Species Impact Statement

For the proposed Private Hospital at Lot 2/1145029

Terrey Hills NSW 2084

Report prepared for Wyvern Health Pty Ltd

18 December 2017

Prepared for:	Wyvern Health Pty Ltd
Prepared by:	Narla Environmental Pty Ltd
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Narla Environmental Pty Ltd
www.narla.com.au

Report Certification

This report was prepared by:

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As Principal of Narla Environmental Pty Ltd, I Kurtis Lindsay, certify that:

- This Species Impact Statement is in writing in accordance with Section 109(1) of the TSC Act.
- This assessment has been prepared in accordance with the brief provided by the client.
- All field workers involved in the preparation of this project were appropriately licensed under section 132C of the *NSW National Parks and Wildlife Act 1974* and the Department of Primary Industries Animal Research Authority.
- The primary author is an accredited BioBanking Assessor
- The information presented in this report is a true and accurate record of the study findings in the opinion of the authors.
- Any change to this document undertaken without the approval of Narla Environmental Pty Ltd renders this document void.
- The declaration below has been signed by the principal author and by the proponent in accordance with Section 109(2).

Kurtis Lindsay
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"I, William Sears, of 52 Hastings Rd, Warrawee, NSW, 2074, being the applicant for the development consent DA2017/0385, 2 / 1145029 Myoora Road Terry Hills, NSW, 2084 have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal."

William Sears
Chairman and Director
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Contents

Glossary

Acronym/ Term	Definition
7-part Test	Assessment of impact significance on threatened species, populations or communities pursuant s. 5A of the *Environmental Planning and Assessment Act 1979*
ANPSA	Australian Native Plants Society
APZ	Asset Protection Zone: required to protect the proposed development from the effects of bushfire. Two types of APZ will exist on the Subject site, Inner Protection Area (IPA) and Outer Protection Area (OPA) both defined below.
BMP	Biodiversity Management Plan
Construction Footprint	The area containing all proposed artificial structures associated with the hospital development. This includes all buildings as well as ancillary structures such as carparks, driveways, pathways and stormwater systems.
DA	Development Application
DCP	Warringah Development Control Plan 2011
Development	The use of land, and the subdivision of land, and the carrying out of a work, and the demolition of a building or work, and the erection of a building, and any other act, matter or thing referred to in section 26 that is controlled by an environmental planning instrument, but does not include any development of a class or description prescribed by the regulations for the purposes of this definition (Environmental Planning and Assessment Act 1979).
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FFA	Flora and Fauna Assessment
General Area	A 5km radius; as defined in section 2.3 plans and maps
ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia (IBRA)
IPA	Inner Protection Area (APZ sub-category) forms part of the Asset Protection Zone as defined above. For forest vegetation types an IPA is an area located immediately adjacent the asset, incorporate a defendable space to significantly reduce the heat intensities at the building surface (NSW Rural Fire Service, 2009).
km	Kilometre
KTP	Key Threatening Process (as listed in the TSC Act)
LEP	Warringah Local Environmental Plan 2011
LGA	Local Government Area
Locality	The area within a 5km radius of the Subject site. The same meaning when describing a local population of a species or local occurrence of an ecological community.
Local Population	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.
Local Occurence	The ecological community that occurs within the study area. However the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
m	metres
mm	millimetres
NPWS	NSW National Parks and Wildlife Services
NSW	New South Wales
OEH	Office of Environment and Heritage
OPA	Outer Protection Area (APZ sub-category) forms part of an Asset Protection Zone as defined above. For forest vegetation types and OPA is a fuel reduced area that is designed to reduce the potential flame length by slowing the rate of spread, filtering embers and suppressing crown fires (NSW Rural Fire Service, 2009).
Proposal	The development, activity or action proposed.
Region	For the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the Chief Executive under subsection (4)) to be appropriate for those purposes, this being the relevant biogeographic region (Sydney Basin Bioregion) per IBRA version 7.
ROTAP	Rare or Threatened Australian Plants
SIS	Species Impact Statement pursuant to s. 5A of the Environmental Planning and Assessment Act 1979
Study Area	Subject site and adjoining properties (subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly)
Subject site	The site of the proposed activity, The property lot boundary of Lot 2/DP1145029
Subject Species	The threatened species, populations and ecological communities that are known or considered likely to occur in the study area.
Threatened species, populations and ecological communities	Species, populations and ecological communities specified in Schedules 1, 1A and 2 and *threatened species, population or ecological community* means a species, population or ecological community specified in any of those Schedules.
TSC Act	New South Wales Threatened Species Conservation Act 1995
WIS	Waterway Impact Statement

Executive Summary

Narla Environmental Pty Ltd (Narla) was engaged by Wyvern Health Pty Ltd (the proponent) to deliver a Species Impact Statement (SIS) for the construction of a new private hospital located at Lot 2/DP1145029, 4a Larool Road, Terrey Hills, NSW (the Subject Site). The proposed hospital will be located in the eastern corner of the subject site on relatively level ground that has been historically cleared of most native vegetation.

This SIS has been prepared in accordance with the Chief Executive's Requirements (CERs) issued by the NSW Office of Environment and Heritage (OEH) on 11 December 2017. The CERs identified twenty-nine (29) fauna, fifteen (15) flora and two (2) endangered ecological communities as species to be considered for inclusion in the list of subject species to be assessed through the SIS. Desktop assessments determined that additional species may be directly or indirectly affected by this proposal and that most species listed in the CERs would not be affected by the proposal. As a result, the list of subject species with the potential to be affected by the proposal was amended to a final total of one flora, one fauna species and two endangered ecological communities.

Background information for this SIS was gathered from various sources, including relevant previous studies, scientific literature, databases aerial photography and maps. Field surveys were also undertaken following the guidelines set out in the relevant threatened species survey guidelines (DEC 2004) and the CERs.

Flora surveys were carried out between November 2016 and December 2017. This included over 72 person hours of flora survey effort with surveys undertaken to meet survey seasonal requirements for targeted flora. Existing vegetation mapping was validated and remapped as required using a combination of ground-truthing (rapid data points and flora survey plots which incorporated plot and transect and full floristic quadrats, six flora survey plots completed) and GIS updating of maps and vegetation types (including calculation of type extent and attribution of types to local, regional and Plant Community Types). Vegetation condition was also assessed as being in low, moderate or good condition according to the quality and portion of intact vegetation within the community, and the number and dominance of native and exotic species present.

A suite of threatened fauna species has been recorded within 10 kilometres of the subject site. An assessment of the likelihood of occurrence of these species was made based on database searches noting previous records, habitat availability, targeted survey, preliminary field inspection and professional knowledge.

Fauna surveys were conducted between October 2016 and December 2017. Standard fauna survey techniques were used to target threatened fauna, including Elliot traps, cage traps, hair funnels, diurnal bird census, pitfall traps, diurnal reptile searches, nocturnal call playback, spotlighting, frog searches, harp trapping, stag watches, remote cameras and ultrasonic bat recording. Assessments of fauna habitat were also undertaken at various locations throughout the study area and a survey of hollow-bearing and potential foraging trees were undertaken.

Three (3) threatened fauna were confirmed present within the Subject Site, including *Cercartetus nanus* (Eastern Pygmy Possum), *Varanus rosenbergi* (Rosenberg's Goanna), *Calyptorhynchus lathami* (Glossy Black-Cockatoo). A further four (4) threatened species were recorded flying over the Subject Site, *Miniopterus schreibersii oceanensis* (Eastern Bent-wing Bat), *Saccolaimus flaviventris (*Yellow-bellied Sheath-tail Bat), *Lophoictinia isura (*Square-tailed Kite) and *Pteropus poliocephalus* (Grey-headed Flying Fox).

For each subject species, communities or populations, an assessment of likely impacts based on the consideration of several factors was undertaken. This included include distribution, abundance, habitat values and utilisation, conservation status and the context of these species, population and communities, in the locality and region. Feasible alternatives and ameliorative strategies were considered in generating the final impact assessments.

Potential impacts to each of the subject species were assessed in relation to the proposal. Assessments took into account a review of previous records in the study area and locality, species database searches, additional surveys in the locality and results of field surveys conducted within the Subject Site in order to address the CERs for the proposal.

A suite of threatened flora species was considered as having the potential to occur within the general locality of the Subject Site. Of these, only one, Caley's Grevillea (*Grevillea caleyi*) required further assessment of impacts.

Two threatened endangered ecological communities (EEC) (Duffy's Forest and Coastal Upland Swamp) were assessed as having the potential to be affected by this proposal.

An Inner Protection Area (IPA) Asset Protection Zone (APZ) will be required to manage part of the Duffy's Forest EEC to reduce bushfire threat to the proposed hospital. Two Outer Protection Area (OPA) APZ will be required to be managed within the adjoining 'Sydney North Exposed Sandstone Woodland' (not EEC). All APZ will be delicately and precisely managed by qualified Bushland Restoration Professionals with experience in Duffys Forest, and qualified Arborists who will selectively thin shrubbery, ground cover and tree canopy in order to ensure this APZ falls within the approved thresholds (as determine by NSW Rural Fire Service). A 4-metre-wide, fire tanker access dirt track will be installed to RFS specifications. This track will traverse bushland located entirely within the boundaries of the existing s. 88b APZ easement for the sole purpose of bushfire management. This track will extend along the existing driveway from Larool Road to the southern side of the proposed hospital. This land use complies with the original purpose of the s. 88b APZ easement.

The proposal (before a consideration of mitigation/amelioration measures) would remove approximately 0.50 hectares of native vegetation. Loss of vegetation generally reduces the habitat available to threatened fauna species that have the potential or are known to occupy the study area. In addition to vegetation, the proposal will require the removal of twenty-one (21) hollow-bearing trees. These habitat features are important to threatened species such as the Powerful Owl, Eastern Pygmy-possum, Rosenberg's Goanna and some microchiropteran bats.

A range of amelioration measures have been developed to mitigate the potential impacts of the proposal on the subject species as well as common flora and fauna species that occur in the study area. Comprehensive amelioration measures are outlined in Section 7 of the report, and the corresponding BMP (Narla 2017a), and are designed to reduce impacts on threatened species as well as other native flora and fauna species in the study area.

Such amelioration measures include:

- All remaining EEC and native vegetation to be conservation and enhanced in perpetuity under a Conservation Agreement including;
    - (0.95 ha) of Duffys Forest endangered ecological community; and
    - protection of all *Grevillea caleyi* within the site.
- Replacement of all fruiting *Allocasuarina* spp. removed from the subject site (at a ratio of 3:1)
- Planting of between 1,180 - 3,120 *Banksia ericifolia* across the subject site in order to replace the 80 Banksia ericifolia lost from the proposed construction footprint;
- Replacement of all nest hollows removed with augmented hollows of the same dimensions at a ratio of 2:1;
- Installation of nest boxes to provide additional nesting habitat for Eastern Pygmy-possum;
- Weed control throughout the site to eradicate noxious weeds and maintain and preserve the health and viability of the EECs; and
- Ehance the areas of Coastal Upland Swap on the sunject site by vegetating all Onsite Stormwater Detention (OSD) systems with Coastal Upland Swamp.

The combined efforts of revegetation and intensive weed removal combines to a total of 0.5 ha of restored native bushland across the Subject site. The combined effort of active revegetation, and on-going weed removal from the site will ensure there is no net loss in biodiversity across the Subject site.

A designated Conservation Area will be declared over the northern portion of the subject site. This area will be bound to the tenure of the property and managed purely for the conservation of threatened species and endangered ecological communities into the future. The only known population of Caley's Grevillea on the subject site will be completely protected within this Conservation Area, as will the majority of the Duffys Forest Ecological Community, and habitat for all known and potentially occurring threatened fauna species.

The proponent is also committed to providing Dundundra Falls Reserve Trust a direct financial allocation to assist in protecting and conserving habitat for Eastern Pygmy Possum, Coastal Upland Swamp EEC and Duffys Forest EEC in Dundundra Falls Reserve, a large bushland reserve that shares habitat connections with the subject site. The proponent will provide $75,000 as a one-off payment to the Dundundra Falls Reserve Trust prior to the issue of an Occupation Certificate. The intention is for this money to be held in Trust, for the use by the Dundundra Falls Reserve Trust. This offer can be confirmed via a prior to occupation certificate condition of consent.

Provided all mitigation and ameliorative measures are followed by the proponent, Narla Environmental have concluded that the proposed development will induce no significant impact on any of the subject flora and fauna species or on endangered ecological communities assessed in this SIS.

1. Purpose and Content of the Species Impact Statement

1.1 Purpose

This species Impact Statement (SIS) has been prepared by Narla Environmental on behalf of Wyvern Health Pty Ltd (Wyvern Health) to identify and determine potential impacts on threatened species, populations and ecological communities associated with the proposed private Hospital at Lot 2/DP1145029, Terrey Hills NSW 2084.

The purpose of a Species Impact Statement (SIS) is to:

- allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration for adverse impacts resulting from the proposal;
- assist consent and determining authorities in the assessment of a development application under Part 4 approval under *the Environmental Planning and Assessment Act 1979* (EP&A Act);
- assist the Chief Executive in deciding whether or not concurrence should be granted for the purposes of Part 4 of the EP&A Act;
- assist the Chief Executive or the Minister for the Environment when consulted for the purposes of Part 4 of the EP&A Act; and
- assist the Chief Execuive in the assessment of Section 91 Licence applications lodged under the *Threatened Species Conservation Act 1995* (TSC Act).

1.2 Chief Executive Requirements

The Chief Executives Requirements (CERs) for this SIS were issued by the NSW Office of Environment and Heritage (OEH) on 11 December 2017 (**Appendix A**).

1.3 Matters which can be Limited

Recovery plans, key threatening processes and threat abatement plans need be addressed only where relevant to this proposal and the subject species. However, it is considered that the following NSW recovery plans, key threatening processes and threat abatement plans are likely to be relevant to this proposal:

Recovery plans, conservation advices and management plans

- *Grevillea caleyi* (a shrub) recovery plan
  - (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10361)
- *Grevillea caleyi* (a shrub) *Assessment of conservation status in NSW* (2013) (www.environment.nsw.gov.au/resources/threatenedspecies/Grevcalrpt.pdf, however note that a more recent update, containing some additional information, of this advice can be found on the Commonwealth Department of Environment and Energy's website at www.environment.gov.au/biodiversity/threatened/nominations/comment/nsw-13-species.
- Darwinia biflora recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10202)
- Melaleuca deanei recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10515)
- Microtis angusii recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10531)
- Southern Brown Bandicoot recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10439)
- Southern Brown Bandicoot Assessment of conservation status in NSW (2016) (www.environment.nsw.gov.au/resources/threatenedspecies/ARSBbandicoot.pdf)

- Large Forest Owls: Powerful Owl *Ninox strenua* Sooty Owl *Tyto tenebricosa* Masked Owl *Tyto novaehollandiae* approved recovery plan (via www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10562)
- Grey-headed Flying Fox recovery plan (draft) (via www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpflyingfox.pdf)

Key threatening processes

- Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners (*Manorina melanocephala*)
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Anthropogenic climate change
- Bushrock removal
- Clearing of native vegetation
- Competition and grazing by the Feral European Rabbit Oryctolagus cuniculus (L.)
- Competition from feral honey bees Apis mellifera
- Forest eucalypt dieback associated with overabundant psyllids and bell miners
- High frequency fires
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
- Infection of native plants by *Phytophthora cinnamomi*
- Introduction and establishment of Exotic Rust Fungi of the Pucciniales pathogenic on plants of the family Myrtaceae
- Invasion and establishment of exotic vines and scramblers
- Invasion of native plant communities by exotic perennial grasses
- Invasion of native plant communities by *Chrysanthemoides monilifera* (Bitou Bush and Boneseed)
- Invasion, establishment and spread of Lantana (Lantana camara L. sens. lat)
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- Loss of hollow-bearing trees
- Predation by the European Red Fox (*Vulpes Vulpes*)
- Predation by the Feral Cat *Felis catus* (Linnaeus, 1758)
- Removal of dead wood and dead trees

Threat abatement plans

- Threat Abatement Plan 'Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)' (www.environment.nsw.gov.au/bitouTAP/index.htm)
- Threat Abatement Plan 'Predation by *the Red Fox* (*Vulpes vulpes*)' (www.environment.nsw.gov.au/pestsweeds/Foxes.htm)

Critical habitat

At this time, there are no areas of declared ciritcal habiat relevant to this proposal.

1.4 Matters to be Addressed

The TSC Act provides that the SIS must meet all the matters specified in Sections 109 and 110 of the TSC Act except where those matters have been limited, as detailed above.

Further requirements related to the matters specified in Sections 109 and 110 are detailed in the following sections.

Table 1. The location where each Chief Executive Requirements (CER) is addressed within the Species Impact Statement

CER's section and heading	SIS section and heading
1 – Form of the Species Impact Statement	
The Species Impact Statement must be in writing	As required by Section 109 (1) of the TSC Act, this SIS is in writing.
The Species Impact Statement must be signed	'Report Certification' The SIS has been signed by the principal author of the statement and by the applicant for the license.
2 - Contextual Information	
2.1 Description of proposal, subject site and study area	2.1 Description of proposal, subject site and study area
2.2 Identification of the development/activity and land to which SIS applies	2.2 Identification of the development/activity and land to which SIS applies
2.3 Plans and Maps	2.3 Plans and Maps Appendix B – Landscape Plan, Appendix C – Hydrology Design.
3 - Initial Assessment	
3.1 Assessment of available information 3.2 Identifying subject threatened species, populations and ecological communities	3.1 Assessment of available information 3.2 Identifying subject threatened species, populations and ecological communities Appendix F: Threatened fauna and flora species within the potential to occur in the study area
4 – Survey	
4.1 Requirement to survey vegetation and ecological communities	4.1 Requirement to survey – vegetation, ecological communities and species
4.2 Requirement to survey for species	4.1 Requirement to survey – vegetation, ecological communities and species
4.3 Documentation	4.2 Documentation 4.2.1 Description of survey techniques and survey locations 4.2.2 Description of survey effort and results 4.2.3 Description and mapping of results of vegetation, flora and fauna surveys Appendix H: field data sheets
5 – Assessment of likely impacts on threatened species and populations	
5.1 Assessment of species likely to be affected	5.1 Assessment of species likely to be affected
5.2 Discussion of local and regional abundance and distribution	5.2 Discussion of local and regional abundance and distribution 5.2.1 Discussion of regional occurrences and the local population
5.3 Assessment of habitat	5.3 Assessment of habitat 5.3.1 Description of habitat values 5.3.2 Discussion of habitat utilisation
5.4 Discussion of conservation status	5.4 Discussion of conservation status
5.5 Discussion of likely effect of the proposal at local and regional scales	5.5 Discussion of likely effect of the proposal at local and regional scales 5.5.1 Significance within a local context 5.5.2 Extent of habitat removal and modification 5.5.3 Discussion of connectivity 5.5.4 Consideration of threatening processes
5.6 Description of feasible alternatives and measures taken to avoid impacts	5.6 Description of feasible alternatives
6 – Assessment of likely impacts on Endangered Ecological Communities	
6.1 Assessment of endangered ecological communities likely to be affected	6.1 Assessment of endangered ecological communities likely to be affected
6.2 Description of habitat	6.2 Description of habitat
6.3 Discussion of conservation status	6.3 Discussion of conservation status
6.4 Discussion of the likely effect of the proposal at local and regional scales	6.4 Discussion of the likely effect of the proposal at local and regional scales 6.4.1 Significance within a local context 6.4.2 Extent of habitat removal or modification 6.4.3 Discussion of connectivity 6.4.4 Consideration of threatening processes
6.5 Description of feasible alternatives and measures taken to avoid impacts	6.5 Description of feasible alternatives
7 – Ameliorative measures	
7.1 Description of ameliorative measures	7.1 Description of ameliorative measures 7.1.1 Long term management strategies 7.1.2 Compensatory strategies 7.1.3 Ongoing monitoring 7.1.4 Translocation
8 – Assessment of Significance of likely effect of proposed actions	8.1 Summary of Assessment Appendix G: EP&A Act Assessment of Significance
9 – Additional Information	
9.1 Qualification and experience	9.1 Qualification and experience
9.2 Other approvals required for the development or activity	9.2 Other approvals required for the development or activity
9.3 Licensing matters relating to conducting surveys	9.3 Licensing matters relating to conducting surveys
9.4 Section 110 (5) reports	9.4 Section 110 (5) reports

2. Contextual Information

2.1 Description of proposal, subject site and study area

Background Information

Narla Environmental Pty Ltd (Narla) was engaged by Wyvern Health Pty Ltd (the proponent) to produce this Species Impact Statement (SIS) in association with the Development Application (DA) for the establishment of a new private hospital (the proposal) at Lot 2/ DP1145029, 4a Larool Road, Terrey Hills NSW 2084 (**Figure 1**) located in the Northern Beaches Local Government Area.

A *Flora and Fauna Impact Assessment* (Narla 2017) and a Biodiversity Management Plan (BMP has been previously prepared for the proposal. Northern Beaches Council concluded that a Species Impact Statement (SIS) would be required as they considered a significant impact was likely for the *Eastern Pygmy-Possum and the local occurrence of Coastal Upland Swamps and Duffys Forest Ecological Community* endangered ecological communities.

Wyvern Health Pty Ltd applied to the NSW Office of Environment and Heritage (OEH) for Chief Executives Requirements (CERs) for the SIS on 13 November 2017 and were received by the proponent on 11 December 2017. The CERs identified two (2) endangered ecological communities, fifteen (15) flora species and twenty-nine (29) fauna species to be considered for inclusion in the list of subject threatened species, populations and ecological communities within the SIS.

The Proposal

The new private hospital will comprise a 2-3 storey building that will provide a range of specialist health services including:

- Radiology, hydrotherapy, rehabilitation, operating theatre, associated administrative and front of house services and a total of 84 beds;
- An additional 12 consultation rooms will be attached as part of the overall development;
- Primary vehicular access to the site will be provided from Myoora Road;
- Access will be provided from Larool Road solely for emergency access by a fire tanker along a maintained bush track that is 4 m wide and approximately 225 m long with a turning bay (type D) at the end;
- A total of 136 parking spaces will be provided, predominately within an underground parking lot; and
- An ambulance and loading bay on the lower ground level as well as drop-off/ pick up and short stay parking on Myoora Road.

Subject to approval, construction is expected to take approximately 20 months to complete. The development is designed to follow the natural contours of the site and will be positioned within an area of the site that minimises impact to adjacent native vegetation communities. The overall design will encompass approximately 1 ha of the 4.32 ha subject site (**Figure 1**).

A comprehensive description of the project design and concept plan is provided within the Statement of Environmental Effects (Think Planners 2017).

Bush Fire Asset Protection Zones (APZ)

The subject site is mapped as 'Bushfire Prone Land'. A thorough Bushfire Hazard Assessment Report produced for the proposed development provides technical examination of the present risk and recommendations relevant to the proposed development (Peterson Bushfire 2017). This report revealed that in order for the proposed hospital development to comply with the conditions of the *Rural Fires Act 1997* and *Planning for Bushfire Protection* (RFS 2006) a portion (approximately 0.99 ha) of the native vegetation on the subject site is required to be managed as an APZ.

All vegetation managed as an APZ on the subject site will continue to provide the biodiversity and habitat values expected of the relevant vegetation community the APZ occurs on. This will be enabled through strategic, delicate, fuel load management that will be delivered only by experienced Bushland Restoration Professionals (and where required Arborists), under the guidance of an experienced and qualified restoration Ecologist. APZ management in Duffys Forest and Sydney North Exposed Sandstone Woodland will be undertaken to the minimum requirements of an APZ in accordance with Peterson Bushfire (2017) and the BMP (Narla 2017a) as mapped in **Figure 1**. No APZ-related vegetation clearing or thinning exceeding minimum thresholds outlined in this report and the BMP (Narla 2017a) will be permitted on the subject site at any time.

The Bushfire Hazard Assessment Report proposes an APZ consisting of two Outer Protection Areas (OPA) across two areas of non-threatened native vegetation communities, and an Inner Protection Area (IPA) extending 50 m, upslope of the proposed hospital footprint (**Figure 1**). Creating the two OPAs will reduce the bushfire hazard on the subject site below 1 hectare and limit the potential for fire spread from bushland located within the subject site from impacting on adjacent properties and assets in accordance with *Section 63 of the Rural Fires Act 1997*. This method will also reduce the impact upon the Duffy's Forest EEC, by allowing the greatest extent of this EEC to be retained whilst meeting Planning for Bushfire Protection guidelines (RFS 2006).

The proponent will deliver all of the required APZ management for the proposed Hospital by qualified and trained Bushland Restoration Professionals, and Arborists under the guidance of experienced and qualified Ecologists and Bushfire Planning Consultants.

The previously established APZ, associated with the 'Johaness Gutenberg Sydney German International School' (German School) (1/-/DP1145029), occupies a significant portion of the subject site. This APZ was declared as an 'easement' under section 88B of the *Conveyancing Act 1919* when Lot 1 DP1145029 (the German School) was subdivided from Lot 2 DP1145029 (the subject site). This entire easement must be managed as an APZ, and free access to the entirety of this established APZ must be retained for the purpose of continued management of hazard reduction areas (Peterson Bushfire 2017).

Drainage Infrastructure

The proposed development will also increase hard surface runoff and reduce percolation of rainwater directly into the soil, however, this is proposed to be addressed through the engineering of OSD with connected level spreaders that will allow the irrigation of stormwater runoff to the areas of vegetation that lie below the proposed construction, including the Coastal Upland Swamp EEC (Martens 2017a; 2017b; Carmichael Studios 2017). Detailed assessment of waterway impacts is provided within the complementary WIS (Narla 2017b).

The design of the new hospital has been development in consultation within qualified hydrologists with the objective to recreate and restore 'natural flows' as closely as possible. The Hospital will commit to taking all appropriate steps to protect the Coastal Upland Swamp EEC on the subject site by ensuring clean, fresh water is allowed to percolate back in to the Coastal Upland Swamp as detailed in the Hydrogeological Report (Martens 2017a) and Stormwater Management Report (Martens 2017b).

Stormwater Disposal Facilities

All of the Onsite Stormwater Disposal (OSD) areas are illustrated in detail in the Landscape Plan (Carmichael Studios 2017). Where OSD is proposed outside of the proposed building and hard surfaced areas, effort has been made to ensure these areas are landscaped with locally indigenous vegetation reflective of the vegetation communities on the subject site including the Coastal Upland Swamp EEC.

Lighting

The proponent has taken designated effort to reduce the effects of light spill into the environment. Light from the roof-top carpark will be prevented from entering into the bushland to the rear of the site through the installation of a purpose-built barrier wall.

Landscaping

A detailed landscape plan was developed for the subject site by Carmichael Studios (2017) with advice from Narla. This plan outlines areas where proposed, locally indigenous native plantings will occur aiding in increasing habitat connectivity across the subject site. The native landscaping will replace the existing cleared land and weed-infestations that currently dominate the south-eastern portions of the subject site, and provide for the potential expansion of existing native flora patches.

- The landscape plan entails planting with 100% locally indigenous plantings
- Effort will be taken to prioritise the planting of feed trees, particularly the planting of
    - Banksia ericifolia for Eastern Pygmy Possum
    - Other known feed plants suitable for Eastern Pygmy Possum (e.g. *Grevillea spp., Banksia spp.* and *Angophora hispida*)
    - Female Allocasuarina littoralis trees for Glossy Black Cockatoo

A key element will be the installation of OSD which will be overlayed with locally indigenous, moisture-loving flora species typical of Coastal Upland Swamp EEC.

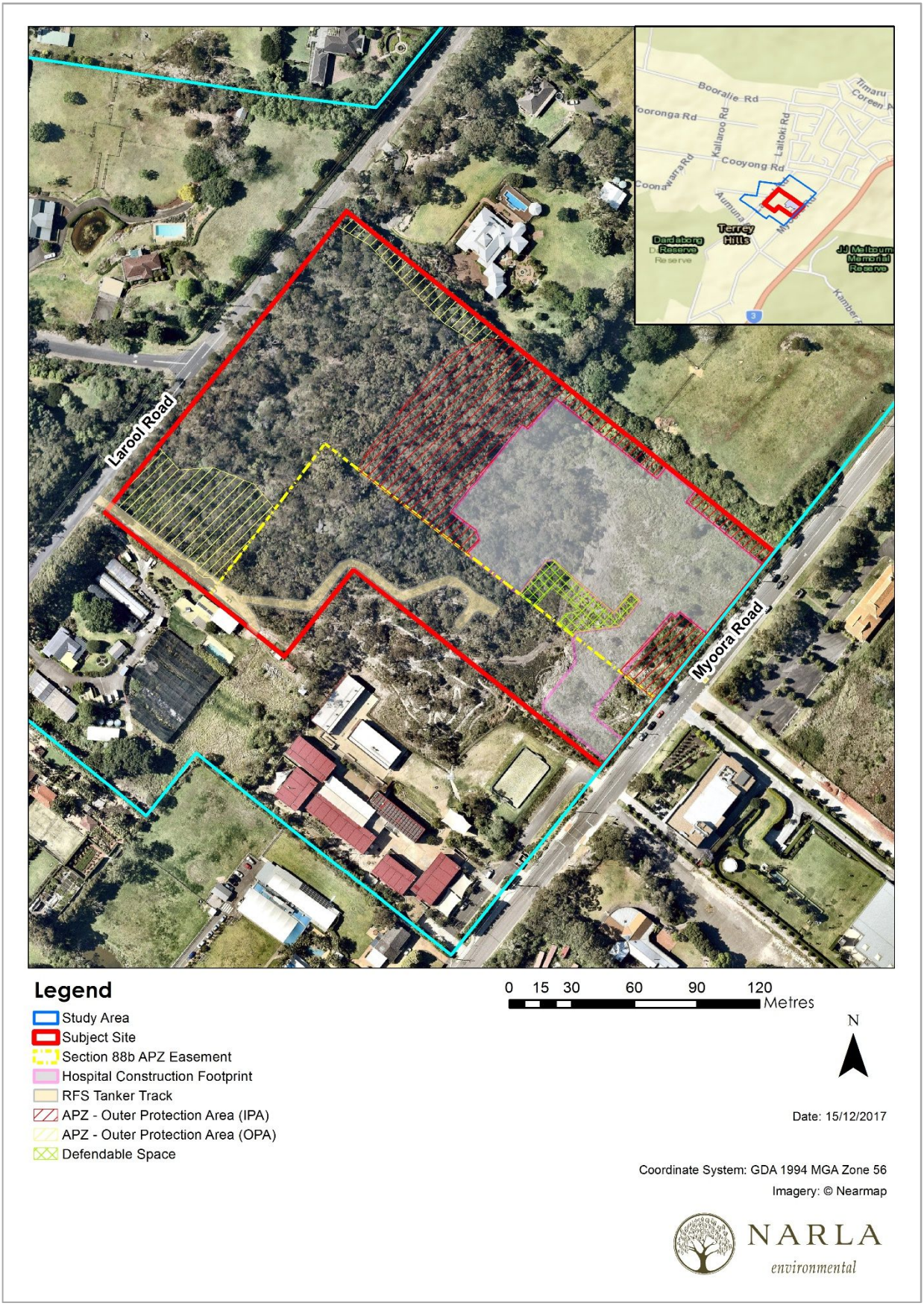


Figure 1. The Proposal including construction boundary, bush fire assessment protection zones, drainage infrastructure and stormwater disposal facilities.

2.2 Identification of the development/activity and land to which the SIS applies

The Subject Site

Residing within Area 18 of Schedule 1 of the Warringah Local Environmental Plan (WLEP) 2011 and near an industrial precinct within Terrey Hills and a large business park within Belrose, the subject site is legally known as Lot 2 DP 1145029.

The subject site is located within the recently amalgamated Northern Beaches Council, however it is noted that the development site is still subject to planning provisions of the former Warringah Council, including the Warringah Local Environmental Plan 2011 (LEP) and Warringah Development Control Plan 2011 (DCP).

The subject site is located near to the intersection of Coolowie Road and Larool Road to the north-west and approximately 350m south-west from the intersection of Cooyong Road and Myoora Road, Terrey Hills. Within close proximity to educational establishments and place of public worship, bus stop with services to Sydney, Macquarie Park, Terrey Hills and Mona Vale is within a 75m walking radius from the development site.

The subject site is a very large irregular land parcel with an east-west orientation, frontage of 131.720m to Myoora Road, a frontage of 185.065m. It covers an area of approximately 4.3 ha. The subject site can be best described as a 'Greenfield Site' with no existing infrastructure or buildings on site. A portion of the site has been the subject of previous land clearing and historical stock grazing, another portion of the site is subject to an APZ serving the adjacent school and a significant portion of the site impacted by weed growth.

The subject site can be characterised as predominantly covered in vegetation with a small portion of the site towards the south-eastern portion partly cleared of vegetation, noting the bulk of the development is to be undertaken within this section of the site.

At the time of preparing this report, areas of the subject site occupied by bushland contained moderate to good quality, remnant fauna and flora habitat with localised weed infestations. Weed infestations were concentrated on the edges of the bushland bordering neighbouring residential lots and roads. The remaining area of the subject site is occupied by native bushland. A small, historical stone quarry exists in the centre north of the block.

The Study Area

The study area as defined by the CERs for the proposal, is the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly (**Figure 2**). The study area encompasses the subject site and adjoining land parcels that form a direct habitat connection with vegetation on the subject site.

The eastern portion of the site bound by Myoora Road, had been cleared of most vegetation and the substrate disturbed. This disturbance has resulted in a severe weed infestation occupying much of the area. The proposed development site will be centred upon this historically disturbed area. This location has been deliberately chosen to minimise impacts upon the remnant vegetation, flora and fauna of the subject site.

The southern portion of the subject site is traversed by an easement declared for the purpose of bushfire management as an Asset Protection Zone (APZ) under section 88b of the *Conveyancing Act 1919*. The APZ was declared when a parcel of land was subdivided off the subject site for the construction of the adjacent school.

Topography

The western section of the site consists of a low hill with a plateau near the top, with prominent rock outcropping and steep slopes on its southern and eastern sides. The remainder of the site is low and hummocky. The elevation of the subject site ranges between approximately 184m Australian Height Datum (AHD) in the south-east corner to approximately 208m AHD at the top of the plateau. The site also experiences slope of between 5% and 10% in moderately undulating sections and greater than 15% in steeper section of the site near the low hill (**Figure 2**).

Hydrology and Hydrogeological Processes

No mapped watercourses occur on the subject site, however a portion of the overland stormwater runoff and groundwater from the subject site accumulates to support a small Coastal Upland Swamp on the subject site. The stormwater that runs off the subject site flows into Kierans Creek which forms part of the Cowan Creek Catchment.

Geology and Soils

The Subject site sits on a boundary between two soil landscapes, Somersby and Gymea. Both share an underlying Hawkesbury Sandstone geology, which is a medium to coarse-grained quartz sandstone with minor shale and laminite lenses. The two soil landscapes can readily be differentiated by the presence or absence of rock outcropping.

The plateau of the subject site is mapped as Gymea Landscape (Chapman & Murphy 1989). Soils of the Gymea soil landscaping consist of sandstone outcropping which is considerably more prominent. Soil depth is generally shallow (30-100cm). Soil make up is shallow to moderately deep (30-100 cm) yellow earths and earthy sands on crests and inside of benches; shallow (<20cm) siliceous sands on leading edges of benches; localised gleyed podzolic soils and yellow podzolic soils on shale lenses; shallow to moderately deep (<100cm) siliceous sands and leached sands along drainage lines (Chapman & Murphy 1989).

Somersby residual soil landscape occupies a larger proportion of the site to the south and east and is typified by deep soils (100-300cm). Rock outcrops are typically absent from the Somersby soil landscape which is low and undulating. The water table is often perched higher in the profile than in surrounding landscapes. Soils of the Somersby Landscape consist of red earths and yellow earths overlying laterite gravels and clays on crests and upper slopes; yellow earths and earthy sands on mid-slopes; grey earths, leached sands and siliceous sands on lower slopes and drainage lines; gley podzolic soils in low lying poorly drained areas. These soils typically have very low fertility and may be highly permeable.

Land Tenure Information

The site is zoned 'RU4 - Primary Production Small Lots' which limits the type and size of development permitted under the Warringah LEP 2011. Hospitals are prohibited within the R4 Zone; however, the site is located within a *subcategory- Area 18*, identified in Schedule 1 of the WLEP 2011. Area 18 applies to certain lands in the vicinity of Mona Vale and Myoora Roads, Terrey Hills and permits developments for a range of purposes including hospitals.

The objectives of the RU4 Primary Production Small Lots are as follows:

- To enable sustainable primary industry and other compatible land uses.
- To encourage and promote diversity and employment opportunities in relation to primary industry enterprises, particularly those that require smaller lots or that are more intensive in nature.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To minimise the impact of development on long distance views of the area and on views to and from adjacent national parks and bushland.
- To maintain and enhance the natural landscape including landform and vegetation.
- To ensure low intensity of land use other than land uses that are primary industry enterprises.
- To maintain the rural and scenic character of the land.

The proposed works will be subject to intensive impact assessment through implementation of this report. The Subject site will be managed in perpetuity by a detailed Biodiversity Management Plan (BMP) (Narla 2017a) that will be reviewed every five years. The objectives of the BMP are to maintain and enhance the landscape including landform and vegetation and to maintain the rural and scenic character of the land. It is therefore considered that the proposed development is consistent with the objectives of the zone.

The southern portion of the subject site is traversed by an easement declared for the purpose of bushfire management as an Asset Protection Zone (APZ) under section 88b of the *Conveyancing Act 1919*. The APZ was declared when a parcel of land was subdivided off the subject site for the construction of the adjacent school.

Construction will be undertaken wholly within privately owned land Lot 2/ DP1145029. Ameliorative measure such as revegetation to improve connective corridors between the subject site and Dundundra Falls Reserve are proposed.

Table 2. Property Ownership

Lot	DP	Owner
2	1145029	Wyvern Health Pty Ltd
1	1145029	Johannes Gutenberg School (Sydney German School)
320	752017	Unknown - private
132	752017	Unknown - private
218	752017	Unknown - private
1	517786	Unknown - private
2	517786	Unknown - private

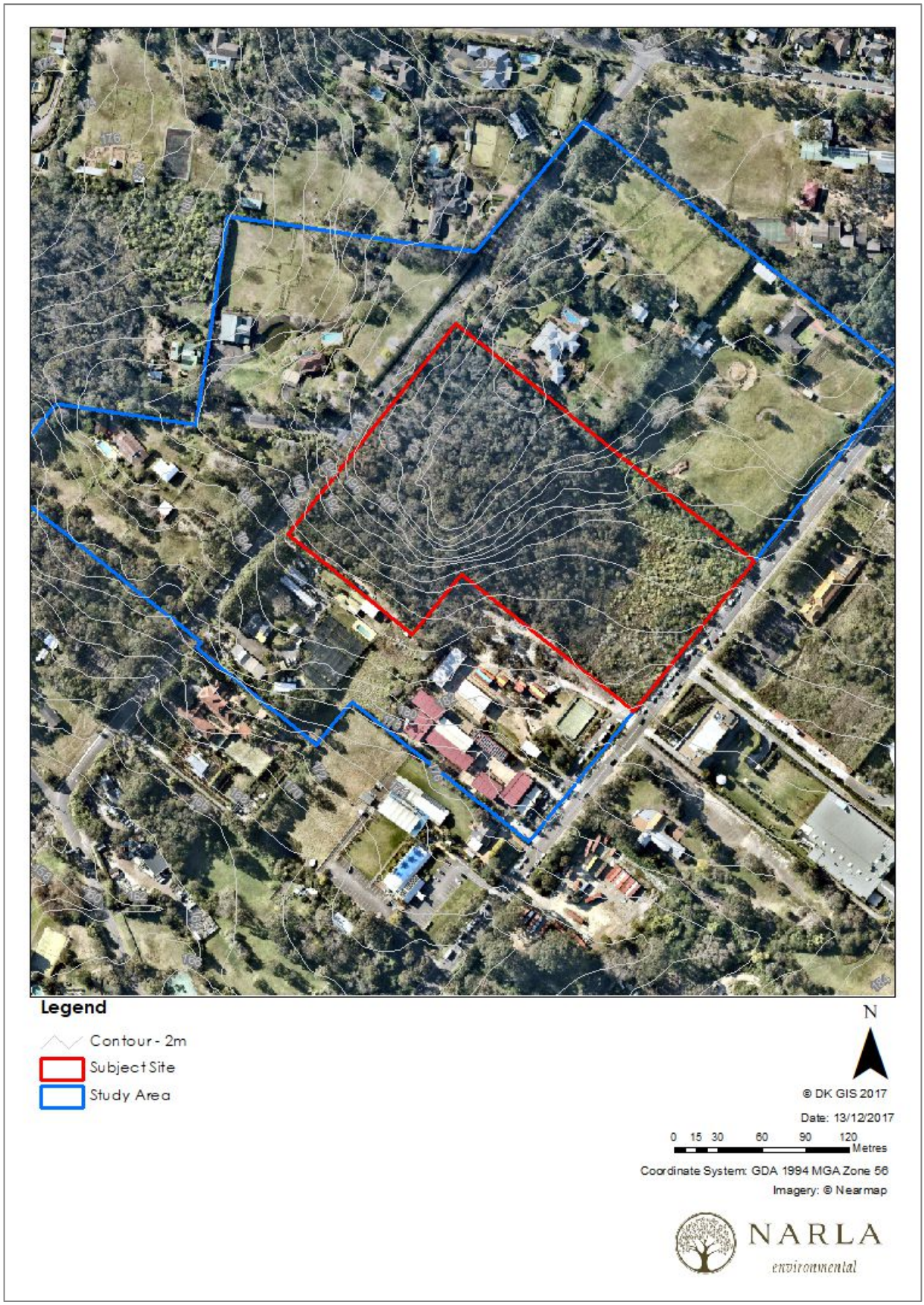


Figure 2. Topographic map of the subject site and study area

Figure 3. Location of the subject site in the broader landscape

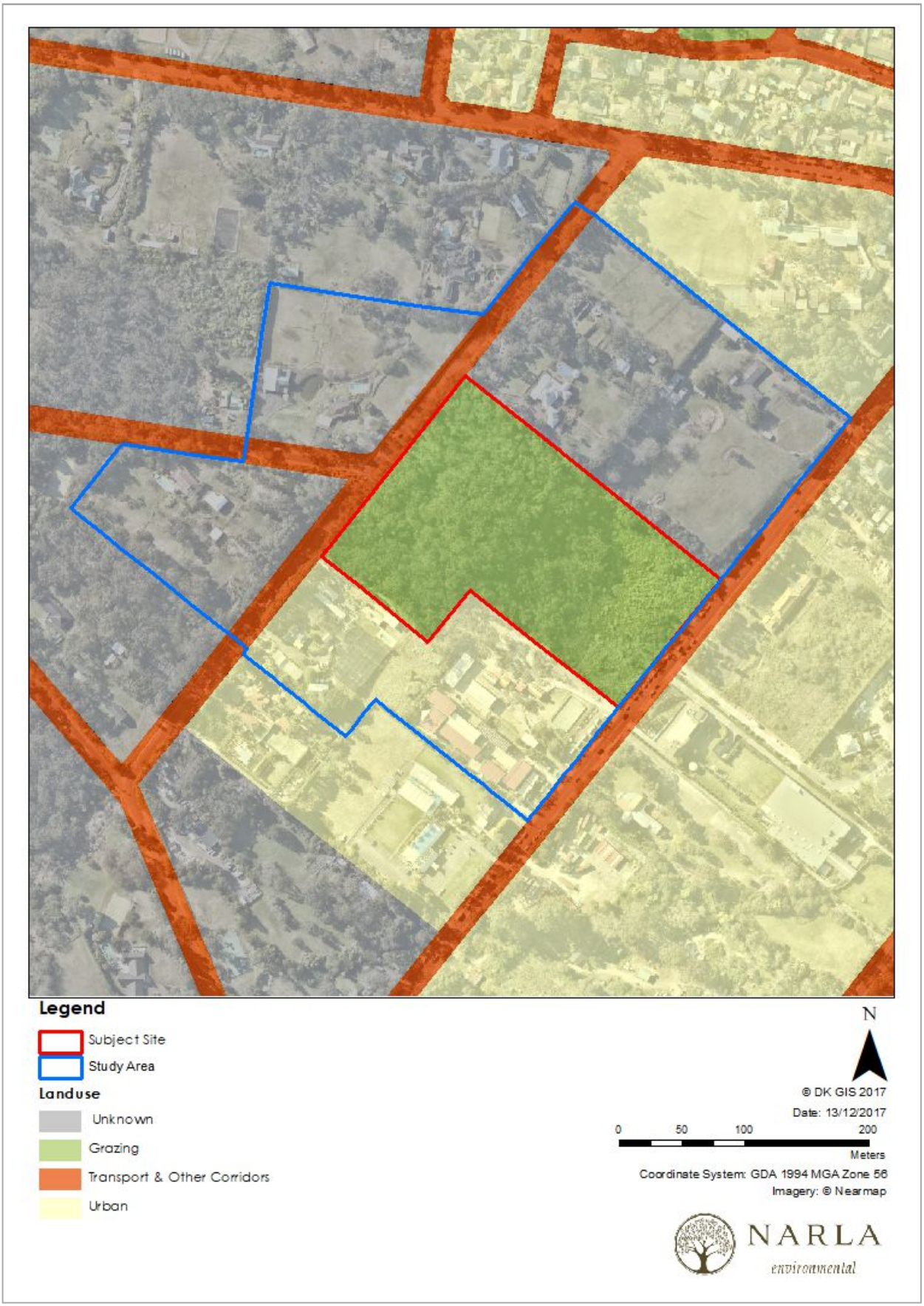


Figure 4. Land uses in the Study Area

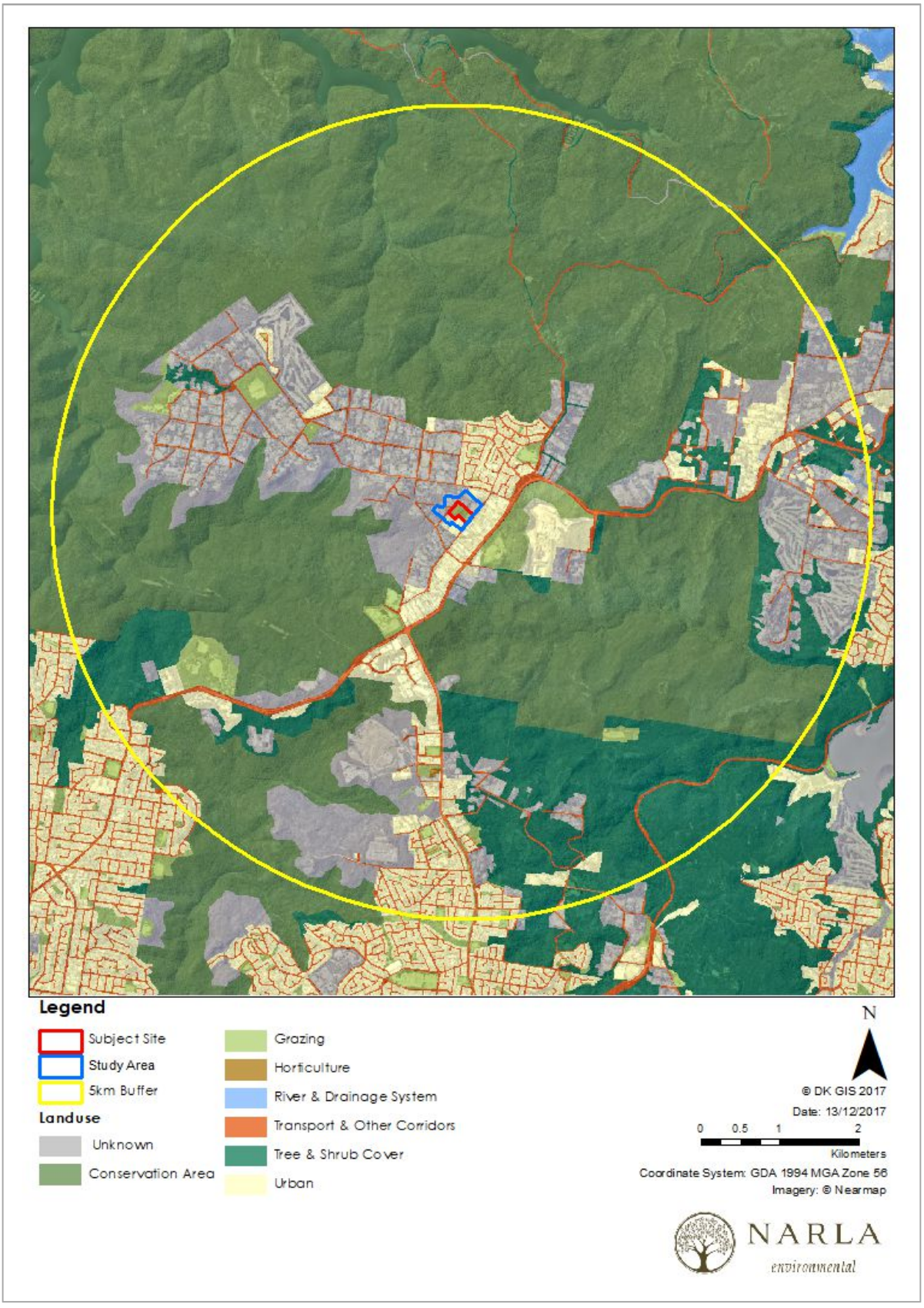


Figure 5. Land uses in the general area (5km)

Vegetation

General area (5km radius of the subject site): Vegetation

The general area surrounding the subject site is well vegetated with a suite of native vegetation communities and includes areas within Ku-ring-gai Chase National Park to the north and Garigal National Park to the south.

The nearest National Park to the subject site is Kur-ring-gai Chase National Park, which lies approximately 800 m to the west. Habitat on the subject site connects with Ku-ring-gai Chase National Park through tree canopy connections with Dundundra Falls Reserve, a 32-hectare Crown Land reserve located between the subject site and Ku-ring-gai Chase National Park.

Larool Road and Coolowie Road form small, artificial barriers to the habitat connectivity, however these roads are narrow and the vehicle traffic is infrequent enough to render these barriers insignificant to the connectivity of the subject site with Ku-ring-gai Chase National Park.

Garigal National Park lies to the South of the subject site, at a distance of roughly 1 km. This National Park is separated from the subject site by private property and Mona Vale Road. The only vegetation connectivity between the subject site and Ku-ring-gai Chase National Park would occur through wind and fauna assisted plant and fungi propagule dispersal across private tenure and Dundundra Falls Reserve.

Vegetation within the general are (5 km radius) has been mapped and described by OEH (2016) 'The Native Vegetation of the Sydney Metropolitan Area' (**Figure 6**). Twenty-five (25) native vegetation types are mapped totalling an area of approximately 6,500 ha. Many of the communities, are restricted to the coastal lowlands (e.g. Swamp Oak Floodplain Forest, Littoral Rainforest and Coastal Saltmarsh) and unrepresentative of the higher sandstone plateau location and the subject site. These communities are not considered likely to exist or have ever existed on the subject site and therefore do not warrant further discussion.

About 30% of the mapped vegetation types are listed as threatened ecological communities under state and/or commonwealth legislation. Of these only two occur on the subject site (see **section 3.2**).

The most extensively occurring communities occur on sandstone and include Coastal Sandstone Gully Forest, Coastal Sandstone Heath-Mallee and Sydney North Exposed Sandstone Woodland.

A summary of the vegetation types occurring within the locality is provided in **Table 3**.

