3 Offset properties

3.1 Overview of the offset properties

3.1.1 Tabooba

Tabooba is located at 226 Farringdon Road, Tabooba, approximately 16 km south of the town of Beaudesert in the Scenic Rim Regional Council LGA (see *Figure 2*) and 37 km south-west of the southern extent of the action. Tabooba covers 390.25 ha in total and is comprised of four lots:

- Lot 3 on RP32561 (152.61 ha)
- Lot 174 on W311810 (64.75 ha)
- Lot 296 on W312231 (44.08 ha)
- Lot 85 on W311299 (129.54 ha).

Tabooba is located on the western and southern slopes of the Jinbroken Range which separates the Albert and Logan River valleys. Geologically, the Jinbroken Range is formed of Albert Basalt and borders the property to the north and east, reaching its highest point at 453m on the north-eastern property boundary at the location known as 'Kerry'.

The most recent landholder had managed Tabooba for cattle grazing for a period of approximately 30 years, prior to the purchase by TMR in April 2022. Land management practices included maintaining cleared pastures on creek flood zones, stick-raking valleys and slopes in the higher country to remove tree regrowth and sowing of exotic, high-yield pasture grasses such as Rhodes grass (*Chloris gayana*) in the cleared areas. These areas were mapped during the ecological surveys as 'cleared', 'young regrowth' and 'mature regrowth' respectively. The cleared areas have been maintained in that condition for decades. The regrowth areas are subject to a re-clearing cycle of circa 5-7 years with the young regrowth areas having been re-cleared in 2020 and over-sown with exotic pasture grasses. The mature regrowth areas were to be re-cleared in 2021; however, the extended wet season prevented this action.

Fire has been used as a tool to reduce fuel loads and decrease risk of wildfire, control regrowth vegetation, and maintain a grassy understorey for cattle grazing beneath the woodland vegetation on higher slopes. Cool, mosaic pattern burning has been carried out since the 1980s. Cattle have not been fenced from watercourses and evidence of erosion and weed proliferation is apparent in watercourses on the lower slopes and alluvial plains. Weed infestation is present throughout the site, including around the base of koala food trees, which may prevent current greater utilisation. These areas would be managed to enhance the habitat for Koala and/or GHFF.

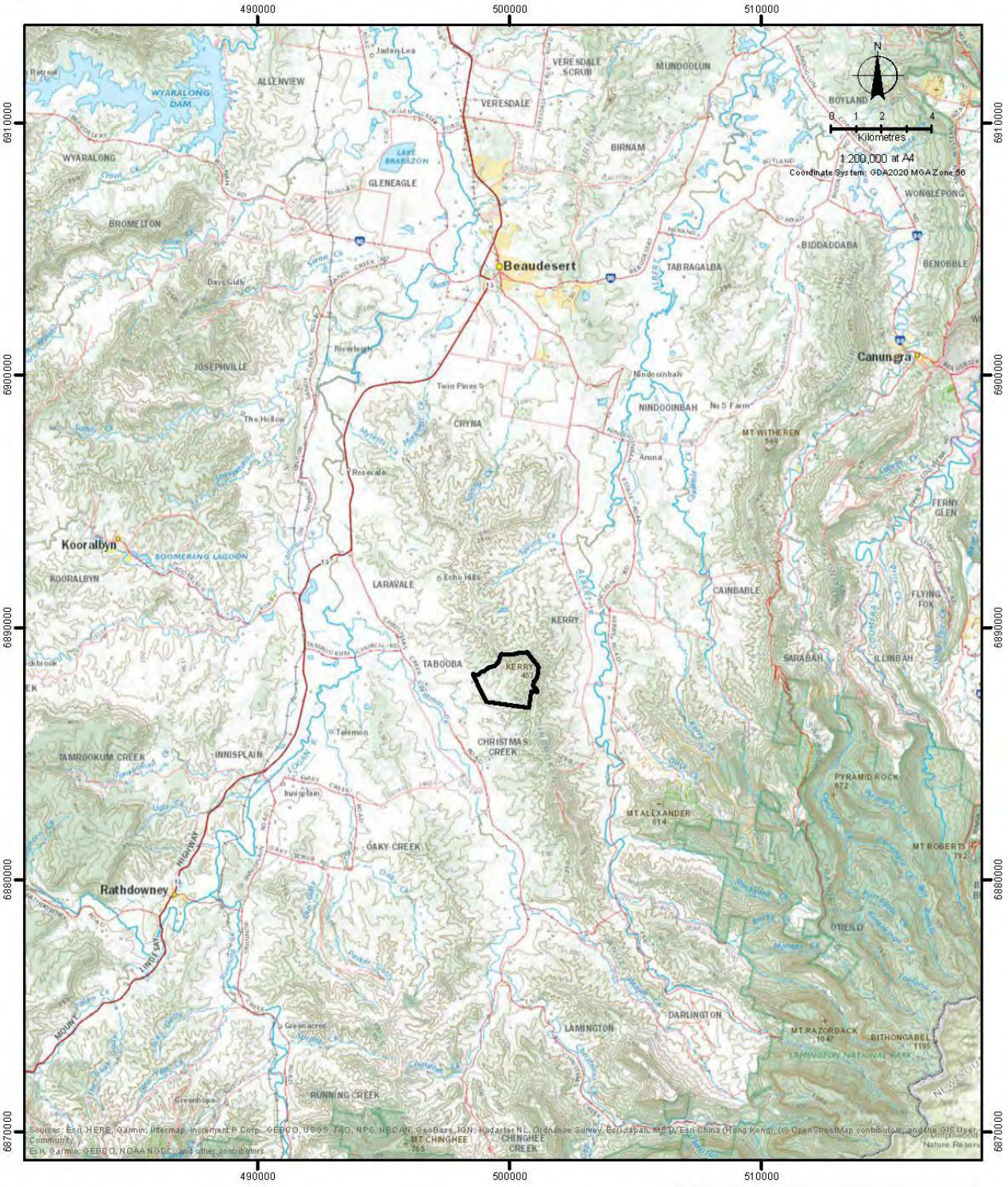
Figure 3 shows the areas of mapped remnant and regrowth vegetation, REs and core Koala habitat on the property and surrounding area.

Connectivity

Where Tabooba includes habitat of the Jinbroken Range to the east, remnant vegetation exists on both the offset property and adjoining properties. This forms a corridor of intact vegetation along the range to the north and south. The *Scenic Rim Regional Council Biodiversity Strategy 2015-2025* indicates that Tabooba is within existing 'core-node' habitat and links landscape along Jinbroken Range connecting to the south with 'core' habitat. Restoring and maintaining koala habitat connectivity between the riparian and ridgeline habitats of Tabooba would have significant benefits by enabling koalas to safely inhabit and move between the range of altitudinal habitats for feeding and breeding purposes and to seek refuge during periods of climatic extremes.

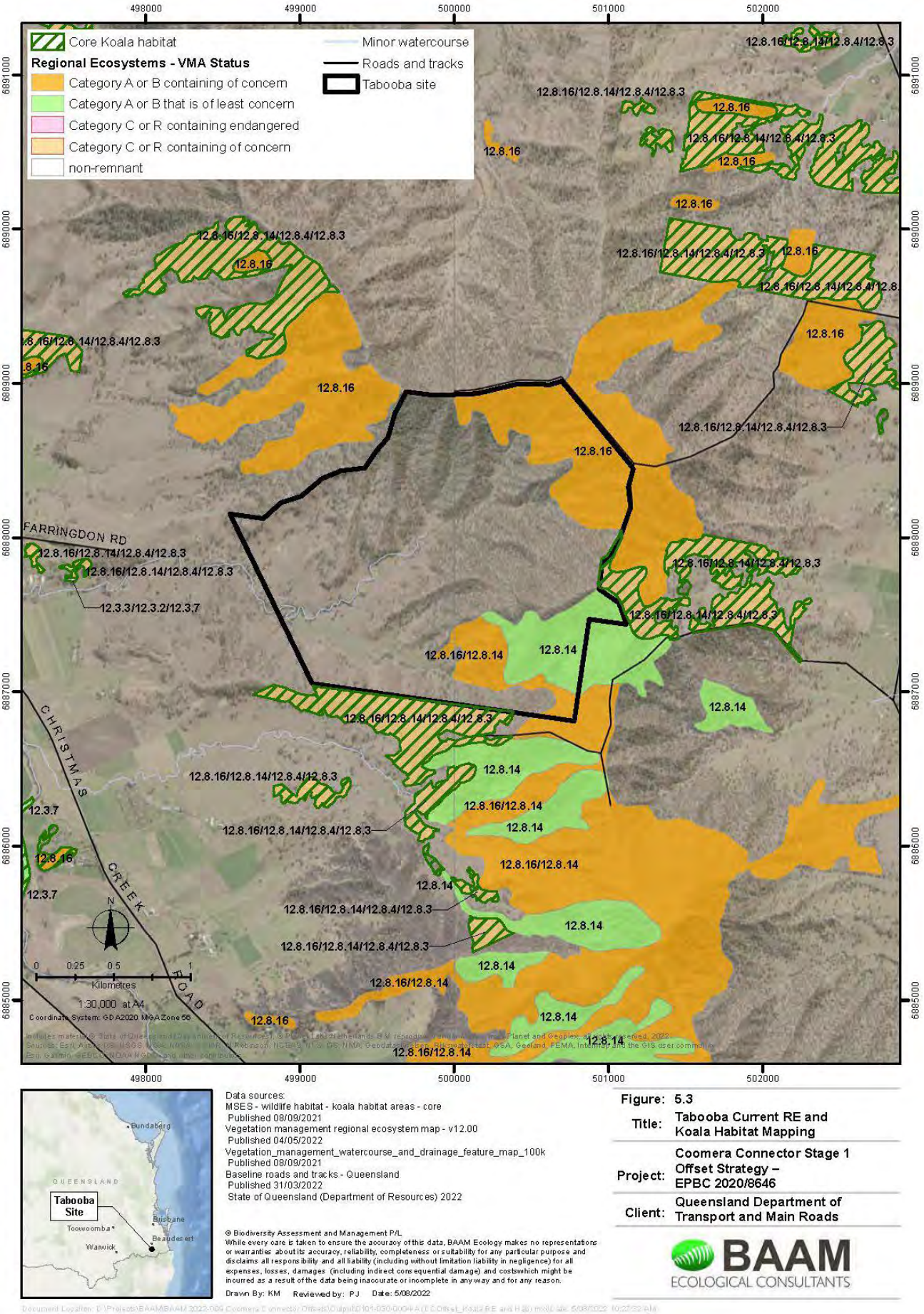
Figure 4 shows the location of Tabooba in relation to riparian features and state and regional biodiversity corridors.

