

Addendum

Species Impact Statement

ELLERTON DRIVE EXTENSION



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ABN: 31 124 444 622

suite 1, 216 carp st (po box 470) bega nsw 2550 australia t (02) 6492 8333

www.nghenvironmental.com.au e ng@nghenvironmental.com.au

unit 18, level 3, 21 mary st
surry hills nsw 2010 australia
t (02) 8202 8333

suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 australia
t (02) 6971 9696

unit 17, 27 yallourn st (po box 62)
fyshwick act 2609 australia
t (02) 6280 5053

35 morrisset st (po box 434)
bathurst nsw 2795 australia
0448 820 748

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ACRONYMS AND ABBREVIATIONS

CEEC	Critically Endangered Ecological Community – as defined under relevant law applying to the proposal
DGRs	Director General’s Requirements
EEC	Endangered Ecological Community – as defined under relevant law applying to the proposal
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
ha	Hectares
km	Kilometres
m	Metres
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
QCC	Queanbeyan City Council
SEWPAC	Department of Environment, Water, Populations and Communities
SIS	Species Impact Statement
sp/spp	Species/multiple species
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>

1 INTRODUCTION

Queanbeyan City Council (QCC) proposes to construct a four kilometre (km) extension of Ellerton Drive, Queanbeyan, from the existing Ellerton Drive at East Queanbeyan to Karabar at Old Cooma Road. A total project length of 4.69km includes upgrade works to a portion of existing Ellerton Drive.

A *Species Impact Statement - Ellerton Drive Extension* ('the SIS') was prepared by NGH Environmental in June 2014. QCC now wishes to modify the proposal.

This *Addendum to the Species Impact Statement - Ellerton Drive Extension* (hereafter 'the Addendum') serves several purposes. It:

1. Describes key changes to the project proposal and the implications of the changes (Sections 2-4, 6), if any, to the:
 - Assessment of impact upon subject threatened species and communities listed under NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).
 - Conclusions, recommendations and mitigation measures given in the SIS.
2. Includes additional survey, assessment and mitigation measures in response to new site information; specifically, the potential sighting of a Squirrel Glider in the study area and the presence of two mine shafts that may provide habitat for the Eastern Bentwing-bat. For the Squirrel Glider, this information is provided in the format of the original SIS (Section 5). For the Eastern Bentwing-bat, this information is included in Section 4.12).
3. Updates information regarding environmental offsetting requirements and BioBanking calculations (Section 7).
4. Includes additional information in response to public submissions received during the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Referral phase of the assessment process, specifically:
 - Comments from scientists with expertise in native grassland management, stating that disturbance is more likely to favour weed establishment rather than Hoary Sunray establishment (addressed in Section 4.2).
 - Reference to vegetation surveys conducted for the proposed Jumping Creek subdivision that identified a significantly larger area of EPBC listed Box-Gum Woodland on the proposed road-line adjacent to the end of Lonergan Drive than was identified in the Ellerton Drive referral (addressed in Section 4.1).
 - Suggestions that Koalas are breeding in the area (addressed in Section 4.11).

1.1 TERMINOLOGY

In this addendum, the 'development footprint' is defined as the final formed extent of the earthworks required for the constructed proposal, including all cut and fill batters, storm drainage, noise walls and boundary fences.

The 'subject site' is defined as the development footprint plus a five metre buffer to allow for additional construction impacts (e.g. establishment of sediment and erosion controls and machinery movements). It also includes additional areas proposed for construction compounds and material stockpiles. To ensure that all areas disturbed by the works are considered, the subject site is used for this assessment of biodiversity impacts, not the development footprint. The revised subject site assessed in this addendum is 49.6 hectares (ha).

The 'study area' for the SIS was defined as the subject site and any additional areas that may be indirectly affected. Generally, the study area was limited to the west by residential development and extended, on average, approximately 300 metres to the south and east where less disturbed habitats are present. The study area equates to approximately 158.5 ha, excluding modified areas (i.e. private residential areas on the northern and western edges, existing roads and intersections and a small stretch of the Queanbeyan River).

2 KEY CHANGES FOR THE PROJECT

Key changes to the proposal since publication of the SIS are outlined below, shown in Figure 2-1 and quantified in Table 2-1:

- The centreline and vertical alignment of the approximately four km extension of Ellerton Drive has shifted marginally in some locations, so that some areas previously not impacted would now be impacted and vice versa. The centreline has been adjusted in different directions and the vertical alignment improved to minimise earthworks and optimise the vertical profile. The subject site is therefore narrower in some locations and slightly wider at several points mostly due to changes in required cut and fill batters.
- Erosion and sediment control elements have been added to the design, some of which are slightly outside the originally assessed areas.
- The proposed northern construction compound area has increased substantially in size, and now also includes a section of the existing Ellerton Drive. The proposed bridge compound area on the south bank of the Queanbeyan River has increased in size.
- Minor adjustments to the footprint have been made to accommodate the shared path connections to various neighbourhoods.
- One bridge would be constructed over Queanbeyan River, rather than two, as the roadway is no longer a dual carriageway. This reduces the project footprint over the river.
- Several new potential stockpile sites have been identified and included in the updated assessment.
- Noise walls are being installed at various locations along the alignment. The area required for the wall along the properties on Severne Street has been added to the footprint. The remainder of the walls are within the original footprint.
- The entire intersection at Edwin Land Parkway and Old Cooma Road is now included within the total project footprint.
- The footprint is slightly wider at one location adjacent to Severne Street to accommodate an access driveway to a residential property.
- Stone Mastic Asphalt is being installed on the main alignment for noise attenuation.
- Public utility relocation is proposed at various locations.

These changes are a result of progressing the detail design towards its final phase.

Table 2-1 Quantification of key changes to the proposal

	Original proposal (ha)	Revised proposal (ha)	Difference (ha)
Subject site (total area)	26.2	49.6	+ 23.4
Native dominated indigenous vegetation within subject site	19.2	29.3	+ 10.1
Disturbed/exotic dominated/planted areas within subject site	6.7	20.1 ¹	+ 13.4
Area of Queanbeyan River within subject site	0.3	0.2	-0.1

Overall, the proposal:

- Has increased the area of the subject site by 23.4 ha, from 26.2 ha to 49.6 ha.
- Is outside of the original study area in four general locations (refer to Figure 2-1); totalling 7.0 ha of land not surveyed as part of the original SIS.

It is noted that of the 49.6 ha within the subject site, approximately 29.3 ha consists of indigenous native vegetation and the remainder comprise a small stretch of the Queanbeyan River (0.2 ha) and existing disturbed areas (20.1 ha), including developed areas, highly disturbed, exotic dominated¹ or planted vegetation.

¹ This includes 1.0 hectares of exotic dominated grassland with a minor native component derived from the clearing of an Endangered Ecological Community. This area is included in the offset requirements for the proposal (refer to Section 7).



Figure 2-1 Revised subject site and subject site assessed in the 2014 SIS

3 IMPLICATIONS FOR SPECIES AND VEGETATION IMPACTS

3.1 SURVEY EFFORT

Surveys for the SIS and Addendum have been undertaken in accordance with:

NSW

- Director General Requirements (DGRs)
- Draft Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004)
- Agreed methodologies negotiated with NSW Office of Environment and Heritage (OEH)

Commonwealth EPBC Guidelines

- EPBC Act Policy Statement: White Box – Yellow Box – Blakely’s Red Gum grassy woodlands and derived native grasslands (DEH 2006)
- Significant Impact Guidelines for the critically endangered golden sun moth (*Synemon plana*) (DEWHA 2009)
- Survey Guidelines for Australia’s threatened birds (DEWHA 2010)
- Survey Guidelines for Australia’s threatened reptiles (SEWPAC 2011)

The EPBC Act Referral Guidelines for the Vulnerable Koala (DoE 2014) was not published at the time of the SIS, but survey techniques used for Koala are consistent with this document.

3.1.1 Study area

The revised subject site is outside of the original study area at four general locations (Figure 2-1). These areas are relatively small and for the most part comprise existing roads, intersections and disturbed areas. Where native vegetation occurs, general habitat and vegetation types can be extrapolated from adjacent survey locations given the close proximity of the additional areas to the study area.

Important habitat features for subject species such as hollow-bearing tree and termite mound data however, cannot be extrapolated. Further survey was undertaken on 10 April 2015 and 2 February 2016 to identify and record these habitat features in all areas where the revised subject site was outside of the original study area (refer to Figure 2-1). An additional inspection of vegetation within the proposed stockpile sites within the Jumping Creek area was also undertaken on 18 March 2015 due to the close proximity of the sites to vegetation of conservation significance.

Survey effort, as it applies to the new subject site, is shown on the revised flora and fauna map sets included as Appendix A and Appendix B respectively. Updated vegetation mapping is included in Appendix A. Updated hollow-bearing tree and termite mound survey results incorporating the areas of the subject site outside of the original study area are included as Appendix C.

3.1.2 Surveys due to new site information

Squirrel Glider

An additional survey program targeting the Squirrel Glider (*Petaurus norfolcensis*) was undertaken between June and November 2015. These surveys were undertaken following a request from Queanbeyan City Council (QCC). QCC were informed of a possible but unconfirmed sighting of the species at a residence by a member of the public.

The surveys targeted potential habitat within and adjacent to the subject site, and specifically, within the vicinity of where Lonergan Drive would meet the new road extension. The detailed survey effort, results and assessment for this species are provided in Section 5. Survey data are provided in full in Appendix C-3.

Microbat survey and assessment of derelict mines

Two previously unknown potential derelict mine sites were identified by the NSW OEH within the subject site which would be impacted by the proposal. The Eastern Bentwing-bat (and other microbat species) uses structures such as caves and mine sites as roost and maternity or staging sites. The potential mines were not known at the time the original SIS was prepared and as such were not included in the assessment. Additional survey was undertaken in February 2016. The results of the additional survey and assessment to investigate impacts of removing these habitat features is presented in Section 4.12.

3.2 SUBJECT SPECIES AND COMMUNITIES

The types of construction and operational impacts identified in the SIS (SIS Section 1.2.1) remain unchanged by the proposal modifications. The threatened² subject species and communities identified as having the potential to be affected by the proposal in the SIS are (listing status given in brackets³):

- Box-Gum Woodland (EEC TSC/ CEEC EPBC)
- Hoary Sunray (V EPBC)
- Pink-tailed Worm-lizard (V TSC/ V EPBC)
- Rosenberg's Goanna (V TSC)
- Brown Treecreeper (V TSC)
- Scarlet Robin (V TSC)
- Hooded Robin (V TSC)
- Diamond Firetail (V TSC)
- Painted Honeyeater (V TSC)
- Gang-gang Cockatoo (V TSC)
- Speckled Warbler (V TSC)
- Koala (V TSC/ V EPBC)
- Eastern False Pipistrelle (V TSC)
- Eastern Bentwing-bat (V TSC)
- Golden Sun Moth (E TSC / CE EPBC)

Of these, the following were found in the study area:

- Box-Gum Woodland
- Hoary Sunray

² Common (non-threatened) species are not considered by a Species Impact Statement.

³ EEC = endangered ecological community, CEEC = critically EEC, V = vulnerable, E = endangered

- Gang-gang Cockatoo
- Speckled Warbler
- Eastern False Pipistrelle
- Eastern Bentwing-bat

Table 3-1 shows the amount of habitat for species and communities likely to be affected in the study area. It also provides a comparison of the magnitude of impact assessed in the SIS and the impacts of the revised proposal. The modification of the subject site affects the assessment (based on quantification) of Hoary Sunray, hollow-bearing trees, termite mounds, and of habitat and vegetation types in the SIS.

The revised proposal would have a greater impact than originally assessed upon all affected species. The significance of impact is discussed in Section 4.

A revised map set detailing the potential impacts of the revised proposal and affected species habitat and resources is included as Appendix A (flora) and Appendix B (fauna).

3.2.1 Additional subject species – Squirrel Glider

This species was not included in the Subject Species list for the original SIS as it was not identified as a Subject Species in the Director General Requirements (DGR's) for the proposal, and was not included in the Atlas of NSW Wildlife (BioNet, OEH 2015a) search results for records of threatened species in the locality. The survey methodologies and findings in relation to the occurrence of this species within the study area and the associated potential impacts of the proposal on the species are documented separately in Section 5 of this report, and independently of the Subject Species of the original SIS listed in the following section.

3.3 HABITAT CONNECTIVITY

The SIS identified areas of strong habitat connectivity in the study area, including links north adjoining reserved land and links south through to Mount Jerrabomberra that are associated with 'regional biolinks'. The biolinks were identified as particularly important to the movement of Rosenberg's Goanna and Speckled Warbler. Further, Queanbeyan River Corridor is part of an extensive riverine corridor that provides habitat for fauna species, primarily birds and microbats.

The SIS found that the original proposal was not expected to affect the integrity of regional biolinks or movement of fauna through such corridors. Similarly, the revised proposal would not be expected to affect local habitat connectivity. The extensions of the revised subject site near the existing Ellerton Drive and near Old Cooma Road for the stockpile areas are along already cleared land between residential development and bushland. The additional entry/exit points link the proposed Ellerton Drive west and north to existing streets, so do not disturb identified local or regional biolinks.

Table 3-1 Extent of occurrence or habitat for subject species and communities in the study area, locality and original and revised subject sites

Subject species	Habitat	Extent in study area and additional areas surveyed	Estimated extent known in the locality in the original SIS	Extent in subject site (i.e. quantified impact areas)		Equal, greater or lesser impact compared to SIS (=, > or <)
				Original proposal	Revised proposal	
Box-Gum Woodland	NA	15.7 ha	3,121 ha (1,546 ha in moderate to good condition)	4.0 ha (moderate to good condition)	6.5 ha (moderate to good condition) 1.0 ha (low condition derived grassland) ⁴	>
Hoary Sunray	Box-Gum Woodland and Dry Forest	7,000 individuals (a further 6,000 just outside study area also) 126.8 ha	36,500 individuals recorded during SIS surveys (actual number likely to be considerably larger)	5,000 individuals 19.0 ha (including 4.0 ha good quality)	5,470 individuals 29.2 ha (including 6.0 ha good quality)	>
Pink-tailed Worm-lizard	Box-Gum Woodland and Grassland south of the Queanbeyan River	4.4 ha (potential low quality habitat only)	Unquantified, but all records of the species are south of the study area. Potential habitat within the study area is separated by roads and residential barriers from known populations	1.9 ha (potential low quality habitat only)	3.7 ha (potential low quality habitat only)	>

⁴ A conservative approach has been applied and 1.0 hectares of exotic dominated grassland has been included as low condition EEC in the revised assessment. Although exotic dominated, the area included has a minor native component which is derived from the clearing of the EEC and as such, is considered to be derived grassland in low condition. This low condition vegetation has been included in determining the offset requirements for the proposal (refer to Section 7).

