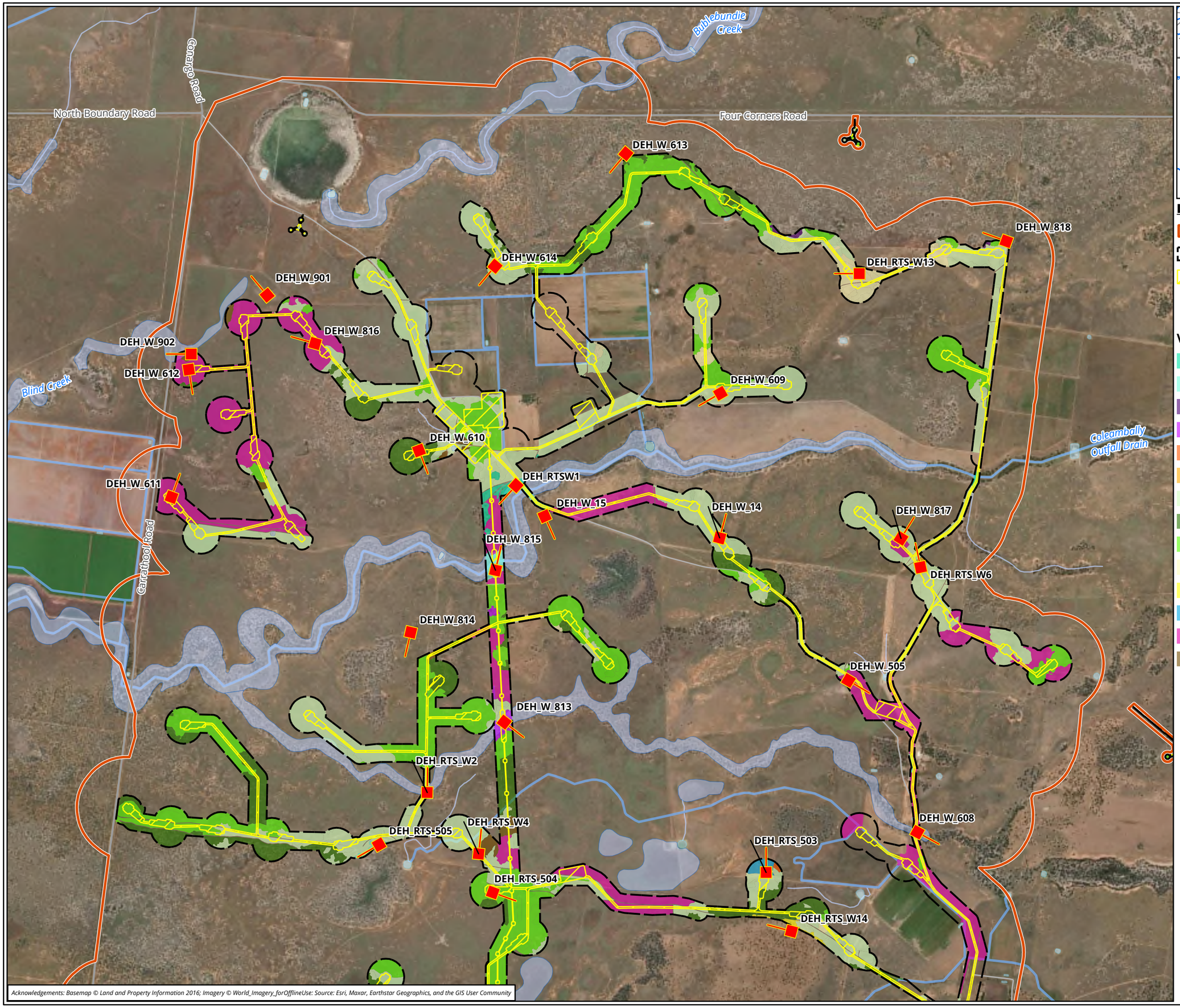

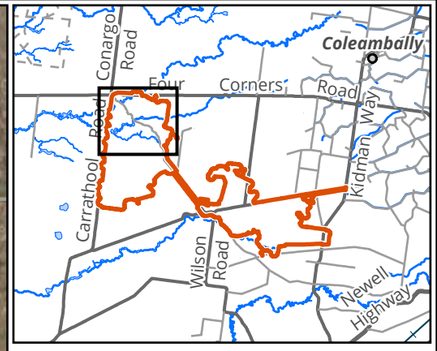

Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot

Vegetation zone

- VZ2 - 13_Moderate
- VZ3 - 13_Thinned
- VZ4 - 15_Moderate
- VZ5 - 15_Thinned
- VZ6 - 17_Mod_Good
- VZ7 - 17_Moderate
- VZ8 - 26_DNG
- VZ9 - 26_Intact
- VZ10 - 26_Sparse_Canopy
- VZ11 - 28_Low
- VZ12 - 28_Moderate
- VZ13 - 45_Mod_Good
- VZ15 - 46_Moderate
- VZ17 - 160_Mod_Good

Figure 9 Vegetation zones and plot locations
Page 1

0 1,000
Meters
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Coordinate System:
GDA2020 MGA Zone 55

N

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GIS: JB, Checked by: MP, Last edited by: jbeckius
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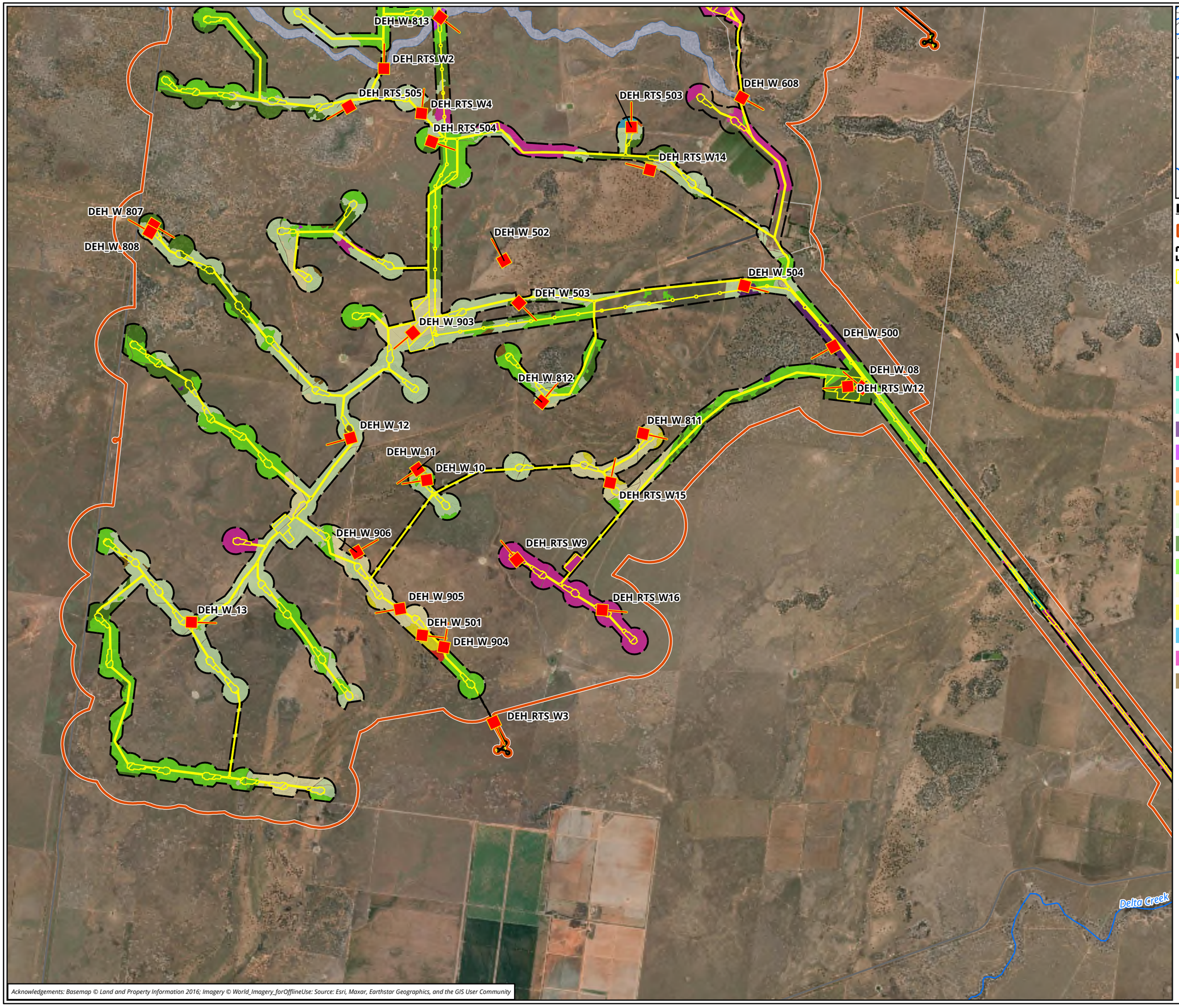

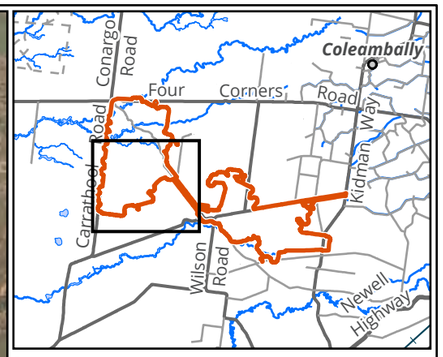

Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot

Vegetation zone

- VZ1 - 10_Moderate
- VZ2 - 13_Moderate
- VZ3 - 13_Thinned
- VZ4 - 15_Moderate
- VZ5 - 15_Thinned
- VZ6 - 17_Mod_Good
- VZ7 - 17_Moderate
- VZ8 - 26_DNG
- VZ9 - 26_Intact
- VZ10 - 26_Sparse_Canopy
- VZ11 - 28_Low
- VZ12 - 28_Moderate
- VZ13 - 45_Mod_Good
- VZ15 - 46_Moderate
- VZ17 - 160_Mod_Good

Figure 9 Vegetation zones and plot locations
Page 2

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GDA2020 MGA Zone 55

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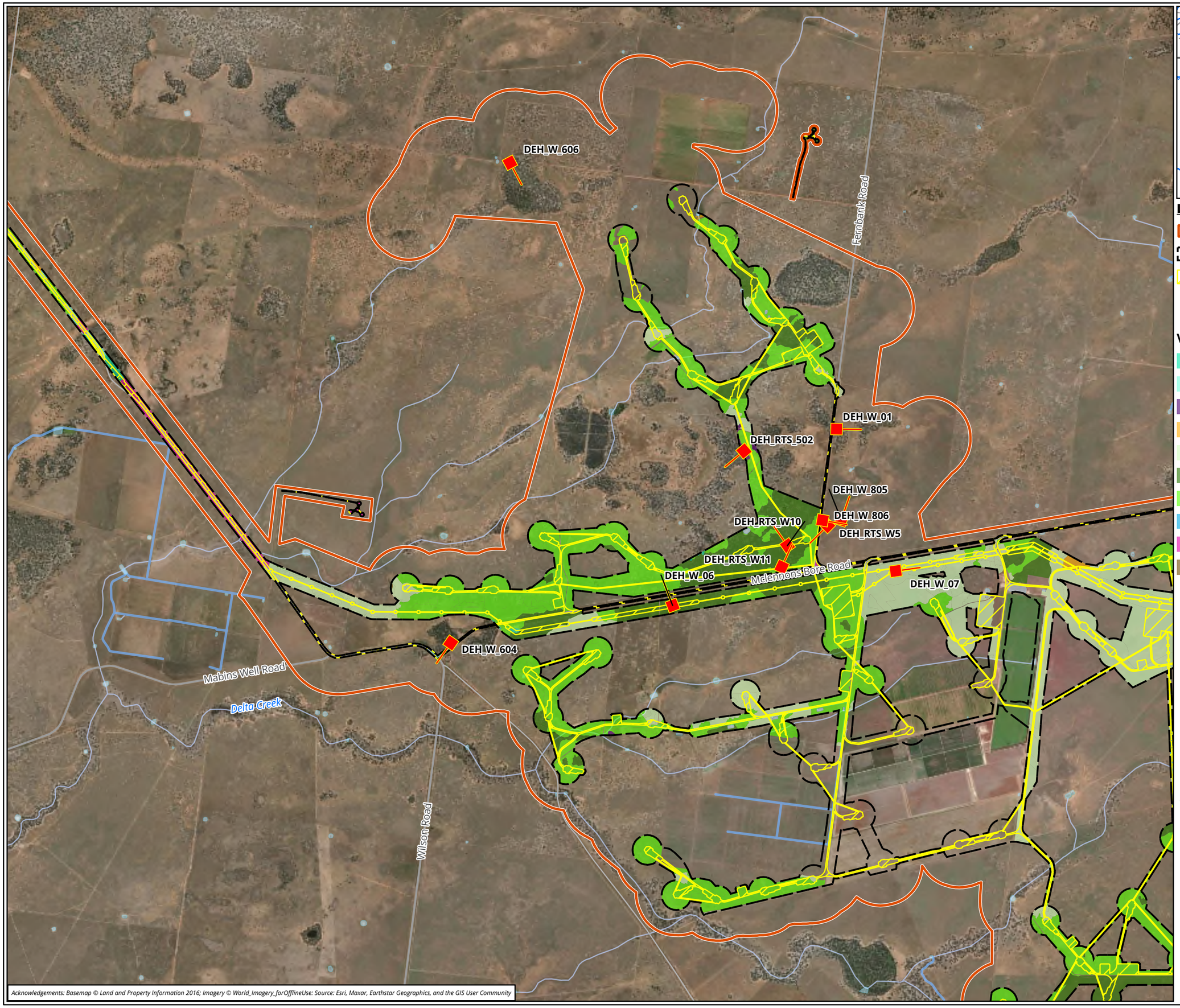

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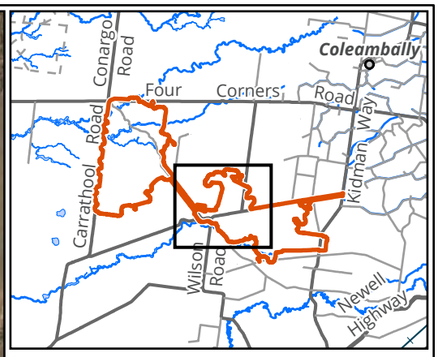

Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot

Vegetation zone

- VZ2 - 13_Moderate
- VZ3 - 13_Thinned
- VZ4 - 15_Moderate
- VZ7 - 17_Moderate
- VZ8 - 26_DNG
- VZ9 - 26_Intact
- VZ10 - 26_Sparse_Canopy
- VZ13 - 45_Mod_Good
- VZ15 - 46_Moderate
- VZ17 - 160_Mod_Good

Figure 9 Vegetation zones and plot locations
Page 3

0 1,000
Meters
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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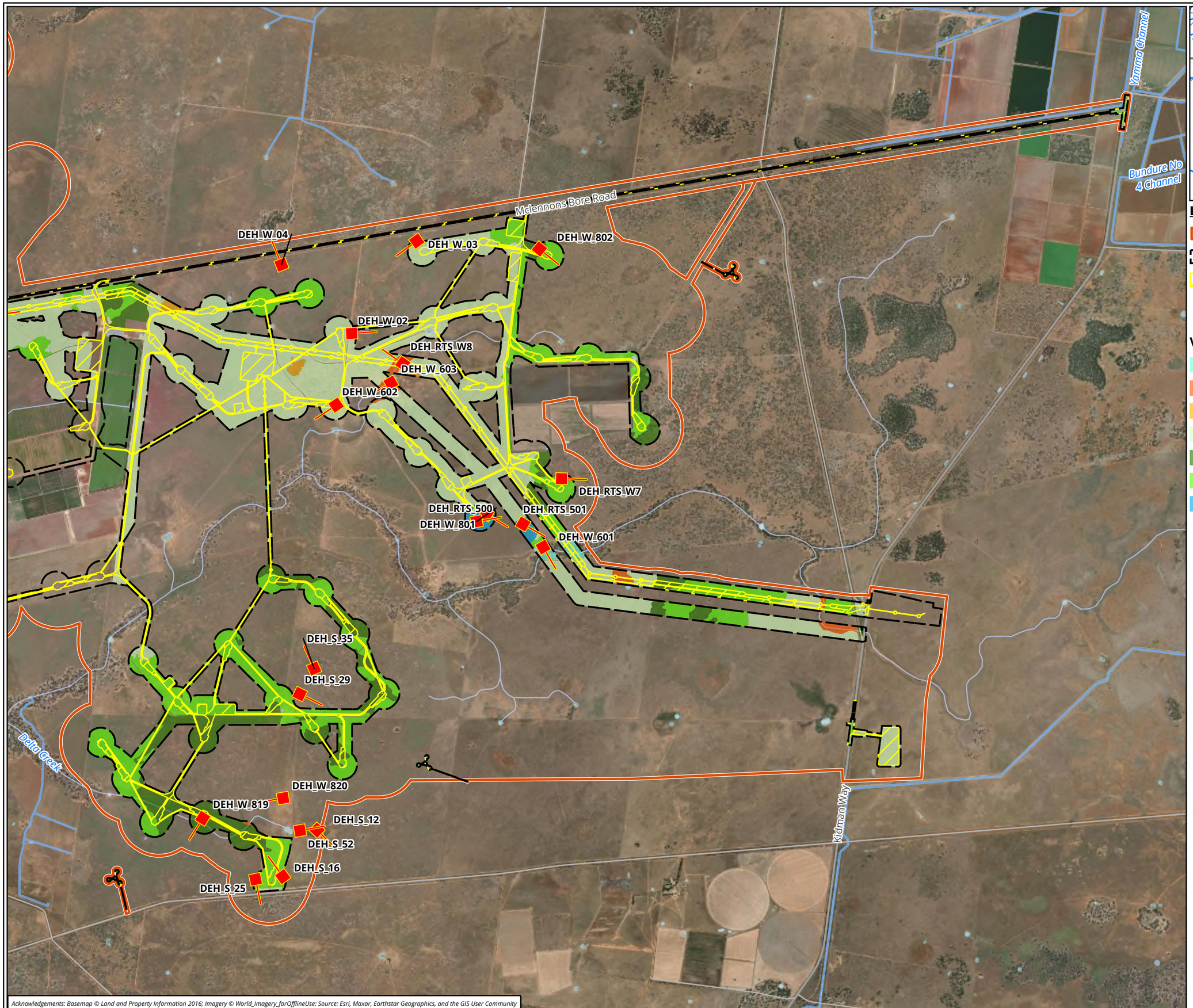

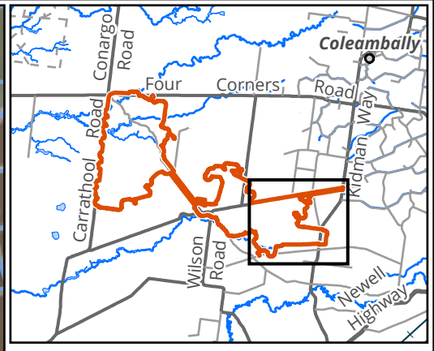

Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot

Vegetation zone

- VZ3 - 13_Thinned
- VZ6 - 17_Mod_Good
- VZ7 - 17_Moderate
- VZ8 - 26_DNG
- VZ9 - 26_Intact
- VZ10 - 26_Sparse_Canopy
- VZ13 - 45_Mod_Good

Figure 9 Vegetation zones and plot locations
Page 4

0 1,000
Meters
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

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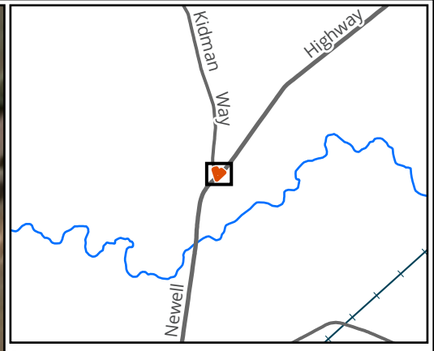

Legend

- Subject land
- Development corridor
- Development footprint

Vegetation zone

- VZ14 - 45_Intersection
- VZ16 - 46_Intersection

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Figure 9 Vegetation zones and plot locations
Page 5

0 — 80

Meters
Scale: 1:2,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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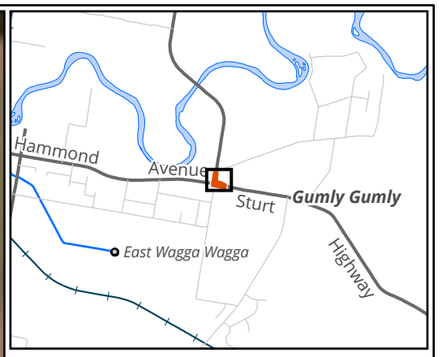

Legend

- Subject land
- Development corridor
- Development footprint

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Figure 9 Vegetation zones and plot locations
Page 6

0 40

Meters
Scale: 1:1,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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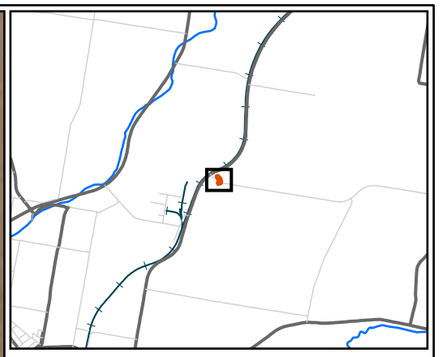

Legend

- Subject land
- Development corridor
- Development footprint

Figure 9 Vegetation zones and plot locations
Page 7

0 50

Meters
Scale: 1:1,500 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

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Matter: 37263, Date: 09 January 2026,
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Layout: 37263_Wind_F9_VegZones_P7-8

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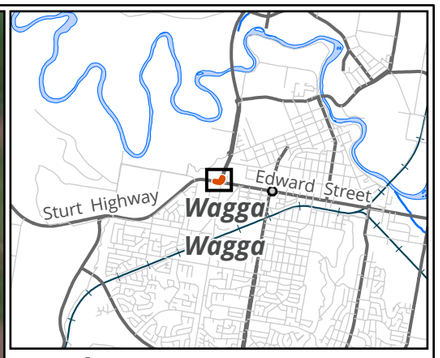

Legend

- Subject land
- Development corridor
- Development footprint

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Figure 9 Vegetation zones and plot locations
Page 8

0 50

Meters
Scale: 1:1,500 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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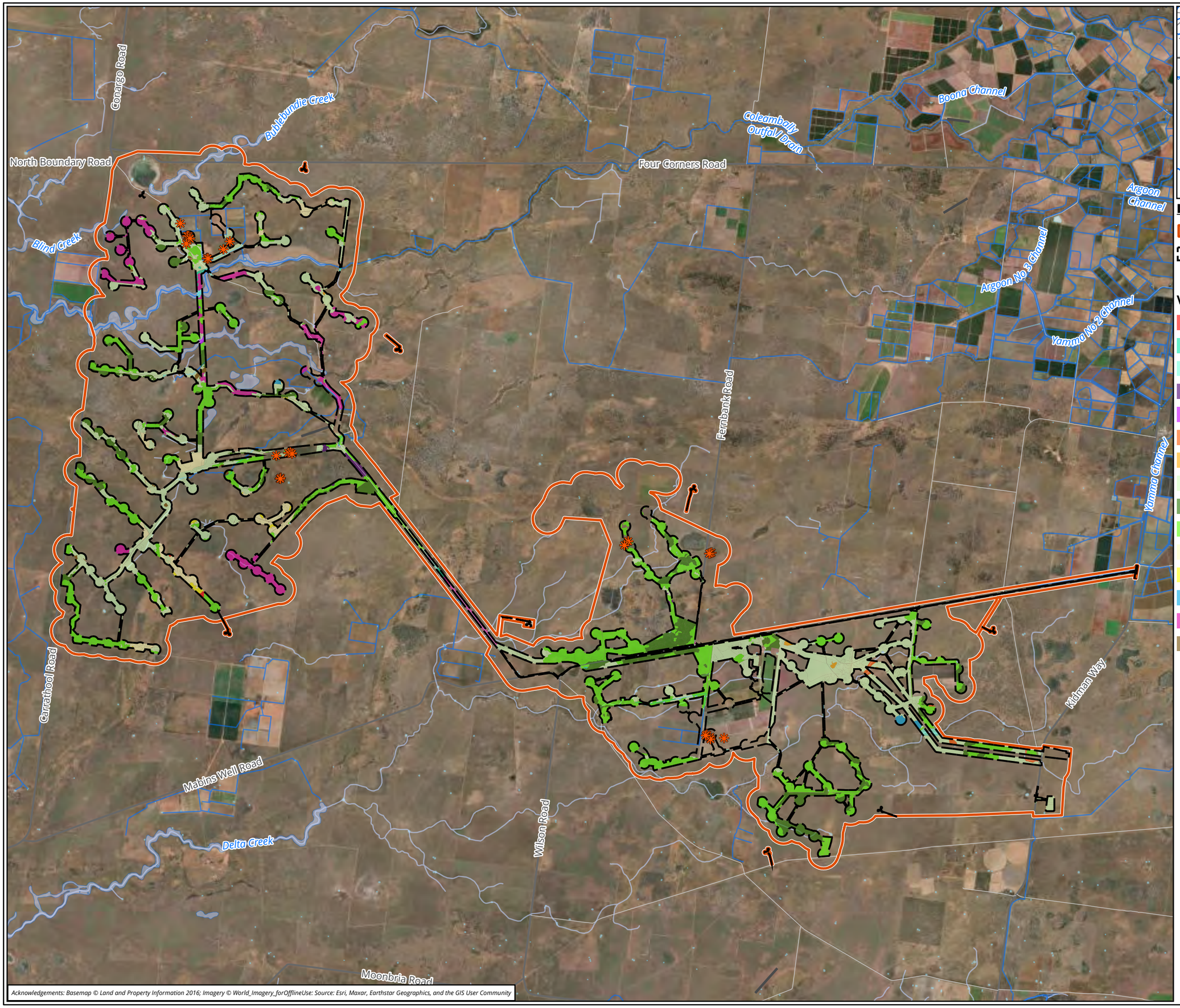

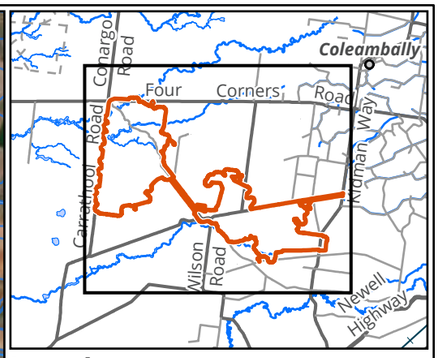

Legend

- Subject land
- Development corridor
- Paddock tree

Vegetation zone

- VZ1 - 10_Moderate
- VZ2 - 13_Moderate
- VZ3 - 13_Thinned
- VZ4 - 15_Moderate
- VZ5 - 15_Thinned
- VZ6 - 17_Mod_Good
- VZ7 - 17_Moderate
- VZ8 - 26_DNG
- VZ9 - 26_Intact
- VZ10 - 26_Sparse_Canopy
- VZ11 - 28_Low
- VZ12 - 28_Moderate
- VZ13 - 45_Mod_Good
- VZ15 - 46_Moderate
- VZ17 - 160_Mod_Good

Figure 10 Scattered paddock trees - Overview

0 1 2 3 4 5

Kilometers
Scale: 1:130,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

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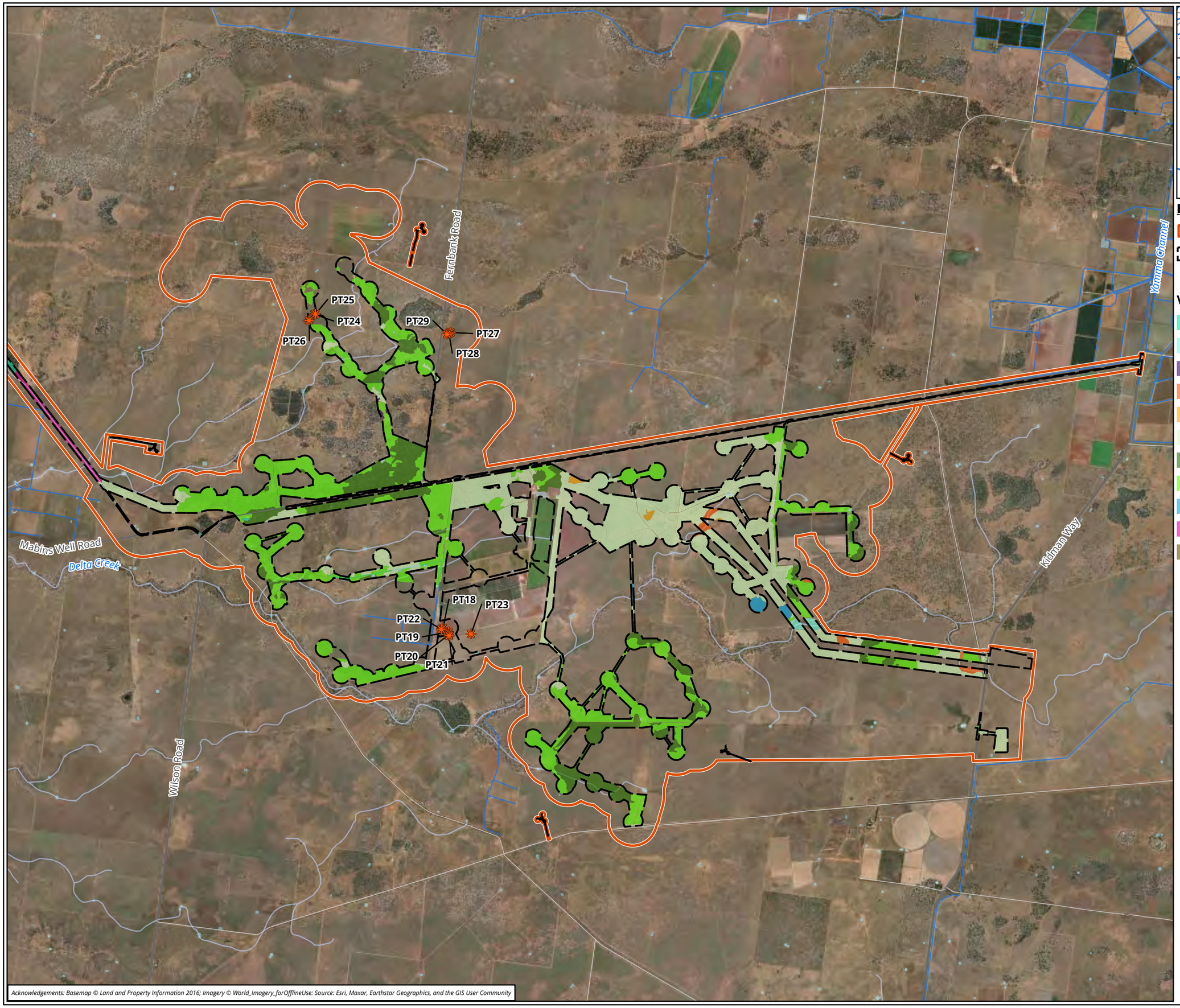

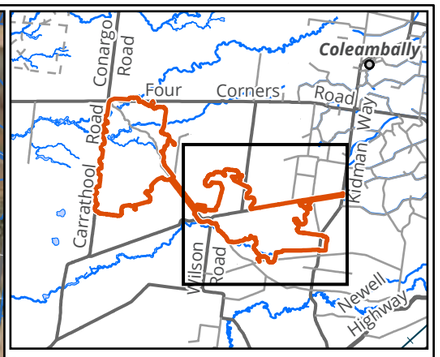

Legend

- Subject land
- Development corridor
- Paddock tree

Vegetation zone

- VZ2 - 13_Moderate
- VZ3 - 13_Thinned
- VZ4 - 15_Moderate
- VZ6 - 17_Mod_Good
- VZ7 - 17_Moderate
- VZ8 - 26_DNG
- VZ9 - 26_Intact
- VZ10 - 26_Sparse_Canopy
- VZ13 - 45_Mod_Good
- VZ15 - 46_Moderate
- VZ17 - 160_Mod_Good

Figure 10 Scattered paddock trees - Eastern area

0 1 2 3

Kilometers
Scale: 1:80,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

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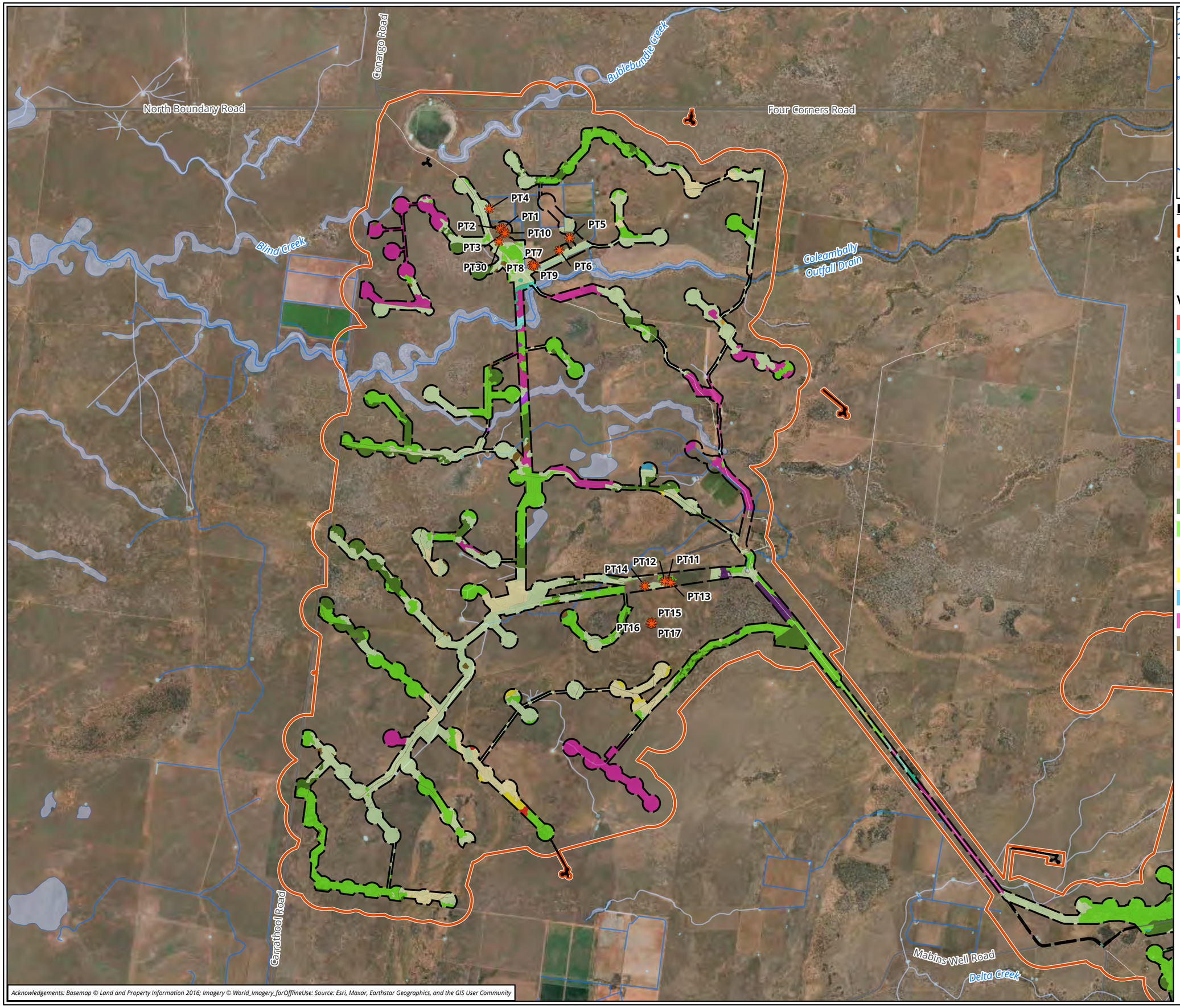

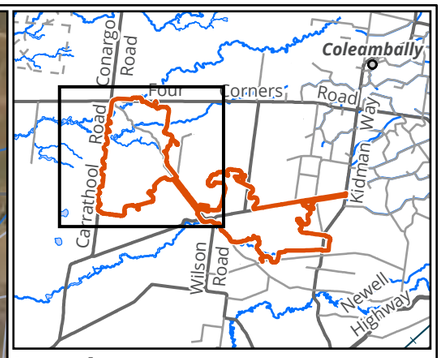

Legend

- Subject land
- Development corridor
- Paddock tree

Vegetation zone

- VZ1 - 10_Moderate
- VZ2 - 13_Moderate
- VZ3 - 13_Thinned
- VZ4 - 15_Moderate
- VZ5 - 15_Thinned
- VZ6 - 17_Mod_Good
- VZ7 - 17_Moderate
- VZ8 - 26_DNG
- VZ9 - 26_Intact
- VZ10 - 26_Sparse_Canopy
- VZ11 - 28_Low
- VZ12 - 28_Moderate
- VZ13 - 45_Mod_Good
- VZ15 - 46_Moderate
- VZ17 - 160_Mod_Good

Figure 10 Scattered paddock trees - Western area

0 1 2 3

Kilometers
Scale: 1:80,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

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Layout: 37263_Wind_F10_PaddockTrees

4. Threatened species

4.1. General habitat types and features

The subject land is predominantly covered with native vegetation in the form of native grasslands (natural and derived), Weeping Myall Woodland, Black Box woodland and wetlands (Lignum or sedge-dominated wetlands) and White Cypress Pine woodlands. Mapping by NSW DCCEEW (2017) clearly indicates this and the preliminary field assessment confirmed the presence of extensive native vegetation cover. There are also multiple natural drainage systems, depressional wetlands and farm dams in the subject land that support seasonal and semi-permanent wetland habitats.

Areas of dryland and irrigated cropping occur within the subject land. Generally, these areas support limited opportunities for biodiversity due to the broadscale historical vegetation removal and regular disturbance to the soil from seasonal agricultural activities (cultivation, fertilising and chemical application). Areas left fallow for a number of seasons are likely to have some natural regeneration of native coloniser species, however the habitat values supported by these areas is also limited. However, during seasonal irrigation in selected areas, water availability does attract common waterbirds, sometimes in large numbers, as well common amphibians, but also threatened species such as Southern Bell Frog *Litoria raniformis*, which was recorded in these areas where more permanent water occurs. Cropping, livestock grazing and historical vegetation removal are the key drivers for habitat condition and the associated potential for threatened flora species to occur. Areas of highest condition vegetation occur in areas where these practices have been generally excluded from grazing or occur at lower intensity. Areas with higher intensity grazing generally support soil types more likely to produce palatable ground-coverage species. Despite historic grazing, cropping and clearing, the subject land supports a diverse array of vegetation communities, often with moderate or higher plant species richness and habitat types.

Black Box dominated woodlands and ephemeral drainage lines, depressions and wetland areas provide foraging, shelter, movement and breeding resources for native fauna such as woodland birds and raptor species, including a number of threatened species recorded across the subject land. Seasonally flooded grassy/sedge drainage lines, wetlands, farm dams and artificial drains and channels in the subject land provide habitat for a range of fauna, including birds, frogs and reptiles.

White Cypress Pine woodlands occur as open areas with varying degrees of density depending on history of clearing. Areas with remnant pine often contain fissures and nests and can support foraging, roosting and breeding habitat for microbat species and range of common fauna, particularly raptor and woodland bird species. Woody vegetation areas support forage opportunities for insectivorous microbat species, that are likely to forage above and below the canopies. Open areas between wooded patches provide flyways, however larger open areas or cropping and grasslands / low chenopod shrublands provide limited opportunities for bats.

Intact Weeping Myall woodland and sparse woodlands (represented by PCT26) occur across the subject land. This woodland vegetation is composed of semi-mature and younger regrowth stands of Weeping Myall. PCT 26 typically occurs on fertile red top brown clay soils and sometimes moderate to extensive gilgai that are subject to seasonal waterlogging. This community provides a range of habitats for more woodland dependent avifauna such as parrots and honeyeaters that rely on the more widely spaced trees with a relatively open canopy.

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As previously mentioned, grasslands within the subject land are likely to be a combination of naturally occurring grasslands and grasslands derived from Weeping Myall woodlands where the woody vegetation cover has been historically cleared, or died out. Defining natural and derived grasslands within the subject land (and in the general region north of Jerilderie) is very difficult due to tree clearing and historical land use and grazing practices. Due to the moderate quality of the native derived grasslands and impacts of grazing, the presence of threatened flora is reduced but isolated individuals and small patches still persist and have been observed. More natural grasslands are in higher condition generally, so potential for threatened flora in these areas is greater. Grasslands and low open chenopod shrublands generally occur across large expanses away from source bordering features such as creeklines, prior-streams, or sandhills. Habitats provided by these areas are limited to shelter habitat for smaller and ground-dwelling fauna species including reptiles, echidna, and ground-dwelling/foraging bird species and common avian species including quail, Brown Songlark and Australasian Pipit. Grassland and shrubland provide open hunting opportunities for raptors and movement pathways for small bird species. Plains Wanderer *Pedionomus torquatus* (EPBC Act critically endangered, BC Act endangered) habitat is present within the subject land with areas of NSW DCCEEW Mapped Important Habitat identified. The presence of woodland and scattered trees is likely to reduce the extent of possible habitat as this species tends to avoid wooded areas, but open areas of native grassland (natural and derived) may support this species at some time, due to the dynamic nature of the Riverina natural and derived grasslands systems.

4.1.1. Flora habitat assessments

Flora habitat assessments were undertaken during preliminary assessment and the stratification of vegetation communities and vegetation zones. Habitat assessment was undertaken to determine if PCTs supported the critical habitat components for flora species, or contained degraded habitat that would not support threatened flora species identified as candidate species (species credit species) by the BAM Calculator. An assessment of the potential for candidate flora species was undertaken following completion of initial habitat assessments and the results are outlined in Section 4.3 and Appendix 2.

4.1.2. Fauna habitat assessments

Fauna habitat assessments were undertaken to determine the presence of microhabitats and other critical habitat components (habitat constraints) suitable for all threatened fauna species considered predicted species (ecosystem credit species) or candidate species (species credit species) under the BAM. Habitat assessments focussed on the presence of the features such as those listed below:

- Habitat trees including large and/or hollow-bearing trees, stick nests, availability of flowering shrubs and canopy/understorey feed tree species.
- Condition and type of native vegetation and the presence of exotic species.
- Presence and condition of waterways, lakes, swamps, wetland and watercourses (artificial and natural).
- Quantity of ground litter and woody debris.
- Searches for indirect evidence of fauna (i.e., feathers, tracks and scats).
- General degradation of the site as a result of past and current disturbances such as cropping, grazing, vegetation clearing (thinning), rural land management practices and exotic species infestation.
- Abundance of introduced predators such as cats and foxes, as well as environmental pests such as rabbits.

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- Topography and landscape morphology.
- Soil type and presence of rocky areas.
- Habitat connectivity.

Several habitat features with potential to support threatened species credit species were identified during these habitat assessments, including fissures in cypress pine trees, stick nests, woody debris, semi-aquatic habitat, grassland and shrubland and sandy rises. An assessment of the suitability for these features to support the presence of potential candidate species is presented Appendix 2.

Field capture of detailed fauna habitat information allowed for confirmation of presence/absence of habitat features and microhabitats for the range of candidate species across surveyed portions of the subject land. Fauna habitat assessments were captured using ArcGIS polygons attributed with specific habitat criteria that allowed for planning of further targeted survey for select species, or the exclusion of the potential for occurrence of various candidate species from the subject land. Fauna habitat assessment details were cross-referenced with vegetation assessment, topology, landscape, soil, current and historic imagery data to draw conclusions regarding potential suitability of habitat for threatened species. Fauna habitat assessment details were cross-referenced with vegetation assessment, topology, landscape, soil, current and historic imagery data to draw conclusions regarding potential suitability of habitat for threatened species.

4.2. Ecosystem credit species

A list of predicted species (ecosystem credit species) expected to occur within the subject land was generated as per Section 5 of the BAM (DPIE 2020a) based on all PCTs and vegetation class present. Impacts to these species require assessment, however targeted surveys are not required as these species are assumed to occur, based on the occurrence of the PCTs, habitat constraints, native vegetation cover in the landscape and calculated patch sizes. These species are identified as ecosystem credit species under the Threatened Biodiversity Data Collection (TBDC). Table 26 lists the ecosystem credit species that could not be discounted, based on geographical restrictions or a lack of suitable habitat, from using the subject land on occasion.

These species were considered when prescribing management and mitigation measures for the project, and a number have been specifically considered as part of the assessment of prescribed impacts and under the Commonwealth EPBC Act.

One ecosystem credit species, Regent Parrot, has been discounted from potentially occurring within the subject land. This is due to the geographical limitation of not being within 10 kilometres of the junction of the Murray River. All other ecosystem credit species are considered relevant to the project.

Table 26 Ecosystem credit species (predicted species) with potential to occur

Common name	Species name	Recorded during surveys	Sensitivity to gain class
Australasian Bittern	*Botaurus poiciloptilus*	No	Moderate
Australian Painted Snipe	*Rostratula australis*	No	Moderate
Black Falcon	*Falco subniger*	Yes	Moderate
Blue-billed Duck	*Oxyura australis*	No	Moderate
Brolga	*Grus rubicunda*	No	Moderate

Common name	Species name	Recorded during surveys	Sensitivity to gain class
Curlew Sandpiper	*Calidris ferruginea*	No	High
Diamond Firetail	*Stagonopleura guttata*	Yes	Moderate
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	Yes	Moderate
Freckled Duck	*Stictonetta naevosa*	No	Moderate
Gilbert's Whistler	*Pachycephala inornata*	No	Moderate
Grey Falcon	*Falco hypoleucos*	No	Moderate
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	Yes	Moderate
Inland Forest Bat	*Vespadelus baverstocki*	Yes	High
Little Eagle	*Hieraaetus morphnoides*	No	Moderate
Little Pied Bat	*Chalinolobus picatus*	Yes	High
Magpie Goose	*Anseranas semipalmata*	No	Moderate
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	No	Moderate
Painted Honeyeater	*Grantiella picta*	Yes	Moderate
Plains-wanderer	*Pedionomus torquatus*	Yes	High
Pied Honeyeater	*Certhionyx variegatus*	Yes	Moderate
Redthroat	*Pyrrholaemus brunneus*	No	Moderate
Scarlet Robin	*Petroica boodang*	No	Moderate
South-eastern Hooded Robin	*Melanodryas cucullata*	No	Moderate
Southern Whiteface	*Aphelocephala leucopsis*	Yes	Moderate
Spotted Harrier	*Circus assimilis*	Yes	Moderate
Square-tailed Kite	*Lophoictinia isura*	No	Moderate
Superb Parrot	*Polytelis swainsonii*	Yes	Moderate
Swift Parrot	*Lathamus discolor*	No	Moderate
Varied Sittella	*Daphoenositta chrysoptera*	No	Moderate
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	No	High
White-fronted Chat	*Epthianura albifrons*	Yes	Moderate
White-throated Needletail	*Hirundapus caudacutus*	No	High
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Yes	High

4.3. Species credit species

Species credit species are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence, or components of their habitat. These candidate species are identified as species credit species in the TBDC. A targeted survey or an expert report is required

to confirm the presence/absence of these species on the subject land, or alternatively the species can be assumed to be present (DPIE 2020a).

Appendix 2 provides the lists of species credit species and EPBC listed species predicted to occur within the subject land based on the IBRA subregion within which the project occurs, the native vegetation cover present within the 1500 metre buffer area, the PCTs present within the development corridor and subject land, and patch sizes listed in within Table 23.

The potential for a species to occur within the subject land was assessed in accordance with Section 5.2 of the BAM (DPIE 2020a) and species with geographical restrictions, or habitat constraints not present, were not required to be assessed. Six predicted species credit species have been excluded from occurring within the subject land based on the following

- Menindee Nightshade *Solanum karsense* – The subject land is not west of Maude.
- Sand-hill Spider Orchid *Caladenia arenaria* - The subject land is not 'East of Jerilderie' and microhabitat within the White Cypress Pine communities has groundcover which is degraded.
- Swift Parrot - No important mapped areas.
- Curlew Sandpiper - No important mapped areas.
- Regent Parrot – The subject land is not within 10km of the Murray River.
- Koala – Limited habitat present within the subject land. No evidence of Koalas was found opportunistically within the subject land, however it is noted that preferred Koala feed trees are present on the rare occasion, River Red Gum *Eucalyptus camaldulensis*, in the development corridor and subject land. Feed tree species present are predominantly secondary feed trees such as Black Box. Black Box (a high use feed tree) is common within the subject land, and occasionally fragmented stands of River Red Gum (a preferred use feed tree) (DPE 2022c) occur within the development corridor, however the subject land is not considered to support habitat for Koala. In the context of the Riverina more broadly, Koala habitat is associated with major rivers, such as the Murrumbidgee, Edward and Murray rivers where large stands of River Red Gum and Black Box trees occur on the regularly inundated inner floodplains along these larger river systems. This is supported by the clear concentration of Koala records along these rivers, the majority of which occur around 70 – 80 km to the north-east, or 80 - 85 km to the south, of the subject land. Records do occur further west, including west of the subject land, however these are again strongly associated with the major river systems. A number of BioNet records occur away from these major rivers, most of which are associated with 'Dan Lunney's Community Wildlife Survey' or WIRES records, however these records all have a high level of uncertainty surrounding the accuracy of the GPS coordinate of the records themselves.

  Habitat connectivity in terms of Koala movement is fragmented between these major river systems and the subject land. It is acknowledged that Koalas traverse treeless landscapes for some distances, however these 'hostile' habitats as noted in the Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE 2022c), are prevalent within the fragmented landscape and riparian corridor along the ephemeral watercourses that provide some level of connectivity through the landscape to the subject land. This is supported by the clear concentration of Koala records along major rivers only, the majority of which occur around 80 km south, or over 80 km northeast, of the subject land.

  The justification of the absence of Koala within the subject land is based on a lack of records in the broad expanse between Hay, Deniliquin, Finley, Corowa, and Coleambally, but more importantly, the naturally sparsely treed to open landscape of this region, and the understanding that regional Koala

populations are restricted to major river systems that support extensive stands of River Red Gum and associated Black box woodlands. The tree cover of the local landscape has also been subject to long-term fragmentation of habitat connectivity through land clearing (across 100 km of 'hostile' habitat [as defined in the BAM Koala guidelines]) between known regional populations along the Murrumbidgee and Edwards Rivers. As seen through aerial imagery it is evident that to the north and south of the subject land the flood runner creek systems that traverse the site have major breaks in tree cover or become very narrow riparian zones with interrupted physical connectivity to the major river systems to the north (Murrumbidgee) and south (Murray). Highly limited connectivity occurs along these degraded, narrow and fragmented riparian corridors to the north and south of the subject land (e.g. Coleambally Outfall Drain and Delta Creek).

The BAM Koala guidelines define fragmented (or discontinuous) habitat as patches of suitable habitat separated by >500 m from other areas of suitable habitat, with suitable habitat defined as PCTs containing Koala feed trees. The landscape surrounding the subject land is dominated by unsuitable grassland/chenopod shrubland habitat, therefore creating discontinuous habitat for 10s to 100s of km surrounding the subject land. To cross these open areas, Koalas would need to spend considerable time on the ground increasing their vulnerability to predation and vehicle strike. It is considered highly unlikely that Koalas occupy the subject land based on the lack of local records or from known populations along the Murrumbidgee River near Hay, a lack of tree cover and very poor connectivity to facilitate their movement from known populations over 80 km to the north-east at Narrandera and south around Tocumwal.

Habitat connectivity is considered a microhabitat (or habitat component) as defined in the BAM for Koala, and the absence of habitat connectivity between the subject land and known regional populations is considered justification for the species absence in accordance with s5.2.3.2.a.ii of the BAM. Furthermore, impacts to habitat connectivity are a known key threat to Koala so it can therefore be inferred that where substantial breaks in connectivity exist, and have existed for a long period of time, the species is highly unlikely to occur in the fragmented and isolated areas such as the subject land.

Although no longer an excluded species, the assessment approach for Southern Myotis has been reviewed with the updated approach outlined below.

- Southern Myotis *Myotis Macropus* – The subject land is at this species most southern and westerly distribution. This species was potentially recorded (only) as part of the 'species complex' via ultrasonic recording (refer Section 4.3.1). Southern Myotis being recorded as part of a species complex does not mean it has been recorded present at the site or incidentally observed, nor does it necessarily mean it should be assumed to be present through application of the precautionary principle.

  Identification of Southern Myotis calls to species level is difficult, and only possible in sequences containing particular features that allow it to be differentiated from other species that produce similar, near vertical, high-bandwidth linear call types where these species overlap in distribution (such as Gould's Long-eared Bat *Nyctophilus gouldii* and Lesser Long-eared Bat *Nyctophilus geoffroyi*). Good quality sequences of Southern Myotis can be differentiated from *Nyctophilus* spp where a feeding buzz is present (a rapid increase in pulse repetition rate, slope, frequency and speed) (Gonsalves & Law 2017). Reinhold et al. (2001) also report that Southern Myotis calls generally have a pulse interval of less than 75 ms, an initial slope of greater than 400 Octaves Per Second (OPS) and that between these values the species cannot be distinguished. No calls containing these distinguishing features were found in the data analysed for the Project that would allow the species to be confirmed as present.

Ultrasonic analysis therefore makes it difficult to identify linear type bat calls to species level. As a result, during the analysis process these types of calls were assigned to a species complex, that for the project, includes Southern Myotis, Gould's Long-eared Bat, Lesser Long-eared Bat and Corben's Long-eared Bat. Assigning a call to the Myotis/Nyctophilus species complex is not confirmation that Southern Myotis is present, rather a reflection of the fact that the call could theoretically belong to either of these species, and it cannot be confirmed which species from the call alone.

This approach is common in bat call analysis and an accepted limitation of the methodology. It is also more conservative than ruling the species out where no calls with distinguishing features are observed despite many sequences being present in the range of values that are indistinguishable. Continuing to include Southern Myotis as possibly present (by assigning it to a species complex) during the call analysis means that additional consideration of the site context and available habitat for the species must be given prior to it being ruled out. The results from the ultrasonic analysis therefore must be viewed in the context of the broader landscape and habitat values within the subject land. This is the approach taken in the BDAR, and the reason the species was assessed in accordance with Section 5.2.2 of the BAM.

Southern Myotis, also known as the "fishing bat", forages in and around dams, streams and waterways with large pools or stretches. The TBDC lists the habitat constraints for the species as "waterbodies with permanent pools/stretches 3 m or wider…", due to the reliance of this species on permanent water for foraging where it scoops prey from the water with its feet (Campbell, 2009). The species also roosts in close proximity to its foraging habitat (within 200 m) utilising both tree hollows or human structures including bridges, culverts, caves and tunnels etc.(Gorecki 2020, Campbell 2009).

The species is primarily coastal, occurring in a narrow coastal band from the Kimberly to North Queensland and along the east coast of Queensland, NSW and Victoria to South Australia. Although its distribution does extend inland, this is predominantly along major inland rivers (such as the Murray River and the Murrumbidgee River), reflecting its close association with water (Gonsalves and Law 2017). Bionet records for Southern Myotis strongly reflect the known habitat preferences for the species, being concentrated on the coast and extending inland via major inland river corridors.

Despite inland rivers representing apparently suitable habitat, the species is still seemingly rare. Law and Anderson (1999) surveyed 18 sites in the State Forests of the Millewa and Koondrook/Perricoota area (about 40 to 50 kilometres south-west of Deniliquin, NSW), targeting Southern Myotis and found it present at only two locations within 7 km of each other, near the Barmah Bridge. This was consistent with previous surveys in the region that recorded the species in a similar location. The authors concluded that the species is "extremely rare" in the study region despite the presence of apparently suitable foraging habitat and abundant roost hollows in River Red Gums. Surveys further downstream on the Victorian side of the border by Lumsden and Bennet (1995) also failed to detect the species.

The most recent data from the vicinity of the project is from the Monitoring, Evaluation and Research program (MER) that has been in place in the Murrumbidgee Catchment area since 2014 overseen by the Commonwealth Environmental Water Office. Surveys from 2021-22 within the Yanco Creek System monitored ten wetlands and recorded Southern Myotis from only one site, known as Sheepwash wetlands located approximately 50 kilometres south-west of Narrandera (approximately 40 km east of the subject land). This more recent study similarly demonstrates the rarity of the species in the region, such that even targeted surveys, in permanent, vegetated waterbodies may fail to detect the species.

A study by Law, Chidel and Towerton (ABS newsletter 2001) found that Southern Myotis 'can persist in some agricultural settings if suitable roosts are present' and that 'rural creeks with intact riparian

vegetation have a good chance of supporting' the species. However, their study was in a vastly different part of the species range, in Northern NSW near Urbenville. Southern Myotis were found roosting beneath an old log bridge on Boomi Creek, well within the coastal distribution of the species and a very typical roost structure. Law, Chidel and Towerton (2001) go on to emphasise that the species is 'clearly uncommon in certain areas, such as along the Murray River' and that 'intensive agricultural practices, such as cropping with irrigation, could be more detrimental to Southern Myotis because of increased fertiliser, herbicide and insecticide run-off".

Maintaining riparian connectivity has previously been observed to be vital for this species in maintaining functional landscape connectivity and facilitating dispersal (Gorecki 2020). It is considered highly improbable that Southern Myotis would be able to exploit these habitats without greater landscape connectivity to core riparian woodland habitat.

Sources of "near-permanent" water within the subject land are restricted to farm dams, and the Coleambally Outfall Drain. Dams are highly isolated, however some fragmented and ephemeral connectivity is likely to be provided along the Coleambally Outfall Drain to areas where the species has been recorded such as the Yanco Creek system. Further connectivity may be possible to areas of presumed areas of core habitat such as the vegetated riparian corridors of the Murrumbidgee / Edward / Murray Rivers.

Seasonal flooding events may increase the area of potential foraging habitat for Southern Myotis on occasion however, this would be on a temporary and transient basis, and their range would presumably retract again as flooding subsides. Given the limited availability of suitable roosting habitat in these vegetation types (such as Nitre-Goosefoot swamp), it is also unlikely that they would provide anything more than additional foraging habitat adjacent to core roosting areas, to be exploited under appropriate seasonal conditions rather than representing an opportunity for the species to expand its range or permanently occupy broader territory. These semi-permanent wetland systems are not consistent with identified habitat constraints in the TBDC of "waterbodies with permanent pools/stretches 3 m or wider" or the species need for breeding and roosting habitat surrounding such waterways. It is recognised that farm dams provide potential habitat for Southern Myotis, however the likelihood of this must be considered in the broader context of the landscape and the known behaviour and distribution of the species.

Calls of the Myotis/Nyctophilus species complex were recorded across the subject land, and as such the species' broader distribution and habitat requirements were assessed to determine the likelihood of calls in the species complex being those of Southern Myotis. It has been concluded that it is unlikely calls represent Southern Myotis being present. However, given the known occurrence of the species approximately 40 km to the east of the subject land within the Yanco Creek system, which could conservatively be considered occasionally connected to the subject land via the Coleambally Outfall Drain, it has been conservatively assessed that there may be a potential impact to the species. This potential for impact is considered to only be associated with the area's most likely to represent the species' habitat within the subject land. Those being the "near-permanent" Coleambally Outfall Drain, and a habitat polygon for the species has been developed in this location, which is further detailed in Section 4.3.3 below.

A complete description and justification for inclusion or exclusion is provided in Appendix 2. Species credit species considered to potentially occur within the subject land, and thus considered 'candidate species credit species' have been either assumed present or the subject of targeted threatened species surveys within the development corridor.

All candidate species credit species considered as part of this assessment, and their associated method of assessment, are listed in Table 27 and Table 28.

Threatened flora candidate species

Habitats for threatened flora species within the development corridor occurs across shrubland, woodland, wetland and grassland communities, including areas of DNG. Some areas of the subject land have been subject to a high and moderate degree of management, including cropping, clearing/thinning and grazing and are less likely to provide threatened flora habitat. This includes open areas of irrigated and dryland cropping, thinned woody vegetation, trees and small areas of lower condition vegetation generally where cattle congregate around gates and dams. However, the vast majority of site is homogeneous in the ecological condition class and potential habitat for threatened flora.

Table 27 provides a list of candidate flora species credit species considered in this assessment, each species' required survey period and the relevant method of assessment. Further detail of the targeted surveys undertaken are provided below.