Figure 2: Tabooba location and topography map



Drawn By: KM Reviewed by: PJ Date: 5/08/2022

Figure 3: Tabooba – RE and Koala habitat mapping



Data sources:
MSES - wildlife habitat - koala habitat areas - core
Published 08/09/2021
Vegetation management regional ecosystem map - v12.00
Published 04/05/2022
Vegetation_management_watercourse_and_drainage_feature_map_100k
Published 08/09/2021
Baseline roads and tracks - Queensland
Published 31/03/2022
State of Queensland (Department of Resources) 2022

Drawn By: KM Reviewed by: PJ Date: 5/08/2022

Figure:	5.3
Title:	Tabooba Current RE and Koala Habitat Mapping
Project:	Coomera Connector Stage 1 Offset Strategy – EPBC 2020/8646
Client:	Queensland Department of Transport and Main Roads

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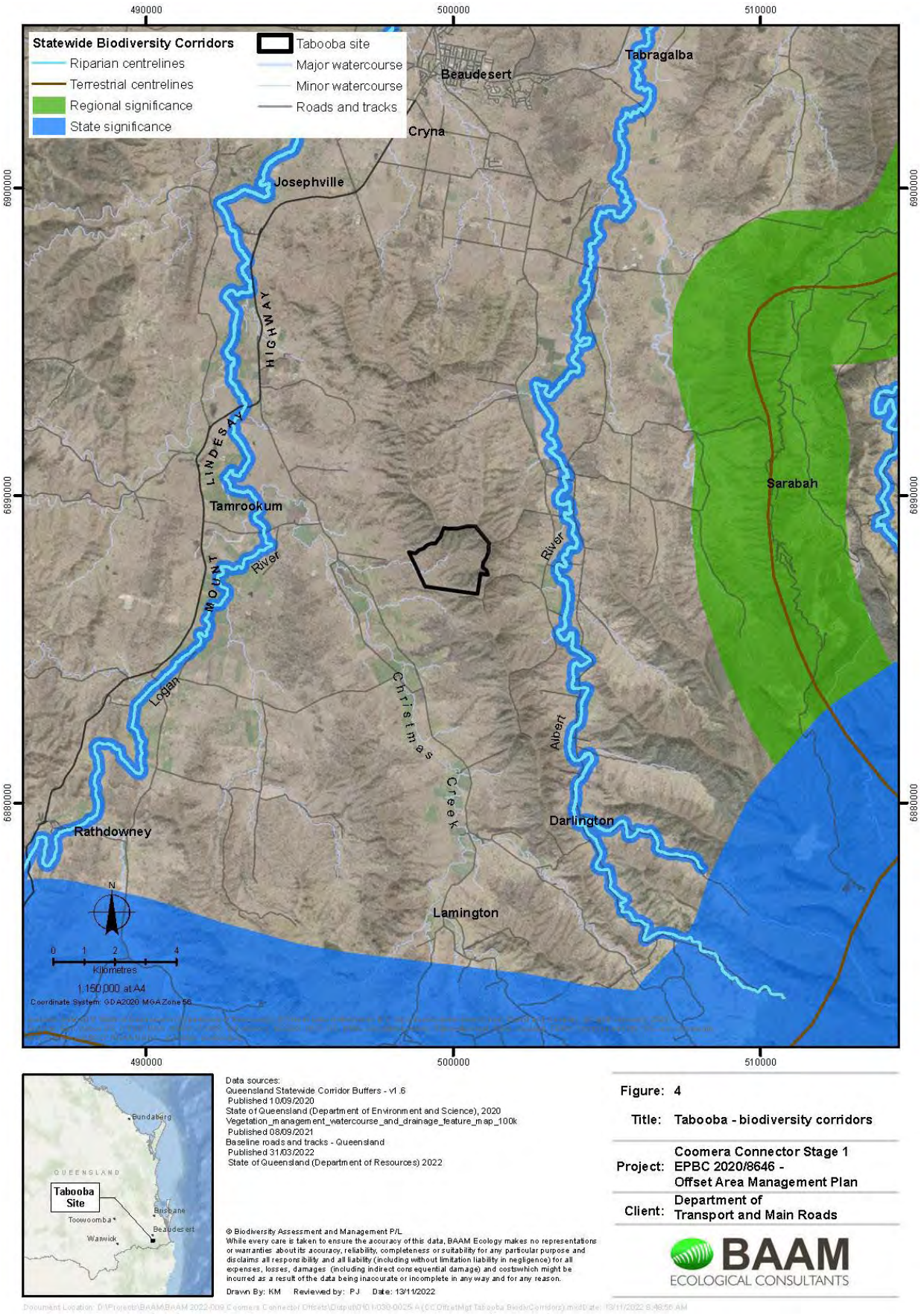
Document Location: D:\Projects\BAAM\BAAM 2022-009 Coomera Connector Offsets\Output\2103-050-0004 A (E Offset_Koala RE and Habitat).mxd 5/08/2022 10:27:32 AM

Figure 4: Tabooba – biodiversity corridors



Data sources:
Queensland Statewide Corridor Buffers - v1.6
Published 10/09/2020
State of Queensland (Department of Environment and Science), 2020
Vegetation_management_watercourse_and_drainage_feature_map_100k
Published 08/09/2021
Baseline roads and tracks - Queensland
Published 31/03/2022
State of Queensland (Department of Resources) 2022

Drawn By: KM Reviewed by: PJ Date: 13/11/2022

Figure:	4
Title:	Tabooba - biodiversity corridors
Project:	Coomera Connector Stage 1 EPBC 2020/8646 - Offset Area Management Plan
Client:	Department of Transport and Main Roads

BAAM ECOLOGICAL CONSULTANTS

Document Location: D:\Projects\BAAM\BAAM 2022-009 Coomera Connector Offsets\Output\010\030-0025 A (OC OffsetMgt Tabooba BiodivCorridors).mxd Date: 13/11/2022 8:46:56 AM

3.1.2 Greenridge

Greenridge is located at 108 Green Meadows Road, Pimpama, approximately 3.5 km north-east of the northern extent of the action. Greenridge covers 407 ha in total and is comprised of 12 lots (see *Figure 5*):

- Lot 121 on RP903491 (28.43 ha)
- Lot 15 on SP145312 (61.71 ha)
- Lot 6 on RP50178 (60.58 ha)
- Lot 7 on RP50178 (26.70 ha)
- Lot 8 on RP50178 (37.70 ha)
- Lot 11 on RP50178 (15.68 ha)
- Lot 12 on RP50178 (16.28 ha)
- Lot 13 on RP50178 (54.61 ha)
- Lot 14 on RP50178 (19.99 ha)
- Lot 15 on RP50178 (40.66 ha)
- Lot 16 on RP50178 (14.37 ha)
- Lot 71 on W31402 (30.36 ha).

Greenridge is situated at the southern-most extent of a broader >100 km^2 area of agricultural land that exists between the Logan River in the north and McCoys Creek in the south. Agricultural land uses in the broader area are dominated by sugar cane production. Other land uses include extractive industries, including sand mining and hard rock quarrying, along with aquaculture enterprises and facilities for boating. This area is bound to the west by the M1, which is adjoined by industrial and residential development. The eastern boundary is the southern extent of Moreton Bay Marine Park including the Moreton Bay Ramsar Wetland, and there are patches of remnant vegetation along the coastline and associated with inlets, rivers and creeks. New residential developments are beginning to emerge along the coastline. Much of the area is less than 10 m above sea level.

The central to southern portions of Greenridge contains small ridges and hills up to 20 m above sea level and composed of sandy clays to stony lithosols derived from Neranleigh-Fernvale beds with colluvial deposits at the base of slopes. These higher areas are characterised by open eucalypt woodland supporting Koala and GHFF habitat. The north-east and north-west of Greenridge consist predominately of alluvial plains supporting a network of shallow alluvial channels draining into the Pimpama River and McCoys Creek. This area is comprised of poorly drained clays to sandy clays, derived from river alluvial, beach and estuarine sediments and supports a mosaic of aquatic and terrestrial vegetation types typical of low-lying coastal areas.

A considerable portion of Greenridge has been cleared in the past for agricultural purposes. The earliest available aerial imagery (from 1955 [8]) indicates the north-western portion of Greenridge was historically cleared of vegetation to facilitate sugarcane farming. Sugar-cane production appears to have ceased between 1978 and 1985. By 1989 Greenridge was being managed primarily for cattle grazing and slash pine plantation, as well as for recreational use by light aircraft. All vegetation on Greenridge was either cleared or substantially thinned and cattle grazing has been the predominant use to recent times.

Though most recently used for cattle grazing, Greenridge does not exhibit any signs of recent cattle usage. Pasture dominated by the exotic South African pigeon grass is heavily overgrown and infested with fireweed (prior to the fire in November 2022), which is toxic to livestock, indicative of little pastoral

[8] https://www.business.qld.gov.au/running-business/support-assistance/mapping-data-imagery/imagery/aerial-photography

management. Fencing has also been removed from areas once restricting cattle access to saltmarsh and mangrove communities in the central to southern portions of Greenridge.

Connectivity

Existing RE mapping for Greenridge is shown in *Figure 6*, indicating the presence of remnant REs 12.11.23, 12.3.20, and 12.3.5. Core Koala habitat is mapped over these REs on Greenridge, which adjoins other areas of core Koala habitat external to the Greenridge boundary to the north and south-west. The southern portion of Greenridge intercepts a mapped state biodiversity corridor and the north-eastern tip of Greenridge adjoins a state riparian corridor associated with the Pimpama River. The location of Greenridge within a regional biodiversity corridor is shown in *Figure 7*.

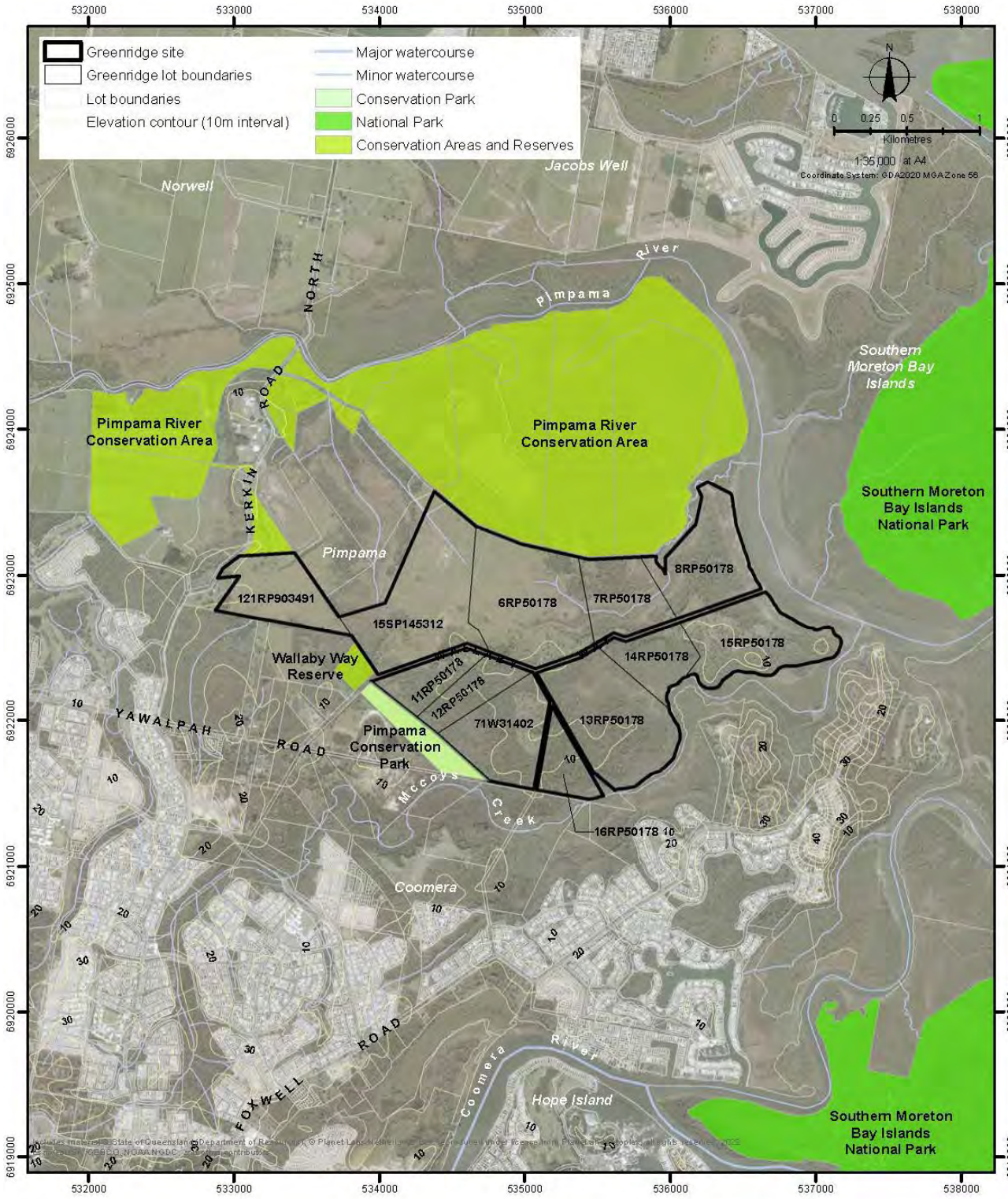
3.2 Suitability of the offset properties

The two properties are considered suitable to provide the values required to address the EOP principles. Consideration was also given to future property planning and any potential future use for the property to avoid the potential for conflicting land use pressures with the offset site.