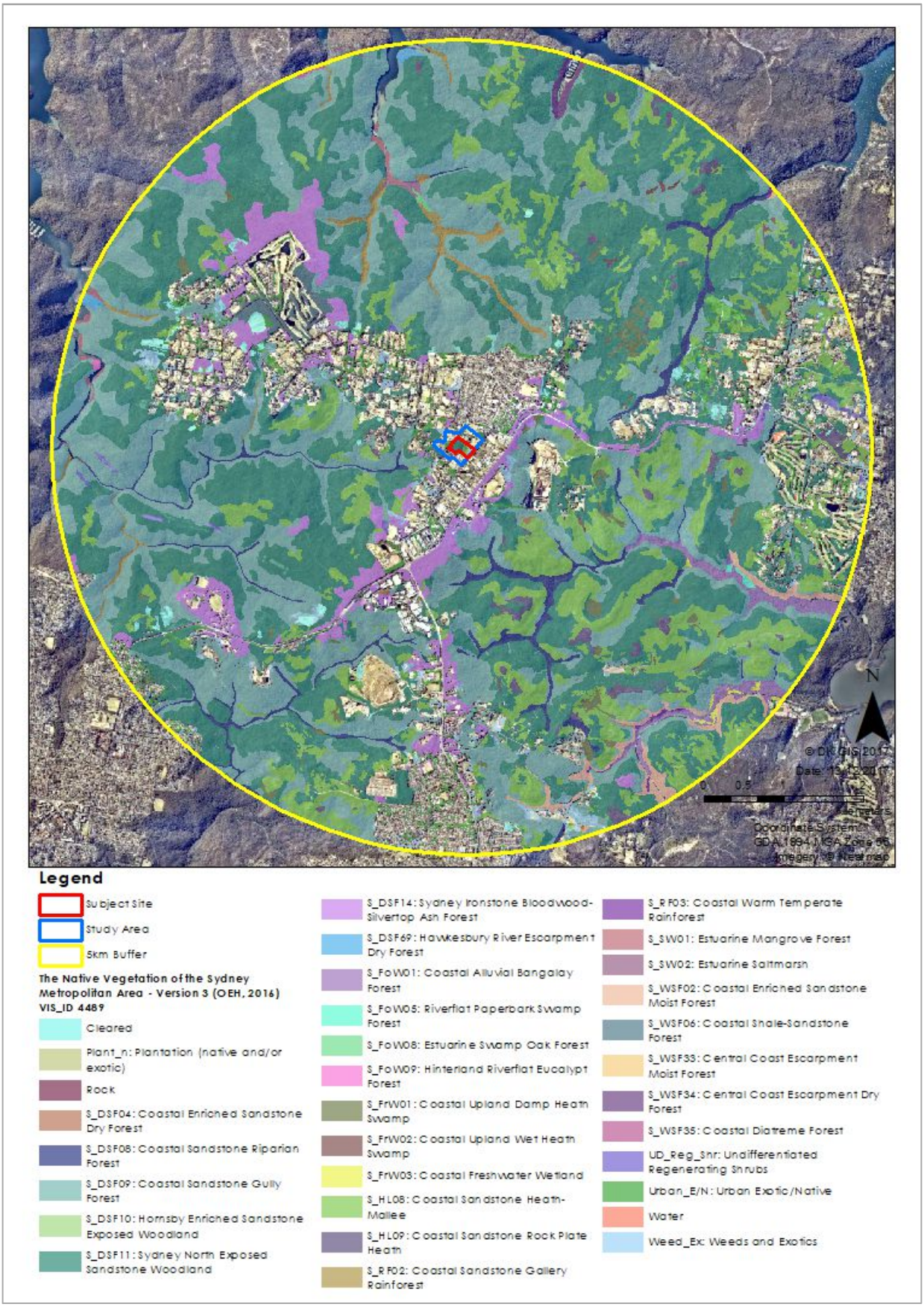


Figure 6. Vegetation communities within a 5km radius of the subject site

Table 3. Vegetation types of the General Area (5 km) (OEH 2016)

Sydney Metro (OEH 2016)	NSW PCT	TSC Act	Area (ha) within the General Area (5 Kilometres)
S_DSF04: Coastal Enriched Sandstone Dry Forest	1776: Coastal Enriched Sandstone Dry Forest	Not Listed	1.3
S_DSF08: Coastal Sandstone Riparian Forest	1780: Coastal Sandstone Riparian Forest	Not Listed	132.1
S_DSF09: Coastal Sandstone Gully Forest	1250: Sydney Peppermint-Smooth-barked Apple-Red Bloodwood Shrubby Open Forest on Slopes of Moist Sandstone Gullies, Eastern Sydney Basin	Not Listed	2042.9
S_DSF10: Hornsby Enriched Sandstone Exposed Woodland	1782: Hornsby Enriched Sandstone Exposed Woodland	Not Listed	0.1
S_DSF11: Sydney North Exposed Sandstone Woodland	1783: Sydney North Exposed Sandstone Woodland	Not Listed	2749.9
S_DSF14: Sydney Ironstone Bloodwood-Silvertop Ash Forest	1786: Sydney Ironstone Bloodwood-Silvertop Ash Forest	Duffys Forest	315.1
S_DSF69: Hawkesbury River Escarpment Dry Forest	1912: Hawkesbury River Escarpment Dry Forest	Not Listed	7.0
S_FoW01: Coastal Alluvial Bangalay Forest	1794: Coastal Alluvial Bangalay Forest	River-flat Eucalypt Forest on Coastal Floodplains	61.2
S_FoW05: Riverflat Paperbark Swamp Forest	1798: Riverflat Paperbark Swamp Forest	Swamp Sclerophyll Forest on Coastal Floodplains	2.8
S_FoW08: Estuarine Swamp Oak Forest	1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Swamp Oak Floodplain Forest	2.4
S_FoW09: Hinterland Riverflat Eucalypt Forest	941: Mountain Blue Gum-Thin-leaved Stringybark Open Forest on River Flat Alluvium in the Burragorang Valley, Sydney Basin	Not Listed	1.2
S_FrW01: Coastal Upland Damp Heath Swamp	1803: Coastal Upland Damp Heath Swamp	Coastal Upland Swamp	50.0
S_FrW02: Coastal Upland Wet Heath Swamp	1804: Coastal Upland Wet Heath Swamp	Coastal Upland Swamp	7.0
S_FrW03: Coastal Freshwater Wetland	781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Coastal Freshwater Wetlands on Coastal Floodplains	5.2
S_HL08: Coastal Sandstone Heath-Mallee	1824: Coastal Sandstone Heath-Mallee	Not Listed	986.3
S_HL09: Coastal Sandstone Rock Plate Heath	881: Hairpin Banksia-Kunzea ambigua-Allocasuarina distyla Heath on Coastal Sandstone Plateau, Sydney Basin	Not Listed	66.2
S_RF02: Coastal Sandstone Gallery Rainforest	1828: Coastal Sandstone Gallery Rainforest	Not Listed	59.1
S_RF03: Coastal Warm Temperate Rainforest	905: Lilly Pilly-Coachwood Warm Temperate Rainforest on Moist Sheltered Slopes and Gullies, Sydney Basin and South East Corner	Part of Lowland Rainforest on North Coast & Sydney Basin	3.4
S_SW01: Estuarine Mangrove Forest	920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner	Coastal Saltmarsh	10.8
S_SW02: Estuarine Saltmarsh	1126: Saltmarsh in Estuaries of the Sydney Basin and South East Corner	Coastal Saltmarsh	4.1
S_WSF02: Coastal Enriched Sandstone Moist Forest	1841: Coastal Enriched Sandstone Moist Forest	Not Listed	53.4
S_WSF06: Coastal Shale-Sandstone Forest	1845: Coastal Shale-Sandstone Forest	Not Listed	32.0
S_WSF33: Central Coast Escarpment Moist Forest	1565: Turpentine-Rough-barked Apple-Forest Oak Moist Shrubby Tall Open Forest of the Central Coast	Not Listed	0.6
S_WSF34: Central Coast Escarpment Dry Forest	1557: Rough-barked Apple-Forest Oak-Grey Gum Grassy Woodland on Sandstone Ranges of the Sydney Basin	Not Listed	12.3
S_WSF35: Coastal Diatreme Forest	1914: Coastal Diatreme Forest	Not Listed	2.2

Subject Site: Vegetation

Vegetation within the subject site was originally mapped and described by Smith and Smith (2011). The Warringah Council Natural Area study mapping of the subject site by P. and J. Smith (Warringah Council 2005b) is coarse and not considered to be representative of the true vegetation assemblages across the subject site. The mapping estimated that prior to the year 1750 the subject site likely supported only Sydney Sandstone Ridgetop Woodland (2005b). This mapping was undertaken over 12 years prior to the present study. The mapping was undertaken at a coarse scale with limited ground truthing.

Subsequent mapping undertaken by NSW Office of Environment and Heritage (OEH) was created in 2013 and updated in 2016. Existing Sydney Metropolitan vegetation mapping of the subject site (OEH 2016) was of low reliability owing to the coarse scale of the mapping combined with a lack of ground truthing. The Sydney Metropolitan Vegetation Mapping Project (OEH 2016) suggested a highly-simplified model of the vegetation on the subject site with only three vegetation types mapped:

- Sydney North Exposed Sandstone Woodland (S_DSF11);
- Coastal Sandstone Heath-Mallee (S_HI08); and
- Weeds and Exotics (OEH 2013a;2013b).

This mapping overlooked the characteristic stand of Sydney Ironstone -Bloodwood-Silvertop Ash Forest (Duffy's Forest EEC) which covers the upper escarpment on the subject site.

Through assessment of the landscape features (topography, geology and soils) of the site in, combination with detailed and systematic floristic data collected by Narla Environmental, it was confirmed that subject site contains four distinct native vegetation communities (**Figure 7**) (for diagnostic summary and nomenclature refer to **Table 4**):

- Duffy's Forest Vegetation Community (endangered ecological community);
- Coastal Upland Damp Heath Swamp (endangered ecological community);
- Coastal Sandstone Heath-Mallee; and
- Sydney North Exposed Sandstone Woodland.

A large remaining area, occupying the low-lying eastern extent of the subject site, was historically cleared of native vegetation. The area represents a highly-disturbed landscape which is now dominated by exotic, weedy vegetation. This area is mapped as 'cleared of vegetation' as it contains less than 5% native cover. Adjacent to this cleared area, along the northern boundary of the subject site, a dense stand of tall, woody weeds has established. These areas include a multitude of significant environmental and priority weeds which pose a severe threat to the vegetation and floristic biodiversity of the subject site if left unmanaged.

Table 4. Vegetation communities confirmed present within the subject site

In Text Reference	Total Extent (ha)	Sydney Metropolitan CMA Unit	Biometric Vegetation Type	NSW PCT ID	TSC Act	EPBC Act
Duffy's Forest EEC	1.57	Sydney Ironstone - Bloodwood-Silvertop Ash Forest (S_DSF14)	ME 98: Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region	1786 Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region (previously 1085)	Duffys Forest Ecological Community in the Sydney Basin Bioregion– endangered ecological community	Not Listed
Coastal Upland Swamp	0.17	Coastal Upland Damp Heath Swamp (S_FRW01)	ME 75: Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin	1803 Coastal upland damp heath swamp (previously 978)	Coastal Upland Swamp in the Sydney Basin Bioregion – endangered ecological community	Coastal Upland Swamps in the Sydney Basin Bioregion - Endangered
Coastal Sandstone Mallee-Heath	0.62	Coastal Sandstone Mallee-Heath (S_HL08)	ME 100: Mallee - Banksia - Tea-tree - Hakea heath-woodland of the coastal sandstone plateaus of the Sydney basin	1824 Coastal sandstone Heath-Mallee (previously 882)	Not Listed	Not Listed
Sydney North Exposed Woodland	0.94	Sydney North Exposed Sandstone Woodland (S_DSF11)	ME 106: Red Bloodwood - Scribbly Gum / Old-man Banksia open forest on sandstone ridges of northern Sydney and the Central Coast	1783 Sydney North exposed sandstone woodland (previously 1083)	Not Listed	Not Listed
Cleared Land / Pampas Grass Infestation	0.65	na	na	na	na	na
Woody Weed Infestation	0.17	na	na	na	na	na
Total	**4.12**					

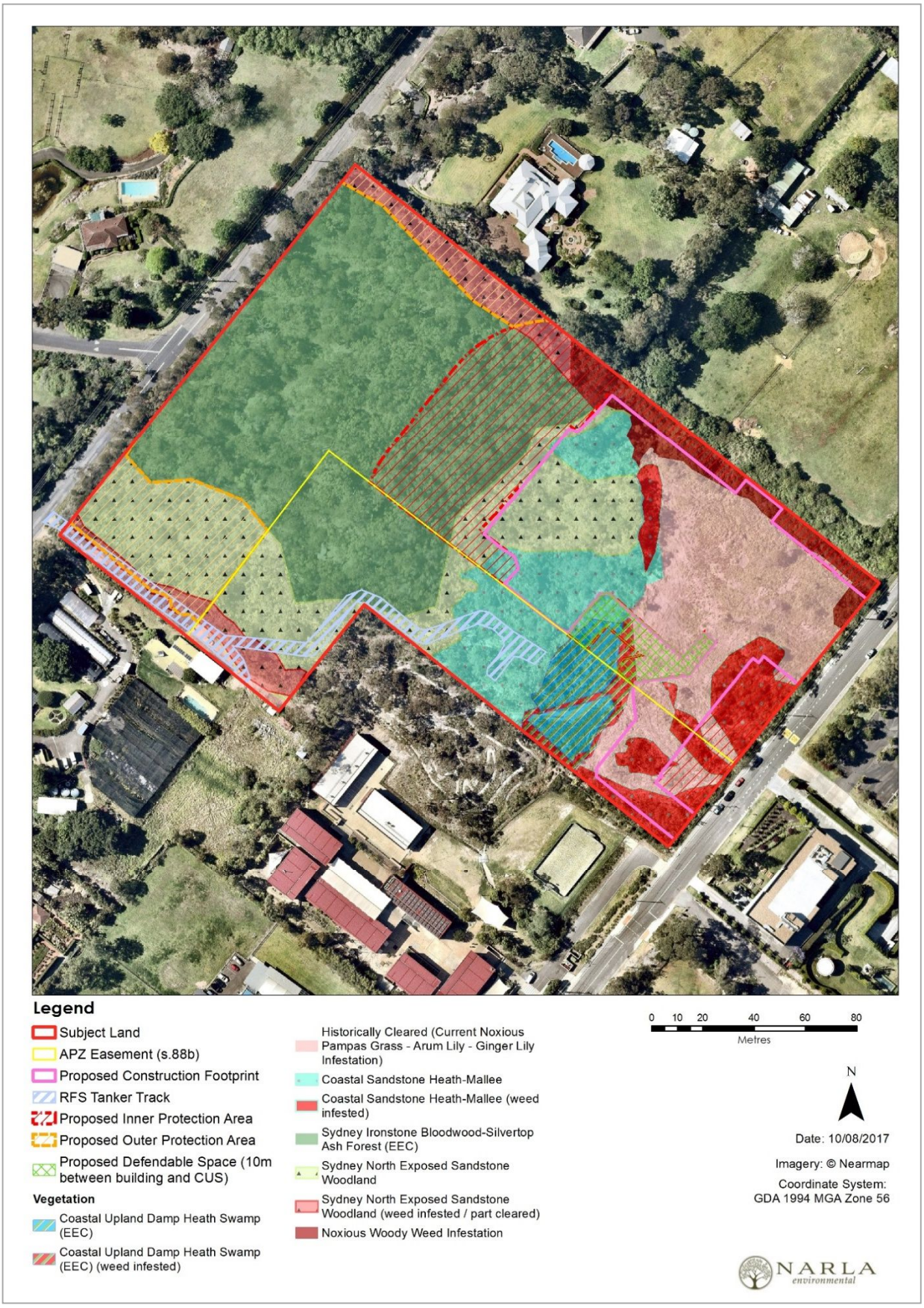


Figure 7. Extent and condition of vegetation communities mapped within the subject site

2.3 Plans and Maps

The location of the study area and subject site, land tenure and land use, significant areas for biodiversity, vegetation types, topography, hydrography, survey locations and survey findings are mapped within the SIS. These figures are located in the relevant sections of the document.

Table 5. Plans and Maps in SIS

Figure no.	Caption	Relevant Section of SIS
1	The Proposal including; construction boundary, Bush Fire Assessment Protection Zones, Drainage Infrastructure and Stormwater disposal facilities.	2.2
2	Topographic map of the subject site and study area	2.2
3	Location of the subject site in the broader landscape	2.2
4	Land uses in the Study Area	2.2
5	Land uses in the general area (5km)	2.2
6	Vegetation communities within a 5km radius of the subject site	2.2
7	Extent and condition of vegetation communities mapped within the Subject site	2.2
8	Threatened fauna records within the general area (5km) of the subject site	3.2
9	Threatened flora records within the general area (5km) of the subject site	3.2
10	Endangered Ecological Communities Map (5km radius)	3.2
11	Previous records and habitat for Caley's Grevillea and Hairy Geebung within the local occurrence	4.1.2
12	Potential habitat for tree-roosting and cave-roosting Microbats within the subject site	4.1.2
13	Location of biometric vegetation survey quadrats within the Study Area	4.2.1
14	Distribution of each technique of fauna survey employed during preparation of FFA	4.2.2
15	Additional survey undertaken for Species Impact Statement	4.2.2
16	Extent and condition of vegetation communities mapped within the Subject site	4.2.3
17	Location of threatened species found on the subject site by Narla Environmental	4.2.3
18	Location of Eastern Pygmy-possum records made during this study in reference to optimal habitat available and habitat linkage.	5.3.1
19	Proposed Eastern Pygmy Possum habitat and connectivity management and restoration measures	5.3.3
20	Habitat connectivity between the subject site and adjoining bushland remnant. Connectivity will remain post development.	5.5.3
21	The location of proposed construction and bushfire hazard management requirements in proximity to the Coastal Upland Swamp	6.1
22	Duffys Forest EEC in the local occurrence mapped by OEH (2013) and additional Duffys Forest Narla Environmental during the undertaking of this SIS.	6.2
23	Extent of Duffys Forest Ecological Community in the General Area (5km)	6.2
24	The local occurrence of Coastal Upland Swamp	6.2
25	Extent of Coastal Upland Swamp in the General Area (5km)	6.2
26	Detailed diagram of how the APZ areas will be managed of fuels while retaining important fauna habitat, particularly Eastern Pygmy Possum Feed plants and hollow limbs.	6.4.2
27	Landscape Plan (Carmichael Studios 2017)	7.1.1
28	Proposed Conservation Area that will be be protected in perpetuity under a Conservation Agreement	7.1.2

3. Initial Assessment

The CERs issued by OEH list species, populations and ecological communities that are to be considered as subject species in the preparation of the SIS (**Table 6**).

Table 6. Subject species, populations and ecological communities listed in the DGRs issued by OEH

Scientific Name	Common Name	TSC Act	EPBC Act	Comments (CERs)
AMPHIBIANS				
Heleioporus australiacus	Giant Burrowing Frog	V	V	Considered to have potential to occur by pre-DA EIA
Pseudophryne australis	Red-crowned Toadlet	V	-	Considered to have potential to occur by pre-DA EIA
BIRDS				
Calyptorhynchus lathami	Glossy Black Cockatoo	V	-	Recorded on/over site in pre-DA surveys
Glossopsitta pusilla	Little Lorikeet	V	-	Considered to have potential to occur by pre-DA EIA
Hieraaetus morphnoides	Little Eagle	V	-	Relatively recent record within 1.7 km
Lophoictinia isura	Square-tailed Kite	V	-	Recorded on/over site in pre-DA surveys
Haliaeetus leucogaster	White-bellied Sea-eagle	V	-	Relatively recent record within 700 m
Daphoensitta chrysoptera	Varied Sitella	V	-	Considered to have potential to occur by pre-DA EIA
Anthochaera phrygia	Regent Honeyeater	CE	CE	Considered to have potential to occur pre-DA EIA, several recent records within 4.5 km
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Records within 2.5-4 km
Lathamus discolor	Swift Parrot	E	CE	Considered to have potential to occur by pre-DA EIA
Tyto novaehollandiae	Masked Owl	V	-	Considered to have potential to occur by pre-DA EIA
Tyto tenebricosa	Sooty Owl	V	-	Considered to have potential to occur by pre-DA EIA
Ninox connivens	Barking Owl	V	-	Considered to have potential to occur by pre-DA EIA
Ninox strenua	Powerful Owl	V	-	Considered to have potential to occur by pre-DA EIA. Relatively recent records as close as 200 m (31 Myoora Rd in 2007
MAMMALS				
Cercartetus nanus	Eastern Pygmy-possum	V	-	Recorded on site in pre-DA surveys
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Considered to have potential to occur by pre-DA EIA
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Considered to have potential to occur by pre-DA EIA
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	Considered to have potential to occur by pre-DA EIA. Recent reliable records within 900 m
Petaurus norfolcensis	Squirrel Glider	V	-	Considered to have potential to occur by pre-DA EIA. Reliable 2008 recordfrom 1.2km NE
Miniopterus australis	Little Bentwing-bat	V	-	Considered to have potential to occur by pre-DA EIA. Recent records within 3.3 km
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Considered to have potential to occur by pre-DA EIA
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Considered to have potential to occur by pre-DA EIA
Saccolaimus flaviventris	Yellow-bellied Sheathtail-Bat	V	-	Recorded on/over site in pre-DA surveys. Recent records within 3.3 km
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Recorded on/over site in pre-DA surveys. Other recent records within 900 m
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Recorded on/over site in pre-DA surveys
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Considered to have potential to occur by pre-DA EIA

Scientific Name	Common Name	TSC Act	EPBC Act	Comments (CERs)
Vespadelus troughtoni	Eastern Cave Bat	V	-	Considered to have potential to occur by pre-DA EIA
REPTILES				
Varanus rosenbergi	Rosenberg's Goanna	V	-	Recorded on/over site in pre-DA surveys. >10 records within 2 km
FLORA				
Callistemon linearifolius	Nettled Bottle Brush	V	-	-
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Considered to have potential to occur by pre-DA EIA
Diuris bracteata		E	K	Atlas record within 3.1 km
Epacris purpurascens var. purpurascens		V	-	Reliable records within 500 m on Somersby soil landcape
Eucalyptus camfieldii	Camfield's Stringybark	V	V	Considered to have potential to occur by pre-DA EIA. Atlas records in locality are pre-1986
Genoplesium baueri	Bauer's Midge Orchid	E	E	Considered to have potential to occur by pre-DA EIA. Recent record from Belrose.
Grevillea caleyi	Caley's Grevillea	CE	E	Recorded on site in earlier surveys and in pre-DA surveys
Haloragodendron lucasii	Hal	E	E	1986 Atlas record within 2 km
Lasiopetalum joyceae		V	V	Considered to have potential to occur by pre-DA EIA
Melaleuca deanei	Deane's Paperbark	V	V	Considered to have potential to occur by pre-DA EIA
Microtis angusii	Angus's Onion Orchid	E	E	Considered to have potential to occur by pre-DA EIA
Persoonia hirsuta	Hairy Geebung	E	E	Considered to have potential to occur by pre-DA EIA
Pimelea curviflora var. curviflora		V	V	Considered to have potential to occur by pre-DA EIA. Several reliable records within 1.2 km reliable on Somersby soil landscape
Syzygium paniculatum	Magenta Lilly Pilly	E	V	Recent records within 700 m and 1200 m
Tetratheca glandulosa		V	-	Considered to have potential to occur by pre-DA EIA. >25 records within 1.2 km
ENDANGERED OR CRITICALLY ENDANGERED ECOLOGICAL COMMUNITIES				
Duffys Forest Ecological Community in the Sydney Basin Bioregion		E	-	-
Coastal Upland Swamp in the Sydney Basin Bioregion		E	E	-

V= vulnerable, E= endangered, CE = critically endangered, K = extinct

3.1 Assessment of available information

A thorough literature review of information relevant to the locality and the Northern Beaches Local Government Area (LGA) was undertaken.

A thorough literature review of local information relevant to the general area (5km x 5km radius) and the Northern Beaches Local Government Area (LGA) was undertaken. Relevant literature that were reviewed in preparation of this report are listed in **Table 7**.

Table 7. Database and literature review

Database/Literature	References
State and Commonwealth Databases	
Atlas of Living Australia	Atlas of Living Australia (2013) Species by Location – Local Government (Warringah), Australian Government, Canberra ACT.
NSW Wildlife Atlas	The Atlas of NSW Wildlife, Office of Environment and Heritage, NSW Government. Available at http://www.bionet.nsw.gov.au/. Accessed on various dates between 2016 and 2017. The OEH Wildlife Data Unit was contacted on 12th December 2017 and provided sensitive data for all sensitive species as per license 1291.
Protected Matters Search Tool (PMST)	DoE (2015) Protected Matters Search Tool, Department of Environment, Canberra ACT. Available at http://www.environment.gov.au/epbc/pmst/. Accessed on various dates between 2016 and 2017
Department of Primary Industries Records viewer	DPI (2013) Threatened and Protected Species – Records Viewer, Department of Primary Industries, NSW Government. Available at http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer. at http://www.dpi.nsw.gov.au/fishing/species-protection/threatened-species-distributions-innsw/freshwater-threatened-species-distribution-maps
NSW Threatened Species Profile Database	OEH (2016) NSW Threatened Species Profile Database, Office of Environment and Heritage, NSW Government. Available at http://www.environment.nsw.gov.au/threatenedspecies/ Accessed on various dates between 2016 and 2017
Office of Environment and Heritage (OEH) (2013b)	OEH (2016) Critical Habitat Register. Available at http://www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm. Accessed on 7 December 2017. Office of Environment and Heritage, NSW Government
Past Ecological Assessment Reports Adjoining the Site	
Narla Environmental Pty Ltd 2016a	Flora and Fauna Assessment Report and Biodiversity Management Plan produced for adjoining German International School, which involved field assessment of the section 88b APZ easement within the subject site.
Blue Mountains Wilderness Services Pty Ltd 2004	Flora and Fauna Assessment Report (Blue Mountains Wilderness Services Pty Ltd 2004) undertaken when the subject site was sub-divided from a bigger land parcel to two smaller land parcels.
NSW Scientific Committee Final Determinations	
NSW Scientific Committee 2012	Coastal Upland Swamp in the Sydney Basin Bioregion - endangered ecological community listing
NSW Scientific Committee 2011	Duffys Forest ecological community in the Sydney Basin Bioregion - endangered ecological community listing
State and Federal Conservation Advice for Threatened Species and EEC	
Department of Environment and Conservation	▪ Recovery Plan for *Melaleuca deanei*, (NSW) (2010) ▪ Approved Recovery Plan for *Grevillea caleyi (2004)* ▪ *Darwinia biflora* Recovery Plan (2010) ▪ Recovery Plan for Microstis angusii (2010) ▪ Approved Recovery Plan for Southern Brown Bandicoot (2006) ▪ Recovery Plan for the Large Forest Owls: Powerful Owl *Ninox strenua* Sooty Owl *Tyto tenebricosa* Masked Owl *Tyto novaehollandiae* (2006) ▪ National Recovery Plan for the Spotted-tailed Quoll Dasyurus maculatus. Commonwealth of Australian 2016) ▪ National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia) (Commownealth of Australia 2016) ▪ Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) (Commonwealth of Australia 2017)
Office of Environment and Heritage (OEH)	▪ Grevillea caleyi (a shrub) recovery plan ▪ Grevillea caleyi (a shrub) *Assessment of conservation status in NSW* (2013) ▪ Darwinia biflora recovery plan

Database/Literature	References
	▪ Melaleuca deanei recovery plan ▪ Microtis angusii ▪ Southern Brown Bandicoot recovery plan ▪ Southern Brown Bandicoot *Assessment of Conservation status in NSW* (2016) ▪ Large Forest Owls: Powerful Owl *Ninox strenua*, Sooty Owl, *Tyto tenebricosa* Masked Owl *Tyto novaehollandiae* approved recovery plan ▪ Grey-headed Flying fox recovery plan (draft)
Saunders and Tzaros	National Recovery Plan for the Swift Parrot Lathamus discolour (2011)
Vegetation Mapping	
Office of Environment and Heritage (OEH) (2013)	The Native Vegetation of the Sydney Metropolitan Area. (OEH 2013a;2013b)
Office of Environment and Heritage (OEH) (2017)	New South Wales Vegetation Information System (VIS) 2.1 (OEH 2017)
Department of Environment Climate Change and water	Operational Manual for BioMetric 3.1. (DECCW 2011)
Department of Primary Industries (DPI) Noxious Weeds – Warringah Council	DPI (2015b) Noxious Weed Declarations for Warringah Council. Department of Primary Industries, NSW Government. Available at http://weeds.dpi.nsw.gov.au/WeedDeclarations?RegionId=116. Accessed on December 2016
State and Federal Guidelines	
Department of Environment and Conservation	▪ Threatened Species Survey and Assessment: Guidelines for developments and activities. Working Draft. (2004) ▪ Threatened species survey and assessment guidelines: field survey methods for fauna: Amphibians (2009)
National Parks and Wildlife Service	Guidelines for Ecologically Sustainable Fire Management (NPWS 2004)
OEH Final Determinations index	http://www.environment.nsw.gov.au/committee/FinalDeterminations.htm .
Surveying Guidelines	
Commonwealth of Australia	▪ Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia 2010a) ▪ Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999(Commonwealth of Australia 2010b) ▪ Survey guidelines for Australia's threatened frogs. Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia 2010c) ▪ Survey guidelines for Australia's threatened mammals. Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia 2011) ▪ Survey guidelines for Australia's threatened orchids. Guidelines for detecting bats listed as 'threatened' under the Environment Protection and Biodiversity Conservation Act 1999(Commonwealth of Australia 2013)
Department of Environment and Conservation (2004)	Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft), New South Wales. Department of Environment and Conservation, Hurstville, NSW.
Office of Environment and Heritage	NSW Guideline to Surveying Threatened Plants (OEH 2016b)

Database/Literature	References
National parks and Wildlife Services	Environmental Impact Assessment Guidelines: Tetratheca glandulosa (NSW NPWS 2002)
Rural Fire Services NSW	Planning for Bushfire Protection. A guide for councils, planners, fire authorities and developers (NSW RFS 2016)
Council Documents	
Warringah Council	▪ Creek Management Study Final (Warringah 2004) ▪ Warringah Natural Area survey: Vegetation communities and plant species (Warringah 2005a) ▪ Warringah Natural Area survey: Vegetation history and wildlife corridors (Warringah 2005b) ▪ Warringah Natural Area Survey: Vegetation History and Wildlife Corridors 2009 Update (Smith and Smith 2009) ▪ Plan of Management: Threatened Bushland Reserves (Duffys Forest Ecological Community) (Warringah 2008a; 2008b) ▪ Warringah Tree Preservation Order Policy (Warringah 2003) ▪ Warringah DCP 2011 ▪ Warringah LEP 2011 ▪ Warringah Council Flora and Fauna Assessment Report Guidelines (Warringah 2014)
Northern Beaches Council	Weeds declared in the Local Control Authority area of Northern Beaches Council (DPI 2017)
Accompanying Project Documents	
Bushfire Assessment	Bushfire Assessment (Peterson Bushfire 2017)
Landscape Plan	Landscape Plan (Carmichael Studios 2017)
Hydrological Assessment	Hydrological Assessment (Martens 2017a)
Stormwater Management Report	Stormwater Management Report (Martens 2017b)
Arboricultural Impact Assessment Report	Arboricultural Impact Assessment Report (Urban Arbor 2017)
Chief Executives Requirements	CERs (data obtained 11 December 2017)
Other Resources	
Briggs and Leigh (1995)	Rare or Threatened Australian Plants. CSIRO Publishing, Collingwood
Birdata	Birdlife Australia (2005-2007) Atlas Bird Lists – Quick Postcode search (2101), Birdlife Australia. Available at http://www.birdata.com.au/maps.vm.
Department of Environment and Climate Change (2010)	Recovery Plan for *Microtis angusii*, Department of Environment, Climate Change and Water, NSW
Law (2013)	A Survey for Eastern Pygmy Possums *Cercartetus nanus* on the Ingleside Escarpment, Pittwater (B. Law June 2013)
Law (2014)	A Survey for Eastern Pygmy Possums *Cercartetus nanus* in selected Reserves of Pittwater (B. Law August 2014)
Office of Environment and Heritage	▪ Threat Abatement Plan 'Invasion of native plant communities by Chrysanthemoides monilifera (bitou bush and boneseed)' ▪ Threat Abatement Plan 'Predation by the Red Fox (*Vulpes Vulpes*)'
Plantnet	The Royal Botanic Gardens Trust Sydney 'Plant Net' database (accessed across the study period)
Robinson (2003)	Robinson (2003) Field Guide to Native Plants of Sydney. Revised 3rd Edition. Kangaroo Press, East Roseville NSW
Scotts (2003)	Scotts, D. (2003) Key Habitats and Corridors for Forest Fauna: A Landscape Framework for Conservation in north-east New South Wales. NSW National Parks and Wildlife Service, Huntsville NSW
Smith and Smith (2005)	Smith, P., Smith, J. (2005) Warringah Natural Area Survey: Vegetation communities and Plant Species. Report Prepared for Warringah Council, Sydney

3.2 Identifying subject threatened species, populations and ecological communities

A list of threatened ecological communities, populations and fauna species within a 5-km radius of the subject site was compiled based on the data available from the sources listed in **Table 7**. NSW Wildlife Atlas data is mapped in **Figure 8** and **Figure 9**.

In developing the list of subject species, populations and ecological communities, consideration was given to the habitat types present within the study area and the known distribution of threatened species, populations and ecological communities in the locality.

- The list of Threatened flora and fauna species and endangered populations recorded or predicted to occur within 5 kilometres of the subject site is provided in **Table 8**.
- The list of threatened ecological communities recorded or predicted to cocur within 5 kilometres of the subject site is provided in
- **Table 9**.

The short list of threatened fauna species and populations confirmed as 'subject species' is provided in **Table 10**.

The short list of threatened flora species and populations confirmed as 'subject species' is provided in **Table 11**.

The only two ecological community 'subject species' present on the Subject Site were:

- *Coastal Upland Swamp in the Sydney Basin Bioregion;* and
- *Duffys Forest Ecological Community in the Sydney Basin Bioregion*.

Table 8. Threatened species and endangered populations recorded within 5 kilometres of the study area or listed within the CERs

	Name	Conservation Status		Records	Habitat within study area	Likelihood of current occurrence in Subject site	Recorded on subject site
		TSC Act	EPBC Act				
Flora	*Tetratheca glandulosa*	V	-	166	Yes	Low	No
	Epacris purpurascens subsp. purpurascens	V	-	39	Yes	Unlikely	No
	Cryptostylis hunteriana	V	V	-	Yes	Unlikely	No
	Haloragodendron lucasii	E	E	2	Marginal	Unlikely	No
	Callistemon linearifolius	V	-	2	Yes	Unlikely	No
	Eucalyptus camfieldii	V	V	23	Yes	Unlikely	No
	Eucalyptus nicholii	V	V	1	No	Nil	No
	Eucalyptus scoparia	E	V	1	No	Nil	No
	Leptospermum deanei	V	V	15	Marginal	Unlikely	No
	Melaleuca deanei	V	V	11	Yes	Unlikely	No
	Syzygium paniculatum	E	V	4	No	Nil	No
	Kunzia rupestris	V	V	1	No	Unlikely	No
	Diuris bracteata	E	X	1	Marginal	Nil	No
	Genoplesium baueri	E	E	49	Yes	Low	No
	Microtis angusii	E	E	80	Yes	Low	No
	Grevillea caleyi	CE	E	726	Yes	Confirmed Present	Yes. Recorded in Blue Mountains Wilderness Services (2004). Recorded by Narla (2017a).
	Lasiopetalum joyceae	V	V	1	Yes	Unlikely	No
	Persoonia hirsuta	E	E	2	Yes	Low	Yes. One specimen recorded by Blue Mountains Wilderness Services (2004) and lodged in the NSW Herbarium. The single plant disappeared soon after. Despite thorough searches it was not relocated in 2004 or 2017.
	Pimelea curviflora subsp. curviflora	V	V	31	Yes	Low	No
Fauna	**AMPHIBIANS**						
	Giant Burrowing Frog	V	V	7	Marginal	Low	No
	Red-crowned Toadlet	V	-	97	Yes	Moderate	No
	Green and Golden Bell Frog	E	V	1	No	Nil	No
	REPTILES						
	Rosenberg's Goanna	V	-	79	Yes	Confirmed Present	Yes
	BIRDS						
	Black Bittern	V	-	1	No	Nil	No
	White-bellied Sea-Eagle	V	C	3	Yes	Moderate	No
	Little Eagle	V	-	1	Yes	Moderate	No
	Square-tailed Kite	V	-	2	Yes	Confirmed Fly-over	Yes
	Gang-gang Cockatoo	V	-	1	Marginal	Nil	No
	Glossy Black-Cockatoo	V	-	39	Yes	Confirmed Present	Yes
	Little Lorikeet	V	-	4	Yes	Moderate	No
	Swift Parrot	E	CE	4	Yes	Low	No
	Barking Owl	V	-	2	Yes	Moderate	No
	Powerful Owl	V	-	37	Yes	High	No
	Masked Owl	V	-	1	Yes	Moderate	No
	Sooty Owl	V	-	2	Yes	Unlikely	No
	Regent Honeyeater	E	CE	8	Yes	Low	No
	Black-chinned Honeyeater (eastern subspecies)	V	-	1	Yes	Unlikely	No
	Dusky Woodswallow	V	-	2	Yes	Low	No
	MAMMALS						
	Spotted-tailed Quoll	V	E	8	Yes	Low	No

Name	Conservation Status		Records	Habitat within study area	Likelihood of current occurrence in Subject site	Recorded on subject site
	TSC Act	EPBC Act				
Southern Brown Bandicoot (eastern)	E	E	68	Yes	Low	No
Koala in the Pittwater Local Government Area	E	V	1	Yes	Unlikely	No
Koala	V	V	8	Yes	Unlikely	No
Eastern Pygmy-possum	V	-	109	Yes	Confirmed Present	Yes
Squirrel Glider	V	-	1	Yes	Low	No
Grey-headed Flying-fox	V	V	35	Yes	Confirmed Fly-over	Yes
Yellow-bellied Sheathtail-bat	V	-	2	Yes	Confirmed Fly-over	Yes
Eastern Freetail-bat	V	-	3	Yes	Moderate	No
Large-eared Pied Bat	V	V	5	Yes	Low	No
Little Bentwing-bat	V	-	11	Yes	Moderate	No
Eastern Bentwing-bat	V	-	43	Yes	Confirmed Present	Yes
Southern Myotis	V	-	12	Yes	Unlikely	No
Greater Broad-nosed Bat	V	-	1	Yes	Moderate	No

Table 9. Endangered ecological communities recorded within 5 kilometres of the study area or listed within the CERs

Name	Conservation Status		Habitat within study area	Likelihood of occurrence	Recorded in initial survey
	TSC Act	EPBC Act			
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	V	No	None	No
Coastal Upland Swamp in the Sydney Basin Bioregion	E	E	Yes	High - Known	Yes
Duffys Forest Ecological Community in the Sydney Basin Bioregion	E		Yes	High - Known	Yes
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		No	None	No
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	No	None	No
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	No	None	No
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	No	None	No

Threatened species: fauna

A list of threatened ecological communities, populations and fauna species within a 5-km radius of the subject site was compiled based on the data available from the sources listed in **Table 7**. BioNet Atlas of NSW fauna data is mapped in **Figure 8**.

Thirty-five (35) threatened fauna species were identified from the data searches or identified in the CERs as species that must be considered for inclusion in the list of subject species. An assessment of likely occurrence was based on frequency of records, habitat availability, level of general and targeted survey and professional knowledge.

Twenty-eight (28) fauna species were determined to have some likelihood of occurrence (low, moderate, high or known probability) on the subject site and warrant inclusion as subject species.

No endangered populations are likely or known to occur within the study area (**Table 10**).

Table 10. Fauna subject species

Name	Conservation Status		Likelihood of occurrence
	TSC Act	EPBC Act	
Giant Burrowing Frog	V	V	Low
Red-crowned Toadlet	V	-	Low
Rosenberg's Goanna	V	-	Known
White-bellied Sea-Eagle	V	C	Moderate
Little Eagle	V	-	Moderate
Square-tailed Kite	V	-	Moderate
Glossy Black-Cockatoo	V	-	Known
Little Lorikeet	V	-	Moderate
Swift Parrot	E	CE	Low
Barking Owl	V	-	Low
Powerful Owl	V	-	High
Masked Owl	V	-	Low
Sooty Owl	V	-	Low
Regent Honeyeater	E	CE	Low
Varied Sittella	V	-	Moderate
Dusky Woodswallow	V	-	Low
Spotted-tailed Quoll	V	E	Low
Southern Brown Bandicoot (eastern)	E	E	Moderate
Eastern Pygmy-possum	V	-	Known
Squirrel Glider	V	-	Low
Grey-headed Flying-fox	V	V	High
Yellow-bellied Sheathtail-bat	V	-	High
Eastern Freetail-bat	V	-	Moderate
Eastern False Pipistrelle	V	-	Moderate
Large-eared Pied Bat	V	V	Low
Little Bentwing-bat	V	-	Moderate
Eastern Bentwing-bat	V	-	Moderate
Greater Broad-nosed Bat	V	-	Moderate

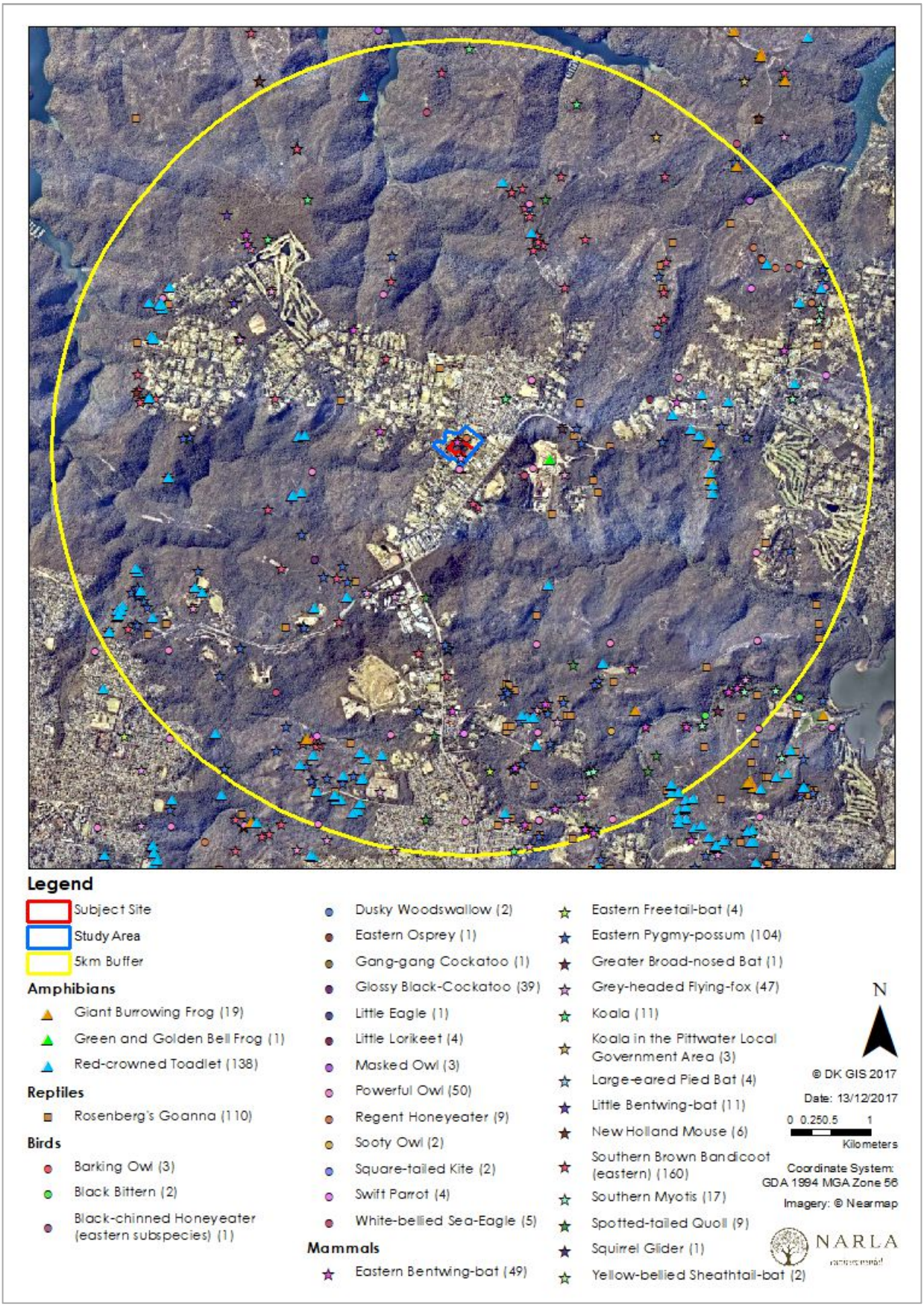


Figure 8. Threatened fauna records within the general area (5km) of the subject site

Threatened species: flora

A list of threatened ecological communities, populations and flora species within a 5-km radius of the subject site was compiled based on the data available from the sources listed in **Table 7**. BioNet Atlas of NSW flora data is mapped in **Figure 9.**

Twenty (20) threatened flora species were identified from the data searches or identified in the CER's as species that must be considered for inclusion in the list of subject species. An assessment of likely occurrence was based on frequency of records, habitat availability, level of general and targeted survey and professional knowledge (**Table 8**).

Eleven (13) species were determined to have a reasonable likelihood of occurrence (moderate and high probability) and warrant inclusion as subject species (**Table 11**).

No endangered populations are likely or known to occur within the study area.

Table 11. Flora subject species

Name	Conservation Status	
	TSC Act	EPBC Act
Tetratheca glandulosa	Vulnerable	-
Epacris purpurascens subsp. purpurascens	Vulnerable	-
Cryptostylis hunteriana	Vulnerable	Vulnerable
Callistemon linearifolius	Vulnerable	-
Darwinia biflora	Vulnerable	-
Melaleuca deanei	Vulnerable	-
Eucalyptus camfieldii	Vulnerable	Vulnerable
Genoplesium baueri	Endangered	Endangered
Microtis angusii	Endangered	Endagered
Grevillea caleyi	Critically Endangered	Endangered
Lasiopetalum joyceae	Vulnerable	Vulnerable
Persoonia hirsuta	Endangered	Endangered
Pimelea curviflora subsp. curviflora	Vulnerable	Vulnerable

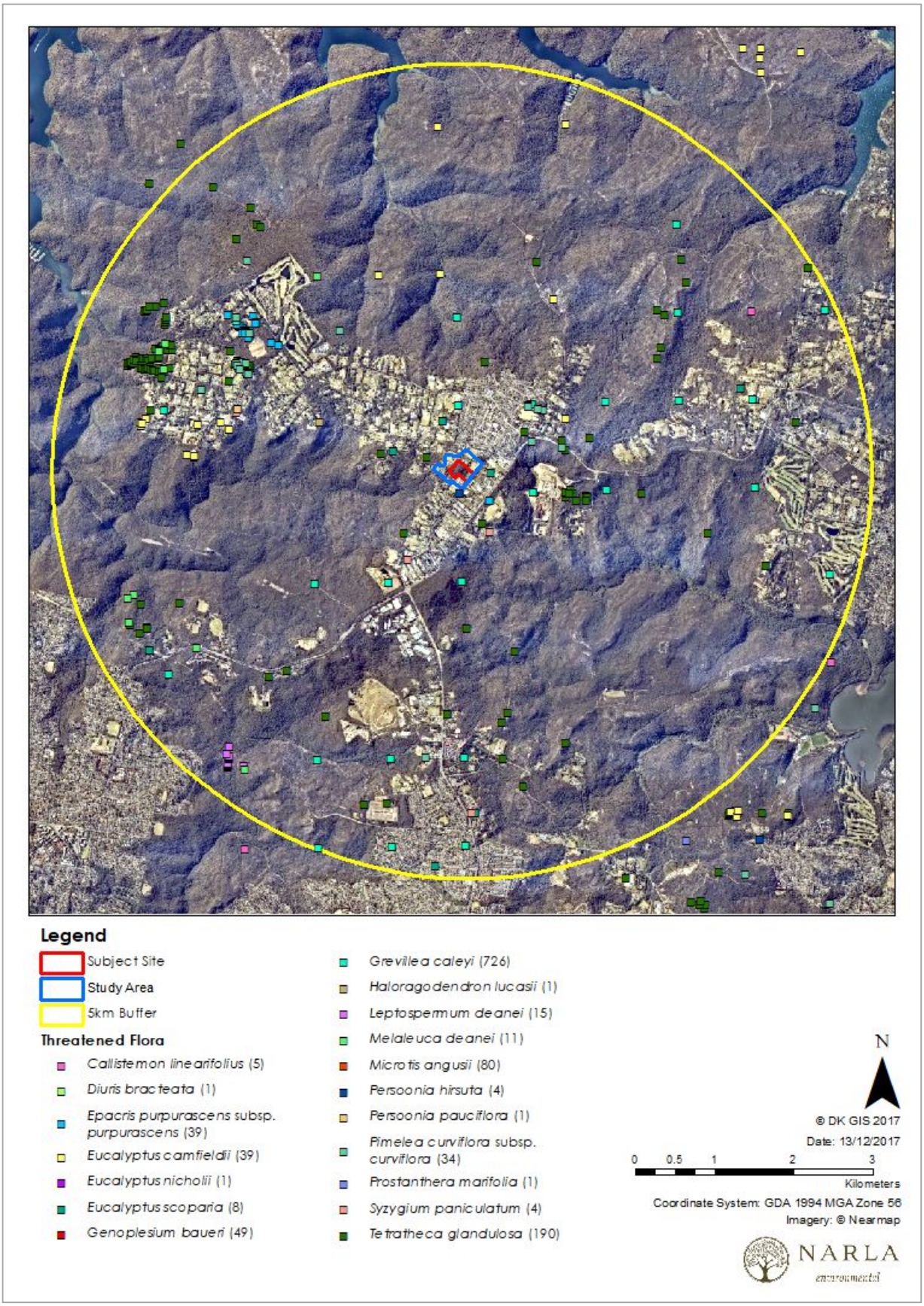


Figure 9. Threatened flora records within the general area (5km) of the subject site

Endangered Ecological Communities

Based on desktop and field assessment, it is predicted that only two (2) of these endangered ecological communities may occur within the site:

- Duffys Forest Ecological Community in the Sydney Basin Bioregion; and
- Coastal Upland Swamp in the Sydney Basin Bioregion.

The presence of each of these communities was confirmed by Narla Environmental during field survey undertaken in 2016. Comprehensive floristic survey, including establishment of biometric plots helped identify these communities to the level of Sydney Metropolitan Vegetation Community (OEH 2013a;2013b) and Plant Community Type (PCT).

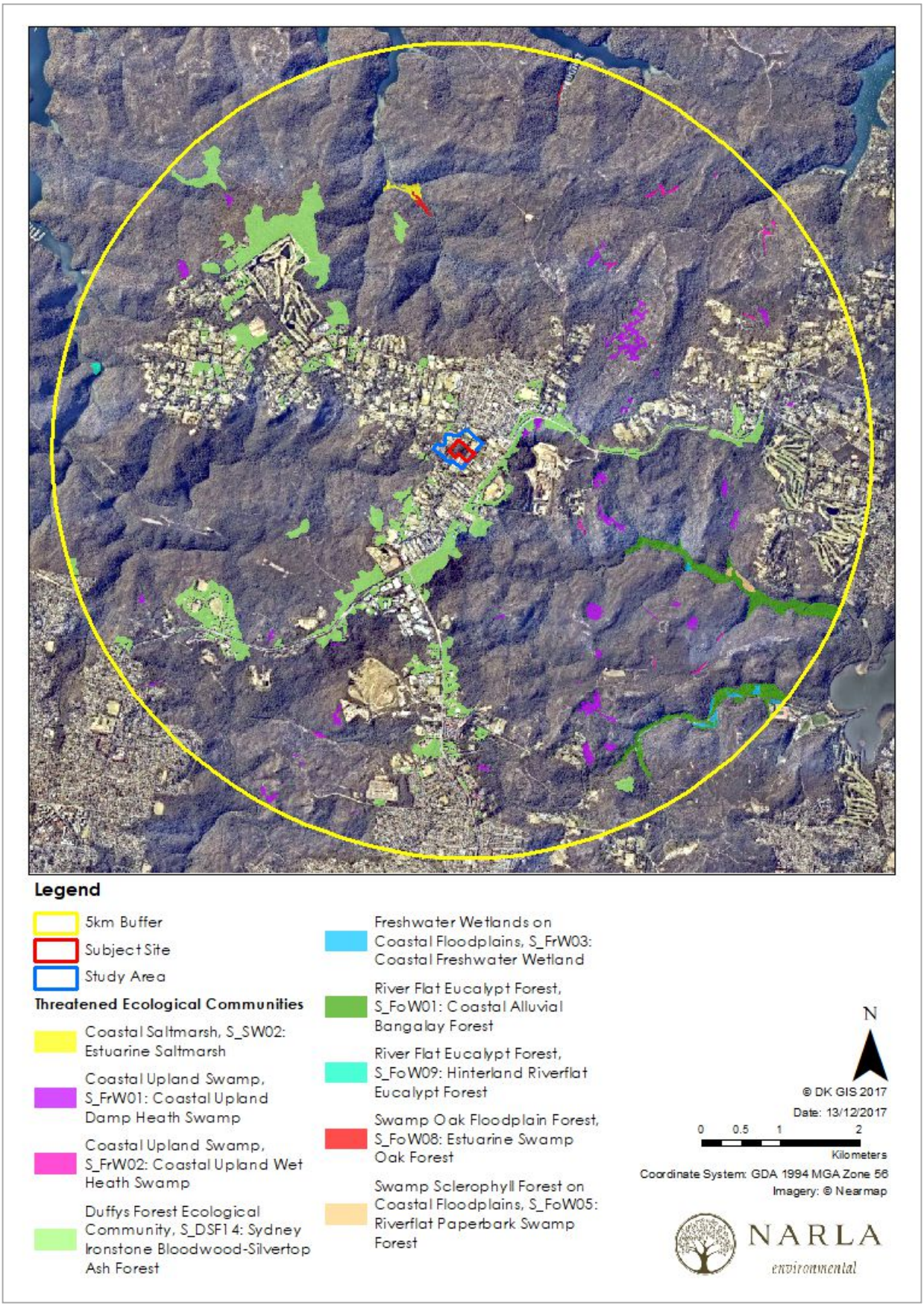


Figure 10. Endangered Ecological Communities Map (5km radius)

4. Survey

4.1 Requirement to survey – vegetation, ecological communities and species

4.1.1 General survey requirements for species

Vegetation and ecological communities on the subject site have been surveyed, described (including documentation of the areal extent of each vegetation community) and accurately mapped by Narla.

