environments and some agricultural areas (Australian Museum, 2022) which all are present in the disturbance footprint. Given the species occupies a wide variety of habitat types and known records of the species been identified within the surrounding Project area and in close proximity to the disturbance footprint, all vegetative areas have the potential to be utilised by the species and therefore are included as habitat.
White-throated needletail Fork-tailed swift	V, Ma, Mi / V MA, Mi / SLC	Known	The species were not detected during this survey event. However, both species were detected in various habitats by Nature Advisory (2022a) within the Disturbance footprint and the wider Project area. Both the fork-tailed swift and white-throated needletail are migratory visitors to Australia and are almost exclusively aerial species when in the country. The species forages over a range of habitat types, including woodland, grasslands, and edges of agricultural areas bordering remnant vegetation. When on passage, both the fork-tailed swift and white-throated needletail favour inland open grasslands, foothills, and cliffs to migrate. Migratory habitat such as this is located throughout the disturbance footprint (Department of Environment, 2022c; 2022d). Both species were previously considered to potentially occur within the area (ELA, 2020).
Oriental cuckoo Spectacled monarch	Mi / SLC MA, Mi / SLC	Known Likely	The species was not detected during this survey event. The species was confirmed during field surveys of the broader Project area and surrounds (ELA, 2022; Nature Advisory, 2022a) and within the Disturbance footprint (Nature Advisory, 2022a). Oriental cuckoo was identified within both the Project area and Disturbance footprint. Spectacled monarch was identified within 1 km of the Project area, in open forest habitat of the Wet Tropics (northeast of the Disturbance footprint). Both species are commonly found in wetter gullies with a thick understory and waterside vegetation like those located in the Disturbance footprint. Further, both species are highly mobile when foraging and during migration using dense understories for passage (Bird Life, 2022). Preferred habitat is located within 50 km of the disturbance footprint in dense rainforest habitat. Both species were previously considered to potentially occur in the area, oriental cuckoo is now known to occur, and spectacled monarch is now considered likely to occur given the presence of suitable habitat within the Disturbance footprint and proximity of recent detections.
Barn swallow	MA, Mi / SLC	Potential	The species was not confirmed during this survey event, or other previous surveys in the wider Project area. The Disturbance footprint includes suitable habitat characteristic of open grasslands and open woodlands in which the species forages. Barn swallow are most commonly observed around powerlines and artificial structures with open

Species	EPBC Act listing / NC Act status	Likelihood of occurrence	Description of species habitat occurring within project impact area
			water source. The barn swallow uses open woodland to migrate each year (Department of Environment, 2022g), these habitats are found frequently around the disturbance footprint.
Satin flycatcher	MA, Mi / SLC	Known	The species were not detected within the Disturbance footprint during this survey event. Both species were identified within the Disturbance footprint and surrounds by Nature Advisory (200a), and in previous surveys (ELA, 2022). The Disturbance footprint includes large areas of favourable foraging habitat within and around eucalypt forests, often near watercourses such as Michael creek. These environments offer taller eucalypt woodlands with a dense understory preferred for foraging. Often inhabiting open understory and a limited ground layer usually recently disturbed by fire and with dense regrowth or fern environments (Department of Environment, 2022e; 2022f). Satin flycatcher and rufous fantail use areas of wet sclerophyll forests and gullies to fly through and forage which are present in the disturbance footprint. Both species were originally considered as likely to occur within the area (ELA, 2020), and are now known to occur.
Rufous fantail	MA, Mi / SLC		

3.7. Observed threatening processes

3.7.1. Exotic fauna

Six exotic fauna species were identified during fauna surveys within the disturbance footprint. Species were identified by either direct observation during on-ground surveys, indirect observation through the identification of scats and tracks, or through remote camera devices. Species identified include: Chital (*Axis axis*), wild dog / dingo (*Canis lupis*), feral cat (*Felis catus*), European rabbit (*Oryctolagus cuniculus*), feral pig (*Sus scrofa*) and cane toad (*Rhinella marina*). Feral cat and wild dog were observed on numerous occasions throughout the disturbance footprint (**Plate 1, Plate 2**). Attack from domestic or wild dog is cited as a key threatening process to koala (DAWE, 2022), and is likely a common predator of Sharman’s rock wallaby and other native fauna species. Predation by feral cat is also cited as a threatening process to Sharman’s rock wallaby (TSSC, 2016). Impacts of herbivorous exotic species, chital deer and the European rabbit, may potentially affect Sharman’s rock wallaby through increased competition pressure for resources such as native grasses and shelter.



Plate 1: Wild dog captured on remote camera device



Plate 2: Feral cat observed on remote camera device

3.7.2. Exotic flora

Exotic flora species were identified during flora surveys across the disturbance footprint (Table 3-11). Most species occurred in low densities and limited distributions, confined to specific habitat types. *Lantana camara* (lantana) was the most widespread exotic flora species identified within the disturbance footprint, and occurred within most broad habitat types including: riparian forest, open woodland on basalt, open woodland to open forest on granite and tertiary surfaces, and open forest to woodlands on upland (Plate 3). Lantana is a heavily branched dense shrub, and where unmanaged can result in widespread infestation smothering native vegetation (DAF, 2020). Habitats which are heavily impacted by Lantana are likely to become progressively unsuitable to native fauna as native vegetation is out competed, and movement within the landscape is impeded. Furthermore, lantana can impact fire regimes by increasing the fuel loading and resulting in high heat and high intensity fires.

Table 3-11: Exotic flora

Species	Common Name	Restricted Matter	WoNS	Occurrence within disturbance footprint	Relative density
<i>Agave sp.</i>	Agave	N/A	No	Infrequent	Low, occurring only in a few isolated patches
<i>Chamaecrista rotundifolia</i>	wynn cassia	N/A	No	Very widespread	Widespread throughout the project impact area, especially growing on basalt soils
<i>Lantana camara</i>	lantana	3	Yes	Very widespread, but largely limited to creek lines, with some occurrence on LZ 5, 8 and 12	Very dense where present

<i>Mesosphaerum suaveolens</i>	hyptis	N/A	No	Only present in some areas on basalt soils or granites	Low
<i>Melinis repens</i>	Red natal	N/A	No	Very widespread	Low
<i>Opuntia sp.</i>	Prickly pear	N/A	Yes	Infrequent	Low
<i>Phytolacca octandra</i>	inkweed	N/A	No	Habitat limited	Low
<i>Praxelis clematidea</i>	Praxelis	N/A	No	Very widespread	Moderate
<i>Sporobolus spp.</i>	American rat's tail grass / giant rat's tail grass	3	Yes	Often observed along access tracks or disturbed areas	Low



Plate 3: Lantana understorey growth in RE 9.12.1a

3.7.3. Changed fire regimes

Evidence of fire, both very recent and aged, was observed throughout the disturbance footprint. Direct impact to vegetation quality and structure was observed as canopy species death, high canopy recruitment rate, and high coverage of burnt woody debris. Some areas in the north of the disturbance footprint had experienced recent high intensity fires (Plate 4). In these areas, fire scarring on tree trucks

reached canopy height, canopy death was apparent, and a dense shrub layer dominated by recruiting canopy species occurred. Fire regimes such as this can be a key threatening process to threatened flora and fauna species and can result in species direct mortality through burning and indirect species mortality through the loss of key breeding and foraging resources, and exposure to predation.



Plate 4: Recent fire scars in RE 7.12.34

4. Conclusions and Recommendations

Ecological surveys were undertaken to determine the presence, extent, and habitat quality of threatened flora and fauna species listed as EPBC and/or NC Act in the disturbance footprint of the proposed Upper Burdekin Wind Farm. The intent of the surveys was to build upon and refine already existing information collected on the condition and extent of environmental values occurring within the broader Project area. Survey results are presented in this report as an addendum to the results of the ecological survey undertaken for the broader Project area, in 2020.

The findings of the surveys confirm the following Commonwealth and/or State listed environmental values within the disturbance footprint, including:

- Ten EPBC At and/or NC Act threatened fauna known to occur:
 - bare-rumped sheath-tailed bat, diadem leaf-nosed bat, greater large-eared horseshoe bat, koala, greater glider, masked owl, red goshawk, Sharman’s rock wallaby, short-beaked echidna, spectacled flying-fox, and white-throated needletail
- Two EPBC At and/or NC Act threatened fauna species identified as likely or having the potential occur:
 - Glossy black-cockatoo, and grey-headed flying-fox.
- Eleven EPBC Act and/or NC Act threatened flora species identified as likely or having potential occur:
 - *Acacia longipedunculata*, *Acacia tingoorensis*, *Commersonia reticulata*, *Corybas cerasinus*, *Corymbia leptoloma*, *Glossocardia orthochaeta*, *Homoranthus cummingii*, *Homoranthus porteri*, *Marsdenia brevifolia*, *Oenanthe javanica*, and *Solanum graniticum*.
- Eight migratory and special least concern species either known or having the potential to occur:
 - Likely or potential species: white-throated needletail, fork tailed swift, oriental cuckoo, spectacled monarch, barn swallow, satin fly catcher, rufous fantail
 - Known species: short-beaked echidna.

It is recommended that the information from this report be used to inform and further refine wind farm infrastructure and development, to mitigate predicted impacts on known environmental values.

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Appendix A - Figures

Figure 1: Project area and disturbance footprint

Figure 2: Summary of threatened species records within 30 km of the disturbance footprint

Figure 3: Fauna survey sites (all surveys)

Figure 4: Flora survey sites (all surveys)

Figure 5: Ground-truthed regional ecosystems

Figure 6: Regulated Vegetation (VM Act)

Figure 7: Habitat types

Figure 8: Known threatened flora records and high-risk mapping

Figure 9: Threatened flora potential habitat (trees and shrubs)

Figure 10: Threatened flora potential habitat (forbs)

Figure 11: Koala records and habitat

Figure 12: Greater glider records and habitat

Figure 13: Sharman's rock-wallaby records and habitat

Figure 14: Threatened micro- and mega-bat records and habitat

Figure 15: Red goshawk records and habitat

Figure 16: Glossy black cockatoo potential habitat

Figure 17: Migratory species and special least concern records and habitat

Figure 18: Masked owl records and habitat

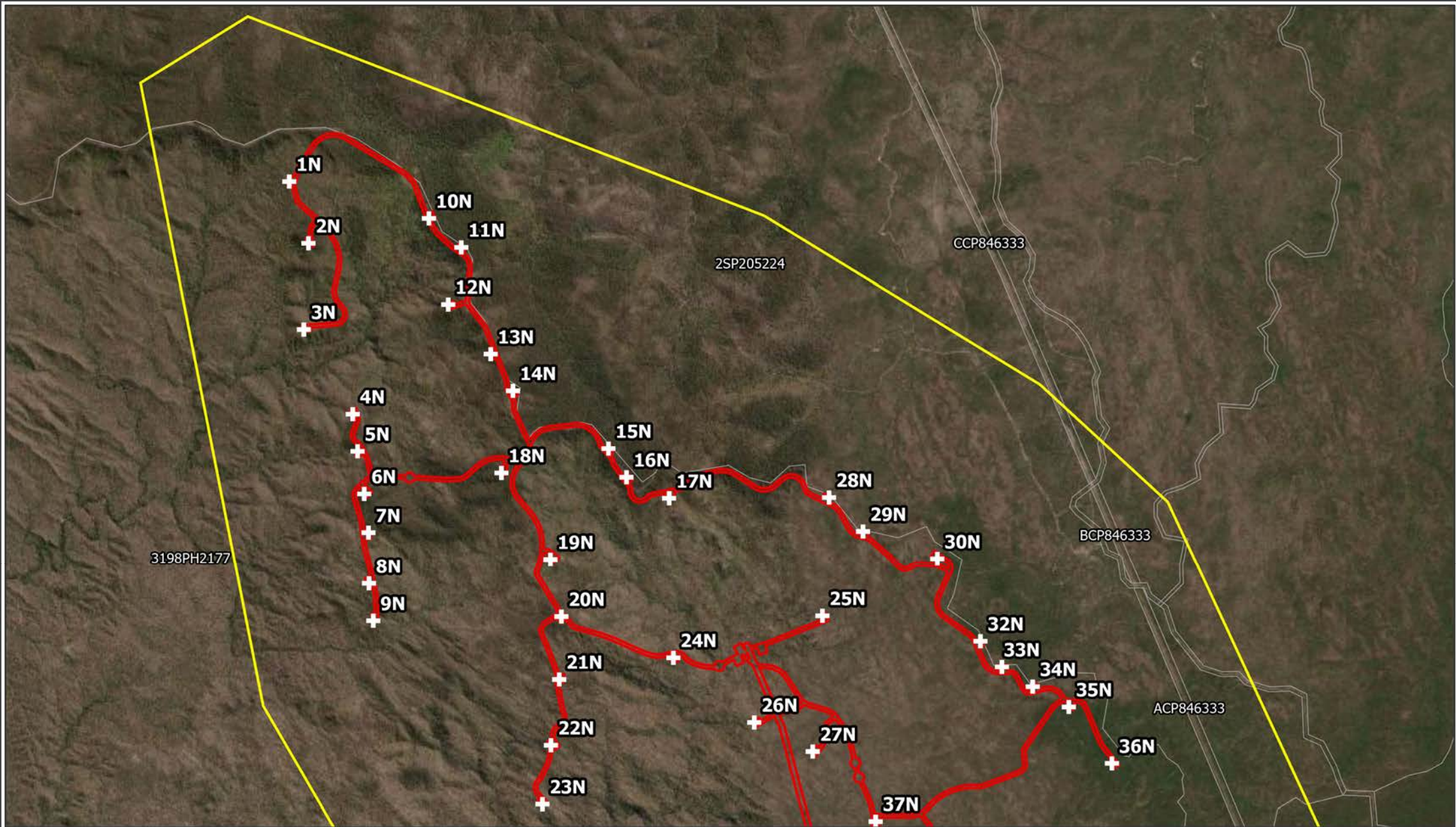
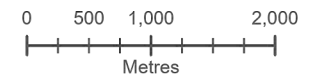
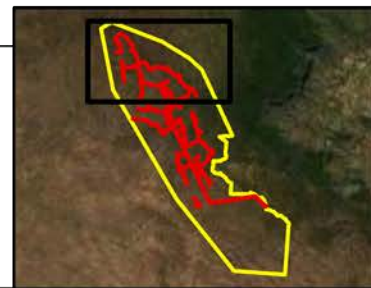