The properties are suitable for locating the offsets for a number of reasons:

- The delivery of the offset will be close to the impact site.
- The offset area at Tabooba connects to remnant vegetation and Koala habitat along the Jinbroken Range (Figure 3).
- The offset area at Greenridge is located within a corridor of regional significance and has vegetation connectivity to the state significant corridor of the Pimpama River (*Figure 7*).
- The relevant field-verified biodiversity values are present on the offset properties.
- The property management objectives align with the offset management objectives, as the properties were purchased for the purpose of providing offsets for the action.
- There is potential for the future location of other offsets on the same properties for other projects, thus creating larger areas of biodiversity offsets and achieving a better environmental outcome.

Figure 5: Greenridge location map



Data sources:
Cadastral data - Queensland - by area of interest, Published 30/05/2022
Elevation contours - 10 metre interval, Published 26/08/2019
Vegetation management watercourse and drainage feature map (1:25000) – South East Queensland v5.0, Published 08/09/2021
MSES - Protected area - estates, Published 08/09/2021
Baseline roads and tracks - Queensland, Published 31/03/2022
State of Queensland (Department of Resources)

Drawn By: KM Reviewed by: PJ Date: 5/08/2022

Document Location: I:\Projects\BAAM\BAAM 2020-009 Coomera Connector Offsets\Output\0901-0000-0001-A\[CC]Final_Greenridge_Topo.mxd Date\5/08/2022 11:20:55 AM

Figure:	6.1
Title:	Greenridge Site Locality Features
Project:	Coomera Connector Stage 1 Offset Strategy – EPBC 2020/8646
Client:	Queensland Department of Transport and Main Roads

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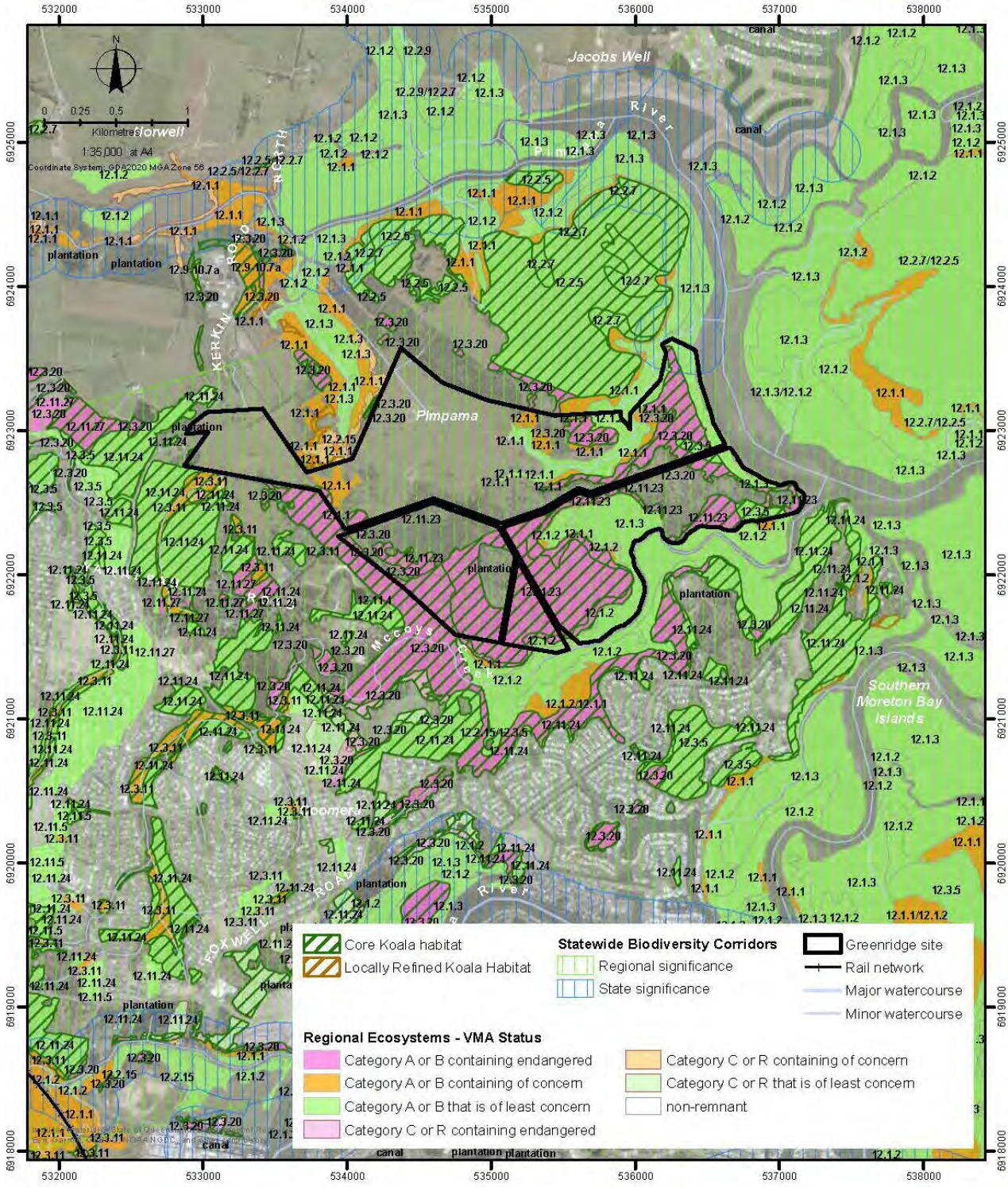
Figure 6: Greenridge – RE and Koala habitat mapping and biodiversity corridors



Data sources:
MSES - wildlife habitat - koala habitat areas - core and
MSES - wildlife habitat - koala habitat area - locally refined, Published 08/09/2021
Queensland Statewide Corridor Buffers - v1.6, Published 10/09/2020
Vegetation management regional ecosystem map - v12.00, Published 04/05/2022
Vegetation management watercourse and drainage feature map (1:25000) – South East Queensland v5.0, Published 08/09/2021
Baseline roads and tracks - Queensland, Published 31/03/2022
State of Queensland (Department of Resources) 2022

Drawn By: KM Reviewed by: PJ Date: 5/08/2022

Figure:	6.4
Title:	Greenridge Current RE and Koala Habitat Mapping
Project:	Coomera Connector Stage 1 Offset Strategy – EPBC 2020/8646
Client:	Queensland Department of Transport and Main Roads

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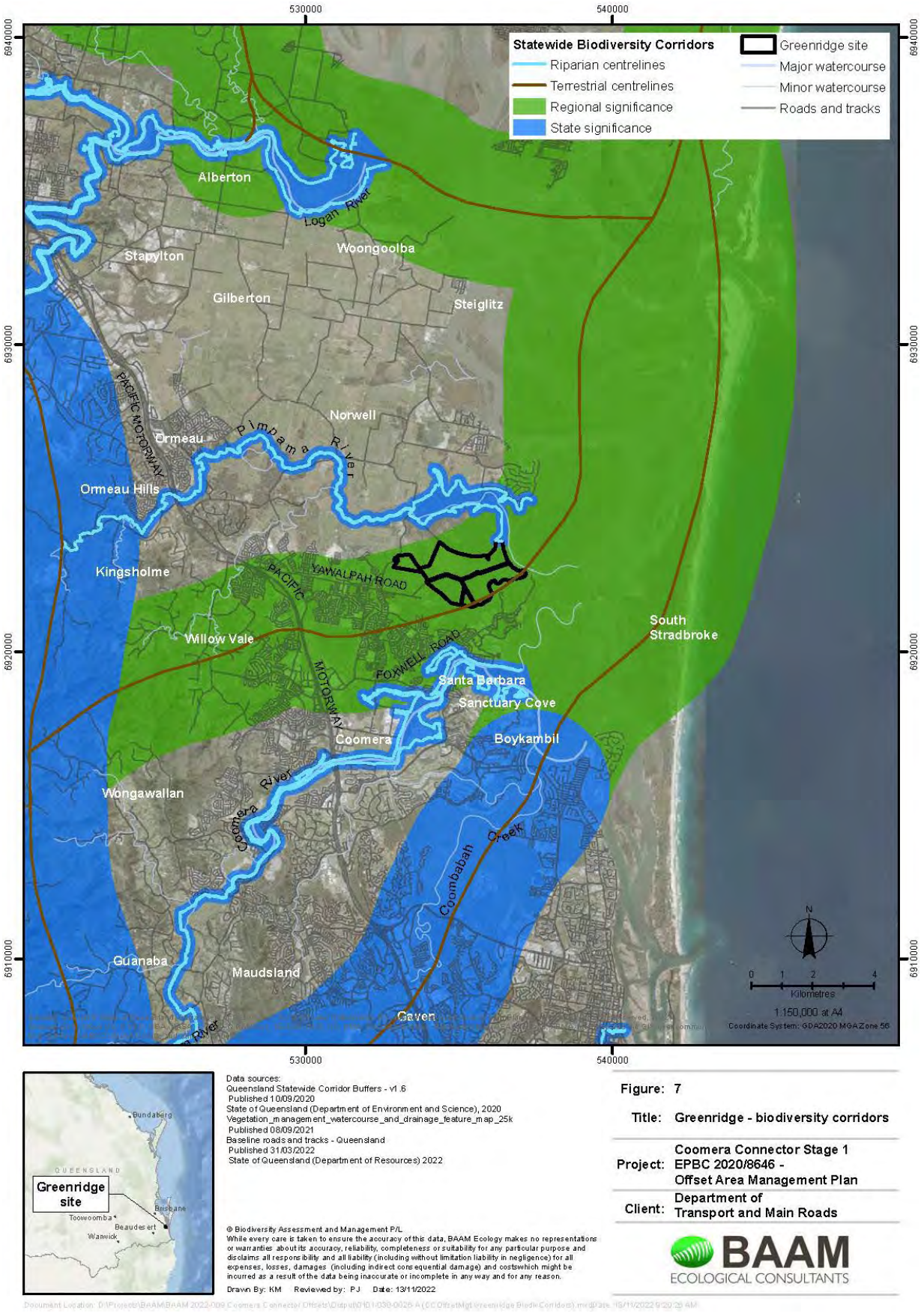
Figure 7: Greenridge – biodiversity corridors



Data sources:
Queensland Statewide Corridor Buffers - v1.6
Published 10/09/2020
State of Queensland (Department of Environment and Science), 2020
Vegetation_management_watercourse_and_drainage_feature_map_25k
Published 08/09/2021
Baseline roads and tracks - Queensland
Published 31/03/2022
State of Queensland (Department of Resources) 2022

Drawn By: KM Reviewed by: PJ Date: 13/11/2022

Figure:	7
Title:	Greenridge - biodiversity corridors
Project:	Coomera Connector Stage 1 EPBC 2020/8646 - Offset Area Management Plan
Client:	Department of Transport and Main Roads

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3.3 Coastal swamp oak TEC – offset requirements and attributes

3.3.1 Coastal swamp oak TEC – habitat requirements

In Queensland, the Coastal Swamp Oak TEC coincides with 2 REs:

- RE 12.1.1 (*Casuarina glauca* woodland on margins of marine clay plains).
- Areas within RE 12.3.20 (*Melaleuca quinquenervia*, *Casuarina glauca* +/- *Eucalyptus tereticornis*, *E. siderophloia* open forest on low coastal alluvial plains) where the canopy is dominated by *Casuarina glauca*.