This includes areas with both introduced and native species, and areas with the potential to regenerate, either naturally or with assistance, to native vegetation.

Vegetation classifications have regard to both structural and floristic elements and are supported by quantitative data from 0.04 ha plots, in accordance with Appendix 4 Modules 1 'Minimum requirements' and Module 2 'Floristics' of the Native Vegetation Interim Type Standard (DECCW, January 2010) (www.environment.nsw.gov.au/resources/nativeveg/10060nvinttypestand.pdf). Prior to sampling the study area was stratified, taking into account variation in composition, structure, condition and disturbance. These stratification units were then sampled using 400 m2 quadrats (BioMetric Plots). Quadrats were placed as randomly as possible, given study area constraints.

Preliminary field surveys and reporting were undertaken by Blue Mountains Wilderness Services in 2004 for a proposal subdividing the study area and the adjoining property (Lot1/DP1145029).

Further survey has been undertaken by Narla Environmental for the current proposal between October 2016 and November 2017. This included:

- Vegetation type and vegetation condition surveys - including floristic, BioMetric plots and transects conducted during November 2016;
- Targeted threatened flora surveys - including identification of threatened, non-threatened, ROTAP and locally significant species, conducted periodically for a total of 8 days between July 2016 and March 2017;
- Fauna habitat assessments and targeted fauna surveys in accordance with DEC's *Threatened Species Survey and Assessment Guidelines* (DEC 2004) - carried out between 31st October 2016 and 30th November 2017.

Narla undertook a detailed array of additional targeted flora surveys to meet the requirements of the CERs and supplement the previous surveys undertaken by Blue Mountains Wilderness Services (2004), including targeted surveys for all species listed in **Table 8**.

4.1.2 Additional survey requirements for specific species

In addition to the survey results reported above, the CERs outline specific survey requirements (see CERs Section 4.2.2) (**Appendix A**) which are addressed in this section of the SIS.

Flora Species

Specific survey requirements were identified in the CERs for three threatened flora species:

- *Grevillea caleyi*;
- *Persoonia hirsuta*; and
- *Pimelea curviflora var. curviflora*

Surveys were timed to coincide with peak flowering, seeding or emergence periods of each of the targeted species as determined from a literature review and summarised in **Table 16**. The survey period was considered to have adequately sampled the range of seasons and climatic conditions (**Table 17**) typically required to record the species targeted.

Any tentative threatened species found were photographed and specimens taken for identification utilising formal keys. Where necessary this involved the use of a microscope. Any confirmed or plausible specimens identified were GPS tagged, for future reference.

Where identification of plausible specimens could not be made with absolute confidence by Narla Ecologists, specimens were collected and sent to the National Herbarium for expert identification. Several specimens of *Epacris spp*. that could not be positively confirmed as Epacris pulchella or *E.purpurascens var. purpurascens* were sent to the Herbarium for identification confirmation.

All orchid species were specifically targeted during their known flowering periods. The level of survey conducted for the orchids should be sufficient to detect these species if flowering.

Targeted flora surveys involved detailed searches of available habitat by specialists. Details of the targeted flora survey are presented (**Table 18**).

***Grevillea caleyi* (Caley's Grevillea)**

Two small clusters of 3 and 7 plants were identified on the subject site (**Figure 17**). These plants are located outside of the proposed construction footprint and APZ areas and will be protected and maintained for the lifespan of the hospital. This area of the subject site is not going to be impacted by the development but will rather be protected under a conservation agreement or covenant.

All specimens were located on the upper escarpment within the Duffy's Forest EEC patch. Caley's Grevillea has been found to rarely grow outside of areas supporting Duffys Forest vegetation community (OEH 2014).

Only mature specimens of the species of comparative age were identified. No evidence of natural recruitment was found within the subject site, which likely reflects the time period since fire. Whilst fire is known to kill mature Caley's Grevillea, evidence suggests that it is also essential for the germination of its seeds (OEH 2014, Auld and Ooi 2008). Propagation of this species occurs solely through seeds, although seed viability can be low (DEC 2004, TSSC 2015).

All Caley's Grevillea on the subject site will be retained and protected in perpetuity. They will be managed under the site BMP (Narla 2017a).

Previous records and habitat mapping are shown in **Figure 11**.

***Persoonia hirsuta* (Hairy Geebung)**

One specimen of *Persoonia hirsuta* (Hairy Geebung) was recorded and mapped within the subject site during a previous study of the subject site which was undertaken over 13 years prior to the present study (Blue Mountains Wilderness Services 2004). The plant was recorded during initial surveys by Blue Mountains Wilderness Services (2004) and a specimen was lodged with the NSW Herbarium.

The plant was recorded on the 'eastern corner of the quarry'. This area of the subject site is not going to be impacted by the development but will rather be protected under a Conservation Agreement.

Targeted random meander surveys for Hairy Geebung were undertaken throughout suitable vegetation types on numerous occasions between July 2016 and December 2017. Additional random meander surveys targeting this species were undertaken in November and December 2017. A total of 65-person survey hours have been undertaken by Narla toargeting this species. All revealed no individuals. Details of the extent of targeted survey are provided in **Table 18**.

Despite multiple targeted surveys undertaken through the subject site by Blue Mountains Wilderness Services (2004) and Narla Environmental across the subject site, no Hairy Geebung has been found since that initial record from 2004. It is presumed to have been extripated from the site, however if it still occurs, it is expected to only occur in the seedbank in close vicinity to the initial record.

Previous records and habitat mapping are shown in **Figure 11.**

Pimelea curviflora var. curviflora

Pimelea curviflora var. curviflora has never been recorded on the subject site (Blue Mountains Wilderness Services 2004; Narla 2017).

Targeted random meander surveys for *Pimelea curviflora var. curviflora* were undertaken throughout suitable vegetation types on numerous occasions between July 2016 and December 2017 whilst this species was flowering. A total of 65-person survey hours have been undertaken by Narla targeting this species. All revealed no individuals. Details of the extent of targeted survey are provided in **Table 18.**

A *Pimelea curviflora var. curviflora* reference site was used to determine suitability for survey timing on the subject site. Narla attended a known population of *Pimelea curviflora var. curviflora* at 9 Cadwells Road, Kenthurst, NSW (-33.628683, 150.969362) and confirmed the species was flowering from 16 November 2016 through to late December 2016.

Despite thorough searches, no specimens were identified within the subject site. Based on Narla's experience in surveying for this species, and our access to a known reference site, it is expected that *Pimelea curviflora var. curviflora* would have been detected if it was present on the subject site during the survey period.

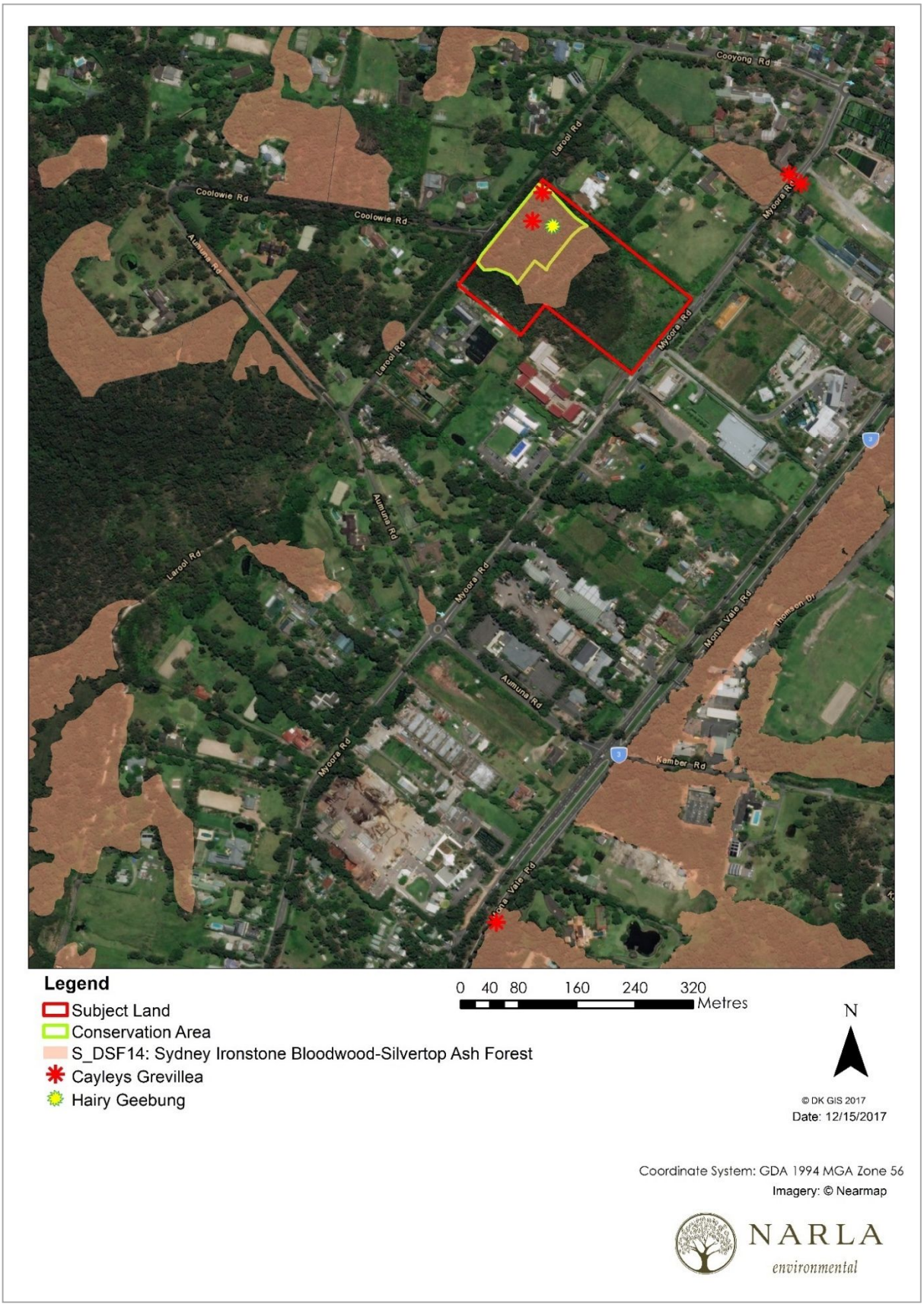


Figure 11. Location of Caley's Grevillea and historical record of Hairy Geebung along with habitat for both species within the local occurrence

Fauna Species

In addition to all standard surveys carried out to assess the subject species, additional targeted surveys were undertaken for the following threatened fauna in accordance with the CERs:

- Eastern Pygmy-possum;
- Tree-roosting microchiropteran bats; and
- Cave, tunnel or culvert-roosting microchiropteran bats.

Narla Environmental performed specialised surveys to target such animals, as summarised in **Table 18**.

Microchiropteran bats

Two bat acoustic monitors (Song Meter SM4 Bat) were installed within habitat most likely to be utilised by micro-bats. Both were installed by attachment to trees, with one directed at flyways and the other towards the entrance of caves associated with the escarpment (**Figure 15**). The units were deployed within the field for a total of six nights and including a combination of set point and hand-held detectors. Analysis of the collected data was undertaken by a specialist Tim Pearson (2016).

All passive acoustic data was analysed by microbat expert, Timothy Pearson, using AnaLookW (Corben 2013) with a generic filter applied to exclude poor quality calls unsuitable for identification and noise. Calls with fewer than four clearly defined non-fragmented pulses were also excluded from analysis. Identification of species was carried out by comparing to regional reference calls and published descriptions (Pennay *et al*. 2004).

Two harp traps were established across three locations within the subject site, across four consecutive nights (27th – 30th November 2017). Two harp traps were placed in suitable flyways to survey the length of the study area this included clearings/tracks in open woodland habitats (excluding 'disturbed' areas). An additional two harp traps were placed at the entrance to sandstone crevices. These traps were positioned to target cave-roosting microbats.

Harp Traps were checked each morning between 05:00 and 07:00 and were then moved or dismantled to prevent bycatch during the day (e.g. birds), before being reset in the evening. Despite suitable placement of harp traps within the subject site, no bats were captured across the four-night survey period.

Diurnal active searches were undertaken and included crevices and under bark and in mammal burrows (for Yellow-bellied Sheathtail-bat) to detect roosting bats. In addition, opportunistic searches of rock overhangs for roost and maternal sites of cave-dwelling bats were undertaken by Narla Environmental during spring and summer surveys.

Habitat mapping are shown **Figure 12.**

Figure 12. Potential habitat for tree-roosting and cave-roosting Microbats within the subject site

Table 12. Weather conditions in the during microchiropteran bat targeted surveys

Activities	Date	Day	Temps		Rain (mm)	Max wind gust		
			Min (°C)	Max (°C)		Dir	Spd (km/h)	Time
Acoustic bat recording survey	01/11/2016	Tu	10.9	21.0	0	E	30	14:39
	02/11/2016	We	11.0	22.4	0	SW	31	09:24
	03/11/2016	Th	12.2	24.2	0	ENE	28	16:27
	04/11/2016	Fr	13.6	28.7	0	WSW	30	12:06
	05/11/2016	Sa	20.2	24.5	0	W	57	08:16
	06/11/2016	Su	11.6	23.1	0	SW	41	10:50
Harp Trapping survey	27/11/2017	Mo	17.9	24.3	0	ENE	31	16:13
	28/11/2017	Tu	16.3	26.0	0	ESE	28	12:39
	29/11/2017	We	18.6	25.3	0.8	E	24	14:13
	30/11/2017	Th	17.3	26.5	1.2	ENE	43	16:37

Eastern Pygmy-possum

Eastern Pygmy-possum surveys were undertaken to determine the importance of individuals within the proposal area to the ongoing/long-term survival of the population that occupies the study area. This included collecting data to gain a better understanding of the movements of individuals across the existing road. The surveys were also undertaken to determine the importance of the habitat present in the study area and the availability of similar habitat in the wider locality to determine the impact on the species and population if this habitat is to be removed.

The Eastern Pygmy-possum had been previously identified on site during 2016 pitfall trapping surveys (**Figure 17**).

Custom designed nest boxes were installed within the subject site on the 9th March 2017 (**Plate 1**). A total of 10 custom-designed Eastern Pygmy Possum nest boxes were installed throughout the subject site within areas outside the proposed development footprint and associated impact areas. Nest Boxes were designed to the standards of the Greater Sydney Local Land Services – Wildlife Nest Box designs (2015). The dimensions of these nest boxes are 90cm x 90cm x 325cm in accordance with Local Land Services (LLS) *Build your own Wildlife Nest Box*. All nest boxes were erected in areas of suitable foraging habitat; this included sheltered areas in close proximity to flowering *Banksia ericifolia, Corymbia gummifera* and *Lambertia formosa,* at heights of approximately 1.5 m (**Figure 19**). Each nest box was filled with crushed Red Bloodwood bark to provide insulation. All nest boxes were subject to two periods of monitoring by Narla Environmental Ecologists in the lead up to this report and the dates of these events are listed (**Table 18**).

In addition to nest box inspections, intensive remote camera trapping for Eastern Pygmy Possum was undertaken across the subject site during:

- 31st October 2016 – 7th November 2016; and
- 11th – 19th of April 2017.

Eastern Pygmy Possums were observed on camera footage on a number of occasions during camera trapping within the subject site in 2017.

Additional targeted survey for Eastern Pygmy Possum was undertaken across the locality surrounding the subject site, from Larool Road to Dundundra Falls Reserve from 23rd of November 2017 – 8th of December 2017.

All remote cameras were erected, facing the inflorescenses of nectar-producing trees (*Banksia spp.*) which were further sprayed with a honey-water mixture.

Plate 1. Eastern Pygmy-possum Nest Boxes Established in the subject site

A local expert on Eastern Pygmy-possum, Ecologist Paul Burcher of Aquila Ecological Surveys undertook a targeted survey for Eastern Pygmy-Possum habitat within the vicinity of the subject site (Dundundra Falls Reserve and Coolowie Road) on three days between 1/12/2017 – 7/12/2017. Dense sands of *Banksia ericifolia* were targeted marked using a hand-held GPS. Extensive foraging habitat suitable for Eastern Pygmy-possum was mapped and presented (**Figure 19**). This mapping helped Narla Environmental target suitable locations for further camera trapping undertakin during the preparation of this SIS.

Rosenberg's Goanna/Heath Monitor

A designated targeted survey for *Varanus rosenbergi* (Rosenberg's Goanna) was conducted during warm weather from the 7th to14th March 2017. During each survey period, five automated wildlife cameras were set up in suitable areas around the Subject site. Locations of camera placement reflected the variety of vegetation structures found within the Subject site (**Figure 14**). Cameras were baited with meat (chicken necks and sardines) to attract Rosenberg's Goanna and other carnivorous fauna. Automated wildlife cameras were attached to trees ~1-2m away and directed at the bait. On the 28th of April 2017 Narla Ecologists observed a Rosenberg's Goanna sunbathing within the subject site. This was located well outside of the APZ and construction footprint.

Automated wildlife camera survey was conducted during dry warm days in order to maximise the possibility of capturing active reptile species. Weather conditions during survey are listed in **Table 13**.

A single Rosenberg's Goanna was observed in the subject site on the 24th April 2017. The location of this sighting is presented (**Figure 17**).

Table 13. Weather conditions in the lead up to and during 2017 Rosenberg's Goanna targeted surveys

Activities	Date	Day	Temps		Rain (mm)	Max wind gust		
			Min (°C)	Max (°C)		Dir	Spd (km/h)	Time
Lead up to Rosenberg's Goanna Survey	4/03/2017	Sa	18.6	21.5	14.8	S	41	13:33
	5/03/2017	Su	18.3	22	10.6	SSW	43	17:54
	6/03/2017	Mo	17.9	23.4	0.4	S	50	14:00
Rosenberg's Goanna: Automated Camera Survey	7/03/2017	Tu	15.4	20.7	0.8	S	44	14:15
	8/03/2017	We	14.8	21.4	7.4	SSW	35	1:47
	9/03/2017	Th	15.4	22.4	3.4	SE	33	14:16
	10/03/2017	Fr	15.4	23	0.2	SSE	33	15:14
	11/03/2017	Sa	15.5	23.3	0	ESE	24	14:36
	12/03/2017	Su	16.7	26.8	0	NE	39	18:50
	13/03/2017	Tu	19.9	26.3	0	ENE	46	15:42
	14/03/2017	We	20.1	21.8	0.2	ENE	46	12:03

Red-crowned Toadlet and Giant Burrowing Frog

Call Playback was undertaken on four nights, each for a three-hour period. Two nights of survey occurred between 1st-2nd November 2016 and additional survey was conducted on the 27th February 2017, and 1st March 2017. Survey was carried out immediately following wet weather, during ideal survey conditions. Weather conditions including rainfall can be found in **Table 14**.

Table 14. Weather conditions in the lead up to and during 2016 Red-crowned Toadlet and Giant Burrowing Frog targeted surveys.

Activities	Date	Day	Temps		Rain (mm)	Max wind gust		
			Min (°C)	Max (°C)		Min (°C)	Max (°C)	Time
Lead up to Red-crowned Toadlet & Giant Burrowing Frog	20/02/2017	Mo	13.5	26	2.4	W	46	9:31
	21/02/2017	Tu	15.1	25.1	0	E	35	17:21
	22/02/2017	We	19.1	26.3	0	NE	44	18:08
	23/02/2017	Th	18.7	27.7	0	NE	33	16:08
	24/02/2017	Fr	18.5	26.6	0	ENE	28	13:07
	25/02/2017	Sa	18	19.7	8.4	SSW	31	2:48
	26/02/2017	Su	16.9	22.6	28.8	SE	35	12:23
	28/02/2017	Tu	18.3	24.4	6.8	NE	33	12:21
Red-crowned Toadlet Surveys & GBF	27/02/2017	Mo	16.7	24.5	43	SE	35	13:56
	1/03/2017	We	19	25.3	9.2	ESE	43	2:53

Nineteen call playback locations were selected within the Subject site, on the basis of containing some habitat potential, particularly wet or moist areas with moist leaf litter, debris, rocks and a cover of sedges or ferns such as *Gleichenia dicarpa*. Red-crowned Toadlet and Giant Burrowing Frog calls were played though a loud speaker to maximise the chance of response. Calls were played for 5-10 minutes at each call-playback site with 5-10 minutes of listening and active searches.

4.2 Documentation

The survey method and effort for each survey component was designed to include and then build on existing data collected for the flora and fauna assessment undertaken for the study area and to meet the specific survey requirements listed in the Chief Executive Requirements (as per Section 4 of the CERs Attachment – dated 11/12/2017 and any subsequent correspondence).

The following sections of this report detail the site assessments undertaken by Narla Environmental including the survey methods and the weather conditions experienced in the lead-up and during each assessment.

4.2.1 Description of survey techniques and survey locations

Survey techniques and locations: Vegetation Communities

Vegetation community assessment first took place in October 2016. Narla Ecologists first assessed aerial imagery, geological mapping, soil landscape mapping and topographic mapping, in addition to existing vegetation mapping (Sydney Metropolitan Vegetation Mapping [OEH 2013a; 2013b]) to stratify the Subject site into distinct stratigraphic units.

The Ecologists then used the 'random meander method' (Cropper 1993) to effectively traverse the site and further validate and delineate vegetation stratigraphic unit across the Subject site. Where the boundaries of vegetation stratigraphic units differed from existing Sydney Metropolitan Vegetation Mapping (OEH 2016a; 2016b) these boundaries were delineated on paper maps in the field and recorded in a GPS. Photographs and GPS waypoints were taken throughout this time for reference.

Quadrats (Biometric)

At least one biometric vegetation plot (including a 20 m x 20 m [400m^2] full floristic plot) was sampled to collect floristic data to assist with the determination of each vegetation community within the Subject site and meet the minimum requirements of the CERs. This data, along with opportunistic floristic data collected from each stratigraphic unit was compared against a suite of Sydney Metropolitan Vegetation Mapping 'positive diagnostic tests' (OEH 2016a; 2016b) to determine each vegetation community against a suite of possible/candidate communities. The first candidate communities assessed were the communities that were initially mapped as occurring within the Subject site in OEH (2016a; 2016b):

- Sydney North Exposed Sandstone Woodland (S_DSF11);
- Coastal Sandstone Heath-Mallee (S_HI08) and; and
- Weeds and Exotics.

Narla allocated each vegetation stratigraphic unit to a 'vegetation community' from OEH (2013a;2013b) based on the number of 'positive diagnostic species' recorded within each stratigraphic unit. The vegetation community description that shared the most 'positive diagnostic' species with each stratigraphic unit was assigned to that stratigraphic unit.

Comprehensive floristic data was recorded at each of the seven BioMetric quadrats (**Figure 13**).

The transect method described within DECCW (2011) was utilised to estimate/measure cover for all vegetation strata. Cover-abundance was estimated for each species (native and exotic) found within the 20 m x 20 m plot. The Braun-Blanquet cover-abundance scores utilised to make species cover-abundance estimates was as follows:

- 1: <5% - rare/ <3 individuals;
- 2: <5% - uncommon / >3 individuals;
- 3: <5% - common, scattered or locally common;
- 4a: <5% - very abundant;
- 4b: 5-25%;
- 5: 25-50%;
- 6: 50-75%;
- 7: 75-100%.

Additional survey parameters were collected from within the BioMetric vegetation plots. These parameters are not typical of BioMetric vegetation plots, and therefore do not have attributed BioMetric benchmarks, however it was considered relevant to collect these additional attributes as they will helped assess fauna habitat values, fuel loads and vegetation restoration efforts over time. The parameters were:

- 'Woody stem count' - The number of woody stems taller than breast height (1.4m) were counted for each shrub and tree species in each plot. Undertaken to gain an understanding of regeneration of both native flora and woody weeds.
- 'Leaf litter % cover' – The percent cover of leaf litter and other organic debris at each BioMetric plot. Will assist in gaining better understanding of organic material layer, and soil formation over time.

Table 15. Vegetation communities and number of biometric plots completed

Vegetation Type	Area of vegetation type in study area (ha)	Plots required (OEH 2014)	Plots Completed
Duffys Forest Ecological Community	1.57	1	2
Coastal Upland Swamps	0.17	1	1
Coastal Sandstone Heath Malee	0.62	1	1
Sydney North Exposed Sandstone	0.94	1	2

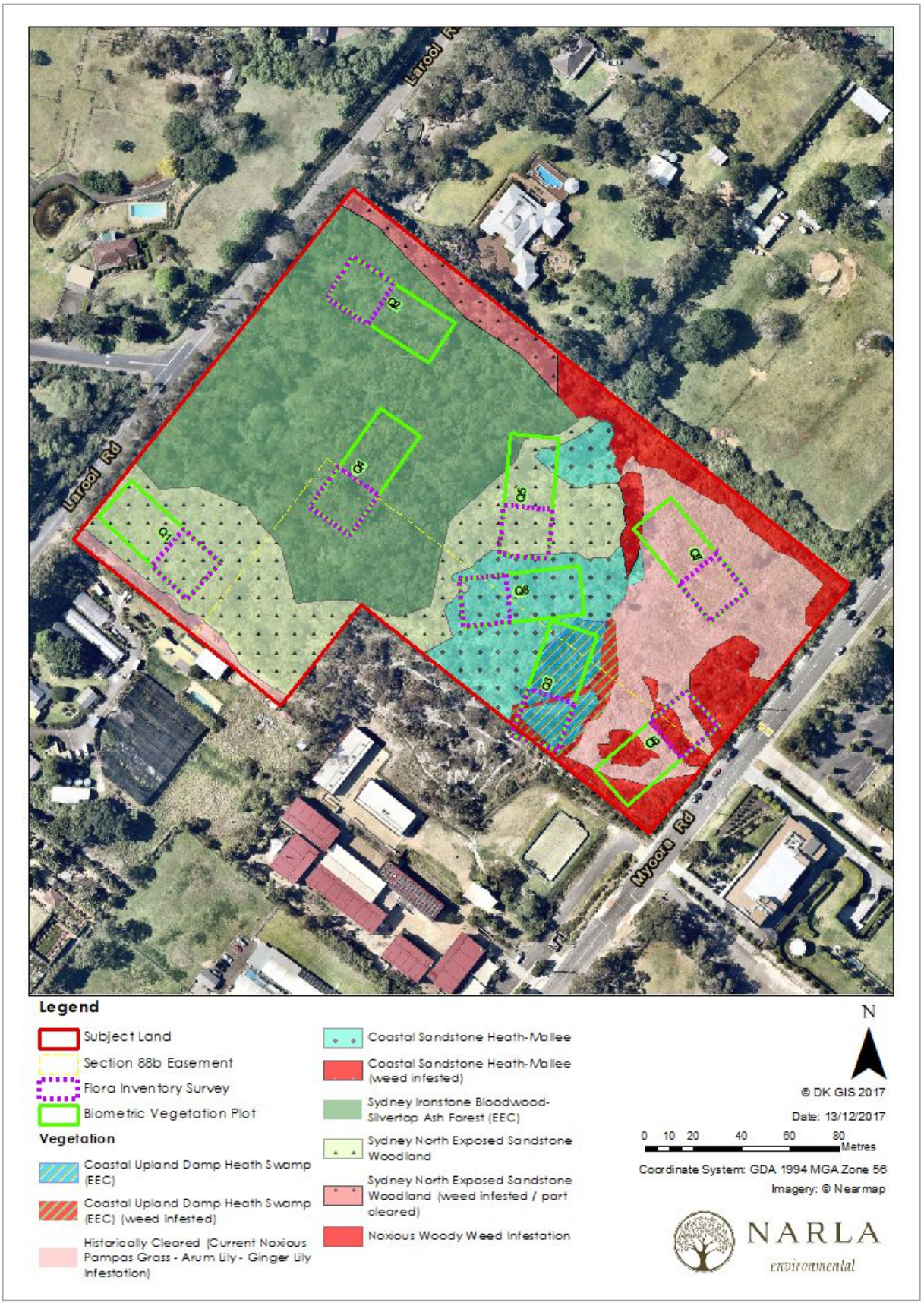


Figure 13. Location of biometric vegetation survey quadrats within the Study Area

Survey techniques and locations: Flora

Targeted surveys were undertaken to confirm the continued presence of the two threatened flora species that had been previously recorded within the subject site, Hairy Geebung (*Persoonia hirsuta*) and Caley's Grevillea (*Grevillea caleyi*) (Blue Mountains Wilderness Services 2004).

Additional threatened flora considered to have reasonable potential to occur within the subject site were targeted in threatened flora surveys are listed in **Table 16**. The conservation status of all species is provided in **Table 11**.

Targeted flora surveys involved detailed searches of available habitat by specialists. The random meander techniques (Cropper 1993) throughout all vegetation types during targeted searches. A total of eight days of targeted flora survey was conducted between July 2016 and December 2017 (**Table 18**). Any tentative threatened species found were photographed and specimens taken for identification utilising formal keys. Where necessary this involved the use of a microscope. Any confirmed or plausible specimens identified were GPS tagged, for future reference.

Where identification of plausible specimens could not be made with absolute confidence by Narla Ecologists, specimens were collected and sent to the National Herbarium for expert identification. Several specimens of *Epacris spp*. that could not be positively confirmed as *E.pulchella* or *E.purpurascens var. purpurascens* and a plant that resembled *Lasiopetalum joyceae* were sent to the Herbarium for identification confirmation.

Surveys were timed to coincide with peak flowering, seeding or emergence periods of each of the targeted species as determined from literature and summarised in **Table 16**. The survey period was considered to have adequately sampled the range of seasons and climatic conditions (**Table 17**) typically required to record the species targeted.

Table 16. Optimal survey periods for the threatened flora species targeted.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Angus's Onion Orchid (*Microtis angusii*)												
Bauer's Midge Orchid (*Genitoplesium baeuri*)												
Camfield's Stringybark *(Eucalyptus camfieldii)*												
Caley's Grevillia (*Grevillea caleyi*)												
Deane's Paperbark (Melaleuca deanei)												
Darwinia biflora												
Epacris purpurascens var. purpurascens												
Joyce's Lasiopetalum *(Lasiopetalum joyceae)*												
Leafless Tongue Orchid (*Cryptostylis hunteriana*)												
Narrow-leaf Finger Fern (Grammitis stenophylla)												
Hairy Geebung *(Persoonia hirsuta)*												
Curved Rice Flower *(Pimelea curviflora var. curviflora)*												
Glandular Pink bell *(Tetratheca glandulosa)*												

KEY Flowering Period | Sporadic flowering/ identifiable from other features

Survey techniques and locations: Fauna

Fauna Habitat

The Narla Ecologists undertook habitat assessments in two phases. The first phase involved identifying all of the potential threatened species habitats and microhabitats present across the entire Subject site and delineating this on maps to guide all targeted surveys.

The second phase involved detailed mapping of all habitat features observed within areas subject to modification or removal as required for the proposed development. Two Narla Ecologists Emily Benn and Alexander Graham attended the Subject site on the 1st, 2nd, 6th and 7th of March 2017. Each Ecologist was equipped with a GPS that contained the proposed construction footprint and APZ areas. The Ecologists traversed each area recording and describing habitat features as they were encountered. This included:

- all trees and shrubs of species known to provide foraging resources (nectar or fruit) for threatened fauna species,
- all trees containing hollows (including dead stags),
- all rock crevices/ caves and burrows that could provide shelter to threatened fauna species,
- all soaks that may support threatened frog species,
- all fauna nests.

Hollow-bearing trees

A hollow-bearing tree assessment was conducted by Narla Environmental within the subject site on March 2017. The information recorded included GPS location of the tree, species name, approximate height of hollow and a georeferenced photograph of each tree. Hollows were classified into three size classes:

- Small (2.5-5cm)
- Medium (5-10cm); and
- Large (10-15cm).

Automated wildlife cameras

Automated wildlife cameras were deployed across the Subject site for the full duration of the fauna survey period. These were installed in a range of vegetation communities, with the aim of capturing fauna which were utilising various habitat features, such as the escarpment, boulders, open ground and dense vegetation. Cameras were set close to the ground, to target species such as the Southern Brown Bandicoot, Spotted-tailed Quoll and Rosenberg's Goanna. Cameras were also placed looking into a tree which contained a medium sized hollow and recent animal scratching on the trunk, in the hope of capturing arboreal mammals and/or monitors. These cameras were set for a total of 47 non-consecutive trapping nights between October 2016 and December 2017 (**Table 18**).

A third targeted survey was undertaken for Eastern Pygmy-Possum for 47 non-consecutive trapping nights between October 2016 and December 2017 cameras were established aiming at flowers trees and trees (e.g. *Banksia spp.*) aiming to capture Eastern Pygmy-possum and Squirrel Glider.

Pitfall trap lines

Two pitfall trapping lines were established, each consisting of three 20 Litre buckets dug into the ground and connected with drift fencing made of dampcourse. These were placed in two separate locations (**Figure 14**), within bushland areas that contained low density ground vegetation and were well shaded by over-storey vegetation. Within each pit, sand, leaf litter and a plastic tube were placed to provide any trapped fauna with shelter. Pits were checked thoroughly twice daily, as a first priority each morning and in the afternoon. At the end of the survey pitfall lines were removed, the pits were backfilled and brush matting was placed over the area.

Aluminium Box 'Elliot' trapping

Two different aluminium 'Elliot' trap sizes were used to select for smaller fauna such as Eastern Pygmy-possums. Trap dimensions used were consistent with Type A (large) and Type E (small) of the 'Elliot' brand of trap. In total seventy-five traps were deployed within the site, including 50 larger and 25 small traps. Traps were set along transect lines of ten traps each, placed in locations deemed most appropriate for trapping small ground mammals. This included along animal runs, and in a variety of vegetation types (**Figure 14**). Elliot traps were open overnight and checked first thing in the morning, before being closed for the duration of the day. All traps were kept away from ants.

Cage Traps

Ten (10) medium-sized cage traps where established within the site for a total of six trapping nights in December 2017. Traps were set along transect lines of ten traps each, placed in locations deemed most appropriate for trapping small ground mammals. This included along animal runs, and in a variety of vegetation types (**Figure 14**). Elliot traps were open overnight and checked first thing in the morning, before being closed for the duration of the day. All traps were kept away from ants.

Hair funnels

Twenty-two hair funnels were randomly set on the ground surrounding the two pitfall trapping lines. An additional eleven hair funnels were firmly attached to trees scattered around the lower edge of the escarpment (**Figure 14**). Arboreal hair funnels were selectively placed within significant habitat trees in the area, including Red Bloodwood, *Banksia spp*., Scribbly Gums and Black Shea-oak. All hair funnels were baited with peanut butter and oats; some were additionally scented with a spray of diluted honey. Hair funnels were deployed for a minimum of six days. All hair wafers collected were sent to Barbara Triggs (Dead Finish Pty Ltd) for expert analysis.

Designated bird census

Twenty-minute designated bird surveys were undertaken at two consistent point locations within the Subject site. One was at the edge of the escarpment and the other from within the Coastal Upland Swamp (**Figure 14**). From each location, a 50m radius of was assumed, from in which birds would most likely be picked up either from aural or visual survey methods. Designated bird surveys were undertaken at each location in the morning and early evening over two days.

Bat passive acoustic monitors

Two bat acoustic monitors (*Song Meter SM4 Bat*) were installed within habitat most likely to be utilised by micro-bats. Both were installed by attachment to trees, with one directed at flyways and the other towards the entrance of caves associated with the escarpment (**Figure 14**). The units were deployed within the field for a total of six nights. Analysis of the collected data was undertaken by a specialist Tim Pearson.

Harp traps

Two harp traps were placed in suitable flyways nearby to suitable roosting habitat (hollows and sandstone outcrops) to sample the length of the study area (clearings/tracks in open woodland habitats determined (excluding "disturbed" areas)). Traps were checked each morning between 05:00 and 07:00 and were then moved or dismantled to prevent bycatch during the day (e.g. birds), before being reset in the evening (**Figure 14**).

Spotlighting

Active spotlight fauna searches within the site were undertaken on two nights. Searches were initiated an hour or more after sunset and involved a meandering walk through the site, whilst also searching canopy, crevices, under logs and within dense foliage. Each spotlight search was of approximately 2 hours duration.

Targeted species call playback

Call playback was undertaken to target a number of suspected threatened species with appropriate habitat available within the site. Red-crowned Toadlet calls were played near the quarry when it was holding water, and on the upper escarpment and below at swamp margins. These were undertaken both diurnally and during spotlighting.

At night a range of nocturnal fauna calls were played, particularly focussing on threatened species, these included, Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*), Koala (*Phascolarctos cinereus*) and Squirrel Glider (*Pteropus novaehollandiae*). Call playback was performed during spotlighting from two locations each night.

Opportunistic sightings and analysis of scats, tracks and traces

During all site visits, throughout the project opportunistic fauna observations including sightings, scats, tracks, characteristic scraps on trees, burrows and bone were collected. These were identified within the site, and/or used as focus areas to position additional targeted survey techniques to determine species presence.

4.2.2 Documenting survey effort and results

Survey effort and conditions: flora

Flora surveys were conducted at the most suitable time of the year for each targeted species. These targeted surveys were undertaken during the same period as general fauna survey during 31st October 2016 – 21st November 2016. A summary of timing and weather conditions during surveys is incuded in **Table 17.**

Table 17. The timing and climatic conditions, during and preceding the targeted threatened flora surveys.

Timing/ Activities	Narla Staff Member	Location within Subject site	Date	Effort	Day	Temperature		Rain (mm)	Max wind gust			Relative Humidity at 9 am (%)
						Min (°C)	Max (°C)		Dir	Spd (km/h)	Time	
Lead up to initial threatened flora survey			5-Jul-16		Tu	7.8	17	5.8	NW	31	20:26	100
			6-Jul-16		We	7.9	15.9	0.2	WSW	50	20:08	61
			7-Jul-16		Th	11.4	14.9	16.4	SW	37	2:09	100
			8-Jul-16		Fr	11.3	14.3	14	WSW	26	5:34	100
			9-Jul-16		Sa	8.5	16.2	13.8	SW	24	10:22	93
			10-Jul-16		Su	9.9	16.8	1.2	N	20	23:04	100
			11-Jul-16		Mo	10.6	19.2	0	WNW	43	13:50	87
Initial threatened flora survey	Kurtis Lindsay	Entire Site	12-Jul-16	8 hours	Tu	13.1	18.1	0.4	NW	46	14:09	53
Lead up to Targeted threatened flora species surveys			9-Sep-16		Fr	13.8	22.4	0	ENE	28	15:19	71
			10-Sep-16		Sa	12.6	21	1	WNW	43	12:18	72
			11-Sep-16		Su	8.8	19.1	0	WSW	22	9:05	56
			12-Sep-16		Mo	10.9	19.8	0	WSW	24	9:01	65
			13-Sep-16		Tu	13.9	18.9	0	S	20	9:24	90
			14-Sep-16		We	14.7	21.9	2	NNW	28	11:49	100
			15-Sep-16		Th	11.8	19.7	0	NW	56	10:15	42
Targeted threatened flora species survey	Dean Sugden	Eastern Portion of Site	16-Sep-16	8 hours	Fr	11	20.8	0	W	31	14:25	62
Lead up to Targeted threatened flora species surveys			17-Sep-16		Sa	9.5	20.8	0	ENE	26	14:01	58
			18-Sep-16		Su	12.6	16	0	WNW	28	21:44	78
Targeted threatened flora species survey	Dean Sugden and Kurtis Lindsay	Western Portion of Site	19-Sep-16	8 hours	Mo	11.9	20	15.6	WSW	44	10:41	73
Lead up to secondary targeted flora species			21-Oct-16		Fr	13.3	25.2	0	NNW	37	21:18	79
			22-Oct-16		Sa	15.2	15.7	9.4	WSW	44	19:52	100
			23-Oct-16		Su	8.3	16.8	1.4	SSW	46	10:48	54
			24-Oct-16		Mo	7.4	19.2	0	ESE	28	12:41	58
			25-Oct-16		Tu	9.9	23.2	0	NE	28	16:29	68
			26-Oct-16		We	13.7	27.6	0	ENE	24	14:54	48
			27-Oct-16		Th	16.6	21	0	SSE	33	7:20	80

Timing/ Activities	Narla Staff Member	Location within Subject site	Date	Effort	Day	Temperature		Rain (mm)	Max wind gust			Relative Humidity at 9 am (%)
						Min (°C)	Max (°C)		Dir	Spd (km/h)	Time	
Secondary targeted flora species	Gavin Thomas	Entire Site	28-Oct-16	8 hours	Fr	12.5	18.4	3.8	SSE	22	23:10	100
Lead up to third threatened flora survey			8-Nov-16		Tu	20.6	29.4	0	S	37	17:20	27
			9-Nov-16		We	16.3	20.3	3	SE	24	14:48	98
			10-Nov-16		Th	14.8	23.1	10.8	E	22	14:33	100
			11-Nov-16		Fr	15.7	22.5	0.2	ENE	35	17:30	85
			12-Nov-16		Sa	17.3	33.5	14.2	WNW	48	17:57	94
			13-Nov-16		Su	18.1	29.5	0	WNW	54	17:16	35
			14-Nov-16		Mo	15.2	21.8	0	WNW	41	0:36	48
Third threatened flora survey	Thomas Hickman	Entire Site	15-Nov-16	8 hours	Tu	12.3	20	4.6	E	26	15:21	78
Lead up to fourth threatened flora survey			21-Dec-16		We	17.4	24.6	2	E	37	12:58	84
			22-Dec-16		Th	17.1	23.1	0.6	ENE	30	17:25	80
			23-Dec-16		Fr	18.4	23.8	0.2	NE	43	13:24	76
			24-Dec-16		Sa	17.4	26.9	0	ENE	28	15:36	82
			25-Dec-16		Su	17.6	26.3	5.4	ENE	41	16:34	83
			26-Dec-16		Mo	19	29.1	0.2	NNE	35	15:08	80
			27-Dec-16		Tu	20.1	28.1	0	NE	33	21:43	85
Fourth threatened flora survey	Kurtis Lindsay	Entire Site	28-Dec-16	8 hours	We	18.6	28.9	0	NE	39	15:57	82
Lead up to initial targeted threatened flora surveys within APZ areas			22-Apr-17		We	19.1	26.3	0	NE	44	18:08	71
			23-Apr-17		Th	18.7	27.7	0	NE	33	16:08	79
			24-Apr-17		Fr	18.5	26.6	0	ENE	28	13:07	78
			25-Apr-17		Sa	18	19.7	8.4	SSW	31	2:48	100
			26-Apr-17		Su	16.9	22.6	28.8	SE	35	12:23	82
			27-Apr-17		Mo	16.7	24.5	43	SE	35	13:56	88
			28-Apr-17		Tu	18.3	24.4	6.8	NE	33	12:21	95
Initial targeted threatened flora surveys within APZ areas	Alexander Graham	APZ Areas	1-Mar-17	8 hours	We	19	25.3	9.2	ESE	43	2:53	100
Lead up to follow-up targeted threatened flora surveys within APZ areas			2-Mar-17		Th	18.9	25	4.8				100
			3-Mar-17		Fr	18.9	23.5		ESE	41	15:07	100
			4-Mar-17		Sa	18.6	21.5	14.8	S	41	13:33	100
			5-Mar-17		Su	18.3	22	10.6	SSW	43	17:54	89
			6-Mar-17		Mo	17.9	23.4	0.4	S	50	14:00	80
targeted threatened flora surveys within APZ areas	Alexander Graham	APZ Areas	7-Mar-17	8 hours	Tu	15.4	20.7	0.8	S	44	14:15	97
targeted threatened flora surveys within APZ areas	Alexander Graham	APZ Areas	1-Dec-17	1 hour	Fri	18.4	27.9	0	ENE	39	12:00	78

Survey effort and conditions: fauna

Fauna surveys were conducted at the most suitable time of the year for each targeted species. These targeted surveys were undertaken during the same period as general fauna survey during 31st October 2016 – 21st November 2016. A summary of timing and weather conditions during surveys undertaken by Narla Environmental for each fauna group is outlined in **Table 18.**

Table 18. Summary of survey effort undertaken throughout the study area

Survey Type	Recommended Effort (DECC Guidelines)	Effort (Narla Environmental)	Recommended Survey Period	Date	Targeted Species
Area Search	▪ observers walk around an area of pre-determined size for a pre-determined length of time. A 1ha (200m x 500m) 20-minute search is the most common method (Loyn 1986)	Twenty-minute designated bird surveys were undertaken at two consistent point locations within the subject site. From each location, a 50m radius was assumed, from in which birds would most likely be picked up either from aural or visual survey methods. Designated bird surveys were undertaken at each location in the morning and early evening over two days.	All year (OEH Threatened Species Survey and Assessment Guidelines)	2nd and 3rd of November 2016	Square-tailed Kite; White-bellied Sea Eagle; Little Eagle, Glossy Black Cockatoo, Regent Honeyeater, Dusky Woodswallow, Swift parrot, Varied Sitella and Little Lorikeet
Diurnal habitat search including scat/ traces/ signs assessment	▪ 30-minute search on two separate days targeting specific habitat ▪ Search habitat for pellets, and likely hollows ▪ One hour per stratification unit for amphibians	Narla ecologists traversed each area recording and describing habitat features as they were encountered. This included: ▪ all trees and shrubs of species known to provide foraging resources (nectar or fruit) for threatened fauna species, ▪ all trees containing hollows (including dead stags), ▪ all rock crevices/ caves and burrows that could provide shelter to threatened fauna species, ▪ all soaks that may support threatened frog species, ▪ all fauna nests.	Reptiles: November to March (OEH Threatened Species Survey and Assessment Guidelines) Mammals (excluding microchiropteran bats): All year (OEH Threatened Species Survey and Assessment Guidelines) Giant Burrowing Frog: September to May (OEH Threatened Species Survey and Assessment Guidelines) Red-crowned Toadlet: July to March (Lemckert and Mahony 2008) Birds: All year	1st, 2nd, 6th and 7th of March 2017	Rosenberg's Goanna Red-crowned Toadlet and Giant Burrowing Frog Barking Owl; Powerful Owl; Masked Owl Grey-headed Flying Fox, Microchiropteran bats
Spotlighting on foot	▪ 2 x 1 hour and 1km up to 200 hectares of stratification unit, walking at approximately 1km per hour on 2 separate nights	Spotlighting undertaken on two nights, initiated an hour or more after sunset and involved a meandering walk through the site, whilst also searching canopy, crevices, under logs and within dense foliage. Each spotlight search was of approximately 2 hours duration.	Mammals: All year Birds: All year	1st and 2nd of November 2016	Grey-headed Flying Fox, Barking Owl; Powerful Owl; Masked Owl
Nocturnal Call Playback	▪ At least one playback on each of two separate nights for amphibians ▪ 2 sites per stratification unit up to 200 hectares, plus an additional site per 100 hectares	Call playback was undertaken whilst spotlighting over a two-hour period on two separate nights.	Giant Burrowing Frog: September to May Red-crowned Toadlet: July to March	1st and 2nd of November 2016	Red-crowned Toadlet and Giant Burrowing Frog Koala, Squirrel Glider

Survey Type	Recommended Effort (DECC Guidelines)	Effort (Narla Environmental)	Recommended Survey Period	Date	Targeted Species
	above 200 hectares. Each playback site must have the session conducted twice, on separate nights for mammals		Mammals: All year Birds: All year		Barking Owl; Powerful Owl; Masked Owl; Sooty Owl
		Conducted on four nights, each for a three-hour period. Efforts were carried out immediately following wet weather. 19 locations were selected within the subject site for call playback survey	Red-crowned Toadlet: July to March	1st and 2nd of November 27th of February and 1st of March	Red-crowned Toadlet
Automated Camera Traps	Not included in DECC Guidelines	5 automated wildlife cameras aimed at bait holders containing a meat lure (chicken necks and sardines)	Mammals: All year Reptiles: November to March	7th – 14th of March 2017	Rosenberg's Goanna Spotted-tailed Quoll
		4 automated cameras situated on the ground aimed at areas of high activity	Mammals: All year Reptiles: November to March	31st October 2016 – 7th November 2016	Southern Brown Bandicoot, New Holland Mouse, Rosenberg's Monitor and Spotted-tailed Quoll
		1 automated camera situated in a tree aimed at a hollow	Mammals: All year Large-eared Pied Bat; Eastern False Pipistrelle; eastern Freetail-bat; Yellow-bellied Sheathtail-bat; Greater Broad-nosed Bat; Eastern Cave Bat: October to March	31st October 2016 – 7th November 2016	Squirrel Glider, Eastern Pygmy Possum, Microchiropteran bats
		6 camera traps were positioned in appropriate microhabitats targeting Eastern Pygmy-possums over 8 consecutive nights.	Mammals: All year	11th – 19th of April 2017	Eastern Pygmy Possum Squirrel Glider
		4 automated wildlife cameras aimed at bait holders containing marsupial lure (peanut butter and oats)	Mammals: All year	28th of November 2017 - 8th of December 2017	Southern Brown Bandicoot (Eastern)
		14 automated cameras were installed in suitable habitat trees within the subject site as well as in vegetation corridors between the subject site and nearby bushland in Ku-ring-gai Chase National Park and Dundundra Falls Reserve. Cameras remained for a total of 8 days.	Mammals: All year	23rd of November 2017 – 8th of December 2017	Eastern Pygmy Possum
Night habitat search of soaks and wetlands	▪ 30 minutes on two separate nights per stratification unit	Active amphibian search was conducted between 17:50 and 19:00 on the 3rd of November and during the spotlighting sessions on the 1st and 2nd of November.	Giant Burrowing Frog: September to May Red-crowned Toadlet: July to March	1st, 2nd and 3rd of November	Red-crowned Toadlet and Giant Burrowing Frog

Survey Type	Recommended Effort (DECC Guidelines)	Effort (Narla Environmental)	Recommended Survey Period	Date	Targeted Species
Medium Sized Wire Cage Traps	▪ 24 trap nights over 3-4 consecutive nights	10 cage traps were set along a transect grid, lured with a marsupial bait (peanut butter and oats). Traps were checked daily and left in situ for a total of 8 days (traps closed in between 4 consecutive day trapping periods).	Mammals: All year	28th of November – 8th of December	Southern Brown Bandicoot (Eastern)
Large Elliot Traps	▪ 100 trap nights over 3-4 consecutive nights	50 large traps set along transect lines of 10 traps each, placed in locations deemed most appropriate for trapping small ground mammals. Traps were checked daily and left in situ for a total of 8 days (traps closed in between 4 consecutive day trapping periods).	Mammals: All year	31st October 2016 – 7th November 2016	New Holland Mouse, Southern Brown Bandicoot, Spotted-tailed Quoll
Arboreal Hair Tubes	▪ 3 tubes in each of 10 habitat trees up to 100 hectares of stratification unit, for at least 4 days and 4 nights	11 arboreal hair tubes were selectively placed within habitat trees around the subject site and lured with marsupial baits and honey. All hair tubes were deployed for a minimum of 6 days	Mammals: All year	2nd – 7th of November 2016	Eastern Pygmy-possum
Baited Hair Tubes	▪ 10 large and 10 small tubes in pairs for at least 4 days and 4 nights	20 hair tubes lured with marsupial bait were installed on the ground. Traps were checked daily and left in situ for a total of 8 days (traps closed in between 4 consecutive day trapping periods).	Mammals: All year	6th of December 2017 – 13th of December 2017	Southern Brown Bandicoot (Eastern) Spotted-tailed Quoll
		22 hair tubes were randomly set on the ground and baited with marsupial bait and honey. Traps were checked daily and left in situ for a total of 8 days (traps closed in between 4 consecutive day trapping periods).	Mammals: All year	31st October 2016 – 7th November 2016	Southern Brown Bandicoot (Eastern) Spotted-tailed Quoll
Small Elliot Traps	▪ 100 trap nights over 3-4 consecutive nights	25 small traps set along transect lines of 10 traps each, placed in locations deemed most appropriate for trapping small ground mammals. Traps were checked daily and left in situ for a total of 8 days (traps closed in between 4 consecutive day trapping periods).	All year	31st October 2016 – 7th November 2016	New Holland Mouse, Southern Brown Bandicoot,
Pitfall traps with drift nest	▪ 24 trap nights over 3-4 consecutive nights	Two pitfall trapping lines which included 3 20L buckets each, were installed in two separate locations. Traps were checked twice daily and left in situ for a total of 8 days (traps closed in between 4 consecutive day trapping periods)	Reptiles: November to March Mammals: All year	31st October 2016 – 7th November 2016	Red Crowned Toadlet Rosenberg's Goanna New Holland Mouse, Eastern Pygmy Possum, Southern Brown Bandicoot