Figure 1 : Project area and disturbance footprint- North

- Disturbance footprint
- Project area
- Cadastral boundaries



Datum/Projection:
GDA2020 MGA Zone 55
Project: 20906-MD Date: 1/07/2022



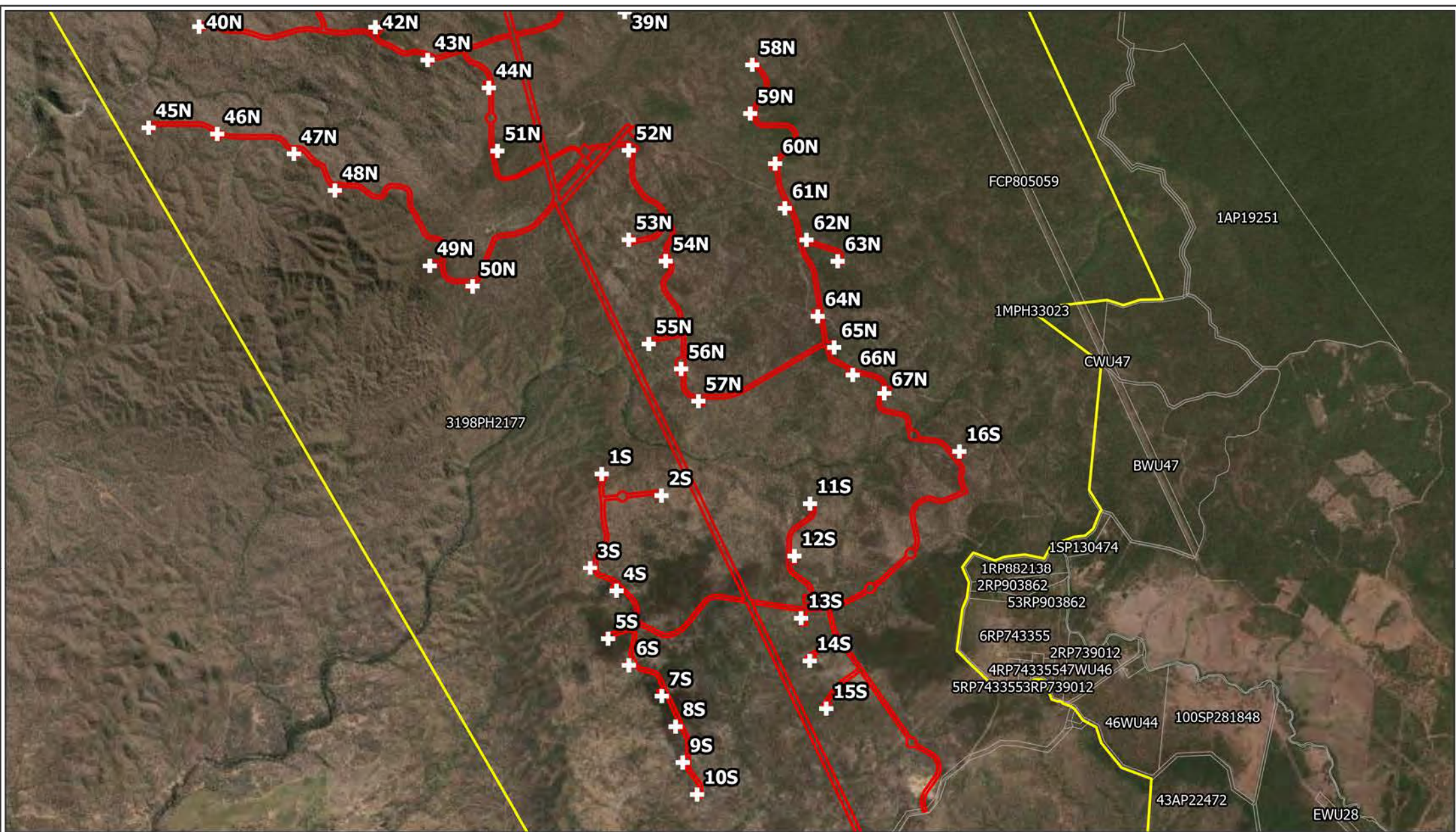
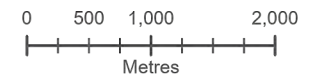
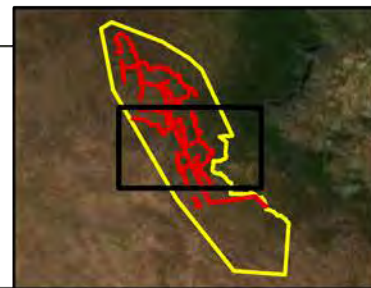


Figure 1 : Project area and disturbance footprint- Centre

- Disturbance footprint
- Project area
- Cadastral boundaries



Datum/Projection:
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Project: 20906-MD Date: 1/07/2022



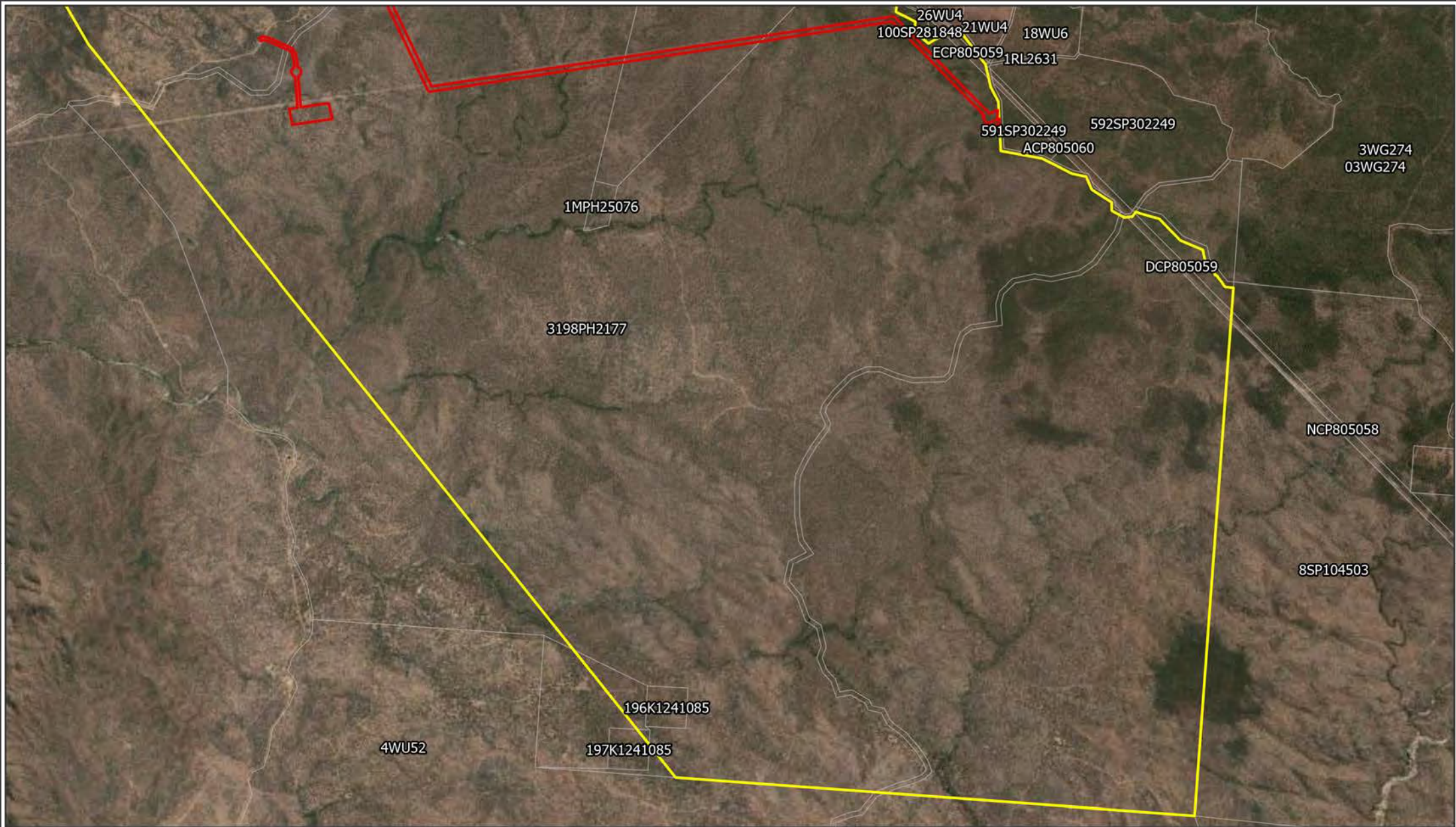
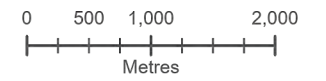
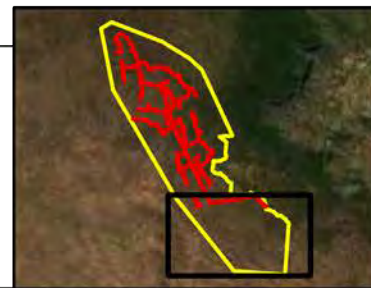


Figure 1 : Project area and disturbance footprint- South

- Disturbance footprint
- Project area
- Cadastral boundaries



Datum/Projection:
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Project: 20906-MD Date: 1/07/2022



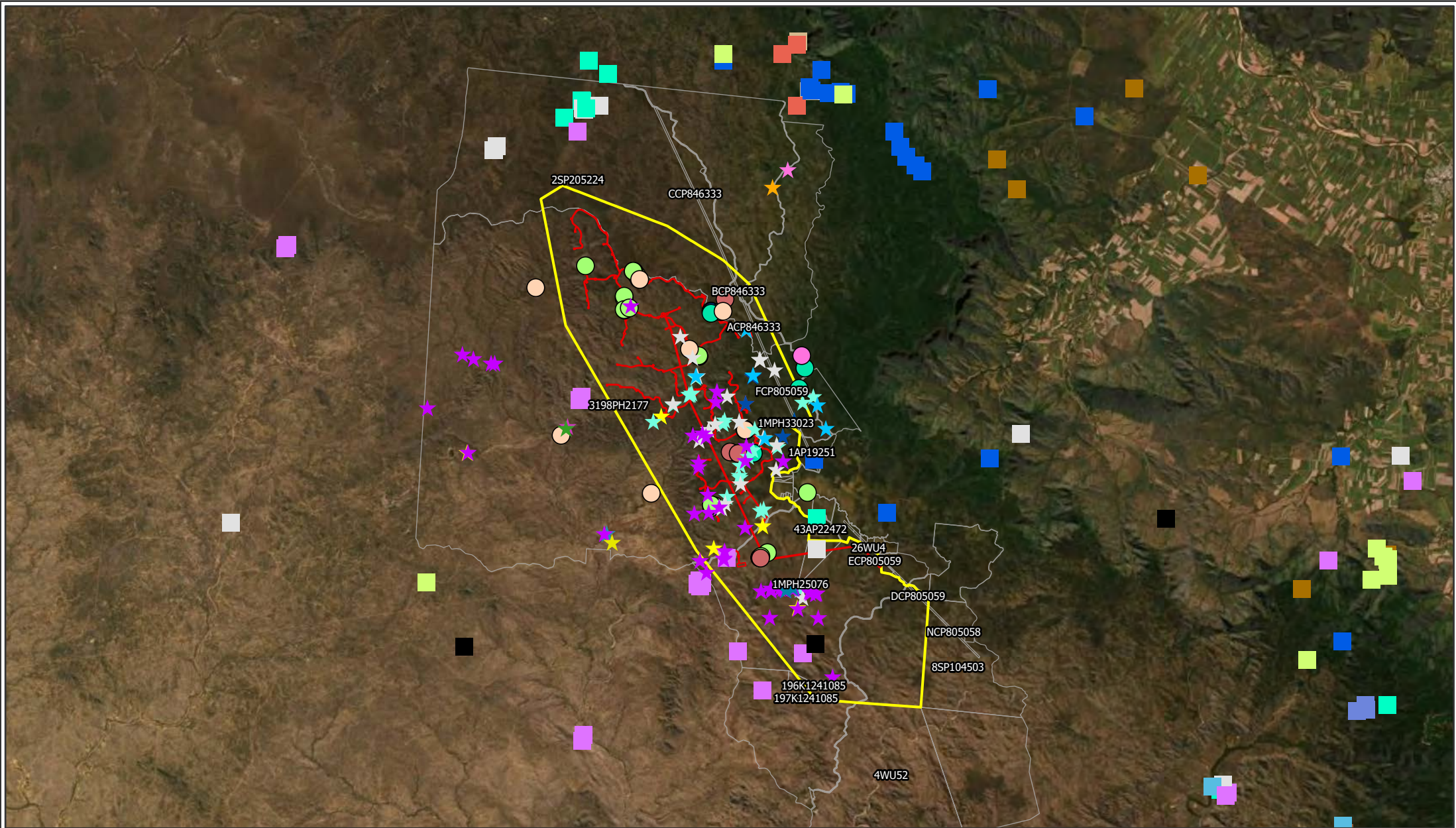
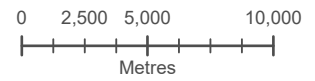


Figure 2 : Summary of threatened species records within 30 km of the disturbance footprint



- | | | | | | | |
|---------------------------------------|-----------------------------------|-------------------------------------|---------------------------|---------------------------------------|------------------------|---------------------------|
| Disturbance footprint | Satin flycatcher | Sharman's Rock wallaby | Rufous Fantail | ALA Threatened species records | | Mahogany Glider |
| Project area | Glider greater | Latham's snipe | Satin Flycatcher | Day's Frog | Masked Owl | Masked Owl |
| Cadastral boundaries | Red goshawk | Spectacled flying fox | Spectacled Monarch | Greater Glider | Sharman's Rock-wallaby | Southern Cassowary |
| ELA Threatened species records | Greater large-eared horseshoe bat | Spectacled monarch | White-throated Needletail | Green-eyed Tree Frog | Spectacled Flying-fox | White-throated Needletail |
| Diadem leaf-nosed bat | Koala | Nature Advisory Records 2022 | | Koala | Black-throated Finch | Black-throated Finch |
| Bare-rumped Sheath-tail Bat | Oriental cuckoo | Fork-tailed Swift | Oriental Cuckoo | Northern Bettong | | |
| Short-beaked echidna | Masked owl (northern) | | | | | |

Datum/Projection:
GDA2020 MGA Zone 55
Project: 20906-MD Date: 5/07/2022



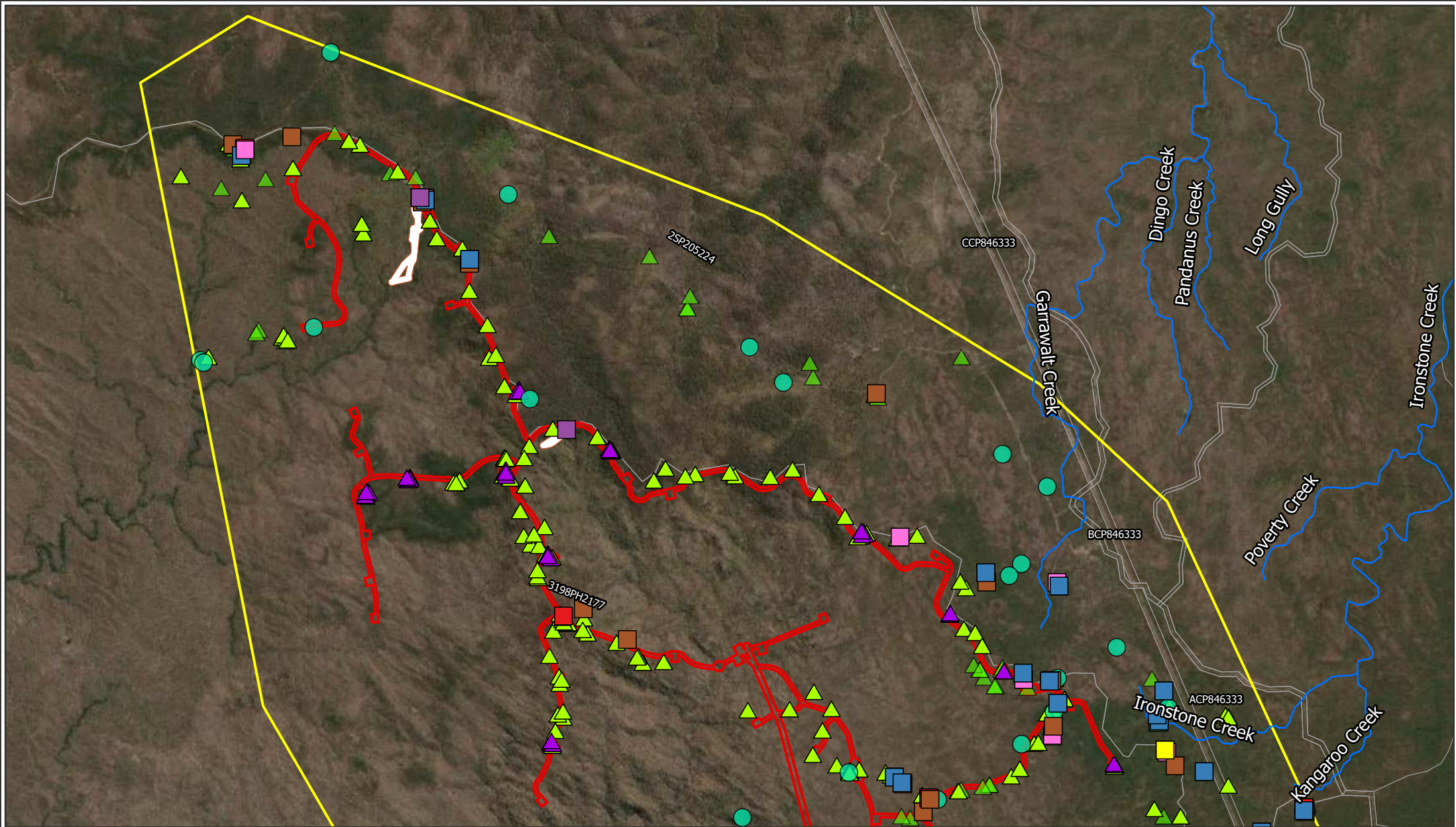
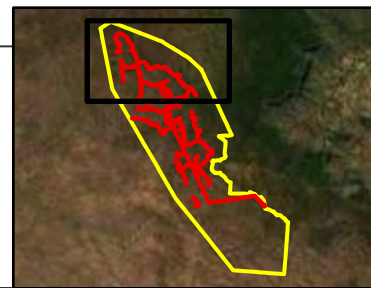