Subject species	Habitat	Extent in study area and additional areas surveyed	Estimated extent known in the locality in the original SIS	Extent in subject site (i.e. quantified impact areas)		Equal, greater or lesser impact compared to SIS (=, > or <)
				Original proposal	Revised proposal	
Rosenberg's Goanna	Dry Grass/Shrub Forest	92.9 ha (20.1 ha important habitat) 69 termite mounds	>500 ha adjacent to the study area. Anecdotal observations and offset surveys suggest that termite mounds are common throughout the locality	13.0 ha habitat (5.4 ha moderate quality; 7.6 ha important habitat) 13 termite mounds	20.3 ha habitat (8.3 ha moderate quality and 12.0 ha important habitat) 49 termite mounds	>
Brown Treecreeper	Box-Gum Woodland and Dry Forest	22.6 ha (potential habitat only, sedentary species not detected during surveys)	>3,000 ha	3.9 ha habitat (potential habitat only) 2 hollow-bearing trees (potential nesting trees)	6.0 ha habitat (potential habitat only) 4 hollow-bearing trees (potential nesting trees)	>
Scarlet Robin Hooded Robin	Dry Grass Forest, Woodland and Dry Shrub Forest	123.6 ha (potential habitat only, sedentary species not detected during surveys)	>7,000 ha	19.0 ha habitat (potential habitat only)	28.9 ha habitat (potential habitat only)	>
Diamond Firetail	Shrubland, Grassland, Open Woodland, and Dry Shrub Forest	30.1 ha (potential habitat species may use on occasion, species not detected but can move locally)	Unquantified. Would include habitats identified for Brown Treecreeper and Scarlet and Hooded Robin, above (>7,000 ha).	6.0 ha habitat	9.6 ha habitat	>

Subject species	Habitat	Extent in study area and additional areas surveyed	Estimated extent known in the locality in the original SIS	Extent in subject site (i.e. quantified impact areas)		Equal, greater or lesser impact compared to SIS (=, > or <)
				Original proposal	Revised proposal	
Painted Honeyeater	Dry Shrub Forest and Box-Gum Woodland supporting mistletoe	18.4 ha (only areas supporting mistletoe, potential habitat only as species not detected and has been recorded only once in the Queanbeyan LGA)	Unquantified. Would be associated with woodland habitats (3, 121 ha) in the locality where mistletoe is present	4.0 ha (potential, marginal habitat only)	6.6 ha (potential, marginal habitat only)	>
Gang-gang Cockatoo	All vegetated areas (good quality habitat Dry Shrub Forest and Woodland with suitable hollow-bearing trees)	155.0 ha (including 20.1 ha good quality habitat)	> 7000 ha likely to support a similar density of hollow-bearing trees to the study area.	26.2 ha (including 7.5 ha good quality habitat) 12 hollowing-bearing trees (potential - not known - breeding sites)	37.9 ha (including 12.0 ha good quality habitat) 24 hollow-bearing trees (potential - not known - breeding sites)	>
Speckled Warbler	All vegetated areas (important habitat based on records and home range size)	155.0 ha (including 26.9 ha of important habitat for this species)	> 3,000 ha Box-Gum Woodland and >7,000 ha Dry Forest habitat	26.2 ha (including 4.5 ha important known habitat)	37.9 ha (including 7.0 ha important known habitat)	>

Subject species	Habitat	Extent in study area and additional areas surveyed	Estimated extent known in the locality in the original SIS	Extent in subject site (i.e. quantified impact areas)		Equal, greater or lesser impact compared to SIS (=, > or <)
				Original proposal	Revised proposal	
Koala	All woodland and forest habitat types of the study area	112.6 ha (potential habitat only. Low quality due to the absence of primary feed trees)	>10,000 ha of similar forest and woodland habitat	20.0 ha (potential low quality habitat)	29.2 ha (potential low quality habitat)	>
Eastern Pipistrelle	False All vegetated areas (good quality habitat good condition Dry Forest with hollow-bearing trees)	155.0 ha	>10,000 ha (foraging habitat > 7000 ha of Dry Forest likely to support a similar density of hollow-bearing trees to the study area.	26.2 ha (including 7.5 ha good quality) 31 hollow-bearing trees (potential roost trees)	37.9 ha (including 15.8 ha good quality) 53 hollow-bearing trees (potential roost trees)	>
Eastern Bentwing-bat	All vegetated areas (foraging) Mines, caves and similar structures (roosting and breeding)	155.0 ha (foraging habitat) Two underground derelict mines (potential roosting habitat only, unlikely to be maternity sites)	>10,000 ha (foraging habitat) Three mine sites known to occur to the east of the study area (potential roosting habitat)	26.2 ha (foraging habitat) No mines were known to occur at the time of the SIS.	37.9 ha (foraging habitat) Two underground derelict mines (potential roosting habitat only, unlikely to be maternity sites)	>
Golden Sun Moth	Box Gum Woodland	4.4 ha (potential low quality habitat only, species not detected during targeted surveys)	Unquantified. Associated with Box-Gum Woodland and natural and derived grasslands with specific habitat components	1.9 ha (low quality habitat not supporting the species)	3.7 ha (low quality habitat not supporting the species)	>

Note: suitability of hollow bearing trees for subject species:

Brown Treecreeper – potentially suitable nesting trees are hollow-bearing trees within Box-Gum Woodland in the south of the study area.

Gang-gang Cockatoo – potentially suitable nesting trees for this species are hollow-bearing trees within good condition dry grass forest or woodland, with diameter-at-breast-height of 60 centimetres or greater, and medium or large hollows present.

Eastern False Pipistrelle – potentially suitable roosting trees are considered to be hollow-bearing trees within the good condition dry forest habitat north of the Queanbeyan River.

4 CHANGES TO ASSESSMENTS OF SIGNIFICANCE

Assessments of significance in the SIS concluded that a significant impact was likely for:

- White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland EEC/CEEC (Box-Gum Woodland)
- Rosenberg’s Goanna
- Speckled Warbler

No significant impacts were considered likely for other species affected by the proposal. What follows is a review of the original assessments for subject species in Table 3-1 and comparison with the quantified impact of the current proposal. Table 4-1 summarises significance results and shows whether there has been any change from the SIS.

Table 4-1 Summary of impact significance assessments for subject species and communities, indicating whether there is any change from final conclusions drawn in the SIS

Subject species / community	Status	Significant impact?	Change from SIS?
Flora			
Hoary Sunray (<i>Leucochrysum albicans</i> var. <i>tricolor</i>)	E EPBC	No	No
Community			
White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland	EEC TSC / CEEC EPBC	Yes	No
Fauna			
Pink-tailed Worm Lizard (<i>Aprasia parapulchella</i>)	V TSC / V EPBC	No	No
Rosenberg’s Goanna (<i>Varanus rosenbergi</i>)	V TSC	Yes	No
Brown Treecreeper (eastern subspecies) (<i>Climacteris picumnus victoriae</i>)	V TSC	No	No
Scarlet Robin (<i>Petroica boodang</i>)	V TSC	No	No
Hooded Robin (South eastern form) (<i>Melanodryas cucullata cucullata</i>)	V TSC	No	No

Subject species / community	Status	Significant impact?	Change from SIS?
Diamond Firetail (<i>Stagonopleura guttata</i>)	V TSC	No	No
Painted Honeyeater (<i>Grantiella picta</i>)	V TSC	No	No
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	V TSC	No	No
Speckled Warbler (<i>Pyrrholaemus sagittatus</i>)	V TSC	Yes	No
Koala (<i>Phascolarctos cinereus</i>)	V TSC	No	No
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V TSC	No	No
Eastern Bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>)	V TSC	No	No
Golden Sun Moth (<i>Synemon plana</i>)	E TSC / CE EPBC	No	No

Under the revised proposal, there would be no change for any of the conclusions in the SIS. Key communities / species are discussed in more detail in sections 4.1-4.13.

Detailed analysis of the local and regional abundance, habitat requirements, movement corridors, condition of local habitats and the conservation status of each species (including relevant Key Threatening Processes) is provided in the original SIS. Some of the more relevant information used in determining the significance of impact is stated herein, however, not all of this information is repeated and the assessments below should be read in conjunction with the more detailed information presented in the original SIS.

4.1 BOX-GUM WOODLAND

Based on the vegetation mapping completed by NGH Environmental, 15.7 hectares of Box-Gum Woodland occurs in the study area. The clearing of approximately 4.0 ha of moderate to good condition Box-Gum Woodland (30% of the local occurrence) was assessed in the SIS and found to be a significant impact under both the TSC Act and EPBC Act. The revised proposal involves clearing approximately 6.5 ha of moderate to good condition Box-Gum Woodland (6.0 ha of the EPBC listed community). A further 1.0 ha of exotic dominated vegetation would also be impacted which is included in this revised assessment as low condition derived grassland. The revised proposal would affect approximately 43% of the local occurrence of moderate to good condition Box-Gum Woodland, and is considered a significant impact.

Public submissions on the EPBC referral refer to vegetation surveys conducted for the proposed Jumping Creek subdivision (ELA 2010) that identified a significantly larger area of EPBC listed Box-Gum Woodland EEC on the proposed road-line adjacent to the end of Lonergan Drive than was identified in the Ellerton Drive referral.

It is acknowledged by NGH Environmental that a larger area of Box-Gum Woodland is mapped in the ELA 2010 report compared to the SIS. This may be due to differences in how the communities have been defined and applied within the study area by the authors.

The NSW Scientific Committee’s final determination for the White Box Yellow Box Blakely’s Red Gum Woodland Endangered Ecological Community Listing (2011) defines the community listed under the TSC Act and states that; “White Box Yellow Box Blakely’s Red Gum Woodland includes those woodlands where the characteristic tree species include one or more of the following species in varying proportions and

combinations - *Eucalyptus albens* (White Box), *Eucalyptus melliodora* (Yellow Box) or *Eucalyptus blakelyi* (Blakely's Red Gum). Grass and herbaceous species generally characterise the ground layer. In some locations, the tree overstorey may be absent as a result of past clearing or thinning and at these locations only an understorey may be present. Shrubs are generally sparse or absent, though they may be locally common." The final determination also provides a list of species that characterise the community.

The ELA 2010 report states that "the community is characterised by a sparse canopy dominated by a few mature and regrowth Yellow Box *Eucalyptus melliodora* trees with occasional individuals of Blakely's Red Gum *Eucalyptus blakelyi*, Apple Box *Eucalyptus bridgesiana*, Red Box *Eucalyptus polyanthemos*, Red Stringybark *Eucalyptus macrorhyncha*, Bundy *Eucalyptus goniocalyx* and Brittle Gum *Eucalyptus mannifera*". A shrub layer is identified as occurring in some areas and the species listed for the groundcover are mostly grasses or herbaceous species.

Within the SIS, the community has been defined on the basis of Yellow Box being at least co-dominant with either Red Box or Apple Box in a woodland formation with a grassy understorey. Where Yellow Box occurs to a lesser degree (not dominant) with a combination of Red Box, Red Stringybark, Bundy, Brittle Gum and/or Scribbly Gum (*Eucalyptus rossii*), and the understorey was more shrubby this was assigned to the Dry Forest vegetation type. In the surveys for the SIS, Yellow Box was found to occur in low numbers throughout the Dry forest vegetation within the study area however, as Yellow Box was not dominant and the vegetation was or was likely to have been more consistent with the Dry Forest composition and structure, the areas defined as the EEC were restricted to those that were more typical of a grassy woodland.

Both the definitions of the community stated in the ELA 2010 report and that of the original SIS, although slightly different, would be considered to be consistent with that of the final determination for the community. It appears that the ELA 2010 mapping has encompassed areas where species such as Red Stringybark, Bundy and Brittle Gum are present whereas during the surveys for the original SIS, these species were observed by NGH Environmental to be associated with the Dry Forest vegetation; these species do not occur in the areas of Box-Gum Woodland mapped south of the Queanbeyan River however, they are common throughout the more extensive Dry Forest in the north of the Ellerton Drive Extension study area. As stated above, areas supporting these species where Yellow Box comprises a more minor component were not included in the areas mapped as Box-Gum Woodland in the original SIS and this may account for some of the discrepancy between the mapping of the ELA 2010 report and the original SIS.

The ELA 2010 report also states that "*the community is generally heavily modified with abundant weeds in the understorey and groundcover, however in a few areas a more diverse native groundcover, and to a lesser extent, understorey persists*". These more diverse areas are not clearly identified on the mapping. In Section 5.3 of the ELA report it states that "*In a few places the disturbances appear to have been less intensive and whilst the vegetation is modified structurally and supports an abundance of weeds, a reasonable abundance and diversity of natives persist and the recovery potential is moderate to good. The vegetation in these parts of the study area are of greater conservation significance and continue to comprise the endangered ecological communities White Box, Yellow Box, Blakely's Red Gum Woodland (Box-Gum Woodland) which is listed on Schedule 1 Part 3 of the TSC Act and the White Box, Yellow Box, Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands which is listed on the EPBC Act*". The statement implies that areas that comprise the listed community occur only "*in a few places*". This suggests that not all of the Box-Gum Woodland mapped in the ELA 2010 report necessarily meets the criteria of the TSC Act and EPBC Act listed communities however, the report does not map the distinction.

The EPBC criteria for the listed CEEC provides strict guidelines for identifying what constitutes the EPBC listed community. There is no analysis in the ELA 2010 report of what criteria are being used to define areas of EPBC listed CEEC or where these areas are. The original SIS has mapped occurrences of what can be

considered both TSC Act and EPBC Act listed communities and provided justification as to why they are considered to be such according to the relevant determinations for the communities.

4.2 HOARY SUNRAY

Hoary Sunray occupies both the Box-Gum Woodland and Dry Forest habitats in the study area. Approximately 7,000 individuals were recorded in the study area and a further 6,000 just 200 metres beyond the study area. The Hoary Sunray was found to be widespread throughout the locality. Surveys by NGH Environmental alone estimated approximately 36,500 individuals which was only a small sample of the local occurrence.

The clearing of approximately 5,000 individuals and 19 ha of habitat was assessed in the SIS and found by NGH Environmental to be non-significant under the EPBC Act. A non-significant impact was determined on the basis that:

1. A level of disturbance is important to the survival of populations of the species and disturbance from the proposed action may in fact result in creating new areas for recruitment (thereby offsetting habitat loss to some extent).
2. That the proposal would be unlikely to fragment the population or disrupt breeding and that the local population would be likely to remain viable.⁵

Public submissions on the EPBC referral stated that disturbance is more likely to encourage weed establishment than Hoary Sunray proliferation. The National Recovery Plan for the species (Sinclair 2011) states that the Hoary Sunray “*relies on the presence of bare ground for germination and establishment*” and “*will also colonise roadsides that have been scraped*”. Sinclair (2011) acknowledges that disturbance also encourages weed establishment and that weed invasion is identified as a high threat to the Hoary Sunray. However, the results of the surveys for the original SIS study area showed that the Hoary Sunray was successfully established on numerous roadsides and in other highly disturbed areas such as regularly mown nature strips and front yards within the Queanbeyan locality. As such, it is considered likely that a similar pattern of recruitment may occur along the verges of the completed proposal particularly considering the close proximity of viable populations which would not be impacted and which would act as a seed source.

Under the revised proposal, approximately 5,470 individuals (based on surveys undertaken in 2012) and 29.2 hectares of habitat would be removed. In terms of the number of individuals, this is a moderate increase in impact and does not affect the factors upon which the assessment was based. The revised proposal is considered a non-significant impact by NGH Environmental however, the Commonwealth Department of Environment has deemed the impact to be significant⁵ and as such all impacts to this species will be offset (refer Section 7).

4.3 PINK-TAILED WORM-LIZARD

The Pink-tailed Worm-lizard is known from the locality with most records south of the study area nearby Tralee or the Poplars, in which the species was identified in rock outcrops (Biosis 2003a; Biosis 2003b). Other records are noted west of Cooma Road nearby the Queanbeyan River on ridges (BES 2008), which is now predominantly surrounded by residential land. Several other studies have failed to locate the species

⁵ The project was deemed a controlled action by the Commonwealth Department of Environment, due to the number of individuals impacted. NGH Environmental’s assessment remains that the local population viability would be unlikely to be impacted by the loss of these individuals.

within the locality (including areas nearby the study area) during targeted searches (BES 2007; ELA 2010a; ELA 2010b; GHD 2009).

Approximately 4.4 ha of marginal habitat for the Pink-tailed Worm-lizard was identified as occurring in the study area. The potential habitat was considered marginal as the area is generally absent of rock habitat, with some sporadic loose scattered rock present, and is surrounded by degraded areas that have been subject to clearance and invasion by exotic grass species. Habitat within the study area is further isolated from existing populations by road and residential barriers and the species has little opportunity to move through local biolinks to habitat in the study area.

Approximately 1.9 ha of habitat was to be cleared within the original construction footprint. Based on the revised footprint, approximately 3.7 ha of habitat for this species would be cleared. The original SIS took a precautionary approach assuming all Box-Gum Woodland to be removed (approximately 4.0 ha) would provide habitat for this species. The assessment of significant impact assumed that this 4.0 ha would be impacted. However, more detailed habitat mapping completed at the request of OEH has refined the impact areas. Given that the 3.7 ha of habitat to be removed by the revised proposal is less than the 4.0 ha originally assumed to be impacted, the conclusion of a non-significant impact is still considered to apply to the revised proposal for this species.

4.4 ROSENBERG'S GOANNA

Termite mounds were identified in the original SIS as an essential breeding resource for Rosenberg's Goanna. Sixty-nine termite mounds have been recorded within the study area from all surveys, mostly in Dry Grass Forest in the central section of the study area. The clearing of 13 termite mounds was assessed in the SIS. Habitat loss under the proposal was found to be non-significant, with the main concern being ongoing road collision mortality. The SIS states *"While ...the direct impacts of habitat loss are relatively minor, the indirect impact of eventual increased traffic volume through an area of known habitat which could result in mortality is likely to have a significant effect on the local population..."*

Under the revised proposal, 49 termite mounds and an additional seven hectares of habitat would be cleared. This number of termite mounds is 69% of potential breeding habitat known to be available in the study area, substantially more than 27% in the SIS. However, not all of the study area (outside of the subject site) has been surveyed intensively for termite mounds and there are likely to be many that have not been recorded. Further, greater than 7,000 ha of largely contiguous dry forest habitat is available within the locality which also supports a similar density of termite mounds to the study area, as determined during locality surveys. ELA (2010a) recorded 81 termite mounds north of Wickerslack Lane in a 100 ha area and GHD (2009) recorded greater than 250 termite mounds over a 130 ha area within habitat that is contiguous with the southern section of the study area. Anecdotal observations during investigations for potential offset sites in the vicinity of the subject site also indicate that there are relatively high densities of termite mounds in the surrounding landscape. In this context, this Addendum supports the conclusion of the SIS that habitat loss is not considered to place the Rosenberg's Goanna at risk. The key issue of ongoing road mortality though, remains unchanged and therefore there is no change to the assessment of significance outcome (i.e. a significant impact is still considered likely).