Table 27 Candidate flora species credit species

Species name	Common name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
Austrostipa wakoolica	A spear-grass	Microhabitats that are more frequently or periodically flooded or has seasonally moist to water-logged soils within 13 – All zones 17- All zones 26 - All zones 28 - All zones	October – December	Moderate – 2
Brachyscome muelleroides	Claypan Daisy	Microhabitats that are more frequently or periodically flooded or has seasonally moist to water-logged soils, particularly in association with seasonal aquatic plants such as *Marsilea* species, within 45_mod_good 46_moderate	September – November	Very High – 3
Brachyscome papillosa	Mossgiel Daisy	Microhabitats that are more frequently or periodically flooded or has seasonally moist	September – November	High – 2

Species name	Common name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
		to water-logged soils, particularly in association with seasonal aquatic plants such as *Marsilea* species, within 13 – All zones 15 - All zones 24_moderate (present in previous development corridor only) 45_mod_Good 46_moderate		
Convolvulus tedmoorei	Bindweed	General areas of grey soil, gilgai and depressions within 17 – All zones 24_moderate (present in previous development corridor only) 26 – All zones 45_mod_good 46_moderate	June – September	Very High – 3
Eucalyptus leucoxylon subsp. Pruinosa	Yellow Gum	13 – All zones 15 – All zones	All Year	High – 2

Species name	Common name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
Leptorhynchos orientalis	Lanky Buttons	Microhabitats with an open structure, herb-rich inter-tussock spaces and presence of cryptogamic crust within 24_moderate (present in previous development corridor only) 26 – All zones 45_mod_good 46_moderate	September – November	High – 2
Lepidium monoplocoides	Winged Peppercress	Frequently or periodically flooded or has seasonally moist to water-logged soils, particularly in association with seasonal aquatic plants such as Marsilea species, within 10_moderate 13 - All zones 24_moderate (present in previous development corridor only) 15 – All zones 26 – All zones	September – December	High – 2
Maireana cheelii	Chariot Wheels	Microhabitats that support heavier clay soils 13 and 15 - All zones 26 – All zones	Maireana cheelii	High – 2

Species name	Common name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
Pilularia novae-hollandiae	Austral Pillwort	Microhabitats that are more frequently or periodically flooded or has seasonally moist to water-logged soils within 13 - All zones 15 – All zones 17 – All zones 26 – All zones 45_mod_good 46_moderate	October – December	Very High – 3
Sclerolaena napiformis	Turnip Copperburr	Microhabitats with an open structure, herb-rich inter-tussock spaces and presence of cryptogamic crust within 26 – All zones 46_Moderate	September – November	High – 2
Swainsona plagiotropis	Red Darling Pea	Microhabitats with an open structure, herb-rich inter-tussock spaces and presence of cryptogamic crust within 26 – All zones 45_Mod_Good 46_Moderate	September	High – 2
Swainsona murrayana	Slender Darling Pea	Microhabitats with an open structure, herb-rich inter-tussock spaces and presence of cryptogamic crust within 15- All zones 26 – All zones 28 – All zones 45_mod_good	September	High – 2

Species name	Common name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
		46_moderate		
Swainsona sericea	Silky Swainsona-pea	Microhabitats with an open structure, herb-rich inter-tussock spaces and presence of cryptogamic crust within 15- All zones 26 – All zones 28 – All zones 45_mod_good 46_moderate	September – November	High – 2

Threatened fauna candidate species

Fauna habitat assessments were undertaken to determine whether the vegetation to be impacted by the project contained microhabitats suitable to support the candidate fauna species credit species, as outlined in Appendix 2. Table 28 provides a list of candidate fauna species credit species considered in this assessment within the subject land, each species' required survey period and the relevant method of assessment.

Table 28 Candidate fauna species credit species

Common name	Species name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
Australian Bustard	*Ardeotis australis*	13 – All zones 15 – All zones 26 – All zones 45_Mod_Good 46_Moderate	All year	High – 2
Barking Owl	*Ninox connivens*	10 – All zones 13 – All zones 15 – All zones 28 – All zones	January – August	High – 2
Bush Stone-curlew	*Burhinus grallarius*	10 – All zones 13 – All zones 15 – All zones 26_Intact 28 – All zones	All year	High – 2
Grey Snake	*Hemiaspis damelii*	10 – All zones 13 – All zones 15 – All zones	October - February	High – 2

Common name	Species name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
		17 – All zones		
Little Eagle (Breeding)	*Hieraaetus morphnoides*	10 – All zones 13 – All zones 15 – All zones 26 – Intact and sparse 28 – All zones	August – October	Moderate – 1.5
Major Mitchell's Cockatoo (Breeding)	*Lophochroa leadbeateri*	10 – All zones 13 – All zones 15 – All zones 26 – Intact and sparse	September – December	High – 2
Masked Owl	*Tyto novaehollandiae*	10 – All zones 13 – All zones 15 – All zones 28 – All zones	January – August	High – 2
Plains Wanderer	*Pedionomus torquatus*	26_DNG 46_Moderate	All year (important mapped areas)	Very High – 3
Southern Bell Frog	*Litoria raniformis*	10 – All zones 13 – All zones 15 – All zones 17 – All zones 26_DNG	October – January	High – 2
Southern Myotis	*Myotis macropus*	10 – All zones 13 – All zones 15 – All zones	October – March	High – 2
Square-tailed Kite (Breeding)	*Lophoictinia isura*	10 – All zones 13 – All zones 15 – All zones 26 – Intact and sparse 28 – All zones	September – January	Moderate – 1.5
Superb Parrot (Breeding)	*Polytelis swainsonii*	10 – All zones 13 – All zones 15 – All zones 26 – Intact and sparse 28 – All zones	September – November	High – 2

Common name	Species name	PCT/Zone	Survey period	Sensitivity to gain/Biodiversity Risk weighting
White-bellied Sea-Eagle (Breeding)	*Haliaeetus leucogaster*	10 – All zones 13 – All zones 15 – All zones	July – December	High – 2

4.3.1. Threatened species survey details

Targeted threatened species surveys of the subject land were undertaken by Biosis between August 2022 and November 2024. Weather observations where available for each survey date are shown in Table 29.

Table 29 Weather observations during targeted flora and fauna surveys (Deniliquin, NSW)

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)	Rain preceding month (mm)
		Min.	Max.		
Vegetation mapping, diurnal bird survey and hollow bearing trees **BBUS Winter 1**	3 August 2022	7.2	21.7	0	17.0
	4 August 2022	10.7	19.2	1.4	
	5 August 2022	7.0	16.7	0.2	
Targeted flora surveys and diurnal bird surveys	19 September 2022	4.5	16.3	3.0	58.0
	20 September 2022	4.0	19.9	0.2	
	21 September 2022	10.6	17.0	11.2	
	22 September 2022	12.2	22.4	1.2	
	23 September 2022	12.5	21.6	0.0	
BAM Plots, targeted flora surveys **BBUS Spring 1**	21 November 2022	8.8	16.7	0.2	187.0
	22 November 2022	6.8	17.1	1.0	
	23 November 2022	9.3	21.8	0	
	24 November 2022	8.1	24.4	0	
	25 November 2022	8.9	25.6	0	
BAM Plots, targeted flora surveys **Litoria surveys**	29 January 2023	21.8	24.4	0	72..2
	30 January 2023	18.4	32.2	8.8	
	31 January 2023	12.2	31.4	0	
	1 February 2023	11.6	29.3	0	
	2 February 2023	12.6	24.0	0	
BAM Plots, targeted flora surveys, hollow bearing trees **BBUS Summer 1**	13 February 2023	10.4	30.2	0	32.6
	14 February 2023	13.0	34.2	0	
	15 February 2023	15.9	39.0	0	
	16 February 2023	18.8	39.0	0	

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)	Rain preceding month (mm)
		Min.	Max.		
	17 February 2023	22.9	41.9	0	
Nocturnal birds surveys, Plains Wanderer surveys, frog surveys	1 April 2023	7.7	19.4	0	9.4
	2 April 2023	4.2	23.5	0	
	3 April 2023	8.4	27.0	0	
	4 April 2023	10.3	29.2	0	
	5 April 2023	11.4	29.5	0	
	11 April 2023	8.9	19.4	0	
	12 April 2023	11.6	20.4	7.2	
	13 April 2023	11.6	21.9	6.8	
	14 April 2023	9.9	25.2	0	
	15 April 2023	14.6	20.7	0	
BBUS Autumn 1	9 May 2023	4.3	17.8	0.2	8
	10 May 2023	3.9	17.2	0	
	11 May 2023	0.6	19.5	0	
	12 May 2023	2.0	20.7	0	
	13 May 2023	4.9	21.6	0	
BAM Plots vegetation mapping additional areas	14 June 2023	5.6	14.1	0.8	15.2
BBUS Winter 2	25 July 2023	0.2	15.4	0.2	24.1
	26 July 2023	-0.8.	11.7	0.2	
	27 July 2023	2.2	20.3	0	
	28 July 2023	4.2	20.0	2.4	
	29 July 2023	4.7	19.1	0.4	
Targeted flora and fauna surveys	11 September 2023	1.5	18.6	0	12
	12 September 2023	3.6	22.4	0	
	13 September 2023	5.7	24.8	0	
	14 September 2023	6.0	26.9	0	
	15 September 2023	10.5	25.8	0	
BBUS Spring 2	16 October 2023	10.8	18.2	1.0	78.1
	17 October 2023	3.5	20.8	0	
	18 October 2023	6.7	24.1	0	
	19 October 2023	10.8	28.6	0	
	20 October 2023	12.1	30.9	0	

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)	Rain preceding month (mm)
		Min.	Max.		
Targeted flora and fauna surveys	19 November 2023	9.1	33.9	0	14.6
	20 November 2023	16.0	33.5	0	
	21 November 2023	17.9	32.2	0	
	22 November 2023	13.4	30.3	19.4	
	23 November 2023	14.3	32.0	0.2	
Targeted fauna surveys – Litoria	15 January 2024	19	31.1	0	72.1
	16 January 2024	18.3	27.6	0	
	17 January 2024	18.3	26.3	1.0	
	18 January 2024	10.7	25.4	4.2	
	19 January 2024	9.3	28.1	0	
BBUS Summer 2	22 January 2024	11.3	29.5	0	67.3
	23 January 2024	10.5	35.1	0	
	24 January 2024	21.0	35.4	0	
	25 January 2024	23.8	30.8	0	
BBUS Autum 2	13 March 2024	20.5	33.5	0	0.6
	14 March 2024	18.2	25.4	0	
	15 March 2024	16.6	31.7	0	
	16 March 2024	18.6	28.8	0	
	17 March 2024	15.9	29.4	0	
Owls and Curlew and microbats (BBUS)	22 July 2024	7.1	18.4	0	22
	23 July 2024	5.4	19.2	0	
	24 July 2024	3.6	17.1	0	
	25 July 2024	7.5	15.1	0	
	26 July 2024	2.4	17.0	0.8	
	27 July 2024	5.0	15.8	0.2	
Targeted Flora survey	16 September 2024	-1.4	18.1	0	19
	17 September 2024	1.1	19.7	0	
	18 September 2024	3.8	24.7	0	
	19 September 2024	5.6	20.0	0	
	20 September 2024	50.0	19.0	0	
Targeted fauna surveys – nests, Hollows, Pink Cockatoo and Bustard	28 October 2024	9.7	25.3	0	7.7
	29 October 2024	7.4	27.1	0	
	30 October 2024	7.6	28.7	0	
	31 October 2024	11.0	25.3	0	

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)	Rain preceding month (mm)
		Min.	Max.		
Targeted Flora survey	18 November 2024	9.9	25.6	0.2	9.2
	19 November 2024	7.6	27.3	0	
	20 November 2024	7.7	30.5	0	
	21 November 2024	12.9	36.1	0	
	22 November 2024	18.2	37.3	0	
Targeted Flora survey	30 June 2025	1.8	13.3	0	50.6 (79 in preceding 3 months)
	1 July 2025	0.6	14.1	0	
	2 July 2025	4.5	14.9	0	
	3 July 2025	4.6	15.5	0	
	15 September 2025	7.6	27.2	0.0	14.2
	16 September 2025	13.4	15.8	0.0	
	17 September 2025	6.2	-	6.2	
	18 September 2025	-	-	0.0	
	19 September 2025	-	-	0.0	
	17 November 2025	8.8	19.3	0.0	28
	18 November 2025	13.2	27.5	0.2	
	19 November 2025	13.0	28.3	0.0	
	20 November 2025	10.8	24.1	0.0	
	21 November 2025	5.4	26.9	0.0	

Information from the Australia Government Bureau of Meteorology website.

Details of surveys undertaken as part of the current assessment are provided below.

Threatened flora

Targeted threatened flora surveys, undertaken by experienced Biosis ecologists (Table 30) on the dates listed in above in Table 29, were completed generally in accordance with the required BAM survey guideline, *Surveying threatened plants and their habitats* (DPIE 2020b). Feedback received from BCS during consultation for both the Dinawan wind and solar projects was also considered and implemented where as much as possible. Targeted threatened flora surveys were undertaken across the development corridor, focussing on the areas of the development footprint that support potential threatened flora habitat as much as possible. Areas excluded from survey included areas where the understorey was substantially depauperate due to being subject to ongoing grazing, areas with significantly high weed species ingress, and areas disturbed by tracks, dams, erosions, farm infrastructure and other associated vectors substantially impacting upon the soil profile.

Surveys were primarily undertaken via implementing a grid-based systematic approach based on the approach prescribed for in *Surveying threatened plants and their habitats* (DPIE 2020b), with parallel field

traverses also utilised between grid survey points, and in areas where habitats and potential impacts were more localised in nature and where microhabitats for some species occur.

Furthermore, slow driving vehicle-based transects were employed to target (and successfully record) flowering *Swainsona spp* across the development corridor, however, have been discounted from survey effort.

Survey method and effort

The BAM survey guideline, *Surveying threatened plants and their habitats* (DPIE 2020b) allows for implementation of a grid-based systematic approach when areas of suitable habitat greater than 50 hectares are required to be surveyed. This method requires a 100 square metre grid to be placed over the survey area, and at each grid intersect point, a 40 metre diameter area is surveyed for each target species.

Due to the very large size and the various reiterations of the development footprint and development corridor (approximately 948 hectares of native vegetation and potential habitat within the amended development footprint alone), and thus the area of suitable habitat requiring survey, as well as the consistent and uniform cover of native vegetation and habitats, a variation to the standard BAM method was applied. The intention of the varied survey effort employed was to achieve a level of survey that responds to the scale of the development footprint and suitable habitat requiring survey, reflects the relatively uniform, largely homogenous and repeated vegetation patterns that occur throughout the subject land (including the slight mosaic microrelief variation that occurs on occasion), as well as the land use history, whilst remaining scientifically robust and repeatable. The varied survey method still employed 100 metre grids within the development corridor, however due to the large number required, selected points surveyed were undertaken across as many representative PCT and conditions as possible, within the areas of highest potential for species being present, as well as where known infrastructure would occur at the time of survey, such as WTG locations, injunction with transects in between grids.

Added complexities to targeted flora survey were due to fluid design changes, predominantly due to efficiencies in road design and transmission requirements, and wet weather in spring 2022 which impeded access, but also as a result of survey results and application of the avoid and minimise principles as a result of biodiversity findings, and other environmental constraints (i.e. heritage). This meant that some survey grids and transects conducted in 2022 and 2023 are now outside of the development corridor. None the less, due to the homogenous nature of the PCT condition types within the development corridor and subject land, the results of these grid searches remain relevant.

Grid-based targeted surveys were implemented as follows:

- A grid spaced at 100 square metres was placed over the development footprint using GIS to locate the survey locations at each grid intersect point, which were accessed by GIS tablet computers in the field.
- Experienced botanist staff members then undertook detailed surveys at each of the survey locations by pacing out 40 m by 40 m square, crossing-over at the grid intersect point.
- This 40 m square was surveyed by walking 5 – 10 m wide parallel transects to ensure a high level of coverage within each survey location.
- When a target threatened species was located, finer scale surveys were used to "locate population extent, to help define the species polygon" in accordance with the two-phase grid-based systematic survey approach for large areas (DPIE 2020b).
- Further 10 m wide transect searches were completed when walking between grid points to increase survey coverage.

Survey progress was captured using handheld GPS units, and ArcGIS Tracker enabled on field staff mobile phones or tablet computers, to geospatially log transects walked throughout the targeted threatened species surveys. Spatial locations of all threatened species recorded were captured by either hand-held GPS units, mobile tablet computers running Collector for ArcGIS (both with accuracy of generally ± 5 metres).

Combining the number of grids undertaken in each corresponding survey month, as well as BAM plots and walking transect, demonstrates that the survey effort of what would be required by implementing grid searches only in the development footprint has been met or exceeded in many instances. Although the systematic grid survey was applied for targeted flora species in conjunction with flora transects in smaller habitats, a high degree of spatial representation across all homogeneous habitats and areas of microhabitats was still achieved, however survey gaps are still present. This meant however that locating areas of assumed presence polygons spatially was challenging. The following methods and results were employed to demonstrate survey gaps and areas of assumed presence, and where further targeted survey were undertaken in September and November 2025. Where shortfalls occur in survey coverage, species have been assumed present within each relevant zone, with the whole vegetation zone included. This would also allow for further design revision and more accurate development footprint and staging design, reducing survey area and, more importantly, potential impacts. Methods were as follows:

- The development footprint was divided into 100x100m grids.
- All grids points completed and non-driving transects in September 2022 to September 2024 (3x survey periods), November 2022-2024 (3x survey periods) as well as July 2025, September 2025 and November 2025 were overlayed within the 100x100m grid area.
- Completed grid points were buffered by 40m.
- Where a completed grid point had been undertaken and the 40m buffer was intersected with areas of impact, this grid square was deemed as surveyed.
- Where no grids, non-driving transects or 40m buffer occurred as completed or intersect within a 100x100m grid, then this grid was deemed as not surveyed, and assumed presence was applied across the entire 100x100m grid.

Furthermore, the grids were then intersected with the PCT and vegetation zones for the development footprint, in addition to the corresponding offset staging. A summary of species polygons is demonstrated in Table 31.

Three threatened flora species have been recorded, *Swainsona sericea*, *Swainsona murrayana* and *Maireana cheelii*. The two *Swainsona* species were found to co-occur in small patches and as isolated individuals in PCT 26 DNG, on the redder soils where forb richness is slightly higher and presence of other native species, such as Bulbine Lily was observed (Photo 3). Scattered individuals were recorded in these areas. *Swainsona sericea* (estimated 1,357 individuals) and *Swainsona murrayana* (estimated 1,527 individuals), were recorded within the subject land and include those recorded within the adjacent Dinawan Solar Farm area. Within the development corridor for Dinawan Wind Farm, approximately 12 and 285 individuals, respectively, were recorded. Not all of these individuals would be directly impacted. Numerous design revisions have occurred to avoid and minimise impacts to larger patches to ensure a viable local population can be maintained. Impacts will occur to isolated individuals and small patches.. This was determined by a 50m buffer around scattered individuals of both *Swainsona* species found (due to their similar habitats and often co-occurrence) as well as mapped extent of known populations, clipped to the development footprint.

Photo 3 (a) PCT 26 DNG with higher grass cover, less forb cover where threatened flora not found, **(b)** lower grass cover, higher forb cover, regenerating myall, where threatened *Swainsona* spp were found and **(c)** depressions and gilgai's targeted for *Pilularia novae-hollandiae* and *Austrostipa wakcoolica*.

Approximately 51 *Maireana cheelii* individuals were recorded along Goolgumbla Road during additional surveys in September 2025. Nearly all of these individuals have been avoided by the project during redesign of the public road upgrade and overhead transmission line, however small areas of buffer habitat will still be impacted and a species credit liability has been generated.

Justification of survey method and effort and timing

Targeted flora surveys were varied but aligned to the methods prescribed in the BAM guidelines *Surveying threatened plants and their habitats* (DPIE 2020b) for large sites with >50 hectares of suitable habitat requiring survey. Surveys were completed during the targeted species' survey periods as detailed in BioNet, as well as when species were recorded on site outside these prescribed timeframes. Reference populations and known records in the broader locality were also checked for *Swainsona* species and *Leptorhynchos orientalis*. Other species such as *Maireana cheelii* and *Brachyscome* species were also known to be flowering at the time of survey from other nearby projects and reference populations.

Survey personnel and relevant experience

Targeted flora surveys were undertaken by the Biosis ecologists listed in Table 30. At all times survey teams consisted of a minimum of one senior botanical specialist staff member, paired on occasion with a botanical specialist with less experience.

Table 30 Targeted flora survey personnel and relevant experience

Staff member	Role	Relevant experience
Mitchell Palmer	Manager – Ecology and GIS (NSW) BAM Accredited Assessor Principal Ecologist	Over 14 years' experience and key expertise in the identification of native flora, vegetation communities and avifauna species throughout NSW, including conducting flora and fauna surveys within the Riverina region.
Paul Price	Principal Botanist	Over 20years' experience and key expertise in the identification of native flora, vegetation communities and avifauna species throughout NSW, including conducting flora surveys within the Riverina region.
Rosie Gray	Senior Botanist	Five years' experience conducting threatened flora surveys within NSW.
Stephanie Cerato	Botanist	Four years' experience conducting threatened flora surveys within NSW.
Jake Schwebel	Botanist	Five years' experience conducting threatened flora surveys within NSW.
Nicholas Lloyd	Botanist	Four years' experience conducting threatened flora surveys within NSW and the Riverina region.
Kit King	Botanist	Three years' experience conducting threatened flora surveys within NSW.
Elise Keane	Senior Botanist	Eight years' experience conducting threatened flora surveys within NSW, particularly in the Riverina
Dimity Bambrick	Senior Ecologist	Six years' experience conducting threatened flora surveys within NSW, particularly in the Riverina
Todd Horton	Botanist	Four years' experience conducting threatened flora surveys within NSW, particularly in the Riverina
Dylan Mason	Botanist	Three years' experience conducting threatened flora surveys within NSW, particularly in the Riverina
Jess Chapman	Botanist	Two years' experience conducting threatened flora surveys within NSW, particularly in the Riverina
Hugh Smylie	Botanist	Two years' experience conducting threatened flora surveys within NSW

Results

Table 31 provides a summary of the results of the targeted flora surveys completed, survey effort and results are illustrated on Figure 11.

Table 31 Summary of targeted flora survey method and results

Species name	Common name	Survey method	Survey results	Species Polygon (ha or count within development footprint)
Austrostipa wakoolica	A spear-grass	• Within areas of potential habitat, parallel transects in areas <50 ha and grid based searches in areas >50 ha • November 2022 • November 2023 • November 2024 • November 2025	Not recorded during surveys to date.	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 17 moderate – 0.68 ha • PCT 26 Intact – 0.23 ha • PCT 26 sparse – 0.68 ha
Pilularia novae-hollandiae	Austral Pillwort	• Within areas of potential habitat, parallel transects in areas <50ha and grid based searches in areas >50 ha • November 2022. • November 2023 • November 2024	Not recorded during surveys to date.	Not detected in surveys undertaken to date Assumed present where survey shortfall occurs • PCT 13 moderate – 2.29 ha • PCT 13 thinned – 3.77 ha • PCT 15 moderate- 1.49 ha • PCT 15 thinned – 1.10 ha • PCT 17_moderate – 0.71 ha • PCT 26 DNG – 6.22 ha • PCT 26 Intact – 0.35 ha • PCT 26 sparse- 8.42 ha • PCT 45 mod_good – 0.27 ha • PCT 45 Intersection – 0.83 ha • PCT 46 moderate- 44.90 ha • PCT 46 Intersection – 0.34 ha
Maireana cheelii	Chariot Wheels	• Within areas of potential habitat, a combination of vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • November 2022 • September 2023 • November 2023 • September 2024 • November 2024 • September 2025 • November 2025	Recorded during surveys,	Detected during surveys (0.44 ha) • PCT13_moderate – 0.29 ha • PCT13_thinned – 0.14 ha Assumed present where survey shortfall occurs (2.54 ha) • PCT 26 DNG – 0.29 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse – 1.12 ha • PCT 46 moderate - 0.93 ha

Species name	Common name	Survey method	Survey results	Species Polygon (ha or count within development footprint)
Brachyscome muelleroides	Claypan Daisy	• Within areas of potential habitat, a combination of vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • November 2022 • September 2023 • November 2023 • September 2024 • November 2024 • September 2025 • November 2025	Not recorded during surveys to date.	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 46 moderate - 0.93 ha
Brachyscome papillosa	Mossgiel Daisy	• Within areas of potential habitat, a combination of vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • November 2022 • September 2023 • November 2023 • September 2024 • November 2024 • September 2025	Not recorded during surveys to date.	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 46 moderate- 1.74 ha
Convolvulus tedmoorei	Bindweed	• Within areas of potential habitat, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • September 2023 • September 2024 • July 2025	Not recorded during surveys.	Not detected in surveys undertaken to date.
Leptorhynchos orientalis	Lanky Buttons	• Within areas of potential habitat, a combination of	Not recorded during surveys to date.	Not detected in surveys undertaken to date.

Species name	Common name	Survey method	Survey results	Species Polygon (ha or count within development footprint)
		vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • November 2022 • September 2023 • November 2023 • September 2024 • November 2024 • September 2025 • November 2025		Assumed present where survey shortfall occurs: • PCT 26 DNG – 0.29 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.21 ha • PCT 46 moderate- 0.93 ha
Swainsona sericea	Silky Swainsona-pea	• Within areas of potential habitat, a combination of vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • November 2022 • September 2023 • November 2023 • September 2024 • November 2024 • September 2025 • November 2025	Recorded during surveys.	Detected during surveys (4.98 ha) • PCT 26 DNG – 1.98 ha • PCT 26 intact – 0.15 ha • PCT 26 sparse – 2.85 ha • PCT 46 moderate – <0.1 ha Assumed present where survey shortfall occurs (4.73 ha): • PCT 26 DNG – 0.97 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha • PCT 28 low – 0.06 ha • PCT 46 moderate – 2.37 ha
Swainsona murrayana	Slender Darling Pea	• Within areas of potential habitat, a combination of vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • September 2023 • September 2024 • September 2025	Recorded during surveys.	Detected during surveys (9.23 ha) • PCT 26 DNG – 2.76 ha • PCT 26 intact – 0.27 ha • PCT 26 sparse – 2.73 ha • PCT 46 moderate – 3.45 ha Assumed present where survey shortfall occurs (4.73 ha): • PCT 26 DNG – 0.97 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha • PCT 28 low – 0.06 ha • PCT 46 moderate – 2.37 ha

Species name	Common name	Survey method	Survey results	Species Polygon (ha or count within development footprint)
Swainsona plagiotropis	Red Darling Pea	• Within areas of potential habitat, a combination of vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • September 2023 • September 2024 • September 2025	Not recorded during surveys to date.	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 26 DNG – 0.97 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha • PCT 46 moderate- 2.37 ha
Sclerolaena napiformis	Turnip Copperburr	• Within areas of potential habitat, a combination of vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • November 2022 • September 2023 • November 2023 • September 2024 • November 2024 • November 2025	Not recorded during surveys to date.	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 26 DNG – 1.26 ha • PCT 26 Intact – 0.40 ha • PCT 26 sparse- 2.24 ha • PCT 46 moderate- 3.12 ha
Lepidium monoplocoides	Winged Peppercress	• Within areas of potential habitat, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • November 2022 • September 2023 • November 2023 • September 2024 • November 2024 • September 2025 • November 2025	Not recorded during surveys to date.	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 26 DNG – 0.29 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha
Eucalyptus leucoxylon	Yellow Gum	• Within areas of potential habitat, a combination of	Not recorded during surveys.	Not detected in surveys undertaken to date.

Species name	Common name	Survey method	Survey results	Species Polygon (ha or count within development footprint)
subsp. Pruinosa		vehicle based driving surveys, parallel transects in areas <50ha and grid based searches in areas >50 ha • September 2022 • February 2023. • September 2023 • September 2024 • November 2024 • September 2025 • November 2025		

Threatened fauna

Several habitat features with potential to support threatened species credit species were identified during habitat assessments. These features have been summarised in Table 32.

Table 32 Habitat features with potential to support threatened species credit species

Habitat feature	Presence within the development footprint
Hollow-bearing trees and fissures	Habitat trees supporting hollows of a variety of size classes from small (<50 mm diameter) through to large (150 – 400 mm diameter) were present across the subject land. These trees have the potential to provide breeding resources for a range of native fauna species including threatened cockatoos (Major Mitchell Cockatoo), and owls (Barking Owl and Masked Owl). These have been prioritised for forestalling to limit collision risk and therefore largely avoided.
Feed tree species	Trees, shrubs and mistletoe providing food resources for a range of bird species including Superb Parrot, Grey-crowned Babbler and more common species such as Red-rumped Parrots and Blue Bonnets.
Open grassland	Areas of open grassland provide foraging resources for large threatened raptors species such as Little Eagle, Spotted Harrier and Square-tailed Kite. The subject land contains areas of mapped Important Area for Plains Wanderer, with one individual recorded opportunistically during surveys in 2024, however these have largely been avoided.
Major and minor watercourses and waterbodies (i.e. dams)	Wetlands, ephemeral waterways and periodically inundated low lying areas and surrounding riparian vegetation support threatened amphibians such as Southern Bell Frog. In addition, large old trees, more likely to support tree hollows, such as Black Box are more common in riparian corridors and may support hollow-dwelling birds and mammals and act as an impart conduit for movement through the heavily modified landscape.
Woody debris and leaf litter	Woody debris and leaf litter was prevalent in the remnant vegetation patches across the subject land providing potential foraging habitat for birds, raptors and owl species.

Nocturnal birds - Barking Owl, Masked Owl and Plains Wanderer

Survey method and effort

Habitat assessments, including the detailed mapping of hollow-bearing trees and opportunistic surveys were undertaken, however no targeted nocturnal surveys for owls were completed. A key focus was to map potential owl habitat and hollow bearing trees, and site infrastructure away from these areas as far as practicable. Additional, targeted survey was undertaken for Bush Stone-curlew, Barking Owl and Masked Owl in July 2024, primarily targeting the presence of large woody debris for Bush-stone Curlew, and larger tree hollows potentially suitable for owl breeding activity, which are sparsely located within the development corridor. Woodland patches supporting suitable woody debris and tree hollows were then selected for nocturnal call-playback and spotlighting surveys, with eight survey locations sampled, across 48 replicates.

Call playback and detection in suitable habitat for threatened owls, included a two-minute call playback period, followed by five-minute listening period, and two-minute spotlighting period (conducted twice per species), with an initial ten-minute listening period and two-minute spotlighting period before commencing; plus a final fifteen-minute listening and spotlighting period following the survey, searching within approximately 60 metre radius of the call playback location.

Although considered unlikely to occur in this region, this survey also was undertaken for Bush Stone-curlew. Call playback and detection in suitable habitat for Bush-stone Curlew, including a 30-second call playback, followed by four minutes and 30 seconds of listening (conducted three times per site per evening). The survey guidelines do not specify the number of replicate nights of survey recommended, however in this case, two to four nights of survey were undertaken per site to align with the owl surveys. Spotlighting through suitable habitat, and lushing of vegetation (opportunistically) for Bush Stone-curlew were also completed. Additional spotlight and driving transects were conducted in March and April 2023 across eight nights, with audio detectors placed out between 29 March and 15 April, across 18 nights. Two Anabat swifts with acoustic microphones, and eight audiomoths were utilised during this period, as well as in November 2022.

No opportunistic records of owls or curlews were observed, nor were calls picked up during acoustic monitoring in March and April 2023 as part of Plains Wanderer surveys.

For Plains Wanderer, avoiding areas of NSW DCCEEW Mapped Important Areas of habitat, and minimising impacts to buffers surrounding mapped important areas was a key focus, however some impacts do occur primarily as a result of site access, including adjacent to an existing public road (Goolgumbla Road). To supplement this, a combination of spotlighting, driving transects, and audio acoustic detection techniques was undertaken. Additional surveys for Plains Wanderer focused on identifying grasslands outside of NSW DCCEEW Mapped Important Areas that nonetheless contained similar structural characteristics to these areas. At the time of surveys (April 2023), limited areas of the grasslands observed were considered optimal within the development corridor, including the nearby Mapped Important Areas, where minimal areas contained optimal habitat structure as described in the *National Recovery Plan for the Plains-wanderer (Pedionomus torquatus)* (DoE 2016), the *Saving Our Species Plains-wanderer Habitat Management Guide* (DPIE 2020d), or more recent research by Nugent et al. (*2022 Multi-scale habitat selection by a cryptic, critically endangered grassland bird—The Plains-wanderer (Pedionomus torquatus): Implications for habitat management and conservation*. The additional survey focused on traversing areas within the development corridor where a dominant cover of *Rytidosperma caespitosum* tussocks, and perennial tussock grasses such as *Chloris truncata* and *Enteropogon acicularis* occur. Generally, grasslands throughout the development corridor were too dense and tall, likely as a result of above average rainfall conditions in the 12 months prior, dominated by species such *Walwhalleya proluta*. Preferred habitat is generally characterised as containing approximately 50 % bare ground, 10 % fallen litter, and 40 % grasses, herbs, and forbs, usually on hard red-brown loams (DPIE 2020).

Grass tussocks are mostly shorter than five centimetres, with some patches of vegetation up to around 30 centimetres important for providing concealment. Inter-tussock space with bare earth and sparse litter is an important habitat component. Plains-wanderers are not likely to use habitat that is too dense with limited space between tussocks, actively avoid areas of dense grass, and their presence is negatively correlated with increased grass height (DoE 2016, DPIE 2020d). Open grassland structure is necessary to allow the birds to forage efficiently and to detect and avoid predators. It is possible though in more average years, density of grass cover will lower and due to the dynamic nature of grasslands in the Riverina, may provide habitat at times in future. Additional areas of potential habitat have been included for SAII assessment purposes including those areas containing microhabitats with an open structure, herb-rich inter-tussock spaces and presence of cryptogamic crust and that overlapped where Swainsona species were found.

Justification of survey method and effort

The key focus was the implementation of avoidance and minimisation of impacts to suitable owl habitat during project design, by siting infrastructure >200m away from areas containing known or potential for, suitable hollow bearing trees. The survey effort is considered adequate and in line with recommended survey requirements within the TBDC.

Avoidance of important mapped areas for Plains Wanderer, in conjunction with detailed survey of other potential areas of habitat, was undertaken. A 300m No Go buffer was placed around the location of the Plains Wanderer individual.

Timing of survey

Survey was conducted in relation to requirements in the TBDC survey guidance (where relevant).

Survey personnel and relevant experience

Nocturnal bird surveys were undertaken by the Biosis ecologists outlined in Table 33, survey effort is illustrated on Figure 11.

Table 33 Targeted nocturnal bird survey personnel and relevant experience

Staff member	Role	Relevant experience
Mitch Palmer	Manager – Ecology and GIS (NSW) BAM Accredited Assessor Principal Ecologist	Over 14 years' experience and key expertise in the identification of native flora, vegetation communities and avifauna species throughout NSW, including conducting flora and fauna surveys within the Riverina region.
Caragh Heenan	Senior Zoologist	Seven years' experience conducting threatened fauna surveys within NSW.
Bret Stewart	Senior Zoologist (Technical Lead)	15 years' experience conducting threatened fauna surveys within NSW.
Rachel Moore	Zoologist	Four years' experience conducting threatened fauna surveys within NSW.
Joel Nicholson	Zoologist	Over five years' experience conducting threatened fauna surveys within NSW.
Aleksei Atkin	Principal Ecologist	13 years' experience conducting threatened fauna surveys within NSW.

Staff member	Role	Relevant experience
Kit King	Botanist (hollow bearing tree assessment)	Three years' experience conducting threatened flora surveys within NSW. (Hollow bearing tree assessment)

Results

Table 34 provides a summary of the results of the nocturnal bird surveys completed. As a result of hollow bearing tree mapping within suitable habitat for threatened owls, numerous hollows were recorded, however due to the large areas and many trees containing hollows, not all were accounted for. However, like many of the hollow bearing trees noted within development corridor, many of the hollows are occupied by more common resident fauna species such as Galahs, Sulphur-crested Cockatoos, Blue Bonnets and Red-rumped Parrots. Of particular note and on the odd occasion where suitable owl sized hollows were encountered, these were occupied by Galahs at the time of survey, and therefore not considered to be in use for any threatened owls.

Now Owls nor Bush Stone Curlew were recorded. One Plains Wanderer individual was incidentally recorded in October 2024 within PCT 26 DNG and PCT 46, and coincidently, in close proximity to important mapped areas.

Avoiding mapped important habitat and identified potential areas of Plains Wanderer habitat was a key focus of the assessment for Plains Wanderer, however some impacts do occur primarily as a result of site access, including adjacent to an existing public road (Goolgumbla Road).

Table 34 Summary of nocturnal bird survey method and results

Species name	Common name	Survey method	Survey results	Species Polygon (ha) within development footprint
Tyto novaehollandiae	Masked Owl	• Habitat assessment and hollow bearing tree assessment • Supplementary acoustic detection	No evidence of Owl use within suitable habitat	N/A
Ninox connivens	Barking Owl	• Habitat assessment and hollow bearing tree assessment • Supplementary acoustic detection	No evidence of Owl use within suitable habitat	N/A
Pedionomus torquatus	Plains Wanderer	• Important mapped areas • Habitat mapping • Driving transects / spotlighting • Audio acoustic detection	Important mapped areas identified with some impacts One individual was recorded opportunistically	2.55 ha of important mapped habitat that intersect native vegetation
Burhinus grallarius	Bush Stone-curlew	• Driving transects / spotlighting • Audio acoustic detection	Not recorded	N/A

Diurnal birds and active nest/hollow searches

Survey method and effort

Seasonal bird utilisation surveys were undertaken to inform collision risk modelling (CRM) and therefore potential prescribed impacts, including the risk of collision with turbine blades. It was also used to inform the targeted species surveys for candidate species credit species.

Background research and data sources were reviewed to identify all protected bird species records within 50 kilometres of the development corridor. Information from relevant literature and incidental species sightings during other surveys were used to inform surveys. Bird utilisation survey (BUS) replicates were undertaken to focus on key species of concern and record data for all species including:

- All threatened species.
- Species which are rarely recorded.
- Species which exist naturally at relatively low densities.
- Waders.
- Larger birds such as raptors (eagles, hawks, kites) and waterbirds (herons, pelicans).
- Migratory birds.

A total of 26 fixed survey sites were established, including 16 impact sites and 10 control sites, consisting of 720 replicates in total. Of the total 26 points, 16 impact sites and four control sites, totalling 574 replicates across all seasons, were utilised in the CRM. The survey locations were selected to represent likely turbine positions identified early in the project design and to obtain data at potential impact locations. They were distributed in different vegetation formations as a surrogate for habitat types. As the design developed, some turbine locations moved to avoid other environmental constraints, which resulted in modifications to the BUS design. Methodology and results of the CRM are discussed further in Section 6.

Over a 24 month (or two year) period, BUS was undertaken within the subject land in the seasons and dates outlined in Table 36 below to support the collision risk modelling, and to describe the avian fauna of the subject land.

Table 35 Summary of bird survey method and results

Year	Summer	Autumn	Winter	Spring
2022	-	-	1- 5 August	21- 25 November
2023	6 - 10 February	8 - 12 May	23 -27 July	16 - 20 October
2024	22 - 26 January	13 - 17 March	-	-

Surveys comprised fixed-point surveys, which comprised one observer stationed at each point for 20 minutes. Survey details including the date, start and end times, site location, weather conditions, and habitat features of interest were recorded during each survey. During surveys, all observations within 360 degrees and up to 3500 metres of the observer were recorded, including:

- Species observed taking flights.
- Count of individuals.
- Height of bird above ground when first detected, in 5 metre increments.
- Distance of bird from observer when first detected.

- Species behaviour, if relevant.
- Flight direction.
- Incidental bird observations were also recorded across the subject land.

Each fixed point was surveyed two to four times per survey, ideally a minimum of once each at three different times of day:

- Morning (6:00 AM to 10:59 AM).
- Mid-day (11:00 PM to 13:59 PM).
- Afternoon (2:00 PM to 6:00 PM).

This methodology aimed to capture seasonal and temporal changes, including migration and species behaviour.

The 26 fixed survey impact and control points and replicates obtained equates to a total of 720 replicates and around 14,400 minutes (or a total of 240 hours) of targeted diurnal bird surveys across multiple habitats, including 467 impact replicates and around 9,340 minutes (or nearly 156 hours) of targeted bird surveys.

The following draft height matrix was defined to classify bird height but will be subject to final turbine specifications for lower and upper blade tip height, and allows for nominal variations within the hub height:

- Below Rotor Swept Area (RSA): <61 metres above ground level.
- Within RSA: 61 to 239 metres above ground level.
- Above RSA: >239 metres above ground level.

The following bird guilds were used to categorise species:

- Raptors.
- Grassland, shrubland and ground-dwelling birds.
- Waterbirds, seabirds and other aquatic foragers.
- Woodland birds (including parrots and songbirds).
- Exotic birds (introduced species).

The above guilds were applied to the BUS results to identify birds of concern for future collision risk modelling.

Initial habitat mapping comprising assessment of tree-hollow densities suitable for parrot nest trees and large raptor nests was undertaken across the majority of woodland patches within the development corridor. In addition to BUS, opportunistic and targeted surveys as well as large stick nest and hollow bearing tree surveys were conducted in September 2022, February 2023, March 2023 and September 2023 and October 2024. Surveys consisted of transects, observing hollows for use and other evidence of breeding.

Targeted parrot surveys were then undertaken by a combination of area searches, point transects and slow driving transects, by two ecologists, and included:

- Observations of any signs of breeding, such as begging birds, any occupied nests/hollows and lone birds within the breeding season.

- Twenty-minute searches completed within woodland patches, dependent on vegetation and habitat distribution.
- A vehicle driven slowly with windows down through suitable habitat (woodland), in approximately 50 -100 m wide parallel transects, with denser areas inspected on foot.

When the target species were recorded, they were followed until they were observed at/in a hollow, or were unable to be followed further.

All known large stick nests within or surrounding the development corridor were visited in October 2024 to ascertain use and species occupancy. Whilst visiting known nests, large areas of wooded habitats were being concurrently surveyed for new nests and the general presence of the target species.

Justification of survey method and effort

Survey was undertaken in accordance with methodology outlined in the NSW *Threatened Biodiversity Survey and Assessment Guidelines* (DEC 2004) and best practice for surveying wind farm developments.

NSW DCCEEW is developing survey guidance for many threatened bird species (DPE 2023d). Methods employed as part of this assessment included:

- Survey for the presence of eucalypts containing hollows that are at least 9 m above the ground, and with hollow diameter of 10 cm or larger.
- Survey for the presence of breeding on site as follows; (a) begging birds of any age or sex; or (b) lone adult males identified during the breeding season; or (c) an occupied nest.
- Survey for the presence of nest trees supporting large stick nests.
- Survey for the presence of living or dead eucalypt trees containing hollows greater than 5 cm diameter and greater than 4 m above the ground (or with a DBH of greater than 30 cm).

Currently, the TBDC stipulates a staged approach for the detection of breeding. This includes the identification of signs of breeding (presence of the species during breeding season) and potential nest trees (suitable hollow-bearing trees).

In conjunction with the substantial BUS survey effort across multiple years and seasons, the survey methods and effort completed by Biosis are considered to fulfil this requirement.

Timing of survey

Seasonal replicate surveys across multiple years were completed, including 2022 that had above average rainfall and flooding events, meaning surveys were timed to provide the best opportunity to record all birds present and that may occur on occasion within the subject land. This includes sedentary or resident birds, migratory or nomadic birds, and also provides an opportunity to determine the presence of certain species during BAM/BioNet specified breeding season survey periods. Active nest searches and targeted hollow bearing tree use mapping was undertaken in October 2024.

Survey personnel and relevant experience

Diurnal bird surveys were undertaken by the Biosis ecologists outlined in Table 36.

Table 36 Targeted diurnal bird survey personnel and relevant experience

Staff member	Role	Relevant experience
Mitch Palmer	Manager – Ecology and GIS (NSW) BAM Accredited Assessor Principal Ecologist	Over 13 years' experience and key expertise in the identification of native flora, vegetation communities and avifauna species throughout NSW, including conducting flora and fauna surveys within the Riverina region.
Caragh Heenan	Senior Zoologist	Seven years' experience conducting threatened fauna surveys within NSW
Stephanie Cerato	Botanist (support fauna field surveys)	Four years' experience conducting threatened flora and fauna surveys within NSW (Superb Parrot surveys 2022)
Bret Stewart	Senior Zoologist (Technical Lead)	Over 15 years' experience conducting threatened fauna surveys within NSW.
Aleksei Atkin	Principal Ecologist	Over 13 years' experience conducting threatened fauna surveys within NSW.
Rachel Moore	Zoologist	Four years' experience conducting threatened fauna surveys within NSW.
Emma Heath	Zoologist	One years' experience conducting threatened fauna surveys within NSW.
Zalia Payne	Zoologist	Three years' experience conducting threatened fauna surveys within NSW.
Joel Nicholson	Zoologist	Over five years' experience conducting threatened fauna surveys within NSW.

Results

Table 37 below provides a summary of the results of the diurnal bird surveys completed.

A total of 140 bird species were recorded within the subject land, including 110 species recorded during BUS and 30 additional bird species recorded as incidental observations, outside of BUS. The total list of species is provided in Appendix 4. The number of species varied across seasons for bird utilisation and incidental surveys with the highest diversity in spring (104 species recorded), closely followed by summer (98 species recorded) and autumn (88 species recorded), with the lowest diversity in winter (70 species recorded).

The only candidate species credit species recorded were Superb Parrots (Photo 4). Superb Parrots were recorded regularly during BUS surveys, particularly foraging within PCT 26 intact vegetation, more frequently along roadside corridors of McLennons Bore Road and Carrathool Road, but also sporadically within the development corridor. Paired individuals and groups including juveniles were recorded, particularly in autumn and summer seasons. This result is not unexpected given the nomadic nature of Superb Parrots in moving to northern and central areas of NSW over winter. Generally though, in all other seasons, Superb Parrots generally tend to remain within or near their breeding territories throughout the year, especially if suitable habitat and food sources are available but may undertake local movements or dispersals, particularly young birds seeking new territories or breeding opportunities.

Wedge-tailed Eagles (Photo 4), and other more common raptors, were a common sighting, and numerous medium to large, active and non-active stick nests were observed, predominantly in White Cypress Pine and Black box vegetation, but also on existing large transmission line towers.

Numerous ecosystem credit species were also recorded. These included Southern Whiteface, Dusky Woodswallow, White-fronted Chat, Grey-crowned Babblers, Painted Honeyeaters, Spotted Harrier and Black Falcon. The Black Falcon and Grey-crowned Babblers were observed to be nesting within the subject land, and other species presumed to be as well.

Photo 4 (a) Wedge-tailed Eagle perched on transmission line adjacent to PCT 28, **(b)** Superb Parrot adult male within canopy of PCT 26. Further information on CRM and results of bird utilisation can be found in Section 6.

Table 37 Summary of diurnal bird survey method and results

Species Name	Common name	Survey method	Survey results	Species polygon (ha) within development footprint
Ardeotis australis	Australian Bustard	Surveys throughout the development corridor in September 2022, March and April 2023, October 2024	This species was not observed during multiple surveys.	N/A
Hieraaetus morphnoides	Little Eagle (Breeding)	Targeted nest surveys in September 2022, September 2023, October 2024 Bird utilisation surveys	This species was not observed during multiple surveys across eight seasons across two years. Large nests detected but in use by Wedge-tailed Eagles.	N/A
Lophochroa leadbeateri	Major Mitchell's Cockatoo (Breeding)	Hollow bearing tree surveys in September 2022, September 2023. October 2024 General diurnal bird surveys Bird utilisation surveys Opportunistic surveys	This species was not observed during multiple surveys across eight seasons across two years.	N/A
Lophoictinia isura	Square-tailed Kite (Breeding)	Targeted nest surveys in September 2022, September 2023 and October 2024 Bird utilisation surveys	This species was observed incidentally foraging on one occasion in December 2024. Large nests detected but in use by Wedge-tailed Eagles.	N/A
Polytelis swainsonii	Superb Parrot (Breeding)	Hollow bearing tree surveys in September 2022, September 2023, October 2024 General diurnal bird surveys Bird utilisation surveys Opportunistic surveys	This species was detected throughout BUS surveys across multiple seasons. Although not observed breeding within the development corridor, it must be assumed due to the presence of paired individuals and juveniles, that breeding is occurring within the subject land. This is expected within the Riverina locality where	100m buffer of associated PCTs within the development corridor with potential HBTs that intersect native vegetation (36.66 ha in total) PCT 10 moderate – 0.19 ha PCT 13 moderate – 3.56 ha PCT 13 thinned – 7.82 ha PCT 15 moderate – 2.54 ha PCT 15 thinned – 1.10 ha

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Species Name	Common name	Survey method	Survey results	Species polygon (ha) within development footprint
			suitable habitat for superb parrots breeding occurs, particularly along river corridors and in woodland patches, more so where River Red Gums are prevalent.	PCT 17 moderate – 0.27 ha PCT 26 DNG – 8.40 ha PCT 26 intact – 1.56 ha PCT 26 sparse – 7.54 ha PCT 28 low – 0.04 ha PCT 28 moderate – 0.21 ha PCT 45 mod_good – 0.15 ha PCT 46 moderate – 2.86 ha PCT 160 moderate – 0.01 ha
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	Targeted nest surveys in September 2022, September 2023 and October 2024 Bird utilisation surveys	This species was not observed during multiple surveys across eight seasons across two years. Large nests detected but in use by Wedge-tailed Eagles, and where nests detected, not optimal for use by White-bellied Sea-Eagle.	N/A

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Amphibians – Southern Bell Frog

Survey method, effort and timing

Habitat assessments were undertaken to determine the likely presence of Southern Bell Fog in November 2022, and this species was observed opportunistically and repeatedly during the broader habitat surveys, as well as again in February and March 2023 during targeted surveys for other nocturnal species. Suitable habitat included seasonally inundated wet areas, farm dams, drainage lines and overflows where grasses, sedges and rushes were present amongst shallow, still water, as well as areas surrounding irrigated cropping areas. It is likely survey results are an indication of above average rainfall and flooding conditions that likely washed individuals from a stronghold area in the Coleambally irrigation areas to the North, via flooding events in the Delta Creek and Coleambally irrigation channel.

Additional targeted survey was completed in 15- 19 January 2024.

Justification of survey method and effort

Targeted surveys were planned to occur in accordance with the *NSW survey guidelines for Threatened frogs* however since this species was observed during habitat assessment surveys, this was deemed sufficient in order to ascertain habitat within the subject land. For the most part, the subject land provides habitat on a temporary basis, and during times of flooding events, with permanent habitat, albeit suboptimal due to limited vegetation cover and water quality, limited to the irrigation channels and farm dams. Surveys undertaken in January 2024 targeted areas of more permanent water in the subject land such as farm dams, irrigated cropping areas and channels.

Survey personnel and relevant experience

Amphibian surveys were undertaken by the Biosis ecologists outlined in Table 38

Table 38 Amphibian survey personnel and relevant experience

Staff member	Role	Relevant experience
Mitch Palmer	Manager – Ecology and GIS (NSW) BAM Accredited Assessor Principal Ecologist	Over 14 years' experience and key expertise in the identification of native flora, vegetation communities and avifauna species throughout NSW, including conducting flora and fauna surveys within the Riverina region.
Aleksei Atkin	Principal Ecologist	Over 14 years' experience conducting threatened fauna surveys within NSW.
Bret Stewart	Senior Zoologist (Technical Lead)	15 years' experience conducting threatened fauna surveys within NSW.
Tara Lillicot	Zoologist	Two years' experience conducting threatened fauna surveys within NSW.

Results

Numerous Southern Bell Frog *Litoria raniformis* were detected within the subject land in April, September and November 2023 and January 2024 (Photo 5). It was noted that where more permanent water was found and *Gambusia holbrooki* were present, the Southern Bell Frog was not recorded or observed to be present. Where more permanent water was found, such as irrigation channels and farm dams, and

Gambusia holbrooki was not present, mature individuals, immature individuals and tadpoles were observed.

Photo 5 *Litoria raniformis* adjacent to Coleambally Outfall Drain

Table 39 Summary of amphibian survey method and results

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count
Litoria raniformis	Southern Bell Frog	Opportunistic observations Multiple (>100) individuals observed and linked to point locations shown on Figure 11.	This species was observed throughout the Coleambally outfall drain and farm dams and fringing areas of PCT 26 DNG within the subject land.	200m buffer of habitat and associated PCTs in accordance with relevant guidelines, that intersect native vegetation, (83.63 ha in total) • PCT 13 moderate – 0.55 ha • PCT 13 thinned – 2.00 ha • PCT 15 thinned – 1.07 ha • PCT 17 mod_good – 0.49 ha • PCT 26 DNG – 28.73 ha • PCT 26 intact – 8.09 ha • PCT 26 sparse – 29.93 ha • PCT 28 Low – 0.77 ha • PCT 45 intersection– 0.64 ha • PCT 46 moderate – 9.53 ha • PCT 46 Intersection – 0.34 • PCT 160 mod_good – 1.48 ha

Reptiles – Grey Snake

Survey method, effort and timing

The project will assume presence of Grey Snake due to the late inclusion of the species as a Species Credit Species, approximately 15 months after the project's SEARS were issued. The Applicant proposes to either produce an Expert Report or progress further surveys to revise and more accurately describe impact to the species as part of post-approval survey.

An Assumed Presence habitat polygon has been developed for Grey Snake, the details of which are provided in Table 40.

Table 40 Summary of reptile survey method and results

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count
Hemiaspis damelii	Grey Snake	N/A	Assumed present	Associated PCTs in accordance with relevant guidelines (22.68 ha in total). • PCT 10 moderate – 0.19 ha • PCT 13 moderate – 3.96 ha • PCT 13 thinned – 7.82 ha • PCT 15 moderate – 2.54 ha • PCT 15 thinned – 1.10 ha • PCT 17 mod_good – 0.76 ha • PCT 17 moderate – 1.33 ha • PCT 160 mod_good – 4.97ha

Microbats

Survey method, effort and timing

Microbat surveys were undertaken across the subject land as part of BBUS. Survey effort and results have been combined between those collected within and outside the subject land, such as impact and control sites, to allow for an assessment of the microbat fauna that may utilise the habitats across the site.

Calls were recorded from dusk until dawn using four Titley Scientific Anabat Express (Full Spectrum upgrade) and one Titley Scientific Anabat Swift ultrasonic recorders, fitted with omnidirectional microphones. Default settings for trigger, sensitivity, sampling rate and minimum / maximum frequency were used. Each time a bat flies past the detector, its call is recorded as a digital file (defined here as a 'pass') that is saved directly onto a memory card in the detector unit. Files were recorded in full spectrum format (.wav). Default settings for trigger, sensitivity, sampling rate and minimum / maximum frequency were used. Units were set on trigger mode to record at night. Units were located in flyways within target habitat areas to allow space in front and around the microphone to minimise echoes from hard surfaces, call attenuation from surrounding vegetation, and ensure adequate flight space around the microphone.

Units were located to allow space in front and around the microphone to minimise echoes from hard surfaces, call attenuation from surrounding vegetation, and ensure adequate flight space around the microphone. The majority of detectors were installed at ground or canopy level. Two Meteorological Masts (Met Masts) were sampled during each survey period commencing from summer 2023. The first

Met Mast installed at the eastern side of the site (MME_DIN01), within the stage 1 area, had a detector mounted to a pulley system approximately 70 metres high in each of summer 2023 and summer 2024, autumn 2023 and 2024, winter 2023 and 2024, and spring 2023 and 2024. In summer, autumn and winter 2024, a unit was also mounted to the second and more recently installed Met Mast (MMW_DIN02) in the site's west, in the stage 2 area. Each Met Mast also had a second detector placed at ground level, for direct comparison with data collected at height (photo 6).

In total across two years and eight seasons, 259 detector nights were undertaken as shown in Table 41.

No reference calls were collected during the survey. Call identification was assisted by the following resources:

- Bat calls of NSW (Pennay, Law, & Reinhold 2004) including sample call files downloaded from https://www.environment.nsw.gov.au/topics/animals-and-plants/surveys-monitoring-and-records/bat-calls-of-nsw
- Key to the bat calls of south-east Queensland and north-east New South Wales (Reinhold et al. 2001)
- Unpublished course materials from the Advanced Bat Call Analysis Workshop (May 2023) – Titley Scientific and Balance! Environmental (Greg Ford and Julie Broken-Brow).

Species nomenclature used in this report follows the Australian Faunal Directory (ABRS 2022) unless otherwise stated. Survey was undertaken with reference to the following guidelines:

- *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (NSW Office of Environment and Heritage, 2018).
- *Survey guidelines for Australia's threatened bats* (Department of the Environment, Water, Heritage and the Arts, 2010).

Table 41 Survey effort per season

Season	Date deployed	Date retrieved	Number of detectors	Detector model	Detector nights
Spring	20-21/11/2022	25/11/2022	10	5 x Anabat Express FS 5 x Anabat Swift	35
Summer	6/2/2023	8-15/2/2023	11	3 x SM4 6 x Anabat Express FS 2 x Anabat Swift	40
Autumn	8/5/2023	10-12/5/2023	10	5 x Anabat Express 4 x Anabat Swift	33
Winter	24/7/2023	28/7/2023	12	4 x Anabat Express 8 x Anabat Swift	43
Spring	15/10/2023	19/10/2023	12	3 x Anabat Express 9 x Anabat Swift	44
Summer	15/1/2024	23/1/2024	4	4 x Anabat	19

Season	Date deployed	Date retrieved	Number of detectors	Detector model	Detector nights
				Express	
Autumn	11/3/2024	16/3/2024	8	7 x Anabat Chorus 1 x Anabat Swift	27
Winter	22/07/2024	27/02/2024	4	4x Anabat Swift	18
TOTAL					**259**

Photo 6 Installed detector on stage 1 Met Mast and example of detector set up within PCT 26 DNG and adjacent PCT 13

Survey personnel and relevant experience

Deployment of detectors was undertaken concurrently with bird utilisation surveys and nocturnal surveys, by Biosis Zoologists with suitable experience in using and deploying ultrasonic bat detectors. Call analysis was undertaken by Felicity Williams. Felicity is experienced in ultrasonic call analysis having used it to complete her Honours thesis titled "*The influence of fire on the foraging activity of insectivorous bats in the Victorian Mallee*" in 2009 under the supervision of Lindy Lumsden (Arthur Rylah Institute for Environmental Research, Victorian Government Department of Land, Environment, Water and Planning). Felicity has over eight years' experience using ultrasonic call detection and analysis for impact assessments on microbats in both Victoria and NSW. A subset of calls for each species identified was sent to an independent bat expert for verification. Positive identifications presented in this assessment were confirmed by Dr Lisa Cawthen.

Table 42 Targeted microbat survey personnel and relevant experience

Staff member	Role	Relevant experience
Felicity Williams	Senior Zoologist – Bat Ecology	Over eight years' experience in bat call data analysis.
Mitch Palmer	Manager – Ecology and GIS (NSW) BAM Accredited Assessor Principal Ecologist	Over 14 years' experience and key expertise in the identification of native flora, vegetation communities and avifauna species throughout

Staff member	Role	Relevant experience
		NSW, including conducting flora and fauna surveys within the Riverina region.
Aleksei Atkin	Senior Zoologist	Over 14 years' experience undertaking diurnal bird surveys in NSW.
Dr Caragh Heenan	Senior Zoologist – Major Projects (Zoology)	Over five years' experience undertaking bat surveys in NSW and 17 years' experience undertaking flora and fauna surveys across South Australia and Northern Territory.
Emma Heath	Zoologist	Over one year of experience undertaking bat surveys in NSW.
Joel Nicholson	Zoologist	Over five years' experience undertaking bat surveys in NSW.

Results

Data was viewed using Anabat Insight (version 2.0.9, licensed), Titley Scientific.

Species identification was first refined by using known species geographic distributions (Churchill 2008, Australasian Bat Society 2022) to generate a list of species with potential to occur at the site. Species identification was guided by the probability of occurrence at the site based on distribution, database records obtained from NSW BioNet and known habitat values at each detector point and across the site more broadly.

Files not containing bat calls (noise files) were filtered out using a standard "allbats" filter in Anabat Insight and not included in further analysis. A custom decision tree was used to sort remaining files into likely species and species groups. Calls were identified by visually comparing the spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls and descriptions from available reference materials (Reinhold et al. 2001, Pennay, Law, & Reinhold 2004).

A call (pass) was defined as a sequence of five or more consecutive pulses of similar frequency and shape. Identification was not attempted for sequences with less than five defined consecutive pulses (unless for readily identifiable species such as the White-striped Freetail-bat *Austronomus australis)*. Similarly, sequences containing multiple bats or pulses with irregular frequency and / or shape (non-search-phase calls) were not identified to species. Once a species was positively identified, it was recorded as present. Species identification was therefore not attempted for all files recorded. Where a threatened species was not recorded through the decision tree, additional checks were used to improve confidence that a false negative was not recorded including target frequency filters and manual review of 'noise' files. Due to variability in the quality of calls and difficulty in distinguishing some species, a conservative approach was taken when analysing calls and assigning an identification. The identification of each call was assigned a confidence rating (Duffy et al. 2000) as summarized in Table 43.

A total of 142,044 files were recorded over 259 detector nights seasonally from spring 2022 to Winter 2024. Of these, 78,861 were discarded by the allbats filter and 5,716 contained less than 5 pulses and were not used in further analysis. This resulted in 56,996 files deemed to be valid bat calls of which 20,798 were manually reviewed during data analysis (equating to 36% of total valid passes).

Fourteen species were positively identified (Almost Certain or Probable) of the 18 species that are known or predicted to occur within the subject land (Australasian Bat Society 2022). Up to four additional species may also have been recorded however reliable identification to species level was not possible due to similarity of call characteristics between species.

Table 43 Call identification confidence ratings

Identification	Description
C – Almost certain	Diagnostic call characteristics present, consistent with descriptions in reference material and / or reference calls.
PR - Probable	Highly likely the call represents a particular species, but call lacks enough detail (e.g. call quality) to be definite or similarities with other species of similar call type or frequency limits identification certainty and/or there is a limited number of sequences to be confident in species presence.
SG – Species Group	Call characteristics (e.g frequency, shape) are indicative of a number of species and call lacks sufficient detail (e.g. call quality, diagnostic features) that would allow identification to species level.
X – Not Detected	Of the data analysed, no calls were attributable to this species.