The TEC occurs in coastal catchments at elevations up to 50m above sea level (**ASL**), typically less than 20m ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks. It occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils where shallow unconsolidated sediments border lithic substrates.

For an offset for the coastal swamp oak TEC to be successful, there are a number of habitat features and requirements to consider.[9] These considerations include:

- Patch size – larger areas are more resilient to edge effect disturbance such as weed invasion and the impacts of human activities
- Proximity to other remnant vegetation – areas of mosaic native vegetation provide a wider range of habitats that benefit diversity of flora and fauna
- Whether the patch is at the natural edge of its range, where there may be a reduction or absence of some threats, or may contain flora and fauna that have largely declined across the broader ecological community
- Whether the patch contains, or is capable of developing, good faunal habitat indicated by containing diversity of landscape, diversity of plant species and vegetation structure, diversity of age class, presence of movement corridors, mature trees (particularly those with hollows), logs, watercourses, etc.
- The presence of nationally or state-listed threatened species, and species richness
- Whether the patch contains relatively low levels of weeds and feral animals, or where these can be managed efficiently.

Threats to the coastal swamp oak TEC are detailed in *Table 5* in *Section 2.2* of this document. In summary, the principal threats to the TEC are:

- Clearing and fragmentation
- Weeds
- Invasive fauna
- Agricultural activities, in particular, grazing
- Inappropriate fire regimes.

[9] Coastal Swamp Oak Forest NSW and SEQ_ Approved Conservation Advice. Available at https://www.environment.gov.au/biodiversity/threatened/communities/pubs/141-conservation-advice.pdf

The management actions for the coastal swamp oak TEC offset area have been developed to specifically deal with these threats and are detailed in *Section 5*.

3.3.2 Field survey methodology for coastal swamp TEC offset areas

To assess the suitability of Greenridge for coastal swamp oak TEC offsets, habitat assessment was undertaken by BAAM Ecological Consultants in 2022. The assessment was undertaken by applying the methods of the *Guide to Determining Terrestrial Habitat Quality – Version 1.3* (Queensland Government 2020) in line with the habitat assessments undertaken at the Coomera Connector Stage 1 impact area for coastal swamp oak TEC (Planit, 2022, see *Appendix E*).

Greenridge was mapped into like Assessment Units (**AU**s), differentiated based on RE type and vegetation condition (remnant, advanced regrowth, young regrowth or cleared). Ground-truthing of a number of polygons of the RE types supporting *Casuarina glauca* was undertaken through applying the quaternary survey method of Neldner et al. (2017). Field observations and the use of historical aerial photography contributed to delineation of the regrowth vegetation.

Additional data were collected during field surveys to inform habitat quality scoring parameters for MNES not captured using the standard BioCondition method. These included the levels of *Casuarina glauca* canopy cover. This was also recorded to assist in identifying patches of coastal swamp oak that would qualify as the TEC.

3.3.3 Field survey results for coastal swamp TEC offset areas

The survey results describe each AU, as listed below:

- **AU1 REMNANT RE 12.1.1:** 14.2 ha. Remnant *Casuarina glauca* open forest. Wholly analogous with the coastal swamp oak TEC.
- **AU2 REGROWTH RE 12.1.1:** 5.16 ha. Regrowth *Casuarina glauca* open forest.
- **AU3 NON-REMNANT RE 12.1.1:** 22.03 ha. Non-remnant *Casuarina glauca* open forest (presently grassland).
- **AU4 REMNANT RE 12.3.20:** 28.22 ha. Remnant *Casuarina glauca*, *Eucalyptus tereticornis* and *Melaleuca quinquenervia* open forest. Where dominated by *Casuarina glauca* the community is analogous with the Coastal Swamp Oak TEC.
- **AU5 REGROWTH RE 12.3.20:** 4.74 ha. Regrowth *Casuarina glauca, Eucalyptus tereticornis* and *Melaleuca quinquenervia* open forest.
- **AU6 NON-REMNANT RE1 2.3.20:** 12.48 ha. Non-remnant *Casuarina glauca, Eucalyptus tereticornis* and *Melaleuca quinquenervia* open forest (presently grassland).

Five occurrences of remnant RE 12.3.20 (AU4) at Greenridge are proposed as part of the offset for this MNES (see *Table 6*). Field assessment has determined that each of these areas represents differing proportions of TEC (ranging from 50 to 100%). The represented proportions have been applied to the total nominated area of remnant RE 12.3.20 (28.22ha), reducing the total area available for the offset within the nominated remnant RE 12.3.20 patches to 22.78ha.

Three occurrences of regrowth RE 12.3.20 (AU5) at Greenridge are proposed to offset the TEC, and all have been ground-truthed. Two were assessed as 100% representative of the TEC and one was 10% representative of the TEC. The represented proportions have been applied to the total nominated area of regrowth 12.3.20 (4.74ha), maintaining the total area available for the offset within the nominated regrowth RE 12.3.20 patches at 4.74ha.

For the non-remnant areas of RE 12.3.20 proposed for offsetting the TEC, all have been ground-truthed at 90-100% TEC. These proportions have been applied to the total area of non-remnant RE 12.3.20, reducing the total area to be considered to provide the TEC offset to 12.48ha.

Table 6: Coastal swamp oak TEC at the offset site

Property	RE	Assessment unit	Type of vegetation	Area of offset (ha)
Greenridge	12.1.1	AU1	Remnant	14.20
	12.1.1	AU2	Regrowth	5.16
	12.1.1	AU3	Non-remnant (cleared)	22.03
	12.3.20	AU4	Remnant	28.22
	12.3.20	AU5	Regrowth	4.74
	12.3.20	AU6	Non-remnant	12.48
			Total:	**86.83**

The quality scores for each of these AUs is shown in *Table 16*.

The full set of raw BioCondition survey data for Greenridge is provided in *Appendix I*. The HQS tables for each AU within the coastal swamp oak TEC offset areas are provided in *Appendix J*.

3.3.4 Ecological benefits of the proposed coastal swamp oak TEC offsets

At Greenridge the most significant impacts on ecosystem health are the result of feral pig damage and weed invasion, along with maintenance of cleared and weed-infested paddocks adjacent to remnant and regrowth vegetation. The current level of feral pig activity would not be managed without the offset, which will be detrimental to the survival of canopy species within the coastal swamp oak TEC – as well as suppressing shrub regrowth and ground species cover.

Removal and ongoing control of feral pigs at Greenridge will allow recovery of the ground surface within the TEC, contributing to the health and growth of existing trees that have been subject to significant root disturbance through pig digging, and allow ground cover, shrub layer and natural Ecologically Dominant Layer (EDL) recruitment to occur unhindered. The nominated non-remnant (cleared) patches of RE 12.1.1 at Greenridge will be planted with *Casuarina glauca*, which has a moderate-high growth rate. The species is commonly used overseas to stabilise soil and create windbreaks. A study by Goel and Behl (2005) recorded average height of plants in an 8-yr-old trial of *Casuarina glauca* of 1033.3 ± 270cm, which is 83% of the benchmark height for RE 12.1.1.

Given the planting at Greenridge will be in ideal conditions for the species, growth rates are likely to be considerably higher as evidenced by the success of replanting *Casuarina glauca* in the adjacent Pimpama River Conservation Area. The revegetation plan is provided at *Appendix C*.

Management of Greenridge for agricultural uses has introduced a range of non-native species, also present in the surrounding landscape, which will continue to infiltrate natural areas, impacting a range of habitat quality measures without management under the offset. Without fire management to benefit ecosystems, fire exclusion may affect the health of coastal swamp oak communities which need disturbance to maintain structure whereas the risk of severe wildfire increases as litter builds. Non-remnant areas will be rehabilitated to reflect the pre-clear REs and are predicted to reach benchmark RE status and TEC status for coastal swamp oak in 20 years under appropriate planning and management.

The proximity of the offset areas to nearby areas of remnant vegetation (including the Pimpama Conservation Park and the Pimpama River Conservation Area) is of benefit to the likelihood of success of the offset. The offset property itself will form a large part of a buffer area between the highly developed residential areas to the south and these conservation areas. This is further enhanced by the large size of the offset property itself, which in total is approximately the same area as the Pimpama River Conservation Area. Additionally, access restrictions that will apply to the property, along with the comprehensive proposed management actions to control weeds and feral animals will enable the offset to meet the habitat requirements.

The offset area is shown in *Figure 8*.

3.3.5 OAG inputs for coastal swamp oak TEC

Inputs for DCCEEW's Offset Assessment Guide (**OAG**) were derived from the survey results described above.

The risk of loss was derived from Appendix One of the document titled *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act.*[10]

The Offsets Assessment Guide requires an estimation of the projected improvements in habitat quality that can be achieved over 20 years through management, along with an indication of the level of confidence in these projections. The time to ecological benefit is set at 10 years for remnant and advanced regrowth communities and 20 years for other regrowth and non-remnant communities, with 85% confidence that the goals for offset area habitat quality will be achieved. Periods of 10 years for remnant and 20 years for regrowth and non-remnant communities are required to realise the results of management actions that will improve habitat quality – of these actions, removal of invasive weeds and implementation of controlled burning to prevent damaging wildfire, encourage EDL recruitment and improve ground cover quality are predicted to raise the quality of the remnant and advanced regrowth ecosystems close to benchmark levels.

At present, the quality of habitats at the Greenridge property are impacted by weeds. Of the 36 introduced plants recorded from within the habitat quality survey plots at the Greenridge property), 2 are weeds of national significance (*Lantana camara* and *Asparagus aethiopicus*) and 19 were identified by Batianoff and Butler (2002) as among the 200 most invasive naturalised plants in South East Queensland, selected from 1060 naturalised taxa.[11] Within the survey plots at Greenridge there was an average of 29.25% non-native cover.

Nationally exotic species account for about 15% of flora (Department of Agriculture, Fisheries and Forestry, 2024). Weeds are known to compete with native species for space, light, water and nutrients, and also suppress and out-compete mid-storey and canopy trees (Department of the Environment, 2011), affecting the structure and function of land-based and aquatic ecosystems, and impacting negatively on native fauna and flora. Nineteen of 20 studies on weed impact in Australia reviewed by Adair and Groves (1998) demonstrated a decline in either species richness, canopy cover or frequency of native species. One of the reviewed studies (Hester & Hobbs. 1992) found weed presence reduced percent cover of natives and reduced seed production in shrublands and woodlands, with removal of weeds resulting in a 3-fold increase in native cover.