Given the substantial increase in breeding resources to be impacted, the potential for individuals to be utilising the resources within the subject site also increases. To discourage the use of breeding resources in the subject site (and avoid undesirable mortalities during works), clearing in areas with a high density of termite mounds would be best undertaken prior to the egg laying and guarding phase of the Goanna's breeding cycle. Long-term studies on Kangaroo Island have identified that courtship and mating takes place over summer, and eggs are usually laid over late summer to mid-autumn (Rismiller *et al.* 2010). These

results are considered to be applicable to the study area given climatic similarities (i.e. the temperate zone). Thus, early autumn clearing (e.g. in March) of the dry forest would avoid at least part of the egg laying period of Rosenberg's Goanna, without compromising timing recommendations for other species. In the event that this tight timeframe is not achievable, pre-clearance surveys could be used to identify any nest sites. This is discussed further in Section 6.

Additionally, an 'Unexpected Threatened Species Find' procedure has been developed to detail the actions to be taken when a threatened species is unexpectedly encountered during excavation / construction activities. The procedure is provided in Appendix D-1.

4.5 BROWN TREECREEPER

Approximately 3.9 ha of potential habitat suitable for this species and two potential nesting trees were to be cleared within the original construction footprint. The habitat was deemed to be potential habitat only as the species is sedentary and considered to be resident in many locations throughout its range and was not detected during surveys. The Brown Treecreeper is a gregarious species that is usually active and conspicuous while foraging in pairs or small groups, and as such it is likely the species would have been observed in the study area, if present.

Based on the revised footprint, approximately 6 ha of potential habitat for this species would be cleared, (i.e. an increase of 2.1 ha) and four potential nesting trees. The SIS concluded a non-significant impact to this species based on the fact that the proposal would not be clearing known habitat and the locality supports extensive areas of similar woodland habitat, including contiguous vegetation to the south of the study area (>3,000 ha). The conclusions are still considered applicable to the revised proposal and does not alter the original conclusion within the SIS of a non-significant impact.

4.6 SCARLET ROBIN, HOODED ROBIN

Both the Scarlet Robin and Hooded Robin are primarily sedentary species. The Hooded Robin or Scarlet Robin were not recorded during the targeted surveys of the study area, although the species are known from the locality. The Scarlet Robin was regularly observed within Cuumbuen Nature Reserve during locality surveys. The detection of the Scarlet Robin in Cuumbuen Reserve but not within the study area during the surveys would suggest the species would have been observed if it were to utilise the study area on a permanent basis. The Hooded Robin has largely been recorded south of the study area nearby the Googong Reservoir.

The clearing of 19 ha of potential habitat suitable for these species was assessed in the SIS. The assessments of significance concluded a non-significant impact on the basis that the locality supports extensive areas of similar habitat, including contiguous vegetation to the west and south of the study area. Further, these conspicuous species were not detected in the study area. The clearing of an additional 9.9 ha of habitat (total 28.9 ha) is not considered substantial in the context of the extensive areas of surrounding habitat and does not alter the original conclusion within the SIS of a non-significant impact.

4.7 DIAMOND FIRETAIL

The Diamond Firetail was not recorded during the targeted surveys of the study area, although the species is known from the locality to the south and far-east of the site. Suitable habitat for the species is primarily associated with grassy woodland and open areas, such as the Box Gum Woodland and more open grassland, shrubland and disturbed dry forest areas in the southern section of the study area. No important habitat

for this species was observed; native grass habitat is patchy and large areas of weed invasion are prevalent in many of these areas, reducing habitat quality for this species.

The Diamond Firetail can be sedentary but also moves locally. The local biolink south and east of Cooma road that stretches towards the Googong Reservoir provides the most likely movement corridor. This biolink supports more suitable grassy habitat than other corridors in the locality. It is expected the Box Gum Woodland areas of this biolink would provide the most suitable habitat due to the open nature of this community and its association with native grass species. Box Gum Woodland is most dominant south of the study area and also occurs adjacent the site, but is not common within the study area. For this reason, the Diamond Firetail appears unlikely to be reliant upon the habitat corridors near the study area for regular movements, due to the lack of records and habitat connectivity through this area.

The clearing of 13.4 ha of habitat was assessed in the SIS however, this was a precautionary approach based on mapped vegetation. More detailed species habitat mapping conducted at the request of OEH identified a revised 6.0 ha of habitat for this species within the original construction footprint. An additional 3.6 ha (9.6 ha total) would be removed due to the revised proposal. The SIS concluded a non-significant impact based on the removal of 13.4 ha and given that the 9.6 ha of habitat to be removed by the revised proposal is less than the 13.4 ha originally assumed to be impacted, the conclusion of a non-significant impact is still applicable to the revised proposal.

4.8 PAINTED HONEYEATER

The Painted Honeyeater's main distribution is not within the Canberra or Queanbeyan LGA. The greatest concentrations recorded of the species, and almost all breeding, occurs on the inland slopes of the Great Dividing Range in NSW. The species was not observed during the current survey however, one record is known for the locality, which was observed by ELA (2010b) on one occasion within the Jumping Creek Estate assessment.

The clearing of 4 ha of potential habitat was assessed in the SIS. The assessments of significance found a non-significant impact on the basis that the habitat present was marginal foraging habitat and not considered important to the Painted Honeyeater given that the species was not detected during surveys and is a rare visitor to the area. Further, the locality supports extensive areas of similar woodland habitat, including contiguous vegetation to the south and east of the study area. The clearing of an additional 2.6 ha of habitat (total 6.6 ha) is not substantial in this context and does not alter the original conclusion within the SIS of a non-significant impact.

4.9 GANG-GANG COCKATOO

The Gang-gang Cockatoo was targeted during the November 2012 and 2013 surveys during their known breeding season. In November 2012 two adults and two juveniles were recorded in the south of the study area and in November 2013 two adults were observed in the north of the study area. These observations were of birds flying through the study area. The species was also recorded in the locality during the field surveys. No birds were observed nesting within the study area despite targeted stag watch surveys of hollow-bearing trees.

Regionally, the species occurs widely and records are common within protected areas, including Tinderry Nature Reserve, Talaganda State Forest, Brindabella National Park, Bondo State Forest, Kosciuszko National Park, and Maragle State Forest.

The clearing of 7.5 ha of good quality habitat and 12 hollow-bearing trees potentially suitable for this species to nest in were assessed as being cleared in the SIS. Good quality habitat was defined as Dry Shrub

Forest and Woodland containing hollow-bearing trees potentially suitable for nesting (trees with a diameter-at-breast-height of 60 cm or greater and with medium or large hollows present). The assessments of significance concluded a non-significant impact for this species on the basis that no nesting Gang-gang Cockatoos were observed in any of the hollow bearing trees to be removed, numerous hollow-bearing trees of similar quality remain in the locality, and the species is mobile and occupies a large home range.

Under the revised proposal, 12.0 ha of good quality habitat and 24 hollow-bearing trees potentially suitable for this species to nest in would be cleared. The revised proposal does not involve substantially more clearing of habitat for the Gang-gang Cockatoo in the context of the habitats available in adjacent areas and the locality, therefore the original conclusion within the SIS of a non-significant impact is still considered applicable to the revised proposal.

4.10 SPECKLED WARBLER

The original SIS took a precautionary approach assuming all areas impacted within the subject site (26.2 ha) would provide habitat for this species. The assessment of significant impact assumed that of this 8.1 ha of important would be impacted. However, more detailed habitat mapping completed at the request of OEH has refined the impact areas. Based on the revised mapping, 4.5 ha is considered important habitat which forms part of a permanent home range for individuals detected during surveys. Habitat characteristics suggest the area may be utilised for breeding. Direct habitat removal, fragmentation of habitat corridors and traffic through important habitat was assessed as a significant impact.

Under the revised proposal, more habitat would be cleared (i.e. 37.9 ha), including an increase of 2.5 ha of important habitat removed (total 7.0 ha). The original conclusion within the SIS of a significant impact therefore is still considered applicable to the revised proposal.

4.11 KOALA

The SIS assessed the clearing of 20.0 ha of potential habitat for the Koala. A non-significant impact was concluded based on the facts that habitat to be impacted is not known to support a Koala population and that the habitat does not contain primary feed trees. Additionally, much of the area to be affected by the proposed works is subject to ongoing disturbances and greater than 10,000 ha of similar woodland and forest habitat is available in the locality. The revised proposal would remove approximately 22.8 ha of potential habitat. This increase of 2.8 ha does not alter the conclusions of the SIS and a non-significant impact is still considered applicable to the revised proposal.

Public submissions on the EPBC referral suggested that Koalas are breeding in the area. As discussed in the SIS, Koalas were not detected in the study area following targeted surveys: 10.5 hours of scat searches (7 Spot Assessment Technique plots) in 2012 and two nocturnal call playback / spotlighting surveys during the Koala breeding period in 2013. Koalas have not been seen opportunistically by ecologists working across the study area during other surveys in 2014 and 2015.

Based on previous records the species is uncommon within the locality. A total of three records (according to BioNet, OEH 2015a) are known; just north of the study area along a minor waterway in 2007, approximately 5 km north of the study area along Sutton Road in 1992 and approximately 3 km south of the study area near the Queanbeyan River in 1984. The closest recent records shown on KoalaMap (AKF 2014) are along Kings Highway on the eastern side of Tallaganda National Park, approximately 60 km east of the study area, and along Peak View Rd approximately 100 km south of the study area.

The Atlas of Living Australia (ALA 2015) also shows two old records (1992) for Koala in Kowen Pine Forest, approximately 20 km north and across the Kings Highway from the study area. The only evidence of Koala

in the study area comes from an anecdotal record within a residential property to the west of the proposed road corridor (Allison Treweek (OEH) pers. comm.). While it is possible that Koala sometimes occur, based on the above, it is considered unlikely that Koalas are currently breeding in the study area.

4.12 EASTERN FALSE PIPISTRELLE AND EASTERN BENTWING-BAT

4.12.1 Eastern false pipistrelle

The SIS assessed the clearing of 26 ha of foraging habitat for both Eastern Bentwing-bat and Eastern False Pipistrelle, and for the Eastern False Pipistrelle, 31 hollow-bearing trees. The assessments of significance found a non-significant impact on the basis of a low detection rate for both species, foraging habitat being locally common and habitat connectivity not being substantially affected.

For Eastern False Pipistrelle, of the hollow-bearing trees to be removed, the SIS concluded that the majority are not large enough to be considered maternity roost sites. This bat is known to change roost sites regularly (every night), although shows fidelity to a group of roost sites (i.e. utilises groups of trees regularly) (Churchill 2008, Herr 1998). One study in NE Victoria identified the roost preferences of Eastern False Pipistrelle as sites within mature vegetation structure (i.e. lower tree density but high density of older trees and hollow-bearing trees with an average diameter-at-breast height of 110 cm) (Herr 2008). The species may roost in colonies of up to 80-100 individuals, and requires a large hollow (and therefore a large tree), with a relatively small entry (Herr 1998).

With the revised proposal, there would be clearing of an additional 11.9 ha of *foraging* habitat (total 37.9 ha) and an additional 22 hollow-bearing trees within the good quality dry grass forest habitat within the middle section of the study area and the Queanbeyan River corridor which is considered the most suitable habitat providing both foraging and roosting resources. While the additional hollow-bearing trees to be removed are potential roosting sites, as discussed above, they are considered unlikely to be of a quality that would support a preferential roost site. Of the additional 22 trees to be removed, there are five trees that support large hollows. The largest of these trees is 80 cm diameter-at-breast height with the remainder below 60 cm.

The increase in impacts is not substantial considering that it is unlikely that any important roosting habitat will be impacted and the large extent of nearby and adjacent foraging habitat. The conclusion in the original SIS of a non-significant impact is still considered applicable to the revised proposal for the Eastern False Pipistrelle.

4.12.2 Eastern Bentwing-bat

The Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) uses structures such as caves and mine sites as roost and maternity or staging sites. Recent information provided by the NSW OEH has identified that there are two previously unknown derelict mine sites present within the subject site which would be impacted by the proposal. One has an entrance diameter of approximately 1.5 m, with an estimated 3 m drop into a larger space below, where it potentially extends laterally. The second mine has two small visible entrances adjacent to one another, each one no wider than 60-70 cm. It is not known how deep they extend.

To determine whether these shafts were being used by bats, one Anabat detector was left at the entrance of each mine over three consecutive nights; 18, 19, 20 January 2016. The weather conditions were suitable with temperatures 11.3°C – 36.9°C during this period, with no rain.

The surveys recorded nine microbat species (Table 4-2). The Eastern Bentwing-bat was not recorded. None of the species recorded are threatened cave dwelling species.

The mine shafts were not initially detected due to vegetation encroachment (particularly Blackberry) at the entrances. The presence of thick Blackberry at the entrances means it is very unlikely that microbats would be utilising the mines due to the potential for the thorns to catch on a microbat's wings (Greg Richards, pers. comm. 08/02/16). Furthermore, the layout of the mines (i.e. vertical and then potentially horizontal) with a relatively narrow entrance (i.e. 0.5 m to 1.5 m diameter) provides a very difficult exit route for a species such as the Eastern Bentwing-bat with a wingspan of 30-35 cm, which would need to conduct a spiral flight up the vertical section of the mine (Greg Richards, pers. comm., 08/02/16). Significant subterranean roost sites for microbats often have a combination of mainly near horizontal tunnels that may range from several metres long to deep complex mines or caves with interconnecting passageways. Vertical shafts are infrequently used (DECC 2007).

Records for the Eastern Bentwing-bat are very scattered in the region, with much higher numbers in the Greater Sydney region and to the north. As such, it is highly unlikely that a maternity roost occurs at the site. Overall, it is highly unlikely that any cave dwelling species utilise these derelict mines, and they are unlikely to provide important habitat for the Eastern Bentwing-bat; therefore their removal is unlikely to have a significant impact on this species.

With the revised proposal, there would be clearing of an additional 11.9 ha of *foraging* habitat (total 37.9 ha) for this species. This is not considered to be substantial in the context of the extent of nearby and adjacent foraging habitat. Given the above, the conclusion within the original SIS of a non-significant impact is still considered to apply to the revised proposal for this species.

An additional mitigation measure (i.e. preclearance at the two mine sites) has been developed in Section 6.2 as a precautionary measure. An 'Unexpected Threatened Species Find' procedure has been developed to detail the actions to be taken when a threatened species is unexpectedly encountered during excavation / construction activities. The procedure is provided in Appendix D-1.

Table 4-2 Microbat species recorded at potential derelict mine sites, January 2016

Anabat 1	18-Jan	19-Jan	20-Jan
<i>Austronomus australis</i>		x	x
<i>Chalinolobus gouldii</i>	x		x
<i>Chalinolobus morio</i>	x		
<i>Mormopterus ridei</i>	x	x	x
<i>Nyctophilus</i> spp.		x	x
<i>Vespadelus darlingtoni</i>	x	x	x
<i>Vespadelus regulus</i>			x
<i>Vespadelus vulturinus</i>	x	x	x
Anabat 2	18-Jan	19-Jan	20-Jan
<i>Mormopterus ridei</i>		x	

4.13 GOLDEN SUN MOTH

No Golden Sun Moths were observed during the survey period, despite a targeted focus over four days on areas containing potential habitat. Several records are known to the south and west of the study area nearby Lanyon Drive (east of the Monaro Highway) (Biosis 2003), Jerrabomberra Valley and Old Cooma Road (ELA 2010a). The species has not been recorded in the locality during other studies (GHD 2009; ELA 2010a, ELA 2010b; BES 2007) indicating that the species is confined to discrete areas of suitable habitat where it is known.

Approximately 4.4 ha of potential habitat for the Golden Sun Moth was identified as occurring in the study area; however, as targeted searches did not detect the species, the habitat is not considered to be important. Approximately 1.9 ha of potential habitat was to be cleared within the original construction footprint. Based on the revised footprint, approximately 3.7 ha of habitat for this species would be cleared. The original SIS took a precautionary approach assuming all Box-Gum Woodland to be removed (approximately 4 ha) would provide habitat for this species. However, more detailed habitat mapping completed at the request of OEH has refined the impact areas. Given that the 3.7 ha of habitat to be removed by the revised proposal is less than the 4 ha originally assumed to be impacted, the conclusion of a non-significant impact is still considered to apply to the revised proposal.