Survey Type	Recommended Effort (DECC Guidelines)	Effort (Narla Environmental)	Recommended Survey Period	Date	Targeted Species
SM4 (Ultrasonic recorder) aimed at flyouts and flyways	▪ Two sound activated recording devices utilised for the entire night (a minimum of four hours), starting at dusk for two nights	Two bat acoustic monitors (*Song Meter SM4 Bat*) were installed and directed at the entrances of potential roosting caves and flyways. Acoustic monitors were deployed for a total of six nights. In addition, a combination of set point monitoring and hand held detectors were utilised.	Large-eared Pied Bat; Eastern False Pipistrelle; eastern Freetail-bat; Yellow-bellied Sheathtail-bat; Greater Broad-nosed Bat; Eastern Cave Bat: October to March	1st – 6th of November 2016	Large-eared Pied Bat; Eastern False Pipistrelle; eastern Freetail-bat; Yellow-bellied Sheathtail-bat; Greater Broad-nosed Bat; Eastern Cave Bat. Eastern Bentwing-bat; Little Bentwing-bat
Harp Trapping	▪ Four harp trap nights over two consecutive nights (with one trap placed outside the flyways for one night)	Two harp nets were installed on the subject site over four consecutive nights. The location of the harp nets were changed following two nights of survey to maximise the chance of microchiropteran bat detection.	Large-eared Pied Bat; Eastern False Pipistrelle; eastern Freetail-bat; Yellow-bellied Sheathtail-bat; Greater Broad-nosed Bat; Eastern Cave Bat: October to March	27th – 30th of November 2017	Large-eared Pied Bat; Eastern False Pipistrelle; eastern Freetail-bat; Yellow-bellied Sheathtail-bat; Greater Broad-nosed Bat; Eastern Cave Bat, Eastern Bentwing-bat; Little Bentwing-bat.
Nest Box Monitoring	Not included in DECC Guidelines	10 custom nest boxes were installed within the subject site	Mammals: All year	Installed on the 9th of March 2017 Nest box monitoring on the 10/04/2017 and the 23/11/2017	Eastern Pygmy Possum
Threatened Flora Targeted Survey	▪ In areas of preferred habitat for threatened biodiversity an area may be searched by the random meander technique. The random meander technique involves traversing areas of suitable habitat in no set pattern, but roughly back and forth, whilst searching for a particular, or several, threatened plant species. (OEH Threatened Species Survey and Assessment Guidelines)	Targeted flora surveys involved detailed searches of available habitat by specialists. The random meander techniques (Cropper 1993) throughout all vegetation types during targeted searches. A total of nine days of targeted flora survey was conducted between July 2016 and December 2017.	Species visible throughout the year include: *Pimelea curviflora var. curviflora; Epacris purpurascens subsp. purpurascens; Callistemon linearifolius; Eucalyptus camfieldii; Lasiopetalum joyceae; Tetratheca glandulosa;* Remaining targeted species required targeted searches at specific times of year to enable detection.	12/07/2016 16/09/2016 19/09/2016 28/10/2016 15/11/2016 28/12/2016 1/03/2017 7/03/2017 1/12/2017	Grevillea caleyi, Persoonia hisuta, Pimele curviflora var. curviflora, Epacris purpurascens, Cryptostylis hunteriana, Callistemon linearifloius, Eucalyptus camfieldii, Lasiopetalum joyceae, Tetratheca glandulosa, Microtis angusii and Genoplesium baueri
Eastern Pygmy Possum habitat survey	*nil*	Targeted flora surveys for suitable Eastern Pygmy-Possum habitat within the adjoining Dundundra Falls Reserve.	*nil*	1/12/2017 6/12/2017 7/12/2017	Eastern Pygmy-Possum

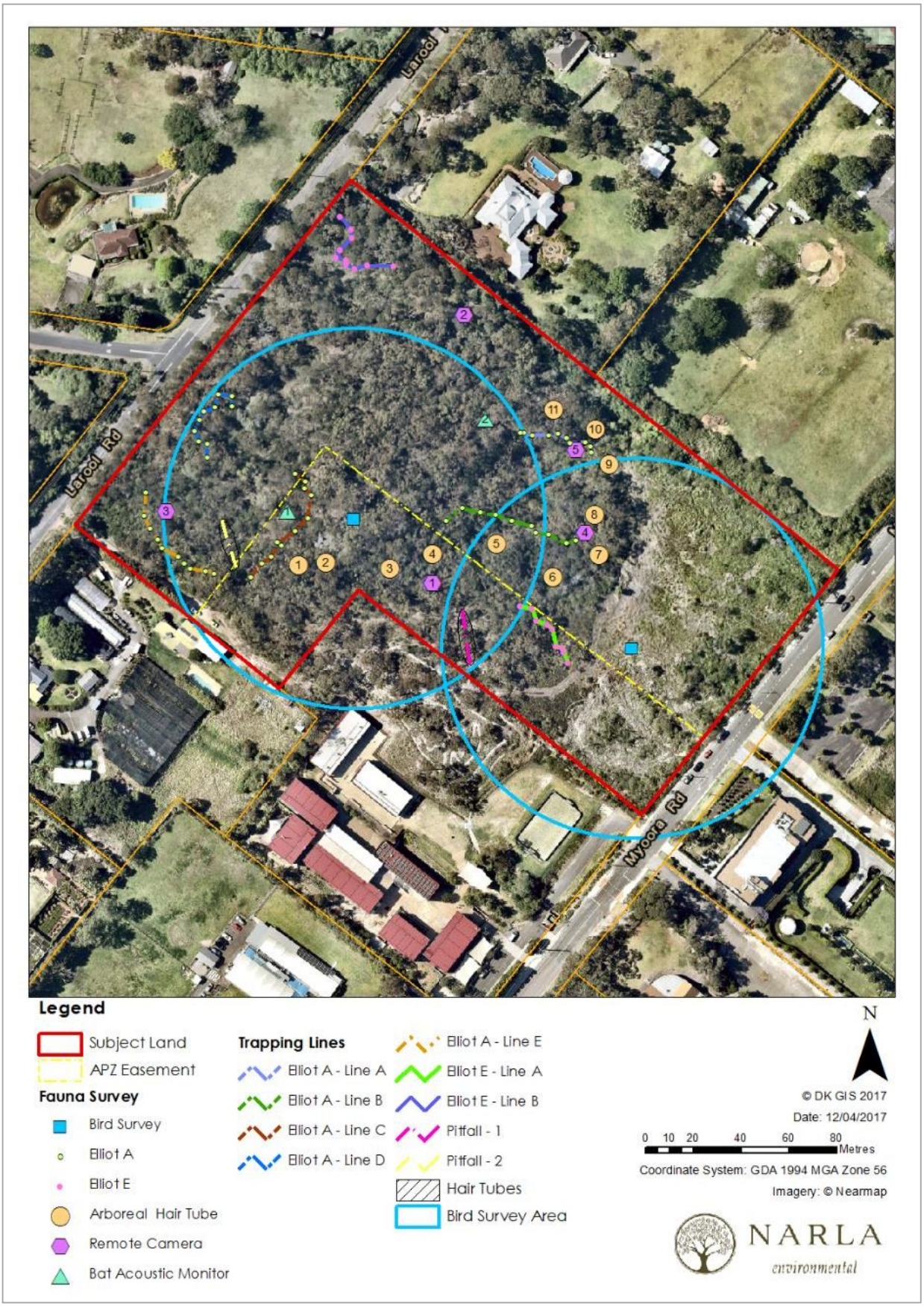


Figure 14. Distribution of each technique of fauna survey employed during preparation of FFA

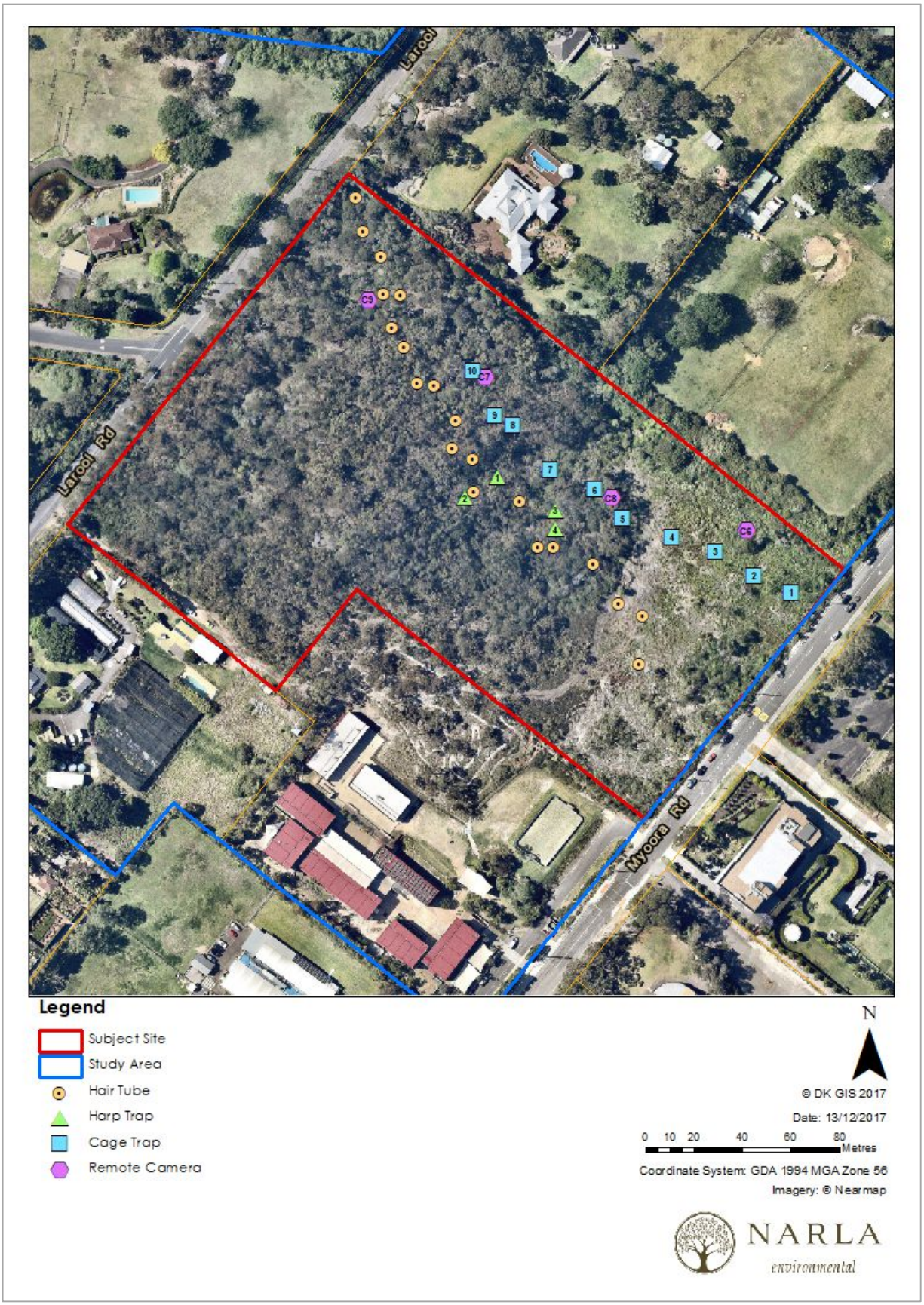


Figure 15. Additional survey undertaken for Species Impact Statement

Study Limitations

The species inventory provided for the site was restricted to what was observed during the survey period by the Narla Ecologists. The timing of the survey may not have coincided with emergence times of some species of flora and fauna, such as seasonally flowering ground orchids or seasonal migratory fauna. Likewise, weather conditions may have played a role in the emergence or activity levels of certain species. However, the extensive study period over two different spring and summer seasons was considered likely to reveal these species if they were present

To account for those species that could not be identified during the field survey, detailed habitat assessments were combined with desktop research and local ecological knowledge to establish an accurate prediction of the potential for such species to occur on or adjacent the subject site.

4.2.3 Description and mapping of results of vegetation, flora and fauna surveys

Survey results: vegetation communities

Vegetation within the study area was originally mapped and described by Smith and Smith (2005;2009) this information was included in the Warringah Council Natural Area study (Warringah Council 2005b). Owing to no site visit having ever been undertaken, the original mapping of the subject site was coarse and not representative of the true vegetation assemblages across the subject site. Warringah Council (2005b) incorrectly estimated that prior to the year 1750 the subject site likely supported only Sydney Sandstone Ridgetop Woodland.

Subsequent mapping undertaken by NSW Office of Environment and Heritage (OEH) was created in 2013 and updated in 2016. Existing Sydney Metropolitan vegetation mapping of the subject site (OEH 2016) was of low reliability owing to the coarse scale of the mapping combined with a lack of ground truthing. The Sydney Metropolitan Vegetation Mapping Project (OEH 2016) suggested a highly-simplified model of the vegetation on the subject site with only three vegetation types mapped:

- Sydney North Exposed Sandstone Woodland (S_DSF11);
- Coastal Sandstone Heath-Mallee (S_HI08); and
- Weeds and Exotics (OEH 2013a;2013b).

The Sydney Metropolitan Vegetation Mapping Project (OEH 2016) mapping overlooked the characteristic stand of Sydney Ironstone -Bloodwood-Silvertop Ash Forest (Duffy's Forest EEC) which covers the upper escarpment on the subject site.

Through assessment of the landscape features (topography, geology and soils) of the site in, combination with detailed and systematic floristic data collected by Narla Environmental, the subject site was determined to contain four distinct native vegetation communities (for diagnostic summary and nomenclature refer to **Table 4**):

- Duffy's Forest Vegetation Community (an EEC);
- Coastal Upland Damp Heath Swamp (an EEC);
- Coastal Sandstone Heath-Mallee; and
- Sydney North Exposed Sandstone Woodland.

A large remaining area occupying the low-lying eastern extent of the subject site, was historically cleared of native vegetation. The area represents a highly-disturbed landscape which is now dominated by exotic, weedy vegetation. This area is mapped as "cleared of vegetation" (**Figure 16**) as it contains less than 5% native cover and no native canopy. Adjacent to this cleared area, along the northern boundary of the subject site, a dense stand of tall, woody weeds has established. These areas include a multitude of significant environmental and noxious weeds which pose a severe threat to the vegetation and floristic biodiversity of the subject site if left unmanaged.

Table 19. Targeted vegetation communities confirmed present within the subject site.

In Text Reference	Total Extent (ha)	Sydney Metropolitan CMA Unit	Biometric Vegetation Type	NSW PCT ID	TSC Act	EPBC Act
Duffy's Forest EEC	1.57	Sydney Ironstone - Bloodwood-Silvertop Ash Forest (S_DSF14)	ME 98: Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region	1786 Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region (previously 1085)	Duffys Forest Ecological Community in the Sydney Basin Bioregion-EEC	Not Listed
Coastal Upland Swamp	0.17	Coastal Upland Damp Heath Swamp (S_FRW01)	ME 75: Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin	1803 Coastal upland damp heath swamp (previously 978)	Coastal Upland Swamp in the Sydney Basin Bioregion - EEC	Coastal Upland Swamps in the Sydney Basin Bioregion - Endangered
Coastal Sandstone Mallee-Heath	0.62	Coastal Sandstone Mallee-Heath (S_HL08)	ME 100: Mallee - Banksia - Tea-tree - Hakea heath-woodland of the coastal sandstone plateaus of the Sydney basin	1824 Coastal sandstone Heath-Mallee (previously 882)	Not Listed	Not Listed
Sydney North Exposed Woodland	0.94	Sydney North Exposed Sandstone Woodland (S_DSF11)	ME 106: Red Bloodwood - Scribbly Gum / Old-man Banksia open forest on sandstone ridges of northern Sydney and the Central Coast	1783 Sydney North exposed sandstone woodland (previously 1083)	Not Listed	Not Listed
Cleared Land / Pampas Grass Infestation	0.65	na	na	na	na	na
Woody Weed Infestation	0.17	na	na	na	na	na
Total	**4.12**					

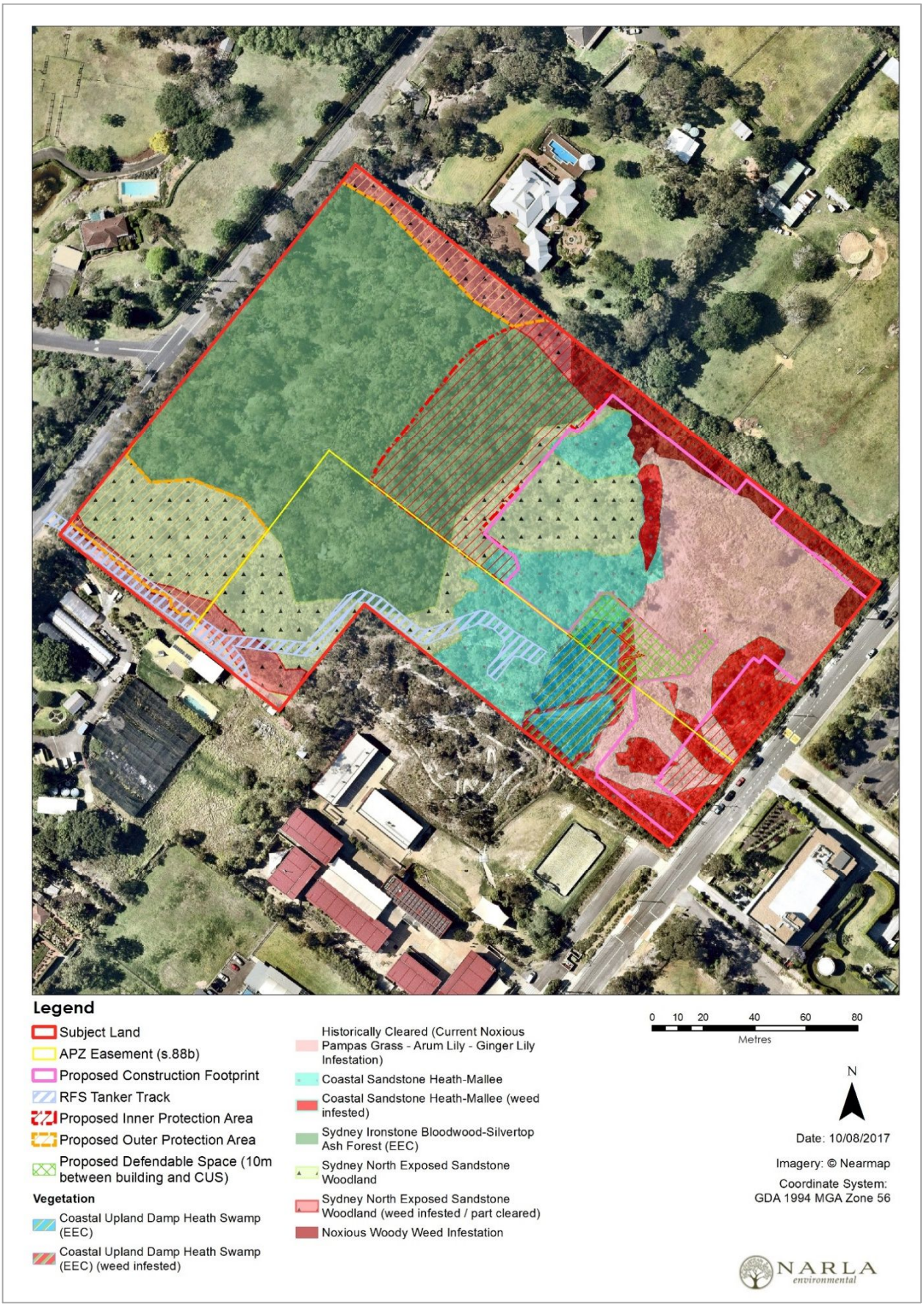


Figure 16. Extent and condition of vegetation communities mapped within the Subject site

Duffy's Forest EEC

An occurrence of Sydney Ironstone Bloodwood-Silvertop Ash Forest was identified on the subject site. This vegetation meets the thresholds to be considered as '*Duffys Forest in the Sydney Basin Bioregion Endangered Ecological Community*' (EEC) (NSW Scientific Committee 2002) here forward referred to as 'Duffys Forest'. This community has a restricted distribution known almost entirely from suburbs of northern Sydney, including the local government areas of Northern Beaches, Kur-ring-gai and Hornsby Local Government Areas, although it may occur elsewhere in the Sydney Basin Bioregion. Duffys Forest has been mapped within the southern reaches of Kur-ring-gai Chase National Park and the northern edge of Garigal National Park (NSW Scientific Committee 2002).

This patch was not mapped in the vegetation mapping project undertaken by Warringah Council in 2005 (Warringah 2005a), nor was it identified by the Office of Environment and heritage during the 'Sydney Metropolitan Catchment Management Area Vegetation Mapping Protect' in 2013 (OEH 2013).

The occurrence of Duffys Forest was determined by the dominance of Red Bloodwood and Silvertop Ash (*Eucalyptus siberi*) within the canopy along with associated Brown Stringybark (*Eucalyptus capitellata*) and Common Sandstone Stringybark (*Eucalyptus oblonga*) overlying a diverse shrub layer including Grey Spider Flower (*Grevillea buxifolia*), Old Man Banksia (*Banksia serrata*), Broad-leaf Geebung (*Persoonia levis*) and Pine-leaf Geebung (*P. pinifolia*).

Analysis of the vegetation assemblage data collected from the two biometric plots sampled revealed 31 positive diagnostic species and an additional 8 associated species out of a total of 68 identified within the quadrats. This conformed to guidelines for determination of this community, which state 29 diagnostic species must be present provided the area contains >45 total native species (OEH 2013a;2013b). A noteworthy feature of this community was the presence of two clumps of Caley's Grevillea (*Grevillea caleyi*). Duffys Forest EEC forms the stronghold for this species (NSW Scientific Committee 2011).

Plate 2. Image taken within the subject site demonstrating characteristic Duffy's Forest EEC

Coastal Upland Swamp EEC

Coastal Upland Damp Heath Swamp (here forward referred to as 'Coastal Upland Swamp') is one of two vegetation communities described in OEH (2016) which constitutes the federally and state listed *'Coastal Upland Swamp in the Sydney Basin Bioregion'* EEC (NSW Scientific Committee 2012). This community usually transitions into sandstone shrubby woodlands and heath communities, as observed within the subject site. There is a distinct difference between the Coastal Upland Damp Heath Swamp and the Coastal Upland Wet Heath Swamp (S_FrW02) which is restricted to the wetter margins of drainage lines or areas receiving higher rainfall. The latter community was not recorded within the subject site.

The Coastal Upland Swamp was initially identified by the distinctive dominance of sedges, situated of waterlogged, peat-rich soils below the elevated sandstone escarpment within the Somersby Soil Landscape area of the subject site. The area is almost devoid of tall shrubs or trees and contains a diverse herb and sedge vegetation assemblage, supported by the high-water retention of the soil which consists of sandy loam overlaid by deep organics (OEH 2012). Notable diagnostic species not found elsewhere within the site included Bloodroot (*Haemodorum corymbosum*), Christmas Bells (*Blandfordia nobilis*), Tall Yellow-eye (*Xyris operculata*) and Golden Spray (*Viminaria juncea*). Analysis of species identified within a 20m x 20m quadrat sampled in this community revealed a total of 17 diagnostic species of Coastal Upland Dam Heath Swamp (OEH 2013a;2013b). This is four species more than the number required for community determination. An additional 13 flora species listed as being associated with this community (OEH 2013a; 2013b) were also identified within the patch. This patch was not mapped in the vegetation mapping project undertaken by Warringah Council in 2005 (Warringah 2005a).

Plate 3. Image taken within the subject site, demonstrating good condition Coastal Upland Swamp EEC.

Survey results: threatened flora

One specimen of Hairy Geebung (*Persoonia hirsuta*) was recorded and mapped within the subject site during a previous study of the subject site which was undertaken over 13 years prior to the present study (Blue Mountains Wilderness Services 2004) (**Figure 11**). This species is listed as 'Endangered' under both the TSC and EPBC Act.

Narla Environmental confirmed the presence of *Grevillea caleyi* within the subject site. Two clusters of 3 and 7 individuals were identified (**Figure 11**). These plants are located outside of the proposed construction footprint and APZ areas.

Despite multiple targeted surveys undertaken through the subject site by Blue Mountains Wilderness Services (2004) and Narla Environmental during 2016 and 2017, no Hairy Geebung has been found within the subject site, since that initial record from 2004. A thorough database search revealed no other records of the species within a 5-km range of the subject site.

Plate 4. The Critically Endangered Caley's Grevillea recorded within the subject site (Narla Environmental 2017)

The vulnerable *Epacris purpurascens var. purpurascens* is known from the Terrey Hills area and is listed under the TSC Act as 'Vulnerable'. Due to the possibility for *Epacris purpurascens var. purpurascens* to occur on the site, extensive targeted surveys were undertaken. All potential *E. p. pupuracens* specimens were collected and sent to the NSW Herbarium for identification confirmation. This first targeted surveys for this species were undertaken across the subject site by Blue Mountains Wilderness Services (2004) which revealed no individuals of this plant. Narla Environmental carried-out a designated survey for this plant on 16th and 19th of September 2016 with follow up surveys undertaken during BioMetric field surveys (**Table 17**). The finding of each survey was that the unlisted species *Epacris pulchella* was present, whilst *E. purpurascens* was not.

In early March 2017 Narla Environmental Principal Ecologist, Kurtis Lindsay collected three specimens of Epacris sp. that demonstrated some overlapping features between the two species from a spread of locations across the subject site and submitted these specimens to the NSW Herbarium. On the 13th March 2017 these specimens were confirmed as *Epacris pulchella* by Barbara Wiecek (NSW Herbarium). It was concluded that *E. purpurascens var. purpurascens* does not occur within the subject site and is not at risk from the proposed development.

Survey results: threatened fauna

Three species of fauna listed as vulnerable under the TSC Act were confirmed utilise habitat within the subject site. They were:

- Eastern Pygmy Possum (*Cercartetus nanus*)
- Glossy Black Cockatoo (*Calyptorhynchus lathami*)
- Rosenberg's Goanna (*Varanus rosenbergi*)

The locations where these fauna species were recorded are mapped (**Figure 17**).

An additional four fauna species listed as vulnerable under the TSC Act were confirmed flying over the subject site but were not confirmed to be roosting, sheltering or foraging within or around the subject site. They were:

- Square-tailed Kite (*Lophoictinia isura*)
- Eastern Bent-wing Bat (*Miniopterus oriane oceanensis*)
- Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*)
- Grey-headed Flying Fox (*Pteropus poliocephalus*)

The Square-tailed Kite is a large diurnal bird of prey. One individual was observed flying over the subject site although was not observed to utilise habitat within. The subject site may provide foraging resources in the form of abundant small and medium sized birds which may be preyed upon. Nesting may occur on the subject site; however, the species prefers tall trees with dense canopies for nesting, usually away from human disturbance. Square-tailed Kite territories are large and likely to contain substantial areas of remnant vegetation with more suitable nesting trees. Potential nesting trees will continue to remain available on the subject site post development.

The two microbats were recorded from the passive acoustic bat recorders deployed in the subject site. It is considered possible that the Eastern Bent-wing Bat could have been foraging along the cliff edge and between tree canopies on the subject site. This species has the potential to forage across the entire subject site. It is also possible that this species is roosting in sandstone cave habitat on the subject site (Pearson 2016). A single call trace of the Yellow-bellied Sheath-tail Bat call was recorded from a passive acoustic bat recorder. This suggests one individual was flying over the subject site. The Yellow-bellied Sheath-tail Bat is an aerial foraging microbat which requires tall forests to roost and breed. While it is possible this species may temporarily roost on the subject site, it is considered more likely that it would simply pass over as it travelled between more optimal habitat patches (Pearson 2016).

It is considered likely that the Grey-headed Flying Fox observed was feeding on flowering Red Bloodwood and/or *Banksia spp*. on the subject site. These trees were abundant on the subject site, and flowering between March and April in 2017.

The Eastern Pygmy-possum was documented on the subject site during the fauna survey by Narla Environmental. The number of adult animals captured during camera trapping in April 2017 (**Plate 5**) suggests that a viable breeding population occurs locally. This population is expected to be contiguous with the local Eastern Pygmy-possum population occurs outside the subject site, supported by habitat connectivity with nearby Dundundra Falls Reserve and Ku-ring-gai Chase National Park.

The presence of Eastern Pygmy-possum in Dundundra Falls Reserve was confirmed by Narla Environmental during the preparation of this SIS. On 31 November 2017 an adult Eastern Pygmy-possum

was recorded attempting to feed from the inflorescens of a *Banksia serrata* (**Plate 6**) located in Dundunra Falls Reserve, close to Larool Road.

Chewed cones of Black She-oak (*Allocasuarina torulosa*) were found within the subject site. The remains of the chewing were characteristic of Glossy Black Cockatoo (*Calyptorhynchus banksii*). It is likely this mobile bird species will continue to intermittently forage within the subject site prior, during and post development of the. It is not expected that breeding will occur within the subject site at present or in the future, since there is a lack of suitable sized tree hollows.

On the 28th of April 2017 Narla Ecologists observed a Rosenberg's Goanna sunbathing within the subject site (**Figure 17**). Rosenberg's Goanna usually requires ground termite mounds and friable sands for nesting, however it may occassionally nest in sandstone caves or crevices.

Two species of threatened fauna that were not recorded during the survey, were still considered likely to occur on the subject site at some point in their lifecycles, they were:

- Little Lorikeet (*Glossopsitta pusilla*) - vulnerable under TSC Act
- Powerful Owl (*Ninox strenua*) - vulnerable under TSC Act

It is considered likely that these species would forage on the subject site, however breeding is considered less likely. Both species have specific breeding requirements that are not well represented on the subject site. The Little Lorikeet requires abundant, suitably sized hollows (narrow, but deep) in tall, flowering *Eucalyptus sp.* such as Forest Red Gum *(Eucalyptus tereticornis)*. The Powerful Owl usually requires large, tree-hollows greater than 20 cm in diameter to nest in. Suitable hollows are usually located in secluded areas that support dense, tall shrub cover such as deep gullies. No suitable nesting habitat for this species was found, however abundant suitable roosting habitat occurs. In accordance with the precautionary principle, each of these species was given careful consideration through the application of a 7-Part Test.

Survey results: Dundundra Falls Reserve

Dundundra Falls Reserve is an approximately 40 ha remnant bushland reserve that adjoins Ku-ring-gai Chase National Park and connects with the subject site through a network of vegetation corridors through public and private land.

For the purpose of producing this SIS, Narla Environmental Ecologists and Paul Burcher of Aquila Ecology carried out extensive surveys across Dundundra Falls Reserve for:

- Coastal Upland Swamp.
- Duffys Forest Ecological Community, and
- Eastern Pygmy Possum

The results revealed an extensive volume of previously undocumented information on:

- Eastern Pygmy Possum habitat in Dundundra Falls Reserve including:
  - A confirmed observation of an Eastern Pygmy Possum utilising habitat in Dundundra Falls Reserve (**Plate 6**)
  - an extensive network of Eastern Pygmy Possum foraging and shelter habitat (**Figure 18**)
- Duffys Forest Ecological community including:
  - the discovery and mapping of 2.32 ha that had not been mapped in the Sydney Metropolitan Mapping Project (OEH 2013a;2013b)
- Coastal Upland Swamp including:
  - an extensive network of high quality, floristically diverse significant Coastal Upland Swamps
  - a previous unmapped and undocumented extent of 1.16 ha of Coastal Upland Swamp
  - occurrences of locally uncommon Coastal Upland Swamp plants including the locally uncommon Swamp Banksia (*Banksia robur*)
  - patches of of lower quality (weed infested) Coastal Upland Swamp that had potential to improve with active management.

Plate 5. Eastern Pygmy Possum feeding on *Banksia ericifolia* in the subject site.

Plate 6. Eastern Pygmy-Possum photographed in Dundundra Falls Reserve on 31 November 2017.

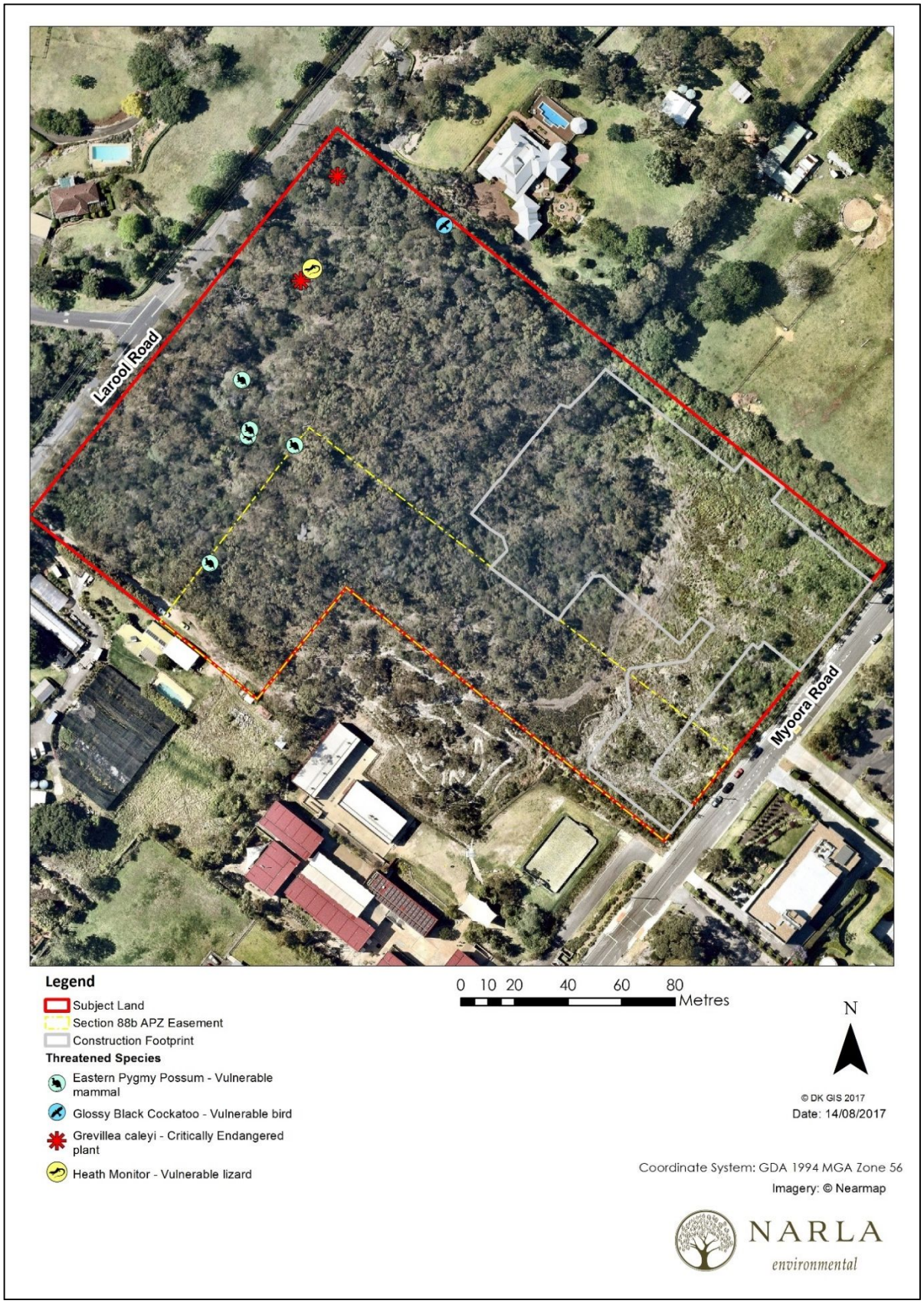


Figure 17. Location of threatened species found on the subject site by Narla Environmental

Threatened Fauna Habitat

The subject site provided many habitat features, suitable for supporting the foraging, nesting and roosting requirements of a diverse suite of fauna. This included structurally diverse forest vegetation that included flowering and fruiting trees and shrubs, mature hollow-bearing trees, dead trees (stags), logs and litter. Other significant habitat features include sandstone outcropping, crevices and small caves. Several small, freshwater seeps and soaks were recorded.

Extensive outcropping of Hawkesbury Sandstone across the north of the subject site contains cracks and crevices which were used for shelter and foraging by common small reptiles and mammals. The larger examples of these structures may also provide refuge for a number of other mammals, amphibians and cave-roosting microbat species. It is unlikely that any of these cracks or crevices are large-enough and of suitable dimensions to provide nursery roosts of any threatened bat species. This was further confimed by the absence of large numbers of individual threatened, cave roosting species during acoustic surveys, or the capture of any individuals during the intensive harp-trapping efforts undertaken.

An abundance of nectar-bearing plants was present within the area which is likely to attract additional species with changes in seasonal fruit/nectar availability. This included Red Bloodwood, *Banksia spp.*, *Angophora spp.* and *Grevillea spp*. These plants provided foraging resources for a range of nectivorous birds, Grey-headed Glying-fox and Eastern Pygmy-possum identified in the subject site.

Eastern Pygmy-possum was confirmed to occur in Dundundra Falls Reserve. This reserve is conntected to the subject site through a network of suitable habitat corridors (containing foraging and sheltering habitat) that connects the subject site with Dundundra Falls Reserve along the edge of Larool Road and within adjoining properties. This indicates that Eastern Pygmy-possums on the subject site form part of a larger population in the area that spans Larool Road, south to Dundundra and into adjoining Ku-ring-gai Chase National Park.

Historical clearing had significantly altered the fauna habitat in the south of subject site. Clearing had heavily impacted upon both the vegetation and sediment. The fauna habitat in this area was restricted to artificially created weed infestations that included fruit-bearing *Privet spp.*, Camphor (*Cinnamomum camphora*) and Blackberry (*Rubus fruticosus aggregate*), dense tussocks of Pampas Grass (*Cortaderia sp*) and scattered remnant and planted paddock trees and shrubs.

A summary of the individual habitat features identified during the quantitative survey within the construction footprint or APZ is provided in **Table 20**. Maps of these habitat features are presented in **Appendix E**.

Table 20. Summary of the habitat features identified within the proposed development footprint and APZ areas.

Item Class	Item	Construction Footprint	Inner Protection Area (IPA)	Outer Protection Area (OPA)	Total
Flowering Tree/Shrub	*Angophora hispida*	0	0	17	17
	Banksia ericifolia	80	50	53	250
	Banksia sericea	1	9	0	10
	Banksia spinulosa	7	4	8	20
	Callistemon citrinus	3	0	0	3
	Corymbia gummifera	25	50	4	104
	Lambertia formosa	0	0	4	4
	Sub-total	*116*	*113*	*86*	*408*
Glossy Black Cockatoo forage tree	*Allocasuarina littoralis*	32	97	84	213
Hollow-bearing Tree	*Allocasuarina littoralis*	1	0	2	3
	Corymbia gummifera	2	20	8	30
	Eucalyptus haemastoma	17	16	8	24
	Eucalyptus sieberi	1	11	0	11
	Eucalyptus spp. 'stringybark'	0	2	3	5
	Stag (Dead tree)	3	5	10	18
	Sub-total	*24*	*54*	*31*	*91*
Other Habitat Features	Nest	0	2	0	2
	Rabbit Warren	1	0	0	1
	Soak	1	0	4	5
	Termite Mound	0	1	1	2
	Sub-total	*2*	*3*	*5*	*10*
All Features	**Total**	**155**	**267**	**206**	**722**

Table 21. Summary of the numbers of tree hollows preliminarily identified within the proposed construction footprint

Small (2.5-5cm diameter)	Medium (6-10cm diameter)	Large (10-15cm diameter)
1	2	1
1	1	2
3	1	1
2	3	0
2	1	0
1	2	0
5	2	0
1	4	0
2	1	0
3	1	0
4	1	0
2	3	0
2	1	0
4	0	0
2	0	0
2	0	0
10	0	0
4	0	0
Total Hollows 51	**23**	**4**

5. Assessment of likely impacts on Threatened Species and Populations

5.1 Assessment of species likely to be affected

The CERs list twenty-nine (29) fauna species, fifteen (15) flora species and two endangered ecological communities to be considered for inclusion as subject species in the preparation of the SIS. Details of how these species, populations and communities were considered (and how other species, population and communities were also selected for consideration) in relation to potential impacts are outlined below.

Flora Species

Previous reports, studies, database searches and field studies identified twenty (20) threatened flora species of which fifteen (15) have known populations within a 5-kilometre radius of the site. An assessment of the likely occurrence of these within the study area identified thirteen (13) species with varying degrees of occurrence likelihood (**Table 22**).

The following species has known extant populations within the study area:

- *Grevillea caleyi* (Caley's Grevillea).

The following species have been previously recorded within the study area:

- *Persoonia hirsuta* (Hairy Geebung).

The location of threatened flora species records within the study area is shown in **Figure 17**.

Species that were considered to have some probability of occurrence on the subject site based on consideration of local records and/suitable habitat being present included the following eleven (11) species:

- *Pimelea curviflora var. curviflora;*
- *Epacris purpurascens subsp. purpurascens;*
- *Callistemon linearifolius;*
- *Eucalyptus camfieldii;*
- *Lasiopetalum joyceae;*
- *Melaleuca deanei;*
- *Darwinia biflora;*
- *Tetratheca glandulosa;*
- *Microtis angusii;*
- *Cryptostylis hunteriana;* and
- *Genoplesium baueri.*

Targeted surveys and habitat assessments for all of these eleven-species confirmed none were present, and all had nil likelihood of occurrence.

A list of subject flora species for the purpose of this SIS was produced. This was based on the species specified in the CERs and a consideration of previous records and habitat, vegetation and habitat mapping and surveys undertaken **Table 22.**

Table 22. Summary of threatened flora species recorded in the locality

Name	Presence within study area	Targeted survey undertaken	Known or predicted location in study area	Further Assessment of Impact Required?
Grevillea caleyi	Two small clusters of 3 and 7 plants were identified on the subject site.	Yes	Located in Duffys Forest Ecological Community within north-west of site. Both are located in the proposed Conservation Area on the subject site.	Yes
Persoonia hirsuta	Recorded by Blue Mountains Wilderness Services in 2004	Yes	Despite multiple targeted surveys undertaken through the subject site by Blue Mountains Wilderness Services (2004) and Narla Environmental, no Hairy Geebung has been found within the subject site, since an initial record from 2004. The record of *Persoonia hirsuta* is located in the proposed Conservation Area on the subject site.	No
Pimelea curviflora var. curviflora	None	Yes	None	No
Epacris purpurascens subsp. purpurascens	None	Yes	None	No
Cryptostylis hunteriana	None	Yes	None	No
Callistemon linearifolius	None	Yes	None	No
Eucalyptus camfieldii	None	Yes	None	No
Melaleuca deanei	None	Yes	None	No
Darwinia biflora	None	Yes	None	No
Lasiopetalum joyceae	None	Yes	None	No
Tetratheca glandulosa	None	Yes	None	No
Microtis angusii	None	Yes	None	No
Genoplesium baueri	None	Yes	None	No

Flora species that require no further assessment

Other than *Grevillea caleyi*, none of the above threatened species were recorded during Narla Environmental's field surveys, despite intensive searches over spring and summer for two successive seasons (2016 – 2017). The following species are visible throughout the year and if present are likely to have been recorded throughout general survey and targeted searches:

- *Pimelea curviflora var. curviflora;*
- *Epacris purpurascens subsp. purpurascens;*
- *Callistemon linearifolius;*
- *Eucalyptus camfieldii;*
- *Melaleuca deanei;*
- *Darwinia biflora;*
- *Lasiopetalum joyceae;* and
- *Tetratheca glandulosa.*

Since only one of the above listed species were recorded during extensive site surveys, it was concluded that the presence of the remaining species on the subject site was unlikely and therefore none of those species would be at risk of impact from the proposed development. For the purpose of this SIS, only Caley's Grevillea will be assessed for impacts from the proposed Hospital development.

Narla Environmental have applied the precautionary principle and undertaken further assessments of significance (7-part tests) for all of these species (**Appendix G**). Assessments of significance concluded that the proposal is unlikely to have a significant impact such that a viable local population of any of these species is likely to be placed at risk of extinction, given that the amount of potential habitat that would be lost is only small in comparison to the habitat remaining in the area and that substantial ameliorative and compensatory measures will be taken to reduce potential impacts (see **Section 7**).

Flora species that require no further assessment in this SIS: *Persoonia hirsuta* (Hairy Geebung)

One specimen of Hairy Geebung was recorded and mapped within the subject site during a previous study of the subject site which was undertaken over 13 years prior to the present study (Blue Mountains Wilderness Services 2004). This species is listed as 'Endangered' under both the TSC and EPBC Act. Despite multiple targeted surveys undertaken through the subject site by both Blue Mountains Wilderness Services and Narla Environmental, no Hairy Geebung has been found within the subject site, since that initial record from 2004. A thorough database search revealed no other records of the species within a 5-km range of the subject site.

It is possible that unidentified seed or rootstock may persist in vicinity of the initial observation, however, as the proposed hospital construction footprint is located outside of the identified habitat for this species, it is considered highly unlikely to occur within the construction footprint.

APZ works will not impact upon potential root stock or seed within APZ management areas as excavation / disturbance to soil surface is not permitted and all works will be undertaken by qualified Bush Regenerators skilled in identification of Hairy Geebung. It is possible that the proposed development may assist in the conservation of Hairy Geebung on the subject site this is because:

- Skilled Bush Regenerators undertaking APZ works are likely to find any previously undetected individuals of this species
- The removal of dense, dead organic matter from the sites will allow light penetration to the soil and assist in germination of the seedbank in the Duffys Forest (near the location of the Hairy Geebung)
- The area where the Hairy Geebung was recorded in 2004 will be located entirely within the proposed 'Conservation Area' (**section 7.1**).

Subject to implementation of the approved biodiversity management plan (BMP) (Narla 2017a) it is considered that habitat for *Persoonia hirsuta* will improve within the subject site. It is considered this species has low potential of being impacted by the proposal and instead is likely to benefit.

Flora species that require further assessment in this SIS: *Grevillea caleyi* (Caley's Grevillea)

Narla Environmental confirmed the presence of Caley's Grevillea *(Grevillea caleyi)* within the subject site. Two clusters of 3 and 7 individuals were identified (**Figure 11**). These plants are located outside of the proposed construction footprint and APZ areas. Since both of these clusters are located entirely outside of the development area and within a proposed Conservation Area, it is considered highly unlikely that these individuals will be impacted by the proposal.

It is possible that unidentified seed or rootstock may persist in vicinity of the initial observation, however, as the proposed hospital construction footprint is located outside of the identified habitat for this species, it is considered highly unlikely to occur within the construction footprint.

APZ works will not impact upon potential root stock or seed within APZ management areas as excavation / disturbance to soil surface is not permitted and all works will be undertaken by qualified Bush Regenerators skilled in identification of Hairy Geebung. It is possible that the proposed development may assist in the conservation o Hairy Geebung on the subject site this is because:

- Skilled Bush Regenerators undertaking APZ works are likely to find any previously undetected individuals of this species

- The removal of dense, dead organic matter from the sites will allow light penetration to the soil and assist in germination of the seedbank in the Duffys Forest (near the location of the Hairy Geebung)
- The area where the Cayley's Grevillea have been recorded will be located entirely within the proposed 'Conservation Area' (section 7.1).
- The two known clusters of Cayleys Grevillea on the subject-site will be fenced-off within the Conservation Area and managed for protection and enhancement.
- Active management of the Conservation Area will include active bush regeneration efforts which will assist in protection and enhancement of the local population into the future.

Subject to implementation of the approved biodiversity management plan (BMP) (Narla 2017a) it is considered that habitat for Caley's Grevillea will improve within the subject site. It is considered this species has low potential of being impacted by the proposal and instead is likely to benefit.

Fauna Species

Previous reports, studies and database searches identified thirty-five (35) threatened fauna species of which thirty (30) have known populations within a 5-kilometre radius of the site. An assessment of the likely occurrence of these within the study area identified suite of species with a moderate or high likelihood of occurrence (**Table 10**).

The following species were confirmed utilising habitat within the Subject site:

- Eastern Pygmy Possum;
- Glossy Black Cockatoo; and
- Rosenberg's Goanna.

The locations where these fauna species were recorded are mapped (**Figure 17**).

An additional four threatened fauna were confirmed flying over the Subject site but where not confirmed to be roosting, sheltering or foraging within the Subject site. As these species only flew over the subject site, their location within the subject site was not mapped.

They were:

- Square-tailed Kite;
- Yellow-bellied Sheathtail-bat;
- Eastern Bent-wing Bat; and
- Grey-headed Flying Fox.

Species that have a low to moderate of occurrence on the subject site based on consideration of local records and/suitable habitat being present include:

- Giant Burrowing Frog;
- Red-crowned Toadlet;
- White-bellied Sea-Eagle;
- Little Eagle;
- Little Lorikeet;
- Swift Parrot;
- Barking Owl;
- Powerful Owl;
- Masked Owl;
- Sooty Owl;
- Regent Honeyeater;
- Varied Sittella;
- Dusky Woodswallow;

- Spotted-tailed Quoll;
- Southern Brown Bandicoot (eastern);
- Squirrel Glider;
- Eastern Freetail-bat;
- Eastern False Pipistrelle;
- Large-eared Pied Bat;
- Little Bentwing-bat;
- Greater Broad-nosed Bat.

A list of subject fauna species was produced for the purpose of this SIS (based on the species specified in the Chief Executive's Requirements and a consideration of previous records and habitat, vegetation, habitat mapping and surveys undertaken). This list of species is summarised in **Table 23.**

Table 23. Subject Fauna Species Summary

Species	Presence within study area	Targeted survey	Known or predicted location in study area
Giant Burrowing Frog	None	Yes	Marginal non-breeding habitat within ephemeral soaks
Red-crowned Toadlet	None	Yes	Breeding habitat within ephemeral soaks, non-breeding habitat within sandstone escarpment (Duffys Forest)
Rosenberg's Goanna	Yes, identified within Duffys Forest in north-east of site	Yes	Foraging habitat throughout subject site. Nests in termite mounds
White-bellied Sea-Eagle	None	Yes	Suitable habitat for prey species. No suitable nesting habitat (tall trees near water).
Little Eagle	None	Yes	Suitable habitat for prey species. Little suitable nesting habitat (tall trees).
Square-tailed Kite	Yes, observed flying over site	Yes	Suitable habitat for prey species. Little suitable nesting habitat (tall trees).
Glossy Black-Cockatoo	Yes, evidence of foraging within Duffys Forest in north-east of site	Yes	Foraging habitat within north-west of subject site. Little to no suitable nesting habitat (large hollow trees).
Little Lorikeet	None	Yes	Foraging and marginal nesting habitat within northern portion of subject site
Swift Parrot	None	Yes	Intermittent foraging habitat in the study area only.
Barking Owl	None	Yes	Suitable habitat for prey species. Roosting habitat within north-west of subject site. No nesting habitat.
Powerful Owl	None, nearby records	Yes	Suitable habitat for prey species. Roosting habitat within north-west of subject site. No nesting habitat.
Masked Owl	None	Yes	Suitable habitat for prey species. Roosting habitat within north-west of subject site. No nesting habitat.
Sooty Owl	None	Yes	Suitable habitat for prey species. Roosting habitat within north-west of subject site. No nesting habitat.
Regent Honeyeater	None	Yes	Intermittent foraging habitat in the study area only.
Varied Sittella	None	Yes	Foraging and breeding habitat throughout the north-west of site.
Dusky Woodswallow	None	Yes	Foraging habitat throughout the study area.
Spotted-tailed Quoll	None	Yes	Unlikely to occur but known from Ku-ring-gai Chase National Park.
Southern Brown Bandicoot (eastern)	None, nearby records	Yes	Unlikely to occur but known from Ku-ring-gai Chase National Park
Eastern Pygmy-possum	Yes, recorded within site	Yes	Known throughout study area, including subject site and adjoining Dundundra Falls Reserve and Ku-ring-gai Chase National Park.
Squirrel Glider	None	Yes	Unlikely to occur but there is one 2008 record approximately 1.2 km NE of site.
Grey-headed Flying-fox	Observed flying over site	Yes	Foraging habitat throughout the study area.
Yellow-bellied Sheathtail-bat	Recorded by acoustic monitor (SM4)	Yes	Foraging habitat in woodland. No suitable roosting habitat.
Eastern Freetail-bat	None	Yes	Roosting and foraging habitat in woodland.
Large-eared Pied Bat	None	Yes	Foraging habitat. Temporary roost habitat only. No suitable breeding habitat.
Little Bentwing-bat	None	Yes	Foraging habitat. Temporary roost habitat only. No suitable breeding habitat.
Eastern Bentwing-bat	Recorded by acoustic monitor (SM4)	Yes	Foraging habitat. Temporary roost habitat only. No suitable breeding habitat.
Eastern False Pipistrelle	None	Yes	Roosting and foraging habitat in woodland
Greater Broad-nosed Bat	None	Yes	Roosting and foraging habitat in woodland.