Table 44 Summary of microbat survey method and results

Species name	Common name	BC Act status	EPBC Act status	Identification
Austronomus australis	White-striped Free-tailed Bat	-	-	C
Chalinolobus gouldii	Gould's Wattled Bat	-	-	C
Chalinolobus morio	Chocolate Wattled Bat	-	-	C
Chalinolobus picatus*	Little Pied bat	V	-	PR
Myotis macropus	Southern Myotis	V	-	SG
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	SG
Nyctophilus geoffroyi	Lesser Long-eared Bat	-	-	SG
Nyctophilus gouldi	Gould's Long-eared Bat	-	-	SG
Ozimops petersi	Inland Free-tailed Bat	-	-	C
Ozimops planiceps	South-eastern Free-tailed Bat	-	-	C
Ozimops ridei	Ride's Free-tailed Bat	-	-	C
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	C

Species name	Common name	BC Act status	EPBC Act status	Identification
Scotorepens balstoni	Inland Broad-nosed Bat	-	-	C
Scotorepens greyii	Little Broad-nosed Bat	-	-	C
Vespadelus baverstocki*	Inland Forest bat	V	-	PR
Vespadelus darlingtoni	Large Forest Bat	-	-	PR
Vespadelus regulus	Southern Forest Bat	-	-	PR
Vespadelus vulturnus	Little Forest Bat	-	-	C

* The study area occurs at the edge of the current accepted distribution range of these species. A small number of possible calls for each of these species were found during call analysis however, their presence within the study area would need to be confirmed through trapping to be confident calls were attributable to these species

The only threatened species identified to species level with confidence was Yellow-bellied Sheathtail Bat. Reliable identification to species level of a further three species was not possible due to poor data quality, similarity of call characteristics between species and / or uncertainty surrounding distribution. These species include:

- Southern Myotis – Difficult to separate from those of Long-eared bats (Nyctophilus spp) in the absence of diagnostic features. Unlikely to be this species as discussed in Section 4.3.
- Corben's Long-eared bat - Calls of Corben's Long-eared Bat cannot be differentiated from those of Gould's Long-eared Bat or Lesser Long-eared Bat, and the species is therefore assumed to be present in areas where Long-eared Bat calls were recorded.
- Little Pied Bat - A small number of potential Little Pied Bat calls were recorded. Due to the low quality and small number of sequences, it was difficult to confirm the presence of this species through call analysis.

These species were identified as part of a species group and identification to species level cannot be confirmed from the ultrasonic analysis.

Limitations

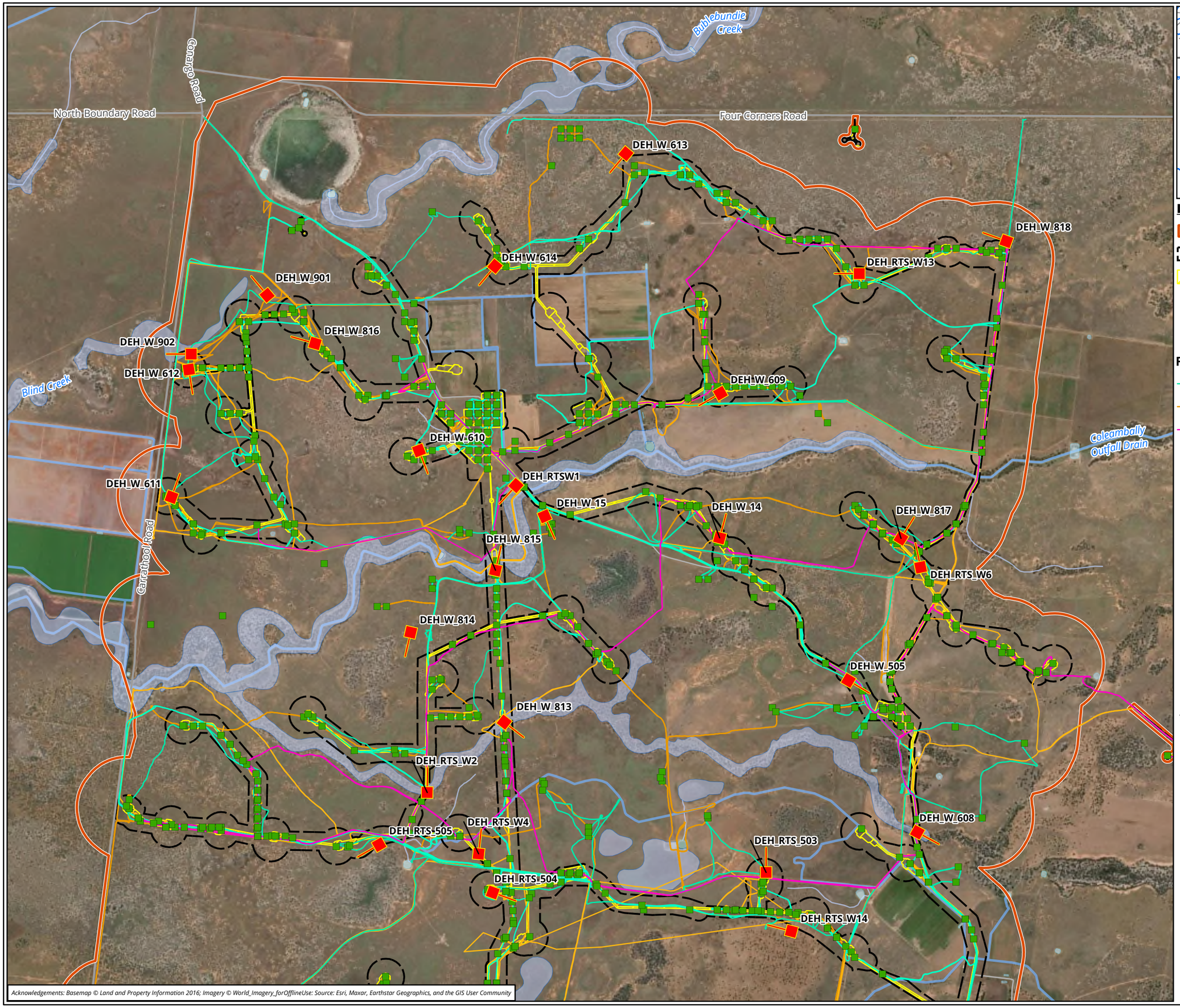
As well as species presence/ absence, bat activity was compared between seasons and habitats as part of site utilisation studies. As described above, not all species were identified to species level. Comparisons of bat activity was based on files assumed to be valid bat calls which included all sequences that passed the allbats filter, and contained more than 5 pulses. It is likely that at least some of these sequences are not actual bat calls (may be insects or noise) and it is also likely that some files that were not included as valid calls (such as containing not enough pulses) were actually bat calls. It is assumed that the error rate is consistent across all units and therefore, valid comparisons of activity can still be made.

Ultrasonic sampling is associated with a number of limitations. Detectability of bats relates to the intensity of their calls, their flight characteristics and the structure of the surrounding vegetation, all of which influence the distance over which a bat can be detected. Differences in the probability of detection

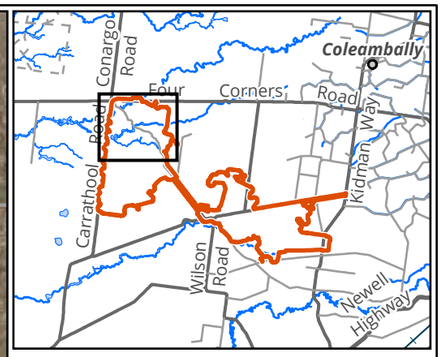
may result in reduced likelihood of recording and therefore positively identifying some species as present within a site. A recorded call constitutes a measure of relative bat activity, but does not reflect species abundance. The number of calls provides a comparable index of activity to estimate the foraging selectivity of individual species between sampling sites. Manual call analysis is also associated with limitations including the sometimes arbitrary selection of useable calls and subjectivity of the observer. Definitions as to which calls are assigned to each species have been provided to improve the consistency at which calls were attributed to a species.

Wind speed and temperature data was collected at 50 metres and 70 metres at single location points across the subject land. This data may not be representative of actual wind and temperature experienced by bats that are recorded at each detector point, and therefore extrapolations of wind and bat activity across the site are limited.

Bat activity is discussed further in Section 6.



Acknowledgements: Basemap © Land and Property Information 2016; Imagery © World_Imagery_forOfflineUse: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot
- Flora grid point

Flora survey tracks

- September
- November
- July

Figure 11A Targeted flora survey
Page 1

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Meters
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

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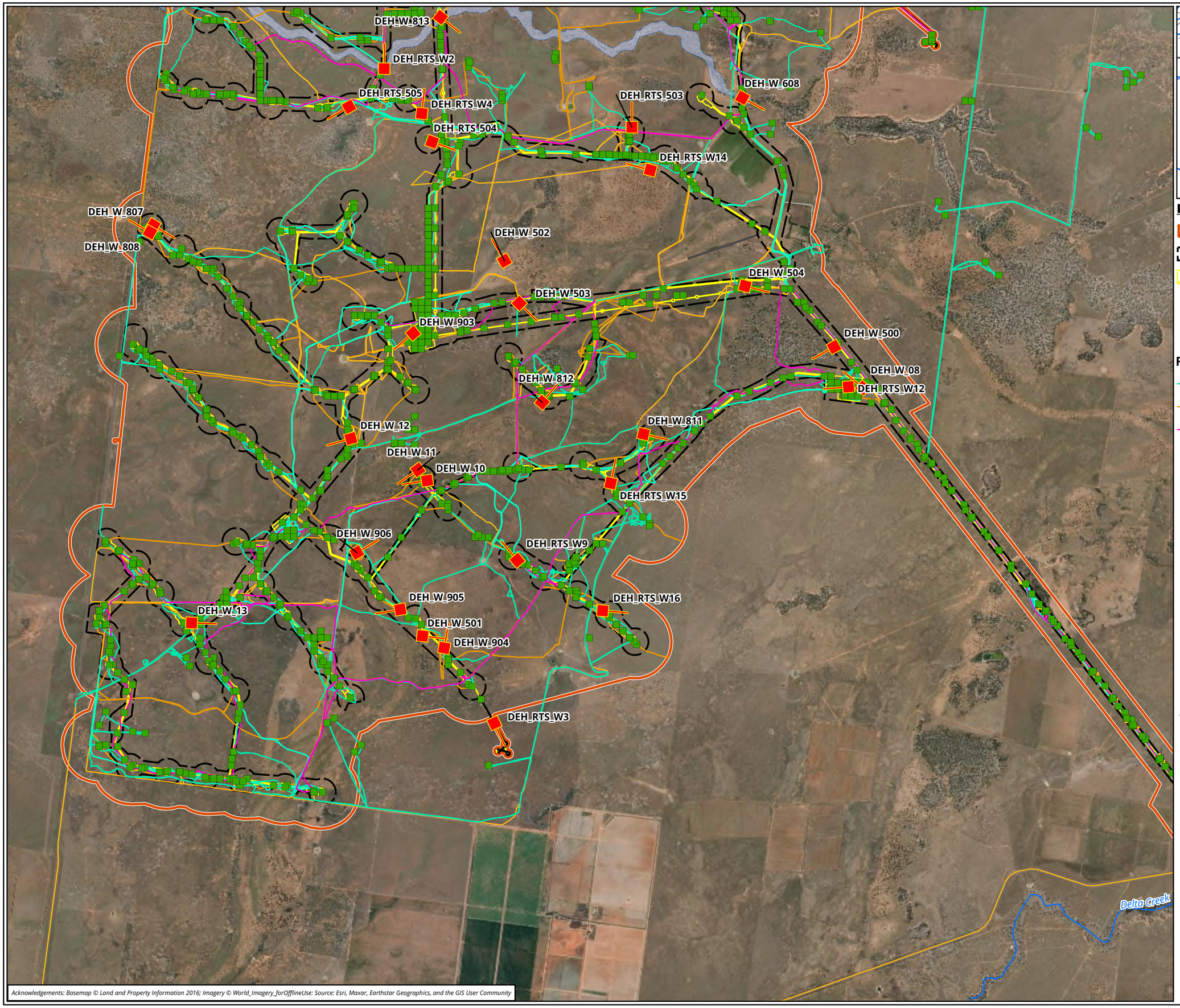

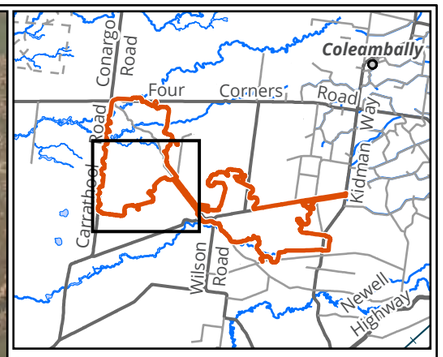

Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot
- Flora grid point

Flora survey tracks

- September
- November
- July

Figure 11A Targeted flora survey
Page 2

0 1,000
Meters
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

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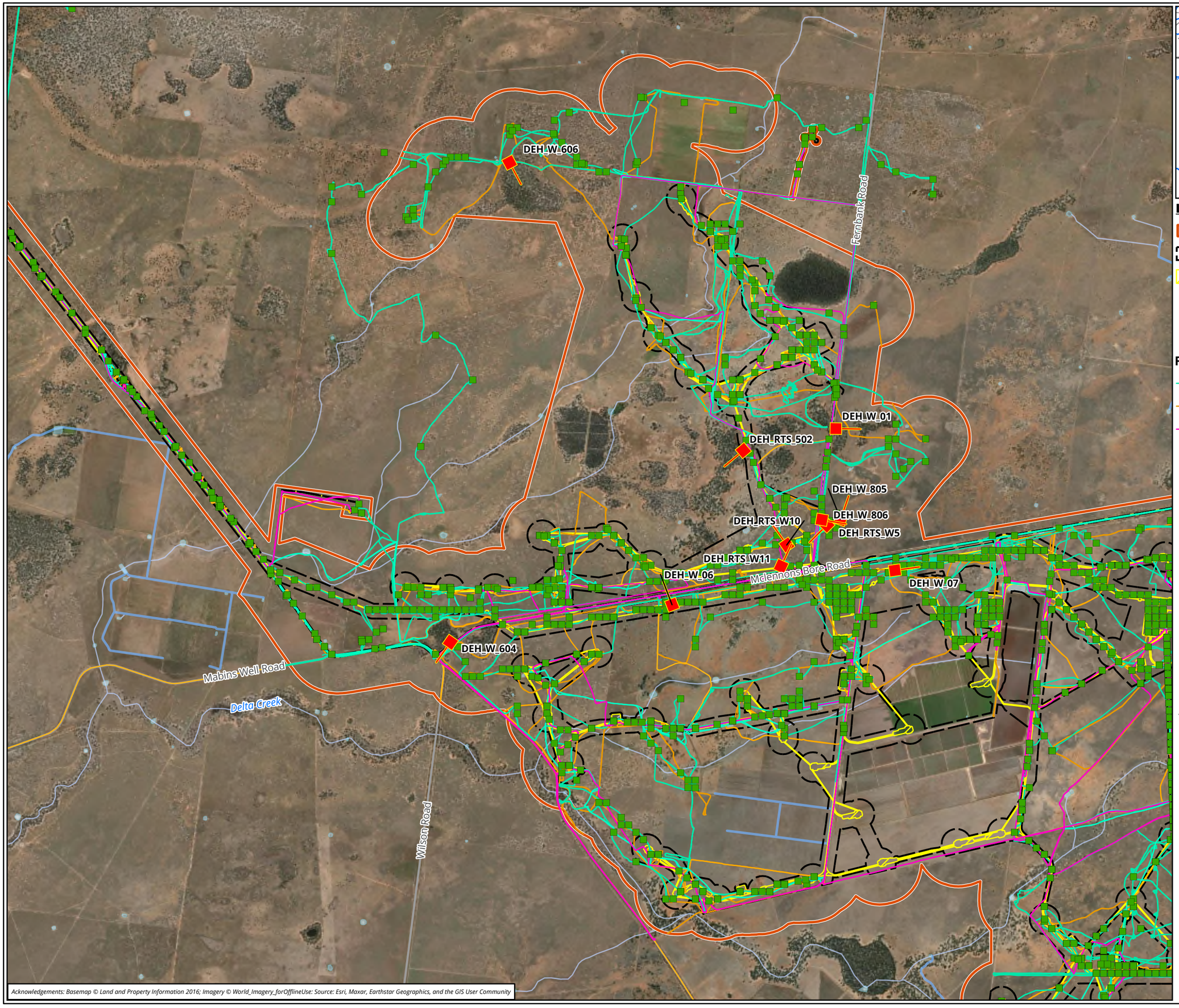

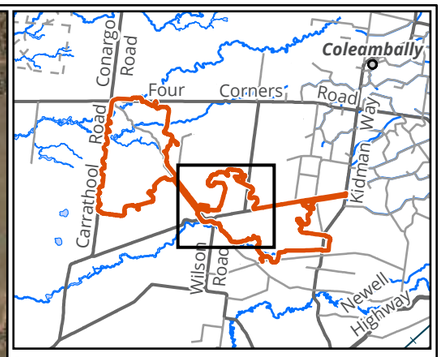

Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot
- Flora grid point

Flora survey tracks

- September
- November
- July

Figure 11A Targeted flora survey
Page 3

0 1,000
Meters
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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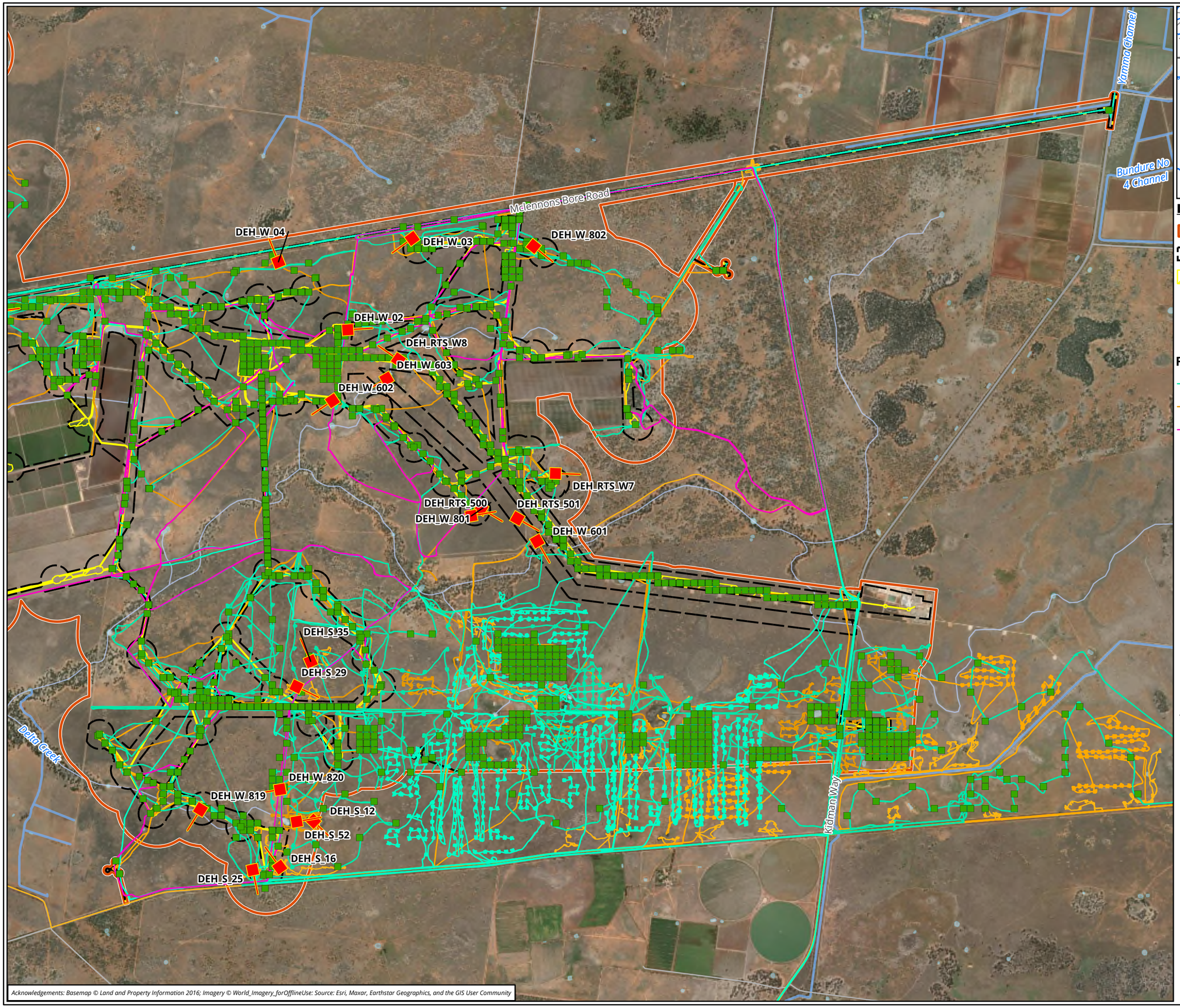
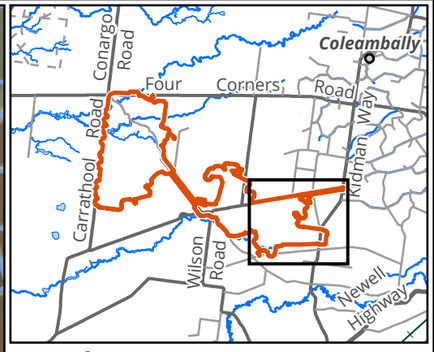
Layout: 37263_Wind_F11A_TrgFlora





Legend

- Subject land
- Development corridor
- Development footprint
- BAM Plot
- Flora grid point

Flora survey tracks

- September
- November
- July

Figure 11A Targeted flora survey
Page 4

0 1,000

Meters
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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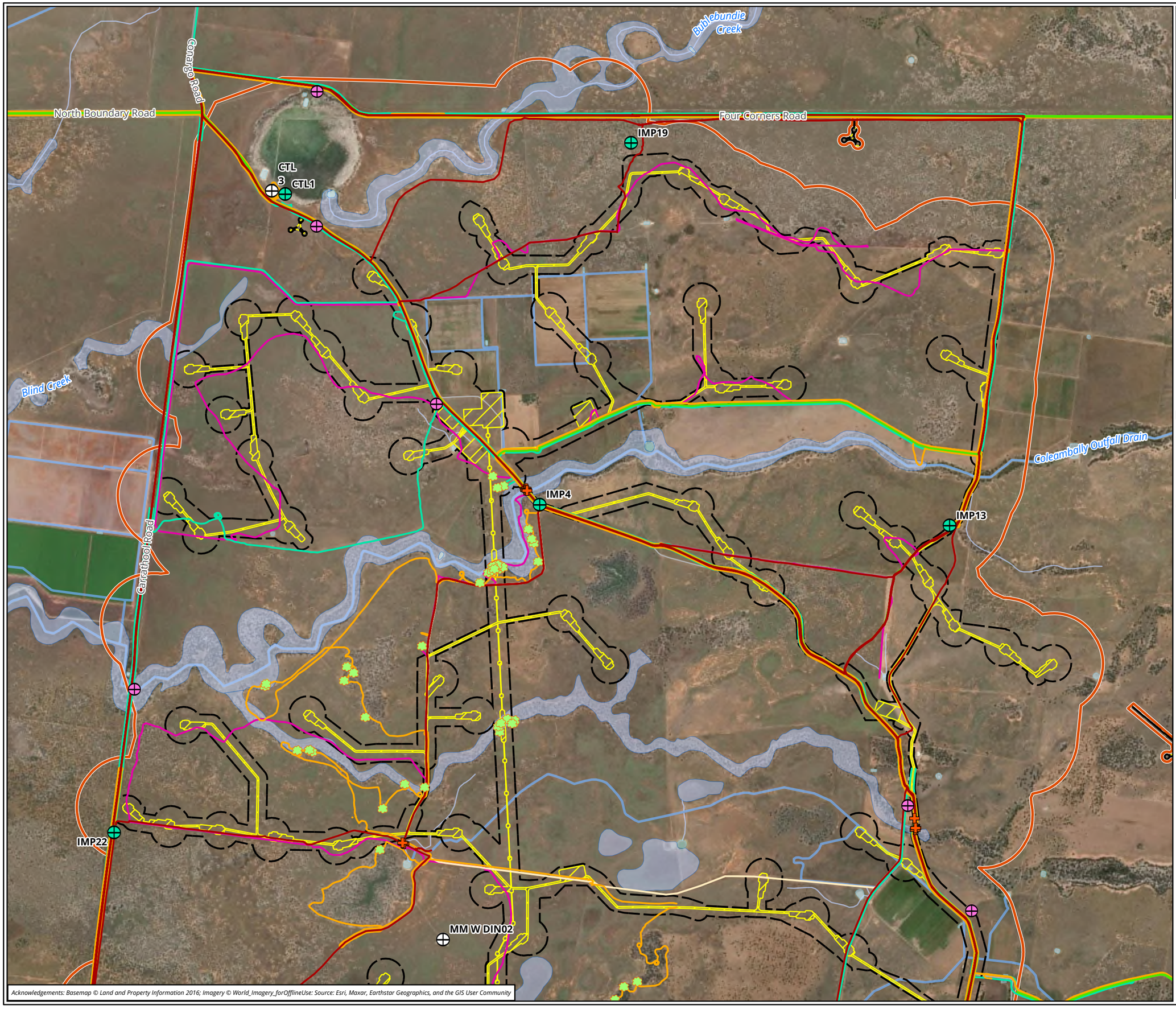

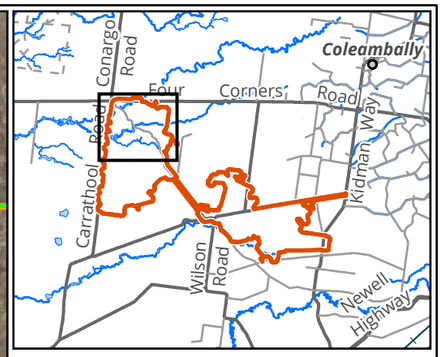

Legend

- Subject land
- Development corridor
- Development footprint
- Hollow-bearing tree
- Call playback
- Audiomoth
- BBUS point - Anabat
- BBUS point - Bird

Fauna survey tracks

- January
- February
- March
- May
- July
- August
- September
- October
- November

Figure 11B Targeted fauna survey
Page 1

0 1,000

Meters
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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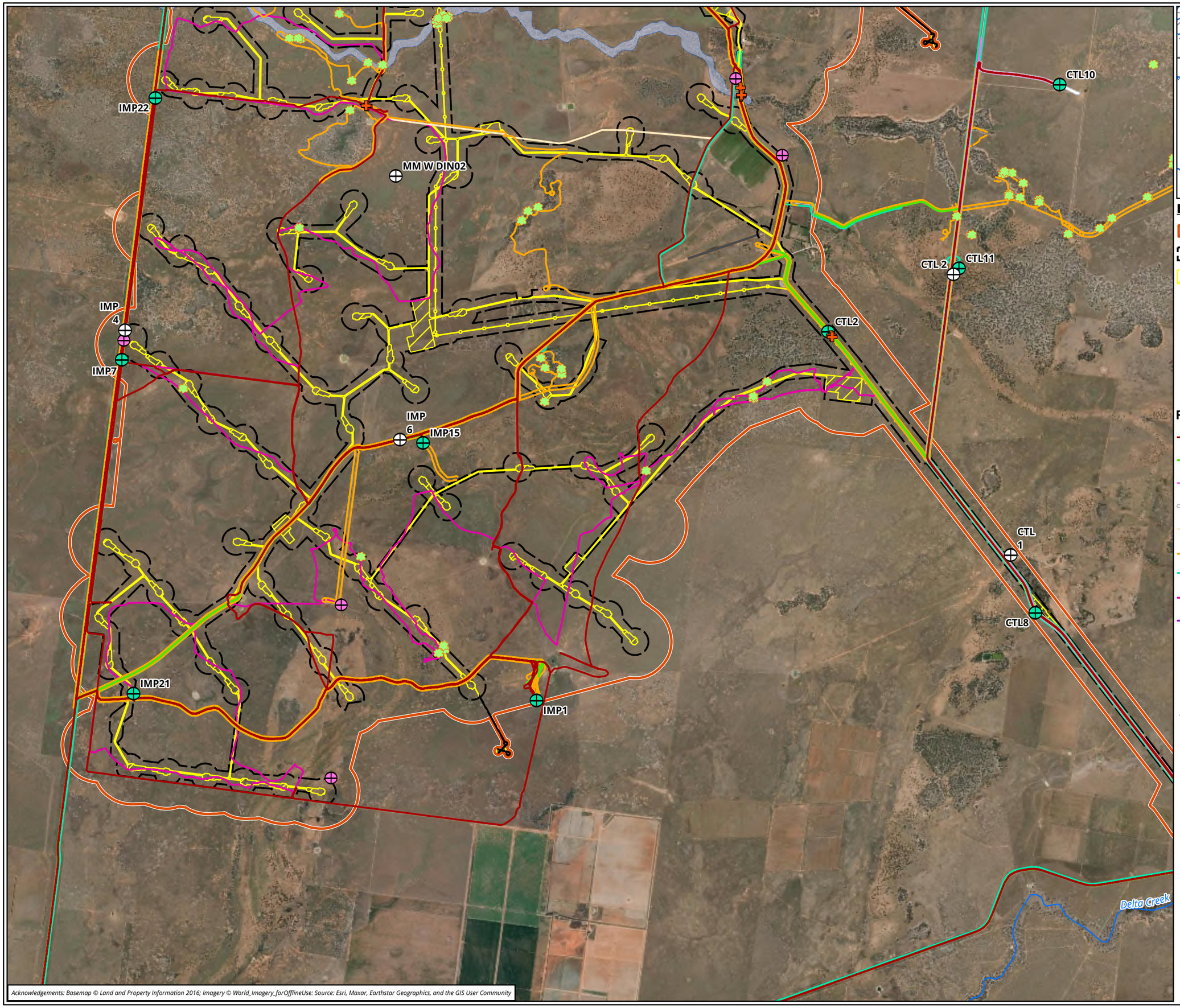

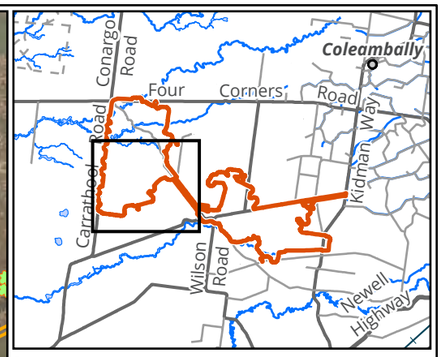

Legend

- Subject land
- Development corridor
- Development footprint
- Hollow-bearing tree
- Call playback
- Audiomoth
- BBUS point - Anabat
- BBUS point - Bird

Fauna survey tracks

- January
- February
- March
- May
- July
- August
- September
- October
- November

Figure 11B Targeted fauna survey
Page 2

0 1,000
Meters
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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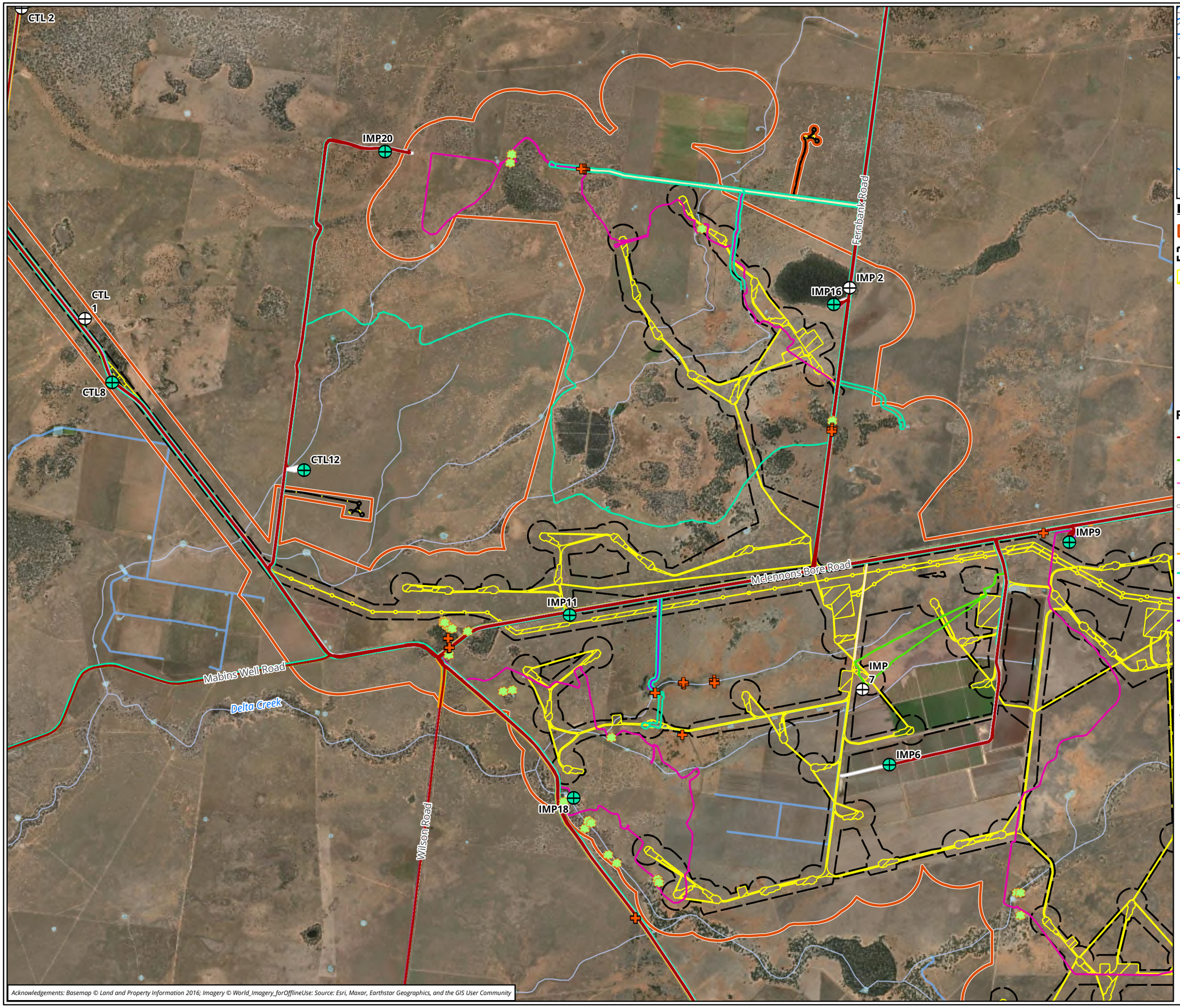

Legend

- Subject land
- Development corridor
- Development footprint
- Hollow-bearing tree
- Call playback
- Audiomoth
- BBUS point - Anabat
- BBUS point - Bird

Fauna survey tracks

- January
- February
- March
- May
- July
- August
- September
- October
- November

Figure 11B Targeted fauna survey
Page 3

0 1,000
Meters
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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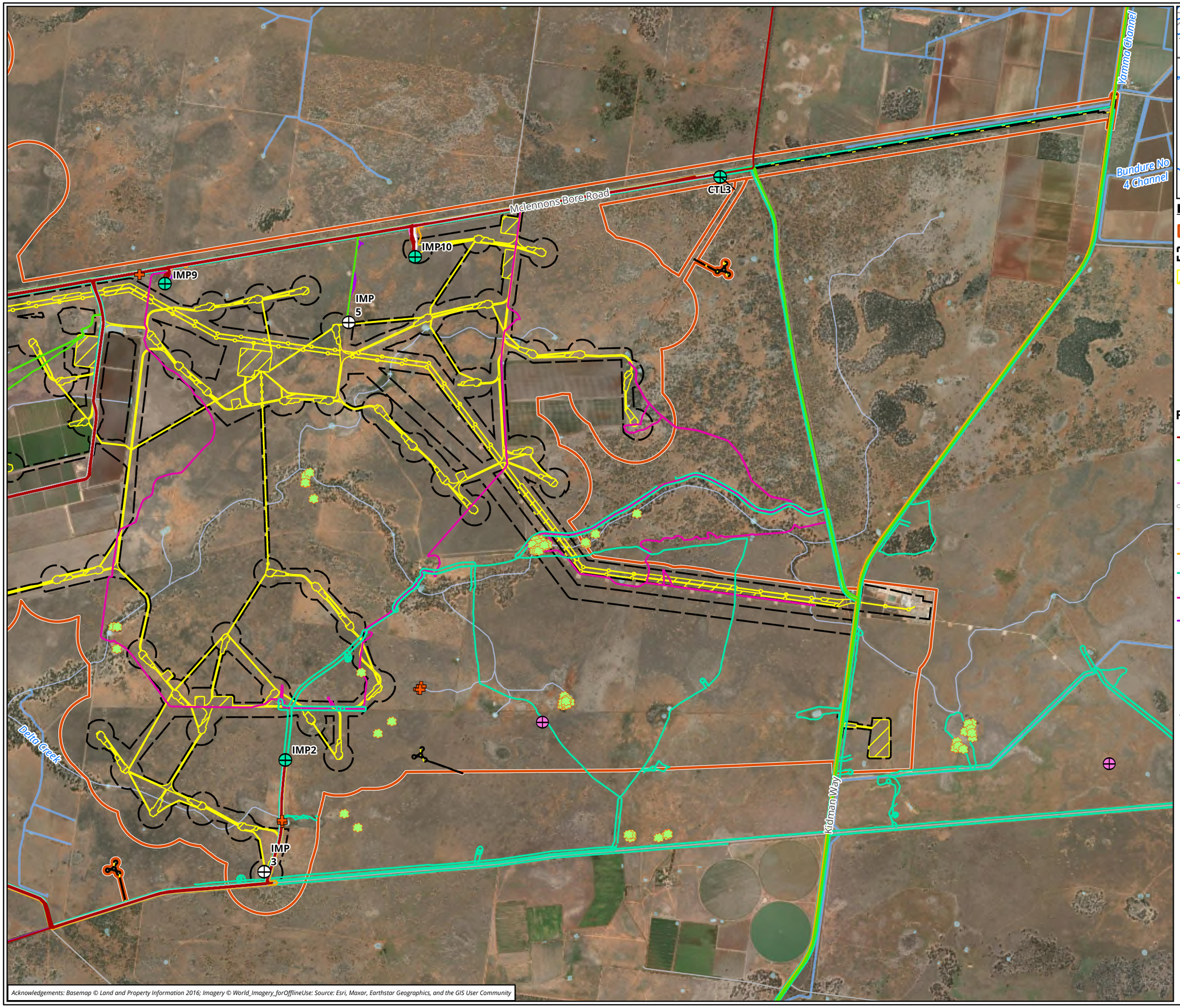

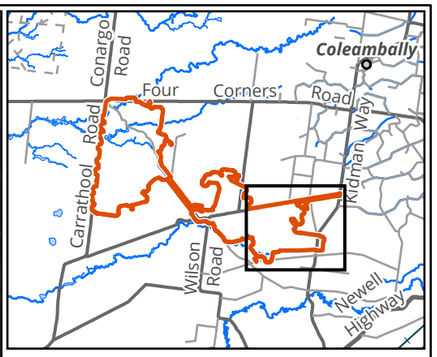

Legend

- Subject land
- Development corridor
- Development footprint
- Hollow-bearing tree
- Call playback
- Audiomoth
- BBUS point - Anabat
- BBUS point - Bird

Fauna survey tracks

- January
- February
- March
- May
- July
- August
- September
- October
- November

Figure 11B Targeted fauna survey
Page 4

0 1,000
Meters
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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4.3.2. Expert reports

Sections 5.2 and 5.3 of the BAM outline that an expert report may be obtained instead of undertaking a species survey for a project, where the expert report is prepared by a person who, in the opinion of the Environment Agency Head, possesses specialised knowledge based on training, study or experience to provide an expert opinion in relation to the biodiversity values to which an expert report relates (DPIE 2020a).

No expert reports were utilised for the current assessment.

4.3.3. Threatened species summary and polygons

Table 45 provides details of threatened species with potential to be impacted by the project and outlines the attributes that comprise the threatened species polygons. The presence of threatened species with potential to be impacted by the project is illustrated in Figure 12.

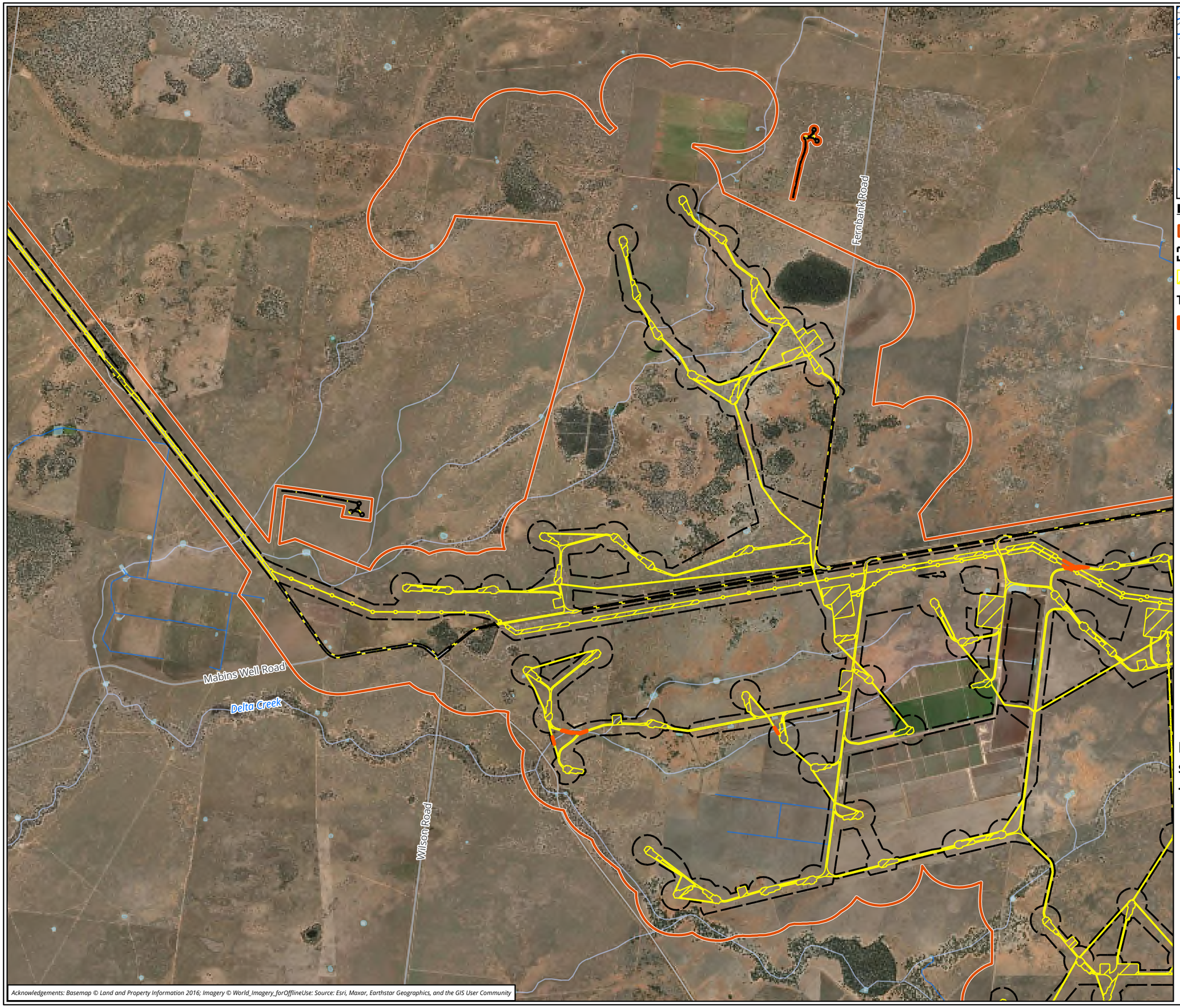
Table 45 Threatened species polygons within the development footprint

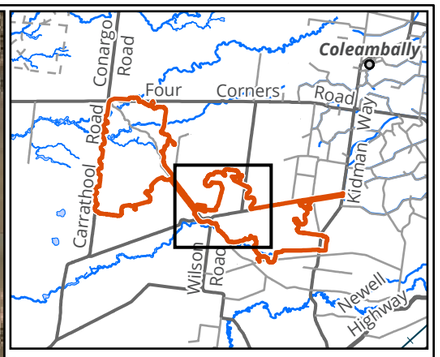
Threatened species	Impact (ha / No. indiv.)	Unit of measure	BRW*	Polygon attributes
Flora				
Austrostipa wakoolica	Assumed present in areas of survey shortfall	Area	2	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 17 moderate – 0.68 ha • PCT 26 Intact – 0.23 ha • PCT 26 sparse – 0.68 ha
Brachyscome muelleroides	Assumed present in areas of survey shortfall	Area	2	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 46 moderate- 0.93 ha
Brachyscome papillosa	Assumed present in areas of survey shortfall	Area	2	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 46 moderate- 1.74 ha
Lepidium monoplocoides	Assumed present in areas of survey shortfall	Area	2	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 26 DNG – 0.29 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha
Leptorhynchos orientalis	Assumed present in areas of survey shortfall	Area	2	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 26 DNG – 0.29 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.21 ha • PCT 46 moderate- 0.93 ha
Maireana cheelii	Assumed present	Area	2	Detected during surveys (0.44 ha) • PCT13_moderate – 0.29 ha

Threatened species	Impact (ha / No. indiv.)	Unit of measure	BRW*	Polygon attributes
	in areas of survey shortfall			• PCT13_thinned - 0.14 ha Assumed present where survey shortfall occurs (2.54 ha) • PCT 26 DNG – 0.29 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse – 1.12 ha • PCT 46 moderate - 0.93 ha
Pilularia novae-hollandiae	Assumed present in areas of survey shortfall	Area	3	Not detected in surveys undertaken to date Assumed present where survey shortfall occurs • PCT 13 moderate – 2.29ha • PCT 13 thinned – 3.77 ha • PCT 15 moderate- 1.49 ha • PCT 15 thinned – 1.10 ha • PCT 17_moderate – 0.71 ha • PCT 26 DNG – 6.22 ha • PCT 26 Intact – 0.35 ha • PCT 26 sparse- 8.42 ha • PCT 45 mod_good – 0.27 ha • PCT 45 Intersection – 0.83 ha • PCT 46 moderate- 44.90 ha • PCT 46 Intersection – 0.34 ha
Sclerolaena napiformis	Assumed present in areas of survey shortfall	Area	2	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 26 DNG – 1.26 ha • PCT 26 Intact – 0.40 ha • PCT 26 sparse- 2.24 ha • PCT 46 moderate- 3.12 ha
Swainsona sericea	Observed Assumed present in areas of survey shortfall	Area	2	Detected during surveys (4.98 ha) • PCT 26 DNG – 1.98 ha • PCT 26 intact – 0.15 ha • PCT 26 sparse – 2.85 ha Assumed present where survey shortfall occurs (4.73 ha): • PCT 26 DNG – 0.97 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha • PCT 28 low – 0.06 ha • PCT 46 moderate – 2.37 ha
Swainsona murrayana	Observed Assumed present in areas of survey shortfall	Area	2	Detected during surveys (9.23 ha) • PCT 26 DNG – 2.76 ha • PCT 26 intact – 0.27 ha • PCT 26 sparse – 2.73 ha • PCT 46 moderate – 3.45 ha Assumed present where survey shortfall occurs (4.73 ha): • PCT 26 DNG – 0.97 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha

Threatened species	Impact (ha / No. indiv.)	Unit of measure	BRW*	Polygon attributes
				• PCT 28 low – 0.06 ha • PCT 46 moderate – 2.37 ha
Swainsona plagiotropis	Assumed present in areas of survey shortfall	Area	2	Not detected in surveys undertaken to date. Assumed present where survey shortfall occurs: • PCT 26 DNG – 0.97 ha • PCT 26 Intact – 0.20 ha • PCT 26 sparse- 1.12 ha • PCT 46 moderate- 2.37 ha
Fauna				
Hemiaspis damelii	Assumed	Area	2	Associated PCTs in accordance with relevant guidelines. • PCT 10 moderate – 0.19 ha • PCT 13 moderate – 3.96 ha • PCT 13 thinned – 7.82 ha • PCT 15 moderate – 2.54 ha • PCT 15 thinned – 1.10 ha • PCT 17 mod_good – 0.76 ha • PCT 17 moderate – 1.33 ha • PCT 160 mod_good – 4.97 ha
Litoria raniformis	Observed	Area	2	The species polygon aligns with aquatic habitats linked directly to the record and a buffer, incorporating the PCTs with which the species is associated, of 200 metres radius from the top of bank. • PCT 13 moderate – 0.55 ha • PCT 13 thinned – 2.00 ha • PCT 15 thinned – 1.07 ha • PCT 17 mod_good – 0.49 ha • PCT 26 DNG – 28.73 ha • PCT 26 intact – 8.09 ha • PCT 26 sparse – 29.93 ha • PCT 28 Low – 0.77 ha • PCT 45 intersection– 0.64 ha • PCT 46 moderate – 9.53 ha • PCT 46 Intersection – 0.34 ha • PCT 160 mod_good – 1.48 ha
Myotis macropus	Assumed	Area	2	200m buffer of semi-permanent water within Coleambally outfall drain and with associated or potential PCT (13 only) containing suitable microhabitats linked to more suitable • PCT 13 moderate – 0.55 ha • PCT 13 thinned – 1.85 ha
Pedionomus torquatus	Direct impacts upon important mapped habitat	Area	3	Total area impacted of 2.55 ha of important mapped habitat • PCT 13 moderate – 0.01 ha • PCT 13 thinned – 0.11 ha • PCT 17 moderate – 0.03 ha • PCT 26 DNG – 0.08 ha • PCT 26 sparse – 0.91 ha

Threatened species	Impact (ha / No. indiv.)	Unit of measure	BRW*	Polygon attributes
				• PCT 46 moderate – 1.42 ha
Polytelis swainsonii	Observed	Area	2	100m buffer of associated PCTs within the development corridor with potential hollow bearing trees. • PCT 10 moderate – 0.19 ha • PCT 13 moderate – 3.56 ha • PCT 13 thinned – 7.82 ha • PCT 15 moderate – 2.54 ha • PCT 15 thinned – 1.10 ha • PCT 17 moderate – 0.27 ha • PCT 26 DNG – 8.40 ha • PCT 26 intact – 1.56 ha • PCT 26 sparse – 7.54 ha • PCT 28 low – 0.04 ha • PCT 28 moderate – 0.21 ha • PCT 45 mod_good – 0.15 ha • PCT 46 moderate – 2.86 ha • PCT 160 moderate – 0.01 ha





Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Austrostipa wakoolica*

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Figure 12A Threatened flora species polygon
- *Austrostipa wakoolica*

0 1
Kilometers
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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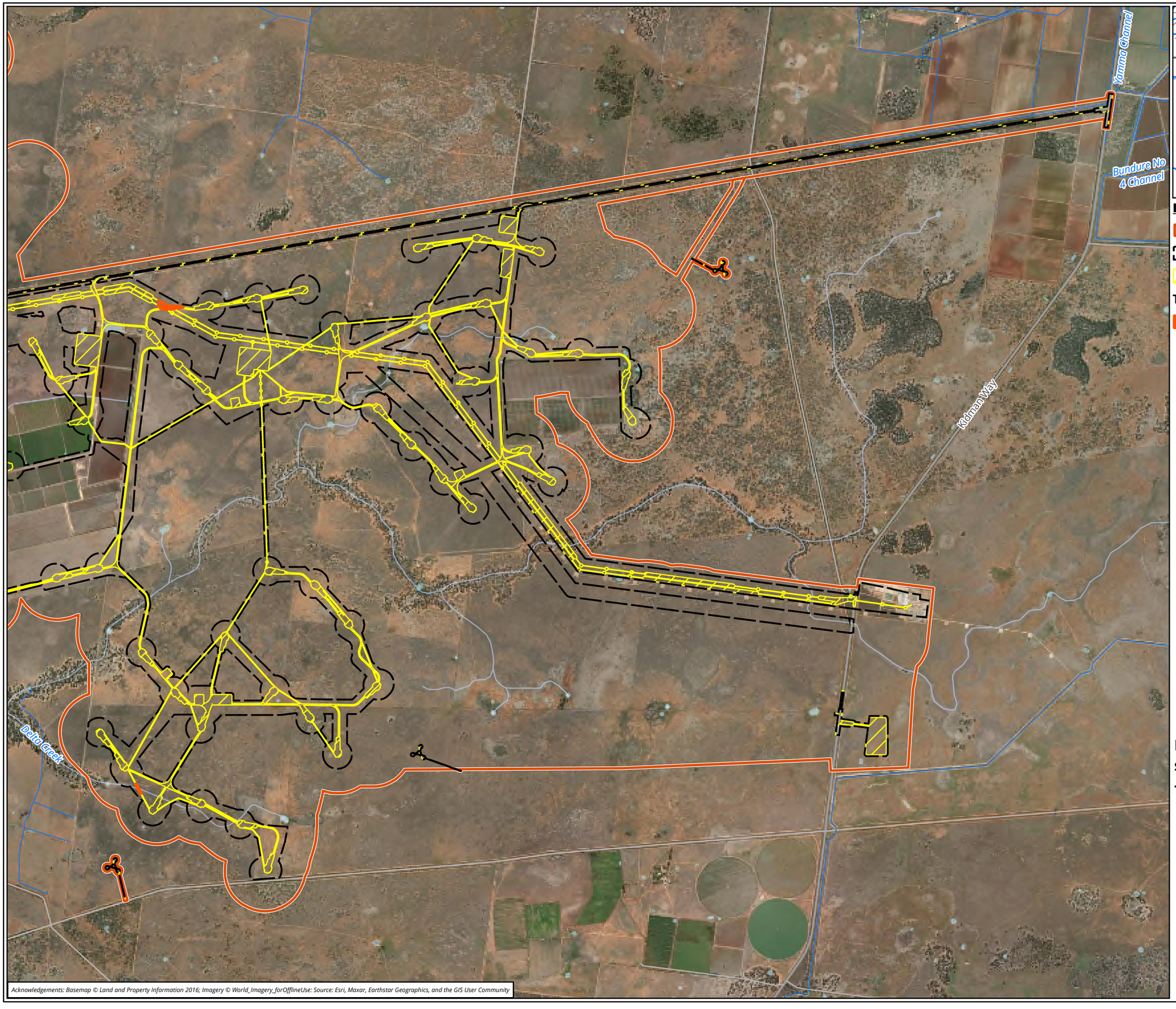

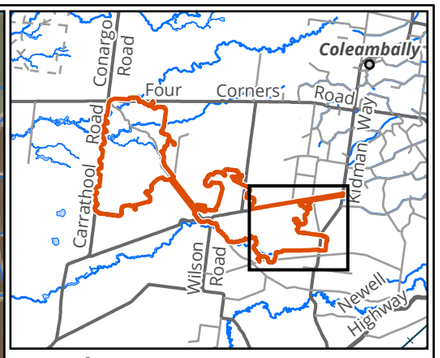

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Austrostipa wakoolica*

Figure 12A Threatened flora species polygon
- *Austrostipa wakoolica*

0 1
Kilometers
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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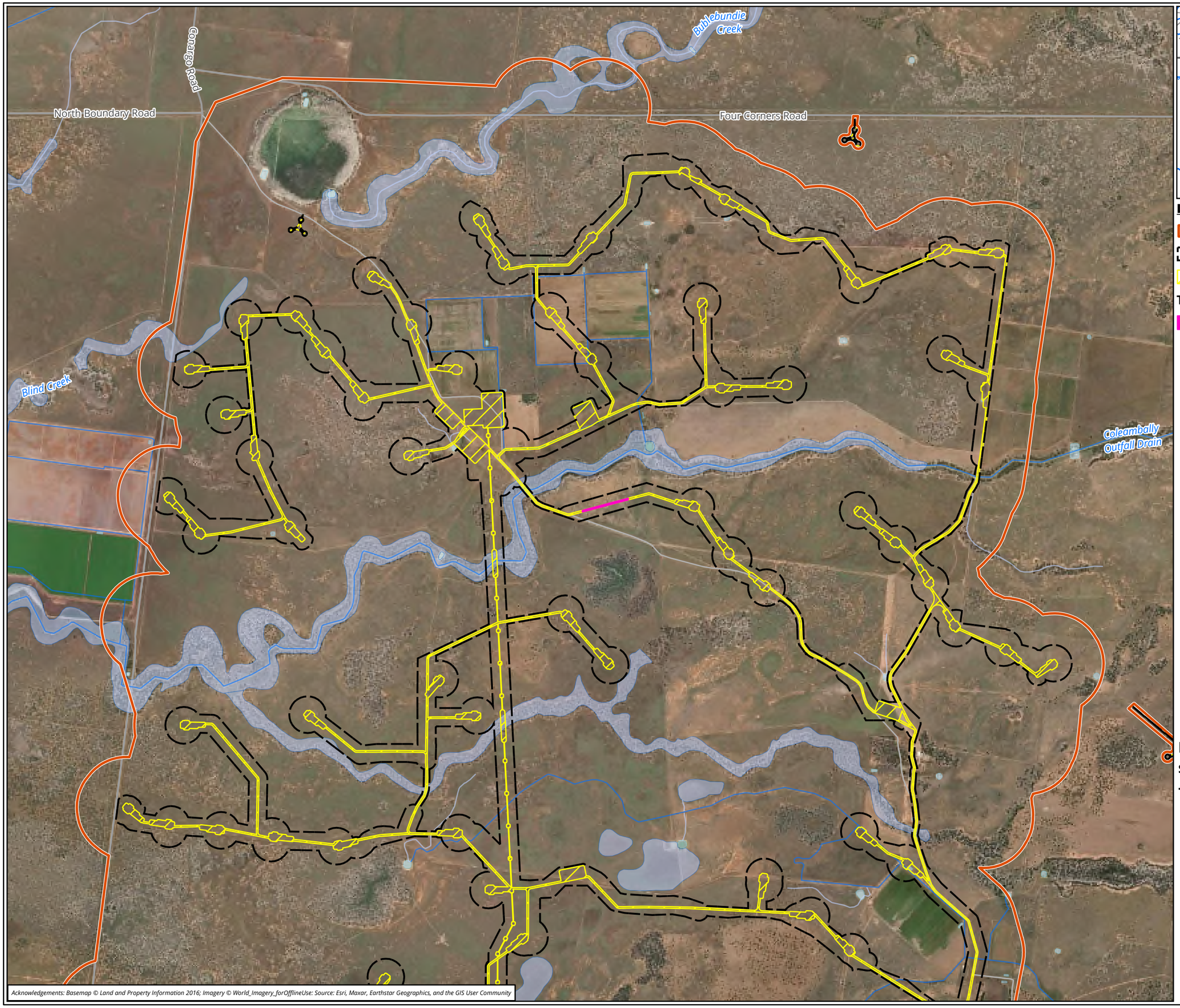

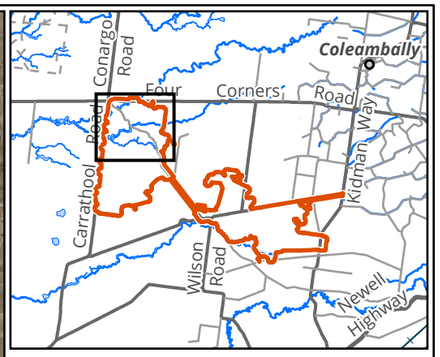

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Brachyscome muelleroides*

Figure 12A Threatened flora species polygon
- *Brachyscome muelleroides*

0 1
Kilometers
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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biosis

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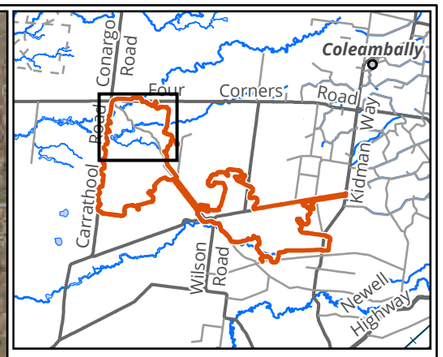
North Boundary Road
Four Corners Road
Gonurigo Road
Bibliebundie Creek
Blind Creek
Coleambally Outfall Drain



Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Brachyscome papillosa*

Figure 12A Threatened flora species polygon
- *Brachyscome papillosa*

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Kilometers
Scale: 1:38,000 @ A3
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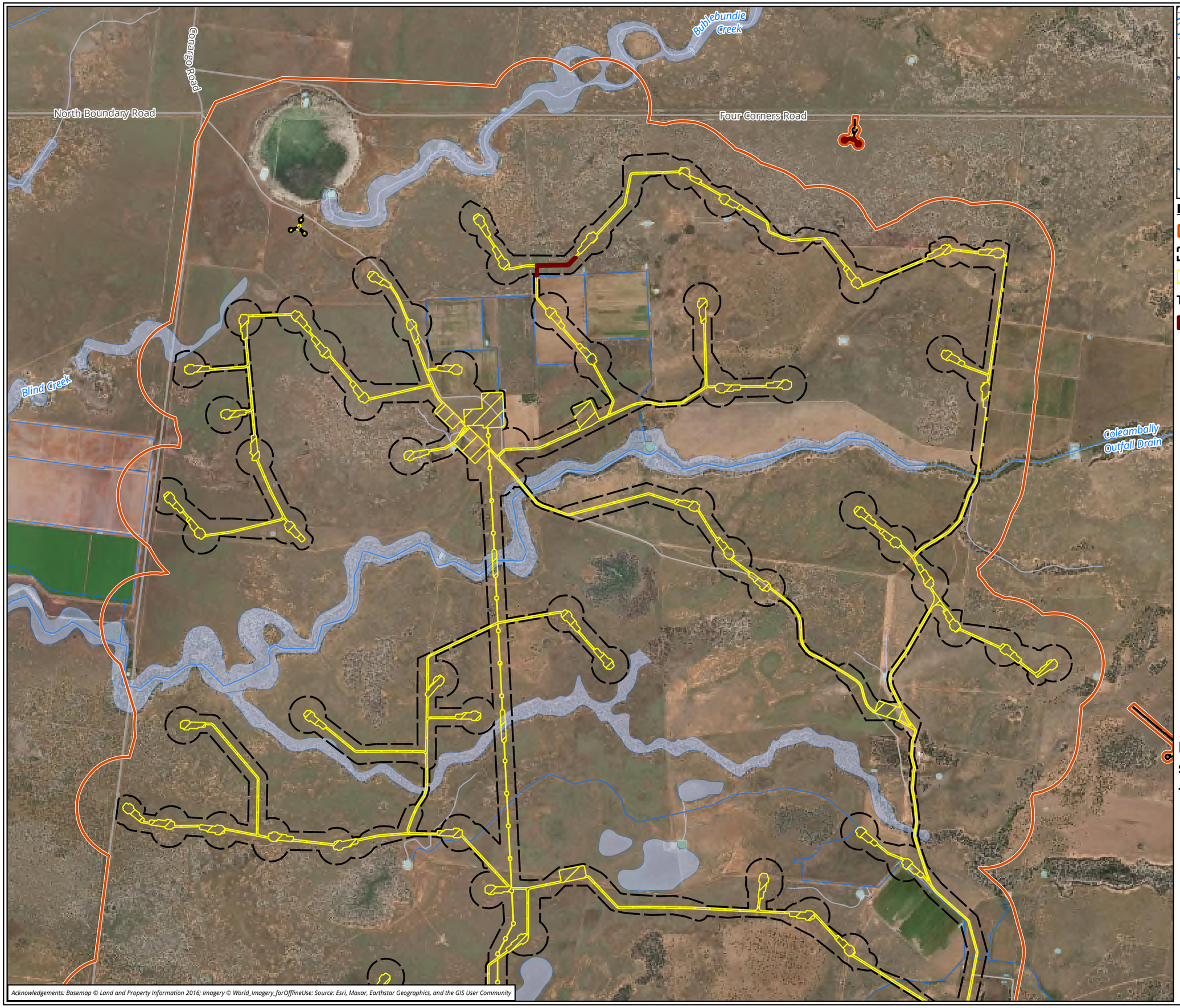

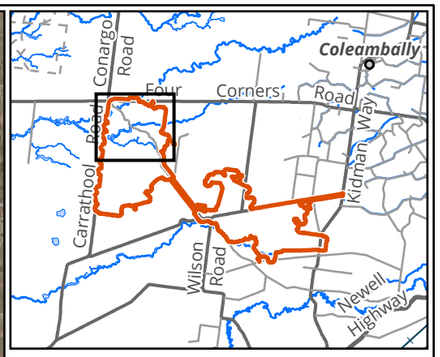

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Lepidium monoplocoides*

Figure 12A Threatened flora species polygon
- Lepidium monoplocoides

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Kilometers
Scale: 1:38,000 @ A3
Coordinate System:
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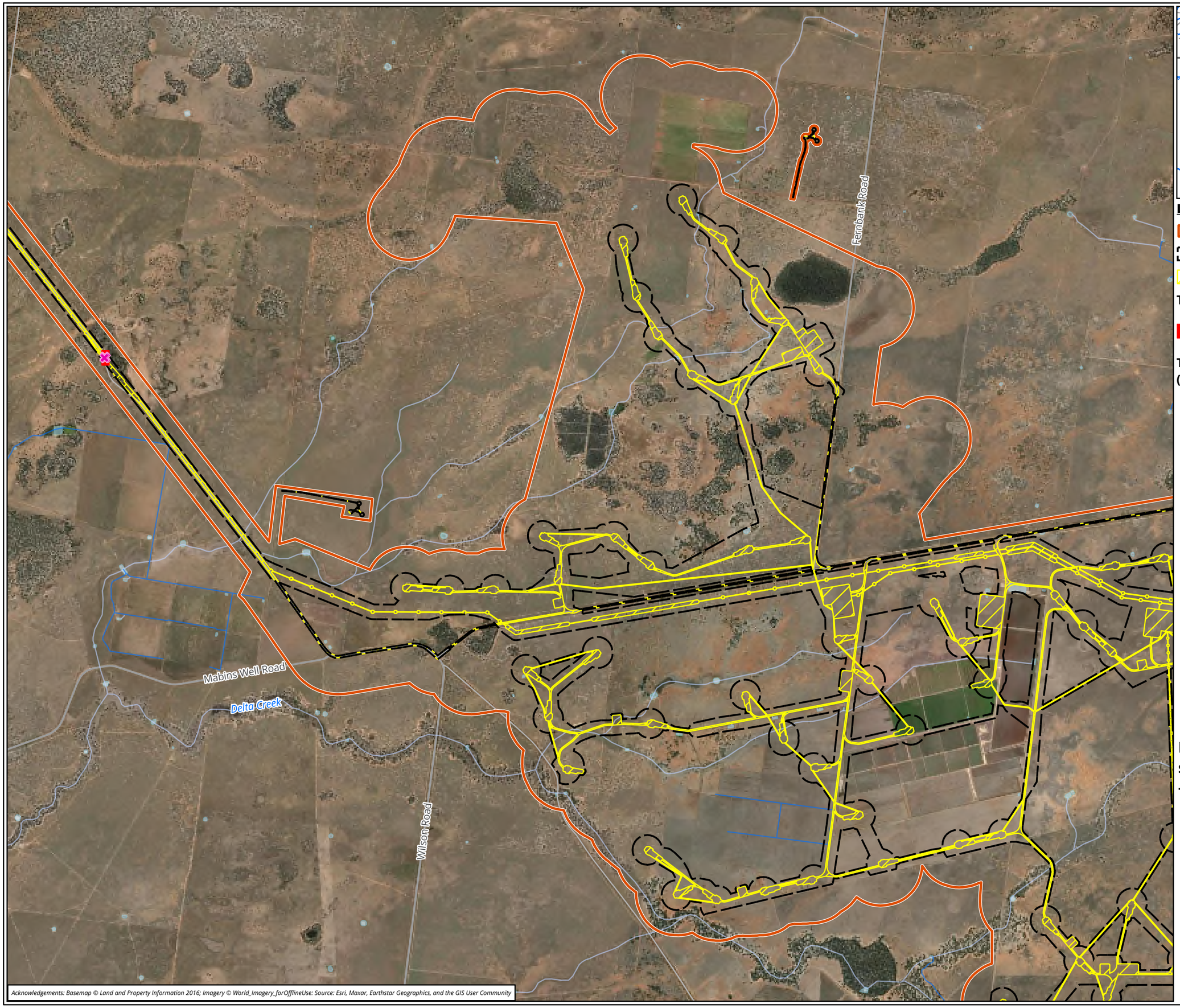

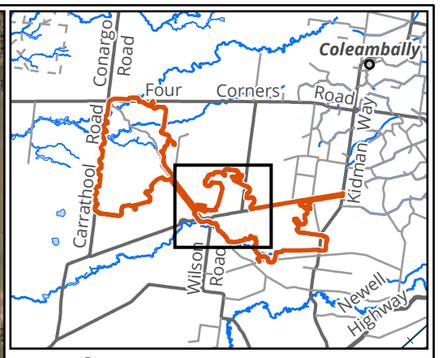

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Maireana cheelii* (confirmed presence)

Threatened flora species records (Biosis)

- *Maireana cheelii*

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Figure 12A Threatened flora species polygon - *Maireana cheelii*

0 1

Kilometers
Scale: 1:47,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

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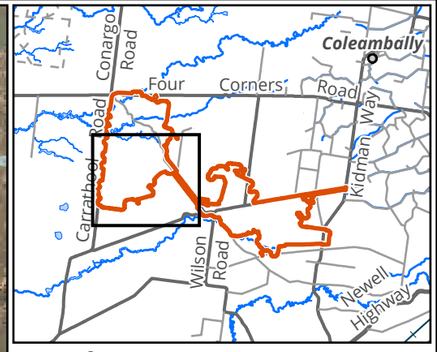

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Maireana cheelii* (confirmed presence)

Threatened flora species records (Biosis)

- *Maireana cheelii*

Carrathool Road

Delta Creek

Mabins Well Road

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © World_Imagery_forOfflineUse: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 12A Threatened flora species polygon
- Maireana cheelii

0 1 2

Kilometers
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
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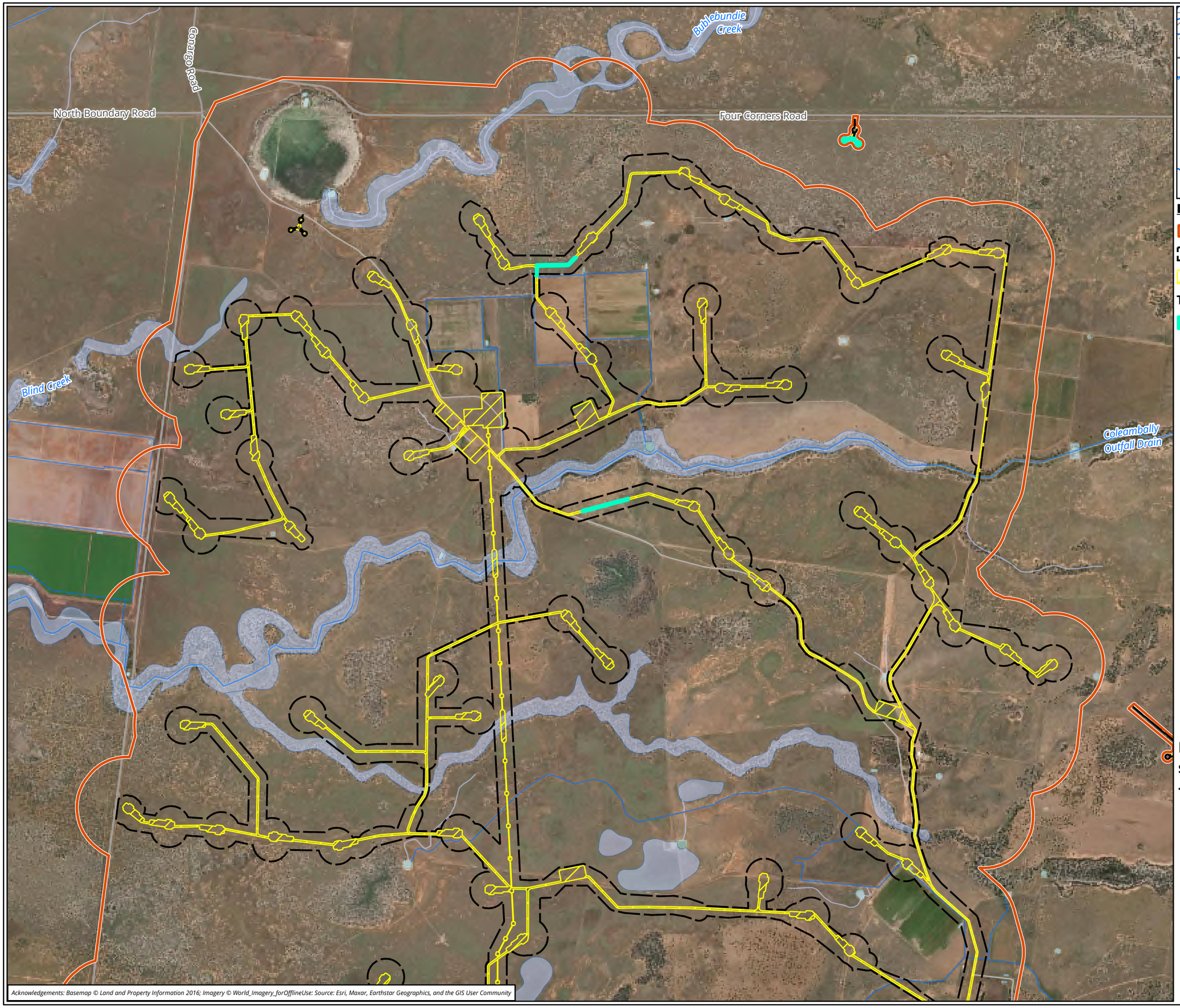
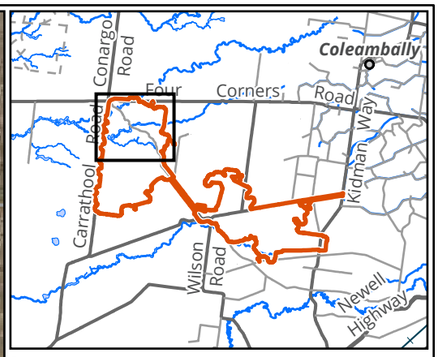




Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Maireana cheelii*

Figure 12A Threatened flora species polygon - *Maireana cheelii*

0 1

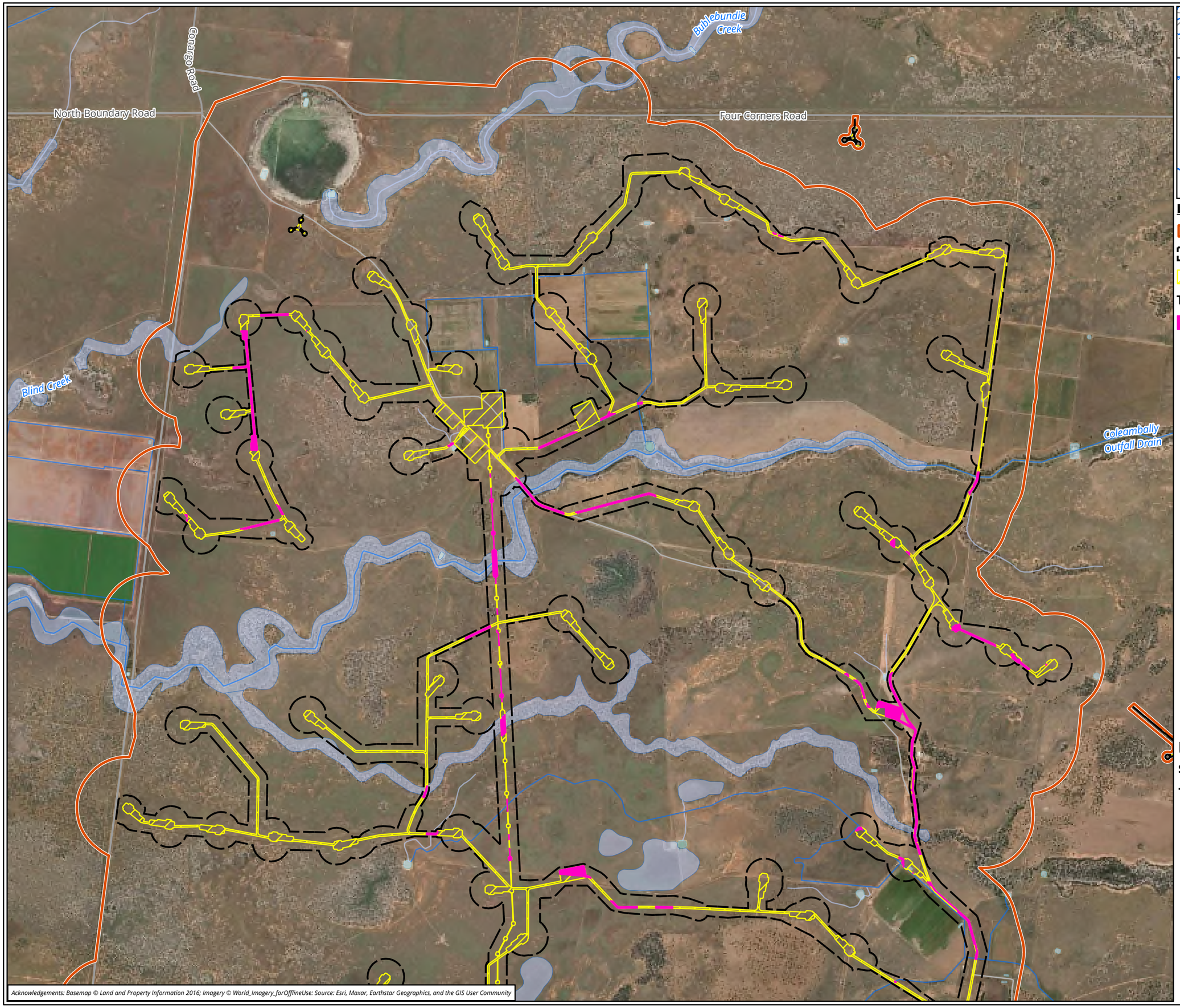
Kilometers
Scale: 1:38,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

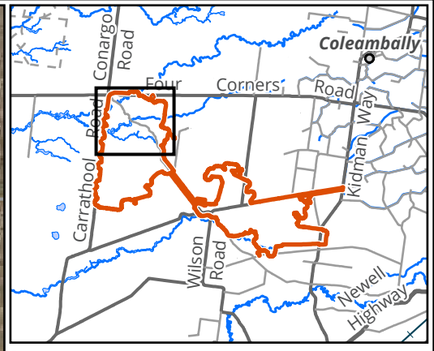
N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F12A_TSPoly_Flora

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © World_Imagery_forOfflineUse: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community





Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Pilularia novae-hollandiae*

Figure 12A Threatened flora species polygon - *Pilularia novae-hollandiae*

0 1

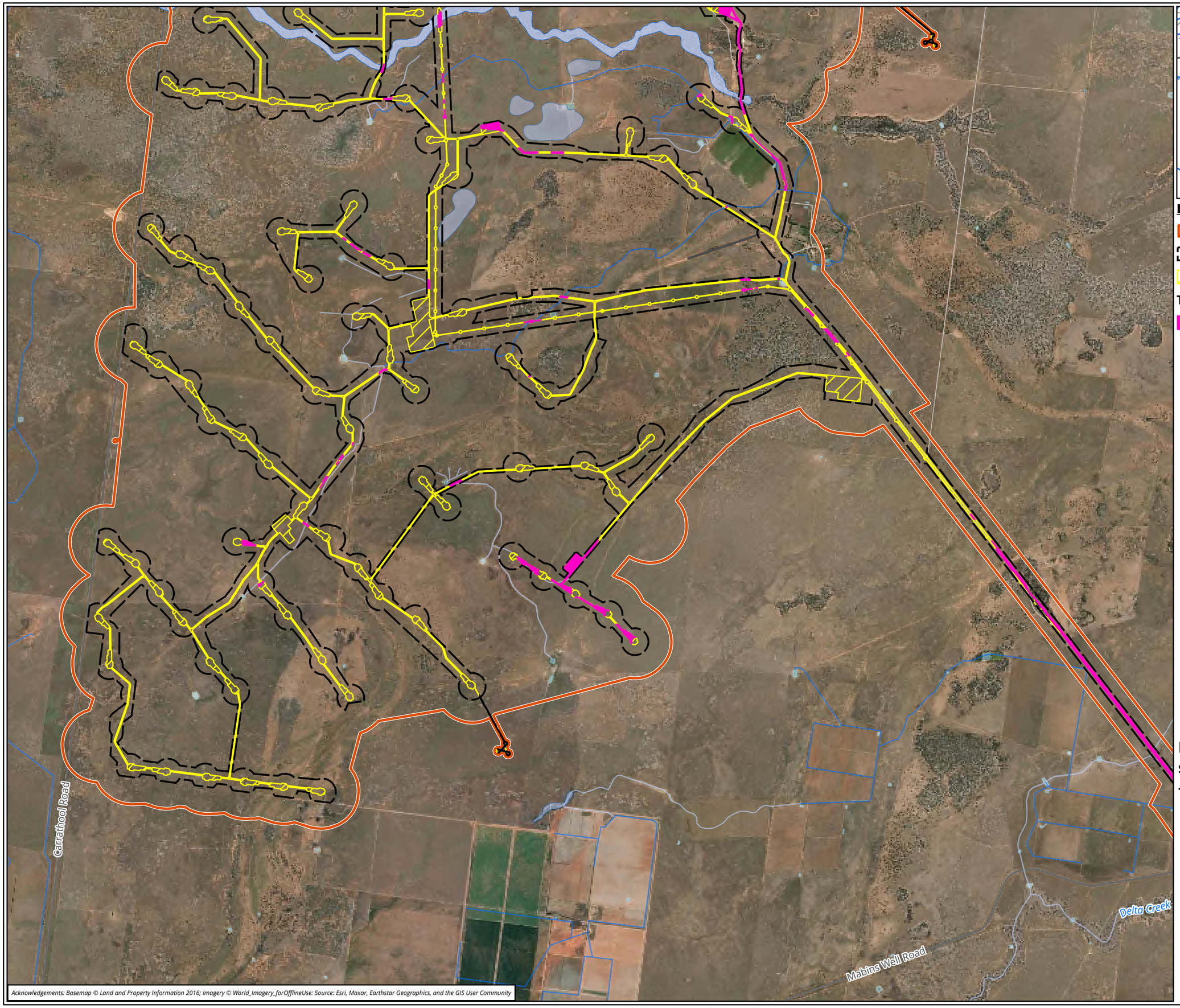
Kilometers
Scale: 1:38,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

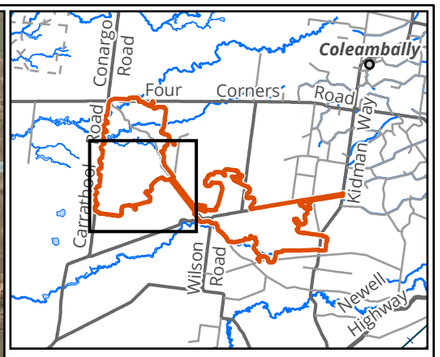
N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F12A_TSPoly_Flora

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © World_Imagery_forOfflineUse: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community





Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Pilularia novae-hollandiae*

Figure 12A Threatened flora species polygon
- *Pilularia novae-hollandiae*

0 1 2

Kilometers
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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Layout: 37263_Wind_F12A_TSPoly_Flora

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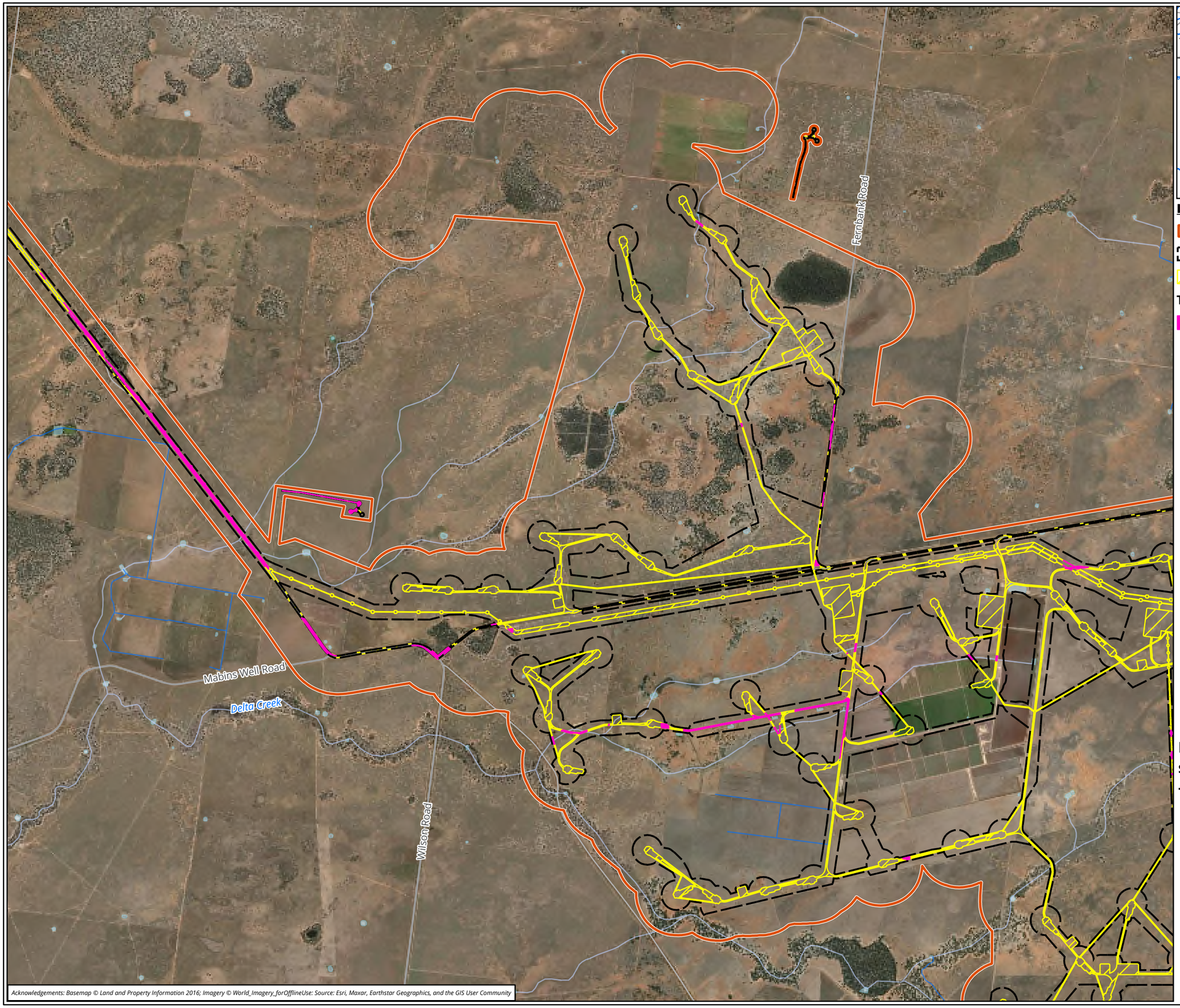

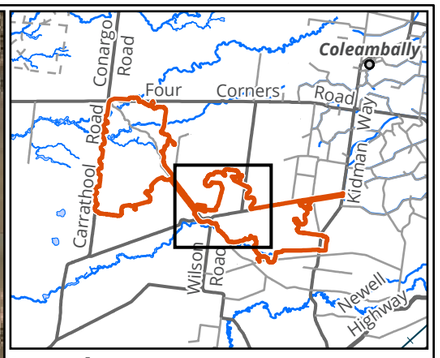

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Pilularia novae-hollandiae*

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © World_Imagery_forOfflineUse: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 12A Threatened flora species polygon
- *Pilularia novae-hollandiae*

0 1
Kilometers
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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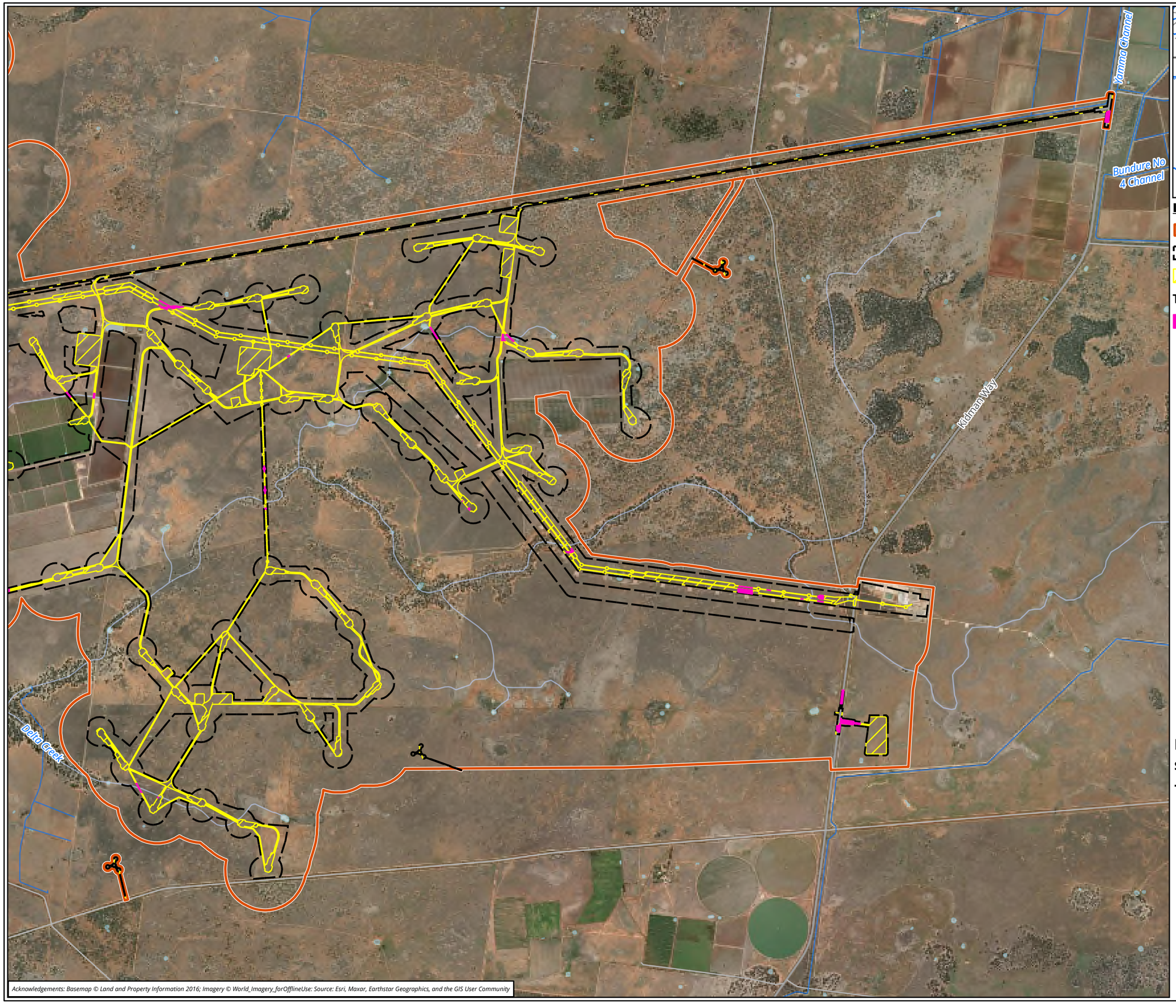

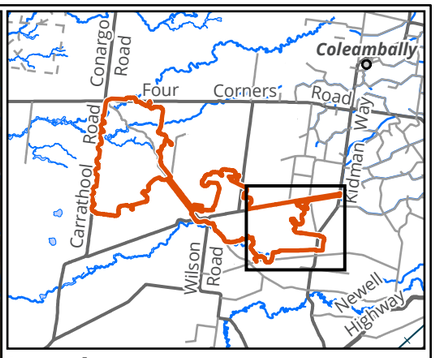

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Pilularia novae-hollandiae*

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Figure 12A Threatened flora species polygon
- *Pilularia novae-hollandiae*

0 1
Kilometers
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

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GIS: JB, Checked by: MP, Last edited by: jbeckius
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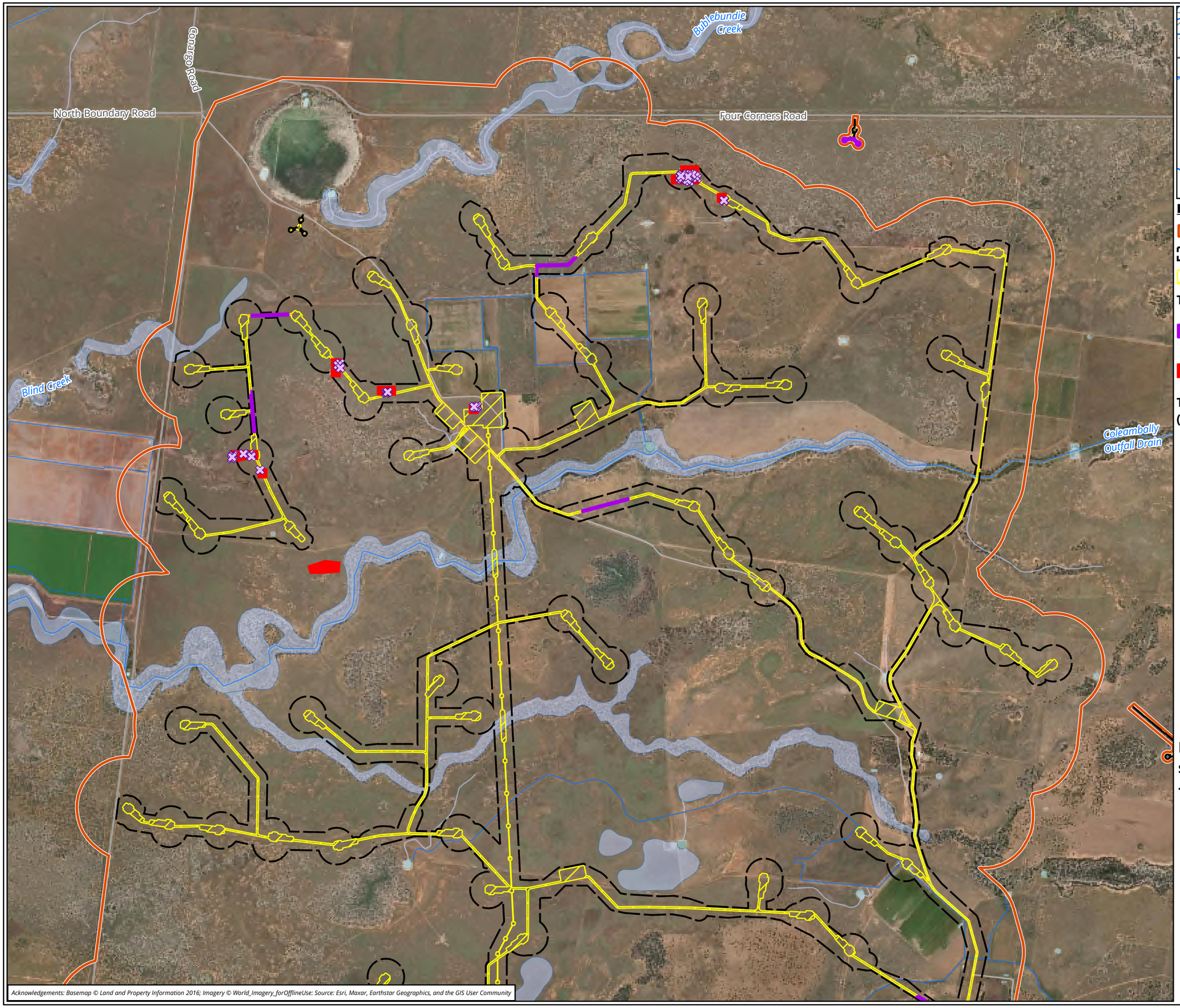

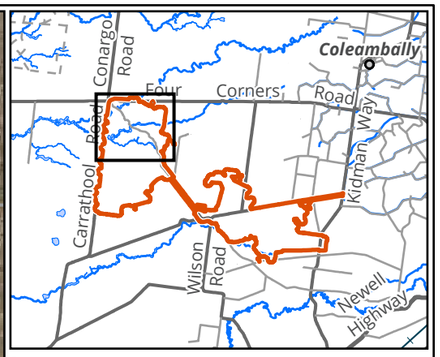

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona murrayana* (assumed presence)
- *Swainsona murrayana* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona murrayana*

Figure 12A Threatened flora species polygon - *Swainsona murrayana*

0 1

Kilometers
Scale: 1:38,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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Layout: 37263_Wind_F12A_TSPoly_Flora

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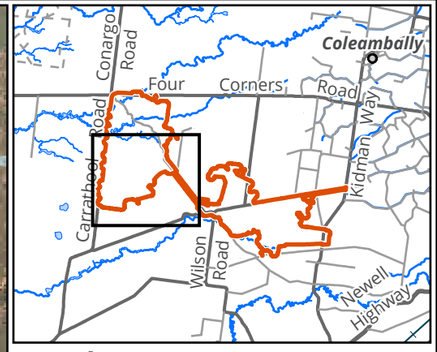

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona murrayana* (assumed presence)
- *Swainsona murrayana* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona murrayana*

Carrathool Road

Delta Creek

Mabins Well Road

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © World_Imagery_forOfflineUse: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 12A Threatened flora species polygon - *Swainsona murrayana*

0 1 2

Kilometers
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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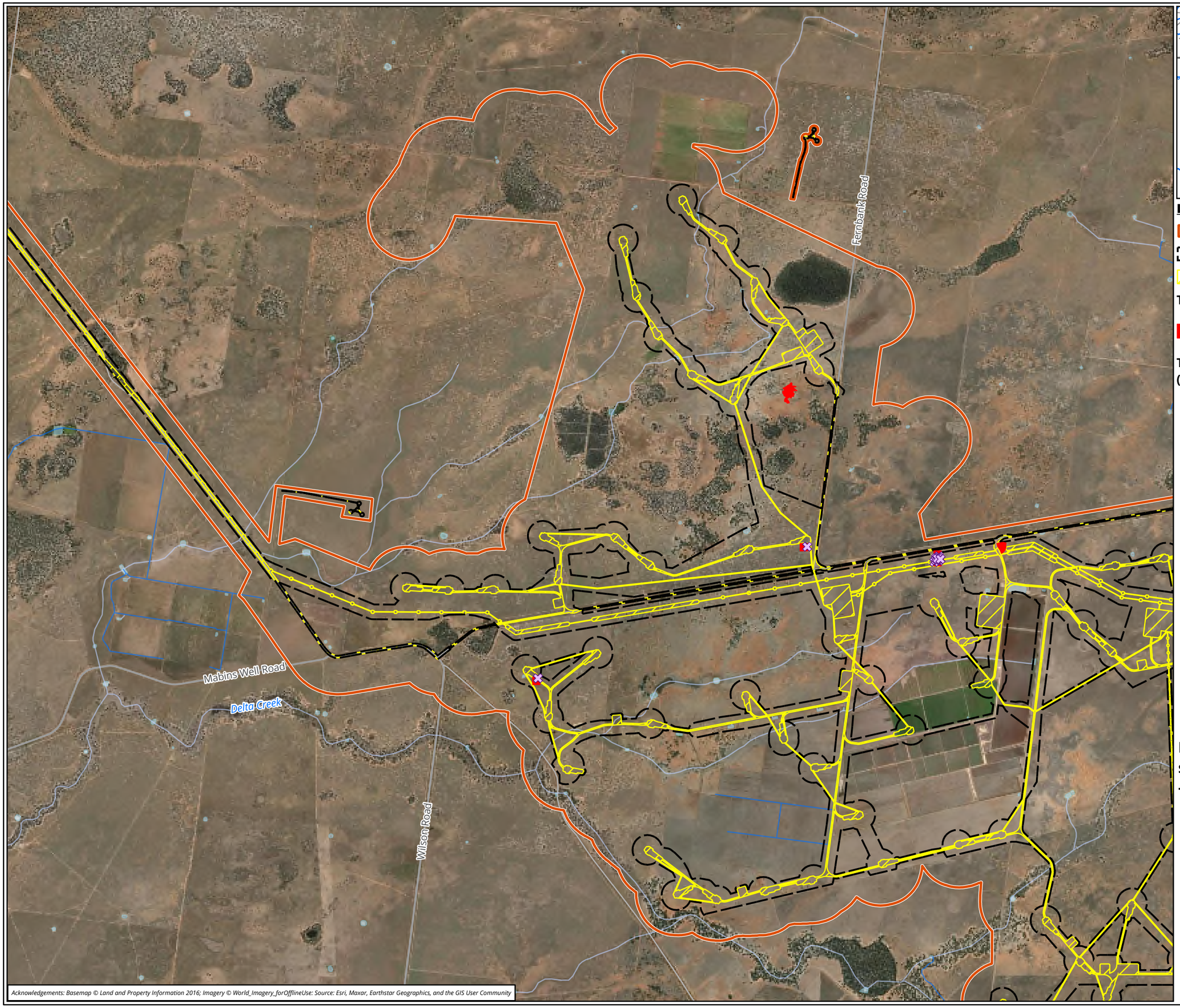

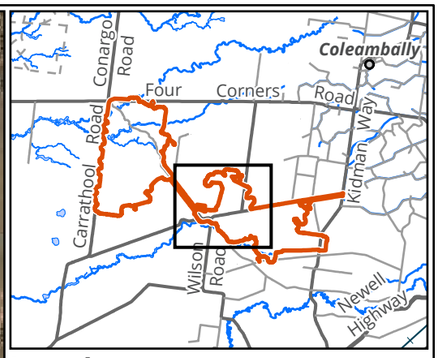

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona murrayana* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona murrayana*

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Figure 12A Threatened flora species polygon
- *Swainsona murrayana*

0 1
Kilometers
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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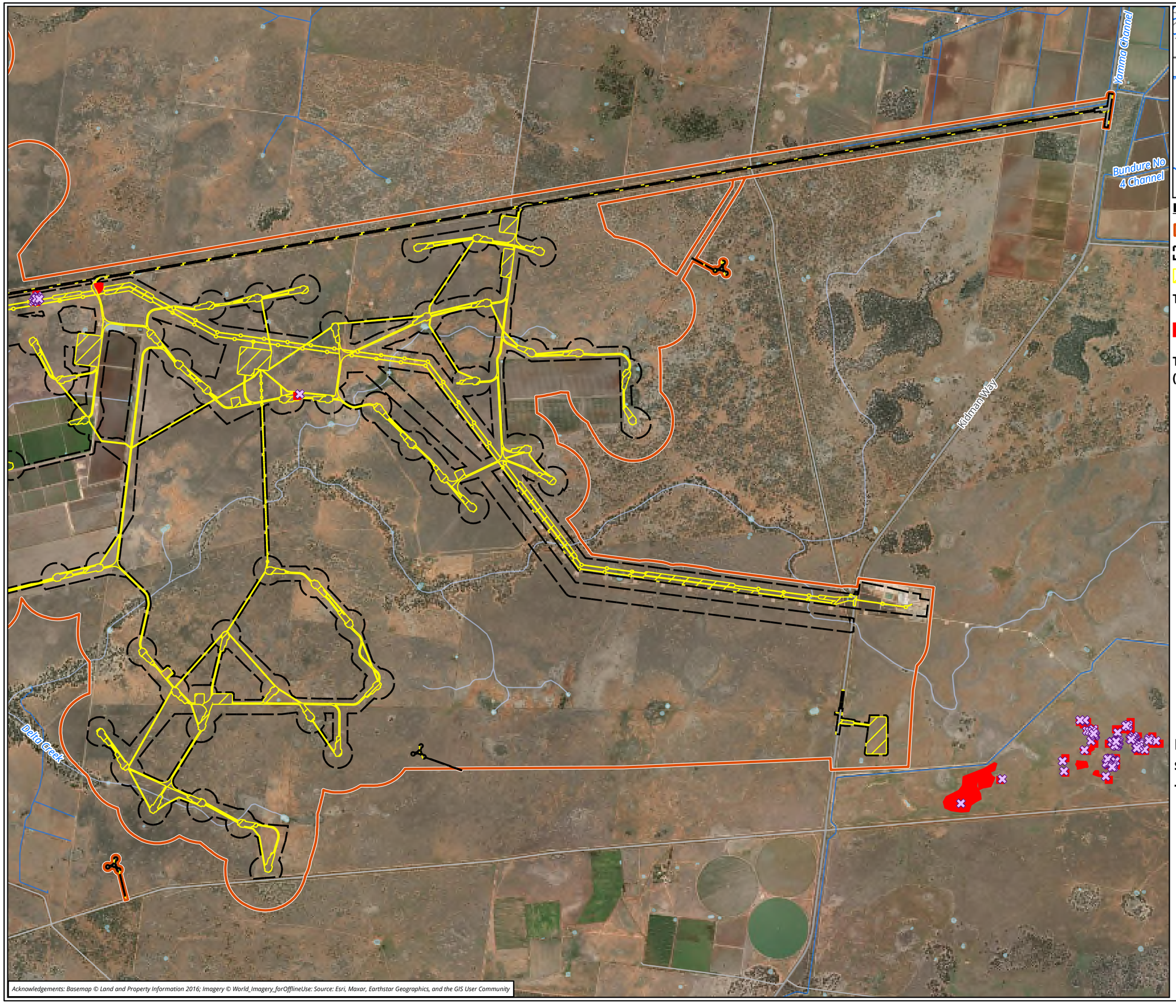

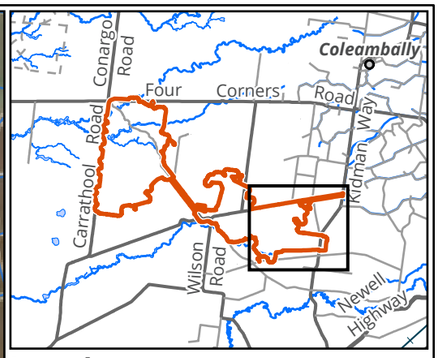

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona murrayana* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona murrayana*

Figure 12A Threatened flora species polygon - *Swainsona murrayana*

0 1

Kilometers
Scale: 1:48,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F12A_TSPoly_Flora

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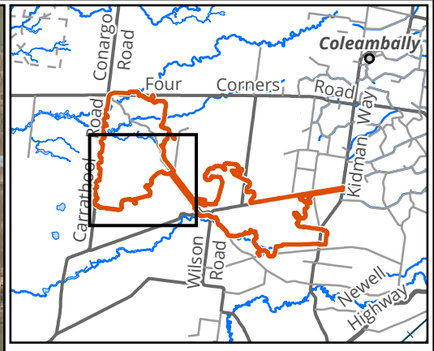

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona plagiotropis*

Figure 12A Threatened flora species polygon - *Swainsona plagiotropis*

0 1 2

Kilometers
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
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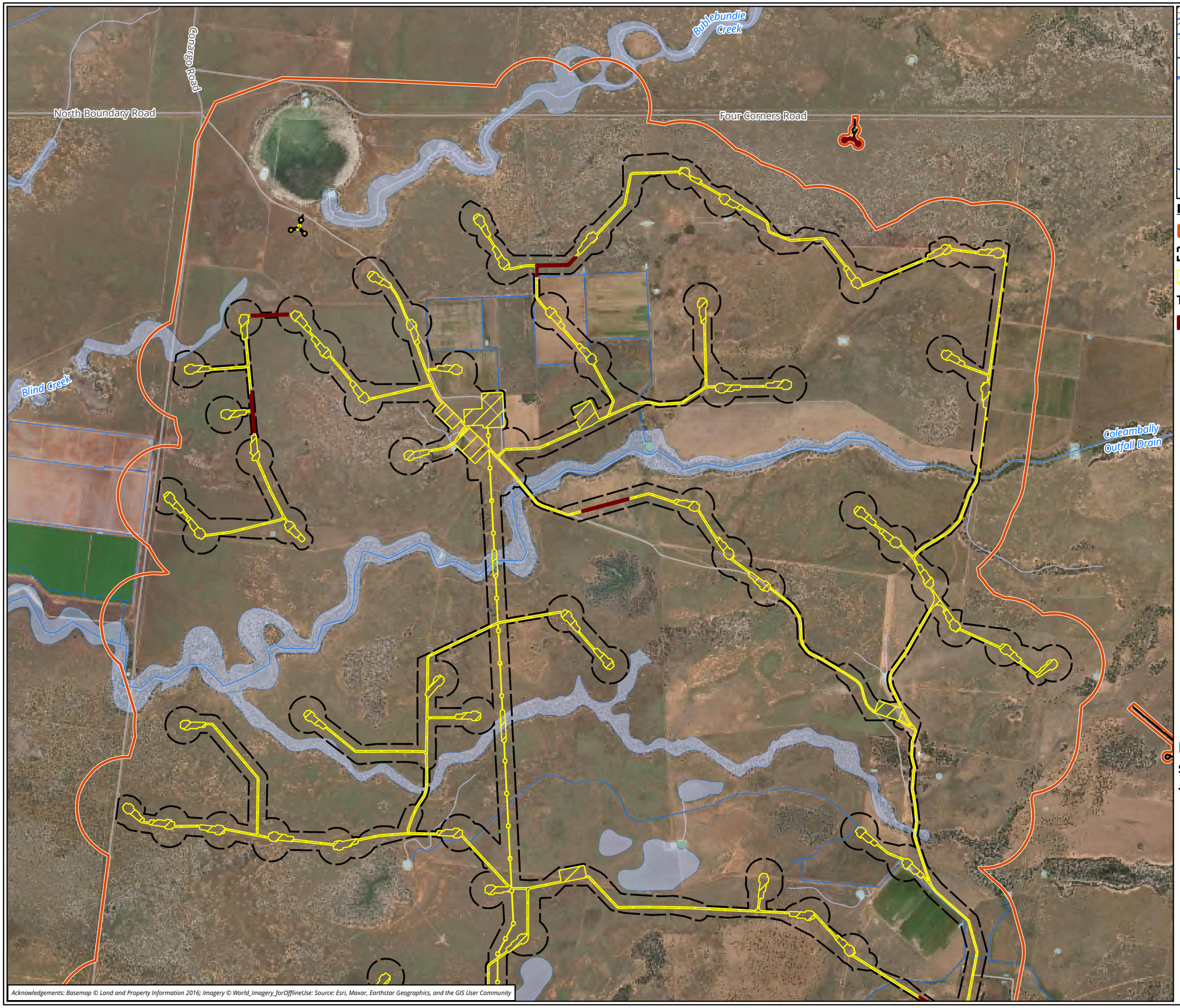

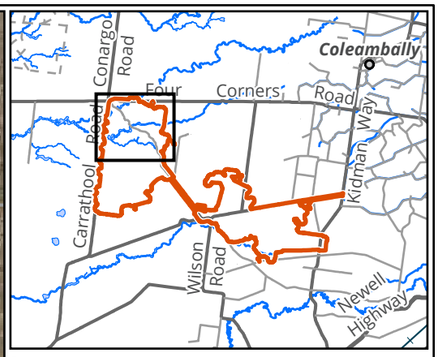

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona plagiotropis*

Figure 12A Threatened flora species polygon - *Swainsona plagiotropis*

0 1

Kilometers
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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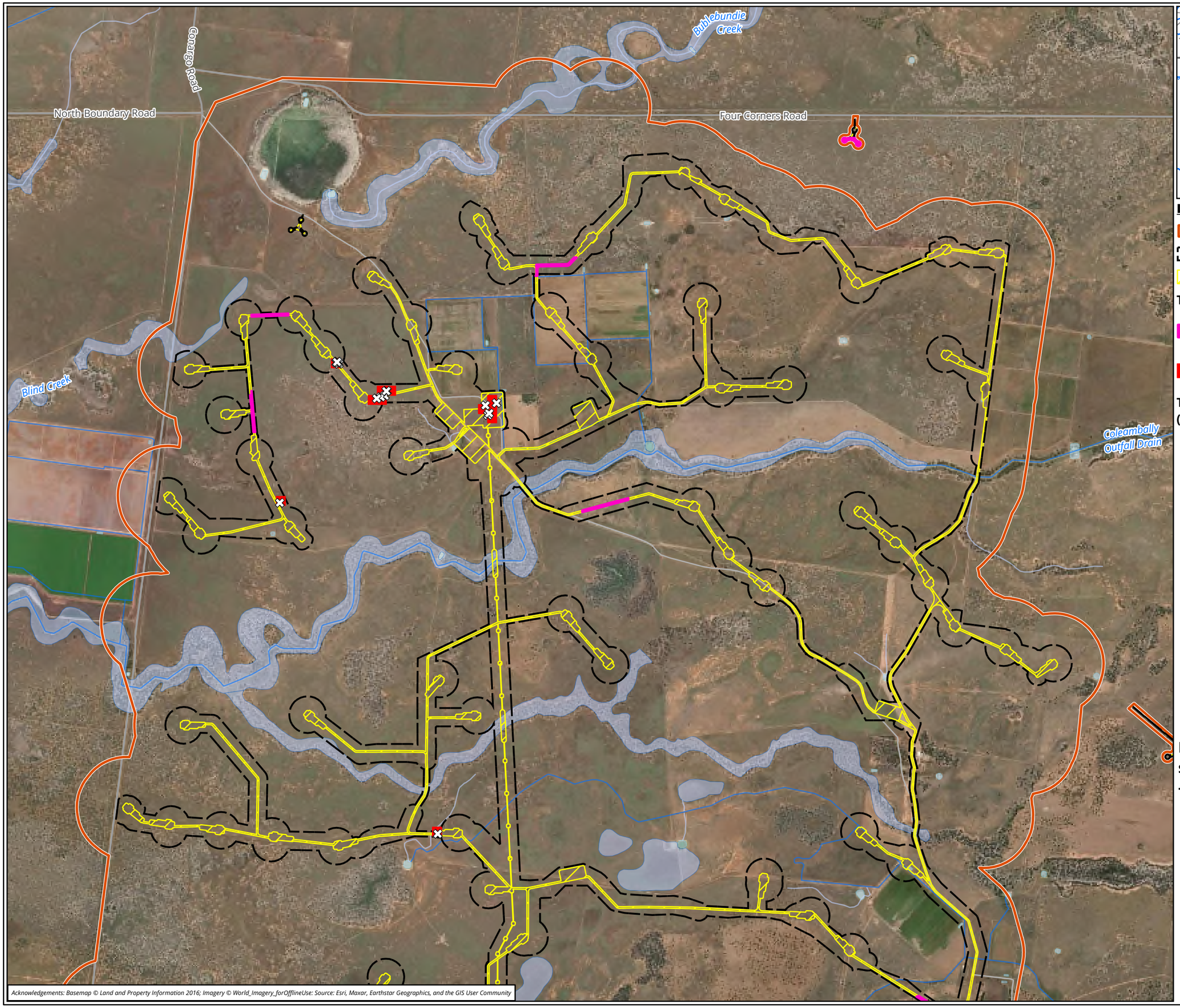

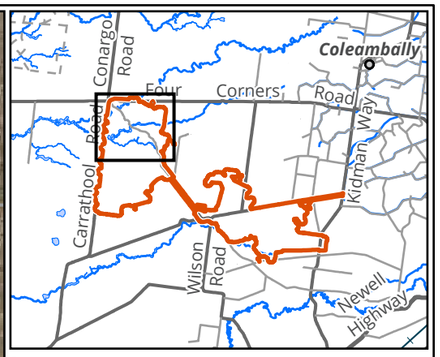

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona sericea* (assumed presence)
- *Swainsona sericea* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona sericea*

Figure 12A Threatened flora species polygon - *Swainsona sericea*

0 1

Kilometers
Scale: 1:38,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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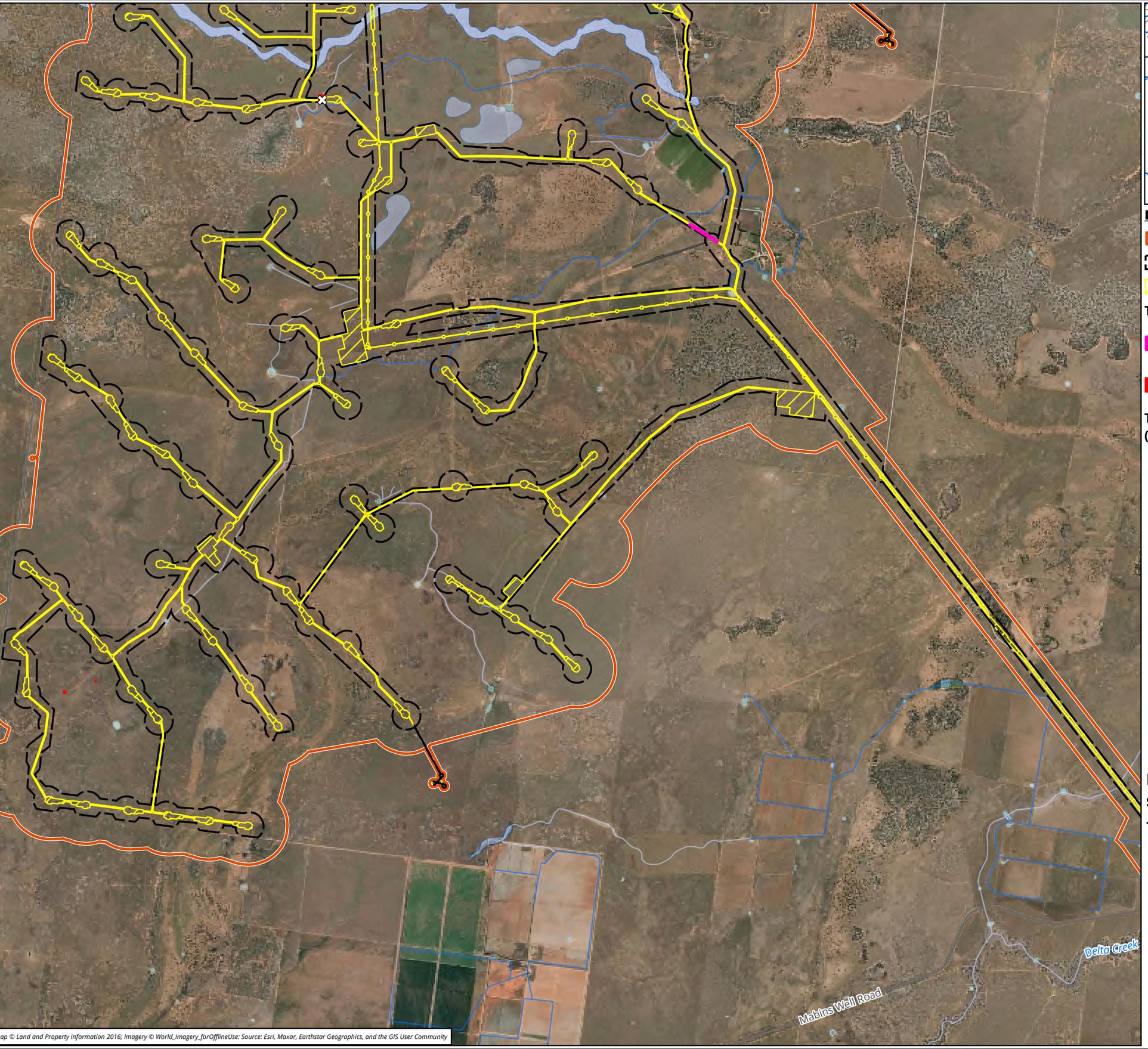

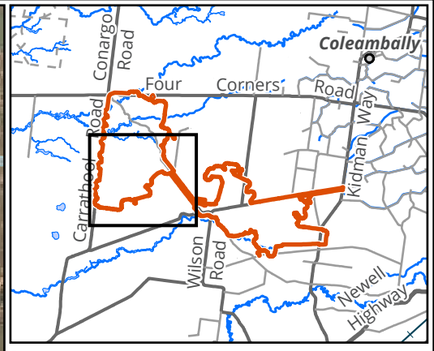

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona sericea* (assumed presence)
- *Swainsona sericea* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona sericea*

Figure 12A Threatened flora species polygon
- *Swainsona sericea*

0 1 2
Kilometers
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
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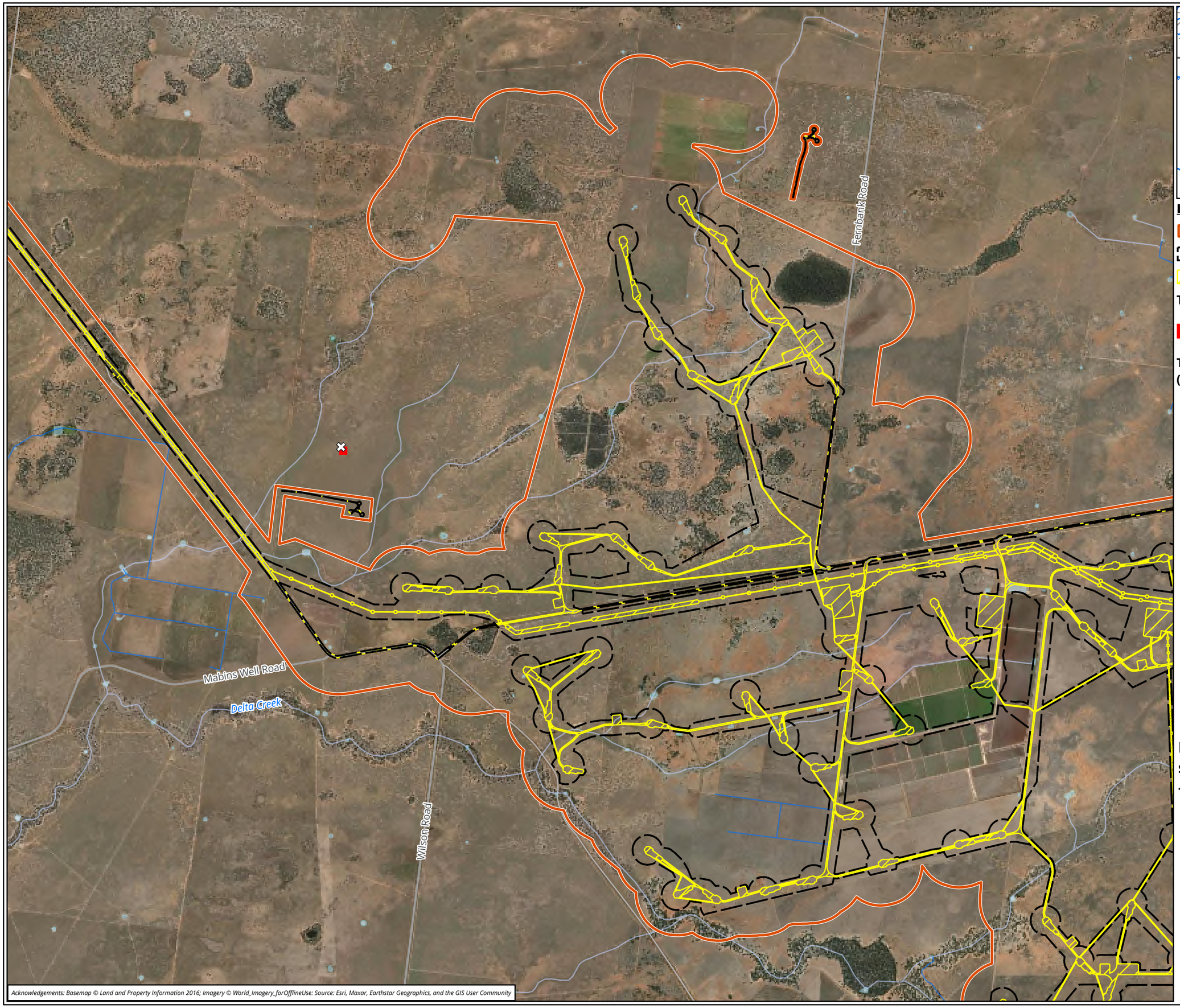