5 ADDITIONAL SUBJECT SPECIES - SQUIRREL GLIDER

This section provides an assessment of the Squirrel Glider as an additional subject species. The Squirrel Glider has been included following notification to QCC of a possible anecdotal record near the subject site.

Note that the information provided below includes applicable sections normally included in a SIS. Not all sections have been covered because the species is not a nominated Subject Species in the DGRs and is not included in the Atlas of NSW Wildlife (BioNet, OEH 2015a) search results. In addition the species was not recorded at the site and is considered unlikely to be present at the site, as described further below. As such a normal, full SIS assessment is not considered necessary for this species.

5.1 CONSERVATION STATUS

The Squirrel Glider is listed as Vulnerable under the NSW TSC Act. It is not listed as threatened under the Commonwealth EPBC Act.

5.2 LOCAL AND REGIONAL ABUNDANCE

The Squirrel Glider was not recorded during the original fauna surveys over the study area conducted for the original SIS. Arboreal mammal trapping was not undertaken. This species is not previously known from the locality and the nearest accepted record of this species is in the northern part of Tallaganda State Forest, approximately 40 km east of the subject site. This is the only confirmed record held by OEH of the species within a 50 km radius of the site.

There are no former or current accepted occurrences of the species locally and correspondingly, the recorded regional abundance within the Southern Tablelands area of the ACT, Queanbeyan, Bungendore, Braidwood, Goulburn and Yass) is considered to be very low.

5.3 HABITAT REQUIREMENTS

The Squirrel Glider inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range, and requires abundant tree hollows for refuge and nest sites. It also generally prefers mixed species stands with a shrub or *Acacia* midstorey. Its diet varies seasonally and consists of *Acacia* gum, *Eucalyptus* sap, nectar, honeydew and manna, with invertebrates and pollen providing protein (OEH 2015b).

Breeding habitat for the Squirrel Glider typically consists of tree hollows or fissures greater than 5 cm diameter/width of opening, and within eucalypt forests and woodlands. Foraging habitat for the species includes mature, mixed-age eucalypt species including native flowering shrubs and wattles in the forest or woodland understorey, although this species is known to occur where there is no understorey but usually only where there is a mix of different eucalypt species in the canopy vegetation (OEH 2015b).

The Squirrel Glider has been known to occupy habitat patches of less than 1 ha and isolated trees if these trees are within 75 m of other suitable habitat patches.

The species is active and identifiable at all times of the year, although activity levels may decrease with cooler and wetter weather, as reported for the closely related Sugar Glider (*P. breviceps*) (Kortner and Geiser 2000).

5.4 STUDY AREA HABITAT VALUES

Suitable, potential habitat for the Squirrel Glider is found within the broader study area, and more specifically within the Box Gum Woodland and Dry Forest associations, both of which support some hollow-bearing trees, and in some places, provide a shrub layer consisting of Acacias. These vegetation descriptions have been previously described in the SIS.

On the whole however, habitat for the Squirrel Glider within the study area is considered marginal. The forested areas surrounding the trapping area are of typically younger age and have proportionally fewer hollow-bearing trees. As such, nesting opportunities within the local area are regarded as limited.

The above assessment is supported by the fact that during the entire targeted survey for gliders, only two gliders (i.e. the Common Sugar Glider) have been observed during the spotlighting surveys, and only two gliders captured during the trapping program (i.e. the Common Sugar Glider). Both of the sightings during the spotlighting showed the individuals utilising a residential roof space. It is likely that they were using this shelter as their nesting habitat. No gliders were observed using any hollow-bearing trees for nesting/sheltering habitat during timed surveys.

5.5 SURVEY EFFORT AND TECHNIQUES

5.5.1 Survey timing

Four survey sessions were undertaken in 2015:

- 15 June – 24 July
- 9 - 14 September
- 4 – 8 October
- 2 – 6 November

5.5.2 Survey personnel

The surveys were undertaken by ecologists experienced in trapping and identification of Squirrel Gliders:

- Alana Gordijn (June/July only)
- George Madani (October only)
- Nick Colman
- Brenton von Takach Dukai
- Freya Gordon (November only)

The Squirrel Glider program was an intensive trapping, spotlighting and stag watching survey undertaken in accordance with the Threatened Species Survey and Assessment Guidelines (DEC 2004) and requirements of OEH, as stipulated in their advice letter to QCC dated 18 August 2015 (a copy of this correspondence is included at Appendix E).

5.5.3 Survey locations

In June/July and October, the surveys were undertaken in suitable habitat in the immediate vicinity of the house where the anecdotal record was made within the existing study area (Appendix B.1). The survey area was expanded for November surveys to include suitable habitat in the whole study area. Target areas included:

- Woodland supporting large diameter trees
- Trees with hollows and shrubby understorey.

Traps were placed in the two main stratification units within the development site: Box-Gum Woodland and Dry Forest. Although the anecdotal Squirrel Glider record is north of the Queanbeyan River, Box-Gum Woodland is a favoured habitat for the target species. The anecdotal Squirrel Glider record occurs in vegetation dominated by Apple Box and this species is present in the Box-Gum Woodland south of the Queanbeyan River. Apple Box and Yellow Box are also present albeit in lower densities in the Dry Forest vegetation in the north of the site, particularly in two main gullies where a shrubby understorey is present. These areas were targeted during the surveys.

5.5.4 Survey methods

Formal survey methods included arboreal cage and pipe trapping, stagwatching and spotlighting. Additional survey techniques employed included bioacoustic recording and camera trapping. Each of these methods are discussed further below.

Trapping

All gliders captured during the trapping program were measured (i.e. body weight, length and sex). The trapping program targeted Squirrel Gliders; however, the common Sugar Glider and the threatened Squirrel Glider are morphologically similar. An experienced ecologist can differentiate the species in the field, however, for absolute certainty, a small tissue sample was also collected from the ear of captured gliders and sent to Dr Steven Cooper of the South Australian Museum for DNA Analysis to confirm the species.

June/July

Twelve wire cage traps and six PVC pipe traps were deployed in the first survey session. Not all 18 traps were opened at the same time with consideration given to weather conditions and the capacity of field staff to return to traps in sufficient time to ensure animal welfare.. Traps were opened opportunistically when overnight temperatures were considered to be suitable over 17 nights from 15 June 2015 to 24 July. As a general rule, each time that traps were opened, at least three consecutive nights of trapping was completed. A total of 137 trap nights was completed during this June/July survey period.

October

Twenty-three small-medium sized mammal wire cage traps were installed on suitable trees within the general area of 2 x 200 m transects. OEH recommended establishing at least 20 traps along transects. The traps were established at a separation of 20 m per trap as recommended by OEH. Trap locations were decided by senior field ecologists with extensive experience in Squirrel Glider trapping. Traps were installed

as near as possible to the OEH recommended spacing whilst aiming to maximise trapping success by installing them in the most appropriate locations.

The trapping was conducted over five consecutive nights from 4 October 2015 (traps set) to 8 October 2015, which was the final night of trapping and spotlighting/stagwatching. This effort exceeds the OEH requirement for four consecutive nights, with overnight temperatures at or above about 10°C. The 23 traps set for the five nights equates to a survey effort of 115 trap nights.

November

A total of 21 wire cage traps with covers were placed across the development site. Traps were secured onto selected tree trunks 3-5 m above the ground. Each cage trap was baited with a mixture of honey, rolled oats and peanut butter, while a trail of diluted honey water was sprayed above the trap to a height of 5 – 10 m. The location of each tree trap was marked with a GPS unit (Appendix B.1).

Trapping was undertaken over four nights by three ecologists experienced in the identification of Squirrel Gliders with the assistance of an additional ecologist who had previously been involved in the trapping program on the night of 4 November. Traps were set for the duration of the survey period, however they were checked, rebaited (if required) and resprayed in the afternoons. They were checked again at sunrise each morning. The survey guidelines (DEC 2004) recommend 24 trap nights over 3-4 nights (i.e. 6-8 traps per 50 ha), however NGH Environmental recommended that a more intensive survey effort be undertaken, therefore 21 traps were installed across the development site. This included seven traps in the southern area of Box-Gum Woodland and 14 traps in the northern area of Dry Forest vegetation, totalling 84 trap nights over the 36.4 hectare development site.

Total

Across the three survey sessions, there has been 336 trap nights during 26 nights of trapping at an average of approximately 13 traps set each night over this period.

Stagwatching and spotlighting

October

The spotlighting and stagwatch surveys were conducted by two experienced ecologists competent in the identification of Sugar and Squirrel Gliders with the assistance of an additional ecologist who had previously been involved in the trapping program on the night of 4 November. Five timed stagwatch surveys were undertaken, totalling approximately 5.8 person hours (or a combined person survey effort of 350 minutes), and five timed spotlighting occasions over the same five nights as the stagwatches totalling 5.8 person hours or a combined 350 person minutes).

November

Two ecologists experienced in the identification of Squirrel Gliders undertook stag watches of hollow-bearing trees on three of the survey nights. A storm event on one of the evenings prevented staff from undertaking the stag watch for a fourth night. Six trees were observed in total over the survey period, however many of these trees had multiple hollows allowing maximum detection of nocturnal fauna (Appendix B.1). The chosen trees were observed from 30 minutes prior to sunset until 30 minutes after sunset. The Threatened Species Guidelines (DEC 2004) recommend 60 minutes after sunset, however with the combination of trapping and spotlighting, a total stag watching time of one hour was considered sufficient. Six hours of stag watching was undertaken.

Approximately 30 minutes of spotlighting by two observers (i.e. 60 person minutes) along a track and a road within the development site was conducted each evening to detect any species in the general area, totalling 4.5 person hours over the survey session.

Total

Total survey effort for stagwatching was 11.8 hours and 10.3 hours for spotlighting for October and November surveys.

Bio-acoustic recordings

September

In addition to the trapping, stagwatching and spotlighting surveys, five days of bio-acoustic recordings were conducted in the area near the anecdotal record using a Frontier Labs Bioacoustic recorder (BAR). This involved attaching an acoustic recorder to one of the trees in the immediate vicinity of the trapping study with the recorder set to record from sunset to sunrise. The recordings commenced on the evening of Wednesday 9 September and ceased on the morning of Monday 14 September, 2015. Recordings were analysed by NGH Environmental using Raven Lite spectrogram analyser software (Cornell Lab of Ornithology) specifically targeting species of glider.

Camera trapping

Motion sensitive infrared cameras were utilised during the June – July and October trapping program. Cameras were placed in locations where they could monitor one or more cage traps. Not all cage traps were monitored and no pipe traps were monitored mostly due to limitations with the numbers of cameras available and/or lack of suitable mounting locations. Cameras were set to record video footage for a period of approximately 10 seconds each time they were triggered.

5.5.5 Survey effort

The survey effort undertaken for Squirrel Gliders is summarised in Table 5-1. Fauna survey effort maps are in Appendix B. Further details of the survey effort, including all dates and trap locations, and stagwatching and spotlighting effort and findings, are provided in Appendix C.3. An assessment of the likely occurrence of the species within the subject site and the corresponding potential impact of the proposal on the species is included in Section 5.7 and 0.

Table 5-1 Summary of survey effort for Squirrel Glider survey sessions in 2015

Dates	Activities	Effort
15 June 2015 to 24 July	Trapping	137 trap nights (refer to Appendix C.3 for details)
4th October	Trapping Stag watch Spotlight	23 trap nights 90 person minutes 90 person minutes
5th October	Trapping Stag watch Spotlight	23 trap nights 60 person minutes 60 person minutes
6th October	Trapping Stag watch Spotlight	23 trap nights 80 person minutes 60 person minutes
7th October	Trapping Stag watch Spotlight	23 trap nights 60 person minutes 60 person minutes
8th October	Trapping	23 trap nights

Dates	Activities	Effort
	Stag watch	60 person minutes
	Spotlight	80 person minutes
2nd November	Trapping	21 trap nights
	Stag watch	120 person minutes
	Spotlight	60 person minutes
3rd November	Trapping	21 trap nights
	Stag watch	120 person minutes
	Spotlight	90 person minutes
4th November	Trapping	21 trap nights
	Stag watch	120 person minutes
	Spotlight	60 person minutes
5th November	Trapping	21 trap nights
	Stag watch	Not possible due to storm event
	Spotlight	60 person minutes
Total	Trapping	336 trap nights
	Stag watch	11.8 hours
	Spotlight	10.3 hours

5.5.6 Survey conditions

Weather conditions for all survey periods are given in Appendix C.3. Initially for the October and November surveys, OEH stipulated that minimum overnight temperatures must be above 10 degrees Celsius for four consecutive nights to maximise trapping success. However, in a letter dated 1 October 2015, OEH agreed to a survey session “if the minimum temperature between dusk and midnight is above 10 degrees”. This was to allow NGH Environmental to take advantage of upcoming warmer weather and also acknowledged that gliders “tend to be most active” during the early part of the night.

Official Bureau of Meteorology (BoM 2015) weather observations from Canberra Airport (Table 5-2) show that survey conditions in October were warm to hot during the day, with the highest maximum for the month recorded on 6 October. Temperatures recorded at midnight were consistently above 10 degrees Celsius (°C) for four consecutive nights during the October trapping program which meets the requirements of OEH. In November, weather conditions during the survey period were mild, and overnight temperatures did not drop below 10°C. Conditions were suitable for detecting arboreal fauna. On all but one night, temperatures during the survey can be shown to be above 10°C.

Table 5-2 Weather conditions during October and November survey sessions in 2015

Dates	Temperature (min) °C	Temperature (midnight) °C	Temperature (max) °C	Rainfall (mm)	Wind speed 3pm (km/h)
4th October	6.7	10.6	28.3	0	28
5th October	9.1	13.0	31.7	0	28
6th October	6.8	12.6	31.8	0	39
7th October	7.4	10.2	18.6	0	26
8th October	8.5	8.9 (at 23:00)	20.0	0	19
2nd November	14.0	NA	25.4	19.4	22

Dates	Temperature (min) °C	Temperature (midnight) °C	Temperature (max) °C	Rainfall (mm)	Wind speed 3pm (km/h)
3rd November	13.8	NA	21.3	0	15
4th November	13.9	NA	20.8	0	20
5th November	13.5	NA	22.3	2.2	19
6th November	14.7	NA	23.7	14.2	22

Observations from Canberra Airport <http://www.bom.gov.au/climate/dwo/IDCIDW2801.latest.shtml>.

5.5.7 Limitations

The cold overnight weather during June/July may have been a limitation to trapping success rates. This limitation was overcome via subsequent survey sessions. Cool overnight conditions are not considered to have been a limitation to October or November surveys, as midnight temperatures were above the minimum temperature requirements for four consecutive nights.

5.6 SURVEY RESULTS

No Squirrel Gliders were captured or observed during the survey program. Raw results are provided in Appendix C.3.

5.6.1 June – July

Two gliders were captured during the trapping program. The captured animals were confirmed as Sugar Gliders via DNA analysis; a copy of the analysis result is given in Appendix C.3.

5.6.2 September

No calls that might belong to a Squirrel Glider were recorded during the Bio-acoustic recording study. The only mammal species recorded was the Common Brush-tailed Possum.

5.6.3 October

No gliders were trapped during the October trapping program. Two gliders were observed during spotlighting. The individuals observed were confidently identified as Sugar Gliders by experienced senior ecologists based on characteristic morphological features (i.e. smaller animals and narrower tails with a white tip which is a feature not seen in Squirrel Gliders). On both of the sightings made during spotlighting, the animals were observed to be utilising the roof space of the target house. It is likely that they were using this shelter as their nesting habitat. No gliders were observed during the timed stagwatching surveys to be using any hollow-bearing trees for nesting/sheltering habitat.

5.6.4 November

No gliders were caught in the cage traps over 84 trap nights. Species detected in the traps included a Brush-tailed Possum (*Trichosurus vulpecula*), a Bowerbird (*Ptilonorhynchus violaceus*) and an Australian Magpie (*Cracticus tibicen*).

No species were recorded utilising hollows during stag watching surveys.

Two Sugar Gliders were confidently identified by experienced senior ecologists during the spotlighting survey within Box-Gum woodland south of the Queanbeyan River on 3 November (Figure 5-1). Both individuals were small in stature with relatively narrow tails. One of the individuals had a white tip on its tail, which is a feature not seen in Squirrel Gliders. Other arboreal species identified during spotlighting transects included a Brush-tailed Possum and a Common Ringtail Possum (*Pseudocheirus peregrinus*).



Figure 5-1 Sugar Glider observed spotlighting (3 November 2015)

5.6.5 Camera traps

The cameras recorded glider and other nocturnal mammal activity on several occasions. Video footage showed animals climbing on and around the cage traps without venturing inside. Animals that were able to be identified included Brush-tailed Possums, Rodents and Sugar Gliders. Gliders were also recorded where the quality of the footage or the position of the animal did not allow for a confident identification.