Potential impacts on threatened fauna from the proposal, include the removal of some potential foraging, breeding and sheltering habitat for a small number of threatened fauna species.

This includes:

- The loss of 24 hollow-bearing trees constituting approximately 78 (51 x 2.5cm – 5cm; 23 x 6cm – 10cm; 4 x 10-15cm) tree hollows (estimates only);
    - All hollows will be replaced with augmented hollows of the same dimensions at a ratio of at least 2:1 per hollow.
- The loss of 0.37 ha of moderate condition vegetation, and 0.13ha of poor condition/weed infested habitat.
    - All-important nectar-producing foraging trees (e.g. *Banksia ericifolia*) removed will be replaced at a ratio of 3:1 per species.
    - The subject site (outside the development footprint) within existing weed infested areas will be landscaped with locally indigenous vegetation, including low shrubs and groundcover suitable for the foraging requirements of this species.
- A total of 32 potential Glossy Black-Cockatoo foraging trees (*Allocasuarina spp.*) will be removed to facilitate the proposal;
    - All removed female (fruiting) *Allocasuarina spp.* that are potential Glossy Black Cockatoo *foraging* trees will be replaced at a ratio of 3:1 as a part of the Landscape Plan (Carmichael Studios 2017).
- The removal of one ephemeral soak, that may offer marginal breeding habitat for the Red-crowned Toadlet;
    - This soak will be replaced elsewhere on the subject site through the implementation of the Onsite Stormwater Drainage system (OSD) (Martens 2017a;2017b)
    - All remaining soaks within the subject site, will not be impacted by the proposal.

Because the management of the APZ areas will be undertaken in a delicate, ecologically sustainable manner by bush regeneration professionals under the guidance of an Ecologist (Peterson Bushfire 2017; Narla 2017;2017a). The impacts of APZ management upon threatened fauna are not assessed in this SIS. This is specifically because:

- APZ management will focus on eradication of dense weed growth as a priority;
- All important Eastern Pygmy-Possum feed trees (particularly *Banksia ericifolia*) will be retained as a priority;
- All mature, fruit-bearing *Allocasuarina littoralis* (Glossy Black Cockatoo Feed Trees) will be retained as a priority;
- The removal of dead biomass (leaf litter, twigs and dead shrubbery) from the subject site will allow the regeneration of fauna habitat through new growth and germination in all layers;
- In the unlikely event any fauna feed trees (e.g. *Banksia ericifolia* or female *Allocasuarina torulosa* are removed, they will be replaced at a ratio of 3:1
- All hollow-bearing trees and limbs will be retained and protected.
- No rock outcrops, crevices or caves will be impacted by the APZ.

A preliminary assessment of potential impacts from the proposal was performed for each of these species based on their habitat requirements and likelihood of occurrence in the study area. For the species listed in **Table 23**, the preliminary assessment determined that the proposal was likely to have negligible impacts on all species, either because little or no habitat for the species is likely to occur in study area or because little or no habitat for the species is likely to be lost, following implementation of the Biodiversity Management Plan (Narla 2017), and Landscape Plan (Carmichael Studios 2017).

It is also believed that the proposed development will not result in a significant impact on:

- Eastern Pygmy Possum
- Glossy Black Cockatoo
- Rosenberg's Goanna

Because these species are all mobile and the individuals recorded on the subject site all form part of larger populations centred on nearby Dundundra Falls Reserve and Ku-ring-gai Chase National Park which are connected to the subject site through habitat corridors.

Narla Environmental have applied the precautionary principle and undertaken further Assessment of Significance (7-part tests) for all of these species (**Appendix G**). Assessments concluded that the proposal is unlikely to have a significant impact such that a viable local population of any of these species is likely to be placed at risk of extinction. This because the amount of potential habitat that would be lost is only small in comparison to the habitat remaining in the area and that substantial ameliorative and compensatory measures will be taken to reduce potential impacts (see **Section 7**).

Following this assessment, Narla determined that only one species required further assessment of impacts from the proposal, this being the Eastern Pygmy-possum, which is known to utilise breeding and foraging habitat throughout the subject site.

Fauna species that require no further assessment in this SIS: Glossy Black Cockatoo

The Glossy Black Cockatoo is listed as 'Vulnerable' under the TSC Act.

Chewed cones of *Allocasuarina torulosa* (Black She-oak) were found within the Subject site. The remains of the chewing were characteristic of Glossy Black Cockatoo. It is considered likely that this mobile bird species will continue to intermittently forage within the subject site prior, during and post development of the proposed hospital. It is not expected that breeding will occur within the subject site owing to a lack of suitably sized tree hollows and the disturbed nature of the site close to urban residential areas and domestic pets. As no suitable breeding habitat for this species was identified within the subject site; it is not expected that breeding behaviours will be impacted either directly or indirectly.

The proposal may involve the removal of a small number of mature, fruiting Black She-oak to allow for the construction footprint. If any mature, fruiting trees are removed, they will be replaced with new female trees at a ratio of 3:1. The feed trees used by the Glossy Black Cockatoo on the subject site will be retained as a priority.

The proposal may involve the select thinning of non-fruiting Black She-oak to meet APZ requirements (Peterson Bushfire 2017). In the unlikely event that any fruiting trees are removed, they will be replaced with female trees at a ratio of 3:1.

Significant impacts to this species as a result of this development are unlikely owing to its mobile nature, the lack of suitable breeding habitat on site, the effort being made to retain feed trees (including those where the species was recorded) and the proposal to replace any fruiting trees that are removed for the development. No further assessment is required for the purpose of this SIS.

Fauna species that require no further assessment in this SIS: Rosenberg's Goanna

Rosenberg's Goanna is listed as 'Vulnerable' under the TSC Act.

Automated camera targeted survey found no evidence of Rosenberg's Goanna during March 2017. However, on the 28th of April 2017 Narla Ecologists observed a Rosenberg's Goanna sunbathing within the Subject Site in the proposed Conservation Area.

No termite mounds will be removed from the site as a part of the proposal. Significant impacts to this species as a result of this development are unlikely. No further assessment is required for the purpose of this SIS.

Fauna species that require further assessment in this SIS: Eastern Pygmy-possum

The Eastern Pygmy-possum is listed as 'Vulnerable' under the TSC Act 1995.

Evidence of a population of Eastern Pygmy-possum was documented during the fauna survey. The number of adult animals captured during camera trapping in April 2017 suggests that a viable breeding

population occurs locally. This population is expected to be contiguous with the local Eastern Pygmy Possum population that occurs outside the Subject site, supported by habitat connectivity with nearby Dundundra Falls Reserve and Ku-ring-gai Chase National Park.

Eastern Pygmy Possum records were obtained on both sides of Larool Road; reflective of the availability of foraging habitat (dense Banksia ericifolia) along Larool Road and in Dundundra Falls Reserve, suggesting moderate to high potential for movement and breeding of Eastern Pygmy-Possums between the subject site and Dundundra Falls Reserve.

No radio-telemetry was undertaken for the purpose of this SIS, as no individuals were captured during nest box monitoring in December 2017, so the number of individuals within the subject site, and their movements across Larool Road is unknown at the time of producing this SIS.

The proposal involves the direct loss of 91 potential feed shrubs to allow for the construction footprint, this consists of:

- 80 x *Banksia ericifolia*
- 1 x *Banksia serrata*
- 7 x *Banksia spinulosa*
- 3 x *Callistemon citrinus*

Branches from senescing *Banksia ericifolia* may be selectively trimmed by qualified Bush Regenerators for APZ management, however removal of whole trees will be avoided. Removal of dead, senescing branches is considered likely to contribute to increased inflorescences the following season and this is likely to benefit Eastern Pygmy-possum on the subject site. In the unlikely event a potential Eastern Pygmy-possum feed plant is removed from an APZ, the plant will be replaced at a ratio of 3:1.

The proposal also is expected to result in the loss of 24 hollow-bearing trees from the construction. These trees containing approximately:

- 51 hollows 2.5 -5cm in diameter;
- 23 hollows 6-10cm in diameter; and
- 4 hollows 10-15cm in diameter.

All of these hollows will be replaced will augmented hollows (e.g. nest boxes, or artificial tree hollows drilled into trees) to a ratio of at least 2:1.

5.2 Discussion of local and regional abundance and distribution

5.2.1 Discussion of regional occurrences and the local population

Flora - Caley's Grevillea

The Cayley's Grevillea population is highly restricted to three ridge-lines at Belrose, Duffys Forest/Terrey Hills and Ingleside and is associated predominantly with the Duffys Forest endangered ecological community (SMEC 2017). There are at least 26 known sites ranging from a few metres squared to 1.2 hectares in area that are representative fragments of its former distribution (Auld and Scott 2013). Population numbers vary considerably depending on time since fire. Most sites are subject to high development pressure, disturbance and inappropriate fire regimes. Population decline within the study area is likely due to the absence of fire >20 years in most areas (Auld and Scott 2013, SMEC 2017). Multiple populations are located within Ku-ring-gai Chase and Garigal National Parks, however these are suffering population decline (Auld and Scott 2013). Local populations are typically small (<3 ha) and in poor condition with high edge to core ratios (SMEC 2017).

Nearby records of Cayley's Grevillea occur:

- multiple plants in Duffys Forest ecological community fringing Terrey Hills Oval;
- along Myoora Road at the junction of Myoora and Mona Vale Road;
- a cluster of plants near the junction of Laitoki and Booralie Road;

- a cluster of plants on private property at 83 Booralie Road;
- multiple plants in bushland at the junction of Booralie Road and Mona Vale Road; and
- one plant on the council reserve along Mona Vale road south-east of the subject site

The following sub-populations occur in close proximity to the subject site (**Figure 11**):

- one large plant in the grounds of Terrey Hills Public School bordering Myoora Road; and
- one large plant in the council roadside reserve bordering Myoora Road, opposite the Terrey Hills Public School.

Two small clusters (3 and 7 individuals) were identified within the subject site. These two clusters are restricted entirely within the Duffys Forest Ecological Community on the subject site, and will be protected entirely within the proposed Conservation Area (**Figure 1**).

Fauna - Eastern Pygmy-possum

Multiple encounters were made by Narla Environmental during the survey period as follows:

- one captured during pitfall trapping surveys
- several captured from three remote cameras positioned in the subject site.

It is considered likely that one interbreeding population of Eastern Pygmy-possum is distributed throughout the subject site, and the adjoining Dundundra Falls Reserve. At least one individual was encountered in Dundundra Falls Reserve during the November 2017 – December 2017 remote camera surveys.

This survey period was suboptimal for detecting Eastern Pygmy-possum as all *Banksia ericifolia* and most other *Banksia spp*. were no longer in flower. Nonetheless, one individual was recorded and it is expected that many more would be recorded if additional camera survey had been undertaken in Dundundra Falls Reserve during the season when *Banksia ericifolia* are in flower and producing nectar (autumn – early spring). No previous atlas records of Eastern Pygmy-possum exist within Dundundra Falls Reserve; however, this is expected to be a result of limited survey effort having been undertaken for this species.

To date, no individuals have been recorded during nest box surveys on the subject site, consequently, no opportunities have arisen to undertake pit-tagging, capture/recapture or radio telemetry to determine population size or track movements throughout the site and into the adjoining Dundundra Fall Reserve. The Pygmy-possum is generally characterised by low capture rates (e.g. Harris and Goldingay 2005; Tulloch and Dickman 2006; Harris *et al.* 2007), implying a low probability of individual recapture, which Bladon *et al.* (2002) estimated to be 53% over a long-term study (about 2.5 years) using nest boxes.

5.3 Assessment of Habitat

5.3.1 Description of habitat values

The condition of vegetation within the study area is based on information provided in the FFA (Narla, 2017) and additional survey undertaken for this SIS. The condition rating (good, moderate, poor, disturbed) is based on resilience or the capacity of a site to regenerate (modified version of Jones and Brodie (1999) as used in SMEC (2017)). The methodology uses biological factors together with the health of the soil profile as well as the level of weed invasion. The Subject site was rated as ranging from good to poor condition, with regenerative capacity throughout. The condition classes are summarised in **Table 24**. Vegetation condition is mapped in **Figure 7.**

Moderate to Good Quality Habitat

Native vegetation extending across approximately half of the Subject site is in good to moderate condition with high to moderate levels of resilience, reflecting the infertile sandstone geology and the elevation of these areas. Native vegetation adjacent to Larool Road and neighbouring properties is edge-affected with evidence of weed invasion and altered micro-climate. The historical quarry has regenerated, with low levels of weed invasion. A summary of vegetation condition within the native vegetation communities based on vegetation data compiled in Narla (2017) is provided in Table 25.

These areas of the subject site provided many habitat features, suitable for supporting the foraging, nesting and roosting requirements of a diverse suite of fauna. This included structurally diverse, forest vegetation comprised of flowering and fruiting trees and shrubs, mature hollow-bearing trees, dead trees (stags), logs and litter. Other significant habitat features include sandstone outcropping, crevices and small caves. Several small, freshwater seeps and soaks were recorded.

Extensive outcropping of Hawkesbury Sandstone across the north of the subject site provided cracks and crevices which were used for shelter and foraging by small reptiles and small mammals. These structures may also provide refuge for a number of other mammals, amphibians and cave-roosting microbat species.

An abundance of nectar-bearing plants was present within the area which is likely to attract additional species with changes in seasonal fruit/nectar availability. This included Red Bloodwoods, *Banksia spp.*, *Angophora spp.* and *Grevillea spp*. These plants provided foraging resources for a range of nectivorous birds and mammals within the subject site. These nectar sources may at times attract threatened nomadic birds.

At the time of preparing this report, the native vegetation of the subject site was in a late successional stage. This was evident by the large number of tall, dense mature *Kunzea ambigua, Leptospermum spp., Acacia spp.*, and Black She-oak senescing and dying. This will reduce the quality of the vegetation over time.

Poor Quality Habitat

The remainder of the site is comprised of historically cleared and weed infested land in low-lying areas (Somersby Soil Landscape) in the south-east of the Subject site and margins bordering neighbouring properties. The most severe woody weed infestation occurs at the boundary of the subject property with the neighbouring property to the north-east, as well as the boundary with Myoora Road. This weed infestation also contains dense herbaceous, vine and graminoid weed infestations. Dominant exotic species within this area include, but are not limited to, Environmental weeds (as listed within Appendix 6 of the Warringah DCP [2011]) such as *Ageratina adenophora* (Crofton), *Aristea ecklonii* (Blue Stars), *Araujia sercifera* (Moth Vine), *Cotoneaster glaucophyllus* (Cotoneaster), *Ligustrum lucidum* (Broad-leaf Privet) and *Senna pendula* (Cassia), and Priority weeds such as *Cortaderia* sp. (Pampas Grass).

Table 24. Summary of vegetation condition within the subject site

Resilience/Condition Class	Description
Good	▪ Weed infestation absent or minor ▪ All structural layers ± intact ▪ In benchmark condition ▪ High species richness
Moderate	▪ Weed infestation minor ▪ One structural layer either absent or in poor condition ▪ Close benchmark condition ▪ Moderate species richness
Poor	▪ Weed infestation moderate to severe ▪ Poor structure ▪ Well outside benchmark condition ▪ Low species richness
Disturbed (Non-resilient)	▪ Soil profile permanently altered with loss of soil seed bank ▪ Limited to no regeneration capacity

*Based on modified version of Jones and Brodie (1999) as used in SMEC (2017)

Table 25. Summary of native vegetation condition within subject site

Vegetation community	Condition	Area within Subject site (Ha)
Sydney Ironstone Bloodwood-Silver-top Ash Forest (Duffys Forest Ecological Community (EEC))	Good	1.57
Sydney North Exposed Sandstone Woodland	Good	0.19
	Moderate (partially cleared)	0.75
Coastal Sandstone Mallee-Heath	Good	0.38
	Moderate (weed infested)	0.24
Coastal Upland Damp Heath Swamp (EEC)	Good	0.12
	Moderate (weed infested)	0.05
Woody Weed Infestation	Poor	0.17
Historically Cleared / Pampas	Poor - Disturbed	0.65

Thirty-six weed species were recorded in vegetation surveys throughout the site (Narla, 2017). A total of six priority weeds have been recorded in surveys within the Subject site (**Table 26**).

Table 26. Inventory of the noxious weeds identified within the subject site.

Species	Measurement	Management Requirement
Rubus fruticosus species aggregate (Blackberry)	Prohibition on dealings	Must not be imported into the State or Sold
Arundo donax (Giant Reed)	Regional Recommended Measure	Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment
Cestrum parqui (Green Cestrum)	Regional Recommended Measure	Land managers should mitigate the risk
Asparagus aethiopicus (Ground Asparagus)	Prohibition on dealings	Must not be imported into the State or sold
Lantana camara (Lantana)	Prohibition on dealings	Must not be imported into the State or Sold
Cortaderia spp. (Pampas Grass)	Regional Recommended Measure	Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Notify local control authority if found

Historical clearing had significantly altered the fauna habitat in the south of subject site. Clearing had heavily impacted upon both the vegetation and sediment. The fauna habitat in this area was restricted to artificially created weed infestations that included fruit-bearing *Privet spp.*, *Cinnamomum camphora* (Camphor) and *Rubus fruticosus aggregate* (Blackberry), dense tussocks of *Cortaderia spp.* (Pampas Grass) and scattered remnant and planted paddock trees and shrubs.

A summary of the individual habitat features identified during the quantitative survey within the construction footprint or APZ is provided in **Table** 20.

Plate 7. Historically cleared land adjoining Coastal Upland Swamp EEC on the subject site in June 2016 (top) in April 2017 (bottom). Extensive growth of Pampas Grass evident between photo periods.

Description of habitat values: Caley's Grevillea

Habitat values: Grevillea caleyi is restricted to an 8km^2 area around Terrey Hills, generally occurring on ridgetops with laterite soils from 170m-240m in elevation. The species is strongly associated with Duffys Forest EEC, however it can also occur within other vegetation types (namely Bloodwood–Scribbly Gum Woodland) if located along ridge-tops associated with ironstone / laterite. The NSW Threatened Species Profile Database list four Plant Community Types (PCTs) associated with *Grevillea caleyi*. Within the study area plants are restricted to Duffy's Forest Ecological Community.

For the purposes of this SIS, *Grevillea caleyi* habitat has been defined as the following:

- Areas within which *G. caleyi* has been recorded (Narla, 2017); and
- Areas of Duffys Forest Ecological Community or Sydney North Exposed Sandstone Woodland (marginal habitat).

About 1.57 hectares of *Grevillea caleyi* habitat occurs within the study area (the extent of DFEC). None of this habitat will be removed as a result of this development.

Condition of habitat: Duffys Forest within the subject site is in relatively good condition with minimal weed infestation away from the property edges and historical quarry. It is structurally intact with good cover in all layers and dense in some places due to lack of recent fire. Most remnants of Duffys Forest within the locality are affected by clearing, fragmentation and edge-related disturbances (DEC 2004).

Fire requirements: The recovery plan for Caley's Grevillea (DEC 2004) identifies fire as a significant influence on successful germination of the seedbank and recruitment of new plants.

Description of habitat values: Eastern Pygmy-possum

Condition of the vegetation within the subject site is described in **Section 5.3.1.** The quality of fauna habitat is generally commensurate the condition of the vegetation.

Habitat values: The Eastern Pygmy-possum occupies habitats that are rich in flowering Myrtaceous and Proteaceous trees and shrubs. Flowering Banksia species appear to be a particularly important foraging resource, especially *Banksia ericifolia*. Given the variety of foraging resources available it is expected that the Eastern Pygmy-Possum would forage extensively within the study area wherever flowering plants, particularly *Banksia ericifolia* occurs. This would include the entire northern portion of the subject site, and the connective habitat corridor that spans Larool Road between the Subject Site and Dundundra Falls Reserve.

Eastern Pygmy-Possums have been widely detected within the study area by Narla Environmental between October 2016 and December 2017. A suite of small hollows that may be suitable for the Eastern Pygmy-Possum were identified within the subject site. The majority of these exist outside of the proposed construction area. Habitat assessment revealed an abundance of potential sheltering and breeding sites for the Eastern Pygmy-Possum across the subject site, north of the historically cleared areas.

The confirmed record of Eastern Pygmy-possum and widespread availability of suitable, *Banksia ericifolia* habitat in Dundundra Falls Reserve to the immediate west of the study area, the study area appears to form part of a large, viable population in the locality. Unfortunately, no individuals were captured within nest box monitoring to conduct radio telemetry in order to assess the movements of the local populations, particularly their ability to cross Larool Road. Therefore, it cannot be confirmed whether these individuals form a part of the same population of if Larool Road acts as a movement barrier to the species. However, it is considered unlikely that Larool Road itself forms a barrier to movement and dispersal. This is because Eastern Pygmy Possum have been known to cross roads in two studies at Royal National Park, most Eastern Pygmy-possum observations were of active or killed individuals seen at night on sealed roads (Rueegger 2011; Schulz & Magery 2012) similar or wider in width to Larool Road. The distance from the subject site to the larger habitat area in Dundundra Falls Reserve and beyond in Ku-ring-gai Chase National Park is less than 300 metres, a distance less than some nightly movements of the

species recorded, including across sandstone rock plates as wide, or wider than Larool Road (Harris 2010, Bladon et al 2002).

Therefore, although Larool Road represents an occasional hazard to the species moving to adjacent habitat areas, it is not unlikely that individuals of the local population cross the road surface or traverse the overlapping tree canopy to access habitat that leads through to Ku-ring-gai Chase National Park.

With the presence of suitable foraging plants (e.g. *Banksia ericifolia*) along the entirety of Larool Road linking the subject site to Dundundra Falls Reserve it appears a continuous, healthy, and viable population of Eastern Pygmy-possum occurs between the subject site, Dundundra Falls Reserve and Ku-ring-gai Chase National Park.

Condition of habitat: The areas of open-forest, woodland and drier heath communities on the subject site are most likely to be occupied by the Eastern Pygmy-possum. These communities are generally in good condition, located away from disturbed edges and are likely to be in good condition generally within the local area.

Vegetation of lower quality (weed infestation) occurs along Larool Road and in private property on Coolowie Road. This vegetation is likely to form a corridor connection between the subject site and Dundundra Falls Reserve. While it is edge effected and narrow, the main corridor that spans Larool Road contains abundant, mature Banksia ericifolia which, when in flower, are likely to lure Eastern Pygmy-possum across the road from the subject site, and vice versa.

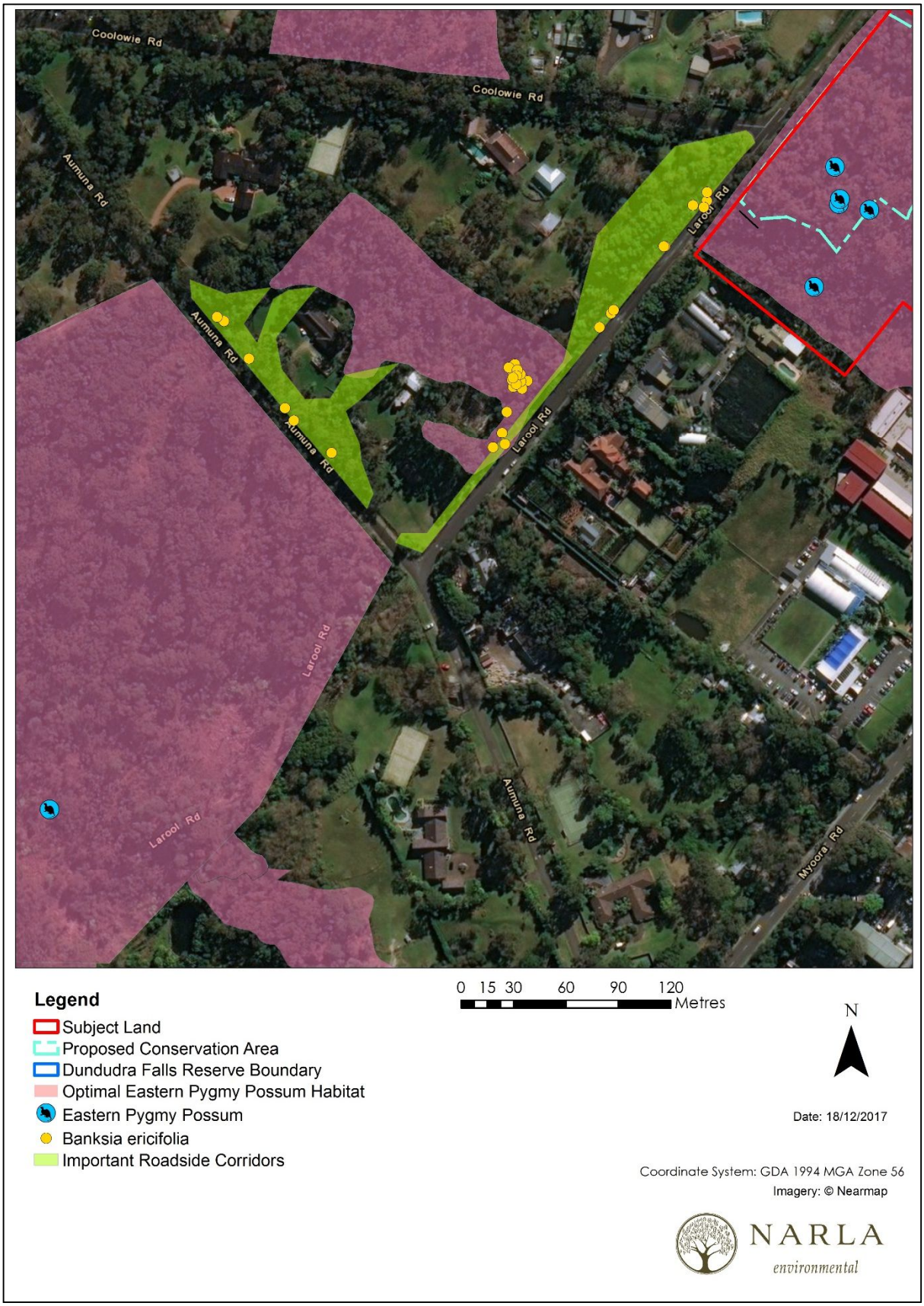


Figure 18.Location of Eastern Pygmy-possum records made during this study in reference to optimal habitat available and habitat linkage.

5.3.2 Discussion of habitat utilisation

Discussion of habitat utilisation: Caley's Grevillea

Population details: Within the Subject site, two clumps of three and seven plants were identified within the Duffys Forest Ecological Community. No other plants were recorded outside of this area during extensive searches of the subject site in the present study, and previous studies. Some plants exist nearby at either end of Myoora Road. NSW Bionet data show 313 *Grevillea caleyi* records within a 5km radius of the subject site.

Significance of the habitat within the study area to the viability of the species in the local area: Cayley's Grevillea is restricted to an 8km^2 area around Terrey Hills, generally occurring on ridgetops with laterite soils from 170m-240m in elevation. The species is strongly associated with Duffys Forest EEC, however it can also occur within other vegetation types namely Bloodwood–Scribbly Gum Woodland along ridge-tops associated with ironstone laterite. Habitat within the subject site is located within the centre of the range of *Grevillea caleyi*. The habitat is generally in good condition and located entirely within an area proposed to form an in-perpetuity Conservation Area. This population lies 800 metres from Ku-ring-gai Chase National Park. Multiple *Grevillea caleyi* sites are located within a secure conservation tenure (SMEC 2017).

Discussion of habitat utilisation: Eastern Pygmy-possum

Population details: Evidence of a population of Eastern Pygmy-possum on the subject site was documented during fauna surveys in 2016 and 2017 (Narla 2017). The number of adult animals captured during camera and pitfall trapping suggests that a viable breeding population occurs locally. This population is expected to be contiguous with the local Eastern Pygmy-possum population that occurs outside the subject site, supported by habitat connectivity with nearby Dundundra Falls Reserve and Ku-ring-gai Chase National Park (**Figure 18**). NSW Bionet data show 76 Eastern Pygmy-possum records within a 5km radius of the subject site.

Significance of the habitat within the study area to the viability of the species in the local area: Given the widespread availability of suitable, *Banksia ericifolia* habitat in Dundundra Falls Reserve 200m to the south-west and Ku-ring-gai Chase NP 800 metres to the west, the subject site appears to form part of a large, viable population in the locality.

Eastern Pygmy-possum shelter in tree hollows, fallen logs, stumps, under bark, rock crevices, within or under the leafy heads of *Xanthorrhoea spp*., burrows and accumulations of leaves between branches. However, breeding females prefer tree hollows, fallen logs and stumps (Ward 1990; Tulloch and Dickman 2007; Law 2014), presumably for nest construction (Rueegger et al. 2012). Hollow-bearing trees are available across much of the study area and given the broad shelter requirements of the Eastern Pygmy-possum, there appears to be adequate shelter and breeding sites available and there will continue to be adequate shelter and breeding sites available post development of the hospital.

At the time of submission of this SIS document the erected Eastern Pygmy-possum nest boxes had been left *in situ* for eight months and monitored twice (in April and December). No evidence of inhabitation by Eastern Pygmy-possums was revealed at the time. It is considered more likely that the nest boxes will be utilised after the nest boxes have been left out *in situ* for at least 12 months.

5.4 Discussion of Conservation Status

Discussion of Conservation Status: Caley's Grevillea

Local and Regional: Most of the known range of Caley's Grevillea is within the locality (within 5 kilometre radius of the subject site) including the suburbs of Terrey Hills, Duffys Forest, Belrose and Ingleside areas. There are over 300 records of this species within an 8 kilometre radius (DEC 2004). Caley's Grevillea is typically restricted to fragmented patches along three ridge-lines, mostly on freehold and Crown lands. These patches are compromised by development, ongoing impacts associated with ridge-top/roadside habitats and adverse fire regimes.

All specimens in the study area were located on the upper escarpment within the DFEC patch. Caley's Grevillea has been found to very rarely grow outside of areas supporting Duffys Forest vegetation community (OEH 2014).

Only mature specimens of the species of comparative age were identified on the subject site. Evidence of natural recruitment was found within the subject site; however, this was entirely centred on the 'seed halo' of the most mature plants in either cluster. Whilst fire is known to kill mature Caley's Grevillea, evidence suggest that it is also essential for the germination of its seeds (OEH 2014, Auld and Ooi 2008). Propagation of this species occurs solely through seeds, although seed viability can be low (DEC 2004, TSSC 2015). As fecundity peaks at ten years (the age which the identified plants are approaching) it is likely that an ecological burning program will be essential to support the ongoing viability of this species within the subject site (DEC 2004).

Table 27. Local populations of *Grevillea caleyi* (SMEC 2017)

Location	Land Tenure	Habitat area	Population	Habitat condition
Sydney East Substation (Site 21 of Recovery Plan)	Government Utility	Known habitat 10 m^2, potential habitat of 50 m^2	1995 – 4 plants Post 1999 fire – 1700 seedlings	Poor
Oates Place, Belrose (Site 8 of Recovery Plan)	Council land	Known habitat 0.4 ha	28 dead adults, 44 adults, 27 seedlings (Sept 94)	Poor
Belrose Quarry, north & south (Site 6 of Recovery Plan)	NSW TAFE	Known habitat 3.2 ha	South – 63 dead plant, 74 seedlings (Jan 95) North – 715 seedlings (Jan 95)	Poor to average
Corner Forest Way & Mona Vale Road (Site 4 of Recovery Plan)	Edge of Garigal NP	Known habitat 12.75	2 adults & c. 113 seedlings in four discrete patches (1994)	Good
Ryland Track, N. side Mona Vale Rd, opposite Austlink Corporate Park (Site 1 of Recovery Plan)	Ku-ring-gai NP	Known habitat 7.5 ha	3015 seedlings in 1994	Good
Duffys Forest (site 3 of Recovery Plan)	Crown land adjacent to Ku-ring-gai NP	Known habitat 2.6 ha	418 ± 82 (1994) 7% juveniles, 707 seedlings in 1998 after fire	Good
Frank Beckham Reserve, Terrey Hills (Site 7 of Recovery Plan)	Council sports reserve	Known habitat 0.3 ha	3 dead adults, 223 adults, 36 seedlings (1994)	Poor
J.J. Melbourne Hills Memorial Reserve (site 12/13 of Recovery Plan)	Council land	Known habitat 0.3 ha	17 dead adults, 55 adults, 1 seedlings (1994) in patches	Poor
Terrey Hills (Sites 10, 11, 14-19 of Recovery Plan)	Variable	Small patches of roadside remnants	Total of 6 dead adults, 64 adults, 21 seedlings (1994); 2000 seedlings at 2 sites in 1995 & 1998	Mostly poor
Namba Road, Duffys Hill (Site 20 of Recovery Plan)	Freehold	Known habitat 0.2 ha	1.3 adults, 1 juvenile (1997)	Moderate

State: Restricted to northern Sydney. Listed as critically endangered under the TSC Act.

Representation within conservation reserves: The species is inadequately conserved within the formal conservation system (DEC 2004). Four remnant sites occur at the edge of Ku-ring-gai Chase and Garigal National Parks, two of which are within the construction zone for the Mona Vale Road West Upgrade and may be lost or seriously compromised by road widening (SMEC 2017). One of the other sites (Ryland Track) within Ku-ring-gai Chase National Park (Site 1 of the recovery plan) is a larger remnant with potential habitat of 7.5 ha. A fourth site is on a road verge, not naturally occurring (arising from accidental translocation of soil) and insecure (Auld and Scott 2013).

Geographical limits: Grevillea caleyi occurs over a limited range within approximately 8km of Terrey Hills, NSW, however the subject site is located towards the centre of the species range.

Comparison with other local populations: Habitat within the subject site is in good to moderate condition, however it forms a small remnant which is isolated from other populations by roads and private properties, with a relatively high edge to core ratio.

Key threats: Ongoing habitat loss through clearing for urbanisation and road construction is the primary threat. An estimated 85% of the original extent of habitat has been lost in this way (Scott et al. 1995). Adverse fire regimes (too frequent or too infrequent), weed invasion and physical disturbance from vehicles, trailbikes, horses and people are also key threats.

Many of the threats identified above are recognised as Key Threatening Processes (KTP) as listed under Schedule 3 of the TSC Act. The most relevant are:

- Clearing and fragmentation of native vegetation resulting in loss of biodiversity as a result of loss and/or degradation of habitat;
- High frequency fire resulting in the disruption of the life cycle processes in plants and animals and loss of vegetation structure and composition;
- Invasion of native plant communities by exotic perennial grasses;
- Invasion and establishment of exotic vines and scramblers;
- Invasion, establishment and spread of *Lantana camara;* and
- Human induced climate change.

Relevant Recovery or Threat Abatement Plans: A recovery plan has been developed for *Grevillea caleyi* (DEC 2004) and 22 priority actions have been identified including:

- Implement appropriate fire management;
- Threat and habitat management including fencing, bush regeneration and weed control, pathogen and runoff control;
- Reservation and/or protection of remnant sites; and
- Undertake ecological research.

Discussion of Conservation Status: Eastern Pygmy-possum

Local and Regional: The local occurrence of other local populations is discussed in **section 5.2.1**. Most Eastern Pygmy-possum records in the locality occur on private or council land, some of which is likely to be subject to future residential development proposals (SMEC 2017). Accordingly, many of these records were obtained in studies commissioned by local councils (e.g. Law 2013). Other records were obtained by Ecosure (2015) associated with the Mona Vale Rd East upgrade. Fewer records have come from Ku-ring-gai NP and Garigal NP, however, this is likely to reflect a comparatively lower survey effort. Law (2014) suggests that the Eastern Pygmy-possum is largely confined to upslope habitats, avoiding deep gullies and it appears locally extinct in smaller coastal reserves. Given the amount of upper slope woodland and sandstone heath, it is likely that a fairly large and important Eastern Pygmy-possum population(s) occurs in the locality, including extensive habitat within Ku-ring-gai NP and Garigal NP. Thus, potential and known Eastern Pygmy-possum habitat appears to be widespread in the locality and well-represented within local conservation reserves.

The broader distribution of Eastern Pygmy-possum occurs within the Sydney Basin Bioregion, which extends from about Batemans Bay north to Nelson Bay and west to near Mudgee. This bioregion contains a variety of important sites used to study the Eastern Pygmy-possum, such as Royal NP, Heathcote NP, Barren Grounds NR and Jervis Bay NP (Harris and Goldingay 2005; Tulloch and Dickman 2006; Harris et al. 2007) in the southern part of the region. To the south, the Atlas of NSW Wildlife contains Eastern Pygmy-possum records from Budderoo NP, Morton NP, Dharawal NP and Dharawal NP in addition to the aforementioned conservation areas. To the north of the study area, records come from Brisbane Waters NP, Marramarra NR and Marramarra NP. To the west there are higher elevation records in Blue Mountains NP, Kanangra-Boyd NP and Yerranderie SCA. Although records are fairly sparse from within all conservation reserves, this is likely to be a reflection of survey effort and the species' low detection rate. Extensive areas of upper slope woodland and heath on sandstone occur within the conservation reserves discussed and other reserves in the region. There are also scattered records of the Eastern Pygmy-possum from private and other public lands within the region. Thus, the Sydney Basin Bioregion appears to be a stronghold of the Eastern Pygmy-possum within the State.

State: Listed as vulnerable under the NSW TSC Act.

Representation within conservation reserves: It is estimated that 45% of the Eastern Pygmy-possums NSW distribution is within conservation reserves (OEH 2014).

Geographical limits: The distribution of the Eastern Pygmy-possum extends from southern Queensland to eastern South Australia and Tasmania. In NSW it extends from the coast inland to the western slopes (e.g. Pilliga, Wagga Wagga. It is only found at higher elevations along the coast north of Newcastle. It is patchily distributed, particularly outside the Sydney Basin Bioregion, and its overall abundance is low (SMEC 2017). The distribution and abundance of the Eastern Pygmy-possum in NSW was reviewed by Bowen and Goldingay (2000). They reviewed studies that amounted to 315,000 Elliott trap nights (though many trap nights were probably not well targeted) and 57,000 pitfall trap nights, which produced 154 captures. Undoubtedly many additional records have been obtained in the intervening 15 years (e.g. Blandon et al. 2002; Harris and Goldingay 2005; Tulloch and Dickman 2006), however, it is unlikely that the general conclusions would alter despite its low detection rate. It can be concluded that the Eastern Pygmy-possum is patchily distributed, particularly outside the Sydney Basin Bioregion, and its overall abundance is low.

The study area is not at the distribution limits of the Eastern Pygmy-possum.

Key threats: KTPs affecting the Eastern Pygmy-possum are recognised as (OEH 2016a):

- Loss and fragmentation habitat through land-clearing for agriculture, forestry and urban development;
- Changed fire regimes that affect the abundance of flowering proteaceous and myrtaceous shrubs, particularly banksias;
- Declining shrub diversity in forests and woodlands due to overgrazing by stock and rabbits;
- Predation from cats, dogs and foxes;
- Loss of nest sites due to removal of firewood; and
- Mortality on roads through habitat and movement areas.

Habitat Requirements: The Eastern Pygmy-possum is found in a broad range of habitats, including rainforest, sclerophyll forest and woodland, and heath. Woodland and heath appear to be preferred across much of its range. Because the species feeds heavily on nectar, a high diversity of Myrtaceous and Proteaceous trees and shrub characterises important habitat. The most important populations appear to be associated with a high density of *Banksia* spp. While tree hollows are important for shelter, particularly for breeding females, a variety of other structures may also be used.

Relevant Recovery or Threat Abatement Plans: There is no recovery plan for the Eastern Pygmy-possum. The only threat abatement plan applying to KTPs affecting the Eastern Pygmy-possum is "Predation by the Red Fox (*Vulpes vulpes*)". The proposal is not expected to increase the operation of this KTP.

Priority actions intended to benefit the Eastern Pygmy-possum, include:

- Surveys of distribution and abundance;
- Controls of feral predators, including cats (*Felis catus*);
- Fire management, particularly seeking a fire frequency of >10 years to maintain habitat types;
- Encouraging research on the ecology, movements, habitat use and genetics of Eastern Pygmy-possum populations; and
- Encouraging and supporting land managers to undertaken management actions that benefit the Eastern Pygmy-Possum.

The Eastern Pygmy-possum has been assigned to the landscape species management stream of the Saving Our Species program. No priority management site has been identified (OEH 2016a). The Saving Our Species program also includes the following actions:

- Negotiating conservation agreements to protect known habitat, preferably in perpetuity using funding mechanisms such as Biobanking. Areas with hollow-bearing trees and an abundance of Myrtaceous and Proteaceous trees and shrubs, particularly with Banksias, are to be targeted. To date, no priority sites for the Eastern Pygmy-possum have been identified;
- Community education to reduce the demand for firewood; and
- Investigate options for improving road safety, such as the installation of road crossing structures such as underpasses and overpasses.

5.5 Discussion of the likely effect of the proposal at local and regional scales

The following direct impacts on affected threatened species habitat are likely to occur within the construction impact area:

- The loss of 24 hollow-bearing trees constituting approximately 57 (51small; 23 medium; 4 large) tree hollows (estimates only);
    - All hollows will be replaced at a ratio of 2:1 per hollow.
- The loss of 0.37 ha of moderate condition vegetation, and 0.13ha of poor condition/weed infested habitat;
    - All important nectar-producing foraging trees (e.g. *Banksia ericifolia*) will be replaced at a ratio of 3:1 per species; and
    - The subject site (outside the development footprint) within existing weed infested areas will be landscaped with locally indigenous vegetation, including low shrubs and groundcover suitable for the foraging requirements of this species.
- Some mature, potential Glossy Black-Cockatoo foraging trees (*Allocasuarina litoralis*) will be removed to facilitate the proposed hospital construction.
    - All removed *Allocasuarina spp.* foraging trees will be replaced at a ratio of 3:1 as a part of the Landscape Plan (Carmichael Studios 2017).
- The removal of one ephemeral soak, that may offer marginal breeding habitat for the Red-crowned Toadlet;
    - This soak will be replaced elsewhere on the subject site through the implementation of the Onsite Stormwater Drainage system (OSD).
    - All remaining soaks within the subject site, will not be impacted by the proposal.
- Loss of seed and rootstock within the seedbank.

Vegetation removal for the proposed hospital is unlikely to impact on threatened flora. Intensive targeted surveys were undertaken for threatened flora throughout the construction area, and minimal suitable habitat within the construction footprint was identified. No APZ works will impact on *Grevillea caleyi* or the viability of unidentified threatened flora species within the seedbank.

Indirect impacts occur beyond the construction footprint and include the following;

- Edge effects (disturbance and weed encroachment);
- Shading;
- Movement of sediment downslope of the construction zone;
- Dust deposition on vegetation and soils during construction;
- Alterations to hydrology and waterflows (changes to drainage and soil moisture levels downslope of the construction zone. This will be mitigated through implementation of the Stormwater Concept Design (Martens 2017a;2017b); and
- Increased lighting.

Edge effects occur within a clearly defined zone of disturbance where changes can include increases in soil temperature, wind velocity, transfer of dust, seeds, insects and disease from adjoining areas, altered soil moisture levels and surface runoff rates with increased rates of erosion and transport of soil and nutrients, and increased invasion by diseases and exotic species. Such changes or 'edge effects' have a degrading impact on native vegetation. Currently, native vegetation is highly vulnerable to encroaching priority weeds within the development footprint. Following the implementation of the BMP (Narla 2017) and strict adherence of its recommendations it is expected that vegetation condition within the site will be enhanced.

5.5.1 Significance within a local context

Significance within a local context: Caley's Grevillea

Caley's Grevillea within the study area occurs exclusively in the DFEC. The structure of the community is predominantly open-forest to low open-forest or rarely open woodland, with a tree canopy including *Eucalyptus sieberi, E. capitellata, E. oblonga, Angophora costata* and *Banksia serrata*. All areas with this general habitat description in an 8 – 10 km radius of Terrey Hills are considered to be of high importance for *Grevillea caleyi*.

Two of the largest known remnants with a potential mature population estimated to comprise >50% of the total population of the species occur along Mona Vale Road. SMEC (2016) identified 29 plants from the study area, considerably less than the 77 plants recorded by Smith and Smith in 2011. In 1994 plants were recorded in their thousands (2,878±496 and 1,847±301 for the western and eastern sites respectively) as documented in the Recovery Plan (Auld and Scott 2004). Lack of fire is likely to be the main factor causing this decline with most areas unburnt since a wildfire in 1994. In these areas plants were noted as mature to senescent. This is likely to be a temporary state, however, with extensive seedling recruitment expected from the soil seed bank following future fires (SMEC 2017). This boom and bust-type cycle is likely to be representative of the general ecology of the species, with overall population numbers highly responsive to fire frequency (too frequent or too infrequent). In the case of *G. caleyi* optimal fire frequency is likely to be in the region of 8-12 years (DEC 2006).

This recruitment cycle was confirmed following more recent ecological burns in the vicinity of the Booralie Road intersection (2012) and more recently (around August 2015) on the northern side of Mona Vale Road adjacent to Ku-ring-gai National Park in the western part of the study area (Site 2 of the Recovery Plan). Small seedlings were observed at the latter site just four months after the August 2015 burn in December. A rapid count of seedlings during December provided a density value of around 0.35 plants/m^2 (similar to that recorded in 2004 as documented in the Recovery Plan), though a more detailed survey of this location and its surrounds in February 2016 revised this estimate down to 0.23 plants/m^2 (SMEC 2016).

Immature saplings to 1 m high, some flowering, were also observed around the Terrey Hills traffic lights following the 2012 burn (SMEC 2016).

Populations known to be affected or likely to be affected by other proposed development in the near future include the Mona Vale Road Upgrade, which will result in the removal of approximately 7 ha habitat for *Grevillea caleyi* and the removal of approximately 77 specimens of *Grevillea caleyi.* A recent report to the NSW Scientific Committee (Auld and Scott 2013) identifies the widening of Mona Vale Road from Terrey Hills to Ingleside as a major threat and stated that *'Given that plants occur only within 10-20 m of the existing road verge (and not downslope off the ridgetop laterite soils) the road widening could potentially result in a worst case scenario of removal or serious disruption of habitat of some 5,000 mature plants, thus reducing or eliminating 45-60% of the potential mature population of the species'*.

Other significant developments include a large site at Belrose owned by TAFE and land owned by the Baha'i Faith (adjacent to study area). These sites are included in the Ingleside Planning Precinct, which is currently under investigation for future housing development. This precinct covers approximately 700 hectares and includes several local populations for *G. caleyi*. In the event that both the Mona Vale Road West Upgrade and the Ingleside release area were realised there is a real possibility of a dramatic reduction in the area of occupancy of this species. This would relate primarily to direct removal for roads, house plots and other infrastructure, but also secondarily to the ongoing frequency of fire. With the implementation of nearby largescale residential development, it is likely that fire regimes in the area would be significantly altered (become less frequent) in view of protecting suburbs and their occupants. This may be tempered somewhat through improved consultation between OEH and RFS with a view to undertaking periodic hazard reduction burns at ecologically advantageous intervals (SMEC 2016).

The two clusters of Caley's Grevillea on the subject site, will be protected in perpetuity should the proposed Hospital Development be approved. The proponent is committed to applying a permanent

Conservation Agreement to the part of the property where the Caley's Grevillea occurs. This area will be managed for the protection and enhancement of the Caley's Grevillea population under the BMP (Narla 2017b).

Significance within a local context: Eastern Pygmy-Possum

The Eastern Pygmy-possum is known to the locality (OEH 2017) and was identified by Narla Environmental during targeted surveys. These records are distributed throughout the north-west of the subject site, as well as in the nearby Dundundra Falls reserve. It is unknown whether the existing road acts as a movement barrier for the species. Eastern Pygmy-Possums were not marked, so the number of individuals detected is not known.

The number of adult animals captured during camera trapping in April 2017 suggests that a viable breeding population occurs locally. This population is expected to be contiguous with the local Eastern Pygmy Possum population the occurs outside the subject site, supported by habitat connectivity with nearby Dundundra Falls Reserve and Kur-ring-gai Chase National Park.

The proposed development would not place any further barriers to movement of the species since all of the development is restricted to an area south of the main bushland on the subject site which will be retained and protected in perpetuity. If the local population is restricted to the subject site, then over time it is likely that inbreeding depression would render it unviable, furthermore, stochastic effects from predation and vehicle collision are likely to have already driven the population on the subject site into the extinction vortex long ago. If the population is not isolated as contended by Narla, then movement of individuals and exchange of genetic material between the subject site and habitat areas to the west is likely to continue unhindered by the proposed development. The proposed management measures (see **section 7.1**) committed by the proponent of the hospital development are considered likely to enhance Eastern Pygmy-possum population size and movement ability across the landscape.

The proposal would affect shelter and breeding habitat occupied by the Eastern Pygmy-possum. Potential direct impacts arising from the proposal include habitat loss through the removal of approximately:

- 78 nest hollows; and
- 80 - 116 potential feed shrubs and trees.

From within the proposed hospital construction footprint.

The study area lies between Dundundra Falls Reserve, Ku-ring-gai Chase NP and Garigal NP, which both have extensive areas of habitat for Eastern Pygmy-possum. These areas have the potential to support large and significant populations of Eastern Pygmy-possum species. The conservation reserves have long-term security of tenure and these reserves, and the connection formed by the present study area, especially the proposed Conservation Area, will become increasingly important to the conservation of the Eastern Pygmy-possum in the locality as other lands become developed in the future.

Vegetation clearance will be largely restricted to the weed infested, historically cleared areas in the south-east of the site, bordering developed and historically cleared areas along Myora Road. Habitat along the northern boundary of the subject site will be protected and enhanced through active plantings of *Banksia ericifolia* along the side of Larool Road, and through the installation of fauna crossing structures (e.g. rope bridges) specifically for Eastern Pygmy-possum. This will help prevent any local population from becoming fragmented or disconnected from nearby populations in Dundundra Falls Reserves.

Foot traverses were undertaken in Dundundra Falls Reserve and other potential Eastern Pygmy-possum habitat areas in the study area on 1/12, 6/12 and 7/12/2017 by Eastern Pygmy-possum specialist Paul Burcher of Aquila Ecological Survey. Stands of *Banksia ericifolia* were targeted mapped. It was found that substantial areas of likely Eastern Pygmy-possum habitat occur in the reserve. Large mature and over-mature *Banksia ericifolia* to six metres tall were abundant in the understorey of the *Angophora costata – Eucalyptus piperita* dominated open forest, in the gully either side of Keirans Creek and

extending to the lower slopes south of the creek. It appeared that much of this vegetation had not been burnt since possibly the 1994 bushfires.

Smaller patches of *B.ericifolia* occurred on the ridge-slopes south of Kierans Creek often associated with the Coastal Upland Swamp endangered ecological community. Patches above the Larool Road Fire Trail, which would have been used as a control line during hazard reduction burns, are to four metres in height and greater than 12 years old. Those below the fire trail and road are four to eight years old and up to two metres in height. Many of these plants have not flowered or have few flowers but are likely to become a more important resource in coming years should fire be excluded.

Other important feeding resources, such as Red Bloodwood (*Corymbia gummifera*) *and* Saw Banksia (*Banksia serrata*), and tree hollows suitable for shelter and breeding, are common throughout the reserve apart from areas of Coastal Upland Swamp.