Figure 3 : Fauna survey sites (all surveys) - North

Disturbance footprint	Survey sites	Drone	General habitat survey
Project area	Acoustic detector	Habitat Search	Habitat quality survey
Cadastral boundaries	Ultrasonic detector	Bat trap	Microhabitat survey
Watercourses	Call Playback Station	Remote Camera	
	Bird Survey	Drone survey	



0 500 1,000 2,000
Metres

Datum/Projection:
GDA2020 MGA Zone 55
Project: 20906-MD Date: 5/07/2022

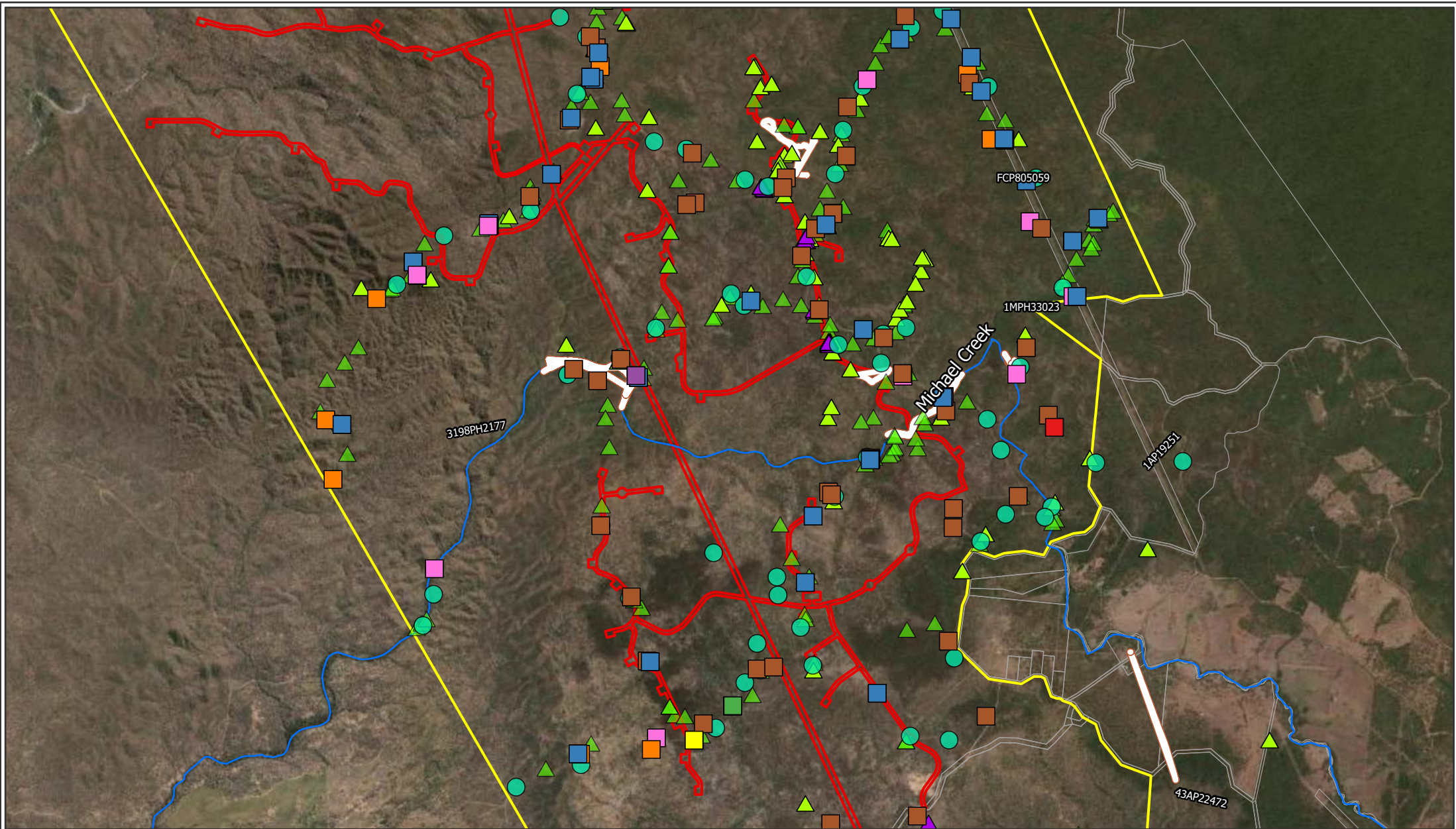
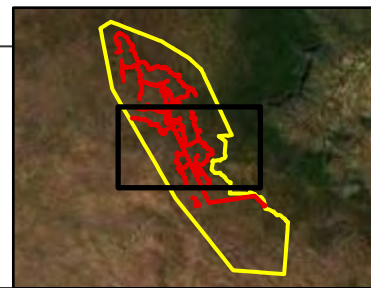


Figure 3 : Fauna survey sites (all surveys) - Centre

Disturbance footprint	Survey sites	Drone	General habitat survey
Project area	Acoustic detector	Habitat Search	Habitat quality survey
Cadastral boundaries	Ultrasonic detector	Bat trap	Microhabitat survey
Watercourses	Call Playback Station	Remote Camera	
	Bird Survey	Drone survey	



0 500 1,000 2,000
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Datum/Projection:
GDA2020 MGA Zone 55
Project: 20906-MD Date: 5/07/2022

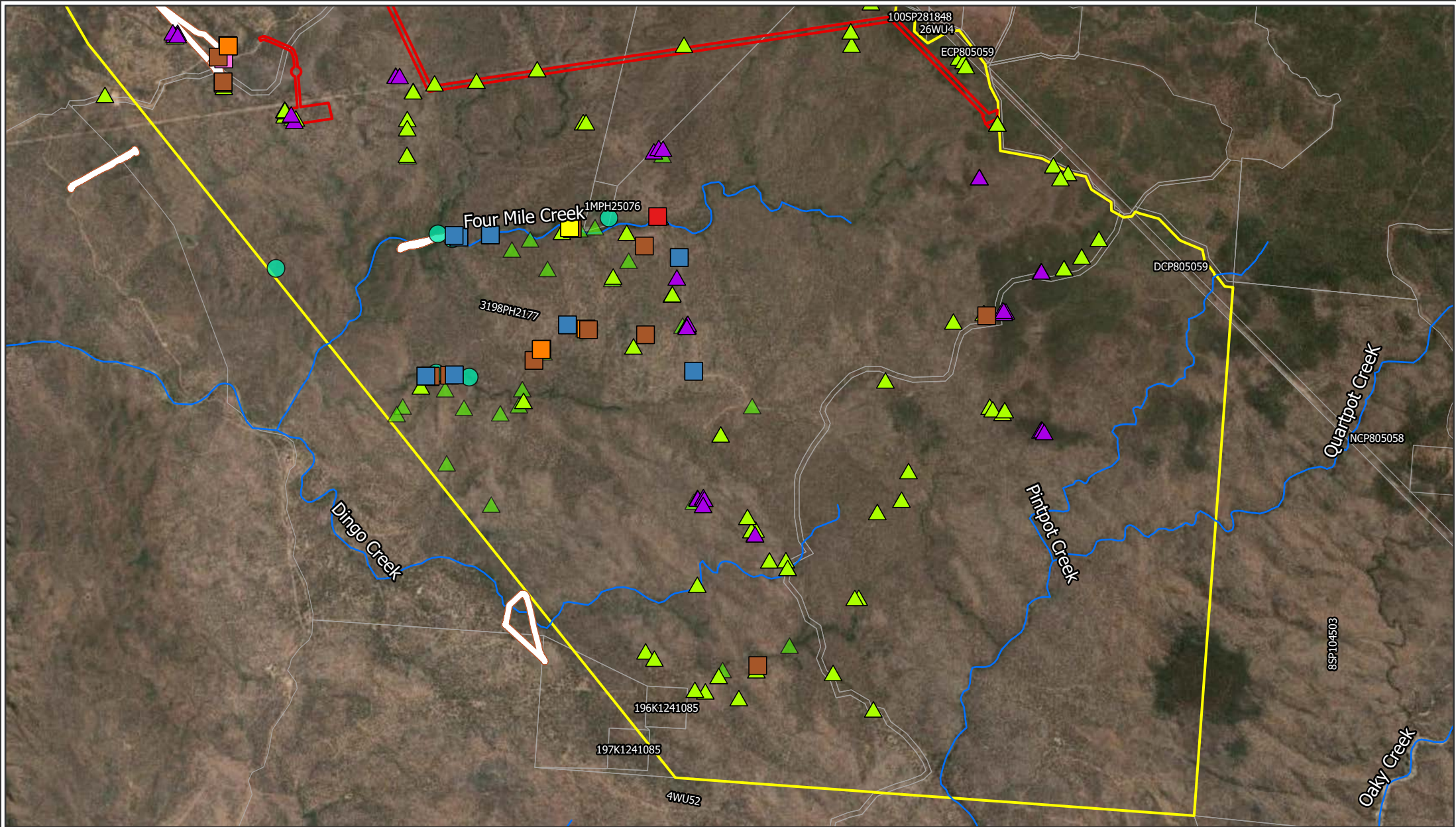
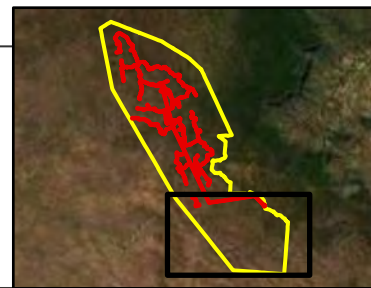


Figure 3 : Fauna survey sites (all surveys) - South

- | | | | |
|-----------------------|-----------------------|----------------|------------------------|
| Disturbance footprint | Survey sites | Drone | General habitat survey |
| Project area | Acoustic detector | Habitat Search | Habitat quality survey |
| Cadastral boundaries | Ultrasonic detector | Bat trap | Microhabitat survey |
| Watercourses | Call Playback Station | Remote Camera | |
| | Bird Survey | Drone survey | |



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Metres

Datum/Projection:
GDA2020 MGA Zone 55
Project: 20906-MD Date: 5/07/2022

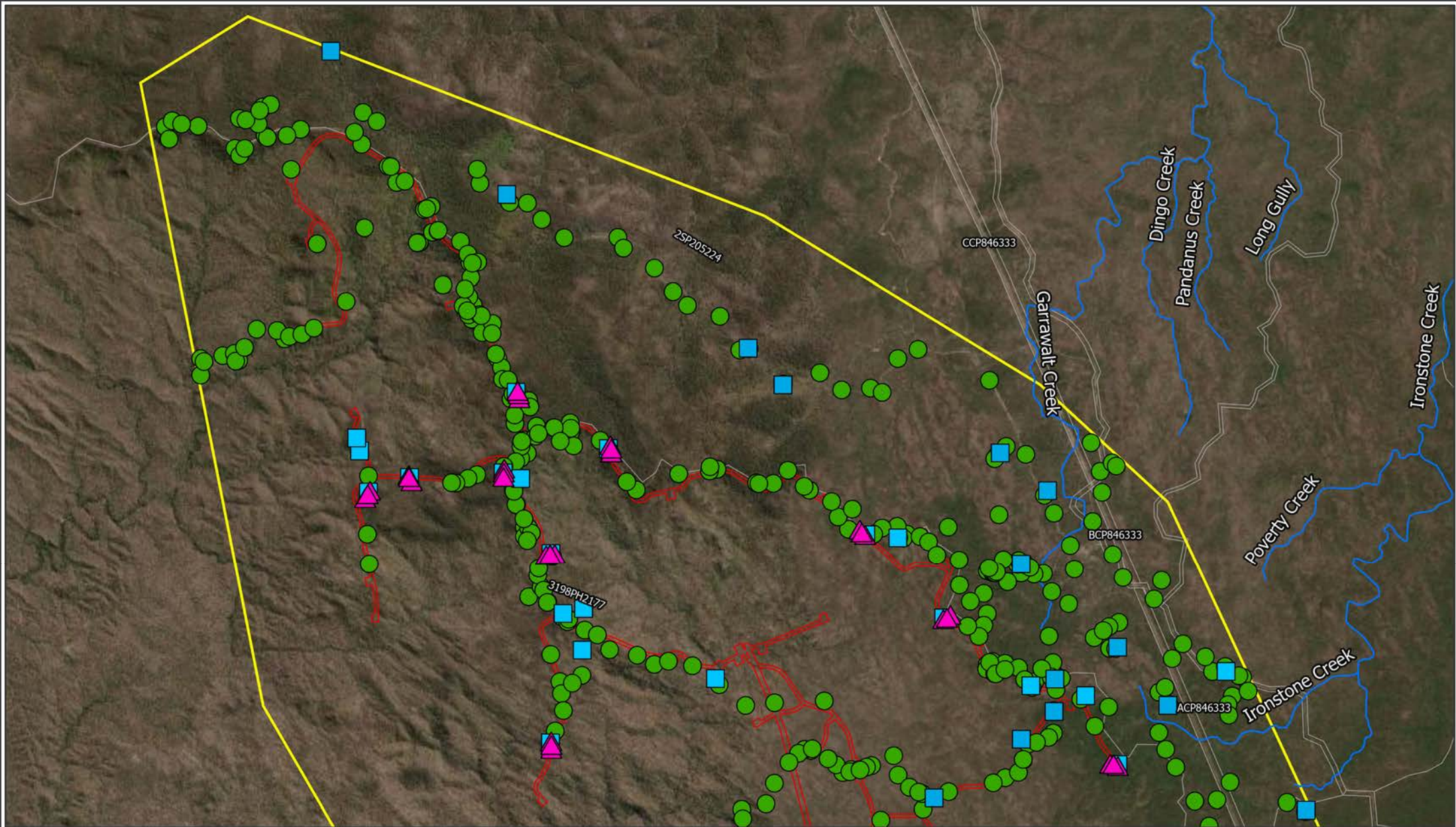
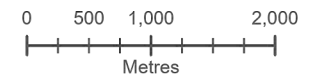
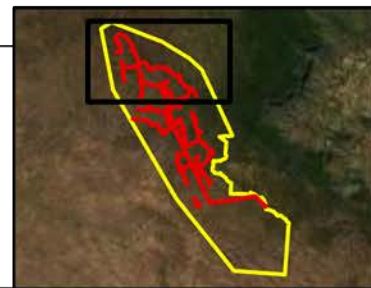


Figure 4 : Flora survey sites (all surveys) - North

- Disturbance footprint
- Project area
- Cadastral boundaries
- Watercourses
- BioCondition survey
- Quaternary survey
- Tertiary survey