[10] Centre of Biodiversity and Conservation Science, School of Earth and Environmental Science, The University of Queensland, Brisbane. (2017) https://www.nespthreatenedspecies.edu.au/media/zpyajjq1/5-1-guidance-for-deriving-risk-of-loss-report_2017_low-res.pdf

[11] Jones, P, pers. comms, (2024)

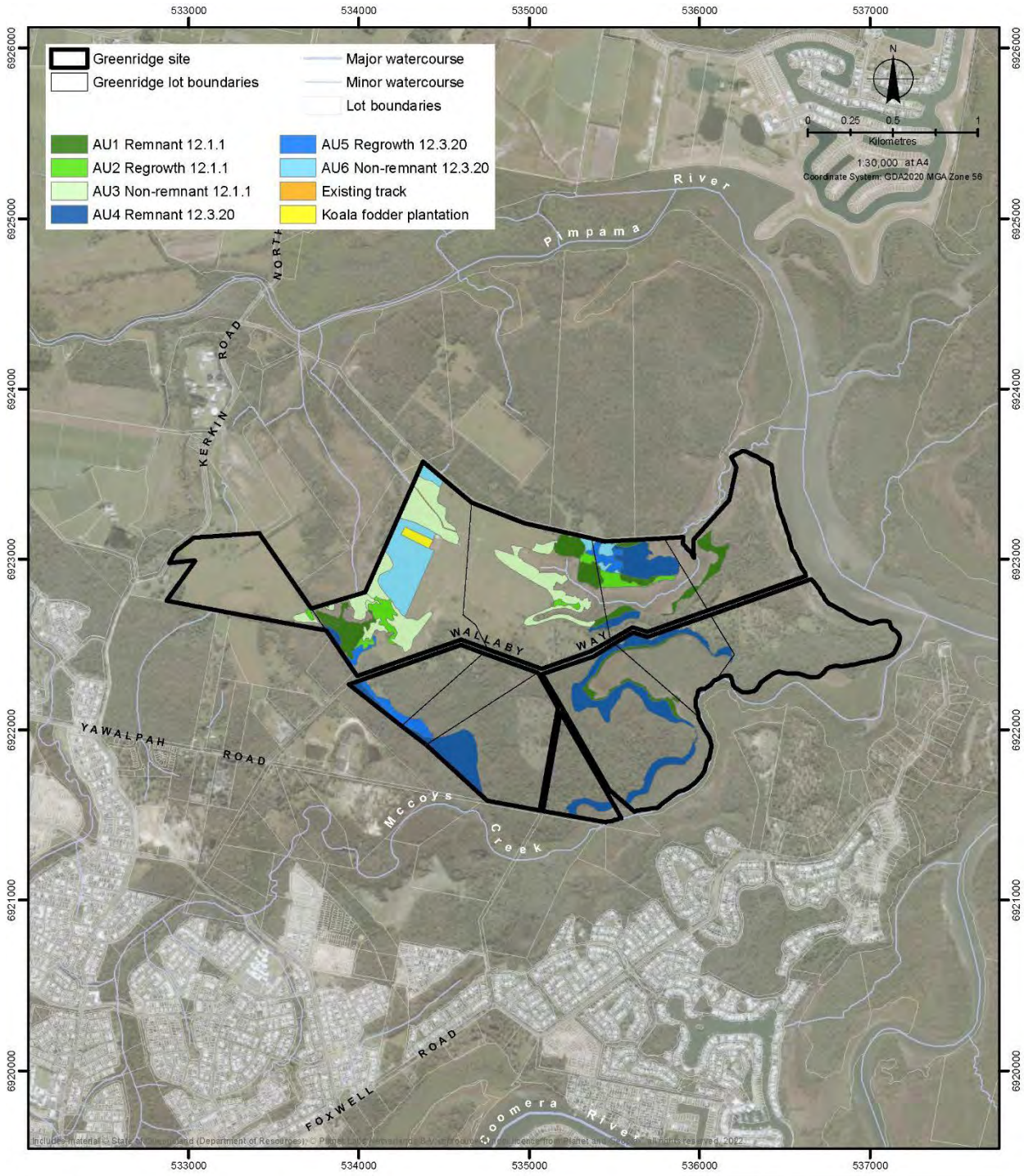
Weeds can also increase the biomass of ecosystems leading to more intense bushfires, changing the composition and structure of native vegetation (Invasive Plants and Animal Committee, 2016).

Greenridge is subject to invasion by exotic grasses. At Greenridge, South African pigeon grass (*Setaria sphacelata*) is a dominant species of open spaces. The species is regarded as an environmental weed in Queensland, New South Wales and Western Australia. It can form dense stands preventing natural plant regeneration and can transform infested areas into open badlands, with potential to invade wetland areas, reducing access for endangered birds (Brisbane City Council, 2024).

Control and removal of lantana and invasive introduced grasses will result in long term positive ecosystem change – by increasing species richness, abundance and recruitment (for lantana, see Gooden et al.,2009) and significantly reducing the risk of intense wildfire. Under these conditions there is high (85%) confidence that the quality of existing ecosystems will be raised to benchmark levels. An additional benefit of the intended weed management is the reestablishment of habitat connectivity for flora and fauna that are impeded by invasive species (Godfree et al. 2017).

The OAG outputs are provided in *Appendix M*.

Figure 8: Coastal Swamp Oak TEC offset area - Greenridge



Data sources:
Cadastral data - Queensland - by area of interest, Published 30/05/2022
Vegetation management watercourse and drainage feature map (1:25000) – South East Queensland v5.0, Published 08/09/2021
Baseline roads and tracks - Queensland, Published 31/03/2022
State of Queensland (Department of Resources)

Figure:	**10.1**
Title:	**Greenridge offsets for Coastal Swamp Oak TEC**
Project:	**Coomera Connector Stage 1 Offset Strategy – EPBC 2020/8646**
Client:	**Queensland Department of Transport and Main Roads**

Drawn By: KM **Reviewed by: PJ** **Date: 6/02/2024**

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Document Location: D:\Projects\BAAM\BAAM 2022-009 Coomera Connector Offsets\Output\0101-030-0021-H (CCOffset Greenridge_Casuarina glauca Offset).mxdDate: 6/02/2024 4:10:28 PM

3.4 Koala habitat – offset requirements and attributes

3.4.1 Koala habitat requirements

Koalas are tree-dwelling, obligate folivores (leaf eaters) with a highly specialised diet. The koala's diet is defined by the availability and palatability of a limited variety of *Eucalyptus*, *Corymbia* and *Angophora* species. Koalas are nocturnal and spend significant periods of time moving across the ground between food and shelter trees. Movement increases in the breeding season (typically September to February) (Melzer & Tucker 2011). Koalas are reported to utilise more than 400 different species of tree for their food and habitat requirements with different tree species varying by habitat type and location across their range. The natural range of the koala is determined by specialist food, habitat and environmental requirements. Typically, this includes forests and woodlands dominated by *Eucalyptus* species (Melzer et al. 2000). The koala's home range (the area an individual needs to survive) is highly variable and dependant on life history stage, soil fertility, habitat quality and nutritional requirements.

Biophysical habitat attributes for the koala include places that contain the resources necessary for individual foraging, survival (including predator avoidance), growth, reproduction and movement. The total amount of resources (including habitat attributes) and how they are arranged in the landscape influence the viability of metapopulations and processes.

Threats to the koala are detailed in *Table 5* in *Section 2.2* of this document. In summary, the principal threats to the species are:

- Climate change driven processes, including loss of climatically suitable habitat, and increased frequency and intensity of heatwaves and droughts
- Human related activities such as clearing and fragmentation of habitat, and mortality associated with vehicles and dogs
- Disease, in particular, koala retrovirus.

The management actions for the koala offset areas have been developed to promote the desired habitat attributes described above, and specifically deal with the threats to the species. These management actions are detailed in *Section 5*.

3.4.2 Field survey methodology for koala offset areas

Tabooba – flora surveys

To assess the suitability of Tabooba for koala offsets, habitat assessment and BioCondition surveys were undertaken in May 2022 to compare with the habitat quality identified in the proposed action corridor. This applied the methods of the *Guide to Determining Terrestrial Habitat Quality – Version 1.3* (Queensland Government 2020) in line with the habitat assessments undertaken in the proposed action corridor for koala (Planit 2022; see Appendix F), as well as per *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland* (Eyre et al., 2015); and *Method for the establishment and survey of reference sites for BioCondition, Version 2.0* (Eyre, et al. 2011) using the most recent Queensland Herbarium Biocondition Benchmarks.

The site vegetation mapping was ground-truthed, compared to satellite imagery and then adjusted accordingly. Due to the different ages of regrowth on the property, regrowth vegetation was divided into the following categories:

- Advanced regrowth: areas supporting a continuous canopy in aerial imagery that was indistinguishable from areas mapped as remnant; and

- Young regrowth: areas supporting a broken canopy with scattered taller trees, but generally dominated by scattered smaller trees as evident in satellite imagery.

This information was also used to determine the number of transects in each AU (which is the vegetation type and condition) to fulfill the recommendations provided in the BioCondition Framework.

Tabooba – fauna surveys

Koala were surveyed at Tabooba in both March and May 2022 by Spot Assessment Technique (SAT; as per Phillips and Callaghan, 2011) to determine localised levels of habitat use by koala, and thermal-imaging drone surveys to gather baseline koala density data in areas that were difficult and/or impossible to survey by foot.

Koala SAT surveys, including searching for individuals in trees and scats within 1m of the base of suitable forage trees, were undertaken in accessible locations on the property on 17 March 2022 and 6-7 May 2022. The nine SAT surveys encompassed 279 koala food trees of *Angophora leiocarpa, Eucalyptus crebra, E. tereticornis, E. melliodora, Lophostemon confertus, Corymbia intermedia* and *C. tessellaris*. These surveys were undertaken predominantly within advanced and young regrowth vegetation, as remnant vegetation on the steeper slopes was relatively inaccessible due to very wet conditions and with dense lantana and/or too steep to survey safely. There was only one site where a SAT survey could be undertaken in riparian vegetation as the channel was relatively shallow and erosion had reduced the amount of weed cover.

Thermal koala surveys utilising a drone over Tabooba were undertaken in March 2022 and May 2022. The area was divided into discrete search polygons and each area was systematically searched using a thermal camera. In the March survey, the drone covered an area of approximately 200 ha and detected 2 koalas. The area droned was limited by the need to keep line of sight of the drone and more importantly, the inability to access areas due to the very wet conditions. In the May survey, the drone was able to be operated from further inside the property, reaching higher into the range and covering an area of approximately 107 ha of habitat.

Greenridge – flora surveys

Utilising the same approach as had been used at Tabooba, the site vegetation mapping for Greenridge was ground-truthed, compared to satellite imagery and then adjusted accordingly. Greenridge was then mapped into like AUs, differentiated based on RE type; and vegetation condition (remnant, advanced regrowth, young regrowth or cleared). Standard BioCondition surveys record canopy cover by measuring the vertical projection of canopy intercepting a 100m transect line (Eyre et al. 2015). To capture the proportion of the canopy comprised of koala food trees, these species were distinguished separately from other canopy species when recording canopy cover over the 100m transect. Distances of the koala tree canopies over the 100m transect were summed and then calculated as a proportion of the total canopy cover (koala tree cover plus non-koala tree cover, less any overlaps).

Greenridge – fauna surveys

SAT surveys and strip transects in general accordance with Dique et al. (2003) were undertaken to measure localised levels of habitat use by koalas to gather baseline koala density data. Seven SAT surveys and 8 strip transect surveys were carried out on Greenridge on 30 June, 1 July, 27 July and 3 August 2022. The results of two of each survey type, undertaken on 27 July and 3 August, are reported as these were the only sites relevant to a proposed koala offset AU4 (remnant RE 12.3.20).

Thermal-imaging drone surveys of the Pimpama River Conservation Area and Greenridge were conducted by EVE over 13 nights from 2 December 2021 to 10 February 2022, with 6 of those nights focused on Greenridge. All areas of koala habitat were surveyed, except for 2 small areas on Greenridge (approximately 9.5 ha in total) where site terrain made it difficult to maintain visual line of sight of the drone (a Civil Aviation Safety Authority requirement). The area was divided into 6 discrete search polygons and each area was systematically searched in an 'up-and-back' lawn-mower pattern, using a dual optical and thermal camera. Thermal heat signatures suggestive of koalas were investigated to positively identify the origin of the heat source.