5.7 LIKELIHOOD OF OCCURRENCE IN THE STUDY AREA

Only a small number of arboreal fauna were detected during the survey period. Conditions were considered suitable for detection over several survey sessions; therefore it is likely that there is a low density of arboreal fauna present at the development site. The results of this survey indicate that the threatened Squirrel Glider is unlikely to be present at the development site; however the relatively common Sugar Glider is present.

The following reasons suggest Squirrel Glider is not present within the proposed development area:

- The lack of detection of the species despite the high level of survey effort targeted at determining the potential occurrence of the species in the vicinity of the anecdotal sighting, which is now considered to most likely be Sugar Gliders
- The lack of any historic records within the locality
- The generally sub-optimal habitat conditions observed throughout most of the site.

Further surveys and assessments for this species are not considered necessary to confirm occurrence of the species within the study area.

It is acknowledged however, that OEH have had contradictory opinions expressed to them and are conducting independent studies to confirm the identity of the gliders in the area.

5.8 ASSESSMENT OF IMPACTS

Given the lack of any records of the Squirrel Glider in the locality, either historically or as part of the recent targeted surveys, despite substantial effort beyond the requirements recommended by OEH, it is considered highly unlikely that the species would be present within the study area, and accordingly, it is considered unlikely that the species would be impacted by the proposed road extension. Given the apparent absence of the species from the study area and locality, an Assessment of Significance in accordance with the 7-Part Test requirements is not considered necessary to arrive at this conclusion and therefore has not been conducted in support of this assessment.

Further to the above, an assessment of the proposal's contribution toward exacerbating any of the Key Threatening Processes listed under the TSC Act and EPBC Act as they relate to this species and a consideration of the proposal's consistency with the recovery strategies⁶ for this species is not considered necessary.

Notwithstanding the above, as a precautionary measure, mitigation measures have been provided below in the unlikely event that a Squirrel Glider is encountered during the construction phase of the development. Additions to mitigation measures are outlined in Section 6. Relevant mitigation measures include the retention of hollow-bearing trees to the greatest extent possible and the use of a staged tree felling protocol.

In addition, any further measures required by OEH as a result of their independent studies, would be addressed by QCC when they are received.

6 CHANGES TO MITIGATION MEASURES

The suite of amelioration measures given in Section 6 of the SIS, including fauna barrier fencing, fauna underpasses and the implementation of a compensatory strategy, is still considered satisfactory to protect the majority of species reviewed herein. The compensatory strategy is considered able to account for the updated residual impacts of the proposal; however, additional measures are recommended in response to:

- Rosenberg's Goanna – increase in breeding habitat clearing (refer to Section 4.4).
- Squirrel Glider – potential for impact to any arboreal species (refer to Section 5).
- Risk of unexpected threatened species finds during the construction phase of the project.

These measures are described below. These measures do not replace, but are in addition to, impact mitigation measures already prepared for this project (refer to Section 6 of the SIS). These measures are therefore to be incorporated into, or read in conjunction with, those measures.

6.1 TIMING OF VEGETATION CLEARANCE

Section 6.1.1 of the SIS provides a clearing window from the end of February to September. Rismiller *et al.* (2010) provide a timeline of breeding behaviour for Rosenberg's Goanna from detailed studies of the species, and identify February through to early March as the egg-laying phase. Without conflicting with recommendations in the SIS, early autumn clearing (e.g. early March) of areas with a high density of termite

⁶ A targeted strategy for managing this species has been developed under the NSW OEH Saving Our Species program.

mounds is recommended to help discourage use of the subject site for breeding and minimise impact to the Rosenberg's Goanna.

It is recognised that such a tight timeframe for clearing may not be achievable. If so, alternatives are to:

1. Destroy termite mounds independently of other vegetation clearance outside of the breeding season.
2. Undertake pre-clearance surveys. It would not be possible to identify mounds that have been used for nesting at any time of year, as the termites reseal the nest within hours. If clearing is likely to occur after mid-March (i.e. 15 March), pre-clearance surveys should be arranged in advance to occur between late January and mid-April (refer to Section 6.2.1). This would be an addition to the pre-clearance surveys already included in Section 6.1.2 of the SIS.

The SIS also recommends that

“Consideration should be given to completing the vegetation clearing north of the Queanbeyan River in two distinct stages, so that the northern and middle sections of the site are not affected simultaneously. Clearing of the middle section of the proposal, supporting the good quality dry grass forest, would be considered first for clearing due to the abundance of hollow-bearing trees. Removing this section first will encourage fauna to move from this area to adjacent habitat and prevent ongoing disturbance... Clearing of forest and woodland habitats containing hollow-bearing trees would not occur between the beginning of spring (September) and the end of summer (February)...”

It is acknowledged that due to program timing, the main clearing of vegetation may need to occur within the spring to summer period. As such, an acceptable alternative would be to fell the hollow-bearing trees between March and August. It is however, recommended that the trees be left in situ for as long as possible to allow any resident fauna (such as bats that may be in torpor) that didn't leave during the felling process to vacate. Once the hollow-bearing trees have been removed, it would no longer be considered necessary to clear the area in two distinct stages. Progressive clearing from either the southern or northern end would be suitable as long as both areas are not affected simultaneously.

6.2 PRE-CLEARANCE SURVEYS

6.2.1 Rosenberg's Goanna

Pre-clearance surveys would aim to detect signs of breeding Rosenberg's Goanna presence around a termite mound. Prior to egg-laying, the Goanna occupies a nearby burrow and regularly visits a termite mound. The Rosenberg's Goanna guards the termite mound where she has deposited her eggs for up to three weeks; this activity may occur from early February until mid-April. During these phases, they leave behind signs of their presence including tracks around and radiating from the mound. Detailed information is given in Rismiller *et al.* (2010).

If a nesting site is positively identified, the nesting site would be cordoned off and left undisturbed until hatching (e.g. leave a 50 m zone of undisturbed forest around the mound until hatching approximately eight months after laying).

6.2.2 Eastern Bentwing-bat

Pre-clearance surveys at the two potential derelict mine sites would be undertaken in the week prior to the commencement of works to check for bat occupancy and prevent bats returning to these sites, if they are present. Specifically:

- No more than seven days prior to the commencement of works, a dusk survey by a qualified ecologist would be undertaken on two consecutive evenings. The mine entrances would be watched for bats exiting the potential derelict mine entrances and ultrasonic (Anabat) recorders deployed to record bat calls and identify species present.
- In the event that bat species are observed exiting the mines, the mine entrances would be netted off to prevent bats returning prior to demolition.

This protocol would also apply to any additional mine shafts that may be identified in the subject site. This protocol assumes impacts to the mines would occur before winter. If the construction program is delayed, the mines should be netted prior to the cooler weather, when bats may occupy the mine sites in torpor for extended periods.

6.3 FAUNA OVERPASSES

Section 6.2 of the original SIS describes the mitigation of operational impacts from the proposed road development such as barrier fencing and fauna underpasses. Barrier fencing would be designed to both exclude terrestrial fauna, such as Rosenberg's Goanna, crossing the busy road and to funnel them toward safe underpasses. Underpasses allow terrestrial fauna to more safely access suitable habitat on both sides of the road.

It is also recommended that as a precautionary measure, a rope bridge or other crossing structures suitable for gliders be installed to further reduce the potential for the project to fragment habitats for any arboreal mammal species. The details (e.g. number and location) of these structures will be confirmed within the finalised Environmental Management Plans.

Wildlife crossings such as rope bridges can take considerable time to be effective (e.g. at least two years for Squirrel Gliders) (Soanes *et al.* 2013), but once fauna are habituated to the structures, they tend to use them successfully and they have been shown to result in improvements to gene flow within five years (Soanes 2015). The placement of one fauna crossing within the Dry Forest habitat adjacent to Lonergan Drive is recommended due to the presence of Sugar Gliders, which were observed while spotlighting in October 2015, utilising the roof space of the target house. A fauna crossing in the vicinity of this property would allow the resident Sugar Gliders and other arboreal fauna from this area access to habitat on the eastern side of the road alignment.

It is recommended that at least one rope ladder crossing be installed, which would bridge the gap between trees on either side of Ellerton Drive. A rope bridge south of the Queanbeyan River is not recommended as the alignment of Ellerton Drive borders the existing houses to the west of the alignment. A second rope bridge crossing could be installed in the Dry Forest habitat in the north of the development site, however considering the apparent low density of arboreal fauna in this area, it is unlikely to provide a great benefit to fauna in the region.

6.4 UNEXPECTED THREATENED SPECIES FINDS

An 'Unexpected Threatened Species Find' procedure has been developed to detail the actions to be taken when a threatened species is unexpectedly encountered during excavation / construction activities. The procedure is provided in Appendix D-1, along with a 'Fauna Handling and Rescue Procedure' in Appendix D-2 of this addendum.

7 ENVIRONMENTAL OFFSET REQUIREMENTS

The Ellerton Drive Extension project would clear native vegetation listed under both NSW and Commonwealth environmental legislation (TSC Act 1995 and EPBC Act 1999). In consultation with NSW OEH and the Commonwealth Department of Environment, it has been confirmed that offsets are required for the project in accordance with:

- NSW OEH Biobanking methodology and
- Commonwealth offsetting tool.

Provided below are summaries of the evaluations, completed using the NSW BioBanking Assessment Methodology (BBAM) 2014 and the Commonwealth EPBC Act Offsets Assessment Guide, on a selection of nominated offset sites, which are mapped in Appendix F.

The results indicate that the proposed offset sites, considered together, would meet the requirements of the NSW Office of Environment and Heritage and the Commonwealth requirements.

Recommendations are provided to progress the provision of the offset plan for the Ellerton Drive Development.

7.1 VEGETATION TYPE TERMINOLOGY

The NSW OEH Biobanking methodology requires that vegetation communities are assigned according to the NSW Biometric vegetation types. This differs to the classification utilised and mapped in the original SIS and therefore the impact areas for each vegetation type also differ, when analysed under their Biometric names. Furthermore, an area of exotic dominated pasture not included in the SIS assessment, is included below (0.97 ha of low condition Box Gum Woodland), to enable appropriate offsets to be calculated under the Biobanking methodology.

The relationships between the NSW Biometric vegetation types utilised in this offset assessment and those mapped in the original SIS are provided below. The names of the Biometric vegetation types that would be impacted are also shortened in this discussion, to increase readability, as follows:

Table 7-1 Vegetation naming terminology

NSW Biometric names (and biometric ID)	Original SIS vegetation types	Impact area (hectares)	Henceforth, referred to as:
Red Stringybark - Red Box - Long-leaved Box - Scribbly Gum shrub - tussock grass open forest of the southern section of the NSW South Western Slopes Bioregion (MR598)	Tablelands Dry Shrub/Tussock Grass Forest Tablelands Acacia/Grass/Herb Dry Forest	22.85	Red Stringybark Open Forest
Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands (MR648).	Tableland Dry Grassy Woodland	7.42	Box Gum Woodland
Commonwealth name		Impact area (hectares)	Henceforth, referred to as:
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Tableland Dry Grassy Woodland	5.99	Box Gum Woodland (CW)

7.2 NSW BIOBANKING ASSESSMENT METHODOLOGY

7.2.1 Ecosystem credits

Offsets are required for areas of Red Stringybark Open Forest and Box Gum Woodland vegetation communities that will be impacted by the development. Table 7-2 outlines the credit requirements for the development site and Table 7-3 outlines the credits generated by the offset site candidates investigated to date.

Table 7-2 Credit summary for the development site (Biobanking proposal ID 0035/2014/1459D Version 3)

Zone	Plant community type name	Red flag	Zone area (ha)	Loss in Landscape Value	Site score	Value	Credits required for TS	TS with highest credit requirement	Ecosystem credits required
1	Red Stringybark Open Forest (moderate to good condition)	No	20.90	24.50	54.69	985	Barking Owl	985	
2	Red Stringybark Open Forest (moderate to good condition)	No	1.95	24.50	45.66	79	Barking Owl	79	
3	Box Gum Woodland (moderate to good condition)	Yes	6.44	24.50	76.04	407	Barking Owl	407	
4	Box Gum Woodland (low condition)	Yes	0.97	24.50	32.81	0		30	

Note:

Note:

- One representative plot for Red Stringybark Open Forest was duplicated after development impact areas were increased, to obtain the required minimum plot number.

Table 7-3 Credit summary for the offset sites

Site	Management zone	Plant community type name	Zone area (ha)	Landscape value score	Current site value score	Future site value score	Gain in site value	Ecosystem credits generated
1	1	Red Stringybark Open Forest (moderate to good condition)	48.47	12.0	77.08	86.28	9.20	347
2	1	Red Stringybark Open Forest (moderate to good condition)	73.99	12.0	77.08	86.28	9.20	530
3	1	Box Gum Woodland (moderate to good condition)	2.85	12.0	66.15	79.17	13.02	25
3	2	Box Gum Woodland (low condition)	0.40	12.0	32.81	49.48	16.67	3
4	1	Box Gum Woodland (moderate to good condition)	5.00	12.0	42.19	64.58	22.39	47
5	1	Box Gum Woodland (moderate to good condition)	5.36	12.0	76.56	89.06	12.5	51
5	2	Box Gum Woodland (derived grassland - moderate to good condition)	1.78	12.0	50.52	56.77	6.25	12
5	3	Box Gum Woodland (moderate to good condition)	22.00	12.0	64.06	89.06	25.00	205
6	1	Box Gum Woodland (moderate to good condition)	58.31	12.0	66.67	75.00	8.33	456
6	2	Box Gum Woodland (disturbed - (moderate to good condition)	3.81	12.0	45.83	61.98	16.15	33
6	3	Red Stringybark Open Forest (moderate to good condition)	12.80	12.0	56.77	79.69	22.92	138
7	1	Red Stringybark Open Forest	61.00	12.0	79.51	91.15	13.10	560
7	2	Box Gum Woodland (derived grassland - (moderate to good condition)	29.00	12.0	59.38	73.44	14.06	257

Notes:

- For Site 5 (zone 3), insufficient plots were collected (2 collected, 4 required). For this site, plots were duplicated to achieve 4 plots for this site.
- For Site 5 (zone 3) and Site 7, fallen logs were scored erroneously on field data sheets and therefore benchmark fallen log scores have been used for these plots.
- For Sites 1, 2, 5 (zone 3) and 7, Rosenberg’s Goanna habitat areas equivalent to the vegetation zone areas where termite mounds were identified were entered into the calculations.

Comparison

Table 7-4 provides a comparison of the credits required by the development and generated at the candidate offset sites. In summary:

- There is a surplus of 511 credits for the Red Stringybark Open Forest.
 - Sites 2 (50% of the requirement) and 7 (53% of the requirement) provide the most credits, and together would fully satisfy the requirement.
- There is a surplus of 605 credits for the Box Gum Woodland.
 - Site 6 provides the most credits and on its own would fully satisfy the requirement (112% of the requirement)
 - Sites 5 (61% of the requirement) and 7 (59% of the requirement) provide the next most credits, and together would fully satisfy the requirement.




Note:




- For the purpose of this evaluation, Site 4 was excluded as it occurs in a different catchment where this vegetation type is less cleared (Southern Rivers CMA, 90% cleared). It is shown in brackets but not summed, in Table 7-4.



Table 7-4 Ecosystem credit comparison for the development and offset sites

Development site	Class	Percent cleared in the CMA	Total habitat loss (ha)	Ecosystem credits required	Offset site vegetation types	Class	Percent cleared	Total area available (ha)	Credits generated	% requirement	Credits difference
Red Stringybark Open Forest (moderate to good condition)	Upper Riverina Dry Sclerophyll Forests	50	22.85	1064	Site 1	Upper Riverina Dry Sclerophyll Forests	50	48.47	347	33%	511
					Site 2			73.99	530	50%	
					Site 6			12.8	138	13%	
					Site 7			61	560	53%	
SUB TOTAL								1575		SURPLUS	
Box Gum Woodland (moderate to good condition)	Southern Tableland Grassy Woodlands	95	6.44	436.81	Site 3	Southern Tableland Grassy Woodland	95	3.25	28	6%	605
					Site 5		95	29.14	268	61%	
					Site 6		95	62.12	489	112%	
					Site 4		90	5	(47)	11%	
					Site 7		90	29	257	59%	
Box Gum Woodland (low condition)		95	0.97								
SUB TOTAL								1042.00		SURPLUS	
GRAND TOTAL			30.26	1500.81				173.31	2617		1116.19

Figure 7-1 Photographs of candidate offset sites.