Dundundra Falls Reserve is linked to the Subject Site by remnant bushland (including stands of *B.ericifolia* and *C.gummifera*) and planted trees in private properties fronting Larool and Aumuna Roads and within the road reserves. The species may also feed in a copse of planted *Melaleuca quinquenervia* directly opposite the site.

Another patch of bushland suitable for the Eastern Pygmy-possum occurs to the west of the site north of Coolowie Road on Lot 2 DP113845a and in the Kinma School property to its west. The front of this bushland was burnt in the last two years and has numerous juvenile *B.ericifolia* as well as *C.gummifera* in the canopy. The rear of Lot 2 has a weed-affected drainage line with remnant mature *B.ericifolia*. This bushland is linked to the Subject Site via trees and shrubs in the Coolowie road reserve and adjacent property frontages, among which are numerous *C.gummifera*, some *B.ericifolia* and planted winter-flowering Swamp Mahogany (*Eucalyptus robusta*).

In the context of habitat availability within locality, the loss of some Eastern Pygmy Possum shelter habitat (24 hollow trees) and 80 – 116 feed trees and shrubs on the edge of historically cleared and weed-infested land due to the proposal is not considered to be particularly important in its own right. All of the potential feed shrubs and trees removed will be replaced at a 3:1 ratio. All of the potential nest hollows removed will be replaced at a 2:1 ratio.

Ku-ring-gai Chase NP is almost 15,000 hectares in area, while Garigal NP covers about 2,200 ha, although the entire areas of these reserves would not be suitable for the Eastern Pygmy-possum as they prefer ridgeline vegetation, it provides an indication of the extensive habitat available in the locality and general region. Furthermore, a large proportion of the bushland, shelter and feed habitat on the subject site will be protected in the proposed Conservation Area.

5.5.2 Extent of habitat removal or modification

Extent of habitat removal or modification: Caley's Grevillea

Within the Subject Site two clumps of three and seven Caley's Grevillea plants were identified within the Duffy's Forest Endangered Ecological Community (DFEC). No other Caley's Grevillea plants were recorded outside of this area during extensive searches of the Subject site in the present study, and previous studies.

As Caley's Grevillea occurs in an area that will be unaffected by the proposed development, it is unlikely that the development will have a significant effect on the survival of these individuals or the species in general. However, to mitigate any (albeit unlikely) potential effects, fencing of approximately 5 m to 10 m will be erected around the Caley's Grevillea. Additional low fencing will be installed. This fencing will be managed for competing native plants and weeds, in order to maximise growth and survivorship of Caley's Grevillea.

The entire extent of the DFEC that contains the Caley's Grevillea on the subject site will be managed for conservation purposes through active weed control and other forms of habitat enhancement such as the possible use of appropriately timed ecological burns. In addition, vegetation including Caley's Grevillea will be monitored by a qualified Ecologist and the health of the plants will be reported on annually with recommendations for additional management put forward if/when required.

The proposed action will not cause a net loss in habitat resources for Caley's Grevillea.

It is expected that the proposed hospital works and the increased resources allocated to managing the Duffy's Forest and the two Caley's Grevillea clumps, will assist in ensuring the long-term survival of this plant on the Subject site, and its entire distribution.

Extent of habitat removal or modification: Eastern Pygmy-possum

The proposed action is unlikely to adversely effect upon the life cycle of the Eastern Pygmy-possum. A small area of potential foraging and sheltering habitat for Pygmy Possums will be removed by the proposed construction works (0.5 ha). This includes 0.37 ha of moderate quality remnant habitat, and 0.13 ha of poor quality/weed infested habitat. This habitat will be replaced through:

- indigenous plantings, including high densities of Banksia ericifolia through implementation of the landscape plan (0.33 ha)
- restoration and revegetation of all weed infested areas on the Subject site
- erecting nest boxes to replaces hollows removed at a higher replacement ratio.

Any potential feed trees and shrubs (e.g. *Banksia ericifolia*) removed from the Subject site in order to facilitate the hospital construction will be replaced at a ratio of 3:1 per species. It is expected that between 80 and 116 feed trees will be removed for hospital construction.

These will be replaced with at least 240 *Banksia ericiflora* and 108 other feed trees according to the percentage of each species removed. The Landscape Plan (Carmichael Studios 2017) has identified suitable locations for the planting of 1160 *Banksia ericifolia* on the subject site. This will provide an overall increase in the availability of Eastern Pygmy Possum habitat.

A total of 24 hollow-bearing trees constituting approximately 78 tree hollows (estimates only) will be removed from the Subject site to allow construction of the hospital. These hollows will be replaced on the subject site at a ratio of 2:1 through hollow augmentation, most likely a combination of nest-box installation and augmenting hollows directly into tree trunks.

All habitat plants removed from the subject site, as identified by an Ecologist, will be replaced with a minimum of three replacement plants of the same species. These plants may be tubestock or advanced stock (where possible advanced, flowering stock will be planted) and will be replaced in proposed landscaping (connected to bushland) and or in 'clumps' within APZ areas or areas removed of weeds.

Habitat plant removal and replacement will be documented in a central database by the Project Ecologist.

All suitable foraging and shelter trees within the APZ areas will be retained un-affected by the proposed development.

No effects to Pygmy Possum movement across the subject property, and between the subject property and adjoining bushland outside of the subject property will occur. This is because the majority of remnant habitat on the Subject site will be retained and enhanced including within a proposed Conservation Area. Furthermore, the remaining area of the subject property outside of the development footprint will be landscaped with locally indigenous vegetation, including abundant Eastern Pygmy Possum feed trees.

Table 28. Impacts of the proposal on the Eastern Pygmy-Possum

Impact	Relevant KTP's	Outcome
Habitat loss	Clearing of native vegetation Loss of hollow-bearing trees Removal of dead wood and dead trees	Clearing will largely be restricted to the weed infested, historically cleared areas in the south-east of site. Only 0.5 hectares of vegetation proposed to be cleared is considered potential foraging and sheltering habitat for the Eastern Pygmy-possum. This includes 0.37 ha of moderate quality remnant habitat, and 0.13 ha of poor quality/weed infested habitat. A total of 80 Banksia ericifolia and 36 other potential feed trees/shrubs will be removed. Habitat loss of the Eastern Pygmy Possum is considered minor as majority of the remnant native habitat will be retained. Removal of nesting and or foraging resources for this species is to be minimised, with habitat enhancement methods to be conducted including installation of nest boxes to a ratio of 2:1 and, and planting o additional foraging trees and shrubs to a ratio of 3:1. At least 1160 *Banksia ericifolia* will be planted on the subject site as part of the Landscape Plan.
Habitat fragmentation	Clearing of native vegetation	All Eastern Pygmy-possum habitat outside of the construction footprint is to be retained and protected, this includes APZ areas (a total of 3.3 ha). The habitat on the subject site will not become fragmented from other areas. Connectivity will continue to occur to adjoining reserves on the Larool Road side of the bushland as the majority of remnant habitat on the subject site, including the location of habitat connectivity (the connection spans across Larool Road) will be retained and enhanced. A large proportion of this area will be protected with a Conservation Area (0.95 ha). Furthermore, the remaining area of the subject property outside of the development footprint will be landscaped with locally indigenous vegetation, including abundant Eastern Pygmy Possum feed plants.
Edge effects	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Edge effect will remain on the southern peripheries of site however will be reduced in the areas surrounding the construction foot print. The implementation of a landscaping plan designed to exclude invasive species through the installation of native flora species will be applied in the cleared areas.
Habitat alteration	Infection of native plants by *Phytophthora cinnamomi* (Phytophthora) Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae Loss of hollow-bearing trees Removal of dead wood and dead trees	Risk of infection to *Phytophthora cinnamomic* and *Rust* is unknown but can be minimised through the implementation and maintenance of hygiene control methods during construction and landscaping works. Removal of nesting resources, including dead and hollow bearing trees, utilised by this species is to be minimised. Hollow augmentation in the form of nest boxes will be installed within the subject site to replace lost hollows / nesting resources as a result of construction works.
Erosion and sedimentation	None	Avoided through appropriate erosion and sediment control measures in accordance with 'The Blue Book' (Landcom 2004).
Mortality during clearing	None	To reduce adverse effects to Eastern Pygmy-possum populations on the subject site an Ecologist pre-clearing assessment should occur no more than 1-2 weeks prior to the commencement of clearing works, and at least 12 hours prior to commencement of clearing works. The Project Ecologist should be notified to attend the subject site in the event that fauna is found within the proposed construction footprint and cannot make their own way out. The Ecologist should take appropriate action to rescue and relocate the fauna.
Mortality from entering buildings or pits.	None	All staff and contractors involved in constructing the hospital, and operating within will be made aware of Eastern Pygmy-possum and will be instructed to report any sightings or displaced individuals to the Project Ecologist for immediate action.
Mortality due to vehicle strike	None	There is to be no modification to remnant vegetation structures which facilitate the movement of Eastern Pygmy Possums across Larool Road to adjacent pockets of bushland. Therefore, there should be no increase in likeliness for mortality due to vehicle strike for Eastern Pygmy Possums within the subject site.
Mortality due to feral and domestic predators (dogs, cats and foxes)	Predation by the Feral Cat (*Felis catus*) Predation by the European Red Fox (*Vulpes vulpes*)	With an increase in management of the remnant bushland areas as a result of the proposal there will better feral animal control measures applied to the habitat areas of the Eastern Pygmy Possum. In addition, the supplementation of native habitat species for the Eastern possum across the subject site will reduce the adverse effects of feral predators in the Eastern Pygmy-possum populations.

Vegetation and flora species richness within the subject site was diverse at the time of assessment (Narla Environmental 2017), however in the absence of natural burning regimes, much of the shrub vegetation was confirmed to be senescing as the site is near the end of a sustainable post-fire (pyric) successional event. The lack of disturbance (such as fire) to promote natural regeneration of dominant, obligate-seeders such as *Banksia ericifolia* can have serious and irreversible impacts to a heathland vegetation community and local populations of *Banksia ericifolia* (Bradstock & Myerscough 1981, Plucinski 2006). The decline of a dominant species as it reaches the end of its life cycle can result in a decrease in total biomass and a sharp increase in the proportion of dead aerial fuel (Plucinski 2006). This biomass build-up smothers the ground and shrub layers. This prevents regeneration of new seedlings and suppresses the soil seedbank. The vegetation community deteriorates and species richness and diversity declines. Over time, obligate seeders like *Banksia ericifolia* disappear from the landscape altogether as there is no, natural recruitment of new plants to replace the old, dead and dying trees.

This process was particularly evident in the proposed OPA areas of the subject site. In these areas, tall, dense shrubs (e.g. *Kunzea ambigua, Leptopsermum spp., Hakea spp., Persoonia spp., Allocasuarina littoralis, Banksia ericifolia*) have produced extensive leaf litter and their dense canopies were shading-the ground layer preventing effective germination of seedlings. Many individuals of these species were found to be senescing or deceased and fallen over. Since vegetation communities and these plants all require fire for effective, long-term reproduction (Bradstock & Myerscough 1981, Benson 1985, Plucinski 2006) the absence of fire or similar disturbances could contribute to long-term alteration or degradation of the vegetation and biodiversity of the subject site.

An analogous example where lack of fire has caused extensive native tree senescence, die back, and decline of floristic structure and species diversity is 'Peace Park' at Oxford Falls in the Warringah Ward of Northern Beaches LGA. Peace Park is located in a similar geological landscape to the subject site. The rear of Peace Park is dominated by similar native vegetation (Sydney North Exposed Sandstone Woodland), however the floristic diversity is low in Peace Park as there has been a considerable lapse in fire and/or other forms of processes to reduce the build-up of senescent vegetative material. The *Banksia ericifolia* and *Allocasuarina littoralis* canopy has grown tall, high in woody biomass and has senesced *en masse*. As a result, the ground and low shrub layer has been smothered and there is little to no recruitment of native shrubs and groundcovers (**Plate 10**). Approximately half of the native vegetation has been replaced with the noxious weed, *Lantana camara* and *Banksia ericifolia* is becoming increasingly rare in the reserve. The author attended this reserve for an unrelated event in August 2017 and found no regenerating *Banksia ericifolia*. There are likely to be extensive examples such as this throughout the Northern Beaches LGA where a lack of management of dead, dry biomass and weed build-up (through fire, or mechanical means) has caused dramatic declines in floristic biodiversity.

The management of the OPA and all other APZ areas on the subject site has the potential to improve flora and fauna species richness and habitat across the subject site, by providing a mode which allows near-natural rates of regeneration among key canopy, shrub and ground cover flora species, which would ordinarily only result from wild fire. By removing excessive build-up of leaf litter and reducing competitive pressures through thinning of older shrubs that are reaching the end of their natural life-cycle, germination of the native seed bank can be promoted.

Ecological burns are the optimal method to enhance natural regeneration in many cases, however, where burns are considered too high risk or difficult to plan, the undertaking of mechanical APZ management can provide similar benefits and is easier to achieve. An illustrated example of how mechanical APZ management will benefit vegetation on the subject site is provided (**Plate 9**).

Ecological burns and other disturbance events (e.g. targeted removal excess debris removal through APZ management) that reverse the deleterious effects of over accumulated, dead, biomass are essential to stimulate the seed germination of *Grevillea caleyi* and *Banksia ericifolia.* The latter is an essential food resource of Eastern Pygmy-possum. The subject site has a healthy population of Eastern Pygmy-possum, however, with the continuing senescence of *Banksia ericifolia* across the site owing to lack of fire and/or other disturbance, the sharp decline in *Banksia ericifolia* and the associated nectar resources, could cause a decline or extirpation of Eastern Pygmy-possum. In the absence of ecological burn regimes, a

well-managed APZ will remove dead biomass that smothers the ground layer and allow natural regeneration and ground and shrub diversity.

5.5.3 Discussion of Connectivity

Caley's Grevillea

The occurrence of Caley's Grevillea on the subject site is already fragmented from nearby populations by Mona Vale Road and urban residential areas. The locally occurring plants, are likely to exchange genetic material with the plants on the subject site through visitation by mobile pollinators, particularly honeyeaters such as Eastern Spinebill (*Acanthorhynchus tenuirostris*). The proposed development is unlikely to further fragment populations of Caley's Grevillea the plants on the subject site are already separated from nearby occurrences. Furthermore, the two clusters on the site will remain connected by managed bushland as part of the proposed Conservation Area.

This species may be susceptible to edge effects and it is considered likely that if left in its current state, the large weed infestation within the south-east of the DFEC may further encroach into native vegetation, increasing the threat to the viability of these species. The proposed active weed management of the entire habitat of Caley's Grevillea (as part of the development proposal) will remove this threat and assist in habitat connectivity for this species.

Eastern Pygmy Possum

The proposed development will not further exacerbate habitat fragmentation within the study area.

The subject site holds habitat connectivity with extensive natural bushland located in Dundundra Falls Reserve and Ku-ring-gai Chase National Park south-west of the subject site (**Figure 19**). A street view image of the connectivity of the subject site with canopy linkage and narrow road gap adjoining bushland is provided (**Plate 8**) a closeup photo of the habitat along Larool Road, including flowering Banksia ericifolia is shown (**Plate 9**). A map showing the location of habitat linkage between the subject site and adjoining vegetation is provided (**Figure 20**). Birds, mammals and reptiles currently traverse this link between the subject site and adjoining bushland areas. It is expected that the Eastern Pygmy-possum will continue to utilise this linkage across Larool Road and into Dundundra Falls Reserve to allowing genetic flow between the subject site and the larger bushland remnants to the west. As a result, it is considered that the subject site forms part of a contiguous population of Eastern Pygmy-possum.

The vegetation on either side of Larool Road is considered likely to provide foraging habitat for Eastern Pygmy Possum. Mature *Banksia ericifolia*, dense ground cover, tall shrub cover and a continuous canopy layer are present and this provides a habitat link to Dundundra Falls Reserve where a known population of Eastern Pygmy Possum occurs (**Figure 18**). The proposed hospital construction and associated infrastructure occurs to the east of the existing Eastern Pygmy Possum habitat corridor. The existing the habitat corridor will be protected and enhanced for use by Eastern Pygmy-possum through active habitat and connectivity restoration measures (**Figure 19**) including:

- declaration and on-going protection and management of a Conservation Area over the majority of the bushland, including the edge of Larool Road.
- the installation of designated road crossing structures (e.g. rope bridges)
- the active management of weeds from public land along Larool Road, and
- the planting of new *Banksia ericifolia* in the roadsides along Larool Road to increase available plantings.

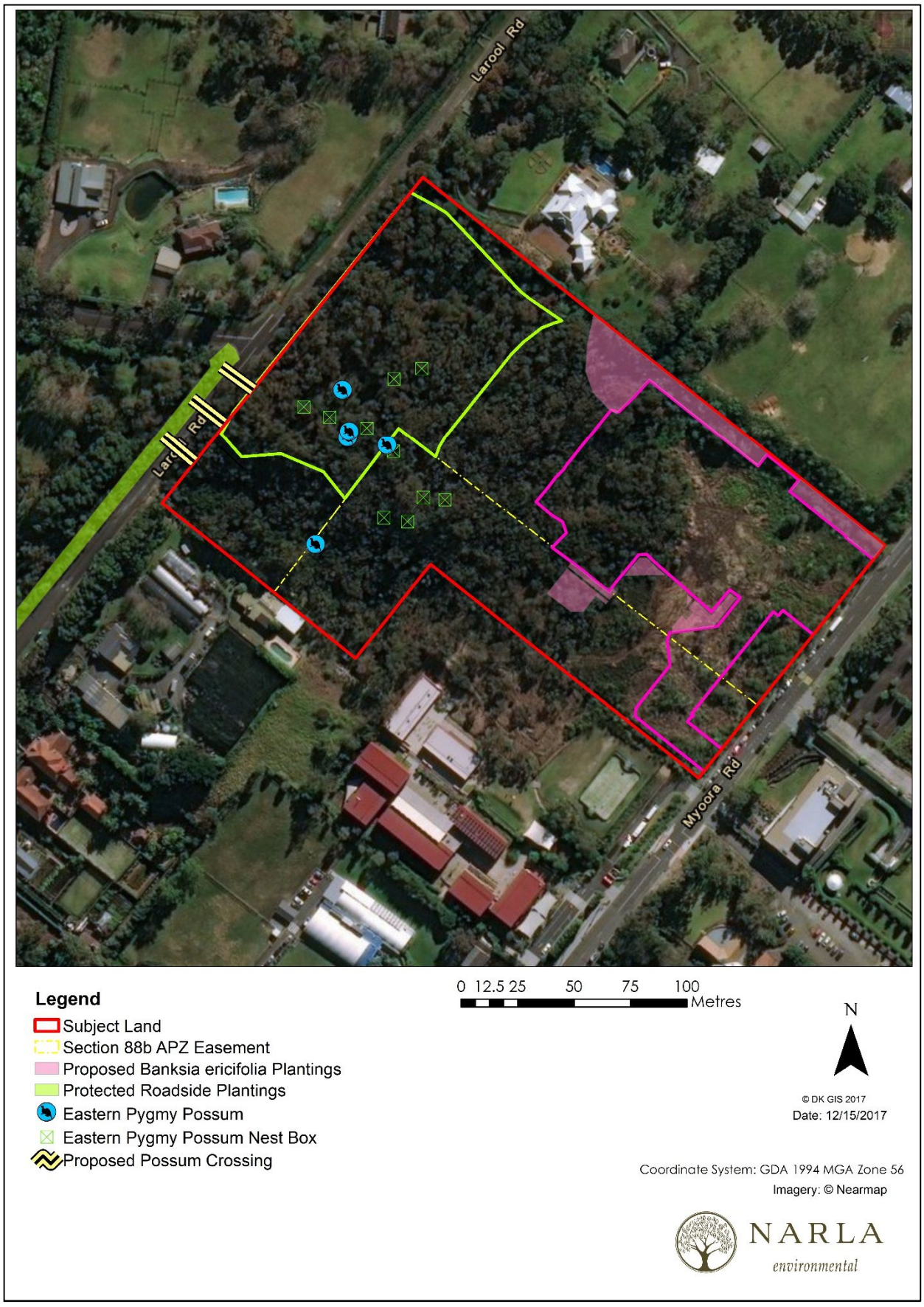


Figure 19. Proposed Eastern Pygmy Possum habitat and connectivity management and restoration measures

Plate 8. Street View image showing connecting native canopy on either side of Larool Road (subject site located on left) and bushland extending south along both sides of the road (source Google Earth 2017).

Plate 9. Suitable Eastern Pygmy Possum habitat located directly opposite the subject site on Larool Road (note the flowering *Banksia ericifolia*)

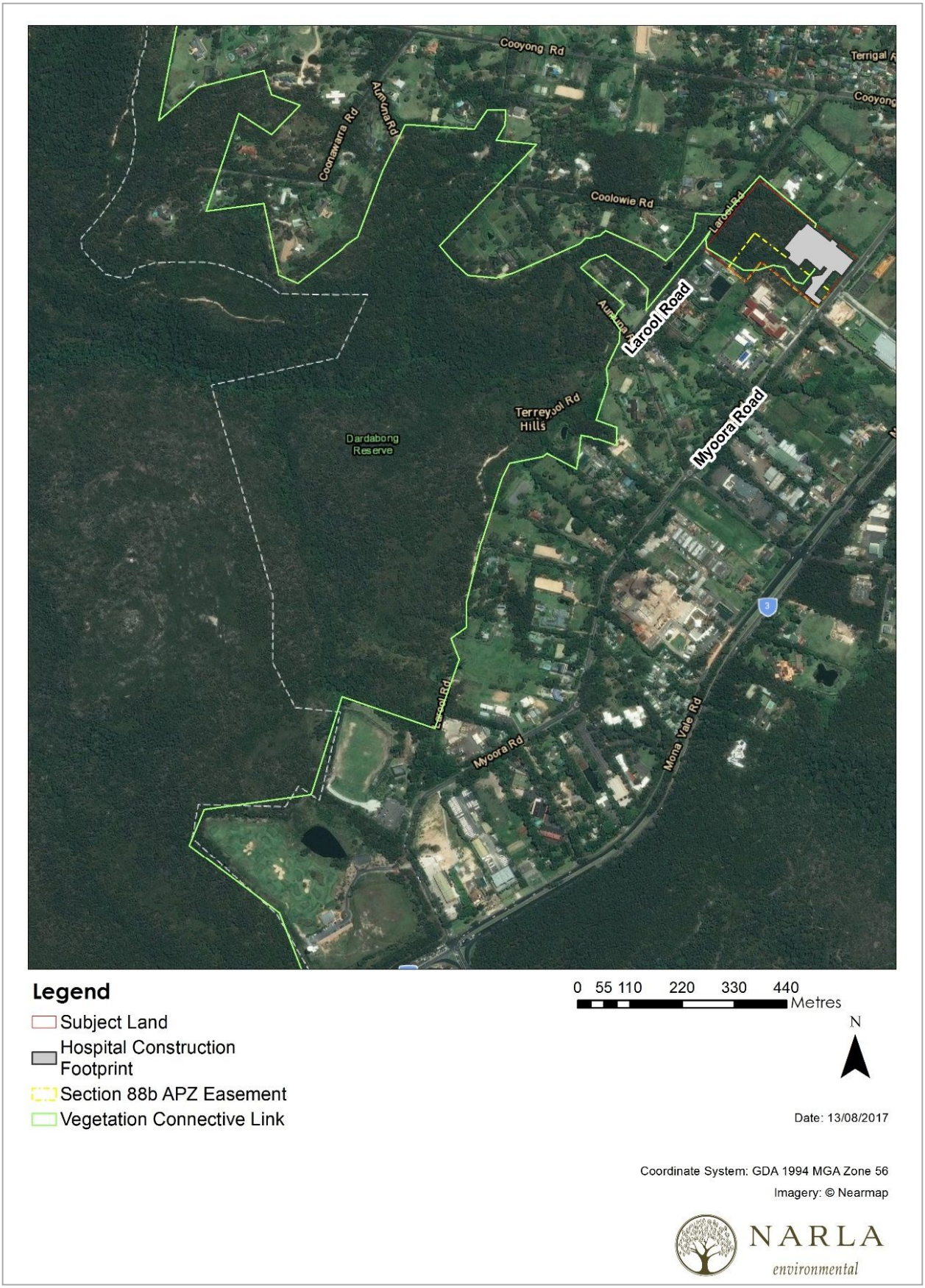


Figure 20. Habitat connectivity between the subject site and adjoining bushland remnant. Connectivity will remain post development.

5.5.4 Consideration of threatening processes

Consideration of threatening processes: Caley's Grevillea

Ongoing habitat loss through clearing for urbanisation and road construction is the primary threat to Cayley's Grevillea. An estimated 85% of the original extent of habitat has been lost in this way (SMEC 2017). Adverse fire regimes (too frequent or too infrequent), weed invasion and physical disturbance from vehicles, bikes, horses and people are also key threats.

Many of the threats identified above are recognised as Key Threatening Processes (KTP) as listed under Schedule 3 of the TSC Act. The most relevant to the proposed development are listed below:

- Clearing and fragmentation of native vegetation resulting in loss of biodiversity as a result of loss and/or degradation of habitat
- High frequency fire resulting in the disruption of the life cycle processes in plants and animals and loss of vegetation structure and composition
- Invasion of native plant communities by exotic perennial grasses
- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of *Lantana camara.*

The recovery plan for *Grevillea caleyi* (DEC 2004) identifies 22 priority actions including:

- Implement appropriate fire management
- Threat and habitat management including fencing, bush regeneration and weed control, pathogen and runoff control
- Reservation and/or protection of remnant sites
- Undertake ecological research.

Grevillea caleyi has been assigned into the site-managed species stream under the Saving our Species program. The *Grevillea caleyi* individuals on the Subject site are not located in a key management site.

The NSW Threatened Species Priority Action Statement sets out the following management objectives:

- Prevent access of recreational users to site
- Reduce and maintain weed densities at low levels
- Maintain appropriate fire regime for the species
- Ensure land management is sympathetic to the long-term requirements of the species
- Augment extant wild populations
- Track species abundance/condition over time.

Consideration of threatening processes: Eastern Pygmy-possum

The following describes KTP threats that affect Eastern Pygmy-possum and their relevance to the proposal:

- Clearing native vegetation: The Eastern Pygmy-possum uses native vegetation for foraging and for shelter, in particular areas of upper slope bushland, which function as corridors for the movement of individuals and provide suitable foraging and denning habitat (Law 2014). The proposal involves clearing 0.5 hectares of vegetation including 0.37 of good quality habitat and 0.13 of weed infested habitat. Of this a total of 80 Banksia ericifolia and 36 other potential feed plants will be removed. This is loss forms a small proportion of known and potential habitat in the locality, which includes suitable habitat in Dundundra Falls Reserve, Ku-ring-gai Chase and Garigal National Parks. All of these feed plants will be replaced at a minimum ration of 3:1. The Landscape Plan (Carmichael Studios 2017) proposes to plant a total of 1160 *Banksia ericifolia* on the subject site.

- Habitat fragmentation: Habitat fragmentation, resulting in the subdivision of populations and a reduction or loss of gene flow, can be a consequence of the clearing native vegetation KTP.

The proposal will not affect connectivity to adjoining habitat in Dundundra Falls Reserve, Ku-ring-gai Chase National Park or adjoining bushland on private land.

- Loss of hollow-bearing trees: The Eastern Pygmy-possum uses tree hollows for shelter and for breeding. The proposal requires the removal of 24 hollow-bearing trees, constituting approximately 78 tree hollows, resulting in the loss of shelter and breeding sites for the Eastern Pygmy-possum. These hollows will be replaced at a ratio of 2:1 through hollow augmentation. A total of 156 augmented hollows are proposed for the subject site.

- Removal of dead wood and dead trees: The Eastern Pygmy-possum use fallen logs and dead trees for shelter and for breeding. The proposal would require the removal of dead trees and fallen logs.

- Bushrock Removal: The Eastern Pygmy-possum is known to shelter occasionally in rock crevices. The subject site contains areas of exposed rock, therefore, shelter sites used by the Eastern Pygmy-possum may be removed by the proposal. Breeding females construct nests and are not likely to use rock crevices for this purpose. Significant areas of rocky outcrops would remain in the north of the subject site, adjacent to the proposed clearing footprint.

- Predation by the European Red Fox (*Vulpes vulpes*) and Predation by the feral cat (*Felis catus*): Dogs mainly attack medium to large species, such as macropods. The Red Fox and feral cats are more likely to be threats to the Eastern Pygmy-possum. However, the proposal is not likely to increase the exposure of the Eastern Pygmy-possum to these species.

- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition: More generally, changed fire regimes that affect the abundance of flowering Proteaceous and Myrtaceous shrubs is a threat to the Eastern Pygmy-possum. However, the proposal is not expected to have any bearing on local fire regimes.

- Weed invasion, including the KTPs
  i) invasion and establishment of exotic vines and scramblers,
  ii) invasion, establishment and spread of *Lantana camara*,
  iii) loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants, and
  iv) invasion of perennial grasses. High levels of weed invasion are present in the south-east of the subject site. Additional weed establishment is most likely to occur in habitat edges disturbed by construction and as a result of changed drainage patterns.

- Infection of native plants by *Phytophthora cinnamomi* and introduction and establishment of exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (both KTPs). These pathogens may already be present in the study area or may be introduced by machinery during construction or in the future by other means (e.g. a landscape supplier is present near the proposal area), if suitable hygiene standards are not met.

The Eastern Pygmy-possum has been assigned to the landscape species management stream of the Saving Our Species program. No priority management sites have been identified (OEH 2016).

5.6 Description of feasible alternatives

Wyvern Health is made up of a consortium of surgeons and doctors who acquired the subject site for development of a modern, state-of-the-art, specialist hospital in order to provide an increasing demand for health services in northern Sydney owing to the ageing population in the area.

With their professional experience and knowledge of holistic healing environments, the directors of Wyvern Health chose to construct the hospital on the subject to seek benefit from the aesthetics and ambience of the bushland environment on the subject site, including the sculpturesque sandstone formations, diversity of wildflowers and abundant wildlife. It was thought by the proponents (Wyvern Health) that the designing of a suitably positioned and designed hospital which complimented this natural scenery would allow patients the opportunity to appreciate the natural aesthetics of the subject site as they undergo their treatment. Ultimately improving their disposition and response to the care and treatment provided. For this reason, the proponents did not desire to explore the purchase of another property in the region. Despite thorough investigation by Wyvern Health, no properties of similar size could be located that provided similar aesthetic values.

During the initial phase of building design, it was intended to place the building footprint as close as possible to Myoora Road in order to focus the construction footprint on the weedy, historically cleared portion of the subject site. A limiting factor in siting the building completely in this area was the requirement for a 7.5-metre-wide setback at the front of the property along Myoora Road. This reduced the area of cleared/degraded land that could be developed and required the northward construction of the proposed hospital toward the bushland portion of the subject site.

The location and extent of the IPA APZ was proposed to minimise the required clearing or modification of the highest quality DFEC located at the core of the patch. The initial building design was reduced in size as much as possible (without compromising the proposed hospital services) in order to further reduce the width of the proposed IPA. This lead to an overall increase in the area of DFEC that would be protected under the proposed Conservation Area.

A comprehensive Biodiversity Management Plan (BMP) (Narla 2017b) has been developed for the site, that Wyvern Health will commit to implementing from the day of DA approval. The implementation value of this BMP will form the largest resource injection the natural environment of this property has ever received. Amongst other things, the BMP will oversee the removal of one of the Northern Beaches largest *Cortaderia selloana* (Pampas Grass) infestations, which endangers the biodiversity values of the site, including the integrity of the increasingly weed infested areas of Coastal Upland Swamp.

The proposed hospital is located within the least conservation significant area of the subject site; within weed infested areas, adjoining developed areas and existing roads. In this context feasible alternatives locations for the proposed hospital are generally limited. Since project conception, Wyvern Health has explored a number of alterations to the design of the hospital, including reduction of the proposed building footprint, in order to reduce the APZ widths.

Multiple amendments have been made to the design, in order to further reduce the construction and APZ footprint and reduce to overall ecological impact, however, owing to the complex nature of the proposed hospital, and the range of services and treatments it will provide, the proposed footprint cannot be further shrunk without comprising the feasibility and purpose of the development.

The location, height and area covered by of the proposed hospital within the subject based was based on a calculated analysis of a combination of:

- council design restrictions (in accordance with the LEP)
- geotechnical
- bushfire, and
- ecological constraints of the site.

Aside from its intended purpose of providing medical care, the proposed hospital in summary has been designed to:

- minimise and avoid significant impacts to native vegetation, including *Caley's Grevillea,* Duffys Forest Ecological Community and Coastal Upland Swamps endangered ecological community;
- incorporate onsite storm water detention (OSD) systems that are completely vegetated with locally indigenous Coastal Upland Swamp flora species and connected with 'level-spreader' water run-off implementation that will allow a natural feed flow of water into the existing Coastal Upland Swamp located downstream of the proposed building (Martens 2017a; Carmichael Studios 2017; Narla 2017b)
- engineer the diversion of the groundwater table around the proposed underground carpark to feed back (through percolation) into the Coastal Upland Swamp in order to maintain underground flows (Martens 2017a;2017b)
- incorporate 100% locally-indigenous landscaping/plantings surrounding the building in direct connectivity with existing bushland. Including the addition of at least 1160 new *Banksia ericifolia shrubs* to be planted as Eastern Pygmy-possum forage habitat.

Furthermore, the design of the proposed hospital allows the creation of a new Conservation Agreement over the majority of the DFEC and all of the Caley's Grevillea on the subject site which will be managed and protected in perpetuity.

6. Assessment of Likely Impacts on Endangered Ecological Communities

6.1 Assessment of endangered ecological communities likely to be affected

All threatened ecological communities listed at state or national levels recorded from within 10km of the study area are summarised in **Table 29.** Based on comprehensive field and desktop assessment of habitat, and floristics, only two endangered ecological communities have been identified within the subject site:

- Coastal Upland Swamp in the Sydney Basin Bioregion; and
- Duffys Forest Ecological Community in the Sydney Basin Bioregion.

Vegetation mapping of the site (OEH 2016) did not identify the presence of either of these communities within the subject site. Previous surveys of the site (Blue Mountains Wilderness Services 2004) also did not identify the presence of these communities. Both communities were first identified on the subject site by Narla Environmental during field assessment in August 2016.

Table 29. Endangered Ecological Communities within 5km of site

Name	Conservation Status		Habitat within study area	Likelihood of occurrence	Recorded in initial survey
	TSC Act	EPBC Act			
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	V	No	None	No
Coastal Upland Swamp in the Sydney Basin Bioregion	E	E	Yes	High - Known	Yes
Duffys Forest Ecological Community in the Sydney Basin Bioregion	E		Yes	High - Known	Yes
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		No	None	No
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	No	None	No
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	No	None	No
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	-	No	None	No

Assessment of endangered ecological communities likely to be affected: Duffys Forest Ecological Community

Duffys Forest ecological community (DFEC) covers 1.57 ha of the subject site. DFEC was first discovered and mapped on the subject site by Narla Environmental in 2016. It had not previously been identified or mapped by Blue Mountains Wilderness Services (2004) or any of the other local and regional mapping projects including:

- Smith, P. and Smith, J. (2000) Survey of the Duffys Forest Vegetation Community. Unpublished report to NSW NPWS and Warringah Council
- Ku-ring-gai Council (2012) Mapping and assessment of key vegetation communities across the Ku-ring-gai Local Government Area
- DEC (2004) Grevillea caleyi R. Br. (Proteaceae) Recovery Plan.
- OEH (2013) The Native Vegetation of the Sydney Metropolitan Area, Version 2.

An approved recovery plan exists for DFEC remnants under the Saving Our Species program with several priority actions identified including:

- Notify landowners and managers of the presence of DFEC remnants under their care and/or control;
- Liaise with public authorities to pursue active management for conservation;
- Develop best practice Management Guidelines for DFEC remnants;
- Practice and implement POM on public land; and
- Collate data for conservation assessment of all DFEC remnants.

Direct Impacts: Duffys Forest Ecological Community

The extent of DFEC on the subject site is considered unlikely to be significantly impacted by the proposed development and associated works. The majority of this vegetation community on the subject site is located away from the development footprint and will therefore be avoided and protected. Established native vegetation buffers will be retained between the development and the DFEC.

The proposed development will require the establishment of an IPA APZ which will overlap with the extent of DFEC (Peterson Bushfire 2017). The location and extent of the IPA APZ proposed will minimise the required clearing or modification of the highest quality DFEC located at the core of the patch. The management requirements of this APZ area will result in the minor modification of 0.51 ha of DFEC community at its southern periphery. The proposed APZ management process will be undertaken in a manner that minimises impact to Duffys Forest EEC and the flora and fauna species that inhabit it, including Eastern Pygmy-possum. Modification will take place solely in the form of select thinning of small trees, dead (non-hollow trees), shrubs (that do not form important Eastern Pygmy Possum Habitat), dense ground covers, weeds and leaf litter.

The area of Duffys Forest that requires modification as an APZ represents approximately 32% of the area of DFEC which occurs within the Subject site and less than 0.01% of the total estimated extent of the community (3,000 ha) in existence (OEH 2017a) or (184 ha) in the Warringah area (Smith and Smith 2009).

Instead of having a significant impact, it is considered that the proposed APZ management works may assist in the long-term viability of the Duffys Forest on the Subject site through the removal of resource pressures (e.g. removal of extensive build-up of dead, vegetative debris and senescent shrubbery) that prevent the germination of the seedbank and the promotion of successful growth of new seedlings, including *Banksia ericifolia* and other DFEC characteristic ground cover species or important feed plants of the Eastern Pygmy-possum. Active management of an APZ in Duffys Forest could have positive effects on DFEC, comparable to the effects of a well-timed ecological burn.

The proposed RFS fire tanker track will incur a total of 0.01 ha of select vegetation removal from the southernmost extent of the DFEC on the Subject site (close to the boundary with the German School). This fire tanker track is considered a 'fire break' and a 'means of access' to the APZ by Fire-fighting Tankers and is therefore a permitted act in accordance with the s.88b APZ easement over the lot burdened. The loss is approximately 0.003% of the total estimated area of DFEC remaining in Warringah ward of Northern beaches LGA (Smith and Smith 2009). The tanker track will be located entirely within an existing, purposely established section 88b APZ easement and therefore does not require further assessment in this SIS.

Indirect impacts: Duffys Forest Ecological Community

Indirect impacts that have potential to occur beyond the clearing footprint without active impact mitigation measures may include the following:

- Introduce or spread of weed species along the road/bushland interface and downslope of the construction zone;
- Increased edge effects, fragmentation and degradation outside of construction zone;
- Increased shading from the hospital buildings;
- Increased lighting from carparks and buildings;
- Dust and sediment deposition on vegetation during construction.

These issues are all addressed in more detail in **section 6.4.4** and ameliorative measures discussed in **section 7.1** (**Table 36**).

Pre-existing Impacts: Duffys Forest Ecological Community

The DFEC on the subject site is currently subject to impacts associated with:

- Intense weed infestation and continuing encroachment from all edges (**Plate 10**). This weed issue has never been actively managed by the land owners and will get progressively worse over time.
- Mesic shift (i.e. proliferation of native, mesic plants such as *Pittosporum undulatum*).
- Lack of natural fire regimes and the associated benefits, such as, germination of the seed bank and removal of organic debris build-up that smothers the ground layer and blocks light infiltration.
- Build-up of dead organic matter which that smothers the ground layer and blocks light.
- Grazing and digging by pest Rabbits (*Oryctolagus cuniculus*)
- Illegal vegetation clearing by unauthorised members of the public involved in the construction of unauthorised structures (**Plate 11**)
- Littering and dumping of wastes by unauthorised members of the public (**Plate 11**)
- Fauna predation, weed spread and digging by pest Foxes (Vulpes vulpes) recorded on the subject site (**Plate 12**).

All of these issues will be actively managed and effectively controlled or eradicated from the subject site, through active, well-resourced management of the entire subject site, particularly the DFEC. Further details of the management of these issues are provided in the BMP (Narla 2017a) and in **Table 36** of this report.

Plate 10. Dense weed infestation in the south-east corner of the DFEC o the subject site

Plate 11. Rubbish and illegal temporary dwelling structures placed by trespassers on the subject site. This area was cleared of Duffys Forest EEC understorey vegetation to make way for these structures.

Plate 12. A Red Fox (*Vulpes vulpes*) photographed in the DFEC on the subject site.

Assessment of endangered ecological communities likely to be affected: Coastal Upland Swamp

The Coastal Upland Swamp (CUS) located on the Subject site covers 0.17 ha. This patch is small and isolated from other occurrences of this community in the locality. Narla have mapped this community into two definable condition units:

- 0.12 ha of moderate to good quality remnant CUS and
- 0.05 ha of low quality (weed infested) CUS.

Coastal Upland Swamp in the Sydney Basin Bioregion was only declared as an EEC in 2012. This listing occurred two years after a bushfire management Asset Protection Zone (APZ) easement was declared through the Subject site in accordance with section 88b of the *Conveyancing Act 1919*. Over 76% of the occurrence of Coastal Upland Swamp (1270 m²) on the Subject site is located within this APZ easement (**Figure 21**). This requires the vegetation to be managed for the purpose of an APZ. This previously established APZ easement that was registered under section 88b of the *Conveyancing Act 1919*, occupies the south-western portion of the subject site, and overlays the majority of the Coastal Upland Swamp endangered ecological community extent 0.13 ha (over 76%). The section 88b easement was registered on 04/02/2010 whereas the '*Coastal Upland Swamp in the Sydney Basin Bioregion*' was only gazetted as an endangered ecological community (EEC):

- under the *Threatened Species Conservation Act 1995* on 09/03/2012, and
- under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* on 17 Jul 2014.

This means that since 2010, an area of 76% of the Coastal Upland Swamp EEC has been legally required (pursuant under section 88b of the *Conveyancing Act 1919)* to be managed as an APZ through slashing, independently of the proposed development. This area is therefore compromised and reduced in its assessable extent.

The only portion that is not legally compromised by the section 88b APZ easement is the remaining 0.04 ha that occurs on the subject site, outside the easement. This 0.04 ha has been assessed of impact under this SIS.

The results of this SIS revealed that in the unlikely event that:

- the 0.04 ha of assessable CUS (i.e. outside the s.88b easement), or
- the entire 0.17 ha of CUS on the subject site

was lost, the loss would cause no significant impact to the EEC, because:

- the patch is already weed infested and becoming increasingly infested by Pampas Grass and Whiskey Grass to such an extent that it may become unrecognisable in the future (e.g. rendered unviable)
- the patch is small and surrounded by nutrient-enriched soils that are densely infested with weeds that are rapidly encroaching into the CUS
- 76% of the CUS patch is already approved for active management as an APZ which leaves only 24% (0.04 ha) unmanaged (outside of an APZ), and since this area is infested by weeds, its small area is unviable.

Furthermore, it is important to note that the current zoning of the land permits the future demise of the CUS, because even if the current development was not approved, any future land use of the site permitted by its current zoning under the Warringah LEP 2011 (including residential development, industrial development, and livestock grazing) is likely to reduce the size, extent and condition of the CUS on the subject site.

Direct Impacts: Coastal Upland Swamp

Coastal Upland Swamp EEC will not be impacted by direct clearing for the construction of the proposed hospital. The proposed hospital buildings and associated carparks will be located in close proximity to the Coastal Upland Swamp, and this will require the management of a 10-metre-wide 'defendable space' to protect the hospital inhabitants from bushfire hazard associated with the Coastal Upland Swamp Vegetation that will be retained (**Figure 21**) (Peterson Bushfire 2017; Carmichael Studios 2017). The vegetation in this defendable space will be slashed to keep short and less likely to promote fire. Slashing will take place at times of the year when the majority of sedges and herbs are not flowering (e.g. avoid spring months) so as to prevent impacts to the reproductive cycles of the floristic component of the CUS. There will be no disturbance to soil surface, laying of aggregates/hard surfaces or planting. It is unlikely that this will significantly affect biodiversity of that part of the Coastal Upland Swamp.

Indirect Impacts: Coastal Upland Swamp

It is difficult to accurately anticipate the impacts of the development on the patch of Coastal Upland Swamp EEC on the Subject site, owing to the complexity of its dependencies on particular geological attributes, hydrological processes, rainfall and climatic variation (NSW Scientific Committee 2012).

The proposed development may induce the following perturbations upon the Coastal Upland Swamp:

- Increased shading from the hospital buildings;
- Reduced area for water infiltration;
- Altered rate of ground water recharge or retention;
- Changes to drainage and soil moisture levels downslope of the construction zone;
- Altered course of surface or subterranean water movement across the Subject site;
- Movement of sediment downslope of the construction zone;
- Altered stormwater flow velocity; and
- Altered surface or subterranean water chemistry.

The proponent will take all precautions to control and mitigate these potential perturbations and these are discussed in **section 7**.

Pre-existing Impacts: Coastal Upland Swamp

Historical clearing and subsequent weed infestation had substantially degraded a significant area of land that has potential to support the Coastal Upland Swamp community.

Photographs were taken of the Coastal Upland swamp at the start of this study June 2016 and ten months later in April 2017 (**Plate XXX**). The extent of weed infestation, particularly of Pampas Grass encroaching into the Coastal Upland Swamp was significant. If this weed infestation is left to proliferate over time the Coastal Upland Swamp will become so badly weed infested that it will be unrecognisable. In contrast, given the right on-ground management from qualified bush regenerators under the proposed BMP (Narla 2017a) it is likely this area will have strong capacity to regenerate. Management of this EEC will be undertaken as a priority into the future in line with the SIS (**Table 36**) BMP (Narla 2017a).

It is important to note that in the absence of the proposed development, the current zoning of the subject site permits the future demise of the CUS. Even if the current development was not approved, any future land use of the site permitted by its current zoning under the Warringah LEP 2011(including low-density residential development, industrial development, and livestock grazing) is likely to reduce the size, extent and condition of the CUS on the subject site without guaranteed resource allocation, such as that proposed by Wyvern Health.

Plate 13. Coastal Upland Swamp on the subject site in June 2016 (top) in April 2017 (bottom). Extensive growth of pampas grass infestation evident between photo periods.

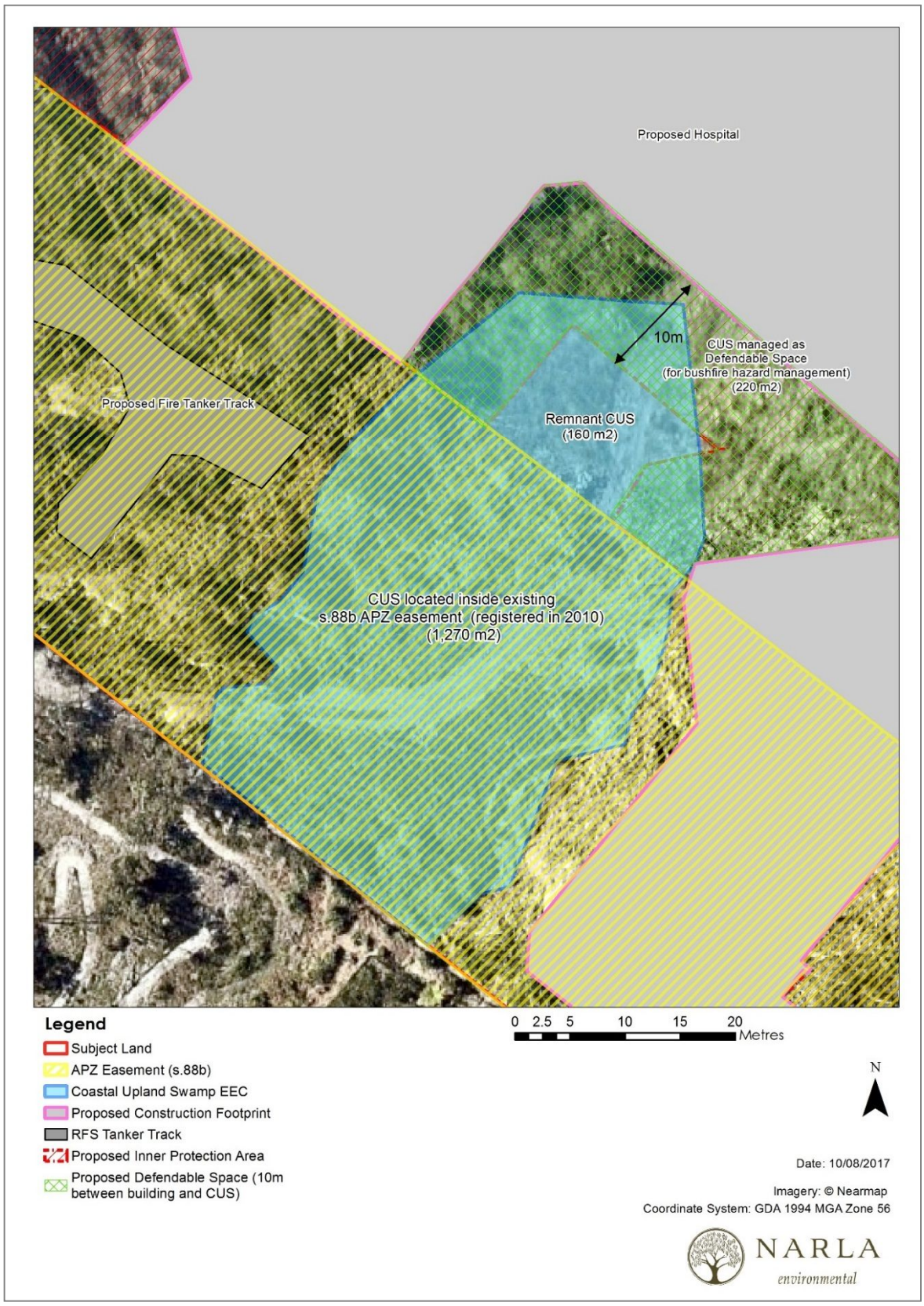


Figure 21. The location of proposed construction and bushfire hazard management requirements in proximity to the Coastal Upland Swamp

6.2 Description of Habitat

Description of habitat in the study area: Duffys Forest Ecological Community

Duffys Forest Ecological Community (DFEC) in the study area is restricted to a single 1.57 ha patch in the north-west of the subject site. The occurrence of Duffys Forest was determined by the dominance of Red Bloodwood and Silvertop Ash (*Eucalyptus sieberi*) within the canopy along with associated Brown Stringybark (*Eucalyptus capitellata*) and Common Sandstone Stringybark (*Eucalyptus oblonga*) overlying a diverse shrub layer including Grey Spider Flower (*Grevillea buxifolia*), Old Man Banksia (*Banksia serrata*), Broad-leaf Geebung (*Persoonia levis*) and Pine-leaf Geebung (*P. pinifolia*).

Analysis of the vegetation assemblage data collected from the two biometric plots sampled within this community confirmed this, with 31 diagnostic species and an additional 8 associated species out of a total of 68 identified within the quadrats. This conformed to guidelines for determination of this community, which state 29 diagnostic species must be present provided the area contains > 45 total native species (OEH 2013a;2013b). A noteworthy feature of this community was the presence of two clumps of Caley's Grevillea (*Grevillea caleyi*). Duffys Forest EEC forms the stronghold for this species (NSW Scientific Committee 2011).

This patch is connected to DFEC in nearby Dundundra Falls Reserve through canopy connections via a small patch of DFEC on Larool Road and private property (**Figure 22**). Another structurally and floristically diverse DFEC patch is located in close proximity to the subject site to the north of Coolowie Road. This large patch of DFEC on Coolowie Road had never been previously mapped (Warringah 2004a; OEH 2013), however it represents a significant local occurrence of the community 0.73 ha.

Description of habitat in the local occurrence: Duffys Forest Ecological Community

The extent of the local occurrence (**Figure 22**) of DFEC is approximately 18 ha (Table 30) and this extends from Dundundra Falls Reserve to the south-west of the subject site north to Cooyong Road. To the east of the subject site, a local occurrence of DFEC 0.73 ha occurs on vacant land north of Coolowie Road. All of these patches are floristically and structurally diverse, and connect with the subject site through vegetation connections along Larool Road, and adjoining private properties. The size of western extent of the local occurrences is larger than many of the other local DFEC sites. They are predominantly in good condition and have good connectivity with adjoining native vegetation including areas of Garigal and Ku-ring-gai Chase National Parks.