3.4.3 Field survey results for koala offset areas

Tabooba

The field flora surveys resulted in AUs described as:

- **AU1 REMNANT RE 12.8.16:** 49.84 ha. Remnant *Eucalyptus crebra*, *E tereticornis* +/- *Angophora subvelutina* open forest.
- **AU2 ADVANCED REGROWTH RE 12.8.16:** 145.02ha. Advanced regrowth of open forest dominated by E*ucalyptus tereticornis* subsp. *basaltica*, *E. crebra* +/- *Corymbia tessellaris*, *C. intermedia*. Occasional relictual trees present.
- **AU3 YOUNG REGROWTH RE 12.8.16:** 48.10 ha. Young regrowth open forest with occasional emergent relictual trees. Dominant species include *Eucalyptus crebra*, *E. tereticornis* and *C. tessellaris*.
- **AU4 REMNANT RE 12.8.14:** 50.62 ha. Remnant open forest dominated by *Eucalyptus melliodora, Eucalyptus tereticornis* subsp. *basaltica*, *E. eugeniodes*, *Angophora subvelutina* and *C. intermedia*.
- **AU5 ADVANCED REGROWTH RE 12.8.14:** 19.81 ha. Advanced regrowth of *Eucalyptus eugeniodes, E. tereticornis* subsp *basaltica*, *Eucalyptus melanophloia* open forest.

These AUs, together with the koala offset AUs from Greenridge, are summarised in *Table 7* in *Section 3.4.4*.

Koala SAT survey results indicated that the surveyed habitat is categorised as 'low-use', with <22.52% scat evidence. However, the results are likely to be a significant underestimation of the koala activity level on the property, due to the challenges with applying this survey method in such steep and complex terrain. Phillips and Callaghan (2011) suggest that low koala activity is expected in the west of the species' East Coast range in areas receiving less than 600 mm annual rainfall. The local area receives over 900 mm annual rainfall and should therefore fall into the Phillips and Callaghan (2011) category of East Coast medium-high Koala activity.

The thermal imaging koala surveys via drone resulted in 2 individuals being detected in the March survey. One individual was recorded just outside of the property boundary in the north-west within mapped remnant RE 12.8.16, and the other in the north-western quarter of the property within AU2 (RE 12.8.16 advanced regrowth). Allowing for a detection probability of 90%, EVE (2022a) estimated the property probably supports four or five koalas (a density of 0.01-0.013 koalas/ha).

For the May survey, the drone was able to be operated from further inside the property, reaching higher into the range and covering an area of approximately 107 ha of habitat. Eight koalas were detected, mostly on the mid-upper slopes of the range in the following AUs:

- 2 koalas in AU1 RE12.8.16 remnant
- 2 koalas in AU2 RE12.8.16 advanced regrowth
- 3 koalas in AU4 RE12.8.14 remnant

- one koala in AU5 RE12.8.14 advanced regrowth.

Allowing for a detection probability of 90%, EVE (2022b) calculated a population density of 0.08 koalas/ha based on the May survey event. EVE (2022b) noted that the presence of such an abundance of koalas on the mid-upper slopes of the ridge was somewhat unexpected given that more nutrient-rich geology undoubtedly occurs on the lower slopes and flats. However, the lower slopes and flats are largely cleared and are managed for beef cattle production.

The full set of raw BioCondition survey data for Tabooba is provided in *Appendix H*. The HQS tables for each AU within the koala offset areas are provided in *Appendix K*.

Greenridge

Existing RE mapping for Greenridge indicates the presence of remnant REs 12.11.23, 12.3.20, and 12.3.5. Core koala habitat is mapped over these REs on Greenridge, which adjoins other areas of core koala habitat external to the Greenridge boundary to the north and south west.

RE 12.11.23 is described as *Eucalyptus pilularis* open forest on coastal metamorphics and interbedded volcanics. Other canopy species include *E. microcorys, Corymbia intermedia, Angophora woodsiana, E. tindaliae* and *E. carnea*. Consideration of the dominant canopy species indicates the RE has high value for koala (DES 2021).

RE 12.3.20 is described as *Melaleuca quinquenervia, Casuarina glauca* +/- *Eucalyptus tereticornis*, *E. siderophloia*, *M. styphelioides* open forest on low coastal alluvial plains. Consideration of the dominant canopy species indicates the RE has medium value for koala (DES 2021).

RE 12.3.5 is described as *Melaleuca quinquenervia* open forest on coastal alluvium. Other tree species that may be present as scattered individuals or clumps include *Lophostemon suaveolens, Eucalyptus robusta, E. tereticornis, E. bancroftii, E. latisinensis, Corymbia intermedia, Melaleuca salicina, Livistona australis, Casuarina glauca*, and *Endiandra sieberi*. Consideration of the dominant canopy species indicates the RE has medium value for koala (DES 2021).

No koala scats were recorded from the 3 SAT surveys undertaken within AU4 and no koalas were recorded from the 3 strip transects undertaken within AU4.

The thermal camera surveys detected the presence of 14 koalas within the remnant, regrowth and non-remnant RE 12.3.20 areas on Greenridge.

The full set of raw BioCondition survey data for Greenridge is provided in *Appendix I*. The HQS tables for each AU within the koala offset areas are provided in *Appendix K*.

3.4.4 Ecological benefits of the proposed koala offsets

Tabooba

Tabooba is well located to provide valuable koala habitat on the ranges, lower slopes and the wetter and more fertile lower slopes and flood zones of the creeks, which are currently cleared and are similarly cleared in the surrounding landscape where beef cattle production dominates land use. Riparian habitats provide important refuge for koalas during times of drought (Reed and Lunney 1990), facilitate local movement (Davies et al. 2013), and are important for long distance dispersal (McAlpine et al. 2006a and b; Norman et al. 2019), with koala persistence within riparian areas supported by the presence of intact non-riparian habitat (Smith et al. 2013).

Restoring and maintaining koala habitat connectivity between the riparian and ridgeline habitats of Tabooba would have significant benefits by enabling koalas to safely inhabit and move between the range of altitudinal habitats for feeding and breeding purposes and to seek refuge during periods of climatic extremes.

The Scenic Rim Regional Council Biodiversity Strategy 2015-2025 shows the location of Tabooba in relation to existing habitats and landscape linkages. Tabooba lies within an area mapped as a 'core node', taking in much of the vegetation of the Jinbroken Range and connecting to the south with core habitat termed by Scenic Rim Regional Council as the 'Lamington Core'.

The remnant REs 12.8.16 and 12.8.14 are located on the high ridges and slopes within and adjacent to Tabooba. RE 12.8.16 is regarded as high value for koala (DES 2021) and RE 12.8.14 is regarded as medium value for koala (DES 2021). Tabooba is bordered to the east and south by habitat mapped by the Queensland Government as core koala habitat over the REs mapped as 12.8.16/12.8.14/12.8.4/12.8.3. REs 12.8.4 and 12.8.3 are both notophyll vine forest REs and these habitats are not considered to represent important koala habitat.

Greenridge

The ecological values of portions of Greenridge are recognised in the Gold Coast City Plan, where the eastern half of Greenridge is zoned for conservation values and forms part of a broader conservation node. The eventual inclusion of an additional 150 ha of currently 'Rural' zoned land on Greenridge into this conservation node in the form of offsets for koalas and other matters would increase available habitat for koalas. For the entire site, including those locations currently supporting remnant and regrowth vegetation, management as offset habitat would implement long-term measures to reduce threats to koalas, such as controlling European foxes and wild dogs and managing lantana where it is a barrier to koala movement and a risk for uncontrolled bushfire.

Movement of koalas between Greenridge and the adjacent state-mapped core koala habitat in the 355 ha Pimpama River Conservation Area (**PRCA**) to the north is known anecdotally from previous camera trap surveys. A tributary of the Pimpama River which separates vegetated eastern and central portions of Greenridge from the PRCA, confines koala movement between these areas to the terrestrial habitats in the western portion of Greenridge. At present, the cleared paddocks in the western portion are mostly treeless and support long pasture grasses and dense *Setaria sphacelate*, which may discourage koala movement though these areas and expose koalas to high risk of predation. The western boundary of Greenridge is adjacent to the 14 ha Pimpama Conservation Park, the 5ha Wallaby Way Reserve, partly treed land zoned for rural uses and a local government sewerage treatment facility, which are ultimately connected to the PRCA and likely form the predominant passage between Greenridge and the PRCA for koalas.

Future restoration of koala habitat in cleared portions of Greenridge would significantly improve connectivity between exiting remnant habitat and the PRCA.

The AUs comprising the offset areas for koala on Tabooba and Greenridge are shown in *Table 7*, and the offset areas at the 2 properties are shown in *Figure 9* and *Figure 10*.

Table 7: Koala habitat at the offset sites

Property	RE	Assessment unit	Type of vegetation	Area of offset (ha)
Tabooba	12.8.16	AU1	Remnant	49.84
		AU2	Advanced regrowth	145.02
		AU3	Young regrowth	48.10
	12.8.14	AU4	Remnant	50.62
		AU5	Advanced regrowth	19.80
Greenridge	12.3.20	AU4	Remnant	28.22
		AU5	Regrowth	4.74
		AU6	Non-remnant	12.48
			Total:	**358.82**

3.4.5 OAG inputs for koala offsets

Inputs for DCCEEW's OAG were derived from the survey results described above.

The risk of loss was derived from Appendix One of the document titled *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act.*[12]

The Offsets Assessment Guide requires an estimation of the projected improvements in habitat quality that can be achieved over 20 years through management, along with an indication of the level of confidence in these projections. The time to ecological benefit is set at 10 years for remnant and advanced regrowth communities and 20 years for other regrowth and non-remnant communities, with 85% confidence that the goals for offset area habitat quality will be achieved. Periods of 10 years for remnant and 20 years for regrowth and non-remnant communities are required to realise the results of management actions that will improve habitat quality – of these actions, removal of invasive weeds and implementation of controlled burning to prevent damaging wildfire, encourage EDL recruitment and improve ground cover quality are predicted to raise the quality of the remnant and advanced regrowth ecosystems close to benchmark levels.

At present, the quality of habitats at the Greenridge and Tabooba properties are impacted by weeds. Of the 36 introduced plants recorded from within the habitat quality survey plots at the Greenridge property, 2 are weeds of national significance (*Lantana camara* and *Asparagus aethiopicus*) and 19 were identified by Batianoff and Butler (2002) as among the 200 most invasive naturalised plants in South East Queensland, selected from 1060 naturalised taxa. Within the survey plots at Greenridge there was an average of 29.25% non-native cover. Of the 43 introduced plants recorded from within the habitat quality survey plots at the Tabooba property, one is a weed of national significance (*Lantana camara*) and 17 were identified by Batianoff and Butler (2002) as among the 200 most invasive naturalised plants in South East Queensland. Within the survey plots at Tabooba there was an average of 20.5% non-native cover.

Nationally exotic species account for about 15% of flora (Department of Agriculture, Fisheries and Forestry, 2024). Weeds are known to compete with native species for space, light, water and

[12] Centre of Biodiversity and Conservation Science, School of Earth and Environmental Science, The University of Queensland, Brisbane. (2017) https://www.nespthreatenedspecies.edu.au/media/zpyajjq1/5-1-guidance-for-deriving-risk-of-loss-report_2017_low-res.pdf

nutrients, and also suppress and out-compete mid-storey and canopy trees (Department of the Environment, 2011), affecting the structure and function of land-based and aquatic ecosystems, and impacting negatively on native fauna and flora. Nineteen of 20 studies on weed impact in Australia reviewed by Adair and Groves (1998) demonstrated a decline in either species richness, canopy cover or frequency of native species. One of the reviewed studies (Hester & Hobbs. 1992) found weed presence reduced percent cover of natives and reduced seed production in shrublands and woodlands, with removal of weeds resulting in a 3-fold increase in native cover.

Weeds can also increase the biomass of ecosystems leading to more intense bushfires, changing the composition and structure of native vegetation (Invasive Plants and Animal Committee, 2016).