Datum/Projection:
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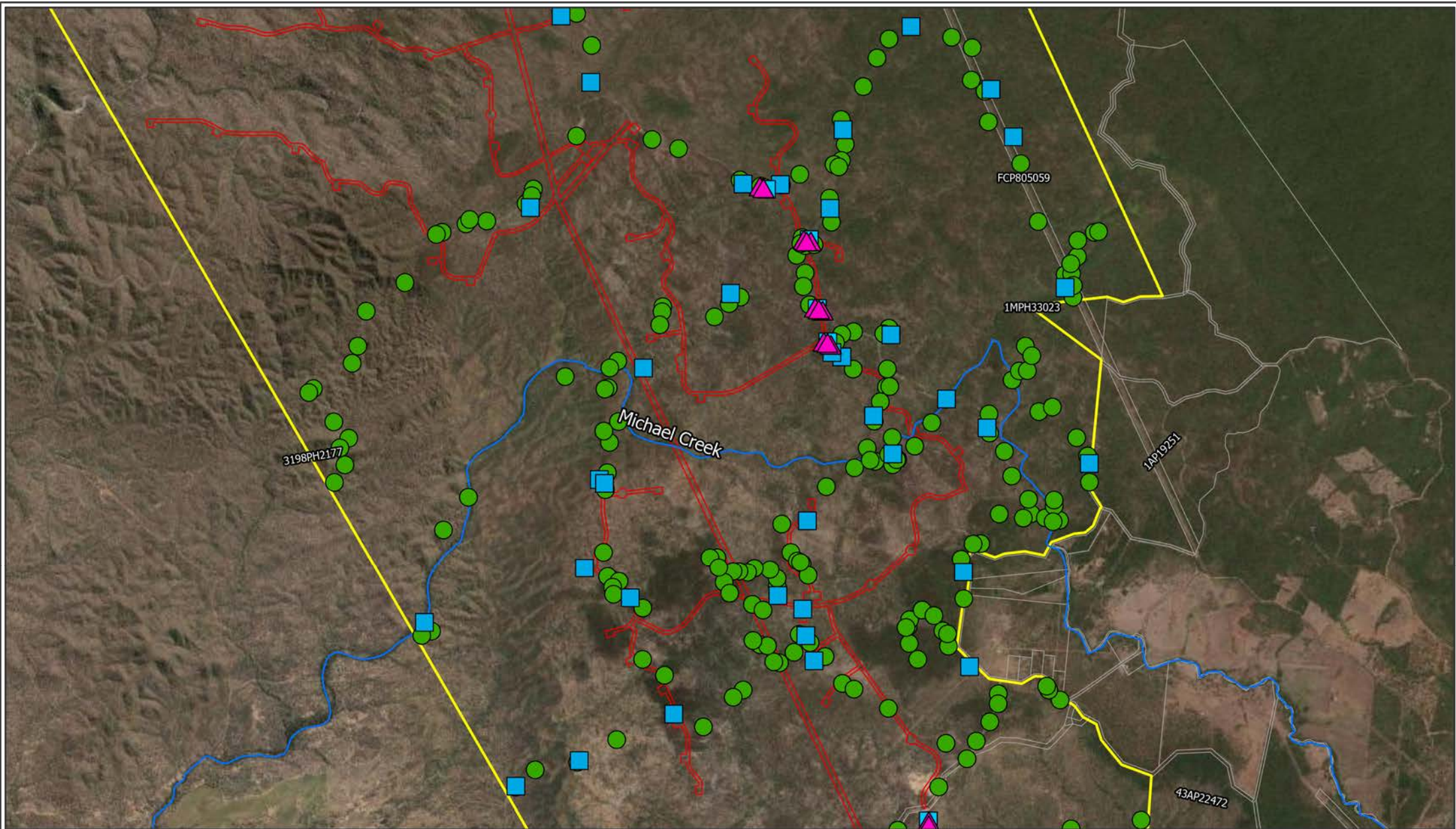
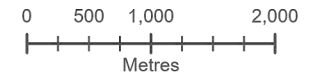
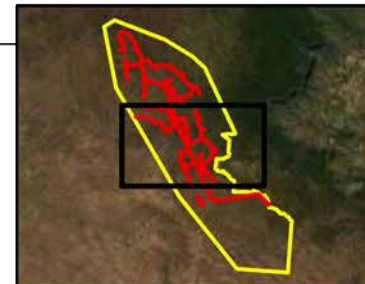


Figure 4 : Flora survey sites (all surveys) - Centre

- Disturbance footprint
- Project area
- Cadastral boundaries
- Watercourses
- BioCondition survey
- Quaternary survey
- Tertiary survey



Datum/Projection:
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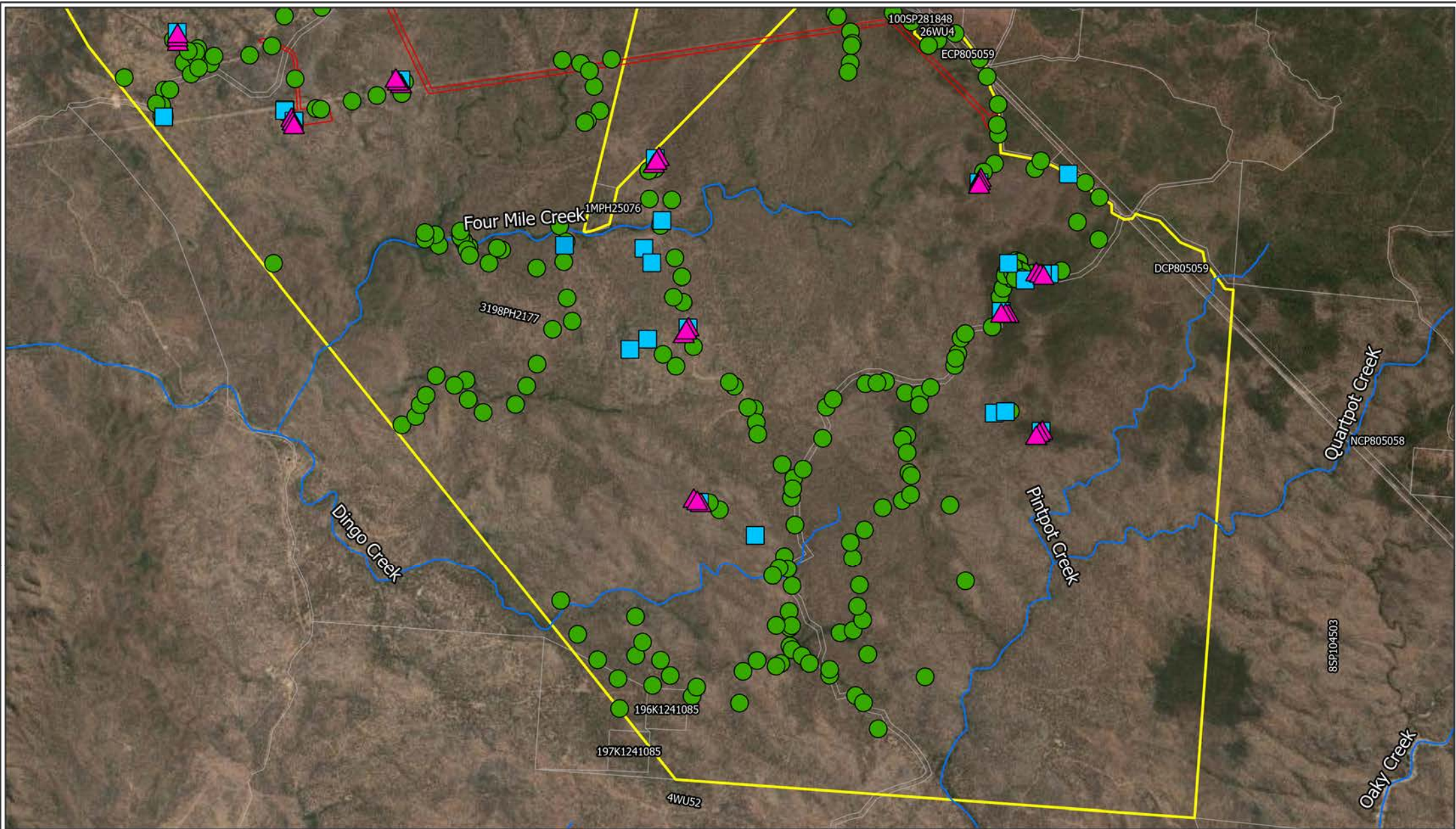
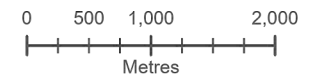
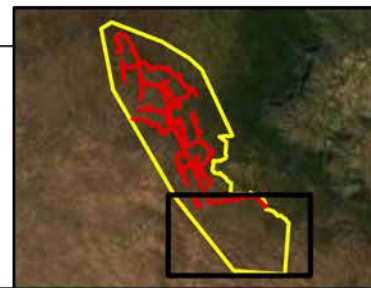


Figure 4 : Flora survey sites (all surveys) - South

- Disturbance footprint
- Project area
- Cadastral boundaries
- Watercourses
- BioCondition survey
- Quaternary survey
- Tertiary survey



Datum/Projection:
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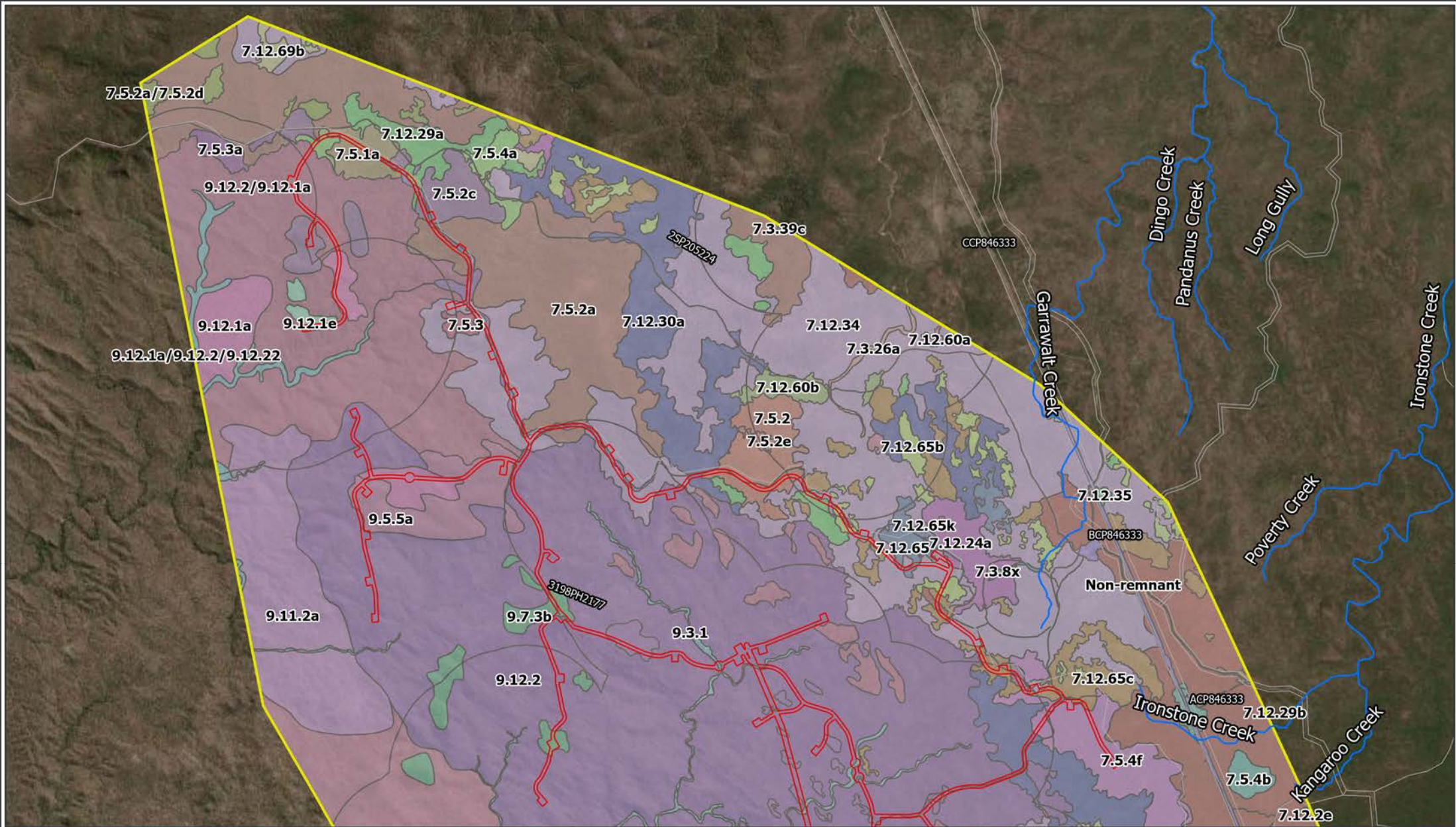
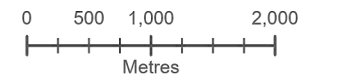
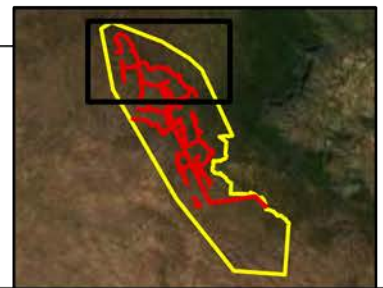


Figure 5 : Ground-truthed regional ecosystems - North

Disturbance footprint	7.12.29b	7.12.65	7.3.8x	7.5.3	9.12.1a/9.12.2/9.12.22	Non-remnant
Project area	7.12.2e	7.12.65b	7.5.1a	7.5.3a	9.12.1e	
Watercourses	7.12.30a	7.12.65c	7.5.2	7.5.4a	9.12.2	
Cadastral boundaries	7.12.34	7.12.65k	7.5.2a	7.5.4b	9.12.2/9.12.1a	
Ground-truthed regional ecosystems	7.12.35	7.12.69b	7.5.2a/7.5.2d	7.5.4f	9.3.1	
7.12.24a	7.12.60a	7.3.26a	7.5.2c	9.11.2a	9.5.5a	
7.12.29a	7.12.60b	7.3.39c	7.5.2e	9.12.1a	9.7.3b	



Datum/Projection:
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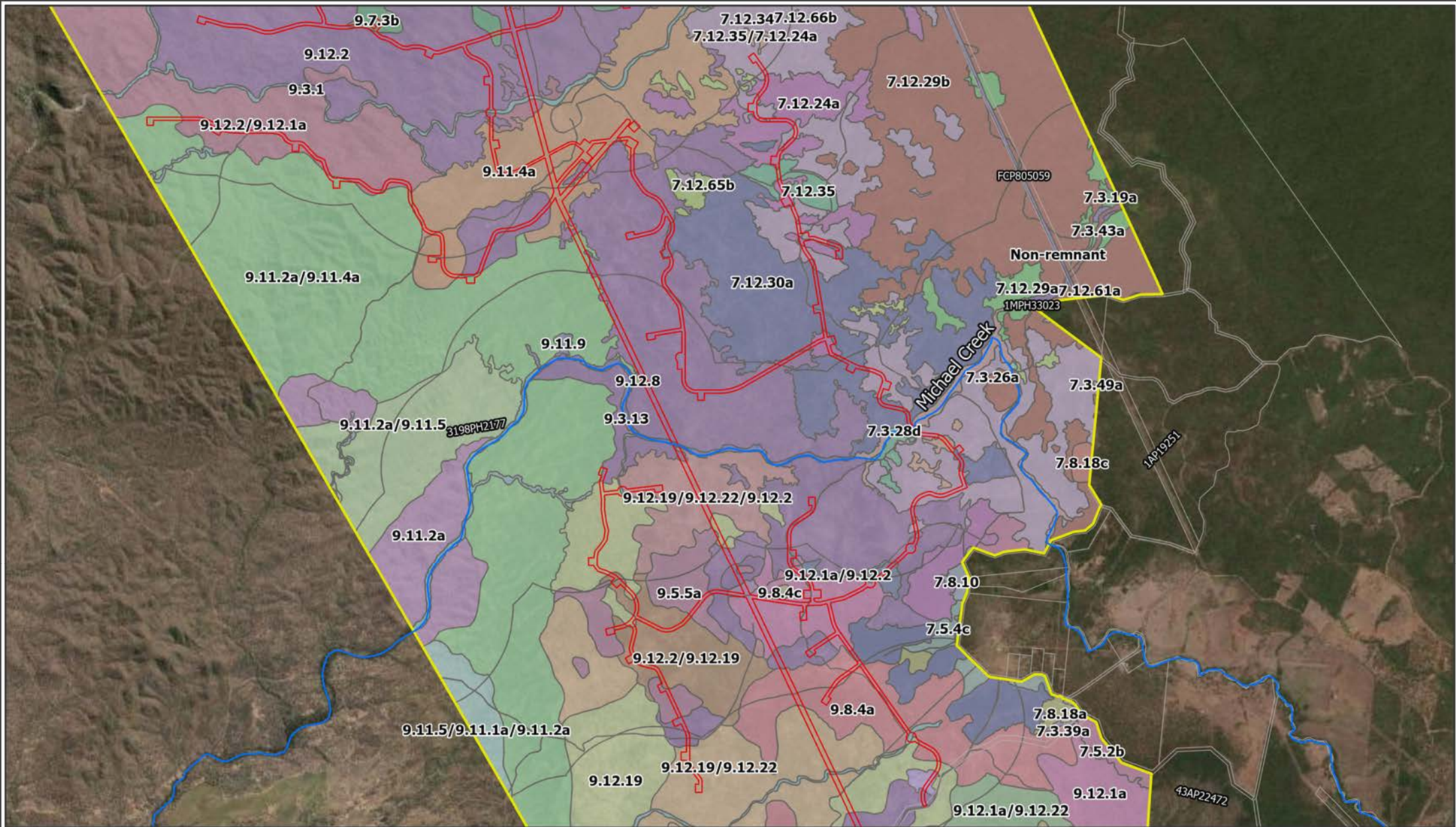
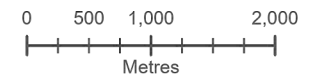
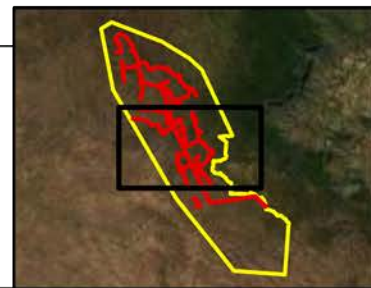