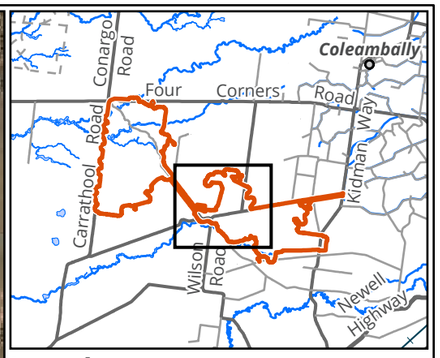

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona sericea* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona sericea*

Figure 12A Threatened flora species polygon - *Swainsona sericea*

0 1

Kilometers
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
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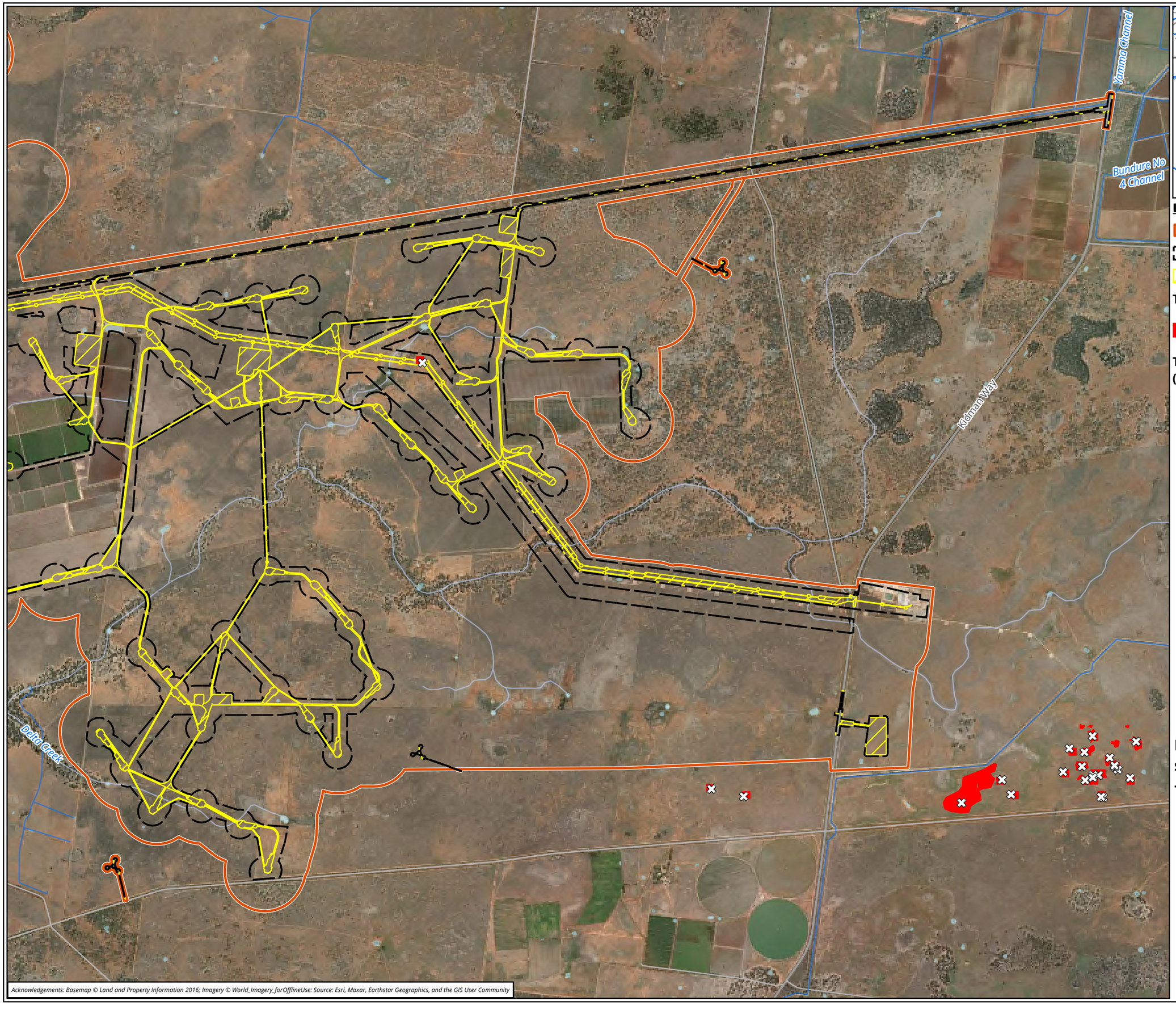

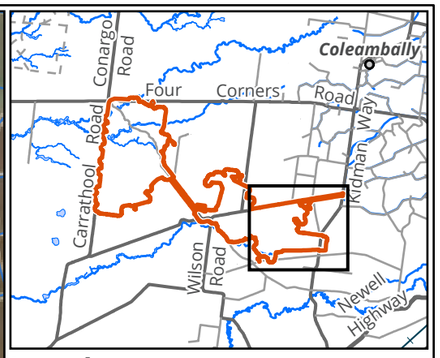

Legend

- Subject land
- Development corridor
- Development footprint

Threatened flora species polygon

- *Swainsona sericea* (confirmed presence)

Threatened flora species records (Biosis)

- *Swainsona sericea*

Figure 12A Threatened flora species polygon - *Swainsona sericea*

0 1
Kilometers
Scale: 1:48,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F12A_TSPoly_Flora

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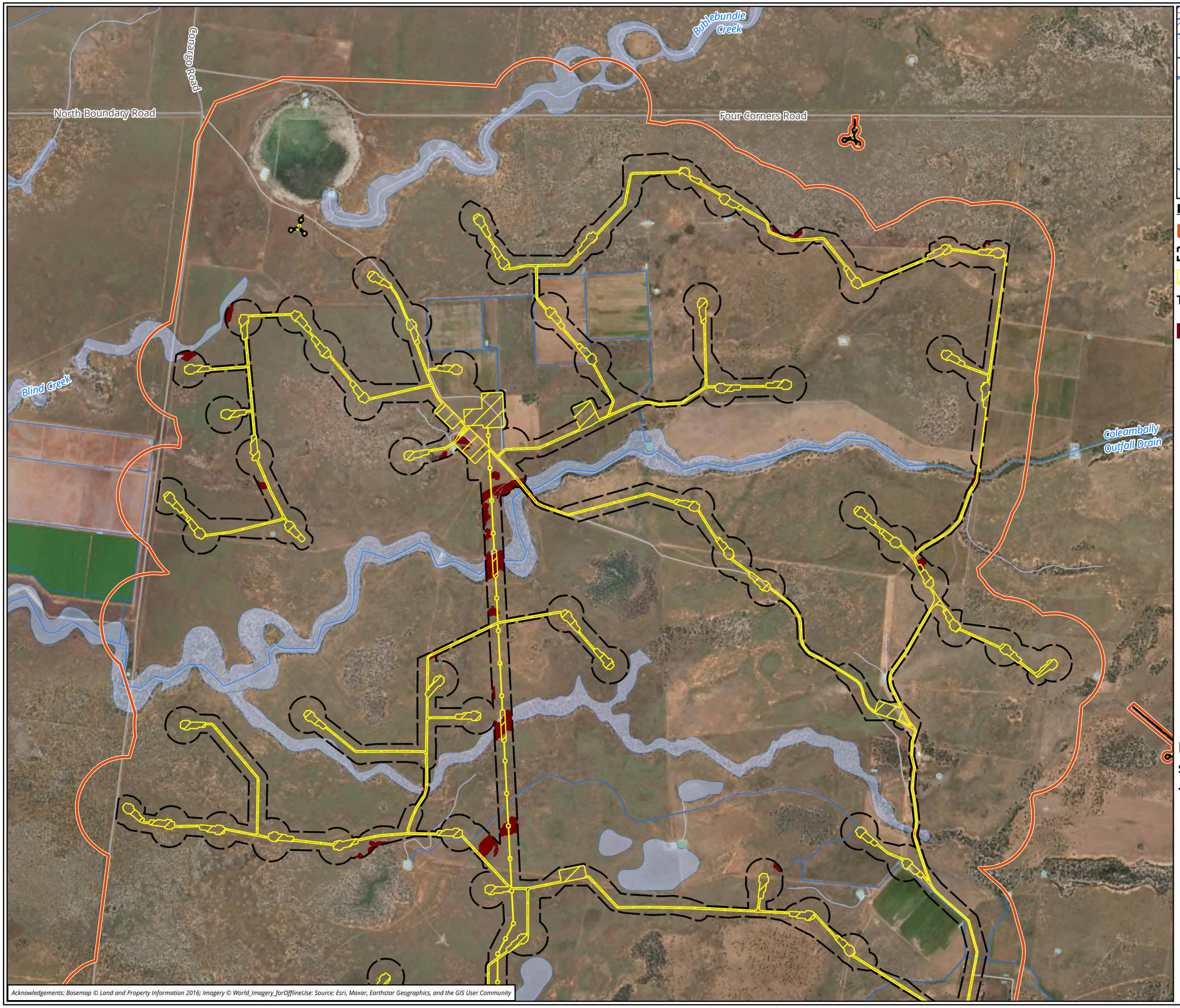

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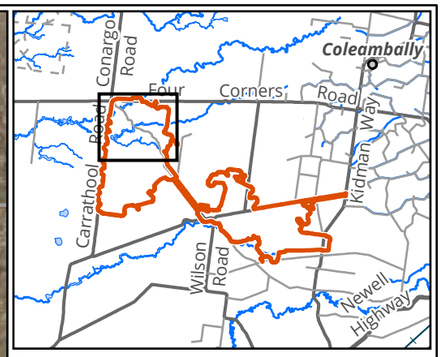


Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Grey Snake - *Hemiaspis damelii* (assmuned presence)

Figure 12B Threatened fauna species polygon - Grey Snake

0 1,000

Meters

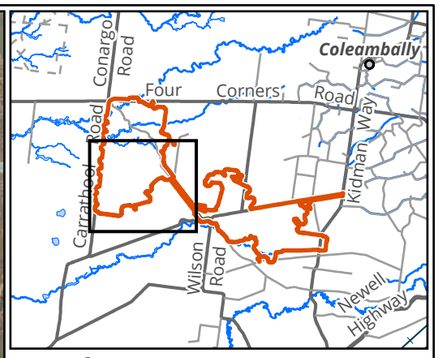
Scale: 1:38,000 @ A3

Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F12B_TSPoly_Fauna



Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Grey Snake - *Hemiaspis damelii* (assmuned presence)

Figure 12B Threatened fauna species polygon - Grey Snake

0 1,000

Meters
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
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Layout: 37263_Wind_F12B_TSPoly_Fauna

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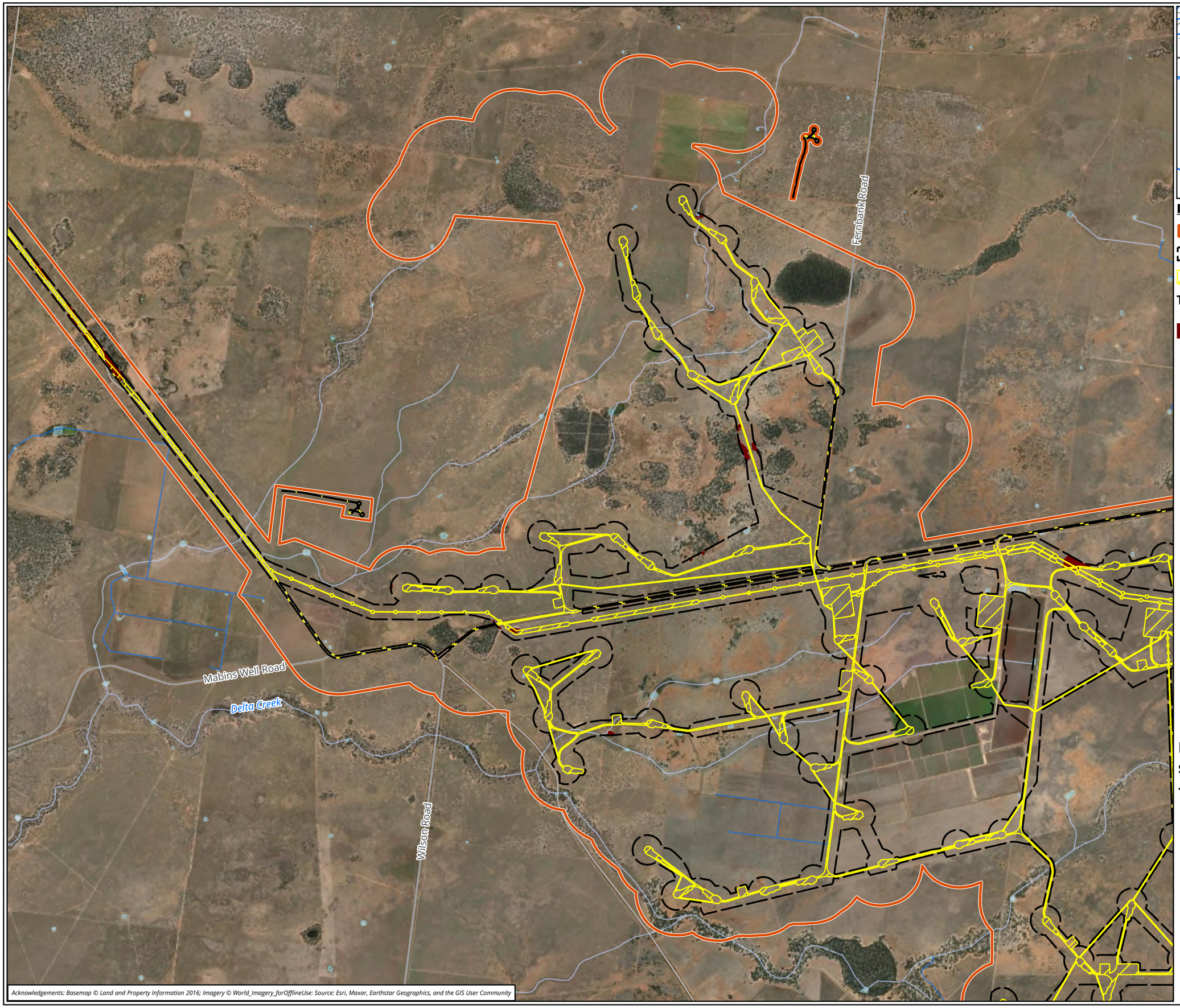

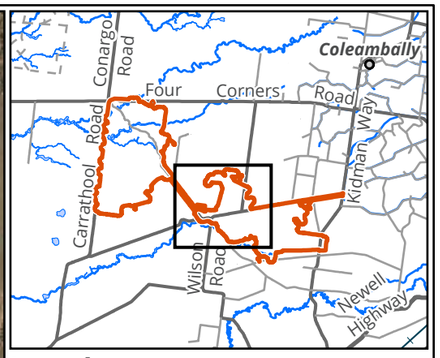

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Grey Snake - *Hemiaspis damelii* (assmuned presence)

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Figure 12B Threatened fauna species polygon - Grey Snake

0 1,000

Meters
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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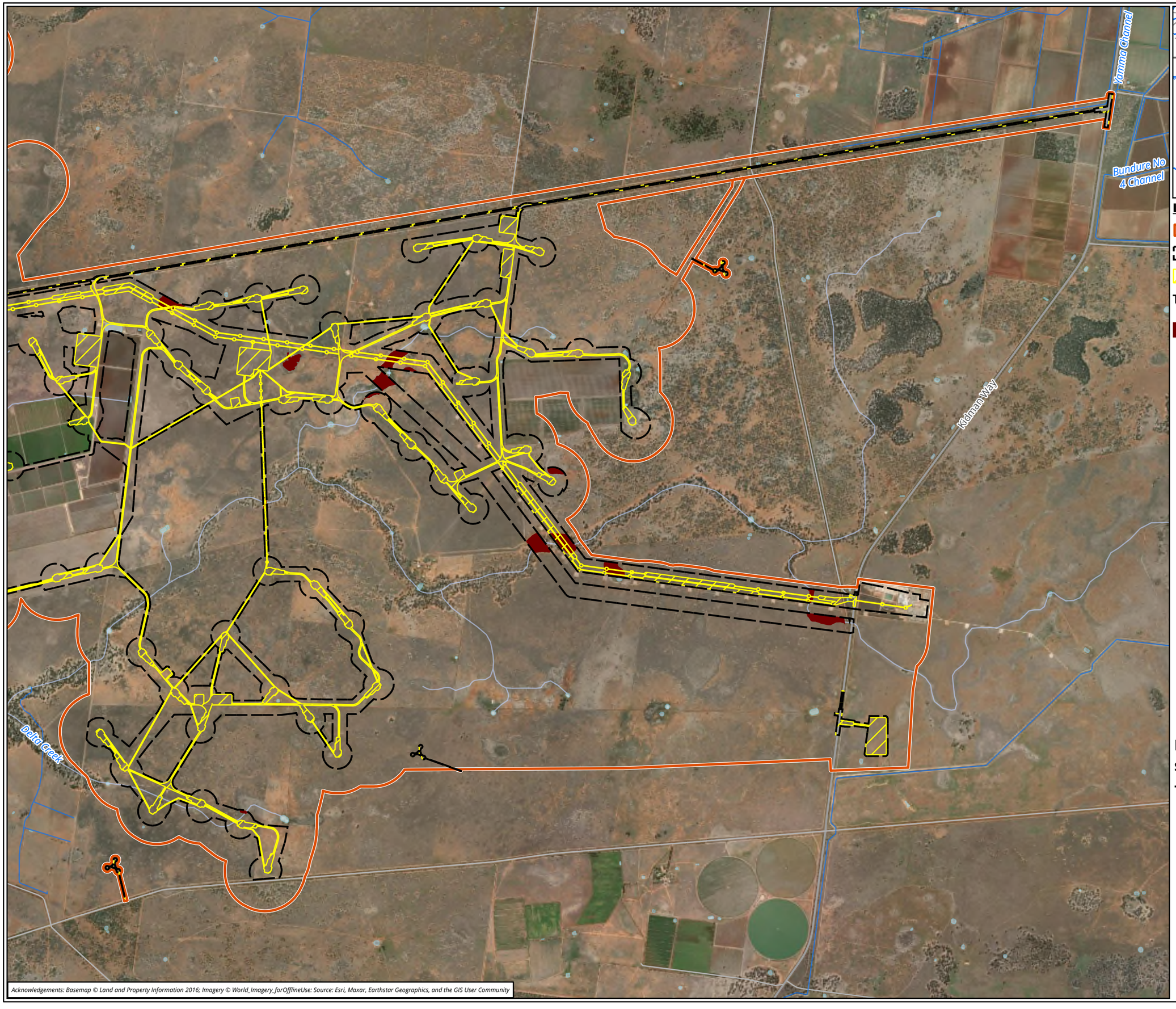

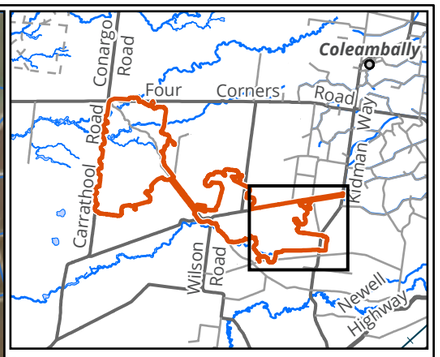

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Grey Snake - *Hemiaspis damelii* (assmuned presence)

Figure 12B Threatened fauna species polygon - Grey Snake

0 1,000

Meters
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
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Layout: 37263_Wind_F12B_TSPoly_Fauna

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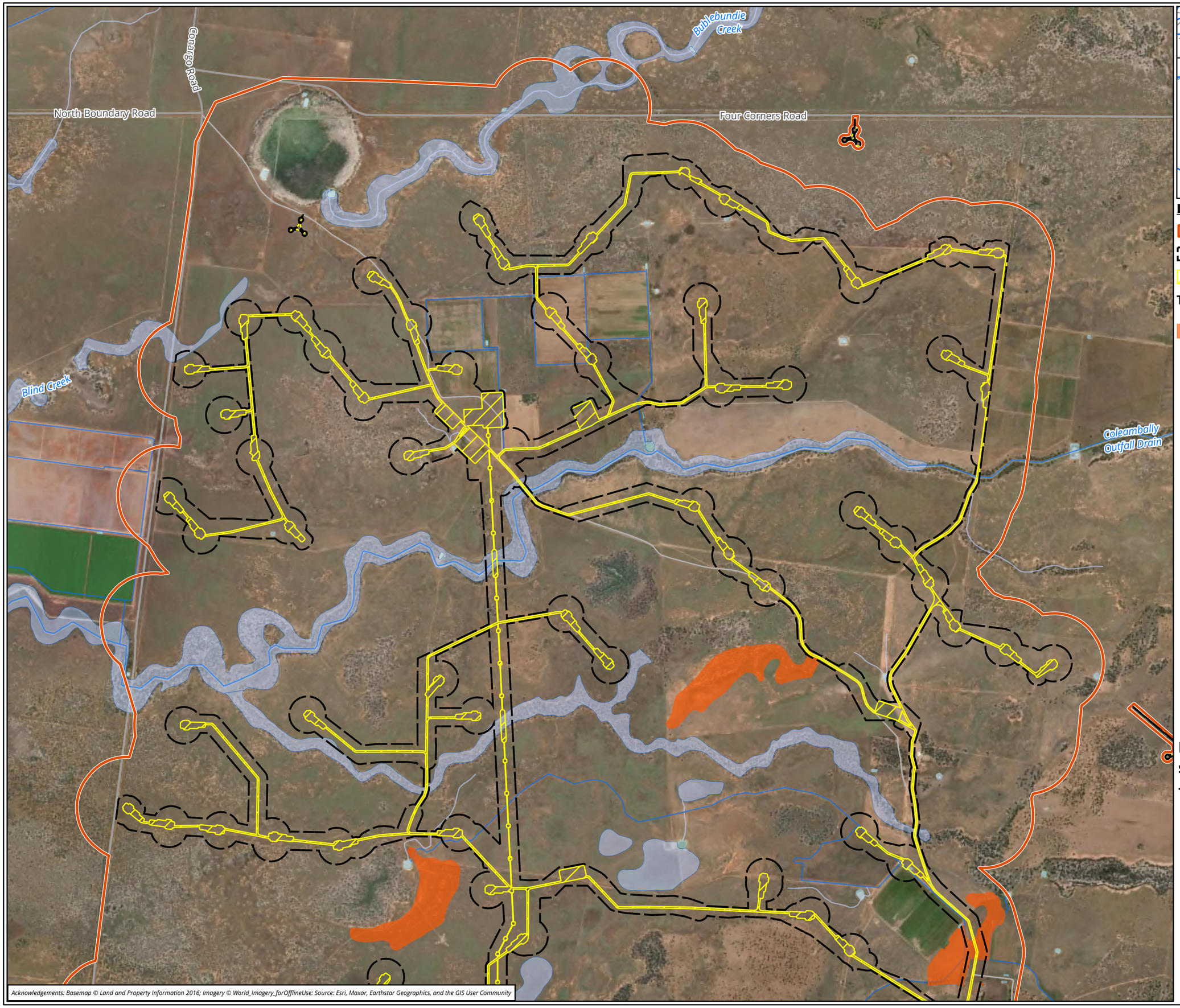

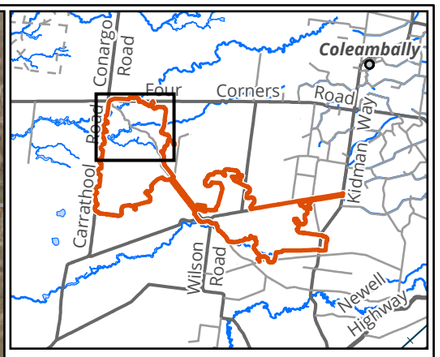

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Plains-wanderer - *Pedionomus torquatus*

Figure 12B Threatened fauna species polygon - Plains-wanderer

0 1,000

Meters
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
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Layout: 37263_Wind_F12B_TSPoly_Fauna

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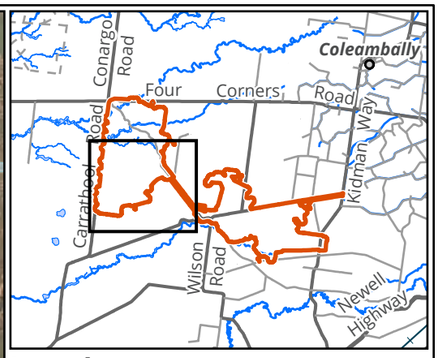

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Plains-wanderer - *Pedionomus torquatus*

Threatened fauna species records (Biosis)

- Plains-wanderer - *Pedionomus torquatus*

Figure 12B Threatened fauna species polygon - Plains-wanderer

0 1,000

Meters
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
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Layout: 37263_Wind_F12B_TSPoly_Fauna

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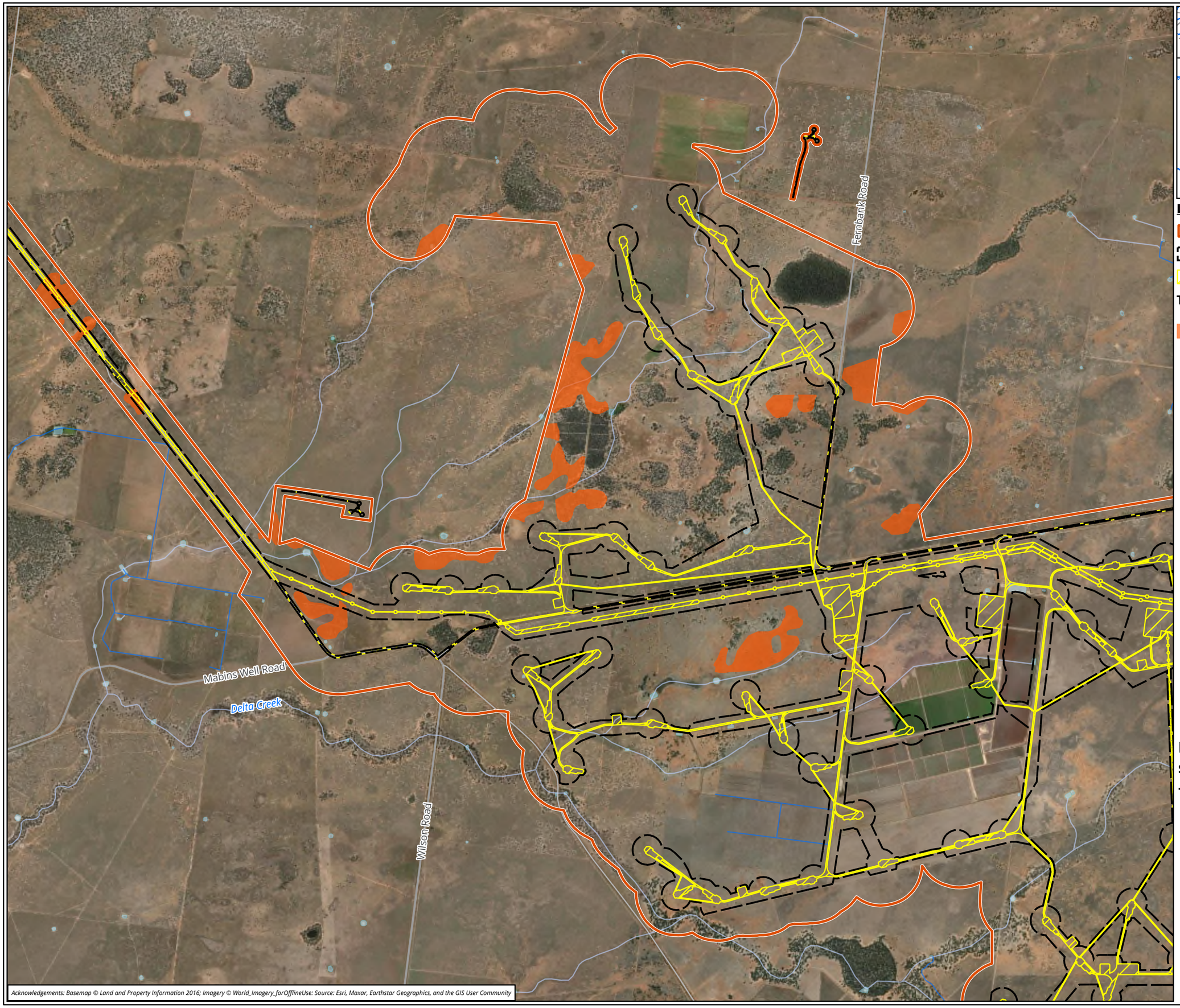

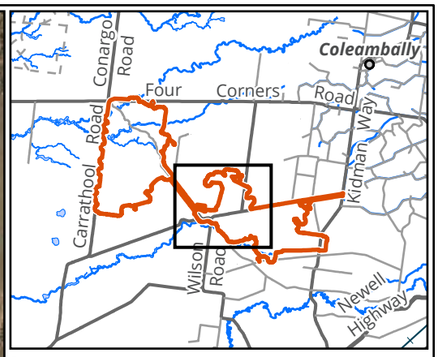

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Plains-wanderer - *Pedionomus torquatus*

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Figure 12B Threatened fauna species polygon - Plains-wanderer

0 1,000

Meters
Scale: 1:47,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
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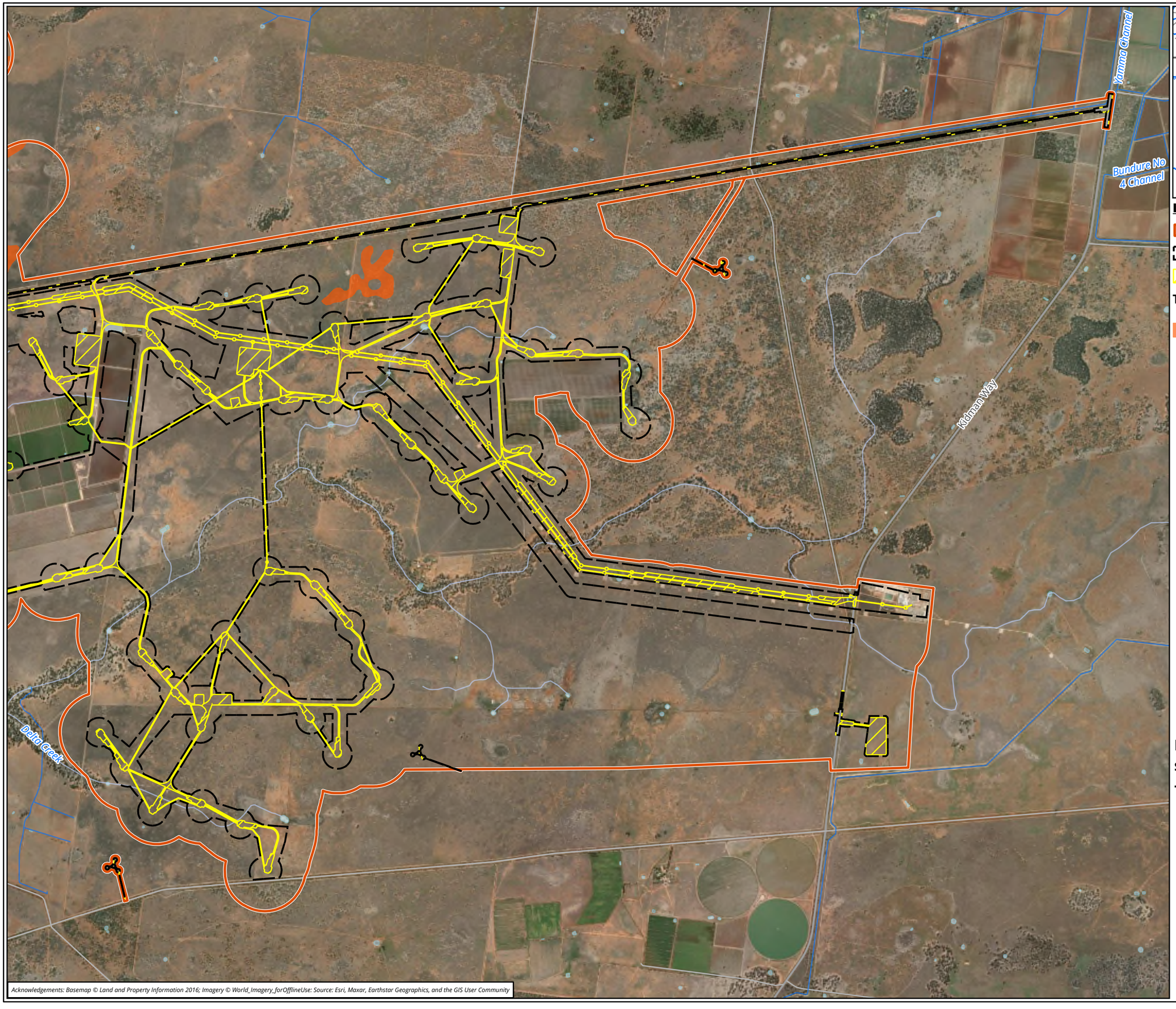

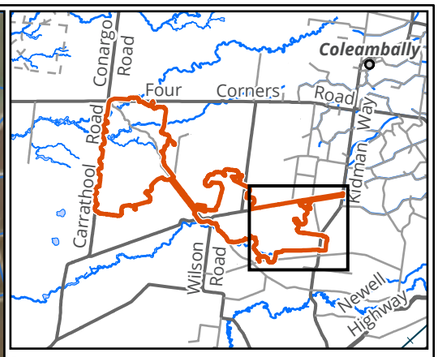

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Plains-wanderer - *Pedionomus torquatus*

Figure 12B Threatened fauna species polygon - Plains-wanderer

0 1,000

Meters
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 10 February 2026,
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Layout: 37263_Wind_F12B_TSPoly_Fauna

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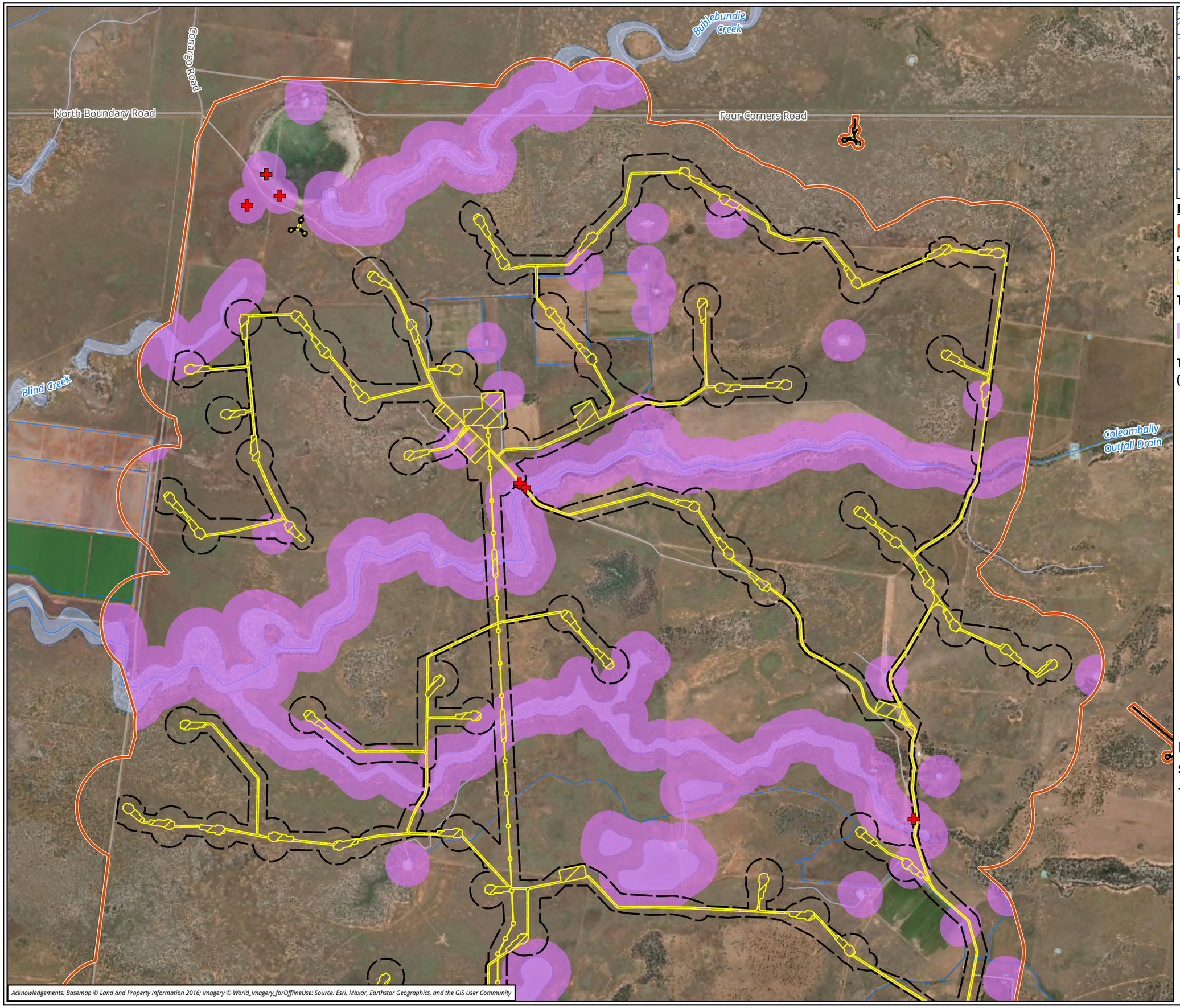

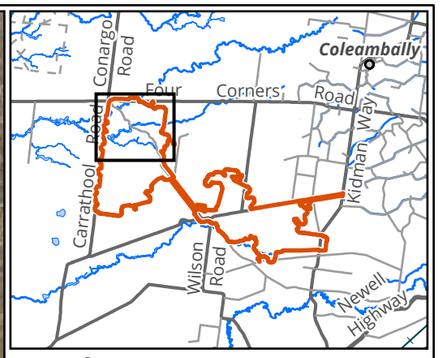

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Southern Bell Frog - *Litoria raniformis*

Threatened fauna species records (Biosis)

- Southern Bell Frog - *Litoria raniformis*

Figure 12B Threatened fauna species polygon - Southern Bell Frog

0 1,000

Meters
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
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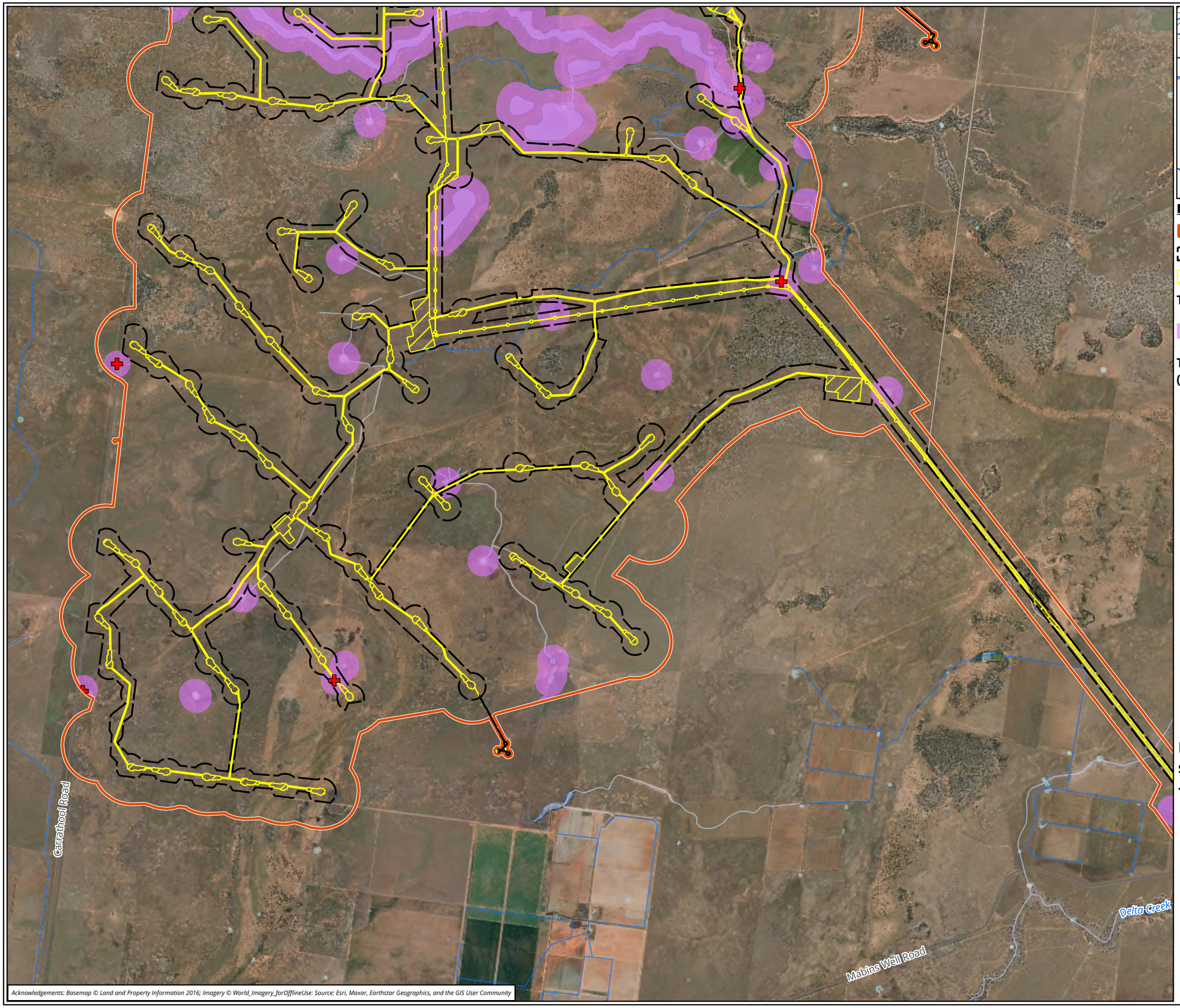

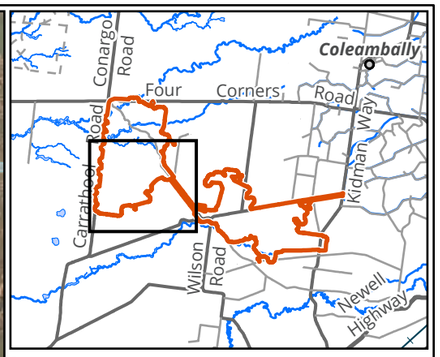

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Southern Bell Frog - *Litoria raniformis*

Threatened fauna species records (Biosis)

- Southern Bell Frog - *Litoria raniformis*

Figure 12B Threatened fauna species polygon - Southern Bell Frog

0 1,000

Meters
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
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Layout: 37263_Wind_F12B_TSPoly_Fauna

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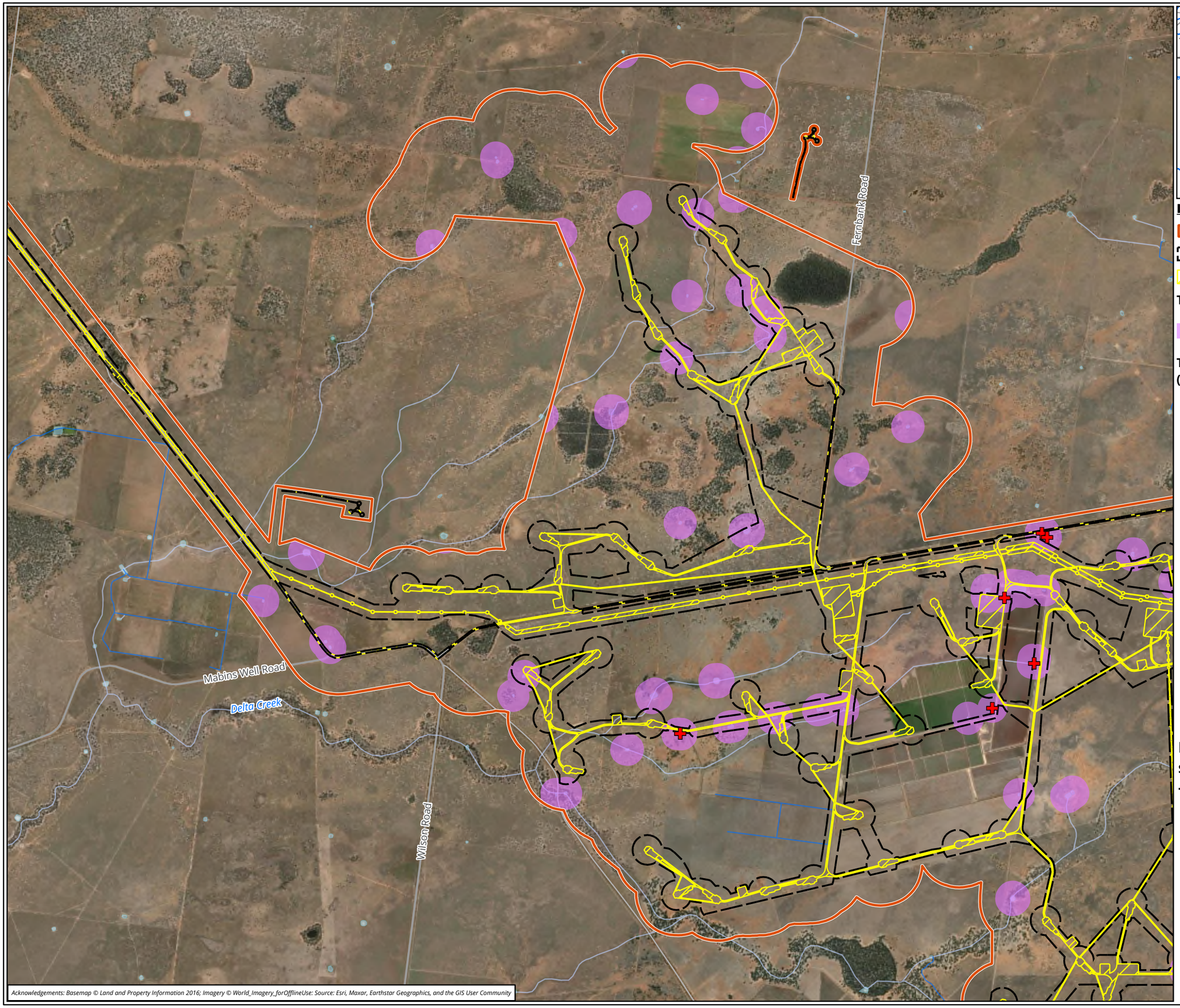

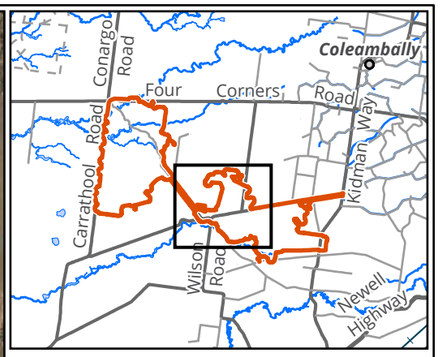

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Southern Bell Frog - *Litoria raniformis*

Threatened fauna species records (Biosis)

- Southern Bell Frog - *Litoria raniformis*

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Figure 12B Threatened fauna species polygon - Southern Bell Frog

0 1,000

Meters
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
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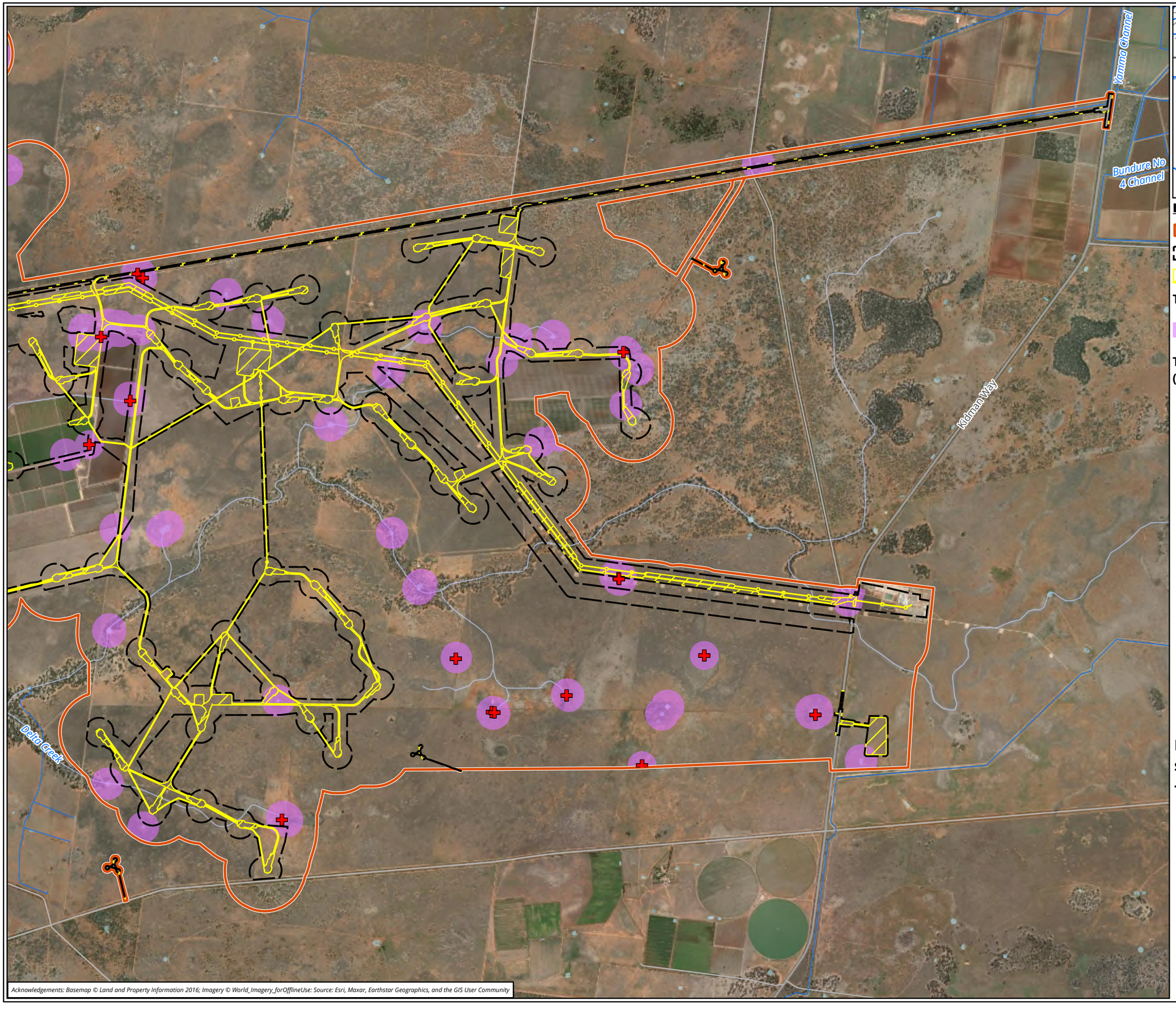

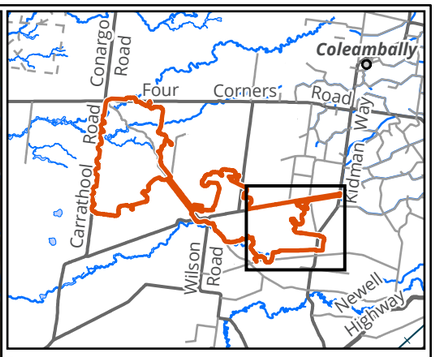

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Southern Bell Frog - *Litoria raniformis*

Threatened fauna species records (Biosis)

- Southern Bell Frog - *Litoria raniformis*

Figure 12B Threatened fauna species polygon - Southern Bell Frog

0 1,000

Meters
Scale: 1:48,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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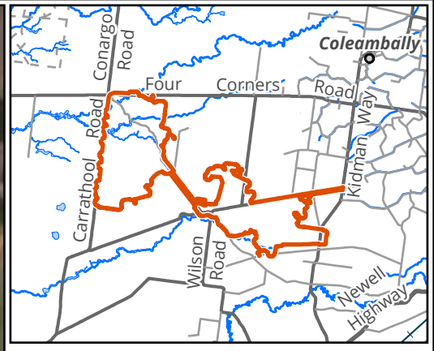

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Southern Bell Frog - *Litoria raniformis*

Figure 12B Threatened fauna species polygon - Southern Bell Frog

0 80

Meters
Scale: 1:2,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

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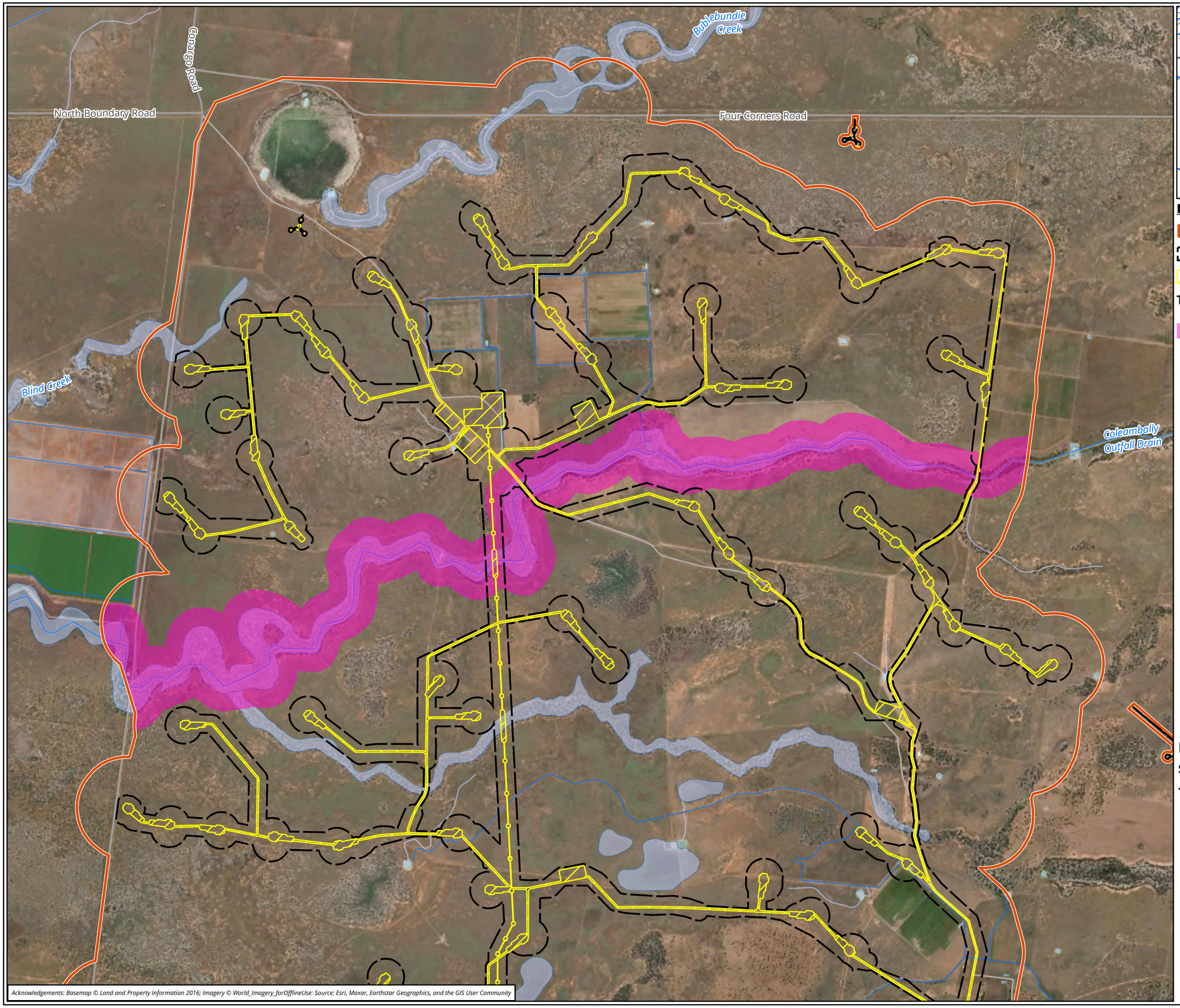

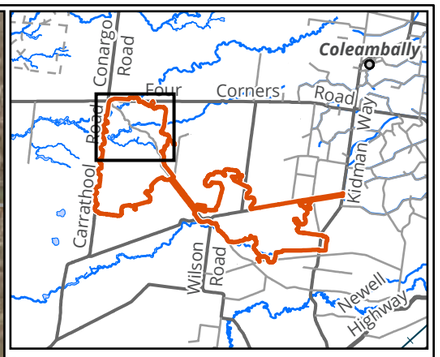

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Southern Myotis - *Myotis macropus*

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Figure 12B Threatened fauna species polygon - Southern Myotis

0 1,000

Meters
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
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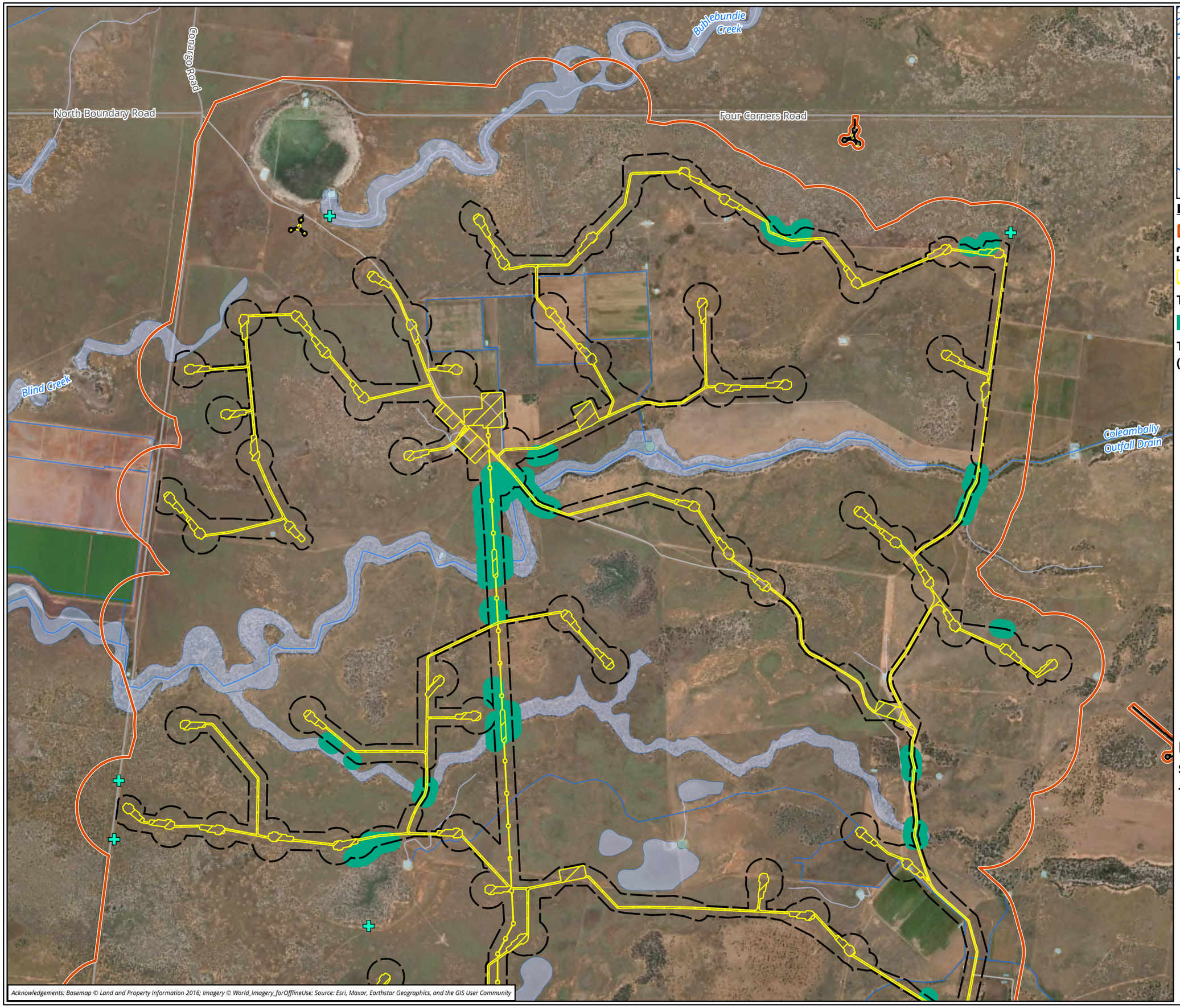