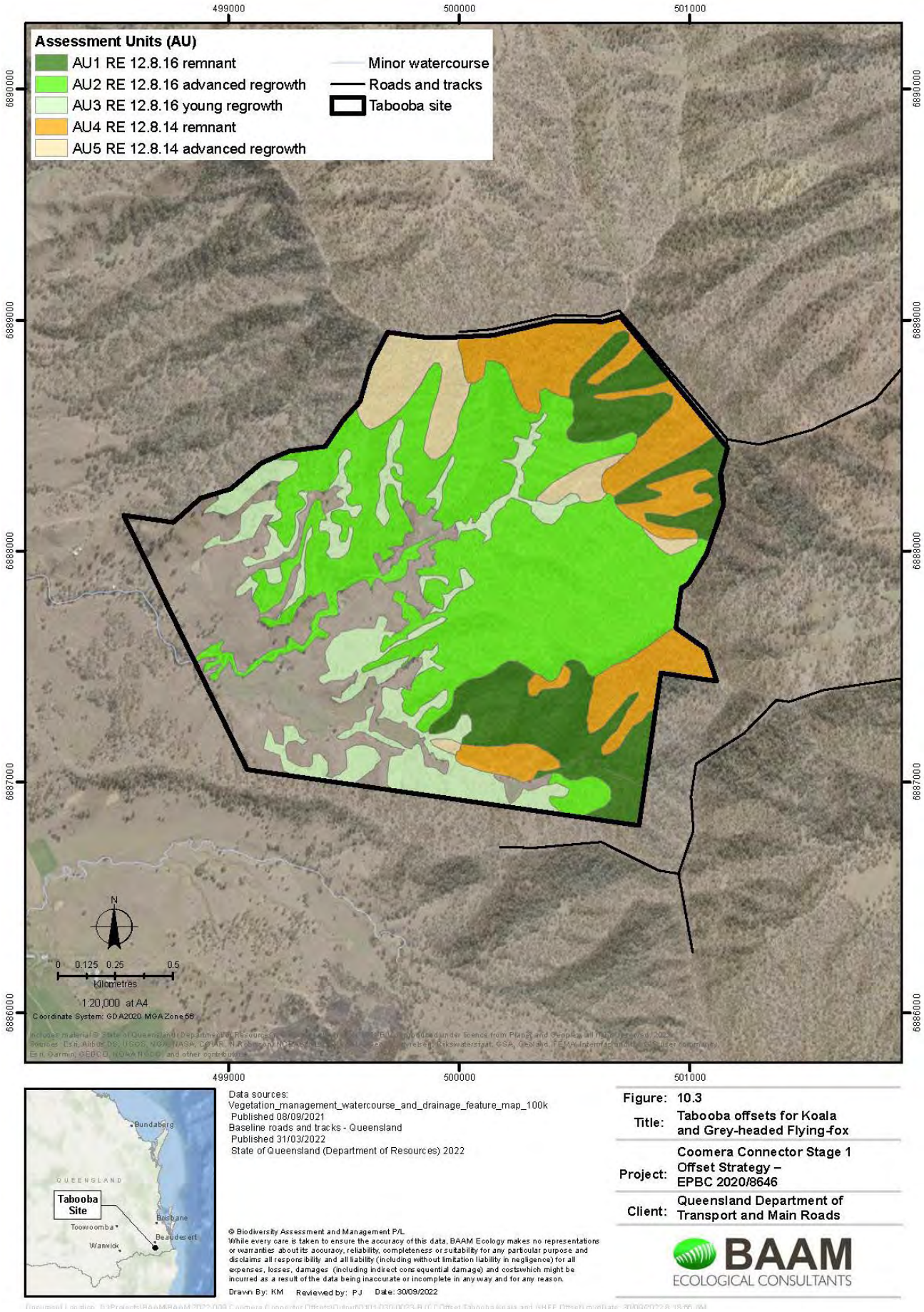
Both properties are subject to invasion by exotic grasses. At Greenridge South African pigeon grass (*Setaria sphacelata*) is a dominant species of open spaces. The species is regarded as an environmental weed in Queensland, New South Wales and Western Australia. It can form dense stands preventing natural plant regeneration and can transform infested areas into open badlands, with potential to invade wetland areas, reducing access for endangered birds (Brisbane City Council, 2024).

Lantana is present on both properties. This is a weed of national significance and was the number one ranked invasive weed in South East Queensland (Batianoff and Butler, 2002). Lantana forms dense thickets that can smother and destroy native vegetation and impede animal movement. Its presence can also create hotter bushfires, altering native vegetation communities (Department of Agriculture and Fisheries, 2023).

Control and removal of lantana and invasive introduced grasses will result in long term positive ecosystem change – by increasing species richness, abundance and recruitment (for lantana, see Gooden et al.,2009) and significantly reducing the risk of intense wildfire. Under these conditions there is high (85%) confidence that the quality of existing ecosystems will be raised to benchmark levels. An additional benefit of the intended weed management is the reestablishment of habitat connectivity for flora and fauna that are impeded by invasive species (Godfree et al. 2017).

The OAG outputs are provided in *Appendix N*.

Figure 9: Tabooba – Koala and grey-headed flying-fox offset area



Data sources:
Vegetation_management_watercourse_and_drainage_feature_map_100k
Published 08/09/2021
Baseline roads and tracks - Queensland
Published 31/03/2022
State of Queensland (Department of Resources) 2022

Drawn By: KM Reviewed by: PJ Date: 30/09/2022

Figure:	10.3
Title:	Tabooba offsets for Koala and Grey-headed Flying-fox
Project:	Coomera Connector Stage 1 Offset Strategy – EPBC 2020/8646
Client:	Queensland Department of Transport and Main Roads

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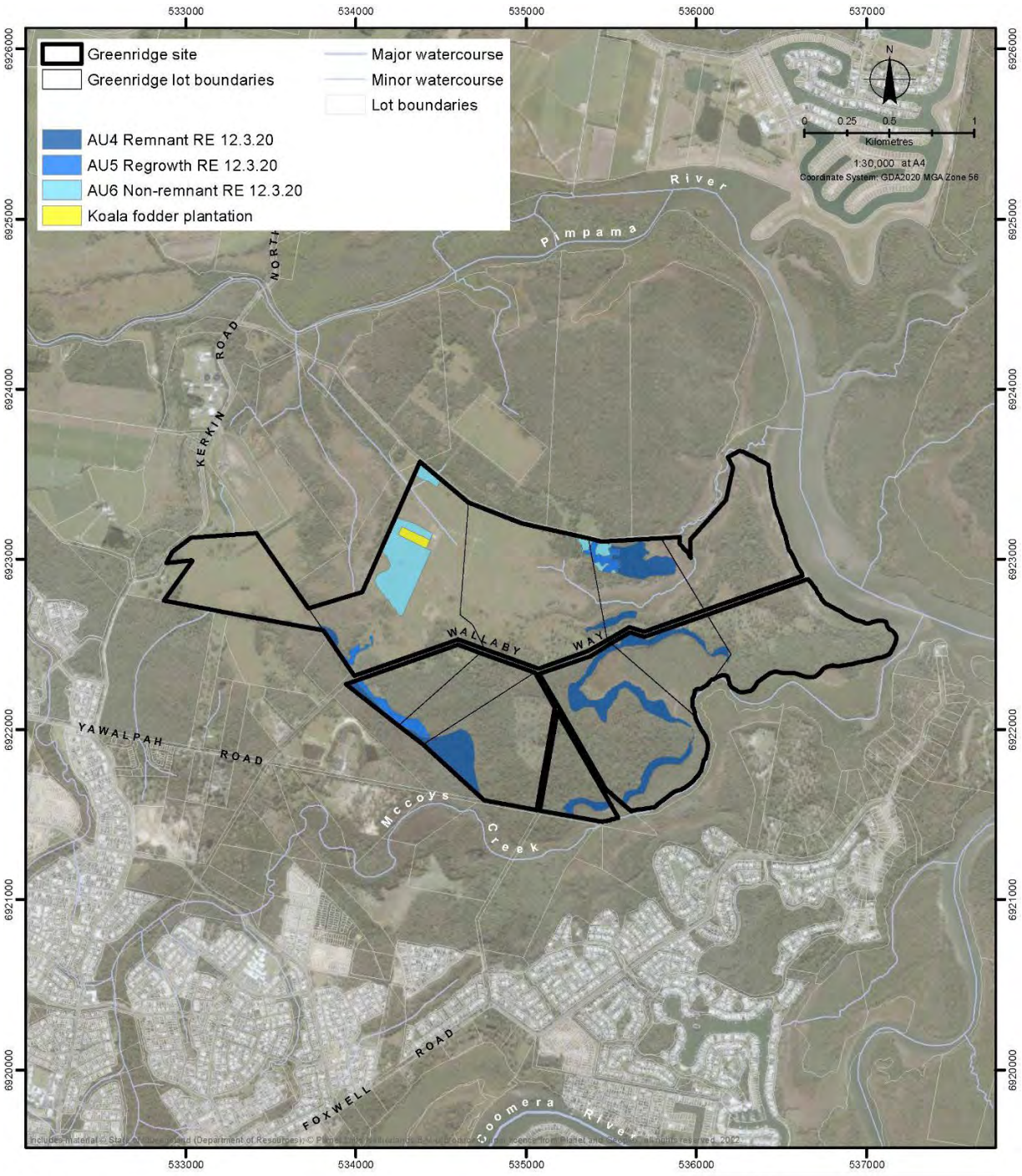
Figure 10: Greenridge – Koala and grey-headed flying-fox offset area



Data sources:
Cadastral data - Queensland - by area of interest, Published 30/05/2022
Vegetation management watercourse and drainage feature map (1:25000) – South East Queensland v5.0, Published 08/09/2021
Baseline roads and tracks - Queensland, Published 31/03/2022
State of Queensland (Department of Resources)

Figure:	**10.2**
Title:	**Greenridge offsets for Koala and Grey-headed Flying-fox**
Project:	**Coomera Connector Stage 1 Offset Strategy – EPBC 2020/8646**
Client:	**Queensland Department of Transport and Main Roads**

Drawn By: KM **Reviewed by: PJ** **Date: 6/02/2024**

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Document location: D:\Projects\BAAM\BAAM 2022-009 Coomera Connector Offsets\Output\0101-030-0022-G (CCOffset Greenridge_Koala and GHFF Offset).mxdDate: 6/02/2024 4:19:42 PM

3.5 Grey-headed flying-fox - offset site requirements and attributes

3.5.1 Grey-headed flying fox habitat requirements

The grey-headed flying-fox has historically occupied forests and woodlands in the coastal lowlands, tablelands and slopes of eastern Australia, from Bundaberg in Queensland to Geelong in Victoria, with some isolated camps and rare sightings outside this range. More recently, camps have established in South Australia, the Australian Capital Territory and inland areas of central and southern New South Wales and Victoria and sightings have increased in Tasmania (*National Recovery Plan for the grey-headed flying fox* Pteropus poliocephalus. DAWE, (2021)) (**GHFF Recovery Plan**).

Flying-foxes are thought to have a maximum natural longevity of 15-20 years. This, combined with slow sexual maturation and a low reproductive rate, is indicative of a species with a low natural mortality rate. Since European settlement, flying-foxes have faced a greatly increased mortality due to habitat loss, persecution and culling. Due to their low reproductive rate, GHFF also have a low population growth rate, even under optimal conditions. This, combined with increased mortality, means the species has limited capacity for recovery from frequent or persistent threats.

The species feeds on over 100 species of flowering trees and fleshy-fruited trees and lianas. In doing so they interact with numerous plant communities and assist seed and pollen dispersal of its food plants that occur within these communities.