Figure 5 : Ground-truthed regional ecosystems - Centre

Disturbance footprint	7.12.30a	7.3.26a	7.8.18a	9.12.19	9.12.2/9.12.1a	9.8.4c
Project area	7.12.34	7.3.28d	7.8.18c	9.12.19/9.12.22	9.12.22	Non-remnant
Watercourses	7.12.35	7.3.39a	9.11.2a	9.12.19/9.12.22/9.12.2	9.12.8	
Cadastral boundaries	7.12.35/7.12.24a	7.3.43a	9.11.2a/9.11.4a	9.12.1a	9.3.1	
Ground-truthed regional ecosystems	7.12.61a	7.3.49a	9.11.2a/9.11.5	9.12.1a/9.12.2	9.3.13	
7.12.24a	7.12.65b	7.5.2b	9.11.4a	9.12.1a/9.12.22	9.5.5a	
7.12.29a	7.12.66b	7.5.4c	9.11.5/9.11.1a/9.11.2a	9.12.2	9.7.3b	
7.12.29b	7.3.19a	7.8.10	9.11.9	9.12.2/9.12.19	9.8.4a	



Datum/Projection:
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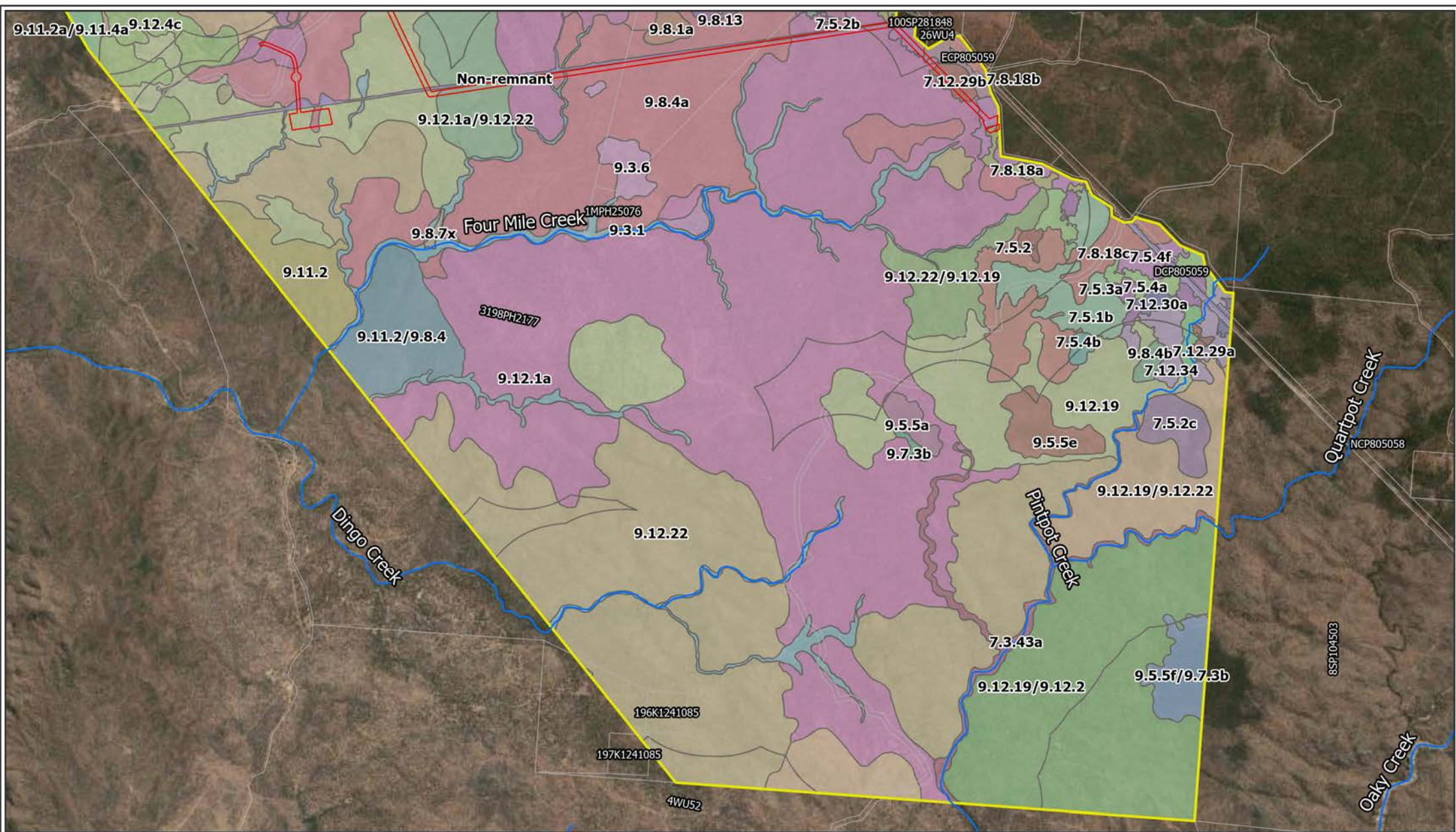
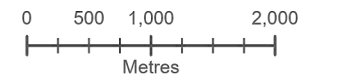
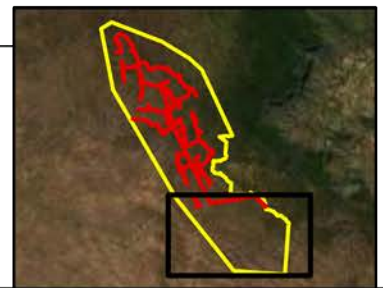


Figure 5 : Ground-truthed regional ecosystems - South

Disturbance footprint	7.12.30a	7.5.3a	7.8.18c	9.12.1a	9.5.5a	9.8.4a
Project area	7.12.34	7.5.4a	9.11.2	9.12.1a/9.12.22	9.5.5e	9.8.4b
Watercourses	7.3.43a	7.5.4b	9.11.2/9.8.4	9.12.22	9.5.5f/9.7.3b	9.8.7x
Cadastral boundaries	7.5.1b	7.5.4c	9.11.2a/9.11.4a	9.12.22/9.12.19	9.7.3b	Non-remnant
Ground-truthed regional ecosystems	7.5.2	7.5.4f	9.12.19	9.12.4c	9.8.13	
7.12.29a	7.5.2b	7.8.18a	9.12.19/9.12.2	9.3.1	9.8.1a	
7.12.29b	7.5.2c	7.8.18b	9.12.19/9.12.22	9.3.6	9.8.1a/9.8.4c	



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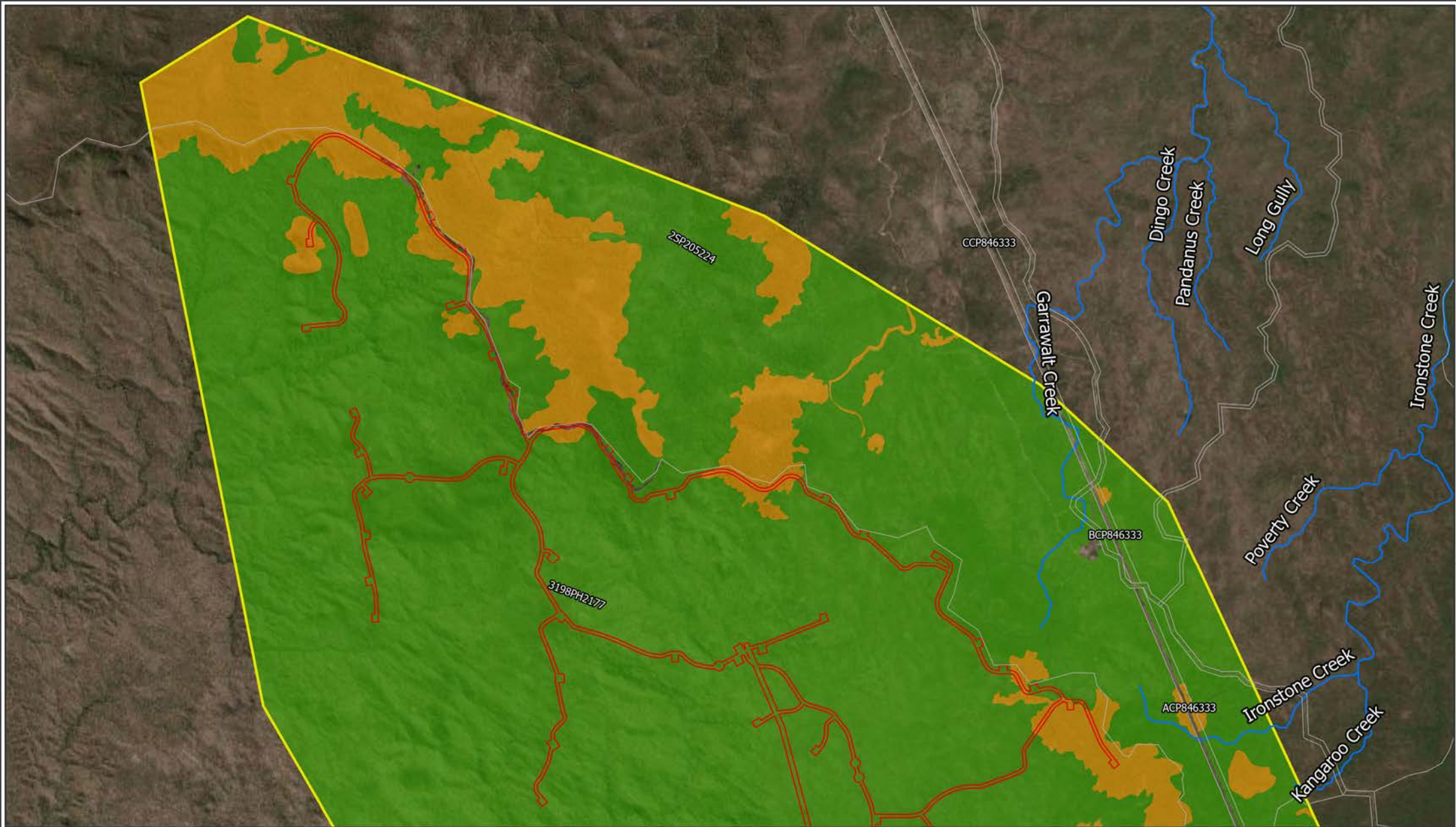
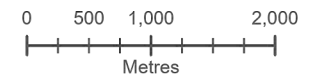
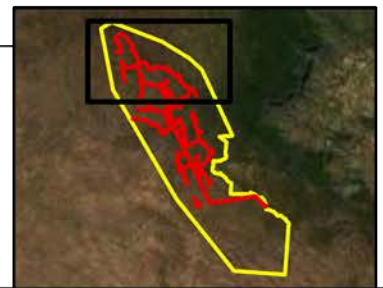


Figure 6 : Regulated Vegetation (VM Act) - North

- | | |
|--|---|
|  Disturbance footprint | Regulated Vegetation (VM Act class) |
|  Project area |  Of concern |
|  Watercourses |  Containing Of concern |
|  Cadastral boundaries |  Least concern |



Datum/Projection:
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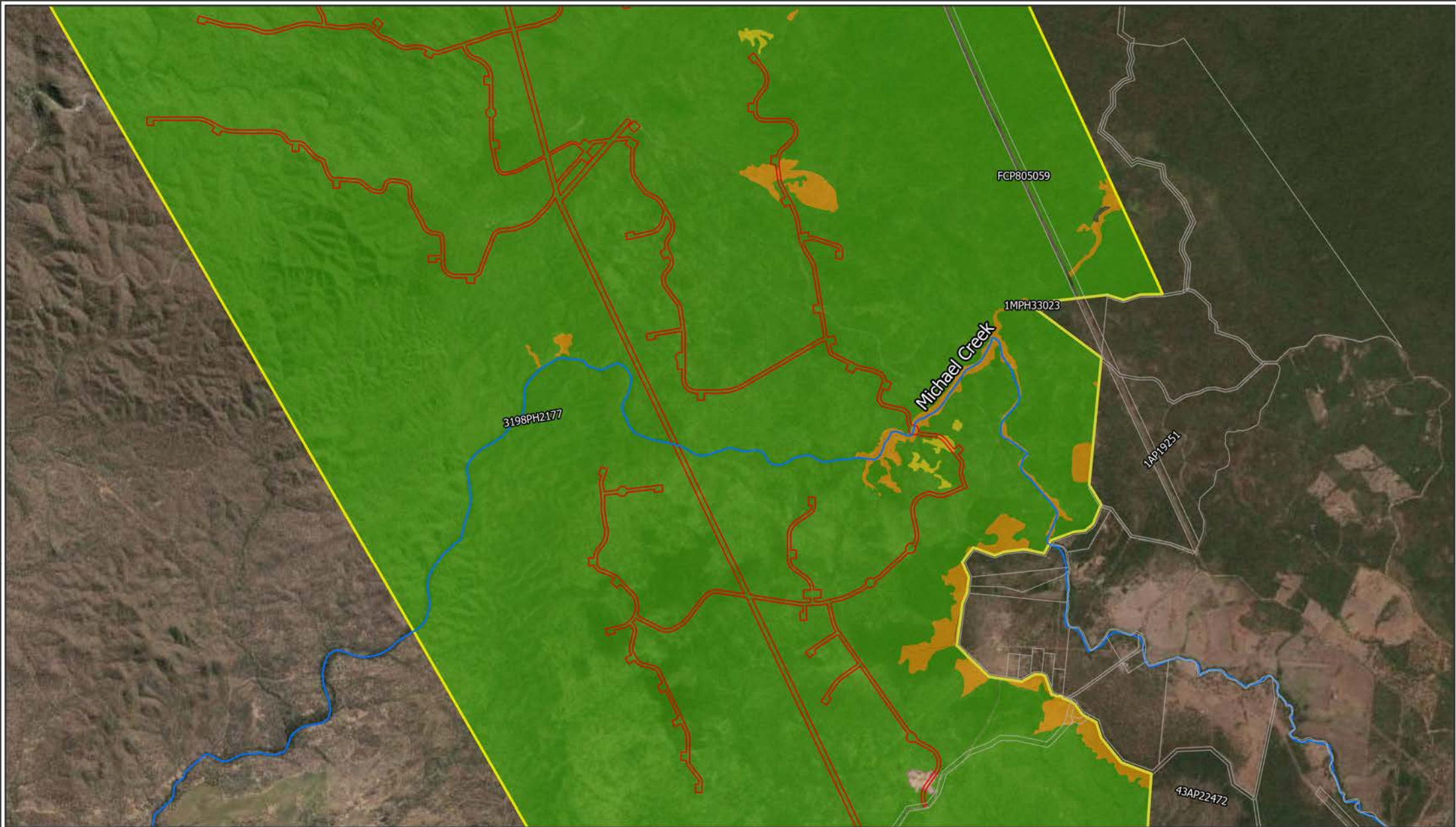
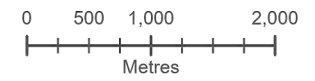
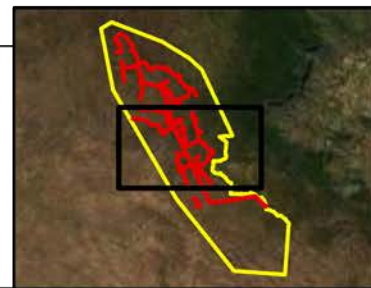