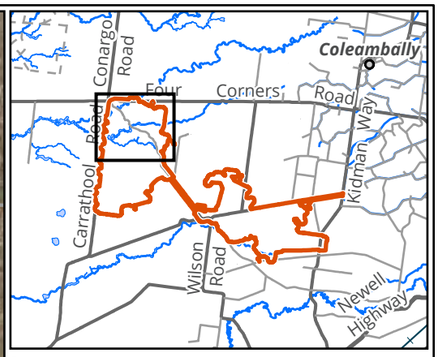

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Superb Parrot - *Polytelis swainsonii*

Threatened fauna species records (Biosis)

- Superb Parrot - *Polytelis swainsonii*

Figure 12B Threatened fauna species polygon - Superb Parrot

0 1,000

Meters
Scale: 1:38,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
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Layout: 37263_Wind_F12B_TSPoly_Fauna

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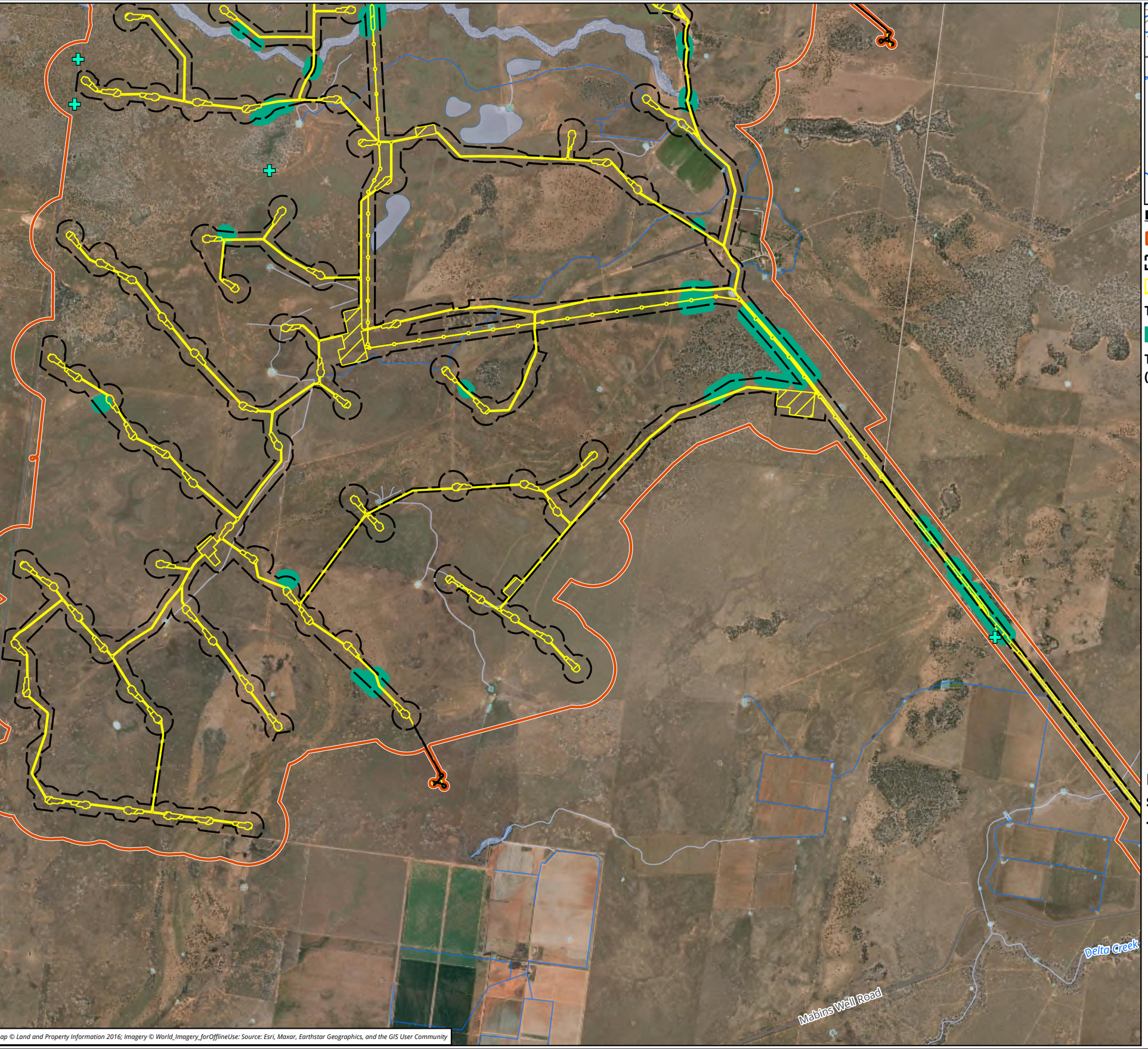

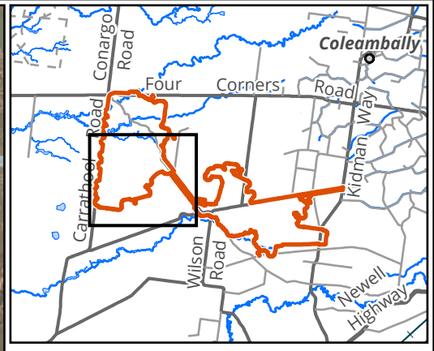

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Superb Parrot - *Polytelis swainsonii*

Threatened fauna species records (Biosis)

- Superb Parrot - *Polytelis swainsonii*

Figure 12B Threatened fauna species polygon - Superb Parrot

0 1,000

Meters
Scale: 1:52,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

N

biosis

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F12B_TSPoly_Fauna

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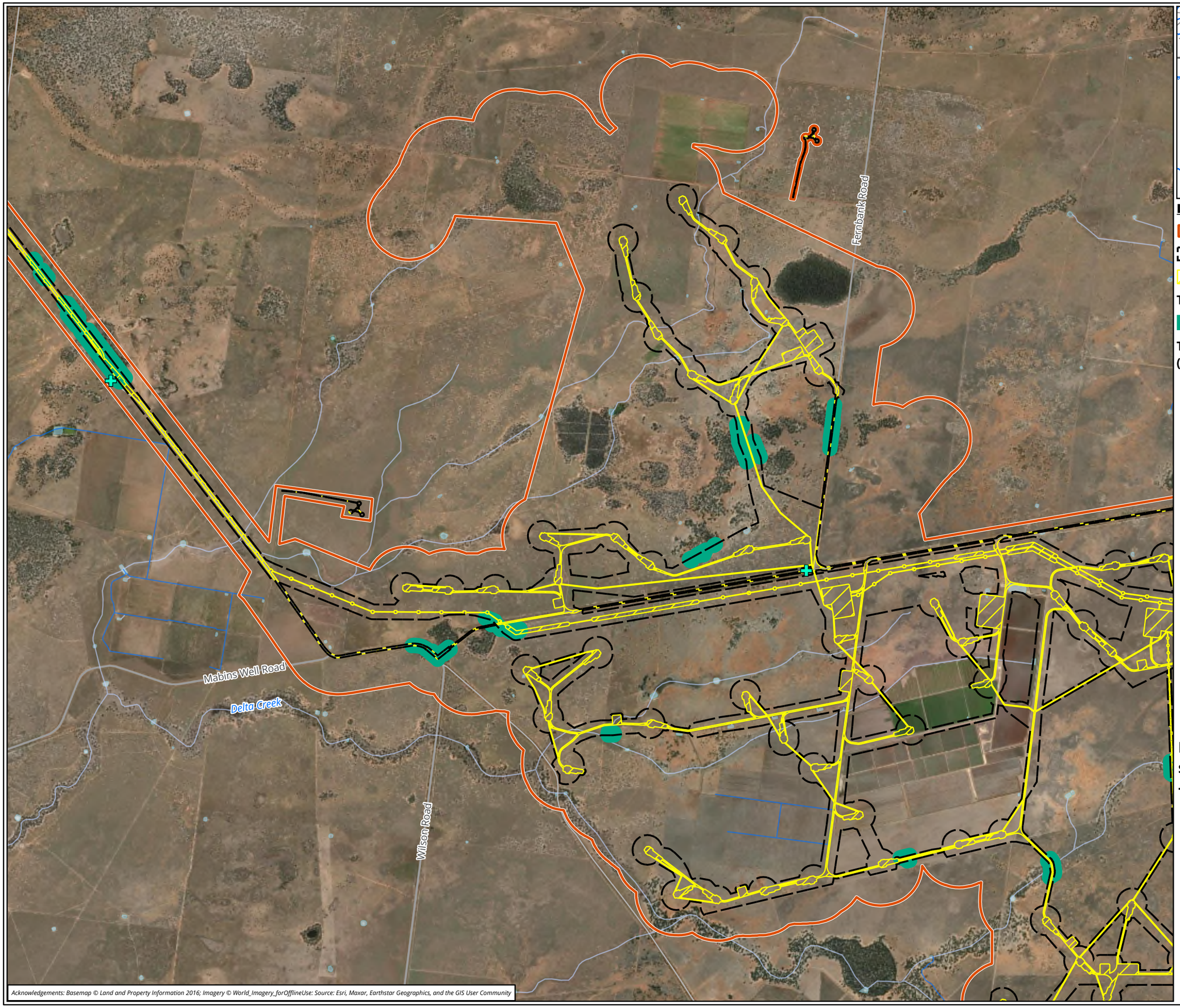

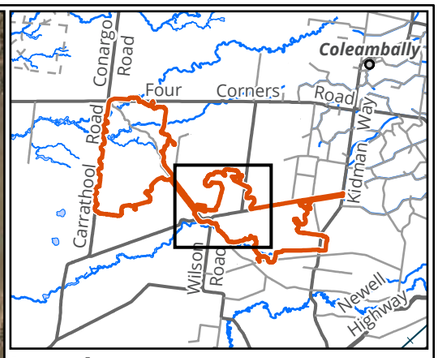

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Superb Parrot - *Polytelis swainsonii*

Threatened fauna species records (Biosis)

- Superb Parrot - *Polytelis swainsonii*

Figure 12B Threatened fauna species polygon - Superb Parrot

0 1,000

Meters
Scale: 1:47,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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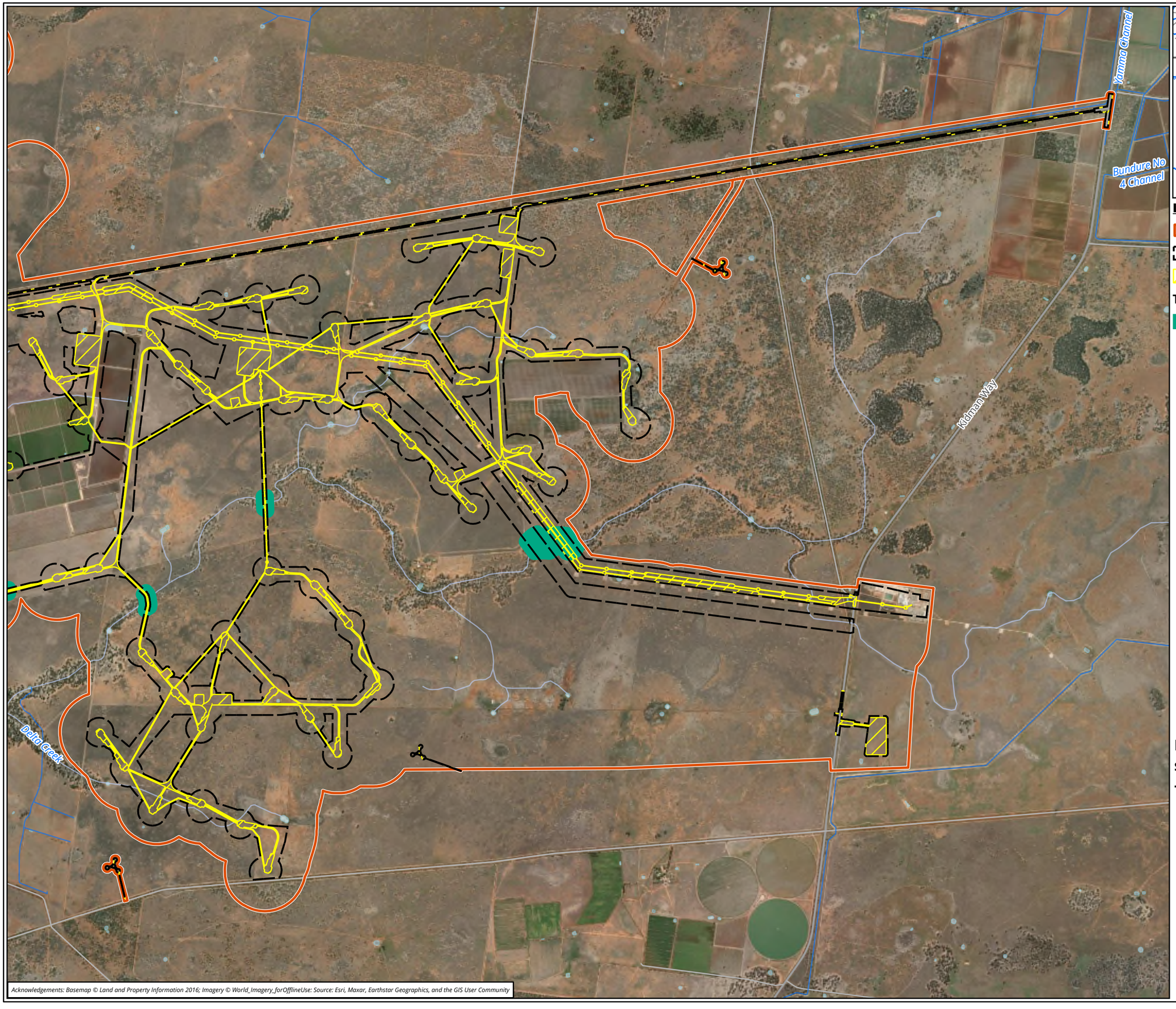

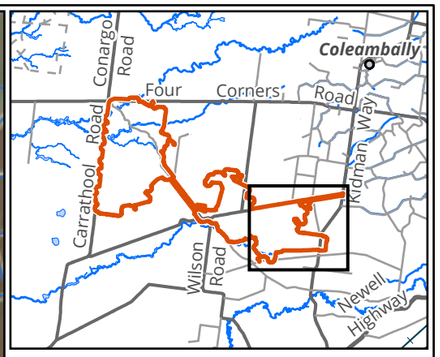

Legend

- Subject land
- Development corridor
- Development footprint

Threatened fauna species polygon

- Superb Parrot - *Polytelis swainsonii*

Figure 12B Threatened fauna species polygon - Superb Parrot

0 1,000

Meters
Scale: 1:48,000 @ A3
Coordinate System:
GDA2020 MGA Zone 55

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5. Identifying prescribed impacts

5.1. Assessment of the occurrence of prescribed impacts

Prescribed impacts have been identified in accordance with Section 6 of the BAM and clause 6.1 of the BC Regulation. Identification of prescribed impacts are outlined below in Table 46 and Sections 5 and 6, and discussed in detail in Section 8.3.

Table 46 Prescribed impacts associated with the project

Feature	Present	Description of feature characteristics and location	Threatened entities that use, are likely to use, or are part of the habitat feature.
Karst, caves, crevices, cliffs, rocks or other geological features of significance	No	No karst, caves, crevices, cliffs, rocks or other geological features of significance occur within the subject land or assessment area.	N/A
Human-made structures and non-native vegetation	Yes	Human made structures are present within the subject land. Within the development corridor the following human made structure are present: • Dams. • Irrigation channels • Farm tracks. • Public roads. • Existing transmission lines • Rural infrastructure (fences, shearing sheds, storage sheds) Non-native vegetation occurs, predominately in the form of irrigated and dryland cropping areas, and exotic components of retained native vegetation.	Avian fauna species are known to utilise artificial and human made structures for nesting due to historic clearing of native vegetation. Dams and irrigation channels are utilised by fauna species as permanent water resources throughout the year, some dams are created in areas that likely originally supported natural ephemeral billabongs. Microbats may use shearing sheds and storage sheds for roosting. Exotic vegetation, including irrigated cropping and dryland cropping areas are known to be utilised by raptor species and waterbirds for foraging. *Litoria raniformis* records were also observed within irrigation channels adjacent to cropping areas Refer to Section 8.3.1.
Habitat connectivity	Yes	Natural corridors in the form of native vegetation and riparian watercourses in both a project level scale and broader landscape scale occur. Landscape scale habitat connectivity also exists for aerial species over the wind farm between water bodies present in the surrounding landscape. This includes both vegetation and non-vegetation (or farmed/cropped) areas.	All threatened fauna, flora and TECs within the landscape. Aerial species are particularly at risk from habitat connectivity issues arising from potential barrier effect of operations wind turbines. Refer to Section 8.3.2.
Waterbodies, water quality and hydrological processes	Yes	The subject land is characterised by low-lying flood prone terrain, with multiple unnamed ephemeral waterways that dissect the subject land and development corridor, with Delta Creek, Blind Creek and Bublebundie Creeks the most significant natural waterways. The subject land is largely flat with some minor drainage depressions that temporarily hold water during and	When containing water, migratory species, and fauna species have the potential to use creeks and floodplain depressions / watercourses outside the subject land. Ephemeral wetland areas that occur may become inundated during periods of high rainfall and wet seasons. Riparian areas are utilised by fauna species as connectivity corridors. Refer to Section 8.3.3

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Feature	Present	Description of feature characteristics and location	Threatened entities that use, are likely to use, or are part of the habitat feature.
		following rainfall. Several minor topographic depressions on the floodplain hold water for longer, creating scattered swamp environments.	
Wind turbine strikes	Yes	See Section 5.2 and 6 below.	See Section 5.2, Sections 6 and 8.3.4 below.
Vehicle strikes	Yes	Vehicle movement will increase during construction, and to a lesser extent during operation, of the project. this increase in vehicle movements has the potential to impact upon threatened fauna species.	During increased vehicle movements, particularly in the early stages of construction and potentially during vegetation clearing, low flying birds and ground dwelling mammals have the potential to collide with vehicles travelling to and from the project. Refer to Section 8.3.5.

5.2. Identification of potential impacts associated with wind farm developments

5.2.1. Background review and bird and bat utilisation surveys

Globally, the onshore wind farm industry continues to experience significant developments and expansion. Turbine infrastructure is larger in both scale and energy output and site footprints have increased in area and capacity. As such, there is an increasing threat to native taxa. The associated environmental impact must be granted appropriate consideration, with bat and bird fatalities representing the principal risk, with recorded instances occurring at international and domestic sites (de Lucas et al. 2012, Smales 2014, Moloney et al. 2019). Despite this, the impacts of wind farms are considered to be relatively low in comparison to other industries, and anthropogenic influences on native taxa (Smales 2014). It is currently estimated that wind farms account for approximately 0.1% of global anthropogenic causes of avian fatalities (Bennett et al. 2022). With the wind industry also being one of the only energy-generating enterprises that must continue systematic monitoring of birds (Smales 2014). While collisions are thought to be the primary cause of mortality, the construction and operation of wind farms can also lead to secondary impacts on bat and bird species including habitat loss or modification, and avoidance response of species (Fox et al. 2006, Masden & Cook 2016, Smales 2014) .

Bird and bat collision risk on wind farms is due to a complex number of factors including species-specific elements, such as flight patterns, size and foraging behaviour, environmental factors, and site -specific factors pertaining to the layout of and configuration of turbine infrastructure (de Lucas et al. 2012, Smallwood & Bell 2020). Considering this, not all wind farm sites would contain the same level of collision risk. Quantifying individual collision for bat and bird species presents many challenges. Wind speeds, landscape features and weather events can also contribute to this (Gorman et al. 2021). Understanding collision risk is important to identifying species which may be susceptible and to determining population level impacts, specifically to threatened taxa, with a view to implementing strategies to reduce impacts (Smales 2014, Moloney et al. 2019).

Birds

Australia is home to considerable avian diversity, with many species inhabiting, utilising, or passing through wind farm sites throughout each year. Studies of bird and bat fatalities across south-eastern Australia have identified 24 species of bird and four species of bat that are most often impacted by direct collision, with larger birds being deemed more likely to collide than smaller birds (Smales 2014, Everaert 2014). Commonly struck species include the Australian Magpie *Cracticus tibicen*, the Nankeen Kestrel *Falco cenchroides*, and the Brown Falcon *Falco berigora* which constitute 24%, 15% and 12% respectively, of all species impacted (Smales 2014). Publicly accessible data from currently operating wind farms in New South Wales have reflected these findings with the Australian Magpie being the most commonly found species in post-construction monitoring searches constituting 18% of all bird carcasses found on these sites. This is followed by Nankeen Kestrels (17%), Wedge-tailed eagle (10%), Crimson rosella (6.6%), and the Sulphur-crested Cockatoo (4.8%).

A major focus of bird collision research has prioritised large raptors (Smales 2014, de Lucas et al. 2012, Hull et al. 2015, Hull & Cawthen 2013). This may be because there is a large number of threatened species within the order, they have a relatively low reproductive output and are thought to be prone to collision risk and are often of great community interest (Garvin et al. 2011). However other larger bird species including waterbirds, such as Ibis and Pelicans, parrots, and migratory species are also at risk.

Nesting densities of species may be useful in identifying some likelihood of collision risk (Marques et al. 2014). While important in assessing population and utilisation of a site by different species, abundance alone has been shown to be a poor predictor of collision mortality (Madders & Whitfield 2006, de Lucas et al. 2008).

Additionally, there are foraging and feeding behaviours that may make some species more susceptible to collision, such as aerial or shrub searching (Hull et al. 2015). This accounts for observations seen in collision fatality comparisons between raptor species occupying the same site. Species including the Wedge-tailed Eagle *Aquila audax*, Brown Falcon and White-bellied Sea Eagle account for a higher proportion of deaths than species such as the Brown Goshawk *Accipiter fasciatus*, Collared Sparrowhawk *Accipiter cirrocephalus* and Grey Goshawk *Accipiter novaehollandia* (Hull et al. 2015). Seasonal changes to behaviour have also been seen to affect collision risk for a species (Smith & McWilliams 2016).

Flight height, particularly species flying at rotor height, may expose some species to higher collision risk, but are not the sole factor (Smales 2014). There are some differences in rates of avoidance in eagle species (Hull et al. 2015). Species-dependent avoidance rates are prescribed by regulatory bodies, but more work is needed to understand the ecological differences between species such as the Wedge-tailed Eagle, and White-bellied Sea Eagle, which have been shown to exhibit differing avoidance rates (Hull et al. 2015). As such, collision risk models assume a great deal about bird behaviour, including uniform avoidance rates for all individuals within a species, which is considered to be unlikely (Masden & Cook 2016). It should be noted that the Biosis collision risk model applies a range of avoidance rates per species to factor in this potential variation in collision risk.

Given the distribution of potential and known habitat south (Victoria) and north (Coleambally/Leeton) of the subject land, and the likely local and seasonal movements from these areas, a portion of Australasian Bitterns using the local wetlands are expected to fly across the subject land on occasion. Satellite tracking and changes in local densities indicate Australasian Bitterns undertake seasonal and dispersive movements between breeding and non-breeding habitats, and as local habitat suitability conditions change (Bitterns in Rice Project 2017, Department of the Environment and Energy 2019). Local and daily movement patterns of Australasian Bitterns are not well documented. Given the similarities with the Eurasian Bittern, movements of the latter species may be helpful in understanding those of the Australasian Bittern, though local habitat suitability and conditions are likely to be strong drivers of movement behaviour. During the non-breeding season, individuals fly out to feed at dawn and return to the roost at dusk (White & Royal Society for the Protection of Birds 2006). Similar to the Eurasian Bitterns, Australasian Bitterns have been observed engaging in aerial displays and chasing of each other, flying out of wetlands before dawn and flying from a nest to forage (Biosis 2021a). These observations have included flights of up to 400 metres within and between wetlands at heights of approximately 2–30 metres, including above tree canopy height (I. Veltheim pers. obs.). However, they are known to ascend to higher altitudes on occasion, and although based on a small sample size of three individuals, recent GPS movement tracking of Australasian Bitterns in New Zealand has shown the species can fly within RSA height, with one individual spending 61% of its time at heights of 20–200 metres. Satellite tracking of the species in Australia has also shown the species flying at heights of 3–100 metres above ground (AOC 2023). At other times, such as during longer-range nomadic flights between coastal and wetland habitats it is likely that the species flies well above RSA height.

Bats (Microbats and Megabats)

The primary cause of bat collision with wind turbine infrastructure turbines is still debated (Hein & Schirmacher 2016, de Lucas et al. 2012). A current hypothesis includes turbines acting as a resource attractant, with food sources, including insects, often present. Other sources have attributed their attraction to the consequence of vegetation clearing and landscape modification that sees spaces between turbines mimic flyways (Kunz et al. 2010). There is also insufficient research to determine at what speed blade tips become invisible to echolocation, if any (Wellig et al. 2018, Lawson et al. 2020). Furthermore, we have limited capacity to study and analyse high-altitude bat behaviour (Werber 2024).

Regardless of the cause, bat fatalities have been recorded globally, with a number of high-flying species suspected to be more susceptible, including the White-striped freetail bat *Austronomus australis*, Gould's wattled bat *Chalinolobus gouldii* and the Chocolate wattled bat *Chalinolobus morio* in south-eastern Australia (Smales 2014, Bennett et al. 2022). The White-striped freetail bat is a common species of bat occurring throughout southern Australia, foraging in open cleared areas often at heights of 50 metres. This species was also the first wind farm-related fatality reported globally and is now known to be the most frequently struck species on sites in Victoria and south-east Australia (Smales 2014, Symbolix 2020). Accessible collision data in New South Wales mirror these findings, with the White-striped freetail bats shown to be the most commonly found microbat species during post-construction carcass monitoring searches. This species was found at seven out of the eight wind farms with accessible monitoring data and represented 40.6% of microbat mortalities found. Gould's wattled bat was the second most commonly found and represented 20.2% of mortalities, followed by Large Forest Bat *Vespadelus darlingtoni* (7.1%), Chocolate Wattled Bat (6.9%), Little Forest Bat *Vespadelus vulturnus* (6.05%), and the Southern free-tailed Bat *Ozimops planiceps* (5.5%).

There is limited data available in Australia for bat fatalities at large wind farms, with more information and monitoring required to further understand collision risk for the taxa. This is due to a number of factors including challenges involved with detection and movement, due to their cryptic nature; difficulties in carcass monitoring; the cost and time prohibitive nature of searches and methods, including detection dogs (Bennett et al. 2022, Wellig et al. 2018). Furthermore, wind farm monitoring programs contain considerable variation, with differences in objectives, design, intensity and duration (Moloney et al. 2019).

Identifying risk for collisions is more attainable for avian species, as their flights can be recorded during BUS. The same cannot be replicated with bat species, and ultrasonic recording or trapping must instead be used to identify species present on site. A key limitation to the current use of these detectors, is the inability to consistently install them within the rotor swept zone. Current survey methods include the deployment of detectors on meteorological towers, however, there is usually only one of these installed per site, the sampling area is quite small at these heights and limited in terms of habitat type sampled (Gration 2011), and there is limited ability to directly compare the findings to ground-based detectors.

The nocturnal forging behaviour of bats makes it difficult to observe the differing heights at which certain species fly at and their landscape utilisation across a site. Megachiropteran species have also been known to travel significant distances in a night to forage. Collisions with aircraft are also common, and as these incidences are often recorded, height collisions ranging from zero to 1524 metres, with the largest proportion of strikes occurring at 152.4 metres (Parsons et al. 2008). The Grey-headed Flying-fox *Pteropus poliocephalus* is a vulnerable species in NSW and has been recorded as a collision fatality on Australian wind farms, mostly recently in Victoria, with Little-red Flying-fox also having unexpected collisions at the Crudine Ridge Wind Farm in central NSW.

Seasonal patterns in fatalities have been observed with Australian bats, with monitoring finding the majority of bat strikes to occur during January to April in temperate zones (Bennett et al. 2022). Bat activity in RSA has also been seen to decrease with higher wind speeds, which is an important environmental factor in assessing collision risk (Smith & McWilliams 2016, Wellig et al. 2018, Gorman et al. 2021).

It was previously accepted that barotrauma was the primary cause of mortality for bats. While conclusive evidence is difficult to attain, it is now accepted that it is unlikely that barotrauma is the predominant cause (Guest & Hein 2018, Lawson et al. 2020). Pressure changes necessary to cause barotrauma would be located at such close proximity to the blade itself, it is deemed unlikely that a bat could experience barotrauma without simultaneously being struck by the blade itself, likely resulting in fatal injury. Furthermore, evidence to suggest that visual inspection of bat carcasses may be less effective at identifying injuries related to collision-related mortalities, in contrast to other techniques such as radiography. Additionally, there are

similar characteristics that may present as signs of barotrauma, including internal bleeding and fluid buildup in the lung, that may also have been resultant of collision (Guest & Hein 2018). Regardless of the cause, bat interaction with wind turbines causes bat mortality, and a greater understanding is needed of bat activity near wind farm sites. Table 47 demonstrates the currently capacity of operational wind farms in NSW and links to annual reporting data where available.

Table 47 NSW operational wind farms reviewed for bird and bat collisions data

Wind farm name	Capacity (MW)	No. of turbines	Turbine Model	Year of completion	Collision data availability and notes
Bango Wind farm	244	46	GE 5.3MW	2023	No data available (new project)
Biala Wind Farm	145	31	Goldwind 3.5MW	2021	Some data available https://bialawind farm.com/the-project/project-approvals-and-documents/
Blayney Wind Farm	10	15	Vestas V47-660kW	2000	No data available
Boco Rock Wind Farm	113	67	GE 100-1.7	2015	Data available. 8 years of monitoring https://www.bocorockwind farm.com.au/_files/ugd/bc9b99_c4b9d1d1dd324bedbaef1852f593f076.pdf
Bodangora Wind Farm	113.2	33	GE 3.43-130	2019	Data available (at least 2 years monitoring) https://www.infigenenergy.com/our-assets/owned-renewable-energy-assets/bodangora https://www.infigenenergy.com/assets/BOD-BBAMP-Annual-Report-2021.pdf
Capital Wind farm	140.7	67	Suzlon S88	2009	No data available
Collector Wind Farm	228	55	Vestas V117-4.2 MW turbines	2021	No data available – website currently inaccessible
Crookwell Wind Farm	4.8	8	Vestas V44-600kW	1998	First operational wind farm in NSW. Small scale project to prove the technology was scalable in Australia. No collision data available
Crookwell 2 Wind Farm	92	46	GE 130-3.4 MW	2018	No data available
Crudine Ridge Wind Farm	135	37	GE 3.8MW	2021	Data available for 2 years of carcass monitoring https://www.squadronenergy.com/our-projects/crudine-ridge-wind-farm
Cullerin Range Wind Farm	30	15	Senvion 2MW	2009	First fully operational wind farm in NSW to be significant in the National Electricity Market. No collision data available
Gullen Range Wind farm	165.5	73	GRW100-2.5MW (56 turbines) and	2013	Data available (at least 2 years monitoring) https://gullenrangewind farm.com/wp-content/uploads/2017/05/2015-Annual-BBAMP-

Wind farm name	Capacity (MW)	No. of turbines	Turbine Model	Year of completion	Collision data availability and notes
			the GW82-1.5MW (17 turbines)		Report_GRWF_BLA_Final.pdf
Gunning Wind Farm	46.5	31	1.5MW	2011	No collision data available
Hampton Wind Park	13.2	2	660 kW Vestas V-47	2001	No collision data. Small project
Sapphire Wind Farm	270	75	Vestas V126 3.6 (200m)	2018	Data available (4 years monitoring) https://www.squadronenergy.com/our-projects/sapphire-wind-farm
Silverton Wind Farm	200	58	GE 3.8MW	2019	Data available (2 years monitoring) https://www.agl.com.au/content/dam/digital/agl/documents/about-agl/how-we-source-energy/silverton-wind-farm/220616-02022-238-silverton-wind-farm-bird-and-bat-mortality-survey-year-2-v3-with-appendices.pdf https://www.agl.com.au/about-agl/how-we-source-energy/silverton-wind-farm/documents
Taralga Wind Farm	107	51	Vestas V90-2.0MW, V100-1.8MW, V90-3.0MW	2015	Report accessible, however no specific data about species included https://www.taralga-windfarm.com.au/_files/ugd/d232bb_5ef21aa789da421691d339d66379acf3.pdf Data not publicly accessible, but there are reports that indicated it was undertaken. (Section 6.0) https://www.taralga-windfarm.com.au/_files/ugd/d232bb_b76545fd807c41698e8922897d52c688.pdf
White Rock Wind Farm	175	70	Goldwind 121 2.5MW	2018	Data available (at least 2 years monitoring) https://whiterockwind farm.com/project/managing-impacts/
Woodlawn Wind Farm	48.3	23	Suzlon S88 2.1 MW	2011	No data available

5.2.2. Bird and bat utilisation survey results

A review of key guidelines with regard to impacts associated with bird and bat utilisation of the subject land, and associated impacts such as wind turbine strikes and barrier effect has been undertaken. The following sources of information were reviewed, and have been relied on in the completion of this portion of the BDAR:

- *Wind Farms and Birds – Interim Standards for Risk Assessment* issued by the Australian Wind Energy Association (AusWEA 2005).
- *Onshore Wind Farms – Interim guidance on bird and bat management* (DAWE 2022).
- *Onshore Wind Farm Guidance* (Cth DCCEEW 2023).
- *Best Practice Guidelines for Wind Energy Developments in Australia* (Clean Energy Council 2018).

- *Draft Wind Energy Guideline: Guidance for state significant wind energy development* (DPE 2023a).
- Unpublished South West Biodiversity and Conservation Division *Draft Turbine Risk Assessment and Avoidance Guidance* (NSW DCCEEW 2023a).
- Unpublished South West Biodiversity and Conservation Division *Suggested BBUS Method* (NSW DCCEEW 2023b).

Bird utilisation survey

Biosis undertook BUS in accordance with the requirements of the Best Practice Guidelines for Wind Energy Developments in Australia issued by the Clean Energy Council (2018) to provide baseline data on the pre-construction utilisation by avian species. Additional to this, surveys were completed in accordance with the *Onshore Wind Farms – Interim guidance on bird and bat management* (DAWE 2022).

Seasonal BUS were undertaken to inform collision risk modelling and therefore potential prescribed impacts, including the risk of collision with turbine blades. It was also used to inform the targeted species surveys for candidate species credit species. A full list per species at each BUS point is demonstrated in Appendix 4.

Background research and data sources were reviewed to identify all protected bird species records within 50 kilometres of the subject land. Information from relevant literature and incidental species sightings during other surveys were used to inform surveys and cover the following species groupings.

- All threatened species.
- Species which are rarely recorded.
- Species which exist naturally at relatively low densities.
- Waders.
- Larger birds such as raptors (eagles, hawks, kites) and waterbirds (herons, pelicans).
- Migratory birds.

A total of 26 fixed survey sites were established, including 16 impact sites and 10 control sites, across two years and eight seasons, and a total of 720 replicates. Methods of survey are described in Section 4.3.1. The survey locations were selected to represent likely turbine positions identified early in the project design and to obtain data at potential impact locations. They were distributed in different vegetation classes as a surrogate for habitat types. As the design developed, some turbine locations moved to avoid other environmental constraints, which resulted in modifications to the bird utilisation survey design, resulting in decommissioning of some sites early on and some control sites becoming impact sites (evident by number ID changes). Some BUS points were placed on the fringes of woodlands, where there is a continuum of habitats (woodland to grassland etc), therefore, some sites sampled multiple habitat types. There are also sites adjacent to or within cropped areas to capture the spatial extent of the subject land.

The locations for impact and control sites are shown in Figure 11b and Table 49.

Table 48 BUS survey seasons

Year	Summer	Autumn	Winter	Spring
2022	-	-	1- 5 August	21- 25 November
2023	6 - 10 February	8 - 12 May	23 -27 July	16 - 20 October
2024	22 - 26 January	13 - 17 March	-	-

Table 49 Bird utilisation survey points

Site	Point type	Purpose	Stage	PCT	Habitat type	Formation
CTL1	Control	CRM/BBAMP	2	160 mod_good	Inland Floodplain Shrublands	Freshwater Wetlands
CTL2	Control	BBAMP only	2	13 moderate	Inland Floodplain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
CTL3	Control	CRM/BBAMP	1	26 intact	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
CTL6	Control	BBAMP only	2	26 sparse	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
CTL7	Control	CRM/BBAMP	1	26 intact	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
CTL8	Control	BBAMP only	2	13 moderate	Inland Floodplain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
CTL9	Control	BBAMP only	2	Cat 1 exempt	Exotic/Cropping	-
CTL10	Control	BBAMP only	2	26 sparse	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
CTL11	Control	CRM/BBAMP	2	28 moderate	Riverine Sandhill Woodlands	Semi-arid Woodlands (Shrubby sub-formation).
CTL12	Control	BBAMP only	1	26 sparse	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP1	Impact	CRM	2	160 mod_good	Inland Floodplain Shrublands	Freshwater Wetlands
IMP2	Impact	CRM	1	26 sparse	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP3/18	Impact	CRM	1	13 thinned	Inland Floodplain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP4	Impact	CRM	2	13 moderate/46 Moderate	Inland Floodplain Woodlands and Riverine Plain Grasslands	Semi-arid Woodlands (Grassy sub-formation) and Grasslands
IMP5/19	Impact	CRM	2	26 intact	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP6	Impact	CRM	1	Cat 1 exempt	Exotic/Cropping	-
IMP7	Impact	CRM	2	26 sparse	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP9	Impact	CRM	1	26 DNG	Riverine Plain Woodlands (DNG)	Semi-arid Woodlands (Grassy sub-formation) and Grasslands
IMP10	Impact	CRM	1	26 DNG	Riverine Plain Woodlands (DNG)	Semi-arid Woodlands (Grassy sub-formation) and Grasslands
IMP11	Impact	CRM	1	26 sparse	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP13	Impact	CRM	2	26 DNG/15 moderate	Riverine Plain Woodlands (DNG) and	Semi-arid Woodlands (Shrubby sub-formation) and

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Site	Point type	Purpose	Stage	PCT	Habitat type	Formation
					Inland Floodplain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP16	Impact	CRM	1	13 moderate	Inland Floodplain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP15	Impact	CRM	2	28 moderate/ 26	Riverine Sandhill Woodlands and Riverine Plain Woodlands	Semi-arid Woodlands (Shrubby sub-formation) and Semi-arid Woodlands (Grassy sub-formation)
IMP20	Impact	CRM	1	28 low	Riverine Sandhill Woodlands	Semi-arid Woodlands (Shrubby sub-formation)
IMP21	Impact	CRM	2	26 sparse	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)
IMP22	Impact	CRM	2	26 intact	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)

The total Biosis survey effort across the eight seasons and two years equates to the equivalent of 28 replicates (720 replicates across 26 sites) at 20 minutes per point. The survey effort included in CRM equates to the equivalent of 28 replicates (574 replicates across 20 sites) at 20 minutes per point. This is adequate and within a reasonable survey tolerance for BBUS and the requirements of the CRM.

A total of 140 bird species were recorded within the subject land during BUS and incidentally within the eight seasons and two years of survey. The total list of species is provided in Appendix 4. The total number of flights recorded was 22,719 and the total number of flights within the Rotor Swept Area (RSA) height was 254 flights at height undertaken by 21 different species. The percentage of flights within RSA compared to that of all flights recorded is 1.12%.

The following height matrix was defined to classify bird height:

- Below RSA: <61 metres.
- Within RSA: 61 – 239 metres.
- Above RSA: >239 metres.

The following guilds were used to categorise species:

- Raptors.
- Grassland, shrubland and ground-dwelling birds.
- Waterbirds, seabirds and other aquatic foragers.
- Woodland birds (including parrots and songbirds).
- Exotic birds.

The following threatened species were recorded during the BUS and incidentally:

- Southern Whiteface *Aphelocephala leucopsis* (Vulnerable, EPBC Act).
- Dusky Woodswallow *Artamus cyanopterus cyanopterus* (Vulnerable, BC Act).
- Pied Honeyeater *Certhionyx variegatus* (Vulnerable, BC Act).
- Spotted Harrier *Circus assimilis* (Vulnerable, BC Act).
- White-fronted Chat *Epthianura albifrons* (Vulnerable, BC Act).
- Black Falcon *Falco subniger* (Vulnerable, BC Act).
- Painted Honeyeater *Grantiella picta* (Vulnerable, EPBC Act and BC Act).
- Square-tailed Kite *Lophoictinia isura* (Vulnerable, BC Act).

- Plains-wanderer *Pedionomus torquatus* (Critically Endangered, EPBC Act, Endangered, BC Act).
- Superb Parrot *Polytelis swainsonii* (Vulnerable, EPBC Act and BC Act).
- Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis temporalis* (Vulnerable, BC Act).
- Diamond Firetail *Stagonopleura guttata* (Vulnerable, EPBC Act and BC Act).

The most diverse guild of birds detected during BUS were the woodland birds which made up about 60% of all species observed, with a total of 66 species. Up to 21 waterbird species were recorded, representing approximately 19% as the second-most recorded group. Raptors made up 10% of all species observed, with 11 species detected.

Graph 1 and Graph 2 below shows the average heights of birds recorded. Section 6 discusses further the results of the CRM and risk assessments for at risk species.

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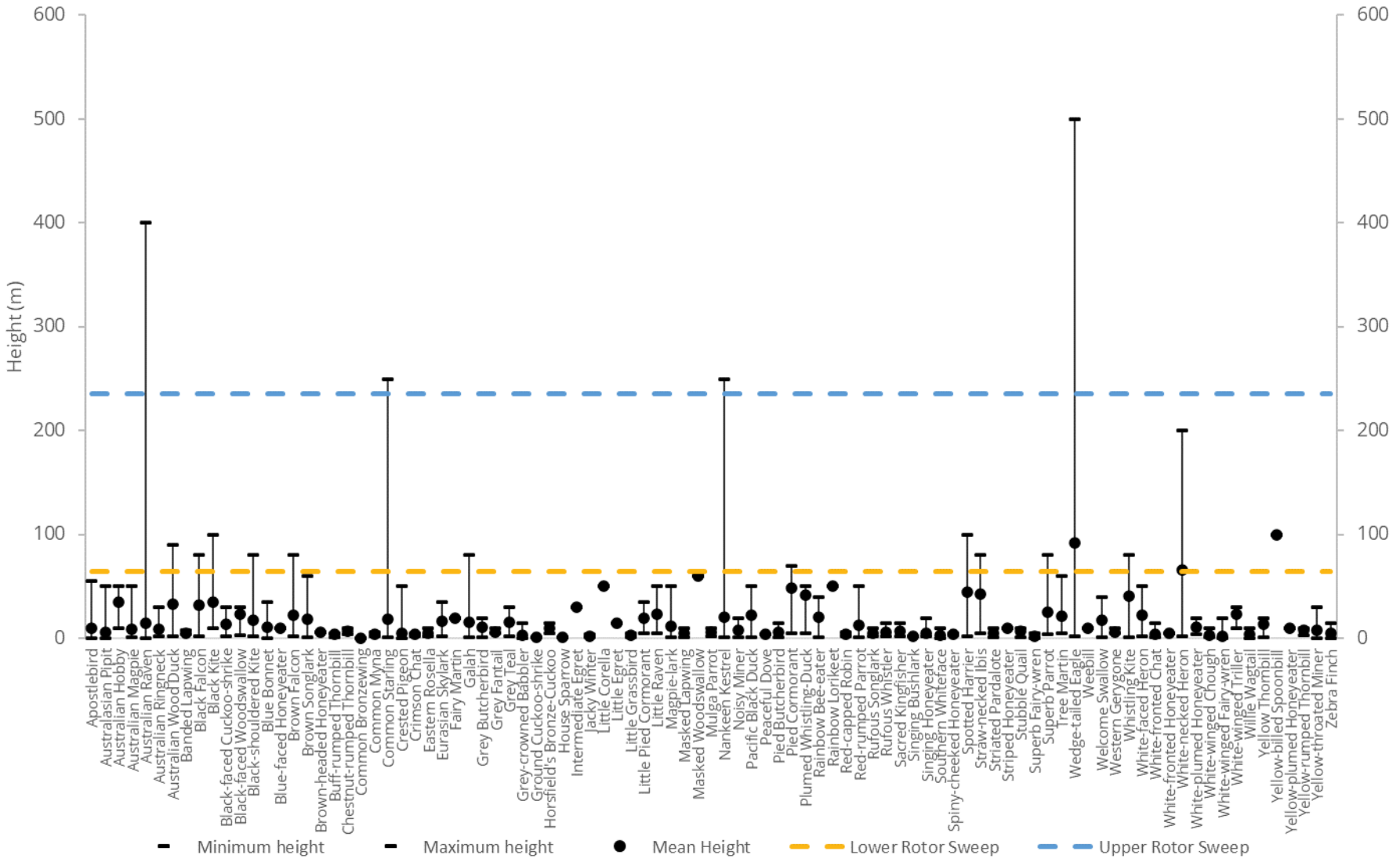
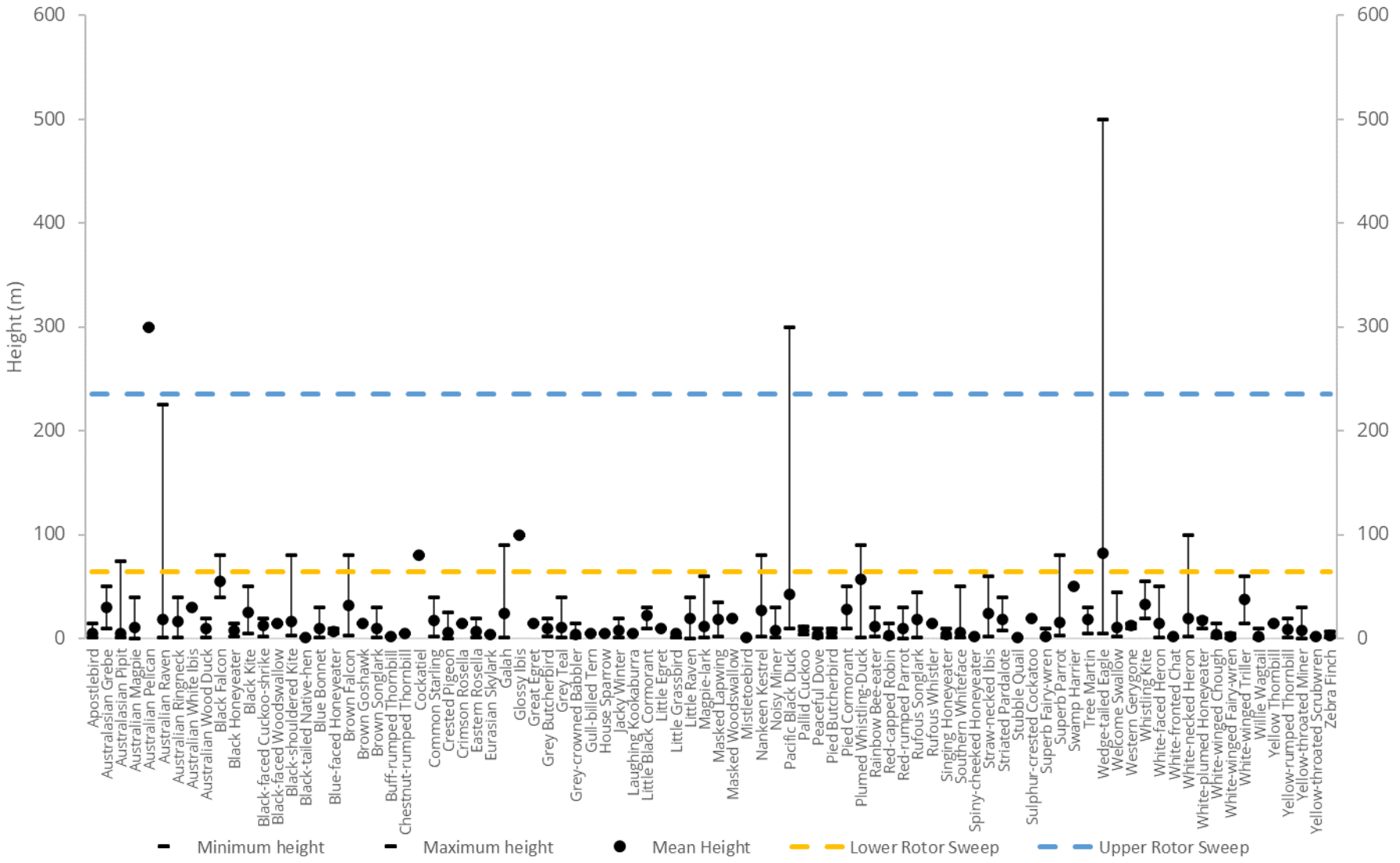


Graph 1 **Average flight heights for bird species recorded at impact sites during BUS**



Graph 2 **Average flight heights for bird species recorded at control sites during BUS**

Bat utilisation survey

Biosis completed seven seasons of surveys from 2022 to 2024 to provide baseline data on the pre-construction utilisation of the subject land by microbat species. The survey effort was a broad analysis undertaken to determine the presence or absence of all possible species predicted to occur in the area, with a particular focus on potential threatened species, as well as analysis of bat activity in conjunction with wind data from the on-site Met Mats.

Table 50 BUS survey seasons

Year	Summer	Autumn	Winter	Spring
2022	-	-	-	21- 25 November
2023	6 - 15 February	8 - 12 May	23 -27 July	15 - 20 October
2024	15 - 23 January	11 - 16 March	22-27 July	-

Bat activity was sampled across a range of habitat types within the subject land. The survey effort per habitat type is shown in Table 51.

Table 51 Microbat survey seasons

PCT	Zone	Vegetation class	Total bat calls recorded	Number of detector nights	Avg activity per detector per night
PCT13, Black Box, Lignum woodland wetland	Moderate	Inland Floodplain Woodlands	30,746	39	788
PCT17, Lignum shrubland wetland	Moderate	Inland Floodplain Shrublands	10,694	16	668
PCT28, White Cypress Pine woodland	Moderate	Riverine Sandhill Woodland	3400	33	103
PCT26, Weeping Myall Woodlands	Sparse	Riverine Plain Woodlands	9399	107	88
PCT26 Weeping Myall Woodlands	Sparse/DNG	Riverine Plain Woodlands/DNG	757	33	55
Totals			**54,996**	**228**	**1702**

It can be seen from Table 51, and Graph 3 below, that bat activity was found to be higher within wetter areas within the subject land such as floodplain woodland and shrublands. This is consistent with what would be expected in dry, open landscapes. Foraging resources are likely to be concentrated in wetter areas, where insect abundance and diversity is also likely to be higher. Structural vegetation diversity is also likely to be associated with increased foraging opportunities for a greater diversity of bats. Eucalypt woodland containing Black Box had the highest activity, which may also reflect increased roosting opportunities available in these habitats compared to other treed habitat types.

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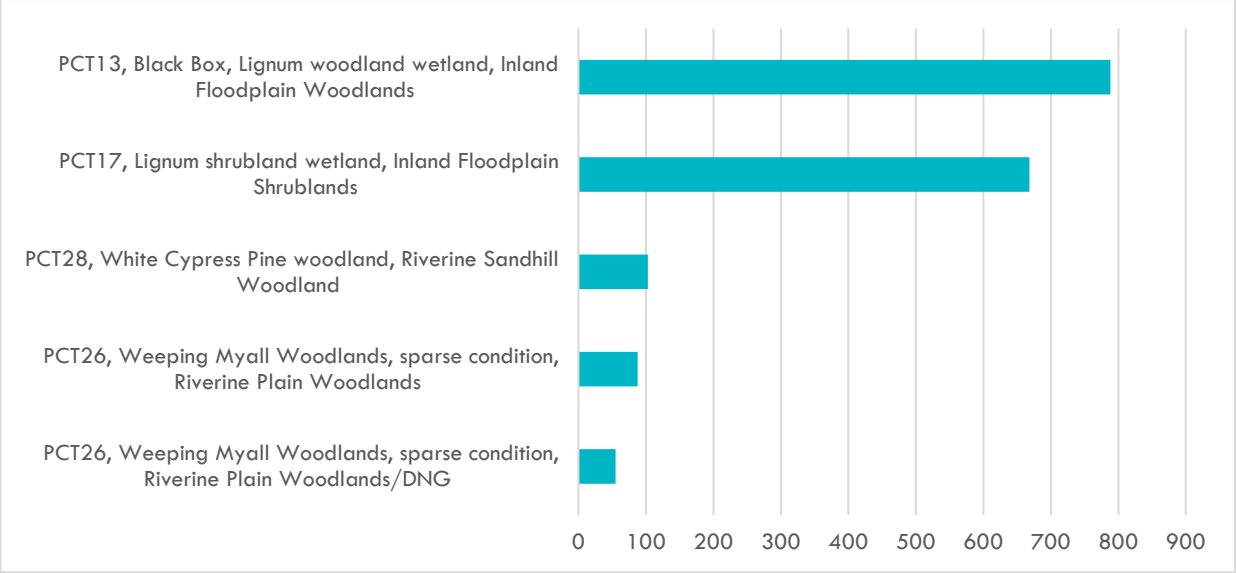


Graph 3 Average bat activity per night per habitat type

Total bat activity each season and number of detector nights is shown in Table 52.

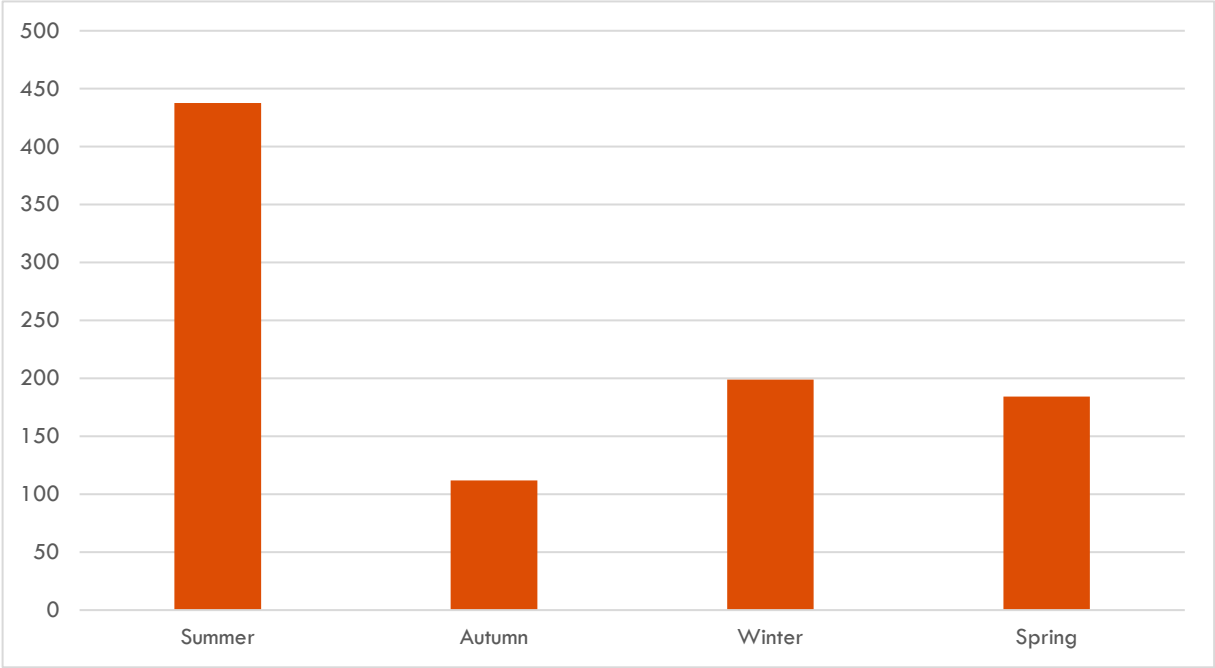
Table 52 Seasonal bat activity and effort (ground level detectors only).

	Summer	Autumn	Winter	Spring
Total activity	25,815	5,934	8,549	14,552
Detector nights	59	53	43	79

The average activity per detector per night is shown for each season in Graph 4. Average activity per detector per night was found to be highest in summer. The peak in summer activity early February coincides with when juvenile bats would be beginning to leave the roost and fly on their own, and may reflect increased numbers of bats and bat activity at this time. The low average activity between 10 - 15 February is likely to be due to only one detector being out at this time, which was located in PCT 26, which did not record high activity overall. This pattern is unlikely to be representative of bat activity across the site during this time, which would presumably be highest in floodplain shrubland and woodlands. Similarly in summer 2024, sampling was only undertaken at paired detectors located on the two met masts, which were both in PCT 26. This may be why the average activity per detector was lower than that observed in summer 2023. Again, this activity level is unlikely to be representative of activity across the site. It does further demonstrate however, that bat activity in this PCT, which is where the majority of turbines are proposed to be located, is consistently low, compared to other PCTs and vegetation classes.

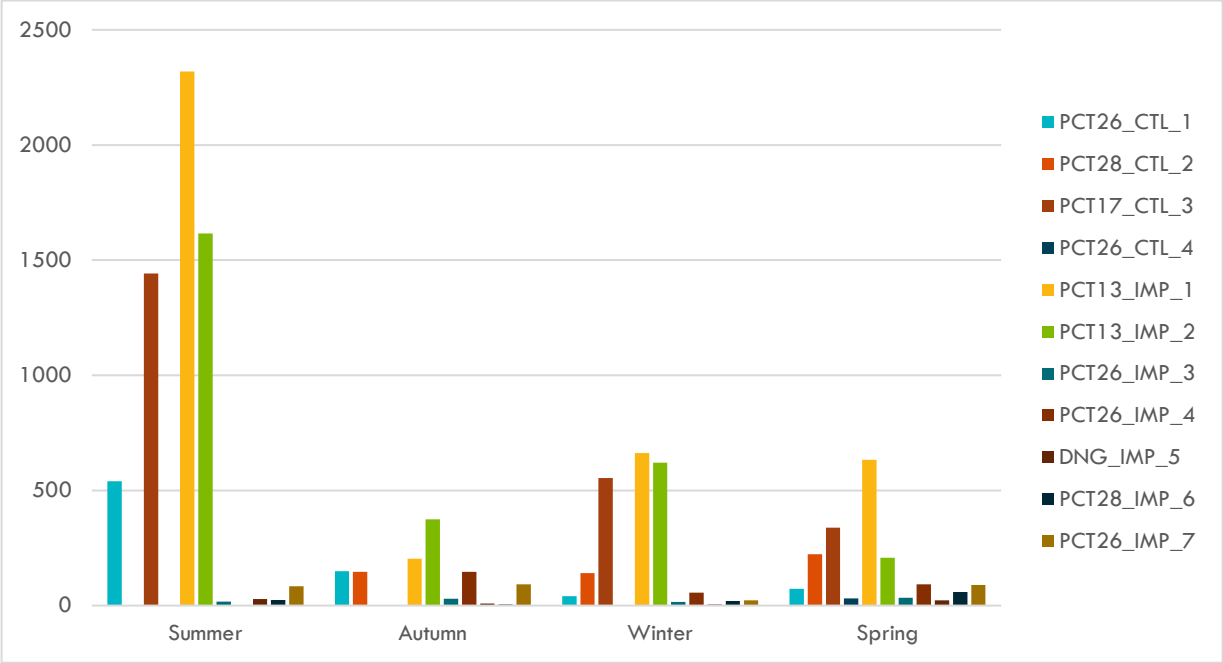
Average bat activity was found to be lowest in autumn. It is unclear why this is the case, and increased replication may be required to further determine why bat activity, particularly in autumn 2024 which occurred in early March, was so much lower than that observed in early February. Similarly, activity in spring was not as high as may be expected, and increased replication may be required to ascertain true activity patterns. Spring 2022 was particularly wet and the site experienced heavy flooding, which may have altered activity patterns.

Activity in winter was unexpectedly higher than in both autumn and spring. Sampling in winter was conducted across four nights only, which may not have been enough to capture nightly variability. When average bat activity is compared per night of sampling, it can be seen that there was a spike in activity during winter on one sampling night (27 July), while the other sampling nights were comparatively much lower.



Graph 4 Average activity (number of calls) per detector per night for each season

The increased activity was associated with three sites in particular, all of which were in floodplain woodland and shrubland habitats where bat activity was found to be highest across all sampling periods. This is consistent with the hypothesis that bat activity is highest in these vegetation communities, such as PCT 13, PCT 15, and most likely PCT 10. It is possible that bat activity temporarily increased at these locations to exploit favourable weather conditions during what is normally a time of reduced activity for microbats due to colder nightly temperatures (Graph 5).