Offset site	Vegetation type	
<p>1</p> <p>Red Stringybark Open Forest (moderate to good condition)</p> <p>48.47 ha</p>		
<p>2</p> <p>Red Stringybark Open Forest (moderate to good condition)</p> <p>73.99 ha</p>		
<p>3</p> <p>Box Gum Woodland (moderate to good condition)</p> <p>2.85 ha</p>		

Offset site	Vegetation type	
3	Box Gum Woodland (low condition)	Image not available
	0.40	
4	Box Gum Woodland (moderate to good condition)	
	5.00 ha	
5	Box Gum Woodland (moderate to good condition)	
	5.36 ha	
5	Box Gum Woodland derived grassland (moderate to good condition)	
	1.78 ha	

Offset site	Vegetation type	
5	Box Gum Woodland (moderate to good condition) 22.00 ha	
6	Box Gum Woodland (moderate to good condition) 58.31 ha	Image not available
6	Box Gum Woodland (disturbed - (moderate to good condition) 3.81 ha	Image not available
6	Red Stringybark Open Forest (moderate to good condition) 12.80 ha	Image not available
7	Red Stringybark Open Forest 61.00 ha	

Offset site	Vegetation type	
7	Box Gum Woodland (derived grassland - (moderate to good condition) 29.00 ha	

7.2.2 Species credits

Based on the revised footprint, approximately 49 termite mounds and 20.3 ha of habitat will be impacted by the development. Using the area of potential habitat with the subject site, the species credits required for Rosenberg’s Goanna at the development site were calculated to be 670 credits.

Table 7-5 shows a comparison between the required Rosenberg’s Goanna credits and those generated at the proposed offset sites. The area of Rosenberg’s Goanna habitat at each offset site has been estimated to obtain these credits. Termite mounds were quantified within a 2 hectare area around each of the BioBanking plots. Extrapolating the results of the 2 hectare areas to the management zones, up to 234 hectares of habitat including an estimated 385 termite mounds occur on these four sites. This is shown in Table 7-6. The areas of habitat were entered in the BioBanking calculations for each offset site separately to obtain the credits generated in Table 7-5.

Table 7-5 Species credits required and generated for Rosenberg’s Goanna

Site	Scientific name	Common name	Red flag	TS offset multiplier	Species credits required	Species credits generated	% of requirement	Credit difference
1	<i>Varanus rosenbergi</i>	Rosenberg's Goanna	No	3.3	670	344	51%	-326
2						525	78%	-145
5 (zone 3)						156	23%	-514
7						639	95%	-31
TOTAL						1664	248%	994

Table 7-6 Results of termite mound sampling

Site	Plot	Mounds within 2 ha radius	Active	Inactive	>30cm tall	Extrapolated to zone	Area of zone (ha)
1	EDO1	10	7	3	6		
	EDO2	7	6	1	5		
	EDO3	11	10	1	11		
	Average	9.33	7.67	1.67	7.33	178	48
2	EDO4	3	3	0	3		
	EDO5	12	8	4	9		
	EDO6	1	1	0	1		
	Average	5.33	4	1.33	4.33	160	74
5 (zone 3)	1	0					
	2	5					
	Average	2.5				28	22
7 (zone 1)	DF 1	0					
	DF 2	0					
	DF 3	2					
	DF 4	0					
	DF 5	0					
	Average	0.4				12	61
7 (zone 2)	GWM 1	1					
	GWM 2	0					
	GWM 3	0					
	GWM 4	1					
	Average	0.5				7	29
Total all sites					385	234	

In summary:

- A total of 1664 credits can be obtained, combining all sites. This is 248% of the credit requirement.
- Sites 1 (51% of the requirement), 2 (78% of the requirement) or 7 (95% of the requirement) are the best candidates but would require an additional one or more of the other offset sites investigated to satisfy the full offset requirement.

Note:

- The Rosenberg's Goanna is a cryptic species and was not actually sighted at the subject site or within the offset sites. Sites 1, 2 and 7 are adjacent to a known population at the Cuumbuen Nature Reserve. They are adjacent to the reserve and have similar habitat types. This species is assumed to occur within the subject site and similarly, assumed to occur at the sites investigated above.

7.3 COMMONWEALTH OFFSETS ASSESSMENT GUIDE (OAG)

Offsets were considered to be required by the Commonwealth Department of Environment for Box Gum Woodland (CW) and Hoary Sunray. The Commonwealth offset methodology differs from the NSW methodology. According to the EPBC Offset Assessment Guide (OAG), at least 90% of the offset requirement must be from direct offsets. Percentages are quoted below for the offset sites investigated.

7.3.1 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

It is calculated that 5.99 hectares of Commonwealth listed Box Gum Woodland would be removed as part of the development of Ellerton Drive Extension. The EPBC Offsets Assessment Guide⁷ (OAG) was completed individually for the Box Gum Woodland at Sites 3, 4, 5, 6 and 7. Based on these assessments:

- Site 3 provides 8.7% of the offset requirement
- Site 4 provides 13.3% of the offset requirement
- Site 5 provides 77.6% of the offset requirement
- Site 6 provides 165.4% of the offset requirement
- Site 7 Road provides 77.2% of the offset requirement.

According to the EPBC Offsets policy, at least 90% of the offset requirement must be from direct offsets. Only Site 6 on its own meets this requirement. Alternatively, Sites 5 and 7 could be supplemented by another site to meet the requirement.

7.3.2 Hoary Sunray

Based on the revised footprint, approximately 5,470 Hoary Sunray individuals would be impacted by the development.

The Hoary Sunray is known to occur at Sites 1, 2, 3, 6 and 7 (zone 2). Estimations of the number of plants within these sites, the anticipated loss and expected gains from the offset sites are shown in Table 7-7. These data were entered into the OAG.

Based on the figures in Table 6, a 101% offset is achieved. This offset is achieved assuming an additional 2,200 Hoary Sunray individuals will be planted within the offset areas. This could be achieved by direct planting or seeding. If seeding is preferred this may require an increase in the time - horizon (time until the gain is realised i.e. the successful establishment of 2,200 plants) in the OAG and the number of individuals required would increase also. Currently a time horizon of 2 years has been entered into the OAG.

⁷ The Offsets Assessment Guide is an excel spreadsheet provided by the Department of Environment (DoE) that quantifies impacts and offsets for matters of national significance to determine the adequacy of offsets.

Table 7-7 Estimated numbers of Hoary Sunray plants within the offset sites and anticipated losses and gains

Site	Area (ha)	Estimated plants per ha (lower range)	Total plants	Estimated loss of plants without offset	Remaining plants without offset	Proposed planting	Total plants with offset	Notes
1	15	120	1800	0	1800	2200	4000	Estimated 100 - 200 plants per hectare. No loss considered as site zoned Environmental Conservation, no proposed development
1	30	30	900	0	900	0	900	Estimated 20 - 50 plants per hectare. No loss considered as site zoned Environmental Conservation, no proposed development
2	75	30	2250	2250	0	0	2250	Estimated 20 - 50 plants per hectare. Complete loss as proposed for residential estate
3	3.25		1400	700	700	0	1400	Plant numbers calculated from GIS (based on 2012 survey results). Anticipated loss of 50% of population if developed for environmental living
5 (3)	22	25	500	0	500	0	500	Estimated 20 - 50 plants per hectare. No loss considered as site zoned Environmental Conservation, no proposed development
6	<i>Known to occur but survey required to confirm area of habitat and individuals</i>							
7	29	35	1000	0	1000	0	1000	Estimated 20 - 50 plants per hectare. No loss considered as site zoned Environmental Conservation, no proposed development
Total			7850	2950	4900	2200	10050	

Notes:

- For Site 5 (zone 3) 50 plants were observed to occur. At Site 7, 150-200 plants were observed to occur. The individuals are grouped and large areas of the sites do not contain this species.
- Estimating the number on each site, in the absence of an exhaustive survey at the sites, we have estimated 25 and 35 individual plants per hectare, per respective site. Both sites are considered to be suitable for offsetting directly and establishing the species.

7.4 OFFSET CONCLUSION AND RECOMMENDATIONS

The lands investigated to date are able to fully meet the offset requirements that would be generated from development of the proposed Ellerton Drive Extension (Table 7-8). As the credits generated are in surplus, either:

- A subset of the areas investigated should be defined and final calculations made to demonstrate the suitability of the final offset package (two examples are shown in Table 7-8). In making this selection it is advised that for ease of management and to maximise the biodiversity benefits of the offset package, that sites:
 - involve as few separate land owners as possible
 - minimise edge areas (and therefore edge effects)
 - contribute to landscape connectivity.

A detailed offset plan would be prepared for these lands detailing management actions and security arrangements. It is recommended that these final decisions be made in consultation with OEH.

OR

- A larger offset area than is required could be secured and managed as an offset, providing surplus credits that may be required for other projects that QCC are commencing or planning.

Note:

- For the purpose of the summary below, the additional 2,200 Hoary Sunray individuals to be planted are assumed to be planted at one site; Site 1.
- Any pre-existing management or security for biodiversity management may result in a 'discount' being applied to credits generated at this site. This relates to the 'additionality' principle for offset sites. The benefits of long term management for biodiversity, which drives the credits, should be additional to any existing arrangements. This should be discussed with OEH.

Table 7-8 Summary of candidate offset sites and the percentage of the credit requirement met

	Percentage of credit requirement met by each offset candidate							Total
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	
Red Stringybark Open Forest	33%	50%	0%	0%	0%	14%	53%	149%
Box Gum Woodland	0%	0%	6%	11%	61%	115%	59%	252%
Rosenberg's Goanna	51%	78%	6%	0%	23%	0%	95%	254%
Box Gum Woodland (CW)	0%	0%	9%	13%	78%	165%	77%	342%
Hoary Sunray	49%	22%	14%	0%	5%	Abundance unknown	10%	122%
Sites 1 and 7 combined	Site 1	Site 7	Total					
Red Stringybark Open Forest	33%	53%	86%					
Box Gum Woodland	0%	59%	59%					
Rosenberg's Goanna	51%	95%	147%					
Box Gum Woodland (CW)	0%	77%	77%					
Hoary Sunray	49%	10%	59%					
Sites 1, 5 and 7 combined	Site 1	Site 5	Site 7	Total				
Red Stringybark Open Forest	33%	0%	53%	86%				
Box Gum Woodland	0%	61%	59%	120%				
Rosenberg's Goanna	51%	23%	95%	170%				
Box Gum Woodland (CW)	0%	78%	77%	155%				
Hoary Sunray	49%	5%	10%	64%				

Supporting attachments are provided in Appendix F and include:

- Development site zones and plot location map
- Biobanking credit summary; development site
- Candidate offset site location map
- Vegetation zones and hoary sun ray location map; Site 6
- Vegetation zone map; Site 5 (zone 3)
- Vegetation zone map; Site 7.

8 CONCLUSION

8.1 CHANGES TO THE SIS ASSESSMENT CONCLUSIONS

The revised proposal has a larger subject site and a slightly different configuration to the original proposal. The revised subject site would have a greater impact, in terms of area of habitat affected, upon Box-Gum Woodland, Hoary Sunray, Pink-tailed Worm-lizard, Rosenberg's Goanna, Brown Treecreeper, Scarlet Robin, Hooded Robin, Diamond Firetail, Painted Honeyeater, Gang-gang Cockatoo, Speckled Warbler, Koala, Eastern False Pipistrelle, Eastern Bentwing-bat and Golden Sun Moth. These species were considered in more detail.

For these species, the increased habitat loss was generally not substantial and in no case did the conclusions change from a non-significant impact to a significant impact. For all but two species (i.e. Rosenberg's Goanna and Eastern Bentwing-bat), no change to mitigation measures is considered to be required.

For Rosenberg's Goanna, 65% of breeding habitat in the study area would be cleared under the revised proposal, compared to the 27% originally assessed. Additional mitigation measures have been included to address Rosenberg's Goanna breeding habitat including clearing vegetation at a time that avoids the breeding period and undertaking pre-clearance surveys to identify breeding sites.

8.2 ADDITIONAL SPECIES CONSIDERATIONS

The targeted surveys for the Eastern Bentwing-bat did not record the presence of the species near two mine shafts within the subject site, and, based on the characteristics of the mines, it is considered unlikely that the species would use the shafts as breeding or staging habitat. The proposed development is therefore considered unlikely to have any impacts to this species. As a precautionary measure, preclearance surveys outside any identified mine shafts have been included as a mitigation strategy.

The targeted surveys for the Squirrel Glider did not record the presence of the species within the survey area, and it is considered unlikely that the species would be present in this locality based on the surveys undertaken and the lack of any historic records of the species within 40 km of the site. The proposed development is therefore considered unlikely to have any impacts on this species. As a precautionary measure, glider crossing structures have been recommended and additional mitigation measures have been proposed in the unlikely event that the species is found to be present within the study area during construction.

8.3 OFFSET SITE EVALUATIONS

Six⁸ sites in the Queanbeyan local area have currently been investigated for their potential to meet the NSW and Commonwealth offset requirements for the project. Considered together, the lands investigated to date are able to fully meet the offset requirements that would be generated from development of the proposed Ellerton Drive Extension. The sites together are in excess of the offset requirements of the proposal, and therefore investigations are continuing to find the most suitable selection of sites. The offset

⁸ An additional site was investigated outside the catchment, Site 4, but will not be investigated further.

package for the proposal would be finalised in consultation with the NSW OEH and Commonwealth Department of Environment, and implemented prior to any construction impacts occurring.

8.4 SUMMARY

This SIS Addendum has found that the revised Ellerton Drive Extension proposal will significantly impact on the following threatened species and communities:

- Box-Gum Woodland EEC (listed under both the TSC Act and EPBC Act)
- Rosenberg's Goanna
- Speckled Warbler

Significant impacts to other threatened entities are considered unlikely by NGH Environmental however, the proposal has been deemed a controlled action by the Commonwealth Department of Environment due to the quantum of impacts incurred on the Hoary Sunray. Adequate offset lands are available in the local area to compensate for the significant residual impacts of the proposal.

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APPENDIX A UPDATED FLORA MAPS

A.1 FLORA SURVEY EFFORT



FLORA SURVEY EFFORT WITHIN THE STUDY AREA

Ellerton Drive extension

- ▭ Study area
- ▭ Revised subject site
- Flora survey effort
- ▣ Quadrat
- Inspection point
- Additional stockpile inspection points March 2015
- Biometric plots
- Threatened species transect

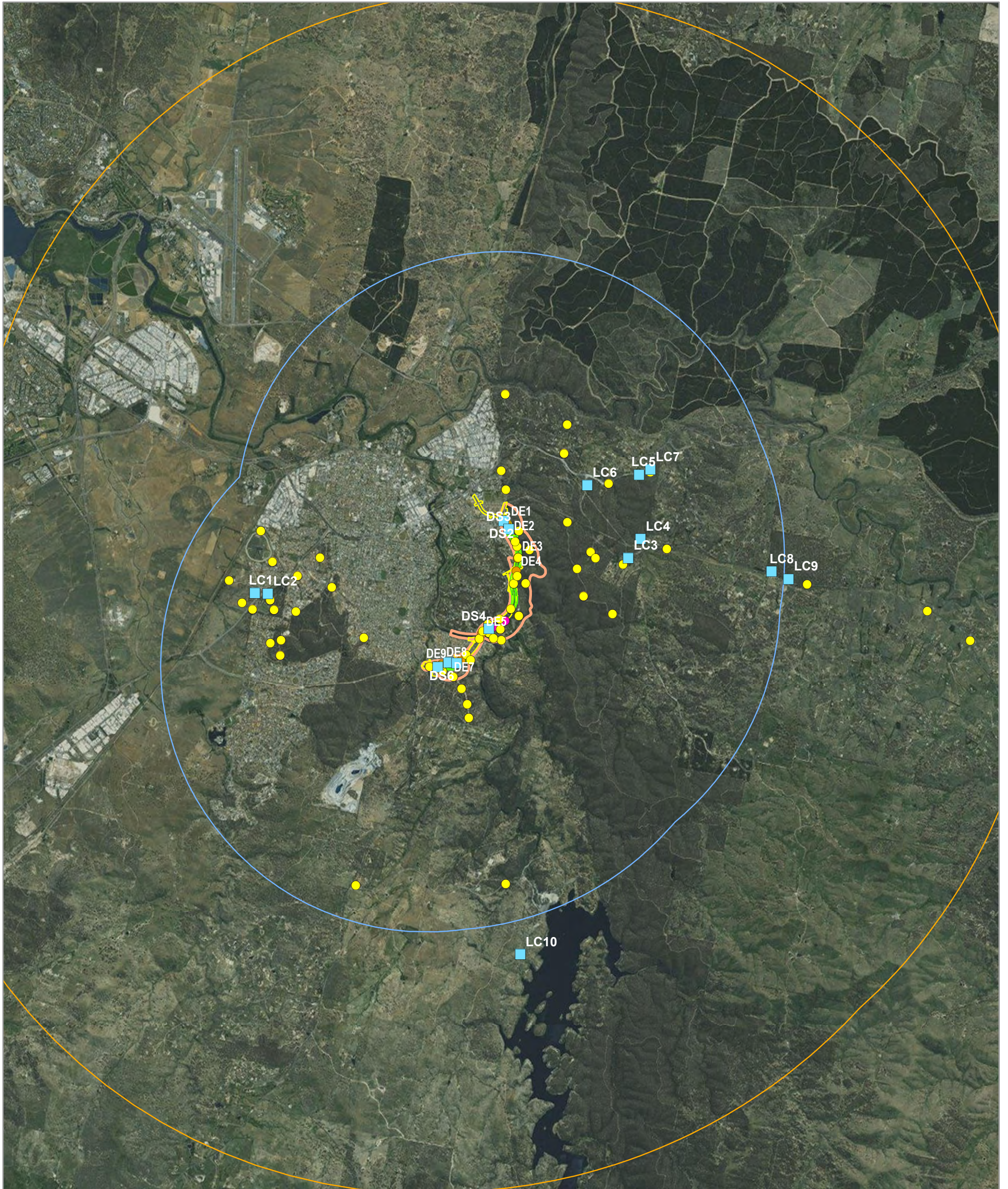
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Author: JB