Figure 6 : Regulated Vegetation (VM Act) - Centre

- | | |
|--|---|
|  Disturbance footprint | Regulated Vegetation (VM Act class) |
|  Project area |  Of concern |
|  Watercourses |  Containing Of concern |
|  Cadastral boundaries |  Least concern |



Datum/Projection:
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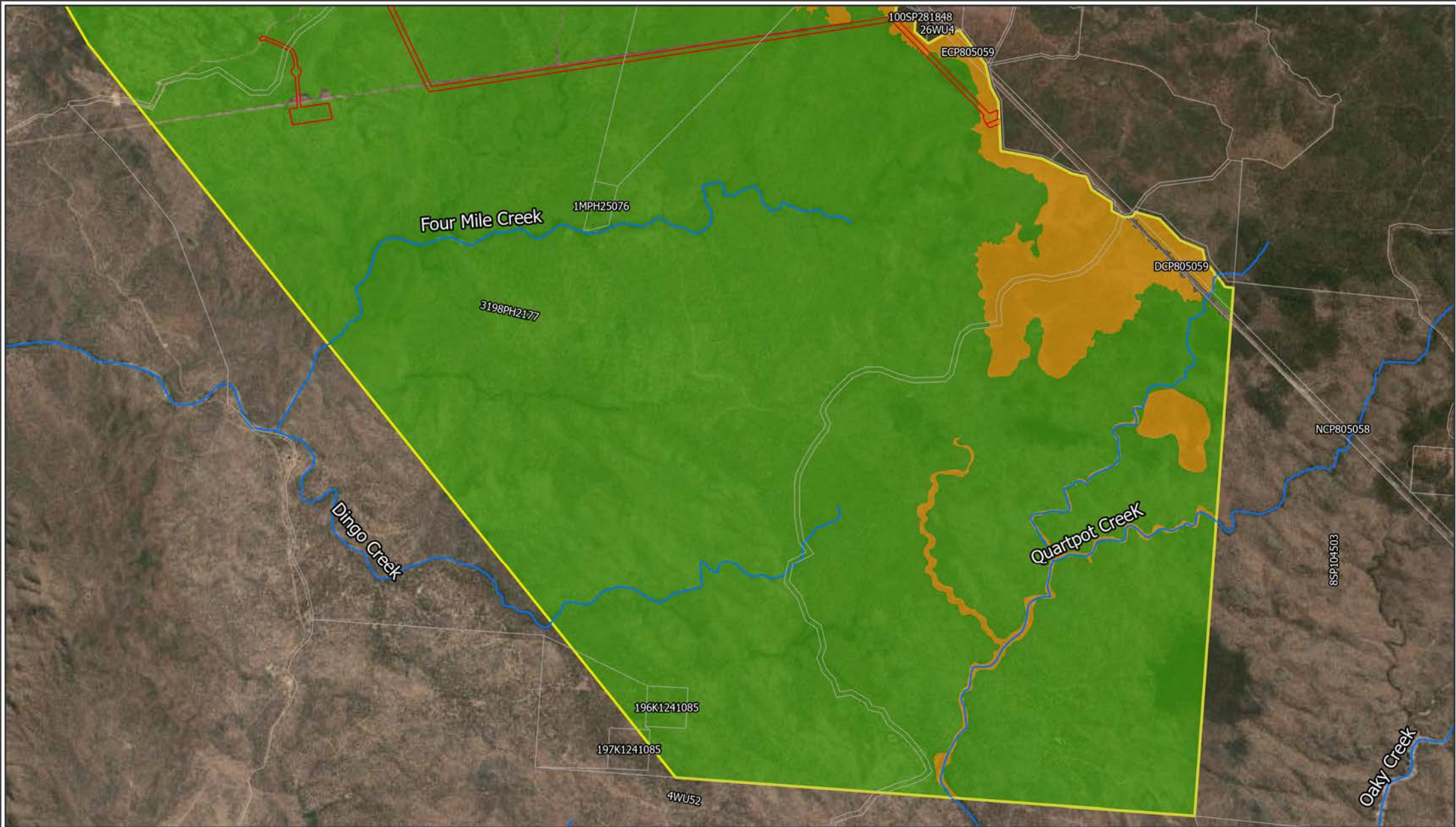







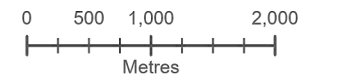
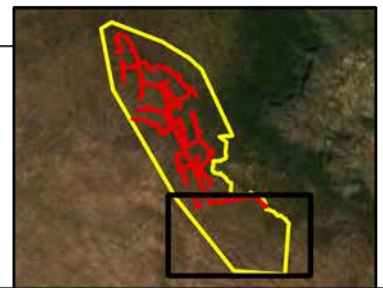


Figure 6 : Regulated Vegetation (VM Act) - South

- | | |
|--|---|
|  Disturbance footprint | Regulated Vegetation (VM Act class) |
|  Project area |  Of concern |
|  Watercourses |  Containing Of concern |
|  Cadastral boundaries |  Least concern |



Datum/Projection:
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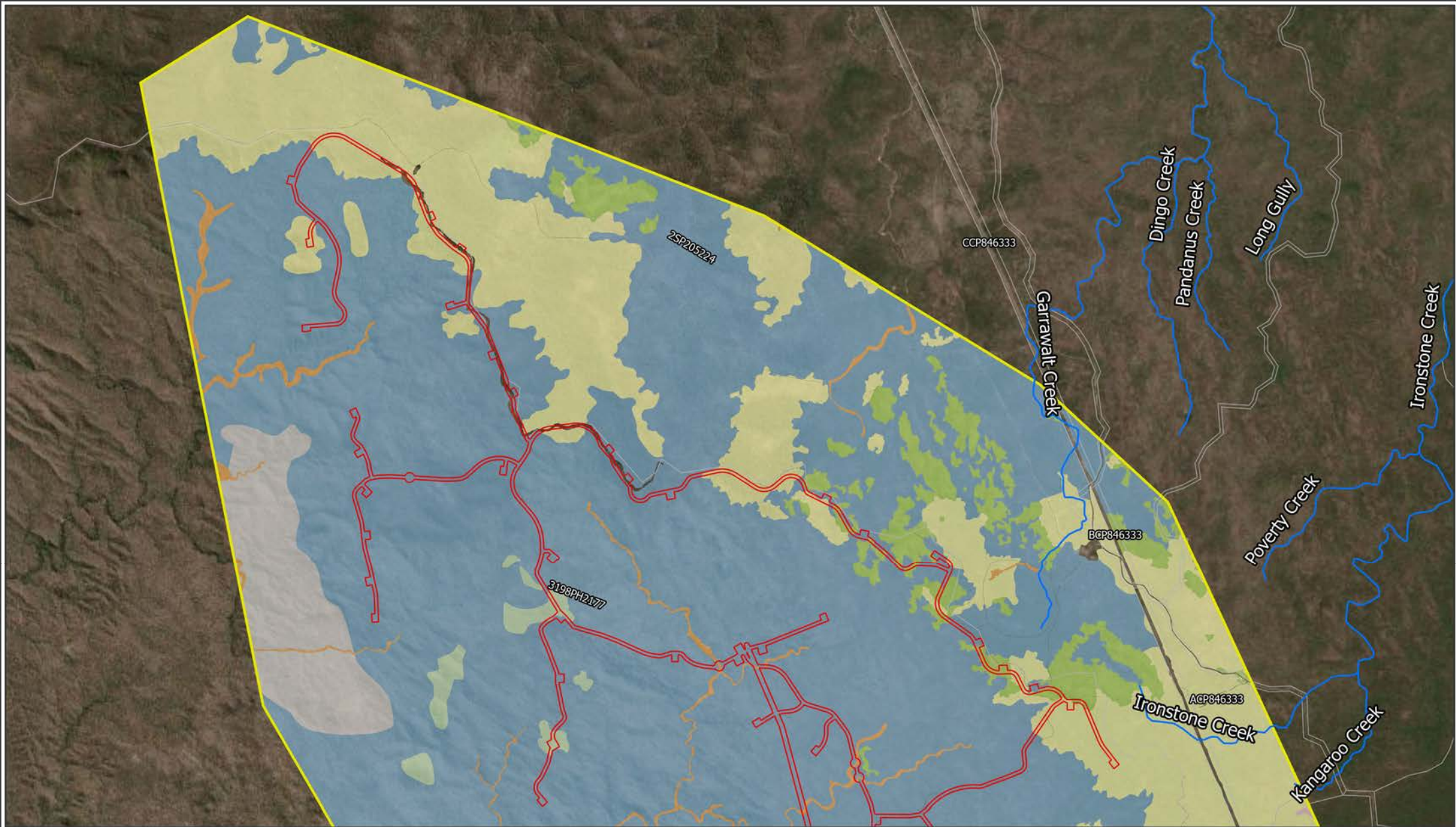
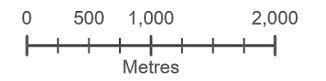
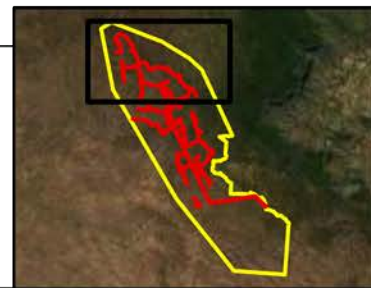


Figure 7 : Habitat types - North

- | | |
|-----------------------|--|
| Disturbance footprint | Broad habitat type |
| Project area | Open forest to woodlands on uplands |
| Cadastral boundaries | Open woodland to open forest on granite or Tertiary surfaces |
| Watercourses | Riparian forest |
| | Rock pavement |
| | Simple or notophyll vine forest |

- | |
|--|
| Very open woodland on metamorphics and low hills |
| Woodland on lateritised surface |



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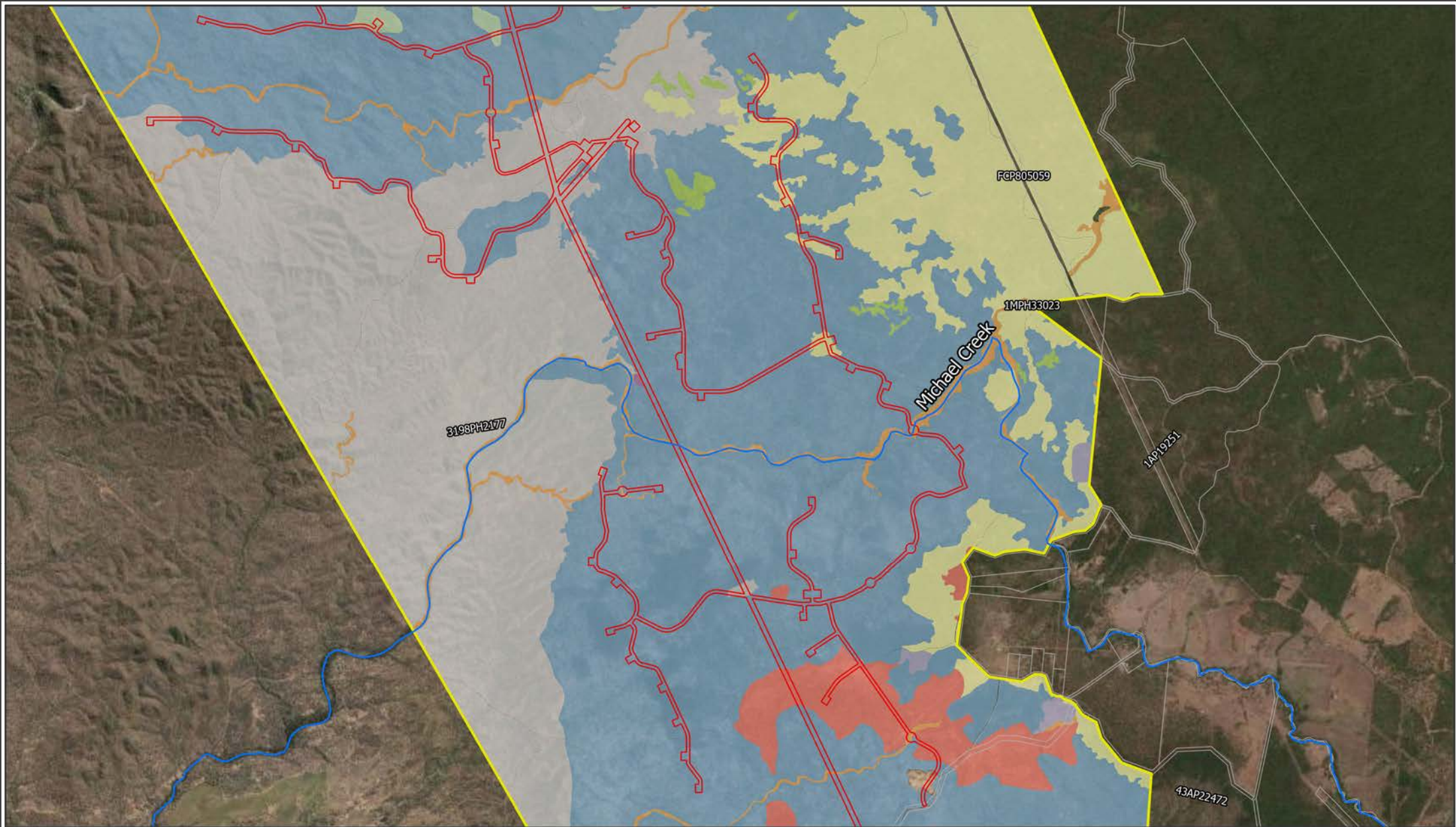
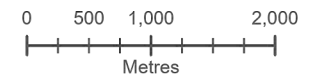
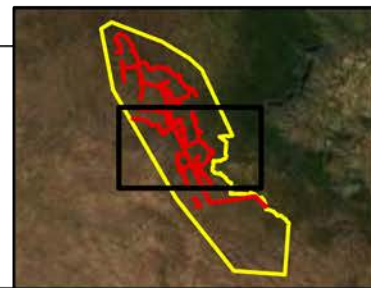


Figure 7 : Habitat types - Centre

- | | | |
|---|---|--|
| <ul style="list-style-type: none"> Disturbance footprint Project area Cadastral boundaries Watercourses | <p>Broad habitat type</p> <ul style="list-style-type: none"> Open forest to woodlands on uplands Open forest with <i>Allocasuarina</i> spp. dominant or co-dominant in the canopy Open woodland on basalt plains Open woodland to open forest on granite or Tertiary surfaces Riparian forest | <ul style="list-style-type: none"> Rock pavement Very open woodland on metamorphics and low hills Vine thicket Woodland on lateritised surface |
|---|---|--|