Graph 5 Average bat activity per night per site each season

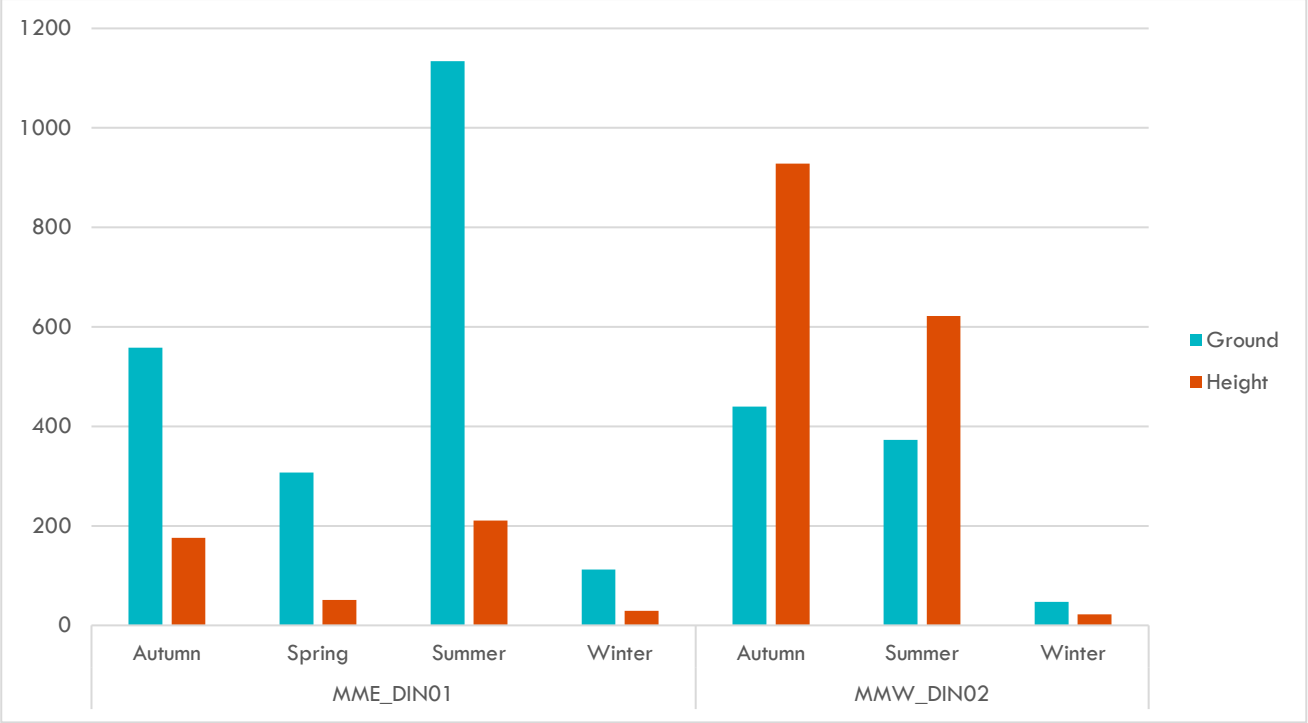
Additionally, bat activity was compared between paired detectors located at MME_DIN_01(eastern Met Mast) in summer, autumn, winter and spring 2023, and paired detectors at both MME_DIN_01 and MMW_DIN_02 (western Met Mast) in summer 2024 and Winter 2024. Species diversity at height was lower than that recorded at ground level. The majority of activity at height could be attributed to known high-flying and aerial foraging bat species such as White-striped Free-tailed Bat, Free-tailed Bats (*Ozimops* spp.) and Gould's Wattled Bat.

When all data is pooled, activity at height was seen to be lower than the activity recorded at ground level in all seasons except autumn. It appears that this pattern was mostly a result of activity at MMW_DIN_02, where activity of bats was higher overall than at MME_DIN_01. Comparing the pattern at each met mast, it can be seen that the activity at height was consistently lower than at ground level at MME_DIN_01 but this was not the same at MMW_DIN_02 (Table 53, Graph 6). Although both Met Masts are located in PCT 26, the habitat surrounding MMW_DIN_02 is higher quality bat habitat compared to that at MME_DIN_01. The eastern met mast (MME_DIN_01) is surrounded by PCT 26 sparse woodland and cropping areas, subject to more frequent agricultural use in the form of cropping and grazing. The western met mast (MMW_DIN_02) is located amongst larger, more intact patches of native vegetation including PCT 26 Intact and PCT 13 moderate, the latter is more likely to represent a focal point in the landscape for bat activity (Graph 6). Data from MMW-DIN_02 also has a smaller sample size compared to MMW_DIN_001.

Table 53 Activity at ground level vs height data

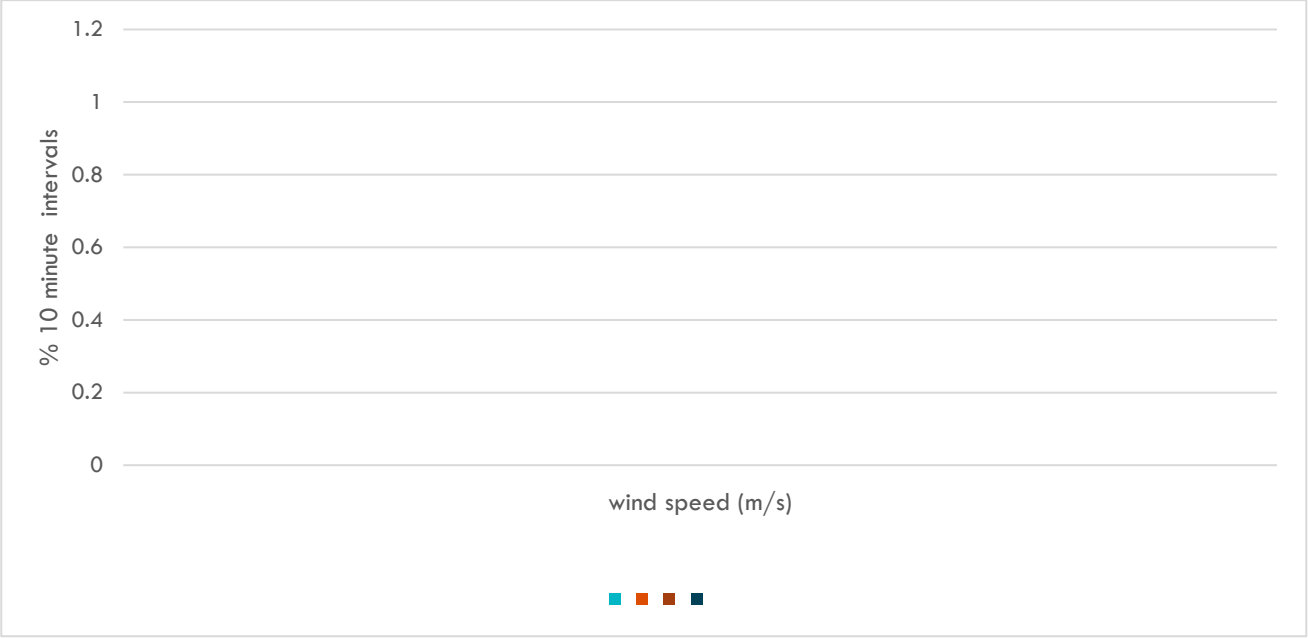
	Detector nights	Total activity (ground)	Total activity (height)
Summer*	26	1507	833
Autumn*	10	998	1104
Winter	22	159	51
Spring	4	307	51
TOTAL	62	2971	2039

*** includes data from paired detectors at DIN_01 in summer 2023, and paired detectors at both DIN_01 and DIN_02 in summer 2024.**



Graph 6 Comparison of activity at height versus ground level at each met mast

Wind speed data was recorded at 10 minute intervals from an anemometer mounted at approximately 50 metres on MME_DIN_01 for the duration of each detector deployment. Data was compared for each season during the times when the detectors were deployed between 6pm and 6am when bats are likely to be active. The percentage of 10 minute intervals for each wind speed each season is shown in Graph 7.

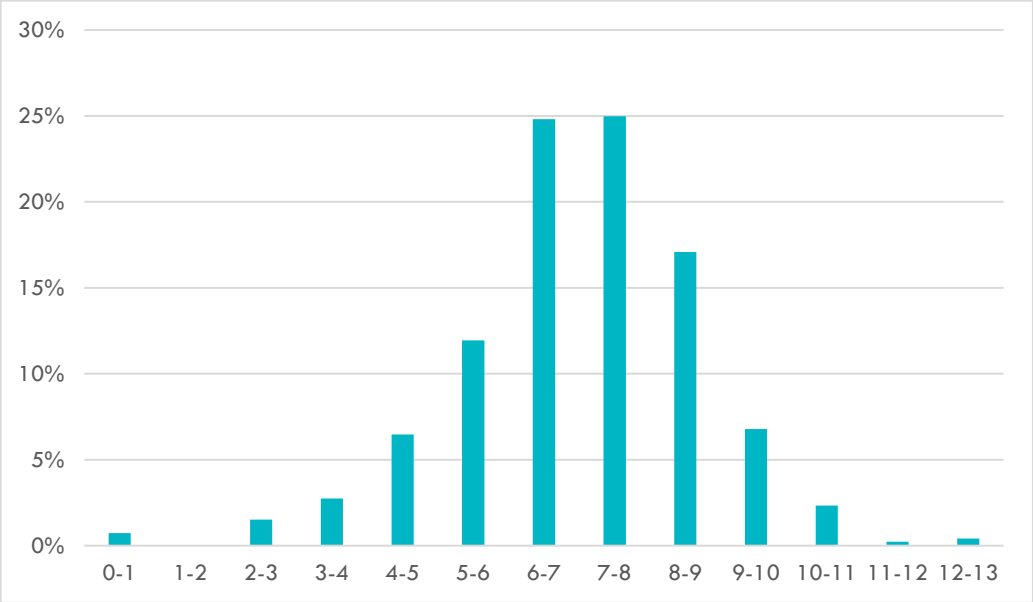


Graph 7 Percentage of 10-minute intervals per windspeed during each night (6pm-6am) of each deployment period

Average bat activity per detector per night was plotted against average nightly temperature and wind speed collected from MME_DIN_01 during each deployment. This data does not show a clear correlation between

temperature, wind speed and bat activity. It is likely that more detailed analysis is needed to interpret the influence of these variables on bat activity within the subject land. Each bat call was assigned a wind speed value based on the nearest 10 minute interval. The percentage of calls for each wind speed is shown in Graph 8. This shows that 73% of bat activity occurred when wind speeds were 8m/s or less. Conversely, only 27% of bat activity occurred at wind speeds greater than 8 m/s. However it must be noted that the low percentage of bat activity at low wind speeds is likely due to the absence or lack of 10-minute intervals during the night that recorded low wind speeds, as shown on Graph 6. That being, the wind data suggests there are very limited times where the wind speed it is actually around the ≤3m/s mark. In summary, the data suggests that bat activity is generally highest up until around 8 m/s before activity begins to taper off.

Overall, data regarding the relationship between bat activity and wind speed or temperature was not conclusive for the project. The strongest predictor of bat activity appears to be habitat type, with inland floodplain woodland (PCT 13 and PCT 15) and shrubland (PCT 17 and PCT 160) consistently recording higher bat activity than other habitat types. These areas are largely being avoided by the project.



Graph 8 Percentage of bat activity per wind speed

5.2.3. Identification of resident, nomadic and migratory species and flight paths

Section 6.1.5 of the BAM dictates that wind farm developments must identify resident threatened aerial species, resident raptor species and nomadic/migratory species likely to fly over the proposed development site as a flyway or migration route. These species are summarised below in their respective categories.

Resident raptor species

The following resident raptor species were identified as being present within the subject land during BUS:

- Brown Goshawk *Accipiter fasciatus*.
- Wedge-tailed Eagle *Aquila audax*.
- Spotted Harrier *Circus assimilis* (Vulnerable, BC Act).
- Swamp Harrier *Circus approximans.*
- Black-shouldered Kite *Elanus axillaris*.

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- Brown Falcon *Falco berigora*.
- Nankeen Kestrel *Falco cenchroides cenchroides*.
- Australian Hobby *Falco longipennis.*
- Black Falcon *Falco subniger* (Vulnerable, BC Act).
- Whistling Kite *Haliastur sphenurus.*
- Black Kite *Milvus migrans*.

Many of these species are considered common/widespread and likely to occur as resident raptor species, with dispersing juveniles, with Spotted Harrier and Black Falcon both listed as Vulnerable under the BC Act.

Threatened woodland aerial species

Threatened woodland aerial species recorded during BBUS include the following species:

- Southern Whiteface *Aphelocephala leucopsis* (Vulnerable EPBC Act and BC Act), credit type not yet assigned.
- Painted Honeyeater *Grantiella picta* (Vulnerable EPBC Act and BC Act).
- Pied Honeyeater Certhionyx variegatus (Vulnerable, BC Act).
- Spotted Harrier *Circus assimilis (Vulnerable, BC Act).*
- White-fronted Chat *Epthianura albifrons (Vulnerable, BC Act).*
- Black Falcon *Falco subniger* (Vulnerable, BC Act).
- Superb Parrot *Polytelis swainsonii* (Vulnerable EPBC Act and BC Act).
- Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris* (Vulnerable, BC Act).

Of these species, all but Painted Honeyeater, Southern Whiteface and White-fronted Chat are considered at risk of collision based on known behaviours and flight heights recorded from BBUS.

Nomadic/Migratory species

The following species considered as nomadic/migratory that were recorded during BUS, or are known to move through the subject land during nomadic movements, such as the Australasian Bittern, within the locality include:

- Australasian Bittern *Botaurus poiciloptilus* (Endangered, BC Act and EPBC Act).
- Australian Pelican *Pelecanus conspicillatus.*
- Australian White Ibis *Threskiornis Molucca.*
- Black Falcon *Falco berigora* (Vulnerable, BC Act).
- Cockatiel *Nymphicus hollandicus.*
- Fairy Martin *Petrochelidon ariel.*
- Fork-tailed Swift *Apus pacificus*
- Great Egret *Ardea alba*
- Grey Teal *Anas gracilis*
- Gull-billed Tern *Gelochelidon nilotica*
- Little Black Cormorant *Phalacrocorax sulcirostris*

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- Little Egret *Egretta garzetta.*
- Little Pied Cormorant *Microcarbo melanoleucos.*
- Masked Woodswallow *Artamus personatus.*
- Mulga Parrot *Psephotus varius.*
- Pacific Black Duck *Anas superciliosa.*
- Plumed Whistling Duck *Dendrocygna eytoni.*
- Pink-eared Duck *Malacorhynchus membranaceus*
- Rainbow-Bee-eater *Merops ornatus.*
- Straw-Necked Ibis *Threskiornis spinicollis.*
- Superb Parrot *Polytelis swainsonii* (Vulnerable EPBC Act and BC Act).
- White-necked Heron *Ardea pacifica.*
- Yellow Spoonbill *Platalea flavipes.*

An assessment of habitat, movements and flight paths of nomadic and migratory species identified was completed. The nomadic/migratory movements within Australia of the non-threatened and threatened species are summarised below in Table 54. The migratory movement of species outside Australia are summarised below in Table 55 that may occur on a rare occurrence or low likelihood.

Table 54 Nomadic/migratory avian species movements within Australia

Species	Nomadic/Migratory movement description	Movement trigger	Habitat in subject land
Threatened species			
Australasian Bittern	Partially nocturnal, cryptic. Not considered highly nomadic, meaning they inhabit a particular area for an extended period but may move within that range in response to changing conditions. Recent satellite tracking work indicates that a large portion of the Riverina rice crop breeding population disperses to coastal wetlands after harvest, whilst other stay local (Bitterns in Rice, 2024).	In response to changes in environmental conditions, such as food availability or weather patterns, searching for suitable breeding habitat or better foraging opportunities.	Sub optimal habitat occurs within the subject land, but may occur transiently in PCT 160 during optimal flooding years, such as the spring /summer 2022/2023 flooding events. Primarily though, the subject land occurs within the flight path between Victoria and Coleambally, with tracking data indicating the movement of Bitterns on occasion through the subject land.
Australian Painted Snipe	Poorly known, but dynamic and highly mobile. Potential for north south migration in eastern Australia, and not often seen in winter in southern eastern Australia.	Responds to flooding of ephemeral inland wetlands, but vanishes for years from key sites even when suitable habitat is available.	Sub optimal habitat occurs within the subject land, but may occur transiently in ephemeral waterways and swamps such as PCT 13, PCT 17 or PCT 160 during optimal flooding years.

Species	Nomadic/Migratory movement description	Movement trigger	Habitat in subject land
Black Falcon	Partially nomadic following rain and the consequent increase in prey numbers.	Inland movements are influenced by rainfall and seasonal factors, as well as prey abundance.	Observed within PCT 28, PCT 10 and fringing PCT 26 sparse woodlands.
Superb Parrot	In the Riverina, mostly sedentary, but can become nomadic or dispersive in winter or based on environmental conditions.	Overwintering or based on foraging resources available.	Observed within PCT 26 intact Myall and PCT 13 riparian areas.
Non-threatened species			
Australian Pelican	Pelicans sometimes flock in large number to breed in inland areas. As waters recede, they head for more permanent wetlands or the coast.	Inland movements are influenced by rainfall and seasonal factors.	Observed in flooded riparian areas such as PCT 13. May also use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Australian White Ibis	Highly nomadic, moving in search of suitable habitat, often with Straw-necked Ibis.	Inland movements are influenced by rainfall and seasonal factors.	Open PCT 26 DNG areas and may use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Cockatiel	Highly dispersive and nomadic species.	Based on food and water sources become more or less prevalent.	Observed in PCT 13 and PCT 26 woodland.
Fairy Martin	Seasonally migratory, moving north for winter.	Breeding and over wintering. Seasonally common and locally abundant across most of its range.	Observed in PCT 13 and PCT 26 woodland.
Fork-tailed Swift	Breeding occurs April – July in Siberia. Migration starts around August-September with birds moving south, arriving in Australia September/October. Once in Australia this species disperses across most of Australia, often following low pressure systems (Cth DCCEEW 2024e).	Species departs from Australia April/May returning to breeding grounds in Siberia. Return migration triggered by temperatures in Australia (Cth DCCEEW 2024e).	Species is almost exclusively aerial, foraging from 1 to 300m above ground. Foraging usually occurs along the edge of low pressure systems occurring over inland plains, above foothills and coastal areas. Roosting can occur in woodland areas but also aerially. Woodland areas may be used for roosting within the subject land.
Grey Teal	Highly dispersive and nomadic species.	Rainfall and/or flooding events that occurred up to 10 km from resident location.	Observed in flooded riparian areas such as PCT 13. May also use dams and irrigated crop areas in the subject land and areas of

Species	Nomadic/Migratory movement description	Movement trigger	Habitat in subject land
			PCT 160 or PCT 17 during optimal years.
Little Black Cormorant	Partially nomadic. Mostly sedentary, but can become nomadic during above average rainfall and flooding events.	Inland movements are influenced by rainfall and seasonal factors.	Observed in flooded riparian areas such as PCT 13. May also use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Little Egret	Dispersive and, in parts of its range, with multi-directional post-breeding movements of up to 280 km recorded. Undertakes regular seasonal movements, mostly to and from breeding colonies, and towards the coast in the dry season.	There is circumstantial evidence of long-distance migration, with regional differences in reporting rates suggesting that individuals migrate north to winter in tropical northern Australia, consistent with changes in the availability of suitable wetland habitat.	Observed in flooded riparian areas such as PCT 13. May also use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Little Pied Cormorant	Partially nomadic. Mostly sedentary, but can become nomadic during above average rainfall and flooding events.	Inland movements are influenced by rainfall and seasonal factors.	Observed in flooded riparian areas such as PCT 13. May also use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Masked Woodswallow	Post-breeding movement to northern Australia over winter months, and returning to southern areas to breed in spring and early summer.	Breeding and over wintering. Seasonally common and locally abundant across most of its range.	Observed commonly in PCT 28 White Cypress Pine communities.
Mulga Parrot	Seasonal movements of the Mulga Parrot are not well known, but it is usually considered to be either nomadic or to stay in much the same area all year.	Based on foraging resource and response to drought .	PCT 26 Weeping Myall Woodlands
Pacific Black Duck	Mostly sedentary, but can become nomadic during above average rainfall and flooding events.	Inland movements are influenced by rainfall and seasonal factors.	May use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Plumed Whistling Duck	Highly dispersive and nomadic species. Prefers margins of shallow, temporary waters and swamps. Feeds in adjacent grassland areas.	Inland movements are influenced by rainfall and seasonal factors.	May use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.

Species	Nomadic/Migratory movement description	Movement trigger	Habitat in subject land
Pink-eared Duck	Highly dispersive and nomadic species. Prefers shallow, temporary waters, however, open wetlands support large flocks.	Inland movements are influenced by rainfall and seasonal factors.	Observed in flooded riparian areas such as PCT 13. May also use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Rainbow-Bee-eater	Majority of global population breeds in Australia. Breeding has also been recorded in Papua New Guinea and may occur in the Lesser Sundas Island, Indonesia. (Cth DCCEEW 2023c).	Seasonally common and locally abundant across most of its range. In Australia, breeding season occurs August – January. Moves north across Australian winter.	Observed commonly in PCT 28 White Cypress Pine communities.
Straw-necked Ibis	Highly nomadic, moving in search of suitable habitat, often with Australian White Ibis.	Inland movements are influenced by rainfall and seasonal factors.	Open PCT 26 DNG areas and may use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
White-necked Heron	Highly mobile, moving around in response to seasonally and annually varying rainfall patterns.	Inland movements are influenced by rainfall and seasonal factors.	May use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Yellow Spoonbill	Nomadic across the north and well-watered inland areas in response to water and habitat.	Inland movements are influenced by rainfall and seasonal factors.	May use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.

Table 55 Migratory avian species movements within and outside of Australia relevant to subject land

Species	Migratory movement description	Movement trigger	Habitat in subject land
Curlew Sandpiper	Nesting occurs in Siberia in June/July. Migration between nesting grounds and Australia occurs from July/August, with birds arriving in northern Australia from August – September. Once in Australia, birds move across Australia from August – December (Cth DCCEEW 2024a) .	Return migration triggered by temperatures in Australia. Foraging in Australia occurs until January – April, where birds begin migration back to breeding grounds in Siberia. Some non-breeding individuals (mostly juveniles) stay in Australia until the following season, when they return to Siberia to breed (Cth DCCEEW 2024a).	Sub-optimal. May use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.

Species	Migratory movement description	Movement trigger	Habitat in subject land
White-throated Needletail	Breeding and nesting occurs in Asia around May – June, with most birds migrating August – October arriving to Australia September/October (Cth DCCEEW 2024b).	Return migration triggered by temperatures in Australia. Foraging in Australia occurs until January – April, where birds begin migration back to breeding grounds in Siberia. Some non-breeding individuals (mostly juveniles) stay in Australia until the following season, when they return to Siberia to breed (Cth DCCEEW 2024a).	Subject land is at this species' most westerly distribution. This species is almost entirely aerial, foraging from 1m to 1000m above the ground, they occur over most habitat types, with a preference towards wooded areas. Roosting occurs in in forest/woodland in dense canopy or hollow, with indications of aerial roosting also occurring (Cth DCCEEW 2024b).
Common Greenshank	Nesting occurs in Palaearctic in the northern hemisphere April – June, with migration to the southern hemisphere occurring from July – September. Birds arrive in Australia from August, and disperse throughout Australia to late December (Cwth DCCEEW 2024b).	Return migration triggered by temperatures in Australia. Foraging occurs in Australia until around February, with birds departing March – April to return to breeding grounds (Cwth DCCEEW 2024b).	Sub-optimal. May use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Latham's Snipe	Breeding/Nesting occurs in Japan and far eastern Russia departing breeding grounds July – November in migration to eastern Australia, arriving in Australia July-November. Once in Australia individuals slowly move south along the coast and inland. Within Australia the species is dispersive, with foraging movements triggered by rainfall and availability of food (Cth DCCEEW 2024d).	Foraging occurs in eastern Australia until around February – March, where individuals, likely triggered by temperature, return to breeding grounds in the northern hemisphere (Cth DCCEEW 2024d).	Sub-optimal. May use dams and irrigated crop areas in the subject land and areas of PCT 160 or PCT 17 during optimal years.
Caspian Tern	Within Australia, this species is resident with breeding occurring year-round subject to seasonal conditions. Migration between foraging and breeding areas occurs between coastal and inland sites (Cwth DCCEEW 2024c).	Migration between foraging and breeding areas occurs between coastal and inland sites based on seasonal conditions (Cwth DCCEEW 2024c).	Sub-optimal. May also use dams and irrigated crop areas in the subject land.
Pectoral Sandpiper	Nesting occurs in northern Russia and North America arriving in Australia August –	Species departs Australia generally March-April, with temperature as the likely	Sub-optimal. May use dams and irrigated crop areas in the subject land and areas of PCT

Species	Migratory movement description	Movement trigger	Habitat in subject land
	September. Noted as an uncommon migrant to Australia, mostly sighted in south-eastern Australia, the Murray Darling Basin and western Victoria. Individuals generally arrive in coastal areas before dispersing inland (Birds in Backyards 2024).	trigger (Birds in Backyards 2024).	160 or PCT 17 during optimal years.

Flyways and nomadic movements

Flyways and movements of aerial taxa likely to occur, or recorded within the subject land are described below in the following guilds: Microbats, raptors, waterbirds, woodland and shrubland birds and ground dwelling birds. Within the subject land, and broader landscape, the vast majority of flights observed were between more intact patches of woody vegetation, roadside corridors and along riparian waterways dominated by PCT 13 and PCT 15, patches of fragmented sandhill vegetation dominated by PCT 28, and more intact areas of PCT 26 Weeping Myall. Raptor species and more common disturbance tolerant woodland species, such as Ravens and Galahs, as well as common parrots such as Blue Bonnets, were also observed transiting or foraging across more open grassland and sparse woodland landscapes.

Raptors

A total of 11 raptor species, including the Black Falcon and Spotted Harrier, were identified during the BUS survey effort by Biosis within the subject land. Raptor presence varied between seasons, however presence of identified raptor species are considered resident, with dispersing juveniles, within the subject land. Predominately raptor movement is influenced by a complex interplay of ecological factors, and specific patterns that can vary greatly between species. Within the subject land, raptors utilise woodland and scattered trees within PCT 13, PCT 15 and PCT 28 for roosting and nesting whilst foraging was observed within the more open grasslands and sparse woodlands. Raptor species move throughout the day and covering larger distances between nesting, roosting and foraging locations, particularly Wedge-tailed Eagles. Table 61 demonstrates a review of the risks associated with collisions for raptors known to occur within the subject land, or predicted to occur on occasion.

Waterbirds

A total of 21 waterbirds were observed during BUS surveys. Movements of waterbird species are likely to occur as a mixture of resident day or nightly movement, nomadic movements subject to climatic conditions and for some species, seasonal migration movements during warm and cold months. Flight paths are likely to occur through the subject land and across into the broader landscape. During wetter seasons and flooding events, such as in spring 2022, larger numbers of waterbirds were observed then on average due to optimal foraging conditions and more permanent water.

Satellite tracking of Australasian Bitterns has record flights through the subject land between Coleambally and Victora (Bitterns in Rice, 2024). The potential flight heights for Australasian Bitterns can vary depending on several factors, including habitat type, weather conditions, and behavioural patterns. Generally, Australasian Bitterns are known to fly at relatively low altitudes, often skimming over wetland vegetation such

as reeds and grasses. This low-level flight behaviour is believed to be an adaptation to their hunting strategy, as they primarily prey on small fish, frogs, and invertebrates found in shallow water within wetland habitats. During normal flight activity, Australasian Bitterns typically fly just above the surface of the water or wetland vegetation, often staying within a few meters above ground level. However, they may occasionally ascend to slightly higher elevations, particularly during certain behaviours such as territorial displays or courtship flights, which may involve flights up to several meters above the ground. Overall, while the precise flight heights of Australasian Bitterns may vary depending on specific circumstances, they generally exhibit a low-level flight behaviour, closely associated with the wetland habitats they inhabit and the hunting strategies they employ. However, recent research shows they can ascend to higher altitudes, and although based on a small sample size of three individuals, recent GPS movement tracking of Australasian Bitterns in New Zealand has shown the species flies at RSA height, with one individual spending 61% of its time at heights of 20–200 metres. Satellite tracking of the species in Australia has also shown the species flying at heights of 3–100 metres above ground (AOC, 2023).

Woodland, grassland and shrubland birds

A total of 67 woodland, grassland and shrubland bird species, including parrots, robins and honeyeaters, were recorded within the subject land during the BUS survey effort by Biosis. The collective sum of these species utilises almost all the habitat within the subject land for foraging, roosting or nesting, however, generally stick to flights within or just above canopy heights. Resident species complete daily movements, moving from roosting habitat across foraging areas. Movements of many species are centred on abundance and availability of food, or occur seasonally with temperature changes and seasonal conditions. Breeding is likely to occur year-round across the species identified. Resident species are likely to hunt and or forage and roost in patches of preferred habitat, with minimal dispersal outside of breeding seasons. Species subject to nomadic movements are likely to use both riparian and terrestrial woodland corridors, and for smaller species, such as the threatened White-fronted Chat and Southern Whiteface, areas of shrubland habitat throughout the landscape. Terrestrial movement corridors have been identified within Figure 13 and Figure 14. Threatened woodland and shrubland bird species identified within the subject land include White-fronted Chat, Grey-crowned Babbler (eastern subspecies), Southern Whiteface and Superb Parrot. Areas of identified habitat that may support the threatened Plains-wanderer were also identified within the subject land, however this species is considered predominately as sedentary, with occasional dispersal movements due to the dynamic nature of grassland habitats.

Microbats

As previously mentioned, 14 species were positively identified of the 20 species that are known or predicted to occur within the subject land (Australasian Bat Society 2022). Up to four additional species may also have been recorded however reliable identification to species level was not possible due to similarity of call characteristics between species. Bat activity was found to be higher in wetter areas within the study area such as floodplain woodland and shrublands. This is consistent with what would be expected in dry, open landscapes. Foraging resources are likely to be concentrated in wetter areas, where insect abundance and diversity is also likely to be higher. Structural vegetation diversity is also likely to be associated with increased foraging opportunities for a greater diversity of bats. Table 56 and Table 62 provides a review of behaviour and flight characteristics of microbat species recorded within the subject land and collision risk.

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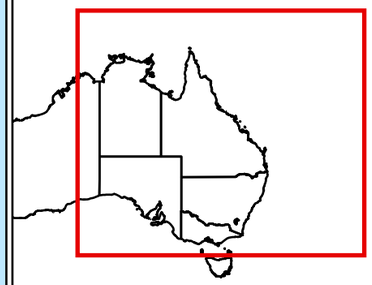
Table 56 Microbat behaviour overview

Species	Foraging space	Flight characteristics	Canopy	Overview
White-striped free-tailed bat *Austronomus australis*	Open	Fast, not designed for manoeuvrability	Above canopy	Fast-flying species intercepting their prey 50 m or more above the ground. (Churchill 2008).
Gould's Wattled Bat *Chalinolobus gouldi*	Edge	Fast, agile	Generally, within the lower level of the tree canopy and along forest edges, creek lines and isolated paddock trees. Can fly at height and open areas on occasion	Feeds on a wide variety of prey, regularly foraging 5 - 10 km from their roost site. They fly just below or within the lower level of the tree canopy and along the forest edges, creek lines and around isolated paddock tree with fast, agile flight (Churchill 2008).
Chocolate Wattled Bat *Chalinolobus morio*	Edge	Fast, agile, direct	Below canopy	In inland areas their distribution is associated with water courses that provide large trees for roosts. They prefer forests to small forest patches (Churchill 2008). They forage up to 5 km from their roost site, their flight is usually fast and direct with considerable agility (Churchill 2008). They mostly forage in the zone between the top of the understorey and the canopy, although sometimes fly low along forest trails.
Long-eared Bat *Nyctophilus sp*	Closed	Slower, more manoeuvrable.	Below canopy, in and around vegetation.	Highly manoeuvrable and able to change direction often and quickly (Churchill 2008). Fly very close to vegetation, usually at canopy height, where they weave between gaps in the canopy (Churchill 2008).
Inland Free-tailed Bat *Ozimops petersi*	Open/ Edge	Fast, direct	Above canopy	Forage in open unobstructed areas. They fly fast above the canopy. They are not very manoeuvrable in flight.
South-eastern Free-Tailed Bat *Ozimops planiceps*	Open/Edge	Fast, agile	Below canopy on ground, edge of canopy and above canopy.	Forage up to 12 km from their roost site. Roost in tree hollows with narrow entrances and cavities. Forage in spaces between trees, at edge of canopy of remnant vegetation and above canopy. Can also forage on the ground due to their agility (Australian Museum 2020).
Ride's Free-tailed Bat *Ozimops ridei*	Open/ Edge	Fast, direct	Above canopy	Fly predominantly in the spaces between trees.

Species	Foraging space	Flight characteristics	Canopy	Overview
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	Open	Fast, direct, not manoeuvrable	Above canopy	Almost all habitats, migratory, probably fly high. Long, narrow wings.
Inland Broad nosed Bat *Scotorepens balstoni*	Edge	Moderately fast, agile	Below canopy	Flight is continuous with sudden rapid diversions. Forage mostly between trees but also at the edges of forests, and out in open areas. (Churchill 2008). They stay within 15 m of the ground and do not forage above the canopy.
Little Broad-nosed Bat *Scotorepens greyii*	Edge	Moderately fast, agile	Below canopy	Flight is continuous, moderately fast, agile. Search for insects close to the tree tops but not above them, flying in the open spaces along the contour of the vegetation within 2 m of the foliage. Forage over water, grasslands and other open habitat. (Churchill 2008).
Large Forest Bat *Vespadelus darlingtoni*	Edge	Fast, less manoeuvrable.	Below canopy	Fast-flying bat that is less manoeuvrable than most *Vespadelus*. Avoid cluttered regrowth and rainforest by foraging mainly within the spaces among trees and between the canopy and the understorey.
Southern Forest Bat *Vespadelus regulus*	Edge	Fast, agile, manoeuvrable	Below canopy	Highly manoeuvrable, moderately fast insectivores. Fly with great agility very close to vegetation and readily enter gaps in the understorey, usually foraging at less than half the canopy height. Small foraging range of less than 10 ha.
Little Forest Bat *Vespadelus vulturnus*	Edge			
Inland Forest Bat ***Vespadelus baverstocki***	Edge	Fast, agile, manoeuvrable	Below canopy	Highly manoeuvrable, moderately fast insectivores. Fly with great agility very close to vegetation and readily enter gaps in the understorey, usually foraging at less than half the canopy height. Small foraging range of less than 10 ha.
In general:				
Open space / aerial = typically free-tail and sheath-tail bats. Fly fast. Long, narrow wings, not manoeuvrable.				
Edge space = most bats (Vespertilionids and Myotis). Fly fast to moderately slow. Moderately long and broad wings.				
Closed = gleaning bats (*Phoniscus, Nyctophilus, Rhinolophus*) = slow, but able to manoeuvre and hover in cluttered places. Broad, shorter wings, rounded tip, large tail membrane.				



Legend

Location of proposed Dinawan wind farm

Migratory bird flight paths

Indicative international migratory flight path

Indicative mainland migratory movements

Indicative nomadic movements

Figure 13 Indicative nomadic and migratory flight paths

0 100 200 300 400 500 600

Kilometers

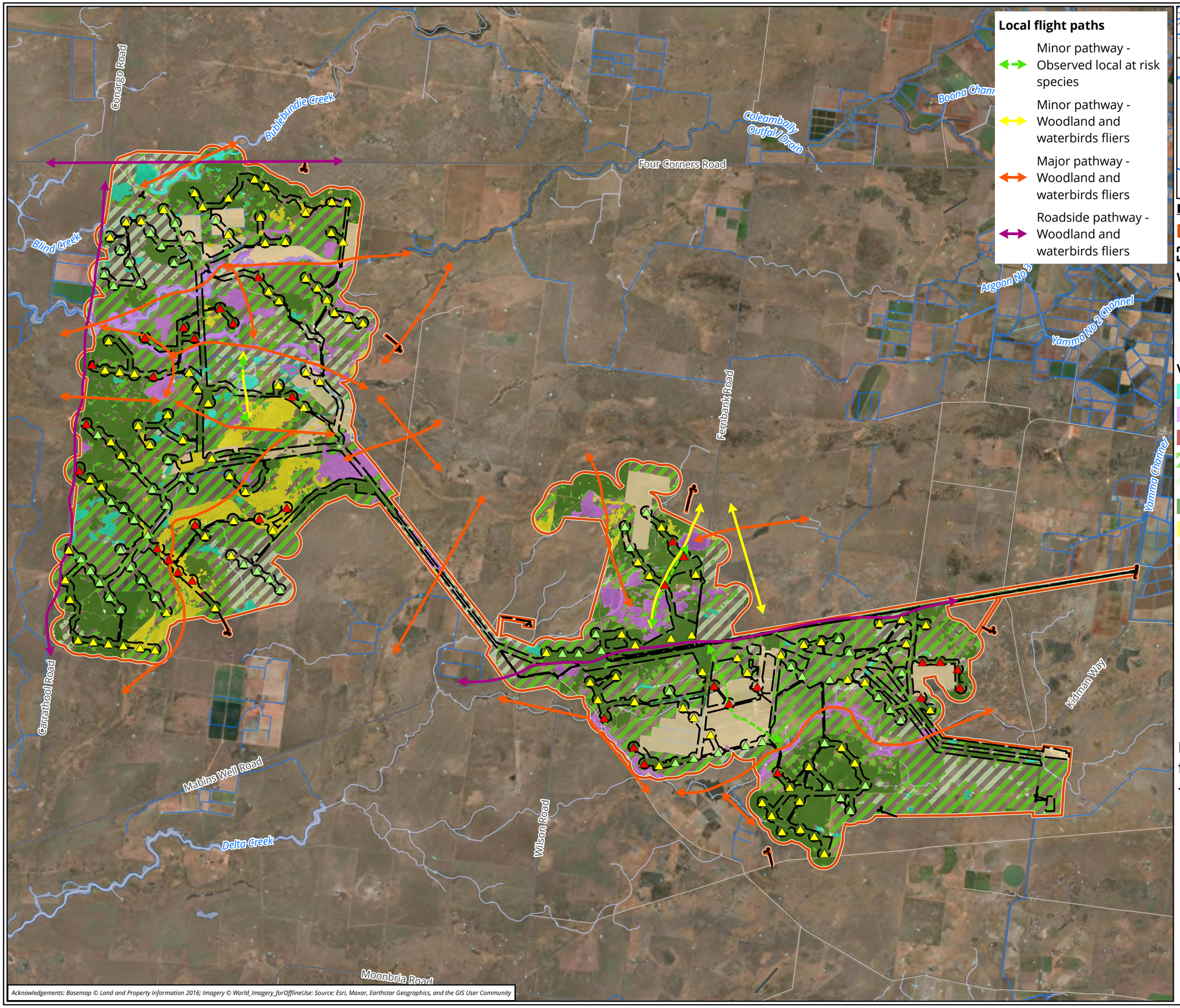
Scale: 1:14,000,000 @ A3

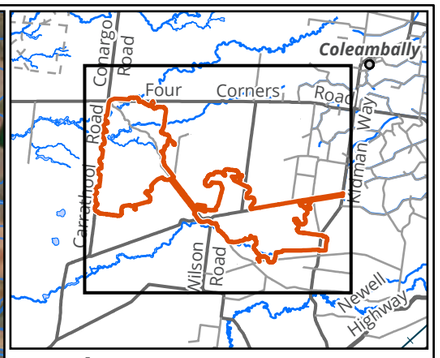
Coordinate System: GDA2020

N

Matter: 37263, Date: 06 February 2026,
GIS: JB, Checked by: MP, Last edited by: jbeckius
Location: P:\37200s\37263\Mapping\
37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F13_MigrFlightPath

Acknowledgements: Basemap © Land and Property Information 2016





Legend

- Subject land
- Development corridor

Wind turbine constraint

- High
- Moderate
- Low

Vegetation class

- Inland Floodplain Shrublands
- Inland Floodplain Woodlands
- Inland Riverine Forest
- Riverine Derived Grasslands
- Riverine Plain Grasslands
- Riverine Plain Woodlands
- Riverine Sandhill Woodlands
- Not-native vegetation

Figure 14 Indicative local flight movements - Overview

0 1 2 3 4 5

Kilometers
Scale: 1:130,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

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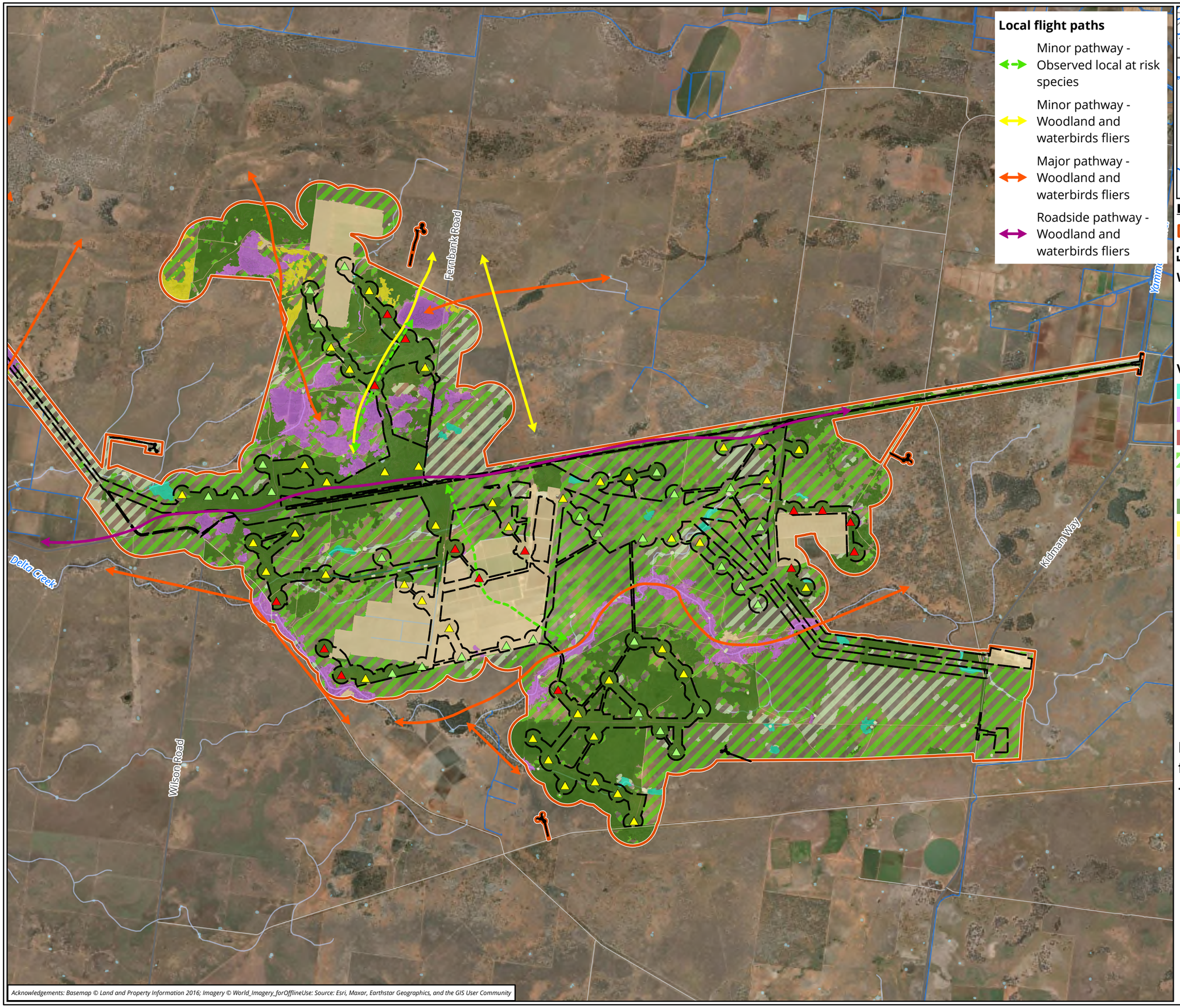

Figure 14 Indicative local flight movements - Eastern area

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Layout: 37263_Wind_F14_LocalFlightPath_WVEg

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © World_Imagery_forOfflineUse: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

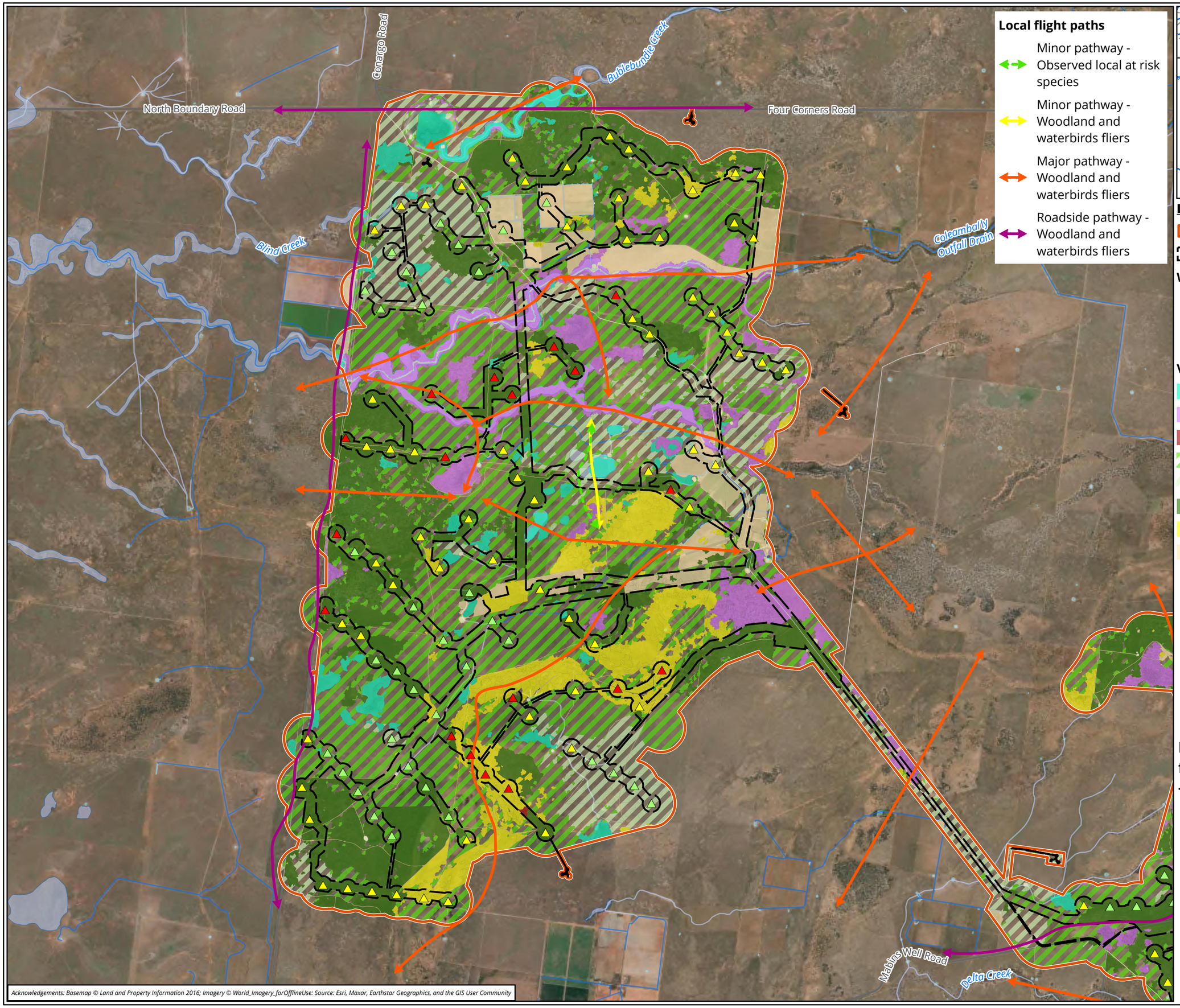

Figure 14 Indicative local flight movements - Western area

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37263_Dinawan_BDAR_Wind_F11-16.aprx
Layout: 37263_Wind_F14_LocalFlightPath_WVEg

6. Collision and barrier effect risk assessments

Biosis undertook collision risk modelling and bird and bat risk assessment to inform the overall biodiversity impact assessment for the project. This assessment identified species or groups of birds and bats considered at potential risk of collision with turbines, and the potential impact on bird and bats subject to disturbance and/or barrier effects posed by constructed wind turbines. The outcome of these assessments enables the targeted assessment of key species to be considered in the preparation of the impact assessment for the wind farm. In addition to direct loss of habitat from the construction of a wind farm, indirect impacts on birds and bats can arise from three potential pathways, including:

- Turbine strike (and possibly barotrauma) with towers and/or operating wind turbine blades at RSA heights.
- Loss of habitat connectivity (barrier effects) between essential resources, such as foraging and roosting areas.
- Avoidance of areas of habitat due to air disturbance surrounding operational turbines (habitat sterilisation).

6.1. Collison Risk Model (CRM)

6.1.1. Background

Collisions of birds and bats with wind turbines have been documented to occur at various frequencies around the world. Quantitative modelling to estimate the number of collision mortalities of threatened and non-threatened taxa is widely used as part of environmental impact assessments for proposed wind energy facilities (Masden & Cook 2016). The impact of any collisions on the viability of threatened and non-threatened fauna populations is more important than determination of simple numbers of mortalities, and population models can be used in combination with results of collision risk models to evaluate such impacts, but population modelling would be a separate exercise to the collision risk modelling presented here.

Modelling of collision risk is reliant on empirical data for flights by species at the wind farm site. There is no practicable method to obtain species-specific flight data for bats that are likely to utilise the site and bat-call data does not provide information about the number of flights by bats. The modelling presented here is therefore confined to diurnal birds. Mathematical modelling of risk is intended to provide an articulated, transparent and replicable evaluation of what may occur in the real world. The rationale behind projections is explicitly stated in the mathematics of a model, which means that the logical consistency of the predictions can be easily evaluated. The explicit nature of inputs and rigour entailed in modelling means that the process is replicable and consistent and it is open to analysis, criticism or modification when new information becomes available. Modelling is designed as a mechanism to evaluate uncertainties – if there was no uncertainty there would be no need to use a model. As a consequence of uncertainty in various parameters, some assumptions are required and while it is necessary to include some assumptions and arbitrary choices when deciding on the structure and parameters of a model, these choices are explicit. To the extent feasible, assumptions are informed by the best available information.

Models are also valuable for their heuristic capacities as they focus attention on important processes and parameters entailed in risk (Brook et al. 2002). Their very nature facilitates incorporation of information as it is learnt (Burgman 2005) and refinements should thus be expected of any model.

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Most factors related to the layout, dimensions and geometry of turbines are known. The risk modelling detailed here entails the use of informed assumptions related particularly to the flights of birds. The bird utilisation data collected from the site provides an empirical basis for extrapolations required for use in the model. We consider the assumptions and values used are reasonable and they are informed by available information about the ecology of relevant species. As a consequence, we consider the results of modelling detailed here provide a basis for evaluation of probable effects of the proposed Dinawan Wind Farm on relevant species of birds. The only alternative to a quantitative modelling approach is one of qualitative subjective judgement. All the benefits of using mathematical modelling outlined above are difficult, if not impossible to achieve with a purely qualitative assessment. A description of the Biosis collision risk model can be found in Smales et al. (2013), provided in Appendix 8.

6.1.2. Overview

The collision risk model takes account of bird flights that occur within the height zone that will be occupied by turbines. Data for the number of flights and their heights was documented by a regime of fixed-time point counts at locations representative of future turbine locations across the subject land. The model uses the empirical sample of flight data for each species and extrapolates that to determine a potential number of such flights that might occur over an entire 12 month period. This factor takes into account what is known about seasonal presence of particular species that may be migratory or may be present only for part of the year for other reasons.

In the model, the turbine is decomposed into its static and dynamic components. The entire turbine (including the tower, nacelle and the rotor when stationary) represents the static component. The dynamic component is the volume swept by the leading edge of the rotor blades in the time it takes the species of interest to pass across the depth of the rotor-swept disk.

Since the turbine tower below rotor swept height is always a static component and poses minimal collision risk, the model takes this into account by dividing flights into those below turbine rotor height, and those within the height zone swept by turbine rotors and allocating different risk rates to these height classes.

The risk assessment accounts for a combination of variables that are specific to the project and to data for birds from within the vicinity of the project. They include the following:

- The numbers of flights of each species below rotor height, and for which just the lower portion of turbine towers present a collision risk.
- The numbers of flights at heights within the zone swept by turbine rotors, and for which the upper portion of towers, nacelles and rotors present a collision risk.
- The numbers of bird movements-at-risk, as recorded during timed point counts, extrapolated to determine an estimated number of movements-at-risk the species makes in an entire year. Account is taken of the portion of the year that birds are within proximity of the subject land and that they may thus be at risk.
- The mean area (m2 per turbine), of tower, nacelle and stationary rotor blades of a wind generator that present a risk to birds. Thus, the mean area presented by a turbine is between the maximum (where the direction of the bird is perpendicular to the plane of the rotor sweep) and the minimum (where the direction of the bird is parallel to the plane of the rotor sweep). The mean presented area is determined from turbine specifications supplied to Biosis for specific make and model of a turbine. It represents the average area presented to an incoming flight from any direction.

- The additional area (m2 per turbine) presented by the movement of rotors during the potential flight of a bird through a turbine. This information is determined via a calculation involving species-specific, independent parameters of the flight speed and body length of the bird and supplied specifications for speed and dimensions of the turbine rotor.
- The model assumes that all turbines represent equal risk.
- A calculation of the average number of turbines a bird is likely to encounter in a given flight through the subject land. This is based on the scattered configuration of turbines in the landscape and the total number of turbines proposed for the project.

6.1.3. Avoidance rates

Results are provided for various avoidance rates. Avoidance rate is the capacity for a bird to avoid a collision, whether that occurs due to a cognitive response on the part of a bird or not. Thus at the extremes of the rates applied, a 0.90 avoidance rate equates to one flight in 10 in which a bird does not avoid a turbine and a 0.99 avoidance rate equates to one flight in 100 in which it does not avoid a turbine. Based on experience with a wide range of bird species, it is certain that virtually all species have high capacity to avoid collision with the static components of turbines. Avoidance rate for these components is thus consistently considered to be 0.99 in the modelling (i.e. one flight in 1,000 in which it does not avoid a static turbine component). Various avoidance rates are modelled for the dynamic turbine components because it is not certain how adept various species may be at evading collision with the moving rotor. For this reason, results are provided for 0.90, 0.95, 0.98 and 0.99 avoidance rates for the dynamic components (moving rotor) of turbines.

It should be noted that internationally there is very little empirical evidence for the actual avoidance rate for any bird species and for this reason it is prudent to provide a range of estimates that are considered to be reasonable. The evidence that is available suggests that avoidance capacity is species-specific and that the great majority of birds have a very high avoidance capability that is higher than 0.98. Nonetheless, the avoidance rate for Wedge-tailed Eagles appears to differ somewhat between wind farms. For three operational wind farms it has been between 0.95 and 0.97, while for a fourth it has been slightly lower than 0.90 (Smales 2023).

6.1.4. Results metrics

Generally, the model's results are expressed as the number of flights at risk of collision per annum for each species. This is a relative measure that permits comparison of risk rates associated with various turbines or turbine configurations. It does not necessarily equate to the number of collisions that might occur because we do not know how many individual birds of each species use the site and may thus be at risk. The difference between flights at risk of collision and number of actual collisions can be simply explained by way of an example. If there are just two individuals of a given species occupying the wind farm, they may make multiple flights that could result in collisions, however the maximum number of fatalities that could occur is two. As can be seen from this example, the number of actual fatalities due to collisions can be no greater than the number of individual birds, but it can also be no more than the number of flights at risk, and if the site-population is small but the birds fly actively within the site, the number of collisions will always be considerably lower than the number of flights at risk.

In cases where a good estimate or estimate of higher confidence for a site-population for particular species can be made, this can be incorporated into the model to provide results and expressed as an annual estimate of collisions.

Existing knowledge of the population dynamics for most of the species within the subject land is not sufficient to allow an estimate to be made for their site-populations. However, for three resident raptors (Nankeen Kestrel, Wedge-tailed Eagle and Black-shouldered Kite), an estimate of their possible site-populations has been made and the model has been run to provide a projection of results for them as an annual estimate of collisions.

The model cannot forecast the frequency of collisions around the predicted annual average and it is important to recognise that the number of any actual collisions that might occur can be expected to vary from year to year in a distribution around the average.

All results are provided to two significant figures, however they represent annual 'average' results and, of course actual bird fatalities will always be measured in numbers of individuals and the average results of modelling must represent a distribution that can be expected to vary from year-to-year around the mean.

6.1.5. Wind farm turbine parameters

The Biosis CRM requires a range of numeric inputs, to quantify the number of turbines, key dimensions of turbines, and to estimate bird utilisation characteristics, including the number of flights within and outside of rotor swept height for species to be included in the model. Following the results of the preliminary evaluation, the CRM used the following Key parameters:

- Number of turbines: *200*
- Turbine type: *Vestas V172-7.2 HH 150*
- Turbine tower hub height: *150 m, with 2% nominal variation*
- Rotor diameter: *172 m*
- Rotational speed: *12.1 rpm*
- The 172 metre diameter blades have a length of 86 metres, resulting in rotor swept height between 61and 239 (worse case) metres above the ground.

It is considered that the updated CRM captures the most conservative scenario in terms of potential collision risk. During consultation with CPHR, there was concurrence that as long as a conservative approach is adopted then it would be acceptable, noting distance above ground is a key parameter. CPHR agreed that post approval plans can address hub height increases. Further amendments to hub height (i.e. up to 164 m) and/or maximum tip height (i.e. up to 250 m) will require an additional collision risk model prior to construction.

In the scattered or 'clustered' array of turbines such as those within the development corridor, a bird has a high probability of encountering multiple turbines in a given flight. The CRM has a built-in function to account for any difference whereby the turbine array can have any setting from 100% of turbines fully clustered to 0% in which turbines are entirely linearly configured.

6.1.6. Bird species data

Following the results of the BUS, undertaken across eight seasons and two years, the CRM was run for all species for which there were any flights recorded at RSA height. That included all flights documented from between 61 and 239 metres above the ground.

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A total of 110 species of birds were recorded during BUS. While many of them may have capacity to fly at rotor swept height, 21 species were recorded doing so, of which 19 were at sites included in the CRM, and thus have data available for use in the model. For those species not recorded within RSA, but have potential to fly within RSA on occasion, or not recorded during BUS due to their cryptic nature, are covered further in risk assessments presented in Section 6.2.2. All modelled species are predicted to be present all year round, despite some aspects of nomadic and seasonal migration behaviours for some.

Many resident raptors and other woodland birds tend to occupy territories that remain stable over periods of several years and, because they are apex predators they occur at relatively low densities. In light of published studies for those species, Biosis undertook a process to estimate the sizes of their potential populations for the subject land. Additional population estimates were based on the number of birds recorded during BUS.

Table 57 Bird utilisation surveys included in the CRM

Site	Summer	Autumn	Winter	Spring	Total
Control sites (included in CRM for assessment)					
CTL1	7	7	7	5	**26**
CTL3	7	7	8	7	**29**
CTL7	7	7	6	7	**27**
CTL11	7	7	6	5	**25**
Impact sites					
IMP1	7	4	9	5	**25**
IMP2	7	8	9	6	**30**
IMP3/18	7	10	9	6	**32**
IMP4	7	8	9	5	**29**
IMP5/19	7	4	10	5	**26**
IMP6	7	8	10	7	**32**
IMP7	7	8	10	5	**30**
IMP9	7	8	12	7	**34**
IMP10	7	8	9	5	**29**
IMP11	7	9	10	6	**32**
IMP13	7	8	10	5	**30**
IMP15	7	8	10	6	**31**
IMP16	7	8	10	7	**32**
IMP20	7	4	9	3	**23**
IMP21	7	4	10	2	**23**
IMP22	7	7	10	5	**29**

6.1.7. Population estimates

Wedge-tailed Eagle

Cherriman (2007) provided an overview of studies, including his own, that have investigated the size of Wedge-tailed Eagle territories in temperate regions. Territory sizes in studies near Perth (Cherriman 2007); at two other sites in the south-east of Western Australia (Ridpath & Brooker 1987); near Canberra in south-eastern Australia (Leopole & Wolfe n.d.); and, in South Australia (Rowe et al. 2017) were all between 31 km² and 42 square kilometres. Foster and Wallis (2010) studied the species west of Melbourne and recorded nearest-neighbour distances averaged 4.7 kilometres. In a study in western NSW, Sharp et al. (2001) found

the mean distance to nearest neighbour between Wedge-tailed Eagle nests was in the order of one pair per 3–9 square kilometres. They noted this was considerably higher than that noted in other semi-arid zone studies (1 pair per 40–48 square kilometres).

Using a conservative mean Wedge-tailed Eagle territory size of 30 square kilometres, the average diameter of a territory would be slightly greater than 12 kilometres. As a consequence, we have based the modelling exercise for Wedge-tailed Eagles on the assumption that the 313 kilometre square array within the subject land may intersect with several territories, occupied by 21 adult birds.

Cherriman (2013) reported that breeding productivity (number of chicks fledged) was 0.73 young per pair, across 15 occupied territory-years. Debus et al. (2007) recorded very similar results with 10 young produced in 12 pair-years, equating to 0.8 young fledged per pair per year. On the basis of those studies, we have conservatively assumed that, on average, three pairs will be accompanied by a total of three flying juveniles, bringing the average site-population of Wedge-tailed Eagles to a total of 31. Hence we have modelled for this number of birds as being at potential risk of collision.

During BUS, Biosis staff documented a number of instances in which three, four and five, and up to eight Wedge-tailed Eagles were observed simultaneously.