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Notes:
- Data collected by nghenvironmental (October 2012, March 2015)
- Development footprint and aerial imagery provided by QCC



FLORA SURVEY EFFORT WITHIN THE LOCALITY

Ellerton Drive extension

- Revised subject site
- 10km buffer
- 5km buffer
- Study area
- Quadrat
- Inspection point
- Bometric plots
- Additional stockpile inspection points March 2015
- Threatened species transect

0 1 2 Kilometres

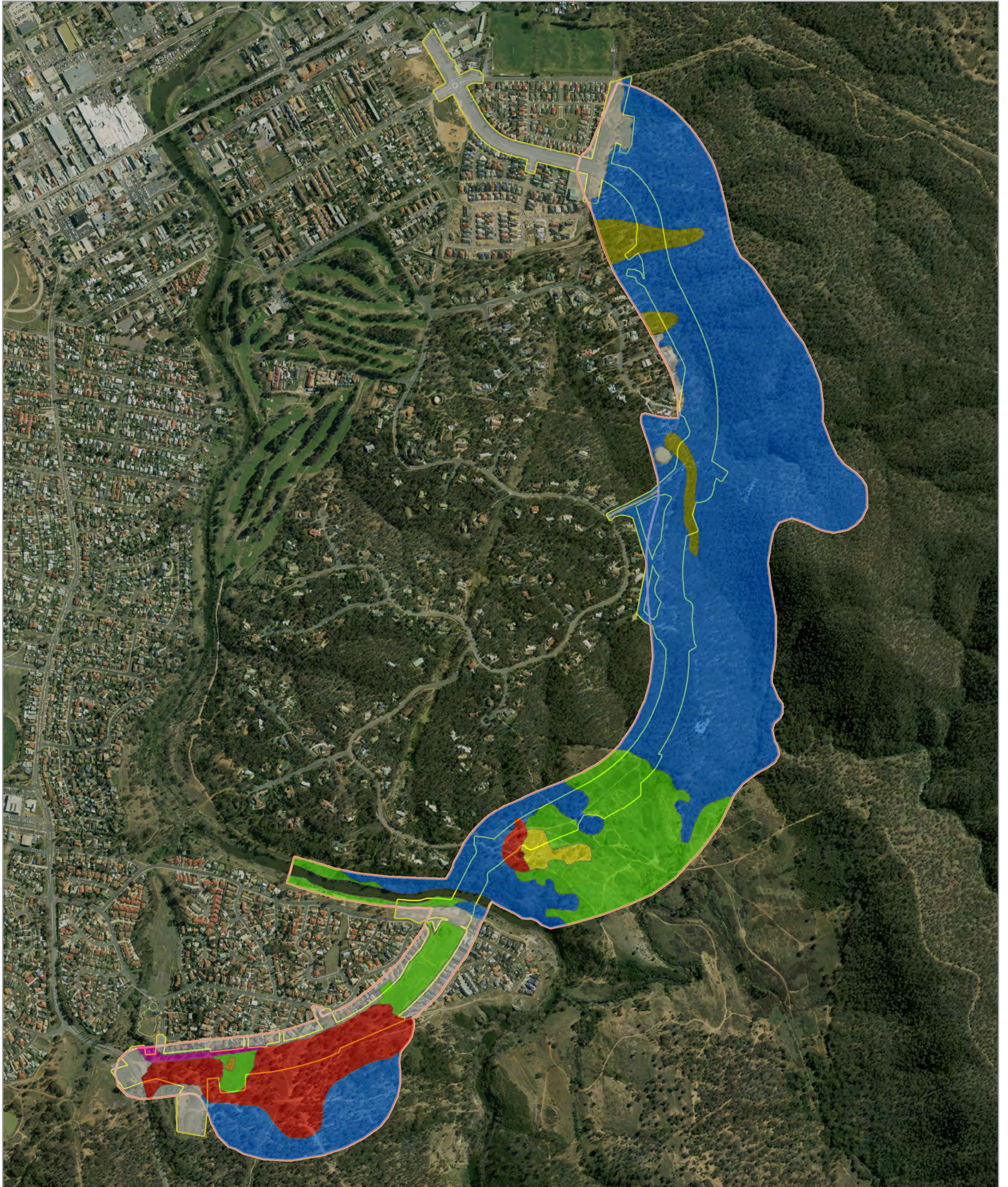
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Notes:
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A.2 FLORA RESULTS



VEGETATION TYPES WITHIN THE STUDY AREA

Ellerton Drive extension

Vegetation types

- South Eastern Tablelands Dry Shrub/Grass/Herb Forest (Box-Gum Woodland, CEEC EPBC)
- South Eastern Tablelands Dry Shrub/Grass/Herb Forest (Box-Gum Woodland, EEC TSC)
- Tablelands Acacia/Grass/Herb Dry Forest
- Tablelands Dry Shrub/Tussock Grass Forest (Dry Forest)
- Planted native vegetation
- Silver Wattle
- Exotic vegetation
- Disturbed

- Study area
- Revised subject site

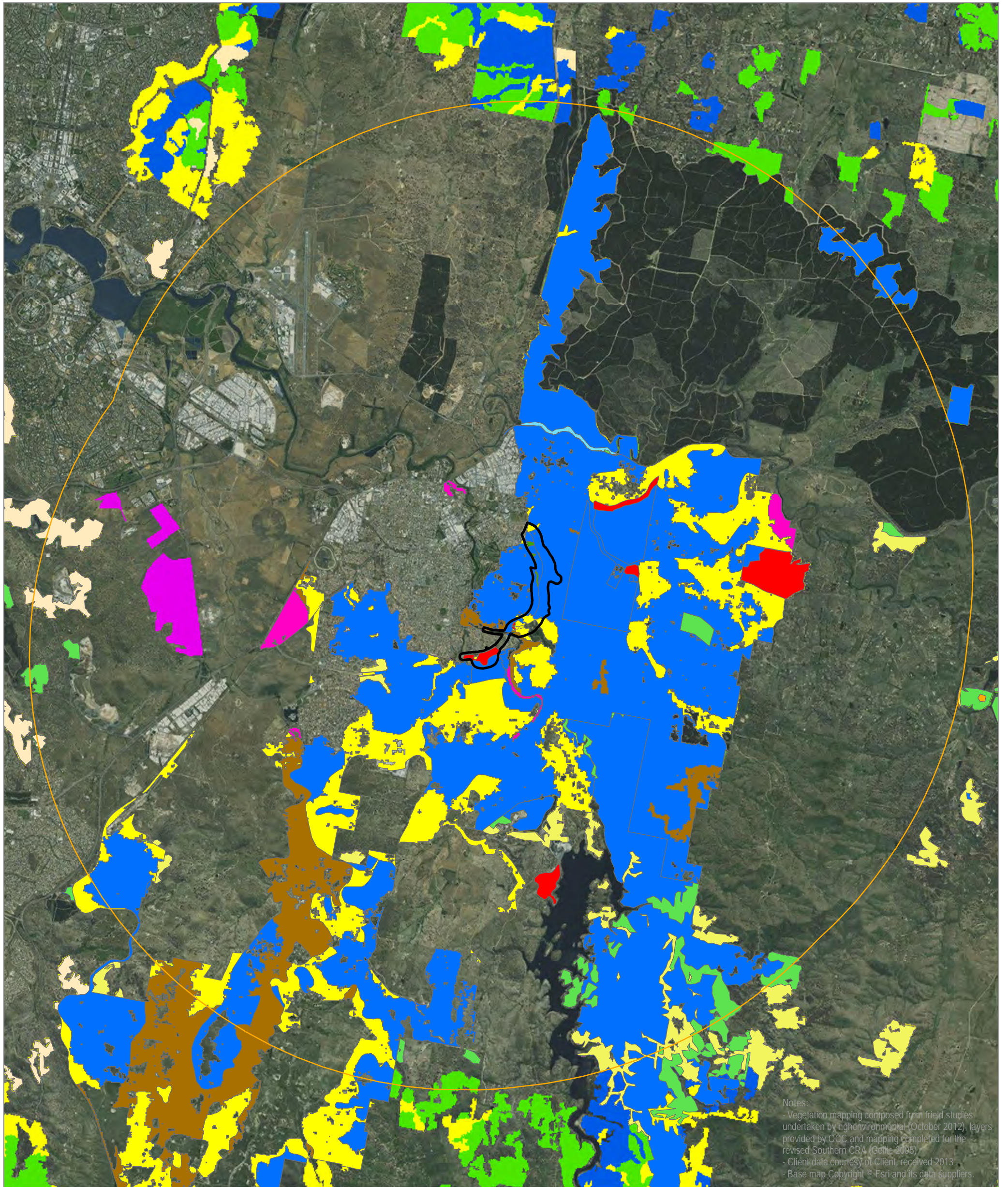
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 - Data collected by nghenvironmental (October 2012, March 2015)
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Notes:
 - Vegetation mapping composed from field studies undertaken by nghenvironmental (October 2012), layers provided by OCC and mapping completed for the revised Southern CRA (Gelle 2005)
 - Client data courtesy of Client, received 2013
 - Base map Copyright © Esri and its data suppliers.

VEGETATION TYPES WITHIN THE LOCALITY

Ellerton Drive extension

10km Buffer

Study area

Vegetation types

South Eastern Tablelands Dry Shrub/Grass/Herb Forest (Box-Gum Woodland, EPBC)

South Eastern Tablelands Dry Shrub/Grass/Herb Forest (Box-Gum Woodland, TSC)

Tablelands Acacia/Grass/Herb Dry Forest

Tablelands Dry Shrub/Tussock Grass Forest (Dry Forest)

Northern Slopes Dry Grass Woodland

Eastern Tableland Dry Shrub/Grass Forest

Riparian Acacia Shrub/Grass/Herb Forest

Tableland Dry Herb/Grass Woodland

Widespread Tablelands Dry Shrub Grass Forest

Grassland Woodland Mosaic

Native Grassland

0 1 2 Kilometres

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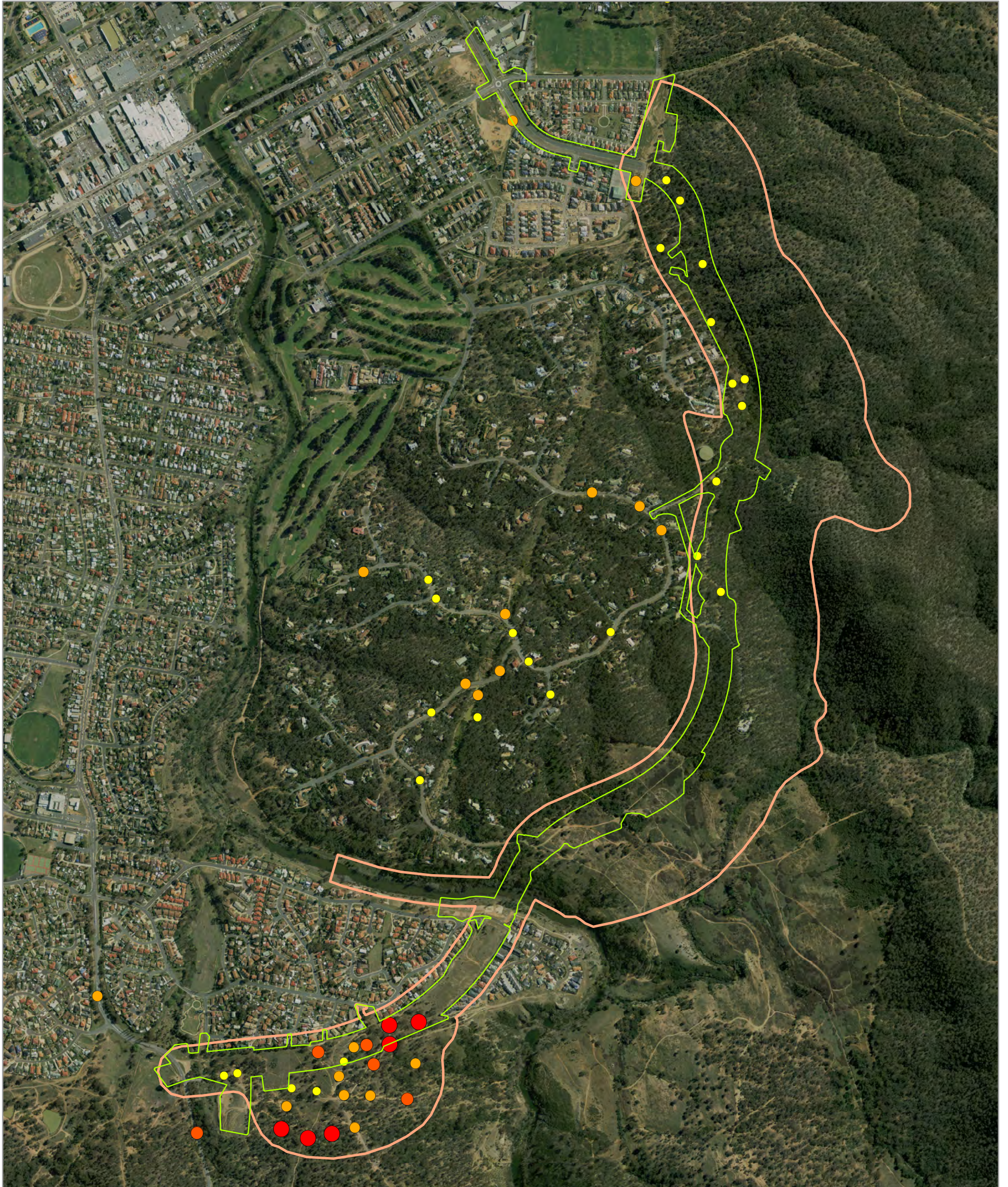
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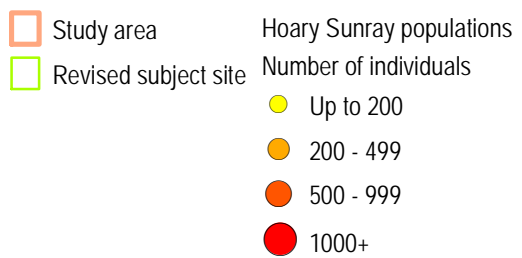


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HOARY SUNRAY POPULATIONS RECORDED WITHIN THE STUDY AREA

Ellerton Drive extension




Notes:
 - Data collected by nghenvironmental (October 2012)
 - Aerial imagery and development footprint provided by QCC