Datum/Projection:
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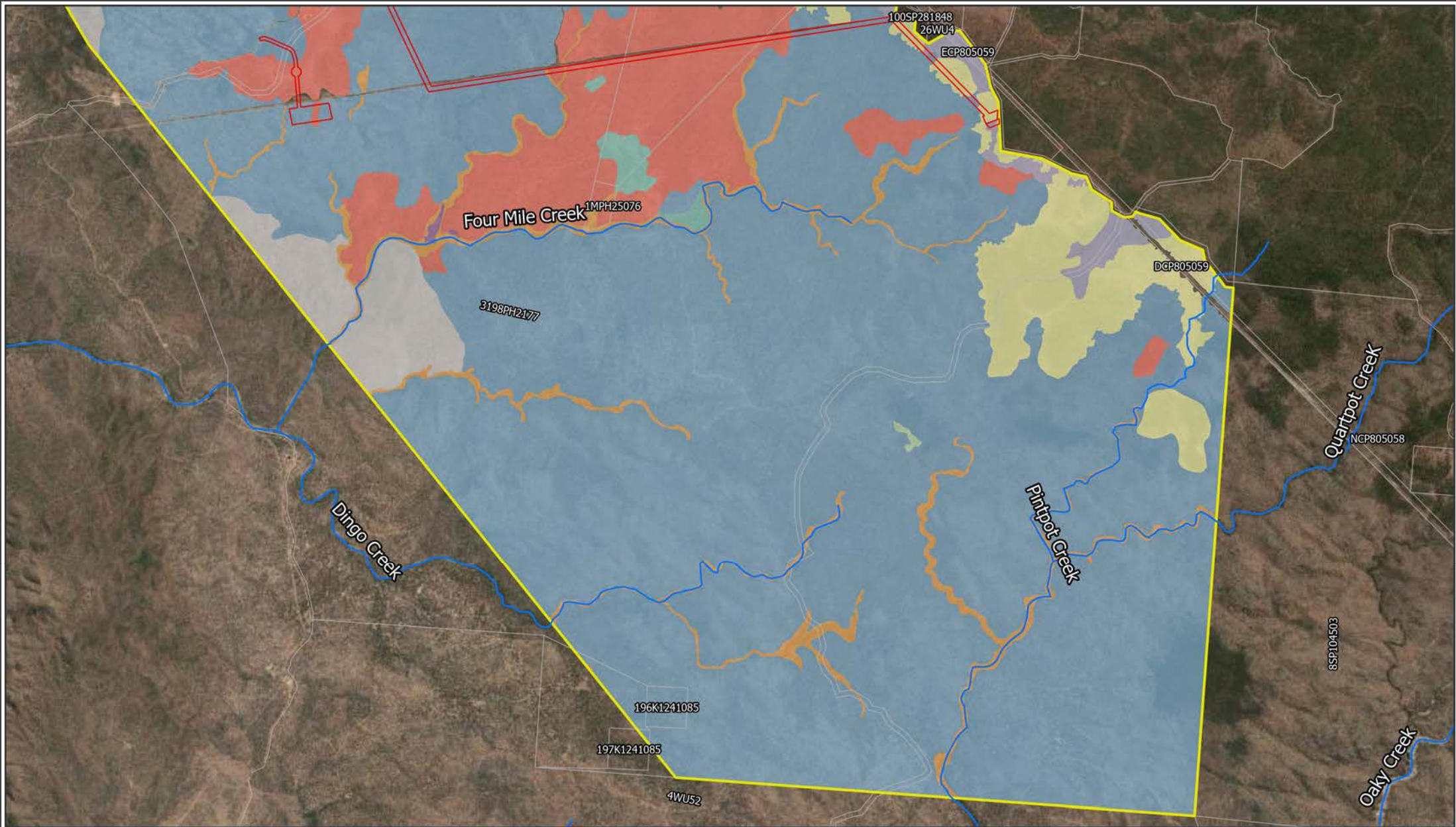
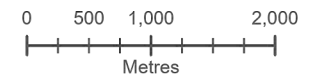
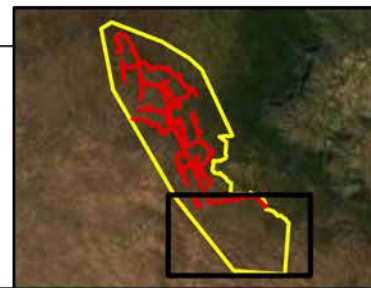


Figure 7 : Habitat types - South

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> Disturbance footprint Project area Cadastral boundaries Watercourses | <p>Broad habitat type</p> <ul style="list-style-type: none"> Floodplain Open forest to woodlands on uplands Open forest with <i>Allocasuarina</i> spp. dominant or co-dominant in the canopy Open woodland on basalt plains Open woodland to open forest on granite or Tertiary surfaces | <ul style="list-style-type: none"> Riparian forest Very open woodland on metamorphics and low hills Vine thicket Woodland on lateritised surface |
|--|--|--|



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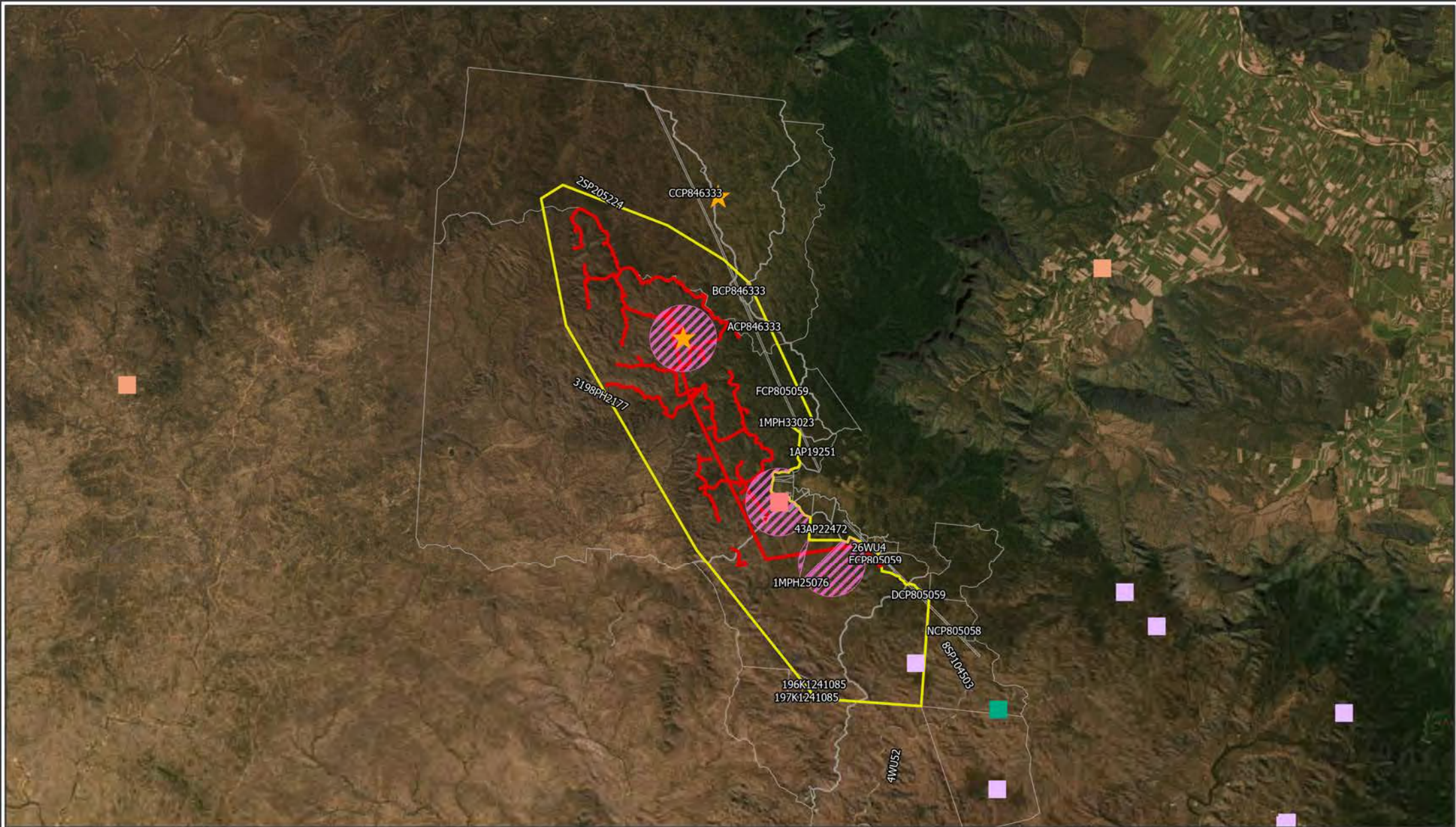
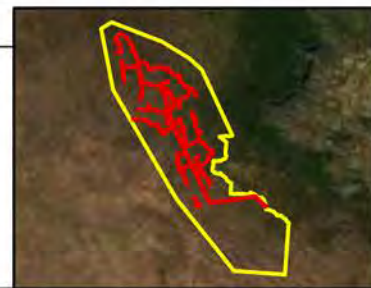


Figure 8 : Known threatened flora records and high-risk mapping

- | | | |
|------------------------------|--------------------------------|---------------------------------|
| Disturbance footprint | ELA Threatened species records | ALA Threatened species records |
| Project area | <i>Commersonia reticulata</i> | <i>Acacia tingoorensis</i> |
| Cadastral boundaries | | <i>Corymbia leptoloma</i> |
| Flora survey trigger map 8.0 | | <i>Glossocardia orthochaeta</i> |



0 2,500 5,000 10,000
Metres

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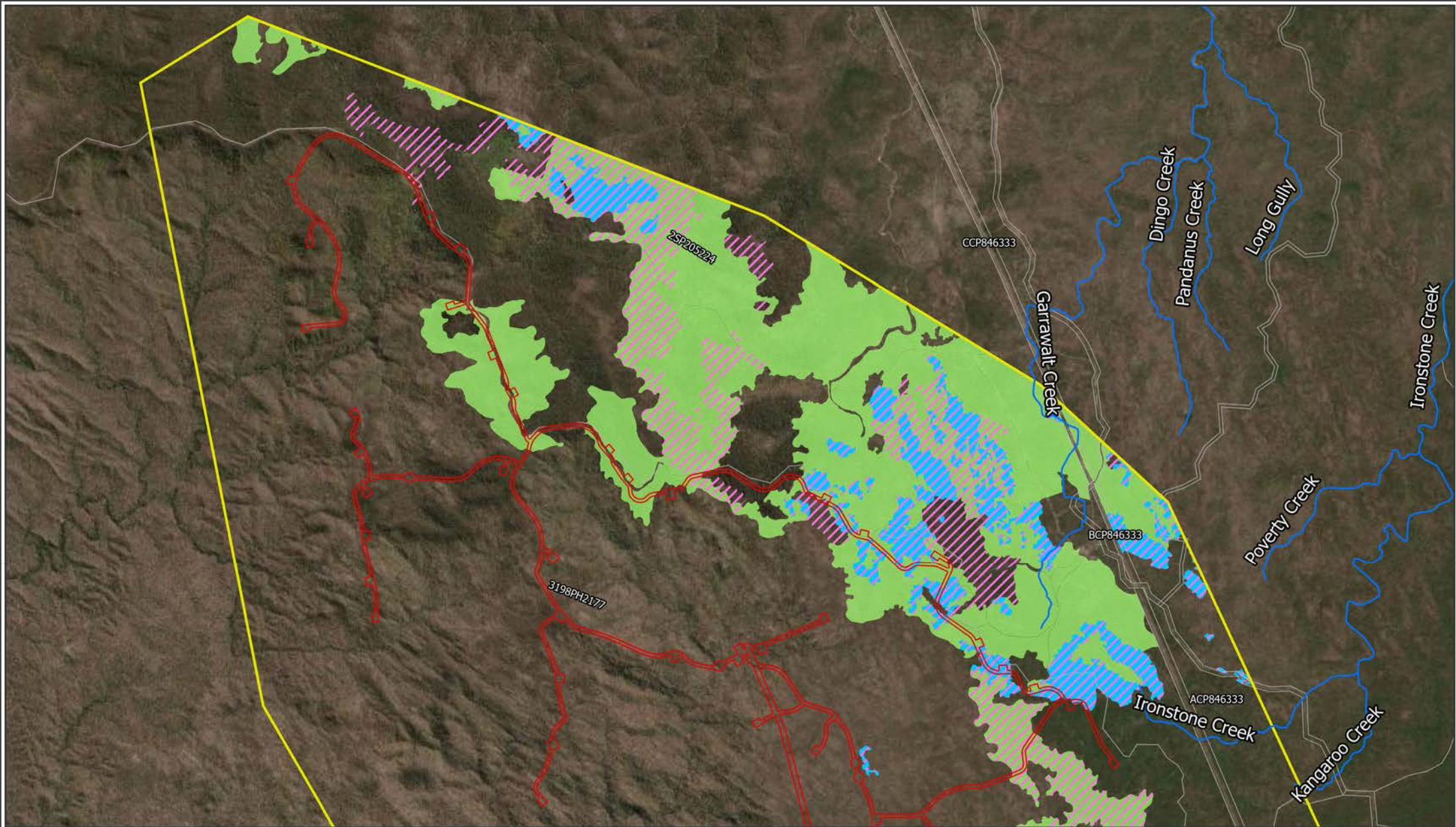
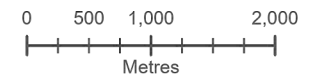
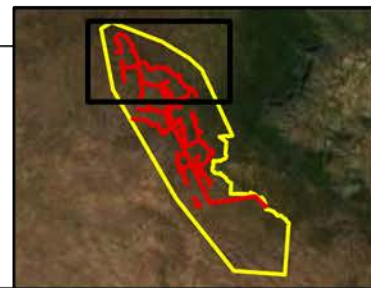


Figure 9 : Threatened flora potential habitat (trees and shrubs) - North

- | | |
|-----------------------|--|
| Disturbance footprint | Potential threatened flora habitat |
| Project area | <i>Acacia longipedunculata</i> |
| Cadastral boundaries | <i>Acacia tingoorensis</i> (Tingoorensis wattle) |
| Watercourses | <i>Corymbia leptoloma</i> (Yellowjacket) |
| | <i>Homoranthus cummingii</i> |
| | <i>Homoranthus porteri</i> |
| | <i>Marsdenia brevifolia</i> |



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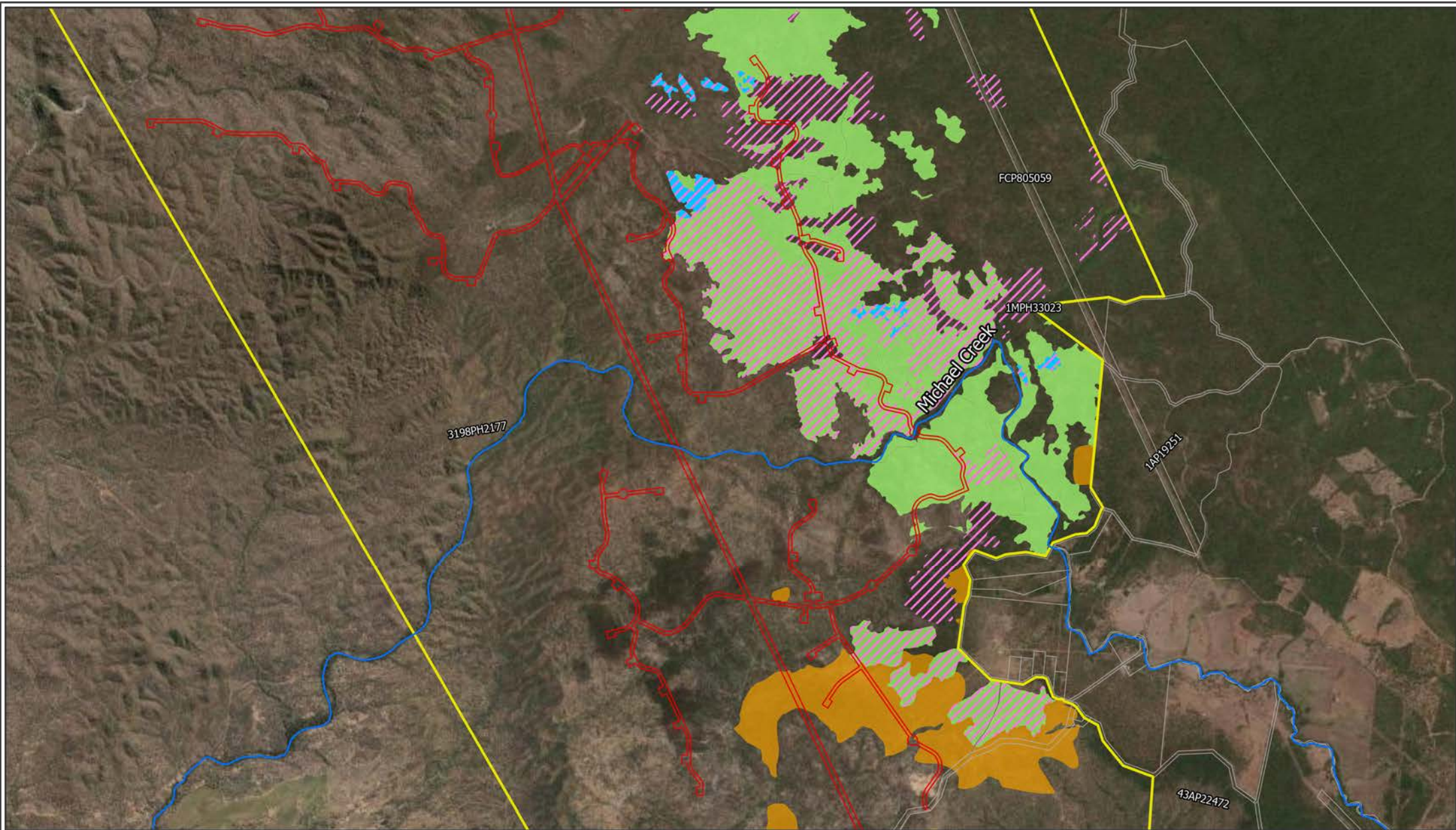
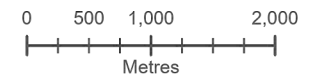
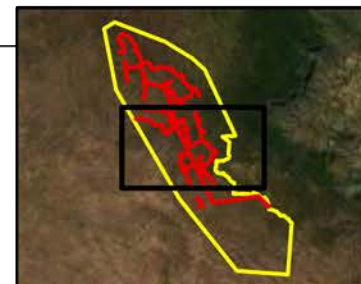