Nankeen Kestrel and Black-shouldered Kite

Near Armidale, NSW, one pair of Nankeen Kestrels occupied at least 200 hectares (2 square kilometres) (Genelly 1978) and active nests were recorded approximately 1 kilometre apart (Baker-Gabb 1985). Near Mildura, Victoria, 12 pairs were documented from an area with a 10 kilometre radius (i.e., approx. 314 square kilometres), and 25 nests averaged 1-3.6 kilometre apart equating to 1 pair per 5.4 square kilometres (Baker-Gabb 1984). At Millewa, Victoria, Campbell (1986) reported an average of 1 active pair per 5.3 square kilometres (all references in HANZAB (Marchant et al. 1990)).

Using a conservative mean Nankeen Kestrel territory size of 5.3 km², the average diameter of a territory would be approximately 2.6 kilometres. As a consequence, we have based the modelling exercise for Nankeen Kestrel and Black-shouldered Kites on the assumption that the 313 kilometre square array within the subject land may intersect with several territories, occupied by 118 adult birds.

Baker-Gabb (1984) reported a mean number of 1.3 fledglings per territorial pair. On the basis of that study, we have assumed that, on average, 10 pairs will be accompanied by a total of 13 flying juveniles, bringing the average site-population of Nankeen Kestrels and Black-shouldered Kites to a total of 194 and we have modelled for 200 birds as being at potential risk of collision.

White-necked Heron

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 17. It is reasonable to assume a total of 20 for the site as a conservative estimate. Flocks are generally small but sometimes include up to 200 individuals according to HANZAB (Marchant et al. 1990).

Australian Wood Duck

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 56. It is reasonable to assume a total of 60 for the site as a

conservative estimate. Flocks are generally of less than 100 individuals but sometimes up to 2000 according to HANZAB (Marchant et al. 1990).

Spotted Harrier

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is five. It is reasonable to assume a total of five for the site as a conservative estimate. This species is not considered to form flocks (Marchant et al. 1990).

Australian Raven

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 133. It is reasonable to assume a total of 130 for the site as a conservative estimate. Flocks are generally of less than 30 individuals but sometimes up to 300 according to HANZAB (Marchant et al. 1990).

Plumed Whistling-Duck

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 35. It is reasonable to assume a total of 35 for the site as a conservative estimate. Flocks are generally of less than 50 individuals but sometimes up to 200 according to HANZAB (Marchant et al. 1990).

Galah

The site population for Galah was based on:

- Breeding pairs occupying approximately 1 km^2 territories for a woodland area of 313 km^2. This area would support 313 territories, equalling a total 626 adult birds.
- Average clutch size of 3.7, with a 48% fledging success (Marchant et al. 1990), equalling 556 flying juveniles.

This provides a site population estimate of 1182, which we have rounded to 1000. During the BUS, the highest count of birds per site within a survey across all sites is 542, and it is feasible that up to 1000 can occur in the subject land. Published literature indicates that flocks of 500 to 1000 can occur, and based on the available woodland habitat for nesting and roosting and the territory size, a total estimate oof 1000 is realistic for the proposed wind farm site (Marchant et al. 1990).

Brown Falcon

The site population estimate for Brown Falcon was based on:

- Wooded and non-wooded habitats within the subject land supporting stick nests being approximately 313 km^2 to support the resident population.
- Breeding pairs occupying 2 km^2 territories (Debus 2022) within the habitat, based on an average density or territory size reported in the literature. This area would support 156 territories, equalling a total 313 adult birds.
- Average 1.77 fledged chicks per successful breeding attempt, with a 69% breeding success (HANZAB) (Marchant et al. 1990) from 156 territories. This totals 192 flying juveniles. Young birds likely to remain floaters for part of the year.

Thus the total estimated number of individuals on site is 505, which has been rounded to 500. During the BUS, the highest count of birds per site within a survey across all sites is 22, however it is feasible that up to 500 can occur in the project area.

Black Falcon

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is five. It is reasonable to assume a total of five for the site as a conservative estimate. This species is not considered to form flocks (Marchant et al. 1990).

Whistling Kite

The site population estimate for Whistling Kite was based on:

- Wooded and non-wooded habitats within the subject land supporting stick nests being approximately 313 km^2 to support the resident population.
- Breeding pairs occupying 3.25 km^2 territories, based on an average density or territory size reported in the literature (Marchant et al. 1990). This area would support 97 territories, equalling a total 193 adult birds.
- Average 1.5 young per pair/territory with 60% fledging success from 97 territories, equalling 87 juveniles (Marchant et al. 1990). Young birds are likely to remain floaters for part of the year.

Thus, the total estimated number of individuals on site is 280 (193 adults and 87 juveniles). During the BUS, the highest count of birds per site within a survey across all sites is 10, and it is feasible that up to 280 can occur in the project area.

Black Kite

The site population estimate for Black Kite was based on:

- Breeding pairs occupying 2.33 km^2 territories ((Marchant et al. 1990); Mildura and Strzelecki floodplain) within 313 km^2 woodland area, based on an average density or territory size reported in the literature. This area would support 135 territories, equalling a total 269 adult birds.
- Average 1.5 young per pair/territory, with a 64% fledging success from 135 territories, equalling 130 flying juveniles (Marchant et al. 1990). Young birds are likely to remain floaters for part of the year.

Thus the total estimated number of individuals on site is 399 (269 adults and 130 juveniles), which has been rounded to 400 birds. During the BUS, the highest count of birds per site within a survey across all sites is 23, and it is feasible that up to 400 can occur in the project area.

Cockatiel

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 7. It is reasonable to assume a total of 10 for the site as a conservative estimate. Flocks are generally of less than 30 individuals but sometimes up to 500 according to HANZAB (Marchant et al. 1990).

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Pied Cormorant

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is four. It is reasonable to assume a total of ten for the site as a conservative estimate. Flocks are generally of less than six individuals but sometimes up to 10,000 according to HANZAB (Marchant et al. 1990).

Yellow-billed Spoonbill

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is five. It is reasonable to assume a total of five for the site as a conservative estimate. Flocks are generally of a few individuals according to HANZAB (Marchant et al. 1990).

Superb Parrot

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 21. It is reasonable to assume a total of 25 for the site as a conservative estimate. Flocks are generally of less than ten individuals but sometimes up to 60 according to HANZAB (Marchant et al. 1990).

Common Starling

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 944. It is reasonable to assume a total of 950 for the site as a conservative estimate. Flocks can be up to thousands according to HANZAB (Marchant et al. 1990).

Straw-necked Ibis

The site population for this species was derived from the BUS data, based on the highest count of birds per site within a survey across all sites, which is 136. It is reasonable to assume a total of 140 for the site as a conservative estimate. Flocks are generally of less than ten individuals but sometimes up to 350 according to HANZAB (Marchant et al. 1990).

6.1.8. Model results

CRM results for Nankeen Kestrel, Black-shouldered Kite and Wedge-tailed Eagle are shown in Table 58. As detailed above, informed assumptions have been made for the possible site-population sizes of these three species, and results for them are provided here expressed as projected numbers of annual average collisions. Results are provided for four potential avoidance rates.

Experience with these species at wind energy facilities in south-eastern Australia demonstrates that raptors often collide with wind turbines (Moloney et al. 2019). For Wedge-tailed Eagles, there is some published empirical data (Smales 2023) where evidence suggests that the model's projections accurately equate to avoidance capacity of between 0.90 and 0.97. As with any forward-projection modelling, the accuracy of the results presented here for the project, will depend upon the precision of all assumptions used for the modelling process. The modelling indicates that between a 95% and 98% avoidance rate, it is estimated that:

- Between six to three Wedge-tailed Eagles respectively may collide with a turbine annually.
- Between five and three Nankeen Kestrels respectively may collide with a turbine annually.

- Approximately one Black-shouldered Kite may collied with a turbine annually.

Table 58 Total CRM results based on two years of data for movements at risk for species within RSA

Scientific name	Common name	Movements at risk				Mortality (Collisions/Year)			
Dynamic avoidance		0%	95%	98%	99%	0%	95%	98%	99%
Aquila audax	Wedge-tailed Eagle	126.33	3.90	1.92	1.26	31.42	3.67	1.87	1.24
Ardea pacifica	White-necked Heron	54.79	1.40	0.76	0.55	18.78	1.35	0.75	0.54
Chenonetta jubata	Australian Wood Duck	55.61	0.67	0.58	0.56	36.57	0.66	0.58	0.55
Circus assimilis	Spotted Harrier	10.53	0.27	0.15	0.11	4.45	0.27	0.15	0.10
Corvus coronoides	Australian Raven	137.61	1.64	1.44	1.38	85.06	1.63	1.43	1.37
Dendrocygna eytoni	Plumed Whistling-Duck	222.35	4.49	2.79	2.22	34.97	4.22	2.69	2.16
Elanus axillaris	Black-shouldered Kite	115.47	1.34	1.20	1.15	88.52	1.34	1.20	1.15
Eolophus roseicapilla	Galah	765.65	7.83	7.70	7.66	537.45	7.80	7.67	7.63
Falco berigora	Brown Falcon	49.52	0.72	0.55	0.50	47.86	0.72	0.55	0.50
Falco cenchroides	Nankeen Kestrel	192.19	2.76	2.13	1.92	124.26	2.74	2.12	1.91
Falco subniger	Black Falcon	40.44	0.86	0.52	0.40	5.00	0.79	0.49	0.39
Haliastur sphenurus	Whistling Kite	23.94	0.52	0.31	0.24	23.35	0.52	0.31	0.24
Milvus migrans	Black Kite	36.75	0.65	0.44	0.37	35.42	0.65	0.44	0.37
Nymphicus hollandicus	Cockatiel	100.34	2.79	1.45	1.00	10.00	2.46	1.36	0.96
Phalacrocorax varius	Pied Cormorant	11.39	0.29	0.16	0.11	6.89	0.29	0.16	0.11
Platalea flavipes	Yellow-billed Spoonbill	19.45	0.65	0.31	0.19	4.93	0.62	0.30	0.19
Polytelis swainsonii	Superb Parrot	225.61	3.51	2.57	2.26	25.00	3.28	2.44	2.16
Sturnus vulgaris*	Common Starling*	1918.26	19.97	19.38	19.18	826.55	19.77	19.19	18.99
Threskiornis spinicollis	Straw-necked Ibis	101.91	1.32	1.09	1.02	72.96	1.31	1.09	1.02

On the assumption that the collision avoidance capacity of the species in Table 58 is at least 95%, the results can be summarised as follows:

- Eight species with less than one flight per annum that would be at some risk of collision.
- Nine species with one to five flights per annum that would be at some risk of collision.

- Two species with greater than five flights per annum that would be at some risk of collision.

In terms of threatened species:

- The Superb Parrot has three to four flights per annum that would be at some risk of collision.
- The Black Falcon has less than one flight per annum that would be at some risk of collision.
- The Spotted Harrier has less than one flight per annum that would be at some risk of collision.

The CRM captures the most conservative scenario in terms of potential collision risk. If any amendments to the hub height are required, the CRM will be updated prior to construction and the revised results will be included in the BBAMP.

6.2. Qualitative risk assessment

6.2.1. Risk matrix methodology

Assessment of potential impacts to avian fauna including microbats as a result of turbine strike has been undertaken by way of a qualitative risk assessment used to determine the likelihood of impact and the potential consequences of any impact that may occur. A risk matrix was applied for individual species of birds and bats that incorporates probability that the wind farm might impact birds or bats from habitats at the wind farm. The risk assessment has also been applied to non-threatened species of birds and bats recorded in the locality, where it is considered that their flight behaviours may put them at a risk of collision, outside of those species used within the CRM.

The species that have been the subject of this risk assessment include bird and bat species recorded or predicted to occur within 50 kilometres of the subject land, based on database searches, including:

- Species listed as threatened under both EPBC Act and/or BC Act.
- Birdlife Australia, the New Atlas of Australian Birds 1998-2015.
- Australasian Bat Society Bat map https://www.ausbats.org.au/batmap.html, accessed 15 March 2024.
- Species known to have documented collisions with turbines based on collision data from other operating wind farms in New South Wales.
- Species that may exhibit risk behaviour and potentially interact with the operation of wind turbines.

The criteria used to establish the likelihood of impact and potential consequences of turbine strike are provided in Table 59. The matrix used to qualify the risk associated with the significance of a collision impact as outlined in Table 59 and Table 60, with results per species provided in Table 61.

Table 59 Qualitative risk assessment criteria for likelihood and consequences of the impacts of turbine strike and barrier effect for birds and microbats

Likelihood	Criteria	Consequence	Criteria
Rare	An event may occur only in unusual circumstances (less than 5 %). The risk event is only theoretically possible, or would require exceptional circumstances to occur.	**Negligible**	Occasional individuals lost but no reduction in population viability.

Likelihood	Criteria	Consequence	Criteria
Unlikely	It is less probable than not that the risk event could occur in any year (< 50%).	**Minimal**	Repeated loss of small number of individuals but no reduction in population viability.
Likely	It is equally probable that the risk event could or could not occur in any year (50%).	**Moderate**	Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years.
Possible	It is more probable than not that the risk event could occur in any year (>50%)	**Significant**	Major loss in number of individuals, leading to reduction in population viability for between five to 10 years.
Probable	It is very probable that the risk event could occur in any year (>95%).	**Severe**	Extreme loss in number of individuals, leading to reduction in population viability for a period of at least 10 years.

Table 60 Qualitative risk assessment matrix for significance of impacts of potential turbine collisions for birds and microbats

Likelihood	Consequence				
	Negligible	Minimal	Moderate	Significant	Severe
Rare	Negligible	Negligible	Negligible	Low	Low
Unlikely	Negligible	Negligible	Low	Moderate	High
Likely	Negligible	Low	Moderate	High	High
Possible	Negligible	Low	Moderate	High	Severe
Probable	Negligible	Low	High	Severe	Severe

6.2.2. Risk matrices

In addition to the CRM, the results of the qualitative risk assessment have identified the likely species at risk of collision with operational wind turbines. This then accounts for species that may fly within RSA, but were not recorded during BBUS and accounted for in the CRM, or species that are vagrant, cryptic or migrate infrequently. The qualitative risk assessment found 31 species (birds and bats) to be at more than a 'Negligible' risk of collision with an operating turbine as shown in Table 61 and Table 62.

The qualitative risk assessment identified 23 bird species with a likelihood of collision greater than 'Low - Repeated loss of small number of individuals but no reduction in population viability', which includes Spotted Harrier, Australian Magpie, Galah and waterbirds such as Straw-necked Ibis, White-necked Heron and Yellow Spoonbill. The qualitative risk assessment also identified seven bat species with a likelihood of collision listed as 'low'.

The risk assessment identified a total of four species with a 'moderate' collision risk such as Black Falcon, Black-Shouldered Kite, Nankeen Kestrel and Superb Parrot, and also one species with 'high' collision risk, being the Wedge-tailed Eagle.

Up to nine species including Australasian Bittern and Wedge-tailed Eagle, are considered to have a low risk of impact as a result of barrier effects for the proposed wind farm layout. This includes nomadic species that may employ macro or meso avoidance (see Section 6.3. All other species have no more than a negligible risk of impact as a result of barrier effect for the proposed wind farm layout.

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Table 61 Bird collision risk and likelihood consequence

Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Botaurus poiciloptilus	Australasian Bittern	EN- BC Act EN - EPBC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Moderate	Low	Low
Tachybaptus novaehollandiae	Australasian Grebe	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Ardeotis australis	Australian Bustard	V - BC Act	Grassland/Shrubland birds and Ground-dwellers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Falco longipennis	Australian Hobby	-	Raptors	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Gymnorhina tibicen	Australian Magpie	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Probable	Minimal	Low	Negligible
Aegotheles cristatus	Australian Owlet-nightjar	-	Nocturnal foragers (Owls and Nightjars)	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Rostratula australis	Australian Painted Snipe	EN - BC Act EN - EPBC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Moderate	Negligible	Low
Pelecanus conspicillatus	Australian Pelican	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Stiltia isabella	Australian Pratincole	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Corvus coronoides	Australian Raven	-	Woodland birds (including Parrots and Songbirds)	Recorded in RSA	Probable	Minimal	Low	Negligible
Barnardius zonarius	Australian Ringneck	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Porzana fluminea	Australian Spotted Crake	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Threskiornis molucca	Australian White Ibis	-	Grassland/Shrubland birds and Ground-dwellers	Recorded onsite, however not within RSA	Likely	Minimal	Low	Negligible
Chenonetta jubata	Australian Wood Duck	-	Waterbirds, Seabirds and other aquatic foragers	Recorded in RSA	Likely	Minimal	Low	Negligible
Vanellus tricolor	Banded Lapwing	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Ninox connivens	Barking Owl	-	Nocturnal foragers (Owls and Nightjars)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Falco subniger	Black Falcon	V - BC Act	Raptors	Recorded in RSA	Likely	Moderate	Moderate	Low
Milvus migrans	Black Kite	-	Raptors	Recorded in RSA	Likely	Minimal	Low	Negligible
Cygnus atratus	Black Swan	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Artamus cinereus	Black-faced Woodswallow	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Elanus axillaris	Black-shouldered Kite	-	Raptors	Recorded in RSA	Probable	Moderate	Moderate	Low
Limosa limosa	Black-tailed Godwit	V - BC Act EN - EPBC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Minimal	Negligible	Negligible
Tribonyx ventralis	Black-tailed Native-hen	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Himantopus himantopus	Black-winged Stilt	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Northiella haematogaster	Blue Bonnet	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Neophema chrysostoma	Blue-winged Parrot	-	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Grus rubicunda	Brolga	V - BC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Falco berigora	Brown Falcon	-	Raptors	Recorded in RSA	Probable	Minimal	Low	Negligible
Accipiter fasciatus	Brown Goshawk	-	Raptors	Not recorded, BioNet Records	Likely	Negligible	Negligible	Negligible
Melopsittacus undulatus	Budgerigar	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Burhinus grallarius	Bush Stone-curlew	V - BC Act	Grassland/Shrubland birds and Ground-dwellers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Hydroprogne caspia	Caspian Tern	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Negligible	Negligible	Negligible
Nymphicus hollandicus	Cockatiel	-	Woodland birds (including Parrots and Songbirds)	Recorded in RSA	Unlikely	Minimal	Negligible	Negligible
Accipiter cirrocephalus	Collared Sparrowhawk	-	Raptors	Not recorded, BioNet Records	Unlikely	Negligible	Negligible	Negligible
Tringa nebularia	Common Greenshank	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Actitis hypoleucos	Common Sandpiper	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Platycercus elegans	Crimson Rosella	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Likely	Minimal	Negligible	Negligible
Calidris ferruginea	Curlew Sandpiper	EN - BC Act CE - EPBC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Eurystomus orientalis	Dollarbird	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Gallinula tenebrosa	Dusky Moorhen	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V - BC Act	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible

Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Tyto javanica	Eastern Barn Owl	-	Nocturnal foragers (Owls and Nightjars)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Bubulcus coromandus	Eastern Cattle Egret	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Likely	Negligible	Negligible	Negligible
Numenius madagascariensis	Eastern Curlew	CE - EPBC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Ardea alba modesta	Eastern Great Egret	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Platycercus eximius	Eastern Rosella	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Petrochelidon ariel	Fairy Martin	-	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Apus pacificus	Fork-tailed Swift	Migratory	Woodland birds (including Parrots and Songbirds)	Recorded above RSA	Possible	Minimal	Low	Low
Eolophus roseicapilla	Galah	-	Woodland birds (including Parrots and Songbirds)	Recorded in RSA	Possible	Minimal	Low	Negligible
Calyptorhynchus lathami	Glossy Black-Cockatoo	V - BC Act V - EPBC Act	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Rare	Minimal	Negligible	Negligible
Plegadis falcinellus	Glossy Ibis	-	Waterbirds, Seabirds and other aquatic foragers	Recorded in RSA	Unlikely	Minimal	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Phalacrocorax carbo	Great Cormorant	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Podiceps cristatus	Great Crested Grebe	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Falco hypoleucos	Grey Falcon	V - BC Act V - EPBC Act	Raptors	Not recorded, BioNet Records	Rare	Moderate	Negligible	Negligible
Anas gracilis	Grey Teal	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Gelochelidon nilotica	Gull-billed Tern	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Aythya australis	Hardhead	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Poliocephalus poliocephalus	Hoary-headed Grebe	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Ardea intermedia	Intermediate Egret	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Gallinago hardwickii	Latham's Snipe	Migratory	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Dacelo novaeguineae	Laughing Kookaburra	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Elanus scriptus	Letter-winged Kite	-	Raptors	Not recorded, BioNet Records	Rare	Moderate	Negligible	Negligible
Phalacrocorax sulcirostris	Little Black Cormorant	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Cacatua sanguinea	Little Corella	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Hieraaetus morphnoides	Little Eagle	V - BC Act	Raptors	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Egretta garzetta	Little Egret	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Likely	Minimal	Low	Negligible
Glossopsitta pusilla	Little Lorikeet	V - BC Act	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Microcarbo melanoleucos	Little Pied Cormorant	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Likely	Minimal	Low	Negligible
Corvus mellori	Little Raven	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Cacatua tenuirostris	Long-billed Corella	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Anseranas semipalmata	Magpie Goose	V - BC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Minimal	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V - BC Act EN - EPBC Act	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Tringa stagnatilis	Marsh Sandpiper	Migratory	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Tyto novaehollandiae	Masked Owl	V - BC Act	Nocturnal foragers (Owls and Nightjars)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Artamus personatus	Masked Woodswallow	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Likely	Negligible	Negligible	Negligible
Psephotus varius	Mulga Parrot	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Biziura lobata	Musk Duck	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Falco cenchroides	Nankeen Kestrel	-	Raptors	Recorded in RSA	Probable	Moderate	Moderate	Low
Nycticorax caledonicus	Nankeen Night Heron	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Anas superciliosa	Pacific Black Duck	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Negligible	Negligible	Negligible
Grantiella picta	Painted Honeyeater	V - BC Act V - EPBC Act	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Calidris melanotos	Pectoral Sandpiper	Migratory	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Falco peregrinus	Peregrine Falcon	-	Raptors	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Phalacrocorax varius	Pied Cormorant	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Certhionyx variegatus	Pied Honeyeater	V - BC Act	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Malacorhynchus membranaceus	Pink-eared Duck	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Pedionomus torquatus	Plains-wanderer	CE- BC Act CE – EPBC Act	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Dendrocygna eytoni	Plumed Whistling-Duck	-	Waterbirds, Seabirds and other aquatic foragers	Recorded in RSA	Possible	Minimal	Low	Negligible
Merops ornatus	Rainbow Bee-eater	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Rare	Negligible	Negligible	Negligible
Charadrius ruficapillus	Red-capped Plover	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Recurvirostra novaehollandiae	Red-necked Avocet	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Psephotus haematonotus	Red-rumped Parrot	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Rare	Minimal	Negligible	Negligible
Platalea regia	Royal Spoonbill	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Negligible	Negligible	Negligible
Calidris acuminata	Sharp-tailed Sandpiper	Migratory	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Ninox novaeseelandiae	Southern Boobook	-	Nocturnal foragers (Owls and Nightjars)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Porzana tabuensis	Spotless Crake	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Circus assimilis	Spotted Harrier	V - BC Act	Raptors	Recorded in RSA	Possible	Minimal	Low	Low
Lophoictinia isura	Square-tailed Kite	V - BC Act	Raptors	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Threskiornis spinicollis	Straw-necked Ibis	-	Waterbirds, Seabirds and other aquatic foragers	Recorded in RSA	Possible	Minimal	Low	Negligible
Cacatua galerita	Sulphur-crested Cockatoo	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Minimal	Negligible	Negligible
Polytelis swainsonii	Superb Parrot	V - BC Act V - EPBC Act	Woodland birds (including Parrots and Songbirds)	Recorded in RSA	Likely	Moderate	Moderate	Low
Circus approximans	Swamp Harrier	-	Raptors	Recorded onsite, BioNet Records	Unlikely	Minimal	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Lathamus discolor	Swift Parrot	CE - BC Act CE - EPBC Act	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Podargus strigoides	Tawny Frogmouth	-	Nocturnal foragers (Owls and Nightjars)	Recorded onsite, however not within RSA	Likely	Negligible	Negligible	Negligible
Sterna sp.	Tern	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Petrochelidon nigricans	Tree Martin	-	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Dendrocygna arcuata	Wandering Whistling-Duck	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Negligible	Negligible	Negligible
Aquila audax	Wedge-tailed Eagle	-	Raptors	Recorded in RSA	Probable	Moderate	High	Low
Hirundo neoxena neoxena	Welcome Swallow	-	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA	Unlikely	Negligible	Negligible	Negligible
Epthianura albifrons	White-fronted Chat	V - BC Act	Woodland birds (including Parrots and Songbirds)	Recorded onsite, however not within RSA. May fly in RSA on uncommon nomadic movement	Unlikely	Minimal	Negligible	Negligible
Numenius phaeopus	Whimbrel	Migratory	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible

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Scientific name	Common name	Status	Guild	Reasoning	Likelihood Collison	Consequence Collison	Risk rating Collison	Risk rating Indirect/barrier
Chlidonias hybrida	Whiskered Tern	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Unlikely	Negligible	Negligible	Negligible
Haliastur sphenurus	Whistling Kite	-	Raptors	Recorded in RSA	Possible	Minimal	Low	Negligible
Haliaeetus leucogaster	White-bellied Sea-Eagle	V - BC Act	Raptors	Not recorded, BioNet Records	Unlikely	Negligible	Negligible	Negligible
Artamus leucorynchus	White-breasted Woodswallow	-	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Artamus superciliosus	White-browed Woodswallow	-	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Unlikely	Minimal	Negligible	Negligible
Egretta novaehollandiae	White-faced Heron	-	Waterbirds, Seabirds and other aquatic foragers	Recorded onsite, however not within RSA	Likely	Minimal	Low	Negligible
Ardea pacifica	White-necked Heron	-	Waterbirds, Seabirds and other aquatic foragers	Recorded in RSA	Likely	Minimal	Low	Negligible
Hirundapus caudacutus	White-throated Needletail	V - BC Act V - EPBC Act	Woodland birds (including Parrots and Songbirds)	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Tringa glareola	Wood Sandpiper	-	Waterbirds, Seabirds and other aquatic foragers	Not recorded, BioNet Records	Rare	Negligible	Negligible	Negligible
Platalea flavipes	Yellow-billed Spoonbill	-	Waterbirds, Seabirds and other aquatic foragers	Recorded in RSA	Likely	Minimal	Low	Negligible

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Table 62 Bat collision risk and likelihood consequence

Species	Common name	Status	Reasoning	Habitat values and behavioural considerations	Likelihood Collison	Consequence Collison	Risk Collison	Risk Indirect/barrier
Austronomus australis	White-striped Free-tailed Bat	-	Recorded via ultrasonic detection in RSA	Prefers open foraging areas above canopy. A very common widespread species recorded in high numbers during site surveys. Recognised as an at risk bat species in relation to wind farm developments due to their foraging and flight behaviour. Due to its poor ability to detect and avoid obstacles, particularly mobile ones, such as turbine blades, White-striped Free-tail Bats are one of the most commonly recorded species in carcass monitoring at Australian wind farms. Highly susceptible to collision mortality regularly, however, populations generally secure and dense to withstand moderate instances of mortality should it occur.	Probable	Minimal	Low	Low
Chalinolobus gouldii	Gould's Wattled Bat		Recorded via ultrasonic detection on ground based detectors only	A common and widespread large microbat that is fast, high flier with restricted manoeuvrability. Like the White-striped Freetail Bat, this species has a poor ability to detect and avoid obstacles while pursuing prey, particularly mobile ones such as turbine blades. Highly susceptible to collision mortality regularly, however populations generally secure and dense to withstand moderate instances of mortality should it occur.	Possible	Minimal	Low	Low

Species	Common name	Status	Reasoning	Habitat values and behavioural considerations	Likelihood Collison	Consequence Collison	Risk Collison	Risk Indirect/barrier
Chalinolobus morio	Chocolate Wattled Bat	-	Recorded via ultrasonic detection on ground based detectors only	A relatively common and widespread microbat that is fast with increased manoeuvrability than the Gould's Wattled Bat. Generally restricted to canopies and fringing vegetation, may be susceptible to collision mortality on occasion, however populations generally secure and dense to withstand low instances of mortality should it occur.	Unlikely	Negligible	Negligible	Negligible
Chalinolobus picatus	Little Pied Bat	V- BC Act	BioNet records	A declining species that occurs in dry open forest and woodlands. The subject land is within its most easterly distribution limit. Roosts in cave and occasionally within trees hollows and other structures. Relatively confined to canopies and timbered areas but may fly within RSA on occasion. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Unlikely	Negligible	Negligible	Negligible
Myotis macropus	Southern Myotis	V- BC Act	Species group recorded via ultrasonic detection on ground based detectors only	Generally found around riparian areas. Not known to fly within RSA and not considered to be at risk of collision due to their favoured foraging and roosting preferences in gullies and surrounding waterways	Rare	Negligible	Negligible	Negligible
Nyctophilus	Corben's	V- BC Act	Species	Generally restricted to foraging within	Unlikely	Minimal	Negligible	Negligible

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Species	Common name	Status	Reasoning	Habitat values and behavioural considerations	Likelihood Collison	Consequence Collison	Risk Collison	Risk Indirect/barrier
corbeni	Long-eared Bat	V- EPBC Act	group recorded via ultrasonic detection on ground based detectors only	or beneath the canopy however may forage within open areas, in conjunction with White Cypress Pine communities. This species is a slow flying agile bat that roosts in tree hollows, crevices and under loose bark. Unlikely to fly within RSA. Should a collision occur, it is likely only to occur to a very small number of individuals that would be impacted.				
Nyctophilus geoffroyi	Lesser Long-eared Bat	-	Species group recorded via ultrasonic detection on ground based detectors only	A relatively common and widespread microbat that is fast with high manoeuvrability. Generally restricted to foraging within or beneath the canopy however may forage within open areas, especially where lights have attracted large insect numbers. Should a collision occur, it is likely only to occur to a very small number of individuals that would be impacted.	Rare	Negligible	Negligible	Negligible
Nyctophilus gouldi	Gould's Long-eared Bat	-	Species group recorded via ultrasonic detection on ground based detectors only	A relatively common and widespread microbat that is fast with high manoeuvrability. Generally restricted to foraging within or beneath the canopy however may forage within open areas or within areas fringing remnant vegetation. Should a collision occur, it is likely only to occur to a very small number of individuals	Unlikely	Negligible	Negligible	Negligible

Species	Common name	Status	Reasoning	Habitat values and behavioural considerations	Likelihood Collison	Consequence Collison	Risk Collison	Risk Indirect/barrier
				that would be impacted.				
Ozimops petersi	Inland Free-tailed Bat	-	Recorded via ultrasonic detection in RSA	Widespread species of varying habitats, but rare within the locality. Fast and direct fliers of unobstructed air-spaces from just above to well above the canopy as well as above grasslands. All three species were recorded in low numbers within RSA at the site. Should a collision occur, it is likely only to occur to a very small number of individuals that would be impacted.	Possible	Minimal	Low	Negligible
Ozimops planiceps	South-eastern Free-tailed Bat	-	Recorded via ultrasonic detection in RSA		Possible	Minimal	Low	Negligible
Ozimops ridei	Ride's Free-tailed Bat	-	Recorded via ultrasonic detection in RSA		Possible	Minimal	Low	Negligible
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V- BC Act	Recorded via ultrasonic detection in RSA	Widespread species within a range of habitats including rainforest, woodland and grassland. High and fast flier over the forest canopy, but lower in more open areas and fringing vegetation. Roosts within tree hollows. Has potential to fly and was within RSA. In the unlikely event that collisions occur, impacts to the local population of the species may eventuate.	Likely	Minimal	Low	Low
Scotorepens balstoni	Inland Broad-nosed Bat	-	Recorded via ultrasonic detection on ground based detectors only	A widespread species that generally fly within riparian areas but may also fly above canopies and RSA on occasion. Highly mobile, however, not recorded within RSA and not considered to be at risk of collision due to their favoured foraging and	Rare	Negligible	Negligible	Negligible

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Species	Common name	Status	Reasoning	Habitat values and behavioural considerations	Likelihood Collison	Consequence Collison	Risk Collison	Risk Indirect/barrier
				roosting preferences. In the unlikely event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur.				
Scotorepens greyii	Little Broad-nosed Bat	-	Recorded via ultrasonic detection on ground based detectors only	A common widespread species recorded regularly during site surveys. Generally, fly within riparian areas and woodland along the fringing areas of vegetation, but may also fly above canopies and RSA on occasion. Highly mobile and susceptible to collision mortality, however populations generally secure and dense to withstand moderate instances of mortality should it occur.	Unlikely	Negligible	Negligible	Negligible
Vespadelus baverstocki	Inland Forest Bat	V- BC Act	Recorded via ultrasonic detection on ground based detectors only	A poorly known species and may cover an extensive foraging area. Like other *Vespadelus*, is not considered to be at risk of collision due to their favoured foraging and roosting preferences in drier woodland habitats with bias towards riparian areas in conjunction with *Vespadelus vulturnus.*	Unlikely	Negligible	Negligible	Negligible
Vespadelus darlingtoni	Large Forest Bat	-	Recorded via ultrasonic detection on ground based detectors	A large widespread bat with restricted manoeuvrability due to its size. Not known to fly within RSA and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely	Rare	Negligible	Negligible	Negligible

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Species	Common name	Status	Reasoning	Habitat values and behavioural considerations	Likelihood Collison	Consequence Collison	Risk Collison	Risk Indirect/barrier
			only	event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur				
Vespadelus regulus	Southern Forest Bat	-	Recorded via ultrasonic detection on ground based detectors only	A moderate sized widespread bat. Not known to fly within RSA and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur.	Rare	Negligible	Negligible	Negligible
Vespadelus vulturnus	Little Forest Bat	-	Recorded via ultrasonic detection on ground based detectors only	A small sized, very common and widespread bat. They are highly agile fast fliers with high manoeuvrability. May fly beneath and above canopy height and on occasion within RSA. Should a collision occur, its likely only to occur to a very small number of individuals that would be impacted	Unlikely	Negligible	Negligible	Negligible
Pteropus poliocephalus	Grey-headed Flying-fox	V- BC Act V- EPBC Act	BioNet records	A declining species that inhabits wide ranging habitats and moves large distances foraging, however generally roosts/breeds close to or near riparian areas. May occur on an intermittent bases transiting through the landscape, however the occurrence of known camps and forage resources mean regular flights through the development footprint	Unlikely	Minimal	Negligible	Negligible

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Species	Common name	Status	Reasoning	Habitat values and behavioural considerations	Likelihood Collison	Consequence Collison	Risk Collison	Risk Indirect/barrier
				are considered unlikely. Recent instances in Victoria have seen an increased rate of collision mortality. Should a collision occur, it is likely only to occur to a very small number of individuals that would be impacted.				
Pteropus scapulatus	Little Red Flying Fox	-	BioNet records	May occur on an intermittent bases transiting through the landscape, however the occurrence of known camps and forage resources mean regular flights through the development footprint are considered unlikely. Should a collision occur, it is likely only to occur to a very small number of individuals that would be impacted.	Unlikely	Minimal	Negligible	Negligible
In general:								
Open space / aerial = typically free-tail and sheath-tail bats. Fly fast. Long, narrow wings, not manoeuvrable.								
Edge space = most bats (Vespertilionids and Myotis). Fly fast to moderately slow. Moderately long and broad wings.								
Closed = gleaning bats (Phoniscus, Nyctophilus, Rhinolophus) = slow, but able to manoeuvre and hover in cluttered places. Broad, shorter wings, rounded tip, large tail membrane.								

6.2.3. 'At-risk' species

The following section summarises species considered to be at risk from collision with turbines such that impacts could occur to the species and/or population levels. A full list of species considered in the qualitative risk assessments and potentially at risk by the project is detailed in Table 61 and Table 62. A total of 23 species of birds and 7 species of bats are considered to be at more than a negligible risk of impact from turbine collisions, and thus 'at-risk' as a result of the project, summarised in Table 63.

As impacts associated with blade strike are considered somewhat uncertain in accordance with the BAM, and as previously mentioned, adaptive management is required through the preparation and implementation of an operational BBAMP that will be finalised prior to operation. Further information is provided in Section 8.3.4 below.

Table 63 Summary of species considered 'at-risk' of collision impacts from the project

Common name	Scientific name	Threat listing		Risk assessed species risk conclusion
		EPBC Act	BC Act	
Birds				
Australasian Bittern	*Botaurus poiciloptilus*	Endangered	Endangered	Low
Australian Magpie	*Gymnorhina tibicen*	-	-	Low
Australian Raven	*Corvus coronoides*	-	-	Low
Australian White Ibis	*Threskiornis molucca*	-	-	Low
Australian Wood Duck	*Chenonetta jubata*	-	-	Low
Black Falcon	*Falco subniger*	-	Vulnerable	Moderate
Black Kite	*Milvus migrans*	-	-	Low
Black-shouldered Kite	*Elanus axillaris*	-	-	Moderate
Brown Falcon	*Falco berigora*	-	-	Low
Fork-tailed Swift	*Apus pacificus*	-	-	Low
Galah	*Eolophus roseicapilla*	-	-	Low
Little Egret	*Egretta garzetta*	-	-	Low
Little Pied Cormorant	*Microcarbo melanoleucos*	-	-	Low
Nankeen Kestrel	*Falco cenchroides*	-	-	Moderate
Plumed Whistling-Duck	*Dendrocygna eytoni*	-	-	Low
Spotted Harrier	*Circus assimilis*	-	Vulnerable	Low
Straw-necked Ibis	*Threskiornis spinicollis*	-	-	Low
Superb Parrot	*Polytelis swainsonii*	Vulnerable	Vulnerable	Moderate
Wedge-tailed Eagle	*Aquila audax*	-	-	High
Whistling Kite	*Haliastur sphenurus*	-	-	Low
White-faced Heron	*Egretta novaehollandiae*	-	-	Low
White-necked Heron	*Ardea pacifica*	-	-	Low
Yellow-billed Spoonbill	*Platalea flavipes*	-	-	Low

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Common name	Scientific name	Threat listing		Risk assessed species risk conclusion
		EPBC Act	BC Act	
Bats				
White-striped Free-tailed Bat	*Austronomus australis*	-	-	Low
Gould's Wattled Bat	*Chalinolobus gouldii*	-	-	Low
Inland Free-tailed Bat	*Ozimops petersi*	-	-	Low
South-eastern Free-tailed Bat	*Ozimops planiceps*	-	-	Low
Ride's Free-tailed Bat	*Ozimops ridei*	-	-	Low
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	-	Vulnerable	Low
Little Red Flying Fox	*Pteropus scapulatus*	-	-	Low

6.3. Turbine risk assessment

The potential risk and consequence of turbine strike has been assessed for at-risk bird and bat species within the subject land, and is outlined above in Section 6.2. Further assessment is provided to determine which individual turbines present the highest risk of potential collisions to allow for targeted mitigation to be applied to reduce the potential risk and consequences of strikes that may occur. This assessment considered the likelihood of each turbine resulting in potential strikes, largely dependent on surrounding habitat types and proximity to operational turbines, and the potential consequence on species utilising those habitats if they were to collide with a turbine, which is largely driven by the 'at-risk' and conservation status of those species.

6.3.1. Turbine strike consequence

The severity of potential impacts of turbine strike to those species of birds and bats determined to be at more than a negligible risk from turbines strike (as outlined in Section 6.2.3 above) have been assessed, for those species rated as having more than a negligible consequence listed in Table 63 above. Table 64 below presents the risk matrix used to determine the severity of potential impacts of turbine strike, with each turbine being given a worst case scenario consequence rating, which is then used, in combination with strike likelihood, to determine the over turbine risk rating.

Table 64 Turbine strike consequence criteria

Threat status (BC Act or EPBC Act)	Bird or bat species 'at risk' rating				
	Negligible	Low	Moderate	Significant	Severe
At risk (non-threatened)	Negligible	Minor	Moderate	Moderate	Major
Migratory	Negligible	Minor	Moderate	Major	Severe
Vulnerable	Negligible	Minor	Moderate	Major	Severe
Endangered	Minor	Moderate	Major	Severe	Severe
Critically Endangered or potential SAII	Minor	Major	Major	Severe	Severe

Key habitats form the basis of the turbine strike likelihood assessment provided in Section 6.3.2 below. Key habitats include roosting / breeding opportunities for at risk species, and in the context of waterbirds species include wetland forage habitats, where habitual flights are more likely to bring individuals in closer proximity to turbine RSA, and thus increase the risk of collision.

6.3.2. Turbine strike likelihood assessment

Turbine strike likelihood has been assessed relative to the criteria outlined in the BCS Draft Turbine Risk Assessment and Avoidance Guidance (BCS 2023), with adjustments made to the recommended criteria to better suit site conditions and to focus on potential flightpaths of at-risk species.

Turbine strike likelihood criteria, developed for the project are presented in Table 65 below. The following turbine parameters have been included as the 'worst case scenario' turbine being considered for the project.

- Hub height – 150 m, +/- nominal 2%variation.
- Blade length – 86 m
- RSA height – 61 m (min) – 239 m (max) as a worse case

Table 65 Turbine strike likelihood criteria

Key habitat features	
• Key habitats for at-risk species that occur on one, or both, sides of a turbine, such that flights between, or into/out of, habitat features/patches are more likely to occur within, or in close proximity to, RSA. • Patches are ≥1 ha in area providing larger, higher quality habitat likely to be used more frequently, by more birds and bats, and more regularly by resident species. • Wetlands and larger watercourses (or large dams) on one, or both, sides of a turbine increasing the risk of collisions from fauna flying into or out of the habitat feature. • Blade tip distances to ephemeral wetlands and waterways, and major movement corridors. • Migratory or nomadic species habitual flight path, or key local flyways. • Stick nest potentially supporting breeding raptors.	
Relevant habitat feature and buffers to WTGs	**Likelihood of turbine strike**
• Major wetland habitats occur <200 m from WTG blade tip, on one or both sides of turbine • PCT 10, PCT 13, PCT 15, PCT 28 woodland habitats occur <200 m from WTG blade tip, on both sides of turbine • Stick nest occurs <200 m from WTG blade tip	**Probable** An event is expected to occur in most circumstances (>95%).
• Minor wetland or woodland habitats (as stated above) occur <200 m of WTG, on one side only • Minor wetland or woodland habitats (all PCT woodland habitats) occur 200 - 500 m of WTG, on both sides of turbine • Major wetland habitats occur >200 m from WTG blade tip, on one side only • Stick nest occurs >200 m from WTG blade tip • Irrigated cropping areas where flocking bird may intermittently congregate	**Possible** An event could occur during most circumstances (>50% - <95%).

• Minor deviations from the above rule set where habitats align with 'possible' likelihood assessment	
• Minor wetland or woodland habitats occur >200 m from WTG blade tip, on one side only • Minor wetland or woodland habitats occur >500 m from WTG blade tip, on both sides of turbine • Main watercourse or major wetland habitats occur >500 m from WTG blade tip, on one side only • Minor deviations from the above rule set where habitats are particularly small, isolated, or degraded	**Unlikely** An event could occur during some circumstances (>5 - <50%).
• Limited habitat features <1000 m from WTG blade tip	**Rare** An event may occur only in unusual circumstances (<5%)

The above criteria are considered to better represent the potential for turbine strike within the subject land than the recommended criteria included in the BCS guidance (BCS 2023). The majority of habitat for bird and bat species within the subject land is present as either ephemeral wooded waterways, isolated pine communities, isolated ephemeral waterbodies, irrigated cropping paddocks or along defined road corridors. Movements through the operational wind farm, with potential to put individuals at risk of collision, are more likely to occur when fauna are flying directly between patchy habitats or along major movement corridors. Therefore, focussing solely on proximity of habitats supported by treed vegetation (as recommended by the BCS guidance) may misrepresent the actual likelihood of collisions.

The above criteria also allows for consideration of birds' (and possibly to a lesser extent bats) capacity for avoidance of collisions with operational turbines, whether that occurs due to a cognitive response on the part of a bird or not. It should be noted that internationally there is little empirical evidence for the actual avoidance rate for any bird species, however the evidence that is available suggests that avoidance capacity is species-specific and that the great majority of birds have very high avoidance capability that is higher than 98 %. The avoidance rate of some large raptors in Australia has been shown to be between 95 % and 98 % (Smales et al. 2013, Smales 2017). 'Avoidance' is recognised at different spatial scales, with commonly used definitions provided by Cook et al. (2014). These different scales of avoidance include: (1) macro-avoidance, when a bird or bat responds to the presence of the entire wind farm by flying around or over it; (2) meso-avoidance, refers to the response in which birds or bats fly within the overall wind farm but avoid collisions by choosing to fly only in the airspace between turbines; and (3) micro-avoidance, when a bird or bat flying in close proximity to a turbine and that is otherwise on a collision course, does not in fact collide with the turbine (Smales 2017).

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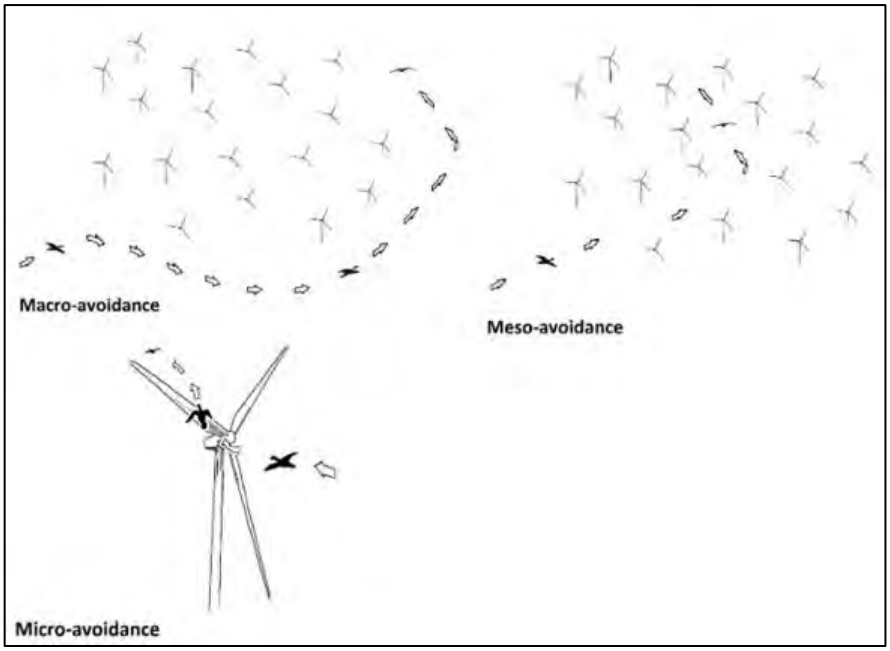

Photo 7 Types of avoidance

The turbine strike likelihood assessment buffer distances have been calculated using the formula for calculating buffers to areas of vegetation developed in *Natural England Technical Information Note TIN051 – Bats and onshore wind turbines interim guidance* (Natural England 2009). This method takes into consideration hub height, blade length, habitat feature height (i.e. tree canopies), and the horizontal distance to habitat features and provides a diagram and formula for how buffer distances between blade tips and adjacent habitat features can be calculated (refer Figure 15 below).

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

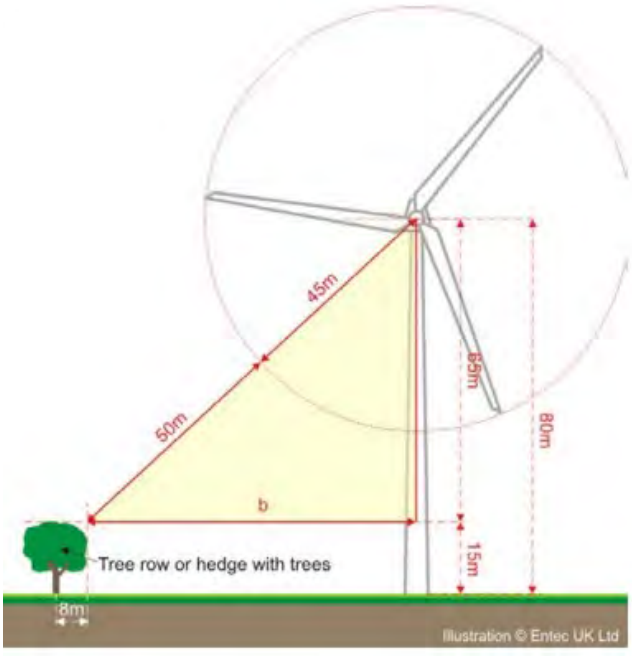

Figure 15 Extract from Technical Information Note TIN051 Bats and onshore wind turbines, showing how buffer distance is determined from top of canopy to blade tip

The above formula was used to calculate the buffer distances for assessment of the presence of key habitat features, with the following horizontal distances calculated for each of the assessed buffer distances:

- 200 m buffer distance from blade tip – 238 m horizontal buffer to key habitat feature
- 500 m buffer distance from blade tip – 547 m horizontal buffer to key habitat feature
- 1000 m buffer distance from blade tip – 1056 m horizontal buffer to key habitat feature

The above distances were calculated based on a maximum feature height of 9 metres for treed vegetation, which equates to the tallest mean canopy height value for PCTs within the subject land as outlined in the BioNet Vegetation Classification database.

6.3.3. Turbine risk assessment

Turbine risk combines the results of the assessment of turbine strike consequence and turbine strike likelihood and has again been based on the BCS Draft Turbine Risk Assessment and Avoidance Guidance (BCS 2023). Adjustments have again been made to the recommended risk rating to better reflect the habitats, aerial fauna, and movement patterns within the subject land, as well as the conclusions of the risk assessments undertaken for all at risk species.

The turbine risk assessment matrix applied to the project is outlined in Table 66.

Table 66 Turbine risk assessment matrix

Likelihood criteria	Consequence criteria			
	Severe	**Major**	**Moderate**	**Minor**
Probable	Very high	Very high	High	Moderate
Possible	Very high	High	Moderate	Moderate
Unlikely	High	High	Moderate	Low
Rare	High	Moderate	Low	Low

Final turbine risk assessment results are presented in Table 67.

Table 67 Turbine risk assessment results

WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
ET1	**Removed from project**			
ET10	Unlikely	Moderate	Moderate	
ET100	Rare	Moderate	Low	
ET101	Unlikely	Moderate	Moderate	
ET102	**Removed from project**			
ET103	Rare	Moderate	Low	
ET104	Rare	Moderate	Low	
ET105	Unlikely	Moderate	Moderate	

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WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
ET106	Unlikely	Moderate	Moderate	
ET107	Rare	Moderate	Low	
ET108	Unlikely	Moderate	Moderate	
ET109	Rare	Moderate	Low	
ET11	Rare	Moderate	Low	
ET110	Rare	Moderate	Low	
ET111	Rare	Moderate	Low	
ET112	Rare	Moderate	Low	
ET113	Rare	Moderate	Low	
ET114	Unlikely	Moderate	Moderate	
ET115	Unlikely	Moderate	Moderate	
ET116	Possible	Moderate	High	
ET117	Unlikely	Moderate	Moderate	
ET118	Possible	Moderate	High	
ET119	Unlikely	Moderate	Moderate	
ET12	Unlikely	Moderate	Moderate	
ET120	Possible	Moderate	High	
ET122	**Removed from project**			
ET123	Possible	Moderate	High	
ET124	**Removed from project**			
ET125	Possible	Moderate	High	
ET126	**Removed from project**			
ET13	**Removed from project**			
ET14	Rare	Moderate	Low	
ET15	Possible	Moderate	High	
ET16	**Removed from project**			
ET17	Rare	Moderate	Low	
ET18	Unlikely	Moderate	Moderate	
ET19	**Removed from project**			
ET20	Unlikely	Moderate	Moderate	

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WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
ET21	Removed from project			
ET22	Rare	Moderate	Low	
ET23	Removed from project			
ET24	Unlikely	Moderate	Moderate	
ET25	Unlikely	Moderate	Moderate	
ET26	Removed from project			
ET27	Possible	Moderate	High	
ET28	Unlikely	Moderate	Moderate	
ET29	Removed from project			
ET3	Unlikely	Moderate	Moderate	
ET30	Possible	Moderate	High	
ET31	Rare	Moderate	Low	
ET32	Removed from project			
ET33	Unlikely	Moderate	Moderate	
ET34	Removed from project			
ET35	Removed from project			
ET36	Unlikely	Moderate	Moderate	
ET37	Unlikely	Moderate	Moderate	
ET38	Possible	Moderate	High	
ET39	Removed from project			
ET4	Removed from project			
ET40	Removed from project			
ET41	Unlikely	Moderate	Moderate	
ET42	Rare	Moderate	Low	
ET43	Possible	Moderate	High	
ET44	Rare	Moderate	Low	
ET45	Unlikely	Moderate	Moderate	
ET47	Removed from project			
ET48	Possible	Moderate	High	
ET49	Unlikely	Moderate	Moderate	

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WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
ET5	Rare	Moderate	Low	
ET50	Unlikely	Moderate	Moderate	
ET51	Rare	Moderate	Low	
ET52	Unlikely	Moderate	Moderate	
ET54	Unlikely	Moderate	Moderate	
ET56	Unlikely	Moderate	Moderate	
ET58	Possible	Moderate	High	
ET59	**Removed from project**			
ET6	**Removed from project**			
ET61	Rare	Moderate	Low	
ET62	**Removed from project**			
ET63	**Removed from project**			
ET64	Possible	Moderate	High	
ET66	**Removed from project**			
ET67	**Removed from project**			
ET69	Unlikely	Moderate	Moderate	
ET7	**Removed from project**			
ET70	Rare	Moderate	Low	
ET71	Unlikely	Moderate	Moderate	
ET72	Possible	Moderate	High	
ET73	Unlikely	Moderate	Moderate	
ET74	Rare	Moderate	Low	
ET75	**Removed from project**			
ET76	**Removed from project**			
ET77	Unlikely	Moderate	Moderate	
ET78	Possible	Moderate	High	
ET79	Unlikely	Moderate	Moderate	
ET8	Rare	Moderate	Low	
ET80	**Removed from project**			
ET81	Unlikely	Moderate	Moderate	

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WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
ET82	Unlikely	Moderate	Moderate	
ET83	Rare	Moderate	Low	
ET84	Removed from project			
ET85	Unlikely	Moderate	Moderate	
ET86	Unlikely	Moderate	Moderate	
ET87	Rare	Moderate	Low	
ET88	Unlikely	Moderate	Moderate	
ET89	Unlikely	Moderate	Moderate	
ET9	Removed from project			
ET90	Removed from project			
ET91	Unlikely	Moderate	Moderate	
ET92	Unlikely	Moderate	Moderate	
ET93	Rare	Moderate	Low	
ET94	Rare	Moderate	Low	
ET95	Unlikely	Moderate	Moderate	
ET96	Removed from project			
ET97	Rare	Moderate	Low	
ET98	Unlikely	Moderate	Moderate	
ET99	Rare	Moderate	Low	
WT1	Unlikely	Moderate	Moderate	
WT10	Possible	Moderate	High	
WT100	Removed from project			
WT101	Unlikely	Moderate	Moderate	
WT102	Unlikely	Moderate	Moderate	
WT103	Unlikely	Moderate	Moderate	
WT104	Unlikely	Moderate	Moderate	
WT105	Unlikely	Moderate	Moderate	
WT106	Possible	Moderate	High	
WT108	Removed from project			
WT109	Removed from project			

WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
WT11	Unlikely	Moderate	Moderate	
WT110	Removed from project			
WT111	Rare	Moderate	Low	
WT112	Removed from project			
WT113	Unlikely	Moderate	Moderate	
WT114	Removed from project			
WT115	Removed from project			
WT118	Removed from project			
WT119	Unlikely	Moderate	Moderate	
WT12	Rare	Moderate	Low	
WT120	Rare	Moderate	Low	
WT121	Possible	Moderate	High	
WT122	Unlikely	Moderate	Moderate	
WT123	Possible	Moderate	High	
WT124	Removed from project			
WT125	Removed from project			
WT127	Unlikely	Moderate	Moderate	
WT128	Unlikely	Moderate	Moderate	
WT129	Unlikely	Moderate	Moderate	
WT13	Possible	Moderate	High	
WT130	Rare	Moderate	Low	
WT131	Unlikely	Moderate	Moderate	
WT133	Unlikely	Moderate	Moderate	
WT134	Unlikely	Moderate	Moderate	
WT135	Removed from project			
WT136	Removed from project			
WT137	Rare	Moderate	Low	
WT138	Removed from project			
WT139	Unlikely	Moderate	Moderate	
WT14	Unlikely	Moderate	Moderate	

WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
WT140	Removed from project			
WT141	Possible	Moderate	High	
WT142	Possible	Moderate	High	
WT143	Removed from project			
WT144	Removed from project			
WT145	Unlikely	Moderate	Moderate	
WT146	Removed from project			
WT147	Unlikely	Moderate	Moderate	
WT148	Rare	Moderate	Moderate	
WT149	Unlikely	Moderate	Moderate	
WT15	Rare	Moderate	Low	
WT150	Unlikely	Moderate	Moderate	
WT152	Unlikely	Moderate	Moderate	
WT153	Unlikely	Moderate	Moderate	
WT154	Removed from project			
WT155	Unlikely	Moderate	Moderate	
WT156	Unlikely	Moderate	Moderate	
WT157	Removed from project			
WT158	Unlikely	Moderate	Moderate	
WT159	Removed from project			
WT16	Removed from project			
WT160	Unlikely	Moderate	Moderate	
WT161	Unlikely	Moderate	Moderate	
WT162	Unlikely	Moderate	Moderate	
WT163	Removed from project			
WT164	Unlikely	Moderate	Moderate	
WT17	Unlikely	Moderate	Moderate	
WT18	Rare	Moderate	Low	
WT19	Rare	Moderate	Low	
WT2	Removed from project			

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WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
WT20	Unlikely	Moderate	Moderate	
WT21	Unlikely	Moderate	Moderate	
WT22	Unlikely	Moderate	Moderate	
WT23	Unlikely	Moderate	Moderate	
WT24	Rare	Moderate	Low	
WT25	Rare	Moderate	Low	
WT26	Unlikely	Moderate	Moderate	
WT27	Rare	Moderate	Low	
WT28	Rare	Moderate	Low	
WT29	Unlikely	Moderate	Moderate	
WT3	Unlikely	Moderate	Moderate	
WT30	**Removed from project**			
WT31	Rare	Moderate	Low	
WT32	Rare	Moderate	Low	
WT33	Unlikely	Moderate	Moderate	
WT34	Unlikely	Moderate	Moderate	
WT35	Rare	Moderate	Low	
WT36	Unlikely	Moderate	Moderate	
WT37	Rare	Moderate	Low	
WT38	Rare	Moderate	Low	
WT39	Rare	Moderate	Low	
WT4	Unlikely	Moderate	Moderate	
WT40	Rare	Moderate	Low	
WT41	Unlikely	Moderate	Moderate	
WT42	Unlikely	Moderate	Moderate	
WT43	Rare	Moderate	Low	
WT44	Unlikely	Moderate	Moderate	
WT45	Unlikely	Moderate	Moderate	
WT46	Rare	Moderate	Low	
WT47	Possible	Moderate	High	

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WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
WT48	Rare	Moderate	Low	
WT49	Rare	Moderate	Low	
WT50	**Removed from project**			
WT51	Unlikely	Moderate	Moderate	
WT52	Rare	Moderate	Low	
WT53	Possible	Moderate	High	
WT54	Unlikely	Moderate	Moderate	
WT55	Rare	Moderate	Low	
WT56	Possible	Moderate	High	
WT57	Unlikely	Moderate	Moderate	
WT58	Unlikely	Moderate	Moderate	
WT59	**Removed from project**			
WT6	Unlikely	Moderate	Moderate	
WT60	Rare	Moderate	Low	
WT61	Unlikely	Moderate	Moderate	
WT62	Rare	Moderate	Low	
WT63	Possible	Moderate	High	
WT64	Unlikely	Moderate	Moderate	
WT66	**Removed from project**			
WT67	Rare	Moderate	Low	
WT68	Rare	Moderate	Low	
WT69	Possible	Moderate	High	
WT7	Possible	Moderate	High	
WT70	**Removed from project**			
WT71	Rare	Moderate	Low	
WT72	Unlikely	Moderate	Moderate	
WT73	Possible	Moderate	High	
WT75	Rare	Moderate	Low	
WT76	Unlikely	Moderate	Moderate	
WT77	**Removed from project**			

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WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk	
WT78	Rare	Moderate	Low	
WT79	Possible	Moderate	High	
WT80	Possible	Moderate	High	
WT81	Possible	Moderate	High	
WT82	Unlikely	Moderate	Moderate	
WT83	Unlikely	Moderate	Moderate	
WT85	**Removed from project**			
WT86	**Removed from project**			
WT87	Unlikely	Moderate	Moderate	
WT88	Unlikely	Moderate	Moderate	
WT89	Unlikely	Moderate	Moderate	
WT9	Rare	Moderate	Low	
WT90	Unlikely	Moderate	Moderate	
WT91	**Removed from project**			
WT92	Unlikely	Moderate	Moderate	
WT93	**Removed from project**			
WT94	Rare	Moderate	Low	
WT95	**Removed from project**			
WT97	Possible	Moderate	High	

Table 68 below summarises the number of turbines within each risk category for the project. In total, 83.5% of the turbines fall within a low to moderate risk category, whilst the remaining 16.5% fall within the high category.

Table 68 Turbine risk assessment summary

Turbine risk	Total	Total %
Very High	-	-
High	33	16.5
Moderate	105	52
Low	62	31.5

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