DFEC within the local occurrence is considered to be significant and important to the long-term survival of the ecological community in the locality. A contributing portion of Duffy's Forest to the local occurrence occurs on the subject site, this will be maintained and protected through establishment of a designated Conservation Area. Connectivity between the subject site and the remainder of the local occurrence will be enhanced through active

During the preparation of this SIS, Narla mapped approximately 8.38 ha of Duffys Forest which was not previously mapped in the locality:

- 1.57 ha in the subject site
- 6.81 in the surrounding local occurrence (connected to varying extents with the subject site). The details of these patches are presented in **Table 30** and **Figure 22.**

Table 30. Details of the local occurrence of Duffys Forest Ecological Community

Vegetation Mapped By	Area (m2)	Ha	Approximate Location
Narla Environmental Pty Ltd	2627	0.26	Stip along North of Aumuna Road
Narla Environmental Pty Ltd	943	0.09	East of Larool Road
Narla Environmental Pty Ltd	1921	0.19	North of Aumuna Road
Narla Environmental Pty Ltd	7312	0.73	North of Coolowie Road
Narla Environmental Pty Ltd	19365	1.94	North of Coolowie Road
Narla Environmental Pty Ltd	2684	0.27	South of Cooyong Road
Narla Environmental Pty Ltd	2119	0.21	North of Cooyong Road
Narla Environmental Pty Ltd	20157	2.02	Dundudra Reserve and Surroundings
Narla Environmental Pty Ltd	3811	0.38	West of Coolowie Road
Narla Environmental Pty Ltd	1064	0.11	Dundudra Reserve
Narla Environmental Pty Ltd	746	0.07	Corner of Myoora Road and Aumuna Road
Narla Environmental Pty Ltd	5394	0.54	West of Myoora Road
Narla Environmental Pty Ltd	15688	1.57	Within Subject Site
Total	**83831**	**8.3831**	
Office of Environment and Heritage	879	0.09	Dundudra Reserve
Office of Environment and Heritage	855	0.09	Dundudra Reserve
Office of Environment and Heritage	17899	1.79	Dundudra Reserve
Office of Environment and Heritage	20289	2.03	Dundudra Reserve
Office of Environment and Heritage	2174	0.22	Dundudra Reserve
Office of Environment and Heritage	375	0.04	Dundudra Reserve
Office of Environment and Heritage	25	0.00	Dundudra Reserve
Office of Environment and Heritage	29239	2.92	Dundudra Reserve
Office of Environment and Heritage	6307	0.63	South of Cooyong Road
Office of Environment and Heritage	5150	0.51	South of Aumuna Road
Office of Environment and Heritage	16892	1.69	West of Myoora Road, East of Dundudra Reserve
Total	**100085**	**10.01**	
Combined Total	**183916**	**18.39**	

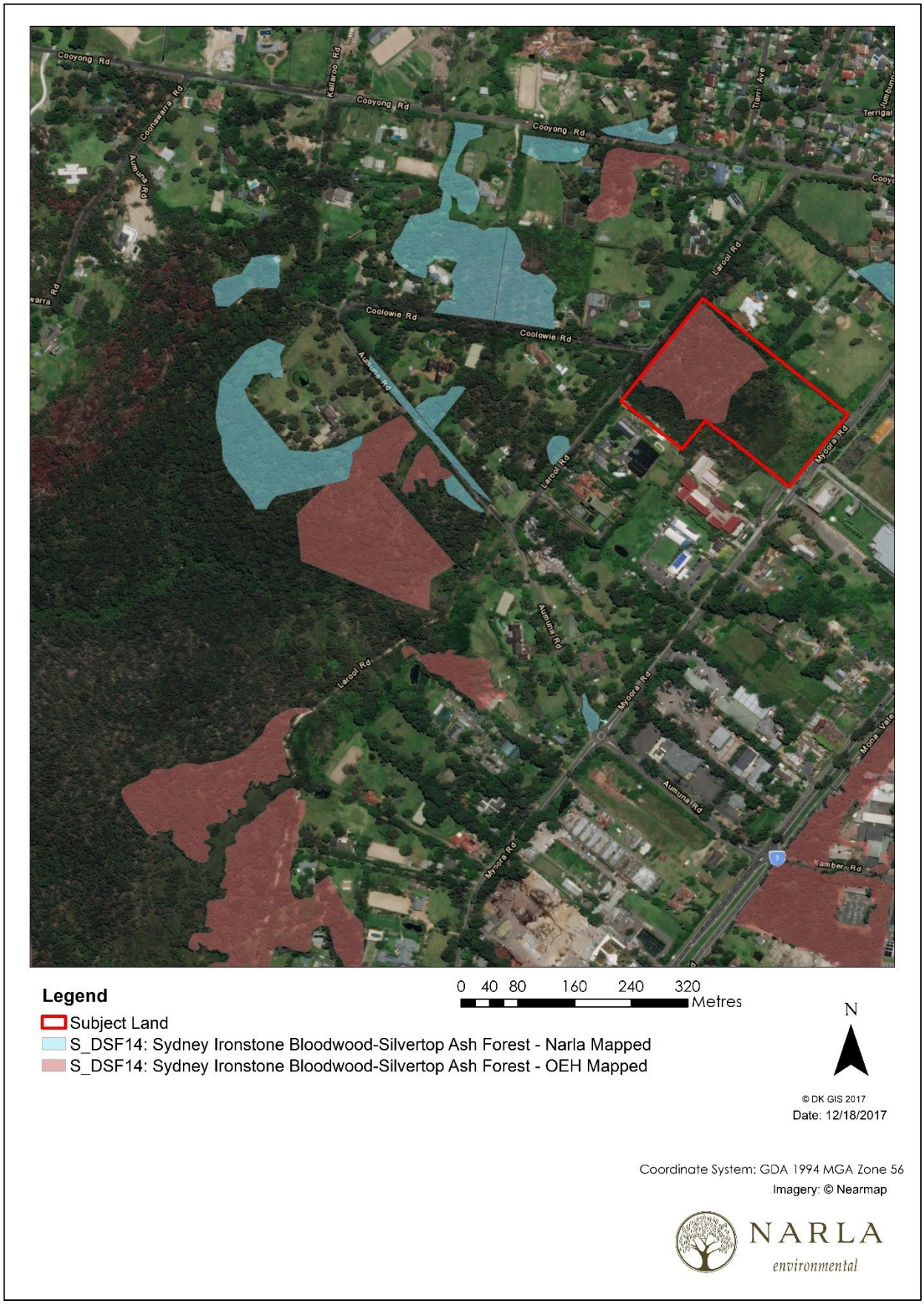


Figure 22. Duffys Forest EEC in the local occurrence mapped by OEH (2013) and additional Duffys Forest Narla Environmental during the undertaking of this SIS.

Description of habitat in the locality / general area: Duffys Forest Ecological Community

DFEC is a highly restricted community occurring primarily within Warringah and Ku-ring-gai local government areas with minor occurrences in the Pittwater (Ingleside and Bilgola Plateau), Manly (Seaforth Oval) and Hornsby (South Turramurra and North Epping) LGAs. The OEH Threatened Species Profile (OEH 2016b) states that only 240 hectares remains although more recent mapping undertaken in the Sydney Metropolitan Area (OEH 2013) identifies about 380 hectares of DFEC remaining within 10 kilometres radius of the study area in varying condition.

DFEC within the locality is restricted to fragmented patches along ridge-lines mostly on freehold and crown lands. These patches are compromised by development (particularly road widening), ongoing impacts associated with ridge-top/roadside habitats and adverse fire regimes. A survey undertaken by Smith and Smith (2000) identified and described 32 sites of DFEC. These sites are summarised in **Table 31**. There are likely to be additional small patches mostly along road reserves and on private land as identified in the Caley's Grevillea Recovery Plan (strong association between this species and the DFEC) and in view of the larger extent of DFEC mapped by OEH (2013).

A comparison of the sites within 5-kilometres radius as listed in **Table 31** indicates the following:

- Over 50% of known sites of DFEC are <5 hectares in size
- Approximately 70% are in average to poor condition
- Seven of the sites identified include areas within a national park protecting approximately 85 hectares (68 hectares at one site)
- Even small remnants can have native species richness.

The total extent in the locality / general area (5-km radius of subject site) is mapped (**Figure 23**).

During the preparation of this SIS, Narla mapped approximately 8.38 ha of Duffys Forest which was not previously mapped in the locality:

- 1.57 ha in the subject site
- 6.81 ha in the surrounding local occurrence (connected to varying extents with the subject site)

The details of these patches are presented in **Table 30**. Combining this area with the total area of DFEC listed in **Table 31** the total area of DFEC in the locality is approximately 183.56 ha.

Table 31. DFEC sites within a 5-kilometre radius of the study area

Location	Land tenure	Habitat area	Habitat condition (Smith and Smith 2000)	Species richness
Aquatic Drive, Frenches Forest	Crown Land	5.3 ha	Poor to average	137
Baha'i Temple, Mona Vale Road	Private land adjoining Mona Vale Road Reserve	1 ha	Poor to average	104 but for larger area
Oats Place, Belrose	Warringah Council and RR	0.6 ha	Poor	81
Belrose Quarry, north and south	NSW TAFE	3.8 ha	Poor to average	96
Morgan Road Fire Trail	Land Aboriginal Land Council and RR	3 ha	Good	67
Bundaleer Street, Belrose	Private land and RR	4.9 ha	Average to poor	67
Austlink Corporation Park	Private land and RR	7.6 ha in 2000 probably less now	Average to poor	92
Ryland Track, Mona Vale Road	Ku-Ring-Gai Chase National Park	15.3 ha	Good	58 from part only
Dundundra Falls Reserve, Terry Hills	Crown Land adjacent to Ku-Ring-Gai Chase National Park	4.7 ha (1.2 in National Park)	Good to poor	119
Frank Beckman Reserve, Terry Hills	Warringah Council sports reserve and RR	1 ha	Poor	113
JJ. Melbourne Hills Memorial Reserve	Warringah Council reserve, RR, Private land and Garigal National Park	3.9 ha (0.1 ha in National Park)	Poor	76
Kinka Reserve, Terrey Hills	Warringah Council reserve and private land	2.6 ha most in reserve	Average	73
NSW Gun Club, Duffys Forest	Private land, some RR	13 ha	Good to poor	84
Durumbil Road, Duffys Forest	Private and crown land	13.7 ha	Average	81
Eurabba Road, Dufffys Forest	Mostly private land	4.5 ha	Average	139
*Perimeter Trail, Duffys Forest	Ku-ring-gai Chase National Park, Crown and Private Lands	75.9 ha (68.2 ha in National Park)	Good	111 in typical form
St Ives Showground and Road safety Centre	Ku-ring-gai Council Reserves, Ku-ring-gai Chase National Park and NSW Government	7.7 ha (0.6 ha in National park)	Average to poor	67
Warimoo Track, Ku-ring-gai	Ku-ring-gai Chase National Park	6.4 ha	Mostly good	111
Ku-ring-gai Wildflower Garden	Ku-ring-gai Council Reserves	1.7 ha	Average	79

* This site contains the Blackbutt-Turpentine Forest form of Duffys Forest as described by Smith and Smith (2000)
but is now likely identified as Coastal Shale Sandstone Forest as described in OEH (2013).

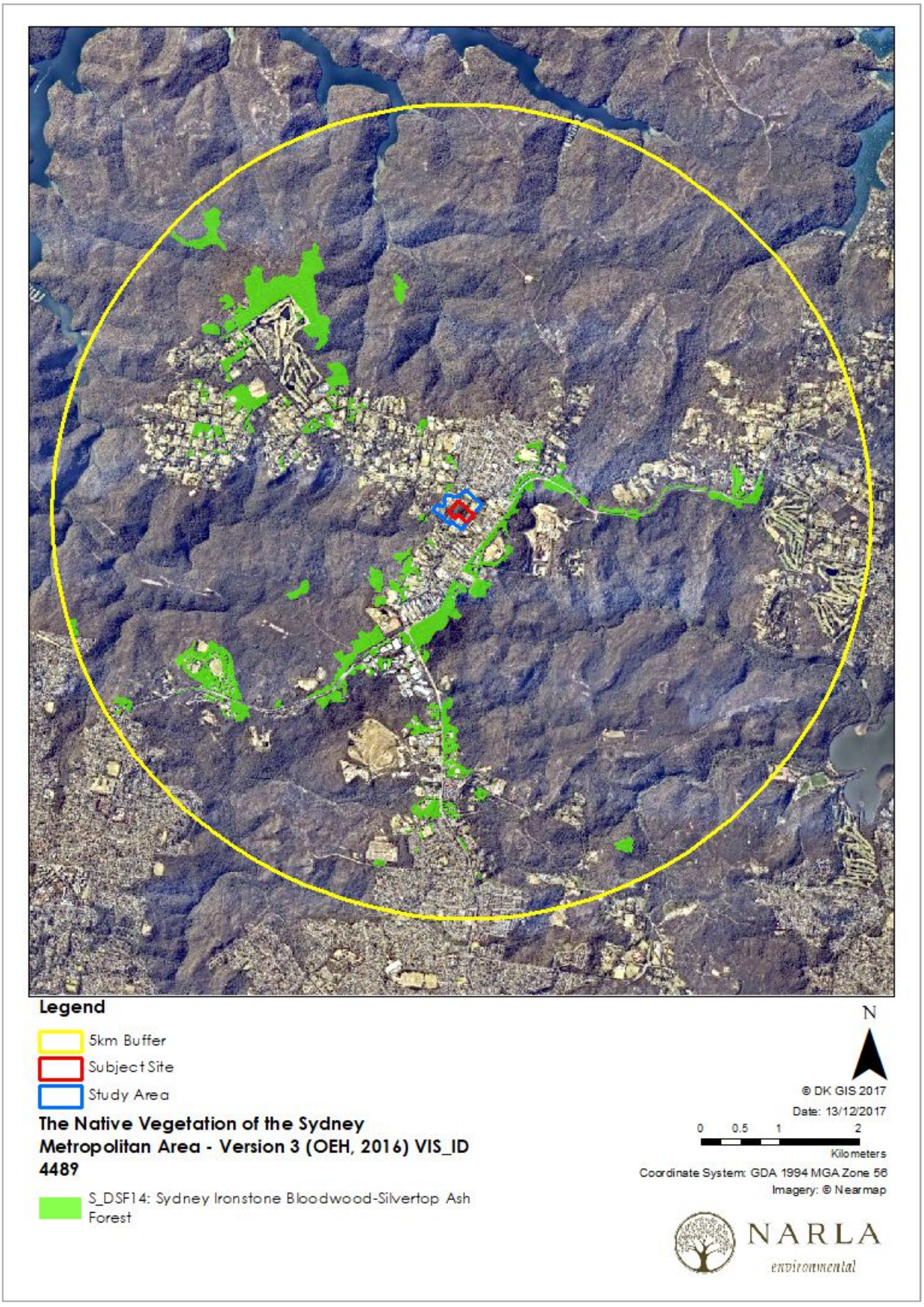


Figure 23. Extent of Duffys Forest Ecological Community in the General Area (5km)

Description of habitat in the study area: Coastal Upland Swamp

A total area of 0.17 ha of Coastal Upland Swamp has been mapped in the study area. The condition of this Coastal Upland Swamp has been presented (**Table 32**).

Table 32. Summary of Coastal Upland Swamp (CUS) in the study area

CUS condition	CUS within subject site	CUS covered by Section 88b Easement
Coastal Upland Damp Heath Swamp (EEC) Good Condition	0.12 ha	0.09 ha
Coastal Upland Damp Heath Swamp (EEC) Weed Infested	0.05 ha	0.03 ha
Total:	**0.17 ha**	**0.12 ha**

The condition states of Coastal Upland Swamp within the study area (entirely within the subject site) are mapped in Figure **7**. All of the Coastal Upland Swamp in the subject site is considered part of the endangered ecological community as listed under the TSC Act.

Historical clearing and subsequent weed infestation had substantially degraded a significant area of land that has potential to support the Coastal Upland Swamp community.

Photographs were taken of the Coastal Upland swamp at the start of this study June 2016 and in ten months later in April 2017. The extent of weed infestation, particularly of Pampas Grass encroaching into the Coastal Upland Swamp was significant. Given the right on-ground management from qualified bush regenerators, it is likely this area will have strong capacity to regenerate. Management of this EEC will be undertaken as a priority into the future in line with the BMP (Narla 2017a).

Coastal Upland Swamp in the Sydney Basin Bioregion was only declared as an EEC in 2012. This listing occurred two years after a bushfire management Asset Protection Zone (APZ) easement was declared through the Subject site in accordance with section 88b of the *Conveyancing Act 1919*. Over 76% of the occurrence of Coastal Upland Swamp (1270 m²) on the Subject site is located within this APZ easement (**Figure 21**). This requires the vegetation to be managed for the purpose of an APZ. This previously established APZ easement that was registered under section 88b of the *Conveyancing Act 1919*, occupies the south-western portion of the subject site, and overlays the majority of the Coastal Upland Swamp endangered ecological community extent 0.13 ha (over 76%). The section 88B easement was registered on 04/02/2010 whereas the '*Coastal Upland Swamp in the Sydney Basin Bioregion*' was only gazetted as an endangered ecological community (EEC):

- under the *Threatened Species Conservation Act 1995* on 09/03/2012, and
- under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* on 17 Jul 2014.

This means that since 2010, an area of 76% of the Coastal Upland Swamp EEC has been legally required (pursuant under section 88B of the Conveyancing Act 1919) to be managed as an APZ through slashing, independently of the proposed development. This area is therefore compromised and reduced in its assessable extent. The only portion that is not legally compromised by the section 88b APZ easement is the remaining 0.04 ha that occurs on the subject site, outside the easement. This 0.04 ha has been assessed of impact under this SIS.

Description of the local occurrence: Coastal Upland Swamp

Coastal Upland Swamp has been mapped in local and regional mapping projects including:

- Department of the Environment (DoE) (2014) *Coastal Upland Swamps in the Sydney Basin*; and
- OEH (2013) The Native Vegetation of the Sydney Metropolitan Area, Version 2.

No regional or local mapping for Coastal Upland Swamp within the study area currently exists within the adjoining Dundundra Falls reserve. Coastal Upland Swamp mapping in of Dundundra Falls Nature Reserve and the study area has been derived solely from field assessment undertaken by Narla Environmental.

During the preparation of this SIS, Narla Environmental undertook a targeted survey of areas of bushland connected to the subject site in order to understand and map the local occurrence of Coastal Upland Swamp (**Figure 24**). Details of the local occurrence is provided (**Table 33**).

Table 33. Details of the local occurrence of Coastal Upland Swamp

Vegetation Mapped By	Area (m2)	Area Ha	Approximate Location
Narla Environmental Pty Ltd	1108	0.11	Dundudra Reserve North near Aumuna Road
Narla Environmental Pty Ltd	1046	0.10	Dundudra Reserve North near Aumuna Road
Narla Environmental Pty Ltd	907	0.09	Dundudra Reserve middle near Larool Road
Narla Environmental Pty Ltd	3208	0.32	Dundudra Reserve middle near Larool Road
Narla Environmental Pty Ltd	417	0.04	Dundudra Reserve middle near Larool Road
Narla Environmental Pty Ltd	2812	0.28	Dundudra Reserve middle near Larool Road
Narla Environmental Pty Ltd	1899	0.19	Dundudra Reserve middle near Larool Road
Narla Environmental Pty Ltd	164	0.02	Dundudra Reserve middle near Larool Road
Narla Environmental Pty Ltd	910	0.09	North of Coolowie Road
Narla Environmental Pty Ltd	1630	0.16	Within Subject Site
Total	**14,101**	**1.41**	
Office of Environment and Heritage	0	0	N/A
Total	**0**	**0**	
Combined Total	**14,101**	**1.41**	

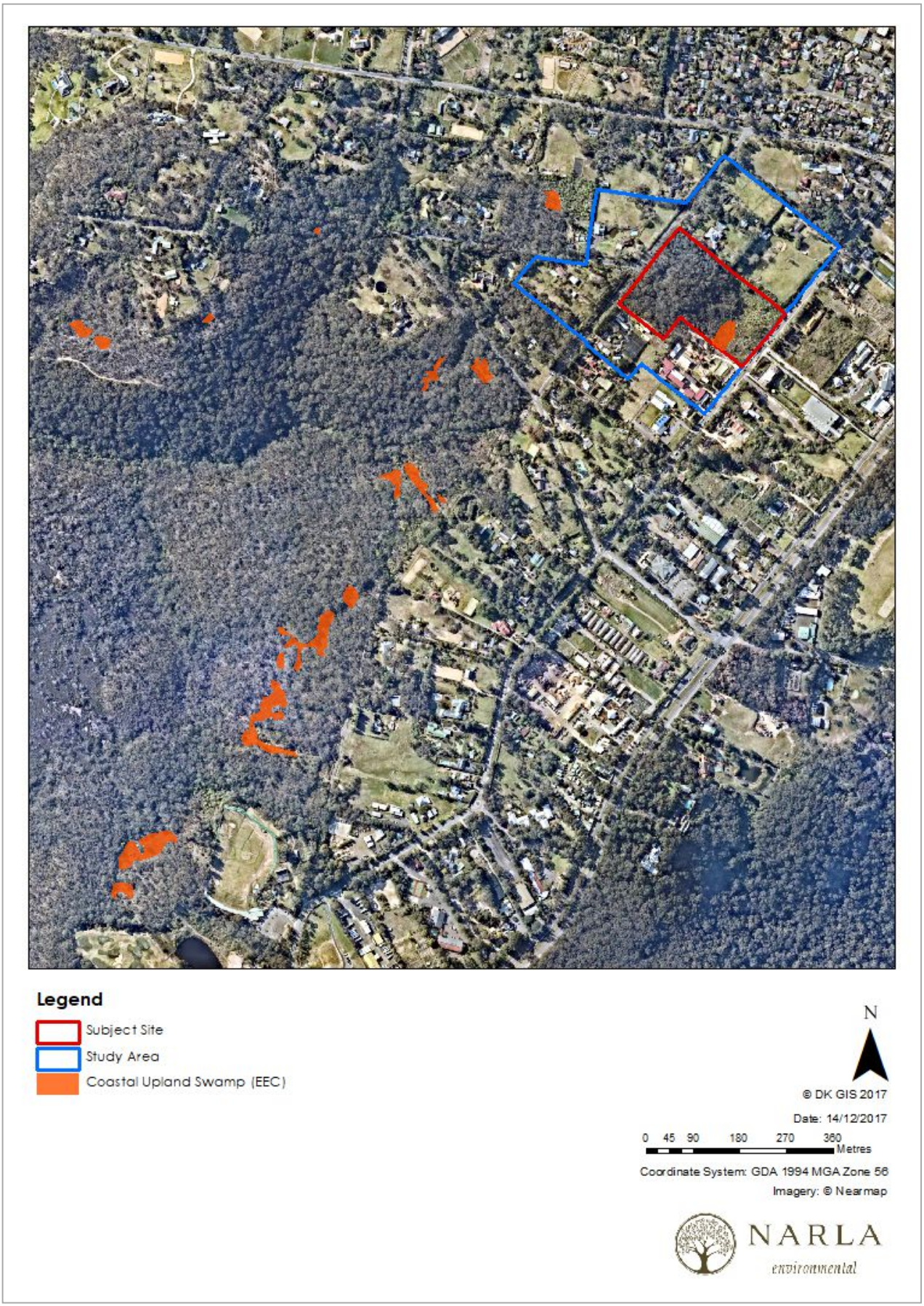


Figure 24. The local occurrence of Coastal Upland Swamp

Description of habitat in the locality / general area: Coastal Upland Swamp

A detailed map (**Figure 25**) and summary table of the Coastal Upland Swamp in the general area / locality (5-km radius of subject site) is presented **Table 34**.

The majority of Coastal Upland Swamp in the locality is protected in National Park estate.

Table 34. CUS sites within a 5-kilometre radius of the subject site

Land tenure	Habitat condition	Habitat area
Subject Site	Moderate-good	0.13
	poor-weedy	0.04
Private Land	moderate - good	2.324246087
	good	0.000276624
Crown Land	moderate - good	1.183822433
	good	134.4678921
	poor-weedy	0.412222138
Freehold	moderate - good	16.34358151
	average-good	0.117040419
	good	0.126112755
	poor-weedy	0.046058102
Garigal National Park	moderate-good	3.920261327
Ku-ring-gai Chase National Park	moderate-good	23.03118036
	moderate- good	13.1342052
Total		**195.8812463**

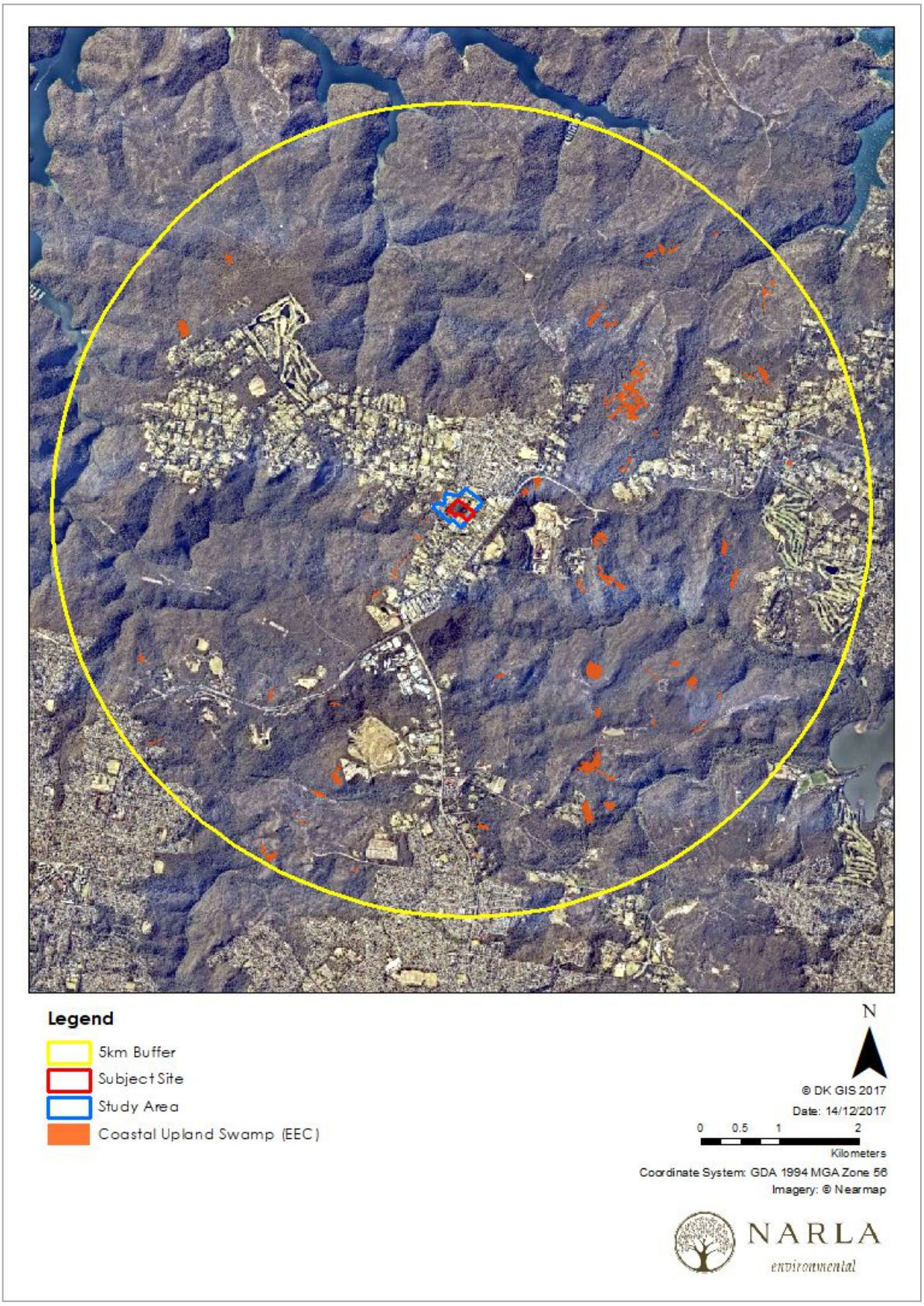


Figure 25. Extent of Coastal Upland Swamp in the General Area (5km)

6.3 Discussion of Conservation Status

Discussion of Conservation Status: Duffys Forest Ecological Community (DFEC)

Local and regional conservation status: Most of the known range of DFEC is within 10 kilometres radius of the subject site and is restricted to fragmented patches along ridge-lines mostly in Council reserves (bushland and recreational) or on NSW Government, private and crown lands. These patches are typically compromised by development (particularly road widening), ongoing impacts associated with small, fragmented ridge-top/roadside habitats and adverse fire regimes. Duffys Forest has been reduced to just 15% of its original extent.

State conservation status: Restricted to northern Sydney. Listed as an Endangered Ecological Community (EEC) under the TSC Act.

Representation within conservation reserves: Less than 8% of the original extent of DFEC occurs within conservation reserves (Garigal and Ku-ring-gai Chase National Parks) and a further 2.7% is protected in Council reserves or Trusts (NPWS 2004). These areas similarly comprise narrow, fragmented remnants adjacent to major roads. DFEC is not considered to be adequately represented in the conservation reserve system (NPWS 2004).

Geographical limits: DFEC within the study area is not at the geographical limits of the community.

Comparison with other local populations: DEFC within the subject site is isolated from other local populations, with some connectivity to adjoining native vegetation including Ku-ring-gai Chase National Park. Although the area of DFEC is small (1.57 ha) with a high edge: area ratio, species richness is comparable with other local populations and the area of DFEC is in relatively good condition with low levels of weed invasion within the core.

Key Threats: Ongoing habitat loss through clearing for urbanisation and road construction is the primary threat. Adverse fire regimes (too frequent or too infrequent), weed invasion and physical disturbance from vehicles, bikes, horses and people are also key threats.

- Many of the threats identified above are recognised as Key Threatening Processes (KTP) as listed under Schedule 3 of the TSC Act. The most relevant are listed below.
- Clearing and fragmentation of native vegetation resulting in loss of biodiversity as a result of loss and/or degradation of habitat
- High frequency fire resulting in the disruption of the life cycle processes in plants and animals and loss of vegetation structure and composition
- Invasion of native plant communities by exotic perennial grasses
- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of *Lantana camara.*

Discussion of Conservation Status: Coastal Upland Swamp

Local and regional conservation status: Coastal Upland Swamps in the Sydney Basin Bioregion occur on periodically waterlogged soils on the Hawkesbury sandstone plateaus, within the eastern Sydney Basin (OEH, 2012). In the south the community occurs on the Woronora plateau, in the north it occurs on the Somersby-Hornsby plateaus. The southern part of this distribution is separated from the north by an area of non-sandstone substrates, less rainfall and lower elevation, and by the urban development of Sydney. It is estimated that up to 10% of the historical extent of the community has been destroyed by clearing.

State conservation status: Listed as an Endangered Ecological Community (EEC) under the TSC Act.

Representation within conservation reserves: The scope for future habitat loss due to clearing is limited, as much of the remaining distribution is on public land managed by Sydney Catchment Authority and the National Parks and Wildlife Service. However, swamps within statutory conservation reserves generally have depth restrictions that do not preclude underground mining operations.

Geographical limits: Coastal Upland Swamp within the study area is not at the geographical limits of the community.

Comparison with other local populations: The small size of the Coastal Upland Swamp at the subject site (0.17 ha) is typical of the vegetation community, with approximately 42% of mapped swamps being less than 1 ha. The largest 5% of swamps (>14 ha) account for just under half of the total area of the community (NSW Scientific Committee 2012). Given the very specific set of variables (local climate, landform and substrate) required for Coastal Upland Swamps to exist and persist, all areas currently occupied are considered to be areas critical to the survival of the community (OEH, 2012).

Key Threats: The primary threats to Coastal Upland Swamp are fracturing and drainage of shallow groundwater aquifers as a result of land subsidence associated with longwall mining, and changes in climatic moisture and fire frequency and intensity associated with climate change. Physical disturbance from unauthorised access and land clearing are also key threats. Key threats relevant to the proposal are listed below:

- Clearing associated with infrastructure, quarries, surface facilities and recreational facilities
- Localised disturbance associated with unauthorised access by vehicles, trail bikes and horses.

A key threat to Coastal Upland Swamp at the subject site is significant encroachment by Pampas Grass, an exotic perennial grass growing in large tussocks to 4 metres high.

Many of the threats identified above are recognised as Key Threatening Processes (KTP) as listed under Schedule 3 of the TSC Act. The most relevant are listed below:

- Clearing and fragmentation of native vegetation resulting in loss of biodiversity as a result of loss and/or degradation of habitat
- High frequency fire resulting in the disruption of the life cycle processes in plants and animals and loss of vegetation structure and composition
- Invasion of native plant communities by exotic perennial grasses
- Anthropogenic climate change.

6.4 Discussion of the likely effect of the proposal at local and regional scales

6.4.1 Significance within a local context

Significance within a local context: Duffys Forest Ecological Community

The subject site contains approximately 1.57 hectares of DFEC located in the northern half of the site, including vegetation in good condition and highly disturbed. The extent of DFEC is mapped in **Figure 8**, all of which is considered part of the EEC as listed under the TSC Act.

The local occurrence of the community is larger with the closest mapped DFEC located 140 metres to the north-west of the subject site. The patch within the subject site is relatively small when compared to sizes of patches in Ku-ring-gai Chase and Garigal National Parks.

The proposal will require management of 0.34 hectares as an APZ. However, effort will be made to prevent significant effects from this APZ management upon the DFEC. Impacts will be avoided by ensuring that:

- prior to any APZ works commencement, a qualified Ecologist and Bushfire Consultant, must meet together in person on the subject site and:
    - traverse all proposed APZ areas (all IPA, OPA areas) on foot,
    - distinctly mark, number and photograph all trees, important feed shrubs / threatened and threatened or significant groundcovers that must be retained (i.e. because they

are threatened species, contain threatened species habitat or form an essential part of an EEC),
    - distinctly mark, number and photograph all shrubs that should be thinned for bushfire management purposes,
    - distinctly mark, number and photograph all trees/branches that should be lopped for bushfire management purposes.
- A detailed map and photograph of each tree and tall shrub removed is maintained by the Ecologist in an 'inventory-style' report that will be provided to the qualified Bush Regeneration Professional and Arborist commissioned to maintain the APZ areas.
- An Ecologist must undertake a pre-clearing assessment of the APZ for any newly emerged threatened flora, or fauna nests no more than 12 hours prior to any APZ works commencing. If APZ works pause for longer than two weeks, an Ecologist should re-assess the area prior to works recommencing.
- All works are only undertaken by Qualified Bush Regenerators, who are familiar with the longer term ecological impacts of works and areas where potential biodiversity gains can be sought.
- Tree canopy thinning is only undertaken to remove 'overlapping crowns'. Prioritising the removal of low health/safety rating although retain all hollow-bearing or habitat trees as determined by an Ecologist during a pre-clearing assessment. All tree lopping and tree removal should only be undertaken by a qualified Arborist.
- All living and dead trees containing hollows or similar habitat values are be retained in situ within the APZ areas and managed of fuel loads by select canopy and branch removal, rather than complete felling (e.g. trimming dead / non-flowering branches from *Banksia ericifolia*).
- Tree canopy thinning and tree removal should only be undertaken by a qualified Arborist. Where tree lopping or felling is required within an APZ area, all work is to be done by hand using chainsaws and pulleys. No heavy machinery is permitted for use within an APZ.
- All work on hollow-bearing trees or around threatened flora should be undertaken under the supervision of the Project Ecologist.
- The residual land outside of the APZs that will remain immediately surrounding the building are to be managed as per an IPA and landscaped following the principles within Appendix 5 of Planning for Bushfire Protection (RFS 2006).
- These areas will only be planted with locally indigenous flora including known Eastern Pygmy Possum feed trees and plants to densities that comply with the requirements of an IPA (Peterson Bushfire 2017; Carmichael Studios 2017).

In the unlikely event that, potential Pygmy Possum feed trees and tall shrubs removed from an APZ, they must be recorded by the project Ecologist (GPS and description) prior to removal. The total number of each species removed must be accurately calculated so that at least three new plants can be planted in replacement for each plant removed. The location of replacement planting will be determined by an Ecologist in conjunction with a Bushfire Planning Consultant and Landscape Architect (**Figure 19**). Planting densities must conform to the requirements of the relevant APZ the plants are planted in to. Planting outside of APZ areas is preferred. This activity will contribute to a net gain in foraging habitat for Eastern Pygmy Possum.

Significance within a local context: Coastal Upland Swamp

The subject site contains approximately 0.17 hectares of Coastal Upland Swamp, located in the south-west of the site, 0.12 hectares of which is in good condition, and 0.05 hectares of which is weed infested. The extent of Coastal Upland Swamp in the subject site / study area and condition states are mapped in Figure **7**, all of which is considered part of the EEC as listed under the TSC Act. The patch is small and isolated from other occurrences of this community in the locality, with the closest mapped Coastal Upland Swamp located 200 metres to the west of the subject site in Dundundra Falls Reserve.

6.4.2 Extent of habitat removal or modification

Significance within a local context: Duffys Forest Ecological Community

The proposal will require clearing of 0.28 hectares of the 1.57 hectares of Duffys Forest on the site (Narla 2017). Less than 16% of the original extent of DFEC remains (OEH 2012) with up to 6 hectares of DFEC recently cleared at Frenchs Forest for the Northern Beaches Hospital Project, and up to an additional 3.4 hectares to be cleared as part of the Mona Vale Road West Upgrade (SMEC 2015, SMEC 2017).

The proposed Inner Protection Area APZ will include 0.34 hectares of DFEC, which will require fuel load management through prioritisation of weed removal and selective thinning of native vegetation where required, including removing dead or senescing tree limbs, shrubs, dense groundcovers (particularly dry grasses) and vegetative litter (leaves, twigs and bark).

The topography of the subject site means that indirect impacts (eg. stormwater runoff) will be minimal, however there is potential for increased movement of weeds into the DFEC due to increased edge effects resulting from clearing of adjoining Sydney North Exposed Sandstone Woodland and Coastal Sandstone Mallee-Heath which are currently providing a buffer.

Vegetation and flora species richness within the subject site was diverse at the time of assessment (Narla Environmental 2017), however in the absence of natural burning regimes, much of the shrub vegetation was confirmed to be senescing as the site is near the end of a sustainable post-fire (pyric) successional event. The lack of disturbance (such as fire) to promote natural regeneration of dominant, obligate-seeders such as *Banksia ericifolia* can have serious and irreversible impacts to a heathland vegetation community and local populations of *Banksia ericifolia* (Bradstock and Myerscough 1981, Plucinski 2006). The decline of a dominant species as it reaches the end of its life cycle can result in a decrease in total biomass and a sharp increase in the proportion of dead aerial fuel (Plucinski 2006). This biomass build-up smothers the ground and shrub layers. This prevents regeneration of new seedlings and suppresses the soil seedbank. The vegetation community deteriorates and species richness and diversity declines. Over time, obligate seeders like *Banksia ericifolia* disappear from the landscape altogether as there is no, natural recruitment of new plants to replace the old, dead and dying trees.

This process was particularly evident in the proposed OPA areas of the subject site. In these areas, tall, dense shrubs (e.g. *Kunzea ambigua, Leptospermum spp., Hakea spp., Persoonia spp., Allocasuarina littoralis* have produced extensive leaf litter and their dense canopies were shading-the ground layer preventing effective germination of seedlings. Many individuals of these species were found to be senescing or deceased and fallen over. Since vegetation communities and these plants all require fire for effective, long-term reproduction (Bradstock and Myerscough 1981, Benson 1985, Plucinski 2006) the absence of fire or similar disturbances could contribute to long-term alteration or degradation of the vegetation and biodiversity of the subject site.

An analogous example where lack of fire has caused extensive native tree senescence, die back, and decline of floristic structure and species diversity is 'Peace Park' at Oxford Falls in the Warringah Ward of Northern Beaches LGA. Peace Park is located in a similar geological landscape to the subject site. The rear of Peace Park is dominated by similar native vegetation (Sydney North Exposed Sandstone Woodland), however the floristic diversity is low in Peace Park as there has been a considerable lapse in fire and/or other forms of processes to reduce the build-up of senescent vegetative material. The *Banksia ericifolia* and *Allocasuarina littoralis* canopy has grown tall, high in woody biomass and has senesced *en masse*. As a result, the ground and low shrub layer has been smothered and there is little to no recruitment of native shrubs and groundcovers (**Plate 14**). Approximately half of the native vegetation has been replaced with the noxious weed, *Lantana camara* and *Banksia ericifolia* is becoming increasingly rare in the reserve. The author attended this reserve for an unrelated event in August 2017 and found no regenerating *Banksia ericifolia*. There are likely to be extensive examples such as this throughout the Northern Beaches LGA where a lack of management of dead, dry biomass and weed build-up (through fire, or mechanical means) has caused dramatic declines in floristic biodiversity.

Plate 14. Senescence in midstorey layer at Peace Park Oxford Falls caused by lack of fire or mechanical management. This build up of debris has prevented germination and recruitment of new trees and has lead to the demise of *Banksia ericifolia* on the site.

The management of the APZ areas on the subject site has the potential to improve flora and fauna species richness in the DFEC across the subject site, by providing a mode which allows near-natural rates of regeneration among key canopy, shrub and ground cover flora species, which would ordinarily only result from wild fire. By removing excessive build-up of leaf litter and reducing competitive pressures through thinning of older shrubs that are reaching the end of their natural life-cycle, germination of the native seed bank can be promoted.

Ecological burns are the optimal method to enhance natural regeneration in many cases, however, where burns are considered too high risk or difficult to plan for and implement, the undertaking of mechanical APZ management can provide similar benefits and is easier to achieve. An illustrated example of how mechanical APZ management will benefit vegetation on the subject site is provided (**Figure 26**).

Figure 26.Detailed diagram of how the APZ areas will be managed of fuels while retaining important fauna habitat, particularly Eastern Pygmy Possum Feed plants and hollow limbs.

Table 35. Extent of Duffys Forest Removal and / or Modification

Total area of DFEC within Subject Site	Extent of DFEC in Proposed Conservation Area	Extent of DFEC in existing s.88b APZ easement (includes tanker track)	Extent of DFEC to be modified as APZ for the proposed Hospital Development
1.57 ha	0.95 ha	0.28 ha in s.88b easement 0.01 ha to remove for the RFS tanker track.	0.34 ha
DFEC in local occurrence Mapped by OEH (2016)	**Additional DFEC in local occurrence as Mapped and confirmed by Narla (2017)**	**DFEC in Warringah LGA (Smith and Smith 2009)**	**DFEC in 5-kilometre radius of subject site**
51.59 ha	8.38 ha	184 ha	315 ha
Total: 59.97 ha			
% of DFEC in local occurrence to be cleared for RFS tanker track	**% of DFEC in local occurrence to be modified as an APZ**	**% of DFEC in Warringah LGA to be cleared/modified**	**% of DFEC in 5-kilometre radius to be cleared/modified**
0.02 %	0.57 %	0.19 %	0.11%

Coastal Upland Swamp

No Coastal Upland Swamp will be directly cleared as part of the proposal, however there is potential that alterations to hydrogeological processes as a result of the proposal may impact on the Coastal Upland Swamp on the subject site.

In the event that the proposed development caused an adverse impact to Coastal Upland Swamp within the subject site, the loss of total extent (0.17 ha) would constitute a loss of:

- 0.003% of the total current extent of this community in existence (5,360 ha) (NSW Scientific Committee 2012)
- 0.3% of the total occurrence of this community in the former Warringah Local Government Area (56.41 ha) (Smith and Smith 2009; Narla 2017).
- 12% of the local occurrence (the area between Cooyong Road and Dundundra Falls Reserve, including the subject site) in Terrey Hills.

Coastal Upland Swamp in the Sydney Basin Bioregion was only declared as an EEC in 2012. This listing occurred two years after a bushfire management Asset Protection Zone (APZ) easement was declared through the Subject site in accordance with section 88b of the *Conveyancing Act 1919*. Over 76% of the occurrence of Coastal Upland Swamp (1270 m²) on the Subject site is located within this APZ easement (**Figure 21**). This requires the vegetation to be managed for the purpose of an APZ. This previously established APZ easement that was registered under section 88b of the *Conveyancing Act 1919*, occupies the south-western portion of the subject site, and overlays the majority of the Coastal Upland Swamp endangered ecological community extent 0.13 ha (over 76%). The section 88B easement was registered on 04/02/2010 whereas the '*Coastal Upland Swamp in the Sydney Basin Bioregion*' was only gazetted as an endangered ecological community (EEC):

- under the *Threatened Species Conservation Act 1995* on 09/03/2012, and
- under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* on 17 Jul 2014.

This means that since 2010, an area of 76% of the Coastal Upland Swamp EEC has been legally required (pursuant under section 88B of the *Conveyancing Act 1919)* to be managed as an APZ through slashing, independently of the proposed development. This area is therefore compromised and reduced in its assessable extent. The only portion that is not legally compromised by the section 88b APZ easement is

the remaining 0.04 ha that occurs on the subject site, outside the easement. This 0.04 ha has been assessed of impact under this SIS.

Considering that the majority of the Coastal Upland Swamp was already impacted by the s88b easement, the impacts to be assessed under this SIS are restricted to the impacts to the small portion of Coastal Upland Swamp that protrudes outside of this easement (0.043ha). This would constitute a loss of:

- 0.00074% of the total current extent of this community in existence (5,360 ha) (NSW Scientific Committee 2012)
- 0.078% of the total occurrence of this community in the former Warringah Local Government Area (56.41 ha) (Smith and Smith 2009; Narla 2017).
- 3% of the local occurrence (the area between Cooyong Road and Dundundra Falls Reserve) in Terrey Hills

Vegetation will be slashed in the 'defendable space' (10m from the hospital building wall) in order to protect hospital inhabitants from bushfire hazards associated with the Coastal Upland Swamp vegetation. It is unlikely that this slashing will significantly affect biodiversity of that part of the Coastal Upland Swamp as:

- slashing will take place at times from the majority of the swamp sedges and herbs are not in flower floristic diversity will remain the same
- slashing will focus on removal of dense weed growth as a priority over natives
- only the minimal slashing permitted to maintain the site as 'defendable space' will be undertaken.

6.4.3 Discussion of connectivity

Duffys Forest Ecological Community (DFEC)

Duffys Forest at the subject site is already fragmented by Myoora Road and Larool Road, side roads and some residential or rural development. The proposal will decrease the size of the remnant patch of DFEC by 18%, as 0.28 hectares of DFEC of 1.57 hectares will be cleared. Due to the level of existing fragmentation, the proposed development will not further exacerbate habitat fragmentation or decrease the movement of individual organisms and gene flow. The pollination and dispersal mechanisms that are known to operate in dry sclerophyll forests such as DFEC (insects and birds eg. honeyeater) are highly mobile, and are not likely to be further impacted beyond existing impacts from current fragmentation. Although clearing of Coastal Sandstone Heath-Mallee and Sydney North Exposed Sandstone Woodland will increase edge effects on DFEC, it is considered likely that if left in its current state, the large weed infestation in the south-east of the site may further encroach into native vegetation, including into DFEC, increasing the threat to the viability of this EEC.

Coastal Upland Swamp

Coastal Upland Swamp occurs in isolated patches due to the specific set of variables required (local climate, landform and substrate), however connectivity with surrounding bushland is vital for the movement of individual organisms and gene flow. Construction of hospital buildings and the RFS tanker track will increase fragmentation of surrounding bushland on the subject site, however connectivity of Coastal Upland Swamp to the adjacent Coastal Sandstone Heath-Mallee and Sydney North Exposed Sandstone Woodland will be maintained. Indirect impacts on the Coastal Upland Swamp, including increased runoff and shading from hospital buildings and slashing during management of the proposed Defendable Space, may exacerbate edge effects and potentially reduce the size of the patch.

6.4.4 Consideration of threatening processes

Duffys Forest Ecological Community (DFEC)

Ongoing habitat loss through clearing for urbanisation and road construction is the primary known threat to DFEC. Clearing and fragmentation of native vegetation resulting in loss of biodiversity as a result of loss and/or degradation of habitat is a Key Threatening Processes as listed under Schedule 3 of the TSC Act. The proposed activity will increase this KTP, as 0.28 ha of DFEC will be cleared. Adverse fire regimes (too frequent or too infrequent), weed invasion and physical disturbance from vehicles, bikes, horses and people are also key threats to the EEC. The current level of threat from these sources is likely to be maintained or marginally increased by the proposed construction works.

Coastal Upland Swamp

Habitat loss through clearing, localised disturbance, weed invasion and changes to drainage are the primary threats to Coastal Upland Swamp in the local area. No Coastal Upland Swamp will be cleared at the subject site; however, the proposed development has the potential to alter the hydrogeology of the subject site. The proposed construction and associated excavation will be located in close proximity to the Coastal Upland Swamp and may alter the underground flows of water across the subject site (Martens 2017a). There is potential that alterations to hydrogeological processes may impact on the Coastal Upland Swamp EEC on the subject site.

It is difficult to accurately anticipate the impacts of the development on the patch of Coastal Upland Swamp EEC on the subject site, owing to the complexity of its dependencies on particular geological attributes, hydrological processes, rainfall and climatic variation (NSW Scientific Committee 2012).

Direct Clearing

No Coastal Upland Swamp will be cleared for construction at the subject site.

Slashing

The proposed 'Defendable Space' between the building and the Coastal Upland Swamp will require slashing of 0.01 hectares of good condition Coastal Upland Swamp and 0.01 hectares of weed infested Coastal Upland Swamp. It is not expected slashing will affect the Coastal Upland Swamp assemblage, other than keeping the sedges to a low level. This is because slashing will only take place after the conclusion of the main flowering period for sedges and herbs (spring). Slashing will also focus on removing the fire hazard associated with senescent shrubs and weeds, rather than native Coastal Upland Swamp sedges and herbs.

Alterations to the Ground Water Table

The proposed building construction will block the natural, intermittent flow of ground water into the coastal upland swamp and may cause:

- Reduced area for water infiltration
- Altered rate of ground water recharge or retention
- Altered course of surface or subterranean water movement across the subject site
- Altered stormwater flow velocity
- Altered surface or subterranean water chemistry.

The groundwater table that feeds the Coastal Upland Swamp is highly intermittent and fed solely by recent rainfall. In times when rainfall is scarce, the groundwater table remains dry and does not contribute water to the Coastal Upland Swamp. This does not seem to have a deleterious effect, and it is therefore understood that the Coastal Upland Swamp can survive without access to the groundwater table for multiple months of the year.

Nonetheless, the proponent will ensure groundwater flows are maintained to the Coastal Upland Swamp by diverting the groundwater water around the underground carpark and into the Coastal Upland Swamp. The mechanism for this diversion has been proposed by Martens (2017).

Shading

The proposed hospital building may also increase shading for part of the day. It is not expected that this shading will significantly affect the Coastal Upland Swamp vegetation. The Coastal Upland Swamp already experiences shading for pat of the day from the existing sandstone escarpment and this has not adversely affected the community.

Indirect Impacts

Other potential indirect impacts to Coastal Upland Swamp include movement of stormwater, sediment and weeds from the construction zone into the Coastal Upland Swamp. These issues will all be avoided through implementation of the ameliorative measures (Table 36).

6.5 Description of feasible alternatives

See **Section 5.6.**

7. Ameliorative measures

7.1 Description of ameliorative measures

A range of ameliorative measures presented below in **Table 36** will be implemented during preconstruction, construction and post construction phases of the proposed Hospital Development. Many of these ameliorative measures will be implemented for the lifetime of the tenure. These measures have been developed to mitigate the potential impacts of the proposal on subject species.

This section is intended to be read with the associated BMP (Narla 2017a) prepared for the subject site.

Where there are any discrepancies between this SIS report and the BMP, the recommendations in this SIS should prevail and be implemented.