Figure 9 : Threatened flora potential habitat (trees and shrubs) - Centre

- | | |
|---|--|
| <ul style="list-style-type: none"> Disturbance footprint Project area Cadastral boundaries Watercourses | <p>Potential threatened flora habitat</p> <ul style="list-style-type: none"> <i>Acacia longipedunculata</i> <i>Acacia tingoorensis</i> (Tingoorensis wattle) <i>Corymbia leptoloma</i> (Yellowjacket) <i>Homoranthus cummingii</i> <i>Homoranthus porteri</i> <i>Marsdenia brevifolia</i> |
|---|--|



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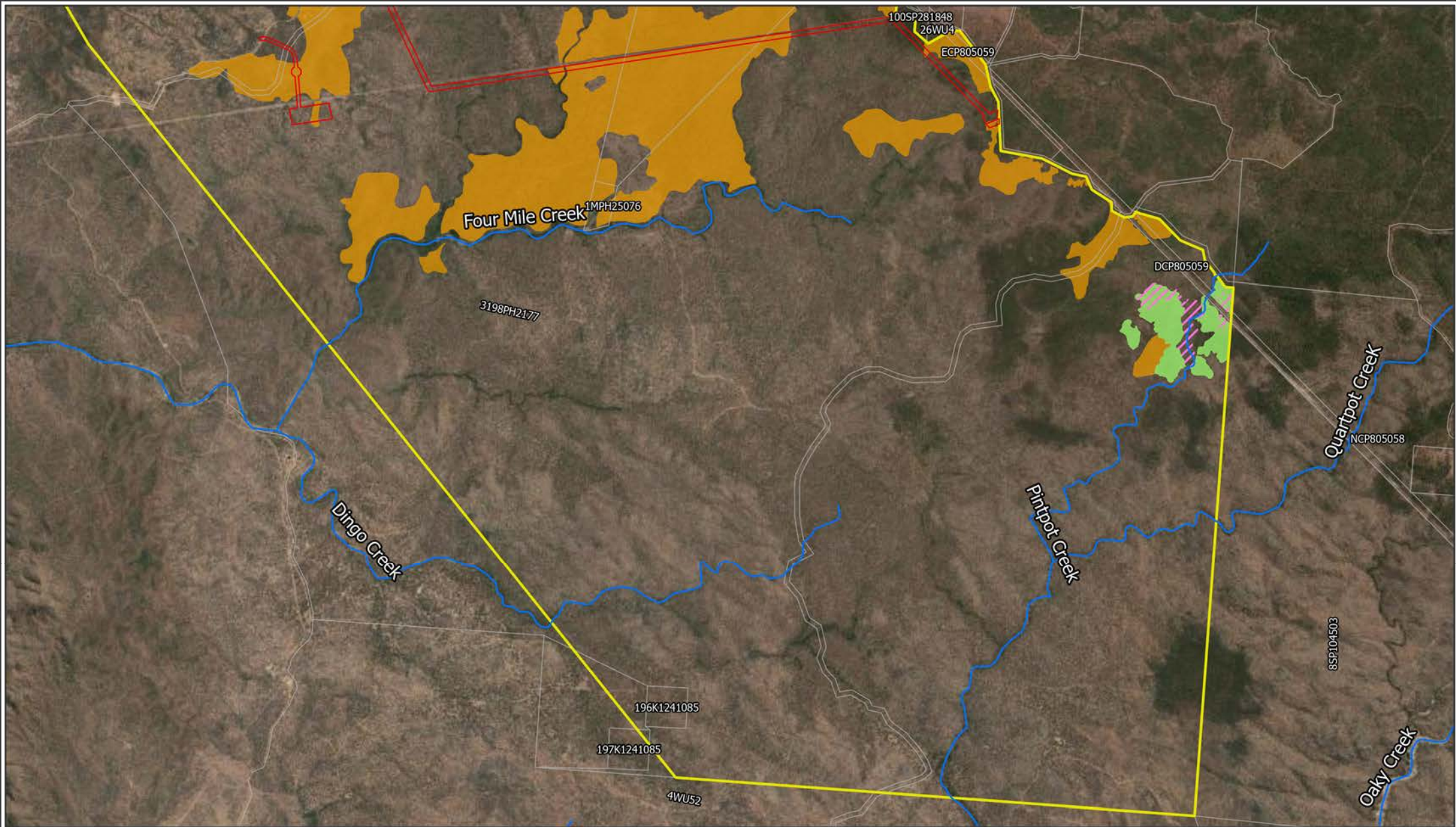
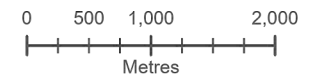
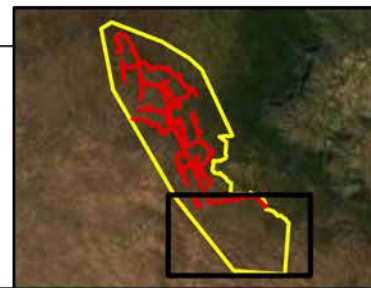


Figure 9 : Threatened flora potential habitat (trees and shrubs) - South

- | | |
|-----------------------|--|
| Disturbance footprint | Potential threatened flora habitat |
| Project area | <i>Acacia longipedunculata</i> |
| Cadastral boundaries | <i>Acacia tingoorensis</i> (Tingoorensis wattle) |
| Watercourses | <i>Corymbia leptoloma</i> (Yellowjacket) |
| | <i>Homoranthus cummingii</i> |
| | <i>Homoranthus porteri</i> |
| | <i>Marsdenia brevifolia</i> |



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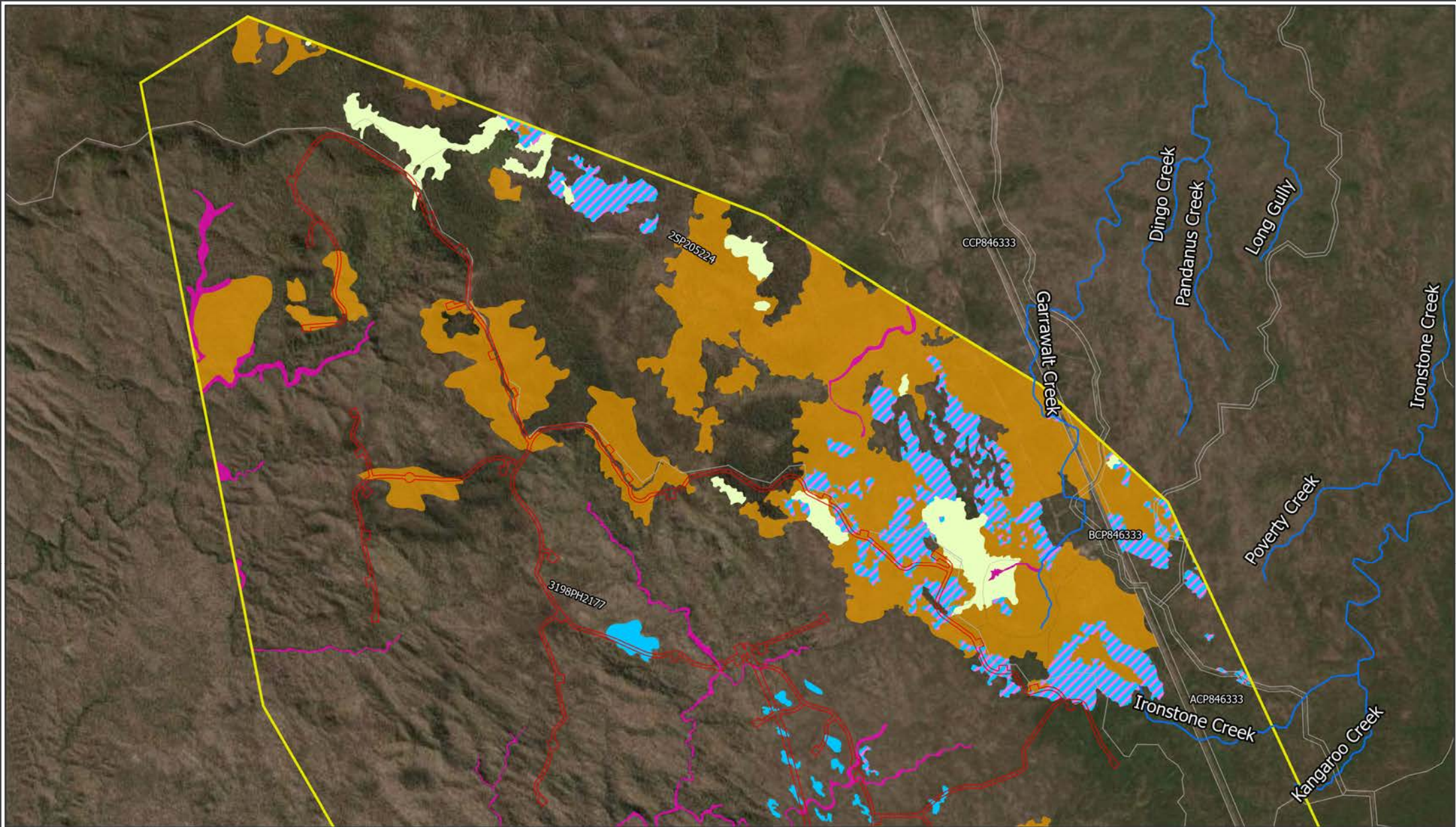
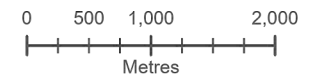
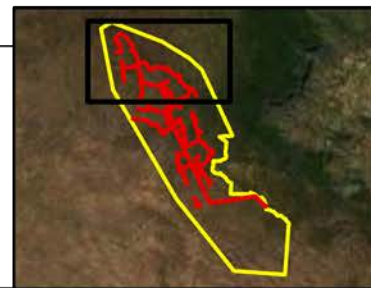


Figure 10 : Threatened flora potential habitat (forbs)

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|-----------------------|--|
| Disturbance footprint | Potential threatened flora habitat |
| Project area | <i>Oenanthe javanica</i> (water celery) |
| Cadastral boundaries | <i>Corybas cerasinus</i> (red helmet orchid) |
| Watercourses | <i>Solanum graniticum</i> (granite nightshade) |
| | <i>Glossocardia orthochaeta</i> |
| | <i>Commersonia reticulata</i> |



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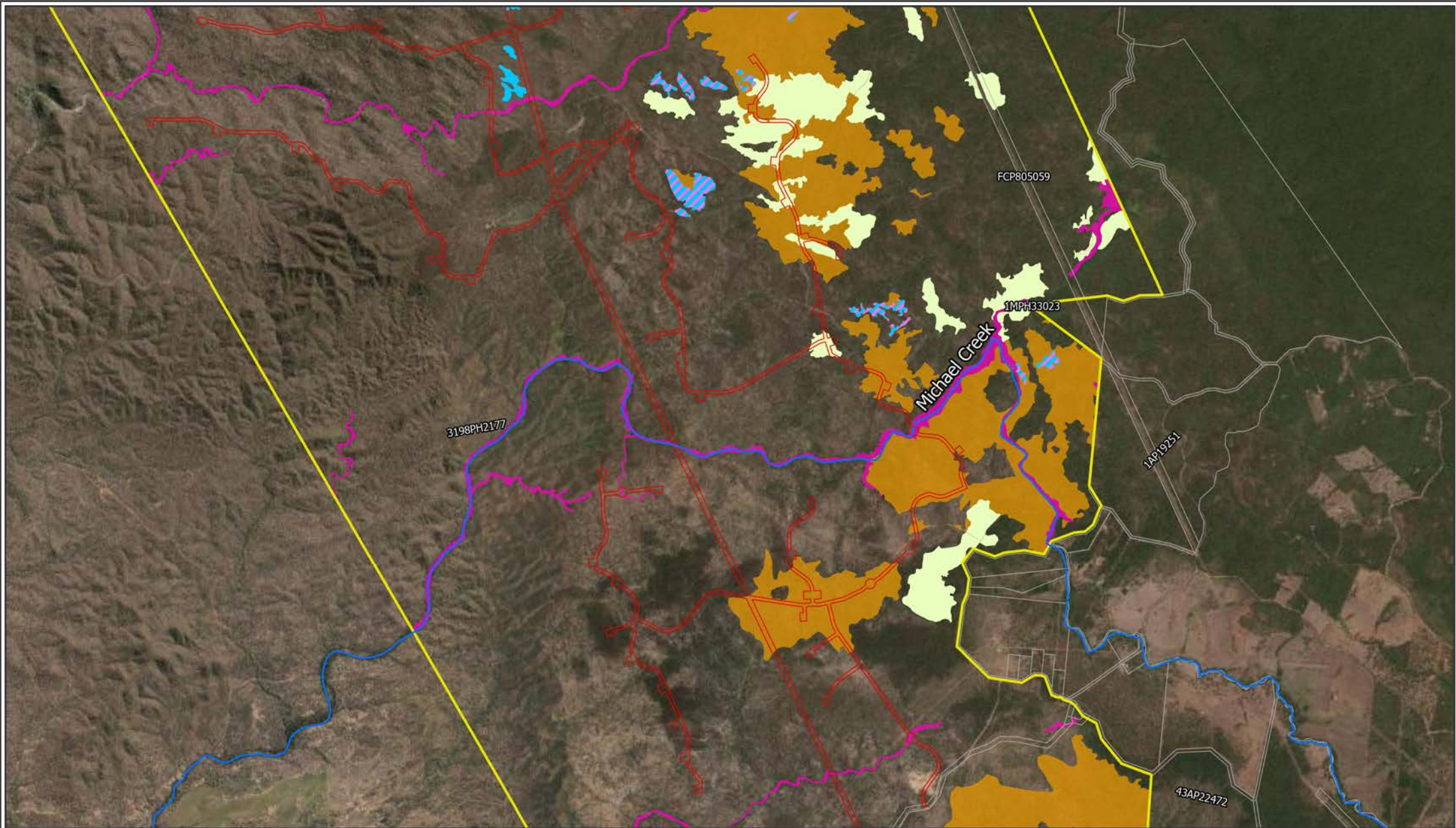
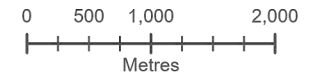
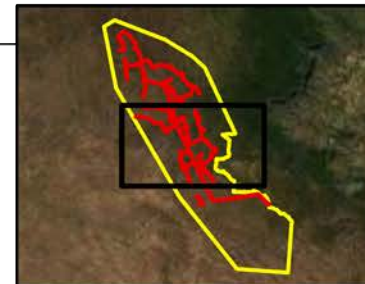


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