Habitat critical to the survival of the grey-headed flying-fox may also be vegetation communities which:

- contain native species that are known to be productive as foraging habitat during the final weeks of gestation, and during the weeks of birth, lactation and conception (August to May)
- contain native species used for foraging and occur within 20 km of a nationally important camp as identified on DCEEW's interactive flying-fox web viewer, or
- contain native and or exotic species used for roosting at the site of a nationally important camp.

Key threats to the species are detailed in *Table 5* in *Section 2.2* of this document. In summary, the principal threats to the species are:

- Habitat loss through land use activities that involve clearing
- Disturbance to camps
- Heat stress, which is expected to increase under climate change
- Entanglement in netting and barbed wire fencing
- Bushfires and inappropriate fire regimes.

The management actions for the GHFF offset areas have been developed to specifically deal with these threats and are detailed in *Section 5*.

3.5.2 Field survey methodology for GHFF offset areas

Tabooba – flora surveys

To assess the suitability of Tabooba for GHFF offsets, habitat assessment and BioCondition surveys were undertaken in May 2022 to compare with the habitat quality identified in the

proposed action corridor. This applied the methods of the *Guide to Determining Terrestrial Habitat Quality – Version 1.3* (Queensland Government 2020) in line with the habitat assessments undertaken in the proposed action corridor for GHFF (Planit 2021b), as well as in line with Eyre et al. (2015); and Eyre, et al. (2011) using the most recent Queensland Herbarium BioCondition benchmarks.

For GHFF, suitable habitat for both properties was considered to be:

- REs with >50% dominant or subdominant vegetation species that are listed in *Ranking the feeding habitats of GHFF for conservation management* (Eby and Law, 2008) as significant flowering or fruiting species; or
- REs with >50% dominant or subdominant vegetation species that are listed in the GHFF Recovery Plan as important winter and spring food trees.

The site vegetation mapping was ground-truthed, compared to satellite imagery and then adjusted accordingly. Due to the different ages of regrowth on the property, regrowth vegetation was divided into the following categories:

- Advanced regrowth: areas supporting a continuous canopy in aerial imagery that was indistinguishable from areas mapped as remnant; and
- Young regrowth: areas supporting a broken canopy with scattered taller trees, but generally dominated by scattered smaller trees as evident in satellite imagery.

Tabooba – fauna surveys

Additional assessment was undertaken for GHFF, and the results have been applied in accordance with *How to use the offsets assessment guide* (DSEWPaC, 2012), taking into account site condition, site context and species stocking rate to contribute to the calculation of habitat quality using the EPBC Act Offsets assessment guide.

No surveys targeting GHFF were conducted at Tabooba as there were no flowering events at the time of surveys. However, the property is dominated by preferred forage species of GHFF, including the winter-flowering *Eucalyptus tereticornis* and *E. crebra*, which are critical resources for the species (GHFF Recovery Plan)

Greenridge – flora surveys

Utilising the same approach as had been used at Tabooba, the site vegetation mapping for Greenridge was ground-truthed, compared to satellite imagery and then adjusted accordingly. Greenridge was then mapped into like AUs, differentiated based on RE type; and vegetation condition (remnant, advanced regrowth, young regrowth or cleared). Standard BioCondition surveys record canopy cover by measuring the vertical projection of canopy intercepting a 100m transect line (Eyre et al. 2015).

Greenridge – fauna surveys

No flying-fox camps were recorded on site, and none have been known from Greenridge previously. GHFF surveys were not undertaken on Greenridge as the REs present are known to be of high value to the species. Greenridge is within 20km of 20 flying-fox camps used by GHFF.

3.5.3 Field survey results for GHFF offset areas

Tabooba

The AUs for vegetation on Tabooba are detailed in *Section 3.4.3* above. The offset area for GHFF is the same area and size as the koala offset area.

Both REs present on Tabooba rank as high-moderate value foraging habitat for GHFF. The GHFF Recovery Plan describes vegetation communities containing (amongst other species) *Eucalyptus crebra*, *E. tereticornis* and *E. melliodora* as important resources for GHFF on coastal lowlands of Southern Queensland as they flower reliably over the winter and spring period. While the property is not located within the coastal lowlands of southern Queensland, Eby and Law (2008) state that productive areas for winter flowering are concentrated in South East Queensland and northern New South Wales where flowering occurs in small remnants in coastal floodplains, coastal dunes and inland slopes, and during spring the extent of productive habitat increases in northern regions, expanding from the coastal lowlands into the coastal ranges and valleys.

The presence of critical forage species and distance to a nationally important flying-fox camp (within 20km) indicates Tabooba supports habitat critical to the survival of GHFF. Protection of existing habitats from clearing, restoration of cleared habitats, weed management to improve canopy recruitment in remnant and advanced regrowth, and improved fire management to reduce the risk of wildfire would ensure available habitat within the property is increased and habitat condition is improved.

The full set of raw BioCondition survey data for Tabooba is provided in *Appendix H*. The HQS tables for each AU within the GHFF offset areas are provided in *Appendix L*.

Greenridge

The AUs for vegetation on Greenridge are detailed in *Section 3.4.3* above. The offset area for GHFF is the same area and size as the koala offset area. A portion of the offset for coastal swamp oak TEC at Greenridge is also high-quality habitat for GHFF.

Greenridge is within 20km of 20 flying-fox camps used by GHFF and the species has been recorded from Greenridge previously, foraging on *Melaleuca quinquenervia* and *Eucalyptus tereticornis* (ddwfauna 2006). During koala surveys in 2022, the EVE koala survey team noted heavy flying-fox use of flowering eucalypts on site.[13] GHFF is expected to forage on site regularly during *Eucalyptus* and *Melaleuca* flowering events.

The full set of raw BioCondition survey data for Greenridge is provided in *Appendix I*. The HQS tables for each AU within the GHFF offset areas are provided in *Appendix L*.

3.5.4 Ecological benefits of the proposed GHFF offsets

Tabooba

As discussed in *Section 3.1.1*, the offset will add to and strengthen the linkages to biodiversity corridors in the area. Additionally, restoration of the vegetation communities to benchmark condition for each RE over a 20-year period will improve the presence and abundance of foraging resources for the GHFF in an area that is within the known distribution and range of the species.

[13] Pers comms, D. de Villiers, cited in BAAM 2022.

The offset will also provide a strengthened level of connectivity to the eastern side of the property where it adjoins habitat classed as 'core habitat" by the Scenic Rim Regional Council. The improved connectivity offered by placing the offsets on Tabooba is discussed further in *Section 3.1.1.*

Greenridge

As discussed in *Section 3.3.4*, the most significant impacts on ecosystem health at Greenridge are the result of feral pig damage and weed invasion, along with maintenance of cleared and weed-infested paddocks adjacent to remnant and regrowth vegetation. The current level of feral pig activity would not be managed without the offset, which will be detrimental to the survival of canopy species that provide foraging resources for the GHFF.

As discussed in Section 3.3.4, the location of the offset areas in relation to nearby areas of remnant vegetation (including the Pimpama Conservation Park and the Pimpama River Conservation Area) is of benefit to the likelihood of success of the offset. The offset property itself will form a large part of a buffer area between the highly developed residential areas to the south and these conservation areas.

The AUs comprising the GHFF offset areas on both properties are shown in

Table 8. These offset areas are the same areas as the koala offsets and are shown in *Figure 9*.and *Figure 10* above.

Table 8: Grey-headed flying-fox habitat at the offset sites

Property	RE	Assessment unit	Type of vegetation	Area of offset (ha)
Tabooba	12.8.16	AU1	Remnant	49.84
		AU2	Advanced regrowth	145.02
		AU3	Young regrowth	48.10
Tabooba	12.8.14	AU4	Remnant	50.62
		AU5	Advanced regrowth	19.80
Greenridge	12.3.20	AU4	Remnant	28.22
		AU5	Regrowth	4.74
		AU6	Non-remnant	12.48
			Total:	**358.82**

3.5.5 OAG inputs for GHFF offsets

Inputs for DCCEEW's OAG were derived from the survey results described above.

The risk of loss was derived from Appendix One of the document titled *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act.*[14]

The Offsets Assessment Guide requires an estimation of the projected improvements in habitat quality that can be achieved over 20 years through management, along with an indication of the level of confidence in these projections. The time to ecological benefit is set at 10 years for remnant and advanced regrowth communities and 20 years for other regrowth and non-remnant

[14] Centre of Biodiversity and Conservation Science, School of Earth and Environmental Science, The University of Queensland, Brisbane. (2017) https://www.nespthreatenedspecies.edu.au/media/zpyajjq1/5-1-guidance-for-deriving-risk-of-loss-report_2017_low-res.pdf

communities, with 85% confidence that the goals for offset area habitat quality will be achieved. Periods of 10 years for remnant and 20 years for regrowth and non-remnant communities are required to realise the results of management actions that will improve habitat quality – of these actions, removal of invasive weeds and implementation of controlled burning to prevent damaging wildfire, encourage EDL recruitment and improve ground cover quality are predicted to raise the quality of the remnant and advanced regrowth ecosystems close to benchmark levels.

At present, the quality of habitats at the Greenridge and Tabooba properties are impacted by weeds. Of the 36 introduced plants recorded from within the habitat quality survey plots at the Greenridge property, 2 are weeds of national significance (*Lantana camara* and *Asparagus aethiopicus*) and 19 were identified by Batianoff and Butler (2002) as among the 200 most invasive naturalised plants in South East Queensland, selected from 1060 naturalised taxa. Within the survey plots at Greenridge there was an average of 29.25% non-native cover. Of the 43 introduced plants recorded from within the habitat quality survey plots at the Tabooba property, one is a weed of national significance (*Lantana camara*) and 17 were identified by Batianoff and Butler (2002) as among the 200 most invasive naturalised plants in South East Queensland. Within the survey plots at Tabooba there was an average of 20.5% non-native cover.

Nationally exotic species account for about 15% of flora (Department of Agriculture, Fisheries and Forestry, 2024). Weeds are known to compete with native species for space, light, water and nutrients, and also suppress and out-compete mid-storey and canopy trees (Department of the Environment, 2011), affecting the structure and function of land-based and aquatic ecosystems, and impacting negatively on native fauna and flora. Nineteen of 20 studies on weed impact in Australia reviewed by Adair and Groves (1998) demonstrated a decline in either species richness, canopy cover or frequency of native species. One of the reviewed studies (Hester & Hobbs. 1992) found weed presence reduced percent cover of natives and reduced seed production in shrublands and woodlands, with removal of weeds resulting in a 3-fold increase in native cover.

Weeds can also increase the biomass of ecosystems leading to more intense bushfires, changing the composition and structure of native vegetation (Invasive Plants and Animal Committee, 2016).

Both properties are subject to invasion by exotic grasses. At Greenridge South African pigeon grass (*Setaria sphacelata*) is a dominant species of open spaces. The species is regarded as an environmental weed in Queensland, New South Wales and Western Australia. It can form dense stands preventing natural plant regeneration and can transform infested areas into open badlands, with potential to invade wetland areas, reducing access for endangered birds (Brisbane City Council, 2024).

Lantana is present on both properties. This is a weed of national significance and was the number one ranked invasive weed in South East Queensland (Batianoff and Butler, 2002). Lantana forms dense thickets that can smother and destroy native vegetation and impede animal movement. Its presence can also create hotter bushfires, altering native vegetation communities (Department of Agriculture and Fisheries, 2023).

Control and removal of lantana and invasive introduced grasses will result in long term positive ecosystem change – by increasing species richness, abundance and recruitment (for lantana, see Gooden et al.,2009) and significantly reducing the risk of intense wildfire. Under these conditions there is high (85%) confidence that the quality of existing ecosystems will be raised to benchmark levels. An additional benefit of the intended weed management is the reestablishment of habitat connectivity for flora and fauna that are impeded by invasive species (Godfree et al. 2017).