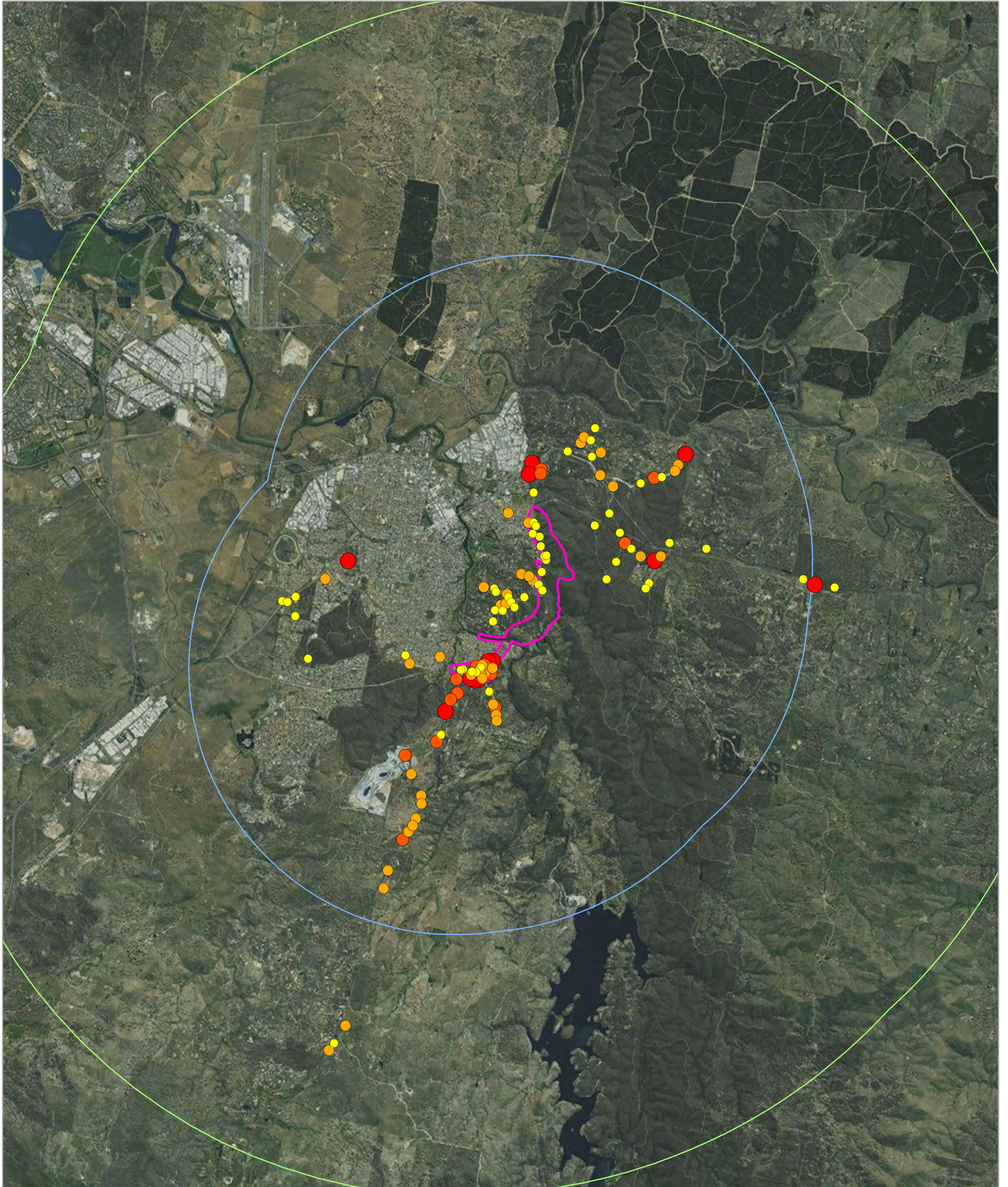
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HOARY SUNRAY POPULATIONS RECORDED WITHIN THE LOCALITY

Ellerton Drive extension

5km buffer

10km buffer

Study area

Hoary Sunray populations

Number of individuals

Up to 200

200 - 499

500 - 999

1000+

0 1 2 Kilometres

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Ref: 4733 - 4-2
Author: JB

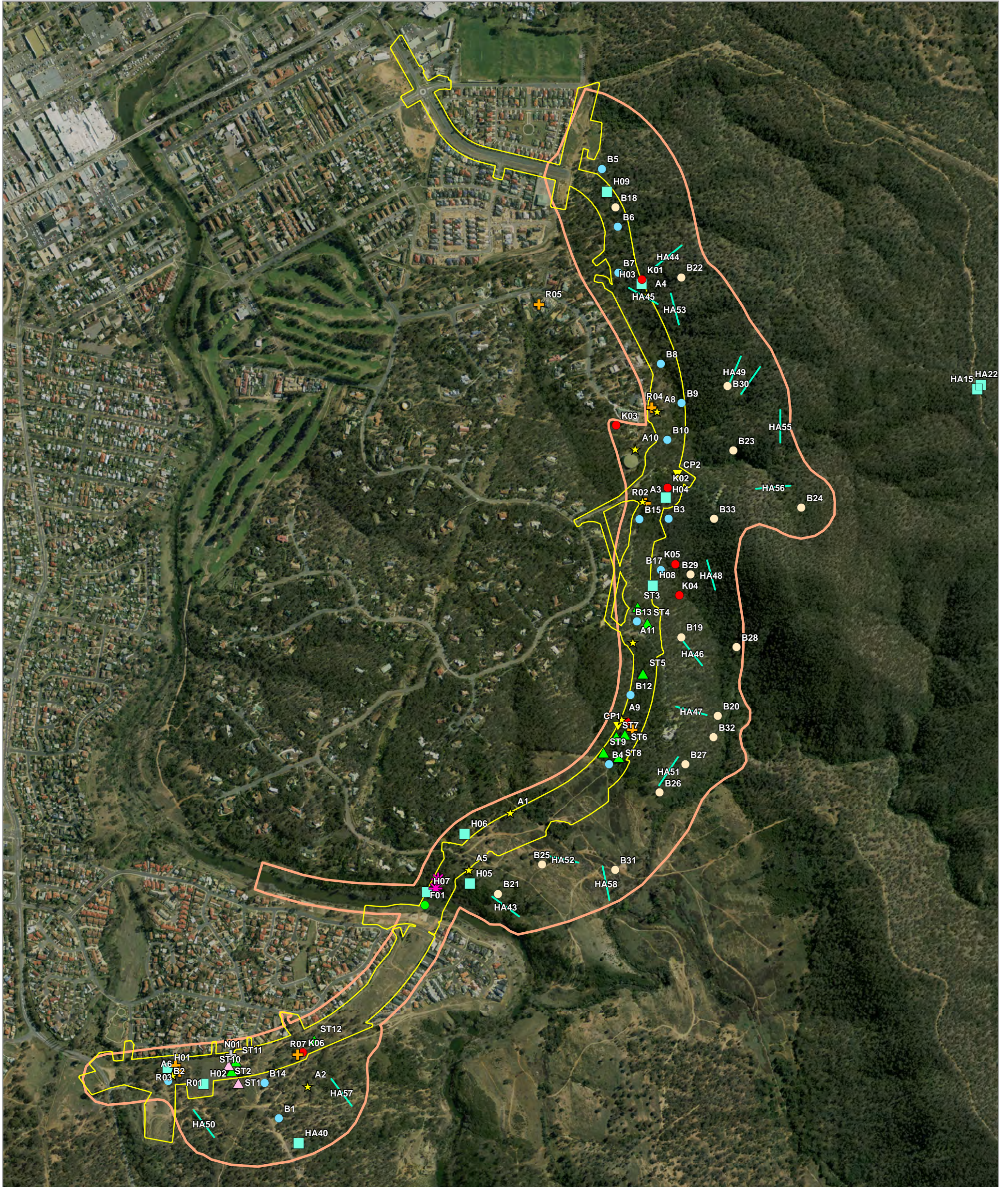
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Notes:
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APPENDIX B UPDATED FAUNA MAPS

B.1 FAUNA SURVEY EFFORT



FAUNA SURVEY EFFORT WITHIN THE STUDY AREA

Ellerton Drive extension

- | | | | | |
|--|--|---|---|---|
| <ul style="list-style-type: none"> □ Study area □ Revised subject site | <ul style="list-style-type: none"> ★ 2012 fauna survey effort Anabat ● Bird census ● Frog census ● Koala scat search | <ul style="list-style-type: none"> ▽ Koala call playback / Spotlight + Diurnal reptile search + Nocturnal reptile search △ Stag watch □ Habitat quadrat assessment | <ul style="list-style-type: none"> ● 2013 fauna survey effort Bird census — Habitat transect assessment ▲ Stagwatch | <ul style="list-style-type: none"> ★ 2016 fauna survey effort Anabat |
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Notes:
 - Data collected by nghenvironmental (October 2012)
 - Development footprint and aerial imagery provided by OCC

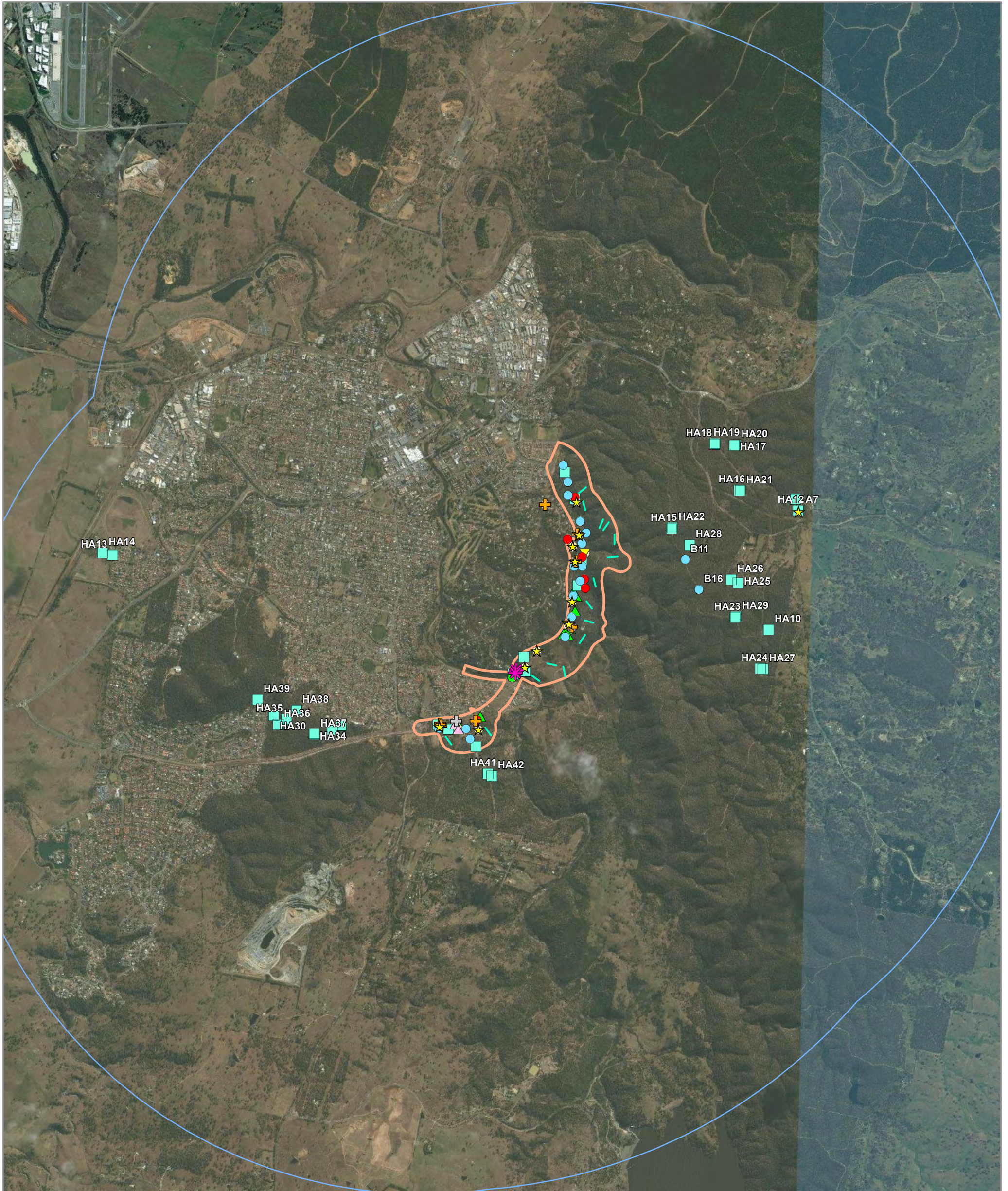
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FAUNA SURVEY EFFORT WITHIN THE LOCALITY

Ellerton Drive extension

- | | | | |
|--------------------------|---------------------------------|-----------------------------|--------------------------|
| Study area | Koala scat search | 2013 fauna survey effort | 2016 fauna survey effort |
| 5km buffer | Koala call playback / Spotlight | Bird census | Anabat |
| 2012 fauna survey effort | Diurnal reptile search | Habitat transect assessment | |
| Anabat | Nocturnal reptile search | Stagwatch | |
| Bird census | Stag watch | | |
| Frog census | Habitat quadrat assessment | | |

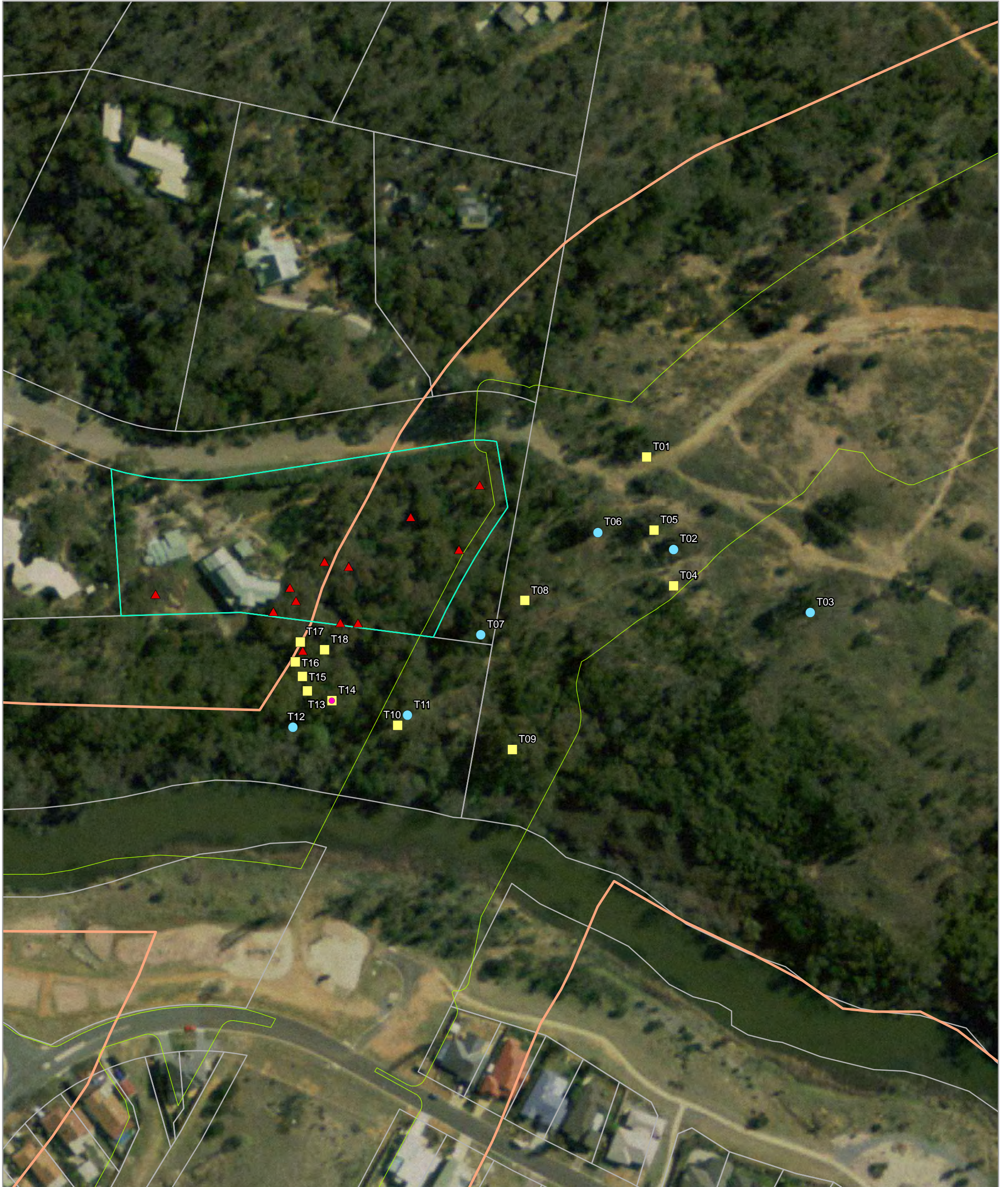
Notes:
 - Data collected by nghenvironmental (October 2012)
 - Development envelope provided by QCC
 - Base map Copyright © Esri and its data suppliers.

0 0.5 1 Kilometres

A3 @ 1:40000
 Ref: 4733 - 5-2
 Author: JB

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GLIDER SURVEYS - June/July 2015

Ellerton Drive extension

- | | |
|---------------------------------------|--------------------------|
| Property boundary - 35 Lonergan Drive | New trap locations |
| Subject site | Cage |
| Study area | Tube |
| Cadastre | Location of captures x 2 |
| Original trap locations | |

0 25 50 Metres

A3 @ 1:1500
Ref: 6134
Author: JB

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Notes:
- Footprint and Cadastre data courtesy OCC
- Aerial imagery supplied by OCC 2012
- Field data collected by NGH Environmental
June - July 2015