Table 36. Ameliorative and mitigation measures listed in the accompanying BMP (Narla 2017)

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
Threatened Species/EECs	**Construction Footprint**	**-**	Proposed hospital to be located in the area of least impact for threatened species and endangered ecological communities within the subject site	Undertaken
Threatened Species/EECs	**Construction Footprint**	**Unauthorised pedestrian or vehicle access**	**Fencing** All habitat areas that are retained, particularly areas containing the Duffy's Forest Ecological Community, Coastal Upland Swamp and Grevillea caleyi to be fenced off prior to beginning any vegetation removal, exaction or construction, to prevent any accidental disturbance to these areas. Process as follows: Fencing and signage should be delineated by a qualified surveyor; Ensure exclusion zones are well established prior to any vegetation clearance; The Project Ecologist must delineate the boundaries of each area to identify the locations for fence installation, unless associated with the proposed hospital footprint; No trees, shrubs or fauna habitat is to be removed or modified for the purpose of fence construction. The Ecologist will attend site to undertake a micro siting survey of the trajectory of all fences during a pre-clearing assessment to ensure the fence construction process does not impact on any fauna or habitat; 'Fauna friendly' fencing designs must be used that do not cause wildlife injury, or mortality or impediment to the movement of wildlife across the subject site. No barbed wire, razor wire, or electric fencing is permitted; APZ areas of the subject site (outside of the construction footprint) should be made off limits to public access in order to reduce the potential for injury to persons from falling trees or branches; and All rock outcrop areas to be clearly delineated to prevent accidental impact during the clearing or construction process.	High
Threatened Species/EECs	**Construction Footprint**	**Unauthorised pedestrian or vehicle access**	**Signage** 'All weather' signage is to be installed along fencing, near points of access to all EEC and threatened species areas to help inform members of the community of the biodiversity values of the site, along with the efforts undertaken to protect and enhance them: Signage will not require any vegetation removal in order to install; Signage to be installed where access is no permitted into any 'biodiversity protection area' on the subject site (e.g. EEC or threatened species areas); Signage should contain a list of activities that are not permitted within the exclusion zone along with contact details of the relevant site manager.	Low
Threatened Species/EECs	**Construction Footprint**	**Accidental killing of trees marked for retention**	**Tree Protections** Trees selected for retention and located within or in the direct vicinity of the proposed work areas must be protected with established tree protection zones (TPZ) including root protection zones prior to commencement of any works. Each TPZ will be bound by portable fencing or an equivalent as recommended by the Arborist Assessment (Urban Arbor 2017); No vehicle movement, excavation, stockpiling or storage is to take place within a TPZ; The removal or canopy thinning of any mature tree on site, including looping and/or felling of any trees required for the progression of the proposed works must be undertaken only after assessment by a qualified Arborist. The extent of safe thinning should be determined by a Consulting Arborist before the thinning takes place so as to prevent accidental harming or killing each tree; and Prior to any vegetation clearing that takes place on the subject site for construction of buildings/ancillary structures or bushfire management requirements, The Project Ecologist must undertake a pre-clearing assessment and distinctly mark all habitat trees proposed for removal. All habitat trees and shrubs required to be retained (e.g. within APZ Areas) will be distinctly marked by the Project Ecologist. The locations of all detailed habitat features will be stored in a database managed by the Project ecologist on behalf of the client (Narla 2017a).	High

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
Threatened Species/EECs	**Construction Footprint**	**Death of plants or loss of microhabitat marked for protection**	**Salvage and translocation** Prior to clearing works in the proposed building footprint, the Project Ecologist and Landscape Architect may survey the area to identify shrubs and trees that could be used in landscaping works elsewhere on the subject site. Salvaged plants may include more expensive and sought-after plants including mature *Xanthorea spp*., *Banksia spp.*, and ferns. No salvaged plants can be taken off site, unless they are to be returned to back to site on a later date. Any plants taken off site must be stored in an experienced native plant nursery and cared for accordingly before being translocated by qualified Bushland Restoration professionals. No salvaged plants may be sold or given to any third party Salvaged plants may be used in landscaping of the subject site. Plant salvage can only be undertaken in areas that are proposed for clearing (where the vegetation is proposed to be destroyed). Topsoil translocation could be investigated and undertaken under the guidance of qualified and experienced bush regenerators.	High
Threatened Species/EECs	**Construction Footprint**	**Sediment Runoff and Accumulation. Smothering of trees / vegetation marked for protection.**	**Stockpiles and laydown areas** Stockpiles and laydown areas will be confined to areas within the development footprint or within cleared/weed infested areas in the south of the site. Stockpiles and site compounds must never be located within a mapped tree protection zone (as determined by a qualified Arborist). This includes anywhere within the canopy 'drip zone' **Erosion and Sediment Control General** All construction areas must be fenced-off and prepared in accordance with the erosion and sedimentation control methods outlined in 'the Blue Book' (Landcom 2004).	High
Threatened Species/EECs	**-**	**Edge-effects or weed spread**	Hand removal of top growth and digging up of roots - this method may be suitable for small and isolated infestations; Mechanical grubbing and scalping - this method can be successful if the hoe or root rake completely removes the plant, including all roots; and Using earthmoving equipment or slashing - this method is unlikely to remove root material and may even promote long-term growth. It is useful to gain initial access to heavy infestations for further treatments. To reduce rick of inadvertent harm to native vegetation, the use of herbicides of weed control should be minimised. Of particular sensitivity are threatened flora and sensitive floristic elements of the Coastal Upland Swamp and Duffys Forest Ecological Community. For this reason, the use of chemicals such as Glyphosate (e.g. Roundup Biactive) should not be utilised within close proximity to these areas, unless necessary (such as to control blackberry) in which case only direct application methods such as scrape and paint should be used.	Very High
Threatened Species/EECs	**Construction Footprint**	**Edge-effects or weed spread**	**Weed Management** Weed management to begin immediately upon approval of DA, subject to DA approval as per the requirements of BMP (Narla 2017). It is a long-term aim of the BMP to ensure all Priority weeds are completely removed from the subject property, and prevented from re-establishing; All weed removal, bushland restoration, and landscape planting works carried out within the subject site must be undertaken by qualified Bushland Restoration Professionals, with experience working in areas that support either Duffys Forest Ecological Community or Coastal Upland Swamp and locally occurring threatened flora species; All Bushland Restoration Professional to have the ability to identify any additional threatened flora which may emerge during the weed management works; and Weed management to be undertaken within all of the weed infested portions of the remnant vegetation communities that remain on the subject site. One of the primary objectives of the BMP (Narla Environmental 2017a) is to manage all weed infestations in order to restore all native vegetation on the subject site back to remnant, pristine condition. Blackberry and Pampas Grass are considered among the most significant Noxious Weeds on the subject site. This is owing to their noxious class, and the difficulty in the achieving successful eradication. It is recommended that the following physical removal methods be used in combination with herbicide use (DPI 2017).	Very High

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
			Landscaping Within the proposed hospital footprint; All plantings are to be locally-indigenous, native flora reflective of the native vegetation communities of the subject site (Carmichael Studios 2017). No exotic or non-native flora are to be planted anywhere on the subject site, at any time. Surrounding the proposed hospital footprint inclusive of all existing weed infested areas: Following weed management works, these areas are to be revegetated with locally-indigenous species, particularly Eastern Pygmy-Possum feed plants (especially Banksia ericifolia) In the event any feed trees are removed from the construction area, or the unlikely event any feed trees are removed from an APZ, all feed trees will be replaced with local provenance stock elsewhere on the subject to a ratio of three new plants for every plant removed from the subject site. This replacement will take place or the lifetime of the tenure. It is considered that the proposed landscaping will provide a net biodiversity gain across the subject site.	
Threatened Species/EECs	-	**Reinfestation of weeds from adjoining properties**	**Weed Management** The properties located to the north of the subject site are both heavily altered landscapes typical of semi-rural acreage blocks in the Terrey Hills area. The property located adjacent to the north-eastern corner of the subject site (Lot 2 DP 517786) contains a dense infestation of noxious, woody weeds along its border. This weed infestation is up to 25 metres wide and spans onto the subject site. The area of weed infestation on the subject site that adjoins Lot 2 DP 517786 will be completely removed and revegetated with locally indigenous native flora tolerant of the environmental conditions of that part of the subject site (post development completion) as defined in the Landscape Plan (Carmichael Studios 2017). Owing to the dense and extensive growth of the weeds, primary weed removal may take place through the use of a tritter, however this must be followed up with extensive secondary weed control by qualified Bush Regenerators. Prior to weed removal, an Ecologist will search the area for any hidden threatened flora (e.g. *Grevillea caleyi*) or significant fauna habitat (e.g. *Banksia ericifolia;* or hollow-bearing trees) and mark these features for retention and protection. These items will be fenced off with temporary wire fencing (supported on stakes) prior to weed removal.	Moderate
Threatened Species/EECs	-	**Bushfire Asset Protection Zones**	**Design/Calculation of Asset Protection Zones** The Bushfire Hazard Assessment (Peterson Bushfire 2017) proposes an APZ consisting of two Outer Protection Areas (OPA) across two areas of non-threatened native vegetation communities, and an Inner Protection Area (IPA) extending 50 m, upslope of the proposed hospital footprint: Creating the two OPAs will reduce the bushfire hazard on the subject site below 1 hectare and limit the potential for fire spread from bushland located within the subject land from impacting on adjacent properties and assets in accordance with *Section 63 of the Rural Fires Act 1997;* This method will also reduce the impact upon the DFEC, by allowing the greatest extent of this EEC to be retained whilst meeting Planning for Bushfire Protection guidelines (RFS 2006).	Commenced

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
Threatened Species/EECs		**Bushfire Asset Protection Zones**	**Asset Protection Zone Management** Prior to any APZ works commencement, a qualified Ecologist and Bushfire Consultant, must meet together in person on the subject site and: traverse all proposed APZ areas (all IPA, OPA areas) on foot; distinctly mark, number and photograph all trees, important feed shrubs / threatened and threatened or significant groundcovers that must be retained (i.e. because they are threatened species, contain threatened species habitat or form an essential part of an EEC); distinctly mark, number and photograph all shrubs that should be thinned for bushfire management purposes; distinctly mark, number and photograph all trees/branches that should be lopped for bushfire management purposes. Heath-leaved Banksia, Red Bloodwood, *Lambertia formosa* and other *Banksia spp*. shrubs/trees are important foraging habitat for Eastern Pygmy Possum and should be retained. Only dead/dying shrubs and/or trees with low SULE rating (as determined by an Arborist) are permitted to be removed. All potential Pygmy Possum feed trees and tall shrubs removed from an APZ must be recorded by the project Ecologist (GPS and description) prior to removal. The total number of each species removed must be accurately calculated so that at least three new plants can be planted in replacement for each plant removed. The location of replacement planting will be determined by an Ecologist in conjunction with a Bushfire Planning Consultant and Landscape Architect. Planting densities must conform to the requirements of the relevant APZ the plants are planted in to. Planting outside of APZ areas is preferred. This activity will contribute to a net gain in foraging habitat for Eastern Pygmy Possum. An Ecologist must undertake a pre-clearing assessment of the APZ for any newly emerged threatened flora, or fauna nests no more than 12 hours prior to any APZ works commencing. If APZ works pause for longer than two weeks, an Ecologist should re-assess the area prior to works recommencing. Regardless of the method chosen for APZ management (either using ecological burns or mechanical removal of fuel), works must be undertaken by Qualified Bush Regenerators, who are familiar with the longer term ecological impacts of works and areas where potential biodiversity gains can be sought. No alteration or removal of any threatened plant is permitted. A buffer of at least10 metres of native vegetation must be maintained around any threatened flora found. Due to the presence of the Caley's Grevillea on site, any APZ works undertaken within a 10m proximity of known specimens must first be undertaken in consultation with the relevant OEH Species Protection Officer. Tree canopy thinning is required to remove 'overlapping crowns'. Prioritize the removal of low health/safety rating (Urban Arbor 2017) although retain all hollow-bearing or habitat trees as determined by an Ecologist during a pre-clearing assessment. All tree lopping and tree removal should only be undertaken by a qualified Arborist. The residual land outside of the APZs that will remain immediately surrounding the building are to be managed as per an IPA and landscaped following the principles within Appendix 5 of Planning for Bushfire Protection (RFS 2006). These areas will only be planted with locally indigenous flora including known Eastern Pygmy Possum feed trees and plants to densities that comply with the requirements of an IPA (Peterson Bushfire 2017; Carmichael Studios 2017). APZ management will be delivered by qualified and experienced Bushland Restoration Professionals, however, if and when any tree lopping is required, qualified and experienced Arborists will deliver such works. All APZ vegetation management works will only be undertaken under close supervision/guidance of experienced and qualified Ecologists; The boundaries of all APZ areas are to be clearly marked out with bunting prior to any APZ management activities taking place; No hollow tree-limbs suitable for vertebrate fauna shelter will be removed; Tree limb removal will be limited to the minimum required to meet the requirements of an APZ;	Very High

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
			Tree canopies lopping to reduce continuous canopy cover, will only be undertaken by Qualified Arborists using chainsaws and pulleys. No machinery is permitted within an APZ. Experienced Bushland Restoration Professionals to prioritise removal of all weeds to reduce fuel loads across APZ areas; All conservation significant plants to remain *in situ*; *Banksia ericifolia* and Red Bloodwood (foraging habitat for Eastern Pygmy Possum) will be retained as a priority; To reduce any fuel associated with potential Eastern Pygmy Possum feed trees and shrubs (especially *Banksia ericifolia* and Red Bloodwood), only select trimming of dead/dying limbs will take place. As much as possible, select limb removal will be undertaken over whole plant removals. If any such plants require removal, they will be replaced with at least three new plants (of the same species) elsewhere on the subject site as determined by the Landscape Plan (Carmichael Studios 2017) No APZ management works or vegetation clearing for construction purposes is permitted to remove any RoTAP flora or threatened flora without additional Ecological Assessment.	
Threatened Species/EECs		**Bushfire Asset Protection Zones**	**Fire Tanker Access** Tracks for access by fire management personnel are considered to be one of the intended uses of the s.88b easement and therefore the construction of a 4m wide fire tanker track entirely within this APZ easement is supported by the tenure of this easement. Nonetheless, the track has been carefully designed under the guidance of an Ecologist, Arborist and Landscape Architect in order to minimise impacts to vegetation, with a focus on reduced removal of trees or impacts to EEC. An Ecologist will be on site to supervise all tree clearing associated with this tanker track.	High
Eastern Pygmy Possum	**Loss of Eastern Pygmy Possum feed plants from Construction footprint**	**Accidental loss of Eastern Pygmy Possum feed plants from APZ**	**Important Feed Plants** A minimum total of 1,180 and a maximum total of 3,120 *Banksia ericifolia* will be planted within the site as per the Landscape Plan (Carmichael Studios 2017). These plants will contribute to a long-term overall increase of *Banksia ericifolia* on the subject site. These plants will be placed in direct connection with the retained bushland in order to provide foraging habitat for Eastern Pygmy Possum. If any of the following feed trees and tall shrubs are to be removed from anywhere on the subject site at any time (including as part of construction, ancillary or APZ works) each individual plant will be assigned an ID number and marked with flagging tape and/or spray paint. Heath-leaved Banksia (Banksia ericifolia) Old man Banksia (Banksia serrata) Hairpin Banksia (Banksia spinulosa) Swamp Banksia (Banksia paludosa) Fern-leaf Banksia (Banksia marginata) Fern-leaved Banksia (Banksia oblongifolia) Mountain Devil (Lambertia formosa) Red Bloodwood (Corymbia gummifera) Dwarf Apple (Angophora hispida) Angophora crassifolia The final number of habitat trees lost from the construction footprint to be replaced will be determined by The Project Ecologist during a pre-clearing assessment of the subject site. This will take place prior to any construction, APZ and ancillary works taking place. These replacement plants will be included in the proposed landscaping or planted elsewhere on the subject site within remnant vegetation. Suitable locations for planting will be determined by the Project Ecologist, however they will include: Planting directly into bushland to replace weeds removed	Moderate

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
			Planting at densities compliance with IPA and OPA APZ directly within bushland (i.e. clumps with 2 metre spacing between and not beneath tree canopies).	
Eastern Pygmy Possum	**-**	**Loss of habitat connectivity across Larool Road**	**Connectivity** Bushland connectivity exists between the subject site and surrounding bushland along / connected to Larool Road Connectivity for fauna movement, particularly small arboreal mammals such as Eastern Pygmy Possum and Sugar Glider could be improved through (where possible) by: allowing natural tree canopy to overarch the road installing one or more custom-designed fauna crossings that overarch the road (Figure 19). Enhancing the cover and density of known threatened fauna feed plants, particularly *Banksia ericifolia,* along the nature strip the entirety (both sides) of Larool road downslope from the northern corner of the subject site (Figure 19).	
Eastern Pygmy Possum	**-**	**Introduced Pests**	**Fox Control** Control foxes on the subject site as often as is required using wherever permitted 1080 baiting, shooting and/or trapping If trapped foxes are euthanised their stomach contents should be analysed to assess prey items with a focus on trying to find evidence of Eastern Pygmy Possum consumption. **Cat Control** Traps stray cats wandering the CA and surrounding bushland as often as is required using designated, baited cat traps and take to the nearest vet for rehoming or dispatch. If feral cats are euthanised their stomach contents should be analysed to assess prey items with a focus on trying to find evidence of Eastern Pygmy Possum consumption.	Moderate
Threatened flora (*Grevillea caleyi)*	**-**	**Construction footprint and APZ (Marginal indirect impact)**	**Ecological Burn** The recovery plan for Caley's Grevillea (DEC 2004a) identifies fire as a significant influence on successful germination of the seedbank and recruitment of new plants. All of the native vegetation communities and threatened species found on the subject site are considered likely to benefit from a well-timed ecological burn. At the time of preparing this report, the native vegetation of the subject site was in a late successional stage. This was evident by the large number of tall, dense mature *Banksia ericifolia, Allocasuarina littoralis, Kunzea ambigua, Leptospermum spp., Persoonia linearis etc.* that had fallen over dead. it is recommended that an Ecologist is assigned to research the most optimal time to undertake the burn in order to maximise regeneration of fire-dependent flora, including *Banksia spp*. and *Grevillea spp;* any burn program should be undertaken through controlled patchwork burning of vegetation within the subject site at intervals no more frequently than every 9 -12 years. It takes up to 8 years for *Banksia ericifolia* to flower after a fire event (Benson1985). However, intervals over 20 years post fire are considered to be too long to maintain floristically diverse and healthy shrub communities (Benson 1985). Ecological burns should only be explored if the local RFS is willing to approve and help facilitate the burn effort.	Low (Subject to approvals e.g. RFS)
Threatened flora (*Grevillea caleyi)*	**-**	**Construction footprint and APZ (Marginal indirect impact)**	**Fencing** The whole Conservation are awill be fenced-off. Each cluster of Grevillea claeyi will be delineated with a chain attached to star pickets or rope allowing 10 metres of 'buffer' vegetation around each cluster of plants, unless where constrained by property boundaries or similar.	Moderate
Threatened flora (*Grevillea caleyi)*	**-**	**Construction footprint and APZ (Marginal indirect impact)**	**Monitoring** *Grevillea caleyi* populations are to be monitored pre, during and post construction to establish baseline habitat conditions, ensure habitats are being maintained and exclusion zones are being adhered to during construction as well as to determine any changes to population size and extent. Following approval, an annual monitoring program of the two *G. caleyi* shall be prepared (in consultation with an appropriately qualified specialist) and implemented for a duration of at least three years post construction. Monitoring would be undertaken by a suitably qualified botanist. All monitoring data should be supplied to Northern Beaches Council and/or the Office of Environment and Heritage.	High

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
			Data collected would include: Number of plants (seedlings, saplings, adults); number of flowers on each plant; associate plant species (native and exotic), including plant heights and densities; overall plant health and vigour; disturbance. The monitoring program shall include a reporting requirement and shall trigger management actions where appropriate. All individual threatened plants on the subject site should be regularly counted and monitored by a qualified Ecologist and the results should be summarised in an Annual Monitoring Report. A more detailed Threatened Species Management Plan may be developed to ensure long-term protection and enhancement of occurrences of threatened plants on the subject site.	
Duffy's Forest – endangered ecological community	-	**Construction Footprint**	Monitor the Duffys Forest EEC pre, during and post construction to establish baseline habitat conditions, ensure habitats are being maintained and exclusion zones are being adhered to during construction as well as to determine any changes to population size and extent. Following approval, an annual monitoring program Duffys Forest endangered ecological community shall be prepared (in consultation with an appropriately qualified specialist) and implemented for a duration of at least three years post construction. Monitoring would be undertaken by a suitably qualified botanist. Data collected would include: Number of plants (seedlings, saplings, adults); plant species (native and exotic), including plant heights and densities; overall plant health and vigour; and disturbance. The monitoring program shall include a reporting requirement and shall trigger management actions where appropriate (based on threshold criteria to be developed).	High
Duffy's Forest – endangered ecological community **Cayleys Grevillea**	-	**Construction Footprint**	Implementing a Conservation Agreement (See Section 7.1.1)	Very High
Coastal Upland Swamp	-	**Changes to surface water absorption from surface construction**	**Maintaining Natural Surface Water and Rain Water Percolation** The following broad measures will be implemented to mitigate the impact of the proposed development on subject site hydrology: Construction of all adjacent pathways using permeable, 'floating' fibre-reinforced plastic or similar grate design rather than paving Installation of native gardens in suitable areas on and around the proposed buildings which will assist with water absorption Implementation of Onsite Stormwater Detention System (OSD) planted entirely with plant species representative of Coastal Upland Swamp EEC. Test the water chemistry of the OSD prior to release events. Design and construct OSD in a manner that permits water \overflow and recharge Coastal Upland Swamp after rainfall events. All existing and proposed watercourses that traverse the subject site will be re-engineered to maximize surface water intake while maintaining a natural a geomorphological structure and flora assemblage. This is detailed further in the WIS (Narla Environmental 2017b), the Hydrogeological Report (Martens 2017a) the Storm Water Management report (Martens 2017b) and the Landscape Plan (Carmichael Studios 2017).	High

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
			Effort will be taken to increase the extent of Coastal Upland Swamp flora in the areas surrounding the proposed OSD systems through the planting of local provenance native moisture-loving flora species diagnostic of the Coastal Upland Swamp of the Sydney Basin Bioregion EEC (Carmichael Studios 2017; Martens 2017a; 2017b).	
Coastal Upland Swamp	**-**	**Changes to groundwater flow and recharge into Coastal Upland Swamp**	**Maintaining Groundwater Flows into Coastal Upland Swamp** Martens (2017a;2017b) has proposed a design and process that will divert groundwater from its current path, around the proposed underground carparks and building, and back into the Coastal Upland Swamp. This impact mitigation measure will implemented and the effectiveness of diverting the water will be monitored over time. It is important to note that the groundwater table is dry for most of the time and requires recent rain in order to recharge. This groundwater diversion system will only come into effect after sufficient water accumulate following an appropriate rainfall event.	High
Coastal Upland Swamp	**-**	**Accidental spill or release of unsuitable water into the Coastal Upland Swamp**	**Onsite Stormwater and Wastewater Disposal** Impacts to ground water are addressed in detail in the Hydrogeological Report (Martens 2017a) the Stormwater Management Plan (Martens 2017b) and the Waterway Impact Statement (WIS) (Narla Environmental 2017b). The following ameliorative measures are proposed to mitigate potential impacts to the EEC: Wastewater systems to be prepared to the highest standards to prevent potential for leak or overflow; Onsite Stormwater Detention (OSD) infrastructure will be located both on and around the hospital buildings. The largest OSD areas will be those located to the immediate west and south of the proposed hospital buildings; A total of 0.12 ha of OSD areas are proposed (Carmichael Studios 2017; Martens 2017b). These will be engineered to all the necessary standards as described in the Stormwater Management Plan (Martens 2017b) and planted with Coastal Upland Swamp Plant species (Carmichael Studios 2017).	High
Coastal Upland Swamp	**-**	**Invasion by exotic weeds and plants.**	**Coastal Upland Swamp Buffer and Raingarden Plantings** The entire Coastal Upland Swamp on the subject site will be completely removed of all weeds by qualified bush regenerators. The entire area of Coastal Upland Swamp on the subject site will be protected from direct vegetation loss by construction. An irregularly shaped buffer area of up to 10 metres in width will be maintained around the entirety of the Coastal Upland Swamp within the subject property and form a barrier between the Swamp and the proposed construction and walkways. This buffer will also be maintained as 'defendable space' in accordance with the recommendations of Peterson Bushfire (2017) This buffer will be kept free of weeds and will be actively restored through regeneration and possibly revegetation to reflect the same floristic assemblage of the Coastal Upland Swamp (Carmichael Studios 2017). Revegetation works should focus on translocation, propagating stock from material found within the subject site (provided this does not reduce the viability of source plants) Where it is not plausible to source plant stock from the subject site, local provenance nursery reared pants may be obtained.	High
Coastal Upland Swamp	**-**	**Changes to floristic assemblage and structure**	**Coastal Upland Swamp Monitoring Program** A comprehensive and detailed Coastal Upland Swamp monitoring program will be developed for the site prior to commencement of works. The monitoring program will include: Quarterly monitoring of weed infestations/encroachment on Coastal Upland Swamp. Regular floristic and structural monitoring within CUS to monitor health and species diversity throughout the lifetime of the project. Assessment of floristic data against rainfall and/or hydrogeological data.	Very High

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
Coastal Upland Swamp	**-**	**Changes to floristic assemblage and structure**	**Riparian Corridor Restoration** All proposed open drainage channels and swales that traverse the subject site, will be engineered to resemble a natural watercourse (Martens 2017a; 2017b; Carmichael Studios 2017) and fully vegetated with moisture-tolerant flora representative of Coastal Upland Swamp EEC; Stream banks must be stabilised with appropriate geotextiles to appropriate state and commonwealth guidelines and standards; and Methods for stream stabilisation and planting should be determined by an appropriately experienced and qualified Bushland Restoration Contractor with proven experience undertaking this type of work in the local area. Such work should be undertaken in consultation with an engineer.	Moderate
			Preclearing Survey and Fauna Management Prior to the removal of any native vegetation of exotic vegetation which may contain potential fauna habitat; a thorough preclearing assessment must be undertaken by the Project Ecologist or their delegate to identify new habitat features (nests, burrows) that could not be accounted for in the SIS. The Project Ecologist is to prepare a map and concise pre-clearing report summarising biodiversity features that will need to be removed for construction of the hospital and associated infrastructure, including: Location and total number of trees forming part of an EEC, Important feed tree/shrubs; and Hollow-bearing trees More detail including a vegetation clearing protocol is provided in the BMP (Narla Environmental 2017)	High
			Nest Boxes The proponent should engage an Ecologist to install nest hollows to replace all-natural tree hollows removed from the proposed construction footprint at a ratio of 2:1 for each hollow lost. Replacement nest hollows may be in the form of: Artificially designed nest boxes Constructed of marine ply and painted with weather-proof paint or oil Capped hollow logs Hollow logs from trees felled on the subject site can be cut into pieces containing the hollow and capped on either end with a metal or plastic cap. They can then be Tree hollow excision A hollow drilled into a living or dead tree. This is to Performed only by an experienced and qualified arborist with a chainsaw. The final number of nest boxes required for each tree removed should be determined by an Ecologist after each tree/limb has been felled. This will enable the Ecologist to measure the diameter of each hollow and count the true numbers of each hollow on each tree, divided into size classes. This will ensure no net loss of fauna nest hollow habitat across the subject site.	High
Fauna Habitat	**Construction Footprint**	**Removal / modification of fauna habitat**	**Soaks** All soaks (areas of seeping or pooling water) will be protected where possible. If they require removal, they will be replaced through the construction of artificial soaks in association with the OSD. These areas will be revegetated with flora representative of *Coastal Upland Swamps in the Sydney Basin Bioregion* EEC.	Very High

Biodiversity Value Affected	Direct Impact	Indirect Impact	Mitigation Measures	Status / Priority for Delivery
Fauna Habitat	**Construction Footprint**	**Removal / modification of fauna habitat**	**Bush Rock** Any sandstone boulders or other 'floating' bush rock present in the construction area should be relocated from this area prior to construction works and provided to Bushland Restoration professionals who will place it within the adjoining bushland so that it can continue to provide fauna habitat values. The relocation and placement of such rock on site will be undertaken in a way that will promote fauna usage. The Project Ecologist will advise relevant site personnel on the best locations to stockpile and relocate bush rock so as to maximise fauna usage in the long term. Clean excavated sandstone can be used in landscaping, however 'mature' (e.g. weathered lichen- encrusted rock) is more valuable from a biodiversity perspective and is to be relocated and be preserved in bushland areas of the subject site.	Moderate
Fauna Habitat	**Construction Footprint**	**Removal / modification of fauna habitat**	**Rock Outcrops** Sandstone outcropping, particularly areas containing cracks/ cervices must be retained and protected outside of work zones. These areas provide refuge for a large range of fauna, including microbats, antechinus and a variety of reptiles. Any construction, machinery operation, excavation, vehicle movement and other works that occur within the bushland area of the subject site should (as much as practicable) avoid impact to sandstone outcropping.	Moderate
Fauna Habitat	**Construction Footprint**	**Removal / modification of fauna habitat**	**Coarse Woody Debris** Fallen or dead wood in any area of the subject site provides shelter and foraging opportunities for local fauna as well as microclimates for essential invertebrates, fungus and bacteria. 'Removal of dead wood and dead trees' is a TSC Act listed KTP. All coarse woody debris (logs) located within the proposed construction or APZ areas will be removed and stockpiled prior to excavation taking place. Suitable pieces of debris will be replaced on the subject site as part of the site landscaping process. Relocation and placement of coarse woody debris on site will be undertaken in a way that will promote fauna usage. The Project Ecologist will advise relevant site personnel on the best locations to stockpile and relocate the coarse woody debris so as to maximise fauna usage in the long term. Hollow pieces may be suitable to cut up and convert in to nest boxes. The Project Ecologist will advise on the suitability of pieces for nest box use. Excess woody debris can be mulched and used in landscaping, but only following inspection and certification by the Project Ecologist.	Moderate

7.1.1 Long term management strategies

Long term management strategies for the protection of threatened flora species and EECs listed in the detailed in the accompanying BMP are outlined in a mitigation measures **Table 36** provided in this SIS.

The proponent has committed to entering into a voluntary Conservation Agreement (CA) or a Biodiversity Stewardship Agreement (BSA) as described under the *Biodiversity Conservation Act 2016* (BC Act).

The proponent is committed to protecting important biodiversity values within the north-west of the site (**Figure 28**) in which a 0.95 ha area of good condition Duffys Forest and all *Grevillea caleyi* within the site will be conserved in perpetuity.

The proponent has not yet decided on the preferred Conservation Agreement; however, it will take the form of a Biodiversity Stewardship Agreement (BSA) or a Conservation Agreement (CA), which are detailed in in **Section 7.1.2.**

Duffys Forest will be protected and enhanced in perpetuity in the west of the site, through the implementation of a Conservation Agreement or Conservation Covenant. The Conservation Agreement will be sought within 12 months following project approval.

The conservation area would be managed in perpetuity under an approved Biodiversity Management Plan. Management actions are required within the offset area as summarised below:

- Retention of regrowth and remnant vegetation.
- Protection and management of Caley's Grevillea.
- Weed control.
- Erosion and sedimentation control.
- Bush regeneration.
- Replanting or supplementary planting where natural regeneration is insufficient.
- Enhancing forage and nesting resources for Eastern-pygmy Possum.
- Maintaining restricted access, allowing only authorised personnel; including, approved hospital staff, personnel, land managers, qualified bushfire assessment professionals, bush regenerators and ecologists.
- Undertaking education walks and training opportunities to educate personnel and community members of the conservation values of the site.
- Retention of dead timber.
- Maintenance of natural surface flow regimes.
- Protection and regeneration/rehabilitation of moderate and good condition Duffys Forest within the north-west of the site. and
- Vertebrate pest (fox, cat and rabbit) management (this would be undertaken in conjunction with pest management programs currently operated by Council in the broader area).

The implementation of a Conservation Covenant as well as the application of an approved Biodiversity Management Plan, is integral to the long-term protection of Duffys Forest Ecological Community, *Grevillea caleyi* and Eastern Pygmy Possum within the subject site. Habitat for both Glossy Black-Cockatoo, a suite of hollow-roosting and cave-roosting microchiropteran bats, Rosenberg's Goanna and any other potentially occurring threatened fauna will also be conserved under a Conservation Agreement.

Long term management strategies: Eastern Pygmy-possum Management Plan

The Applicant will prepare and implement an Eastern Pygmy-possum Management Plan for the subject site.

This Plan will be prepared in consultation with Council and OEH prior to any clearing within the subject site and shall include:

- measures to establish the range of the colony using the subject site;
- a census of suitable tree hollows in the subject site suitable for Eastern Pygmy-possums;
- establishing, maintaining and monitoring the survival and use the food resources utilised by the colony (e.g Banksia ericifolia plantings);
- a vegetation clearing protocol to protect individual Eastern Pygmy-possums;
- a protocol for notifying relevant authorities in the event an Eastern Pygmy Possum is found on the subject site in and around the construction sites, or buildings;
- relocation of trees containing suitable tree hollows;
- installation of suitable nest boxes at a ratio of least 2:1 for each suitable hollow removed by the development and their long-term management;
- measures to assess the rate of tree hollow development within the Conservation Area;
- implementation of three proposed Eastern Pygmy-possum crossings at Larool Road subject to Council approval;
- implementation of proposals to enhance vegetation, particularly in the Conservation Area, to create recruitment and dispersal pathways for the Eastern Pygmy-possum.

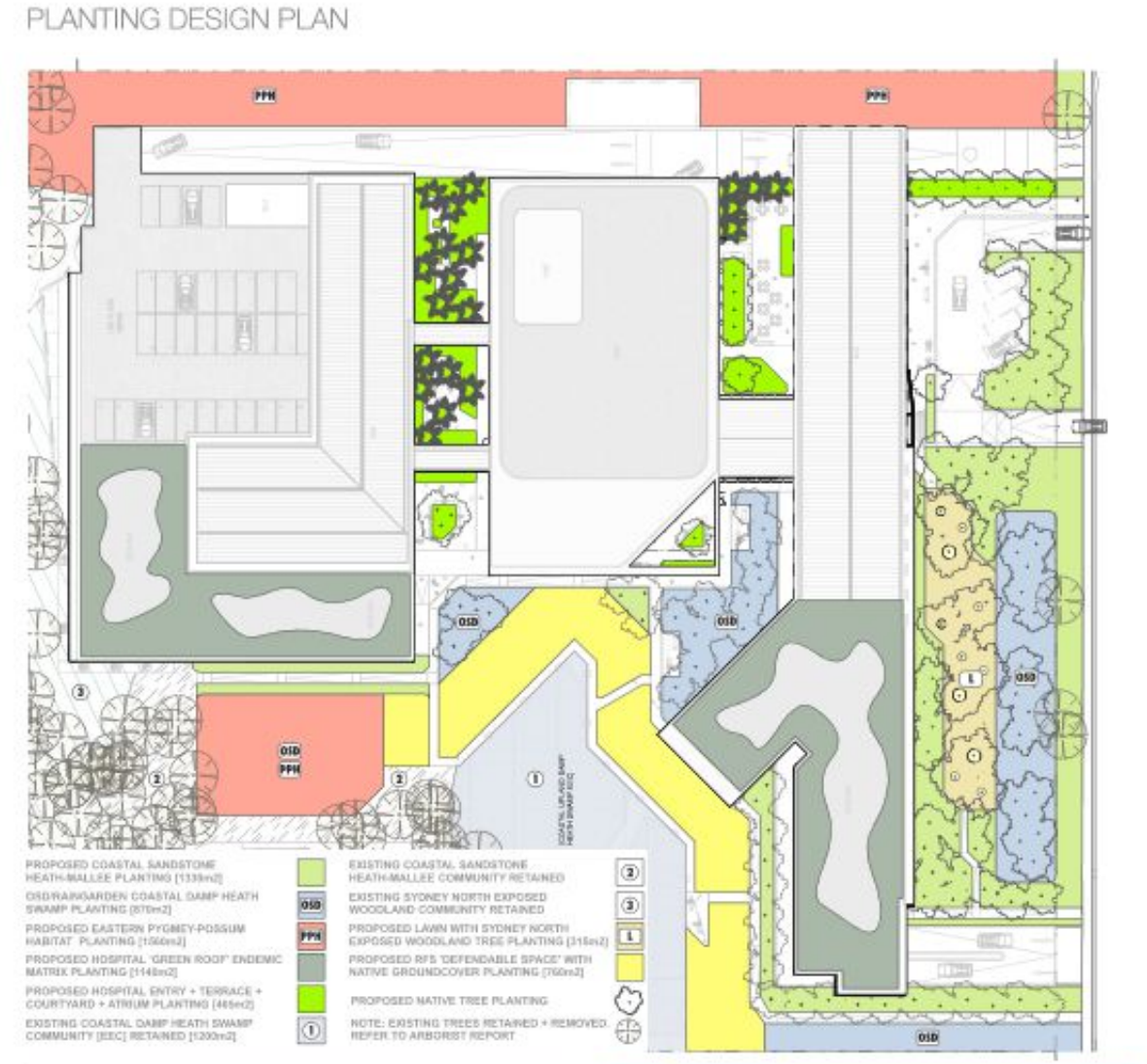
The Eastern Pygmy-possum Management Plan will help monitor the maturation and use of the designated *Banksia ericifolia* plantings proposed in the landscape plan (Carmichael Studios 2017).

Long term management strategies: Nest Box Monitoring and Maintenance

The monitoring of nest boxes across the subject site should be carried out for the lifetime of this BMP for the purpose of assessing habitat use by Eastern Pygmy-possum and other hollow-dependant fauna.

Each nest box installed within the subject site should be monitored for use by fauna every six months for the duration of the BMP. The survey should involve the inspection of each nest box by an experienced Ecologist. Monitoring must be undertaken during optimal survey times, when Eastern Possums are likely to be active but not breeding. Survey period is recommended in late summer to early autumn (Harris 2010).

The state of each nest box should be assessed and noted during each monitoring period. Following each monitoring period, all boxes that are damaged, fallen or decaying should be maintained or replaced by the Project Ecologist. Any nest boxes containing pest species or excessive debris should be carefully cleaned out by the Project Ecologist. The details of the monitoring are to be summarised in an annual Fauna Monitoring Report.



HOSPITAL 'GREEN ROOF' ENDEMIC MATRIX PLANTING

BOTANICAL NAME	COMMON NAME	ESTIMATED POT SIZE
TREES		
NA	NA	NA
SHRUBS		
Correa reflexa	Native Fuchsia	tube-150mm
Correa alba	White correa	tube-150mm
Westringia fruticosa	Coastal rosemary	tube-150mm
GROUNDCOVERS/GRASSES/SEDGES		
Xanthorrhoea resinosa	Grass tree	relocated
Gahnia sieberiana	Sword Grass	tube-150mm
Juncus Usitatus	Common Rush	tube-150mm
Isolepsis nodosa	Club-rush	tube-150mm
Lomandra longifolia	Piny-head Mat-rush	tube-150mm
Schoenus brevifolius	Zig-zag Bog-rush	tube-150mm
Epacris microphylla	Coral Heath	tube-150mm
Epacris obtusifolia	Wallum Heath	tube-150mm
Lomandra glauca'Aussie Blue'	'Aussie Blue'	tube-150mm

EASTERN PYGMEY-POSSUM HABITAT PLANTING

BOTANICAL NAME	COMMON NAME	ESTIMATED POT SIZE
TREES		
NA	NA	NA
SHRUBS		
Banksia ericifolia	Heath Banksia	tube-150mm
GROUNDCOVERS/GRASSES/SEDGES		
NA	NA	NA

NOTE
Banksia ericifolia to be planted at a density of 02 plants per m2.
Total proposed Eastern Pygmey-possum habitat planting area 1560m2.
Total proposed planting of Banksia ericifolia 3120 plants.

Figure 27. Landscape Plan (Carmichael Studios 2017)

7.1.2 Compensatory Measures

Voluntary Conservation Agreement

The proponent has committed to protecting the entire area of Duffys Forest Ecological Community (that exists outside of the APZ areas) for the lifetime of the tenure. The proponent will implement a Voluntary Conservation Agreement under the *Biodiversity Conservation Act 2016* (BC Act).

Under the BC Act there are three main types of voluntary private land conservation agreements, which are explained below as detailed by BCT (2017):

- Biodiversity stewardship agreements (BSAs) that provide permanent protection and management of biodiversity and allow for the creation of biodiversity credits,
- Conservation Agreements (CAs) which are permanent or time-bound agreements and may be eligible for stewardship payments,
- Wildlife refuge agreements (WRAs) which are an entry level option for landholders who want to protect the biodiversity on their property but do not wish to enter into a permanent agreement.

The proponent will implement one of the following CA over 0.95 ha of the subject site as displayed (generally in accordance) in **Figure 28**:

Biodiversity Stewardship Agreement (BSA)

A Biodiversity Stewardship Agreement (BSA) is an agreement that will provide for the permanent protection and management of biodiversity across the BSA. This option allows for the creation of biodiversity credits. The proponent may choose how much of their land they enter into a BSA. To do this, a landholder needs to enter into a Biodiversity Stewardship Agreement, which is a voluntary agreement between the Minister for the Environment and a landholder to permanently protect and manage an area of land to improve its biodiversity values. A Stewardship Site will generate biodiversity credits which represent the expected improvement in biodiversity that will result from the protection and management of the site. A landholder can sell the biodiversity credits to developers, philanthropists or to the NSW Biodiversity Conservation Trust (should they desire them) and the landholder will receive payments in return for implementing all management actions on the property.

Conservation Agreement (CA)

A Conservation Agreement (CA) is a permanent agreement or agreement for a specific time period that may be eligible for stewardship payments to provide support for landholders in carrying out actions to help protect and manage the land. Landholders that are interested in this type of agreement will be able to access the Landholder Support Program. The Landholder Support Program provides a range of assistance and support to landholders.

The Landholder Support Program (LSP) provides ongoing support to landholders with conservation agreements. The program will have a group of measures that helps landholders to access advice and assistance.

As the BCT is still becoming established, more information about the support they can provide will become available later in 2017. The support that they will be able to provide to landholders to encourage the management and protection of high environmental value land will be guided by the Biodiversity Conservation Investment Strategy and our Business Plan which will guide BCT to seek agreements with landholders and farmers in priority investment areas in NSW.

It is intended that landholders entering into an agreement to protect private land may be able to access a range of support and benefits depending on their location, such as:

- having site visits, including monitoring,
- accessing staff for assistance and advice, including about management actions,
- receiving regular newsletters,
- receiving information about funding and volunteer opportunities,
- being able to attend field days, meetings, workshops and social events,
- accessing the website for information and resources as well as an on-line forum,
- accessing a social network/platform for landholders,
- education and capacity building for looking after land under conservation, and
- linking with other Natural Resource Management agencies or groups (e.g. Local Land Services, Landcare).

Provision of Long Term Funding for Biodiversity Conservation in Dundundra Falls Reserve

Dundundra Falls Reserve is Crown Land (i.e. the land is owned by the state government of New South Wales). The management of the reserve is delivered by Dundundra Falls Reserve Trust with volunteers from the local community under the guidance of the NSW Department of Industry: Lands.

All members of the community are permitted to utilise the reserve for walking, horse and bike riding.

Extensive work has been undertaken throughout the reserve to control weeds and undertake plantings to regenerate native bush. This is delivered by dedicated volunteers with the assistance of various grants received over the years.

The proponent is also committed to providing Dundundra Falls Reserve Trust a direct financial allocation to assist in protecting and conserving habitat for:

- Coastal Upland Swamp,
- Eastern Pygmy Possum Habitat, and
- Duffy's Forest Ecological Community

A total of $75,000 is to be made as a one-off payment to the Dundundra Falls Reserve Trust prior to the issue of an Occupation Certificate. The intention is for this money to be held in Trust, for the use by the Dundundra Falls Reserve Trust. This offer can be confirmed via a prior to occupation certificate condition of consent.

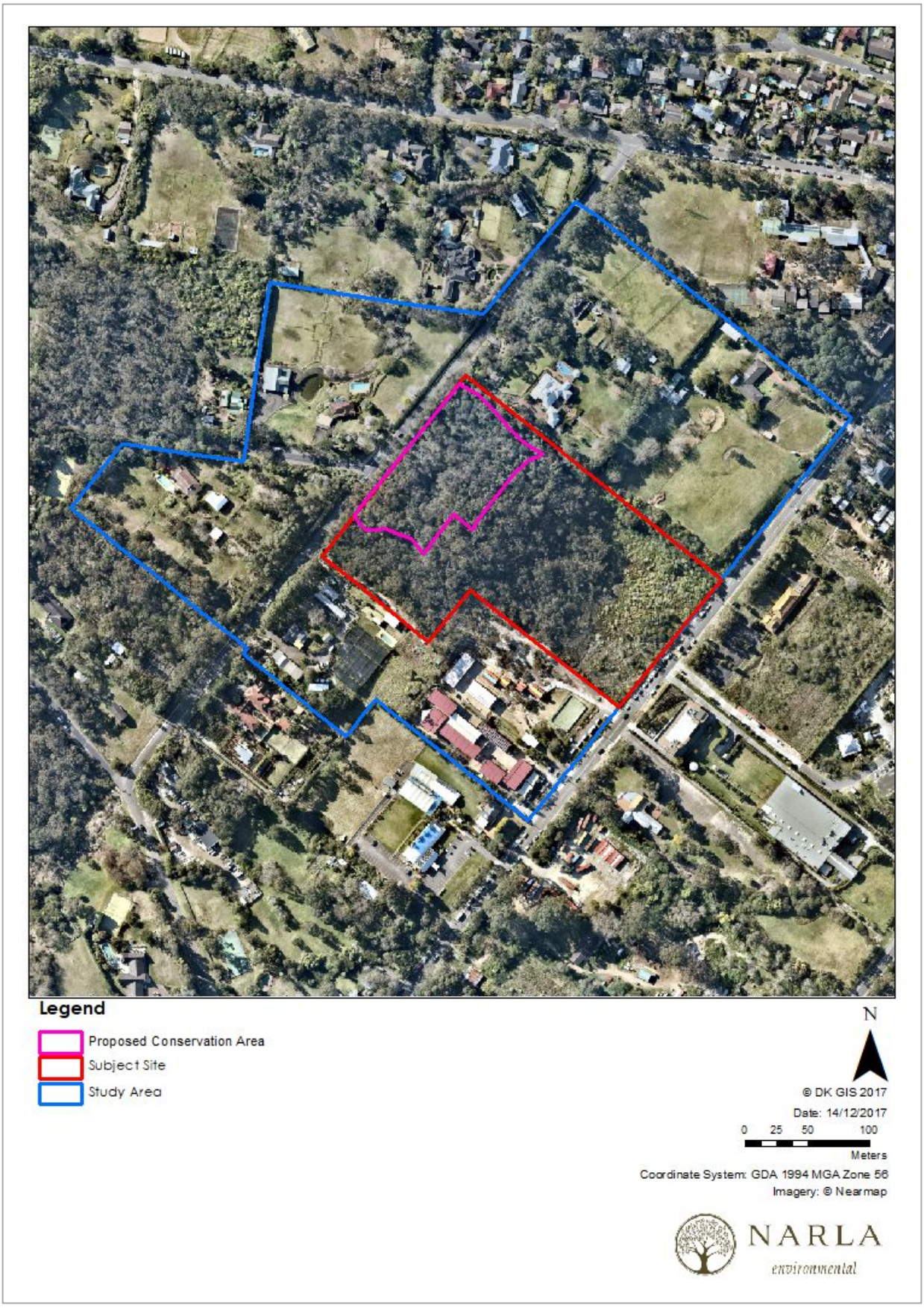


Figure 28. Proposed Conservation Area that will be be protected in perpetuity under a Conservation Agreement

7.1.3 Ongoing monitoring

Monitoring of vegetation within the Conservation Area, Landscaping and revegetation areas is essential to determine the long-term success of protection and management strategies included in the BMP.

Flora

Biannual vegetation/biodiversity monitoring of the entire subject site must be undertaken by a Qualified Ecologist as per Council requirements. Timing of all proposed monitoring activities have been included within the accompanying site BMP (Narla 2017).

An annual threatened flora monitoring survey should be undertaken by a qualified Ecologist. The survey should be undertaken to assess the extent, abundance and health of each threatened flora species on the subject site, with a focus on Caley's Grevillea.

A general flora and vegetation survey should be undertaken each spring. It should assess each of the BioMetric vegetation plots that were established during the approval phase of this project (Narla Environmental 2017a). Additional BioMetric plots should be included in order to enhance the survey coverage and cumulative flora species list for the subject site.

Each zone should be assessed by the Ecologist for weed cover and species richness in all stratum levels. The Ecologist will assess the weed condition against the performance criteria assigned for that particular zone.

Fauna

An annual threatened fauna monitoring survey should be undertaken by a qualified Ecologist in mid to late spring each year. The monitoring survey will involve surveys being undertaken for threatened microbats, Eastern Pygmy-possum, Rosenberg's Goanna and Glossy Black Cockatoo during the optimal survey time for each species as determine by the most up to date, relevant survey guidelines. The details of the monitoring are to be summarised in an annual Fauna Monitoring Report.

7.2 Plant Salvage and Translocation

Prior to clearing works in the proposed building footprint, the Project Ecologist and Landscape Architect may survey the area to identify shrubs and trees that could be used in landscaping works elsewhere on the subject site.

- Salvaged plants may include more expensive and sought-after plants including mature *Xanthorea spp.*, *Banksia spp.*, and ferns.
- No salvaged plants can be taken off site, unless they are to be returned to back to site on a later date. Any plants taken off site must be stored in an experienced native plant nursery and cared for accordingly before being translocated by qualified Bushland Restoration professionals.
- No salvaged plants may be sold or given to any third party.
- Salvaged plants may be used in landscaping of the subject site.
- Plant salvage can only be undertaken in areas that are proposed for clearing (where the vegetation is proposed to be destroyed).
- Topsoil translocation could be investigated and undertaken under the guidance of qualified and experienced bush regenerators.

8. Assessment of Significance

8.1 Summary of Assessment

Assessment of significance have been undertaken for each of the subject species, considering the findings of Chapters 5, 6 and 7 of this document.

Amelioration measures are detailed in Section 7 and include:

- Conservation and enhancement of all EEC and threatened flora that remain on the subject site outside of development footprints, including:
  - (0.95 ha) of Duffys Forest endangered ecological community; and
  - All *Grevillea caleyi* within the site.
- Preclearance Ecologist assessment and relocation of sheltering fauna within the construction footprint to areas of suitable habitat elsewhere within the site.
- Replacement of all fruiting *Allocasuarina* spp. removed from the subject site (at a ratio of 3:1)
- Planting of a minimum of 1,180 and a maximum 3,120 replacement *Banksia ericifolia* (Carmichael Studios 2017)
- Replacement of all hollows removed for the construction site to a ratio of 2:1
- Installation of nest boxes to provide additional nesting habitat for Eastern Pygmy-possum;
- Undertaking intensive weed control throughout the site to restore and maintain the health and viability of the EECs; and threatened fauna habitat;
- Development of a 'rain garden' through development of an Onsite Stormwater Detention (OSD) system to maintain hydrology for retained Coastal Upland Swamp within Section 88b Easement.

The location of the proposed hospital (within highly disturbed, weed infested areas) greatly limits potential impacts to threatened species and endangered ecological communities within the subject site, however, despite ameliorative measure proposed, there are likely to be residual effects on the following communities within the subject site:

- Duffys Forest Ecological Community (marginal); and
- Coastal Uplands Swamp (moderate – worst case scenario resulting in the complete loss of this ecological community from the subject site but not the local occurrence.

It is not considered likely that a significant impact will occur to these TECs or species populations within the region, local government area or local occurrence.

Despite the potential for impact (particularly on Coastal Upland Swamp) it is expected that following implementation of:

- The recommendations in this SIS,
- The BMP (Narla Environmental 2017a), and
- A Conservation Agreement for the proposed 0.95 ha Duffy Forest Conservation Area,

the proposed development will result in a positive biodiversity conservation outcome for the threatened species and communities on the site and their local occurrence.

Assessments of significance under the EP&A Act are presented in **Appendix D**.

9. Additional Information

9.1 Qualifications and Experience

Narla Environmental is comprised of a small team of passionate and dedicated individuals with expertise across multiple fields including ecological survey and monitoring, flora and fauna ecology, botany, project management, estuary and saltmarsh ecology and management, impact assessments. Narla Environmental's industry experience spans across a variety of key industry sectors including conservation, residential development, infrastructure and mining.

Curriculum Vitae demonstrating the qualifications and experience of principal Narla Environmental staff that were associated with the preparation of this SIS are provided below.

Principle SIS authors are: Kurtis Lindsay, Alexander Graham and Emily Benn.

Assistance has also been provided by the following specialists:

- Elissa McFarlane
- Nathan Banks
- Deidre Krejzlik
- Dean Sugden
- Tim Peason
- Paul Burcher
- Gavin Thomas
- Emily Strautins
- Thomas Hickman
- Barbara Triggs

Kurtis Lindsay is the Manager and Principle Ecologist at Narla Environmental with extensive experience in ecological survey and project management for private and public industry clients. He has advanced knowledge of fauna and flora ecology, skills in the application and management of Geographic Information Systems (GIS) and excellent working knowledge of New South Wales planning and environmental legislation.

Alexander Graham is an Ecologist with extensive working experience in New South Wales, Queensland and the Northern Territory. With over 5 years of experience working on a range of small and large scale projects, Alex has developed the skills required to conduct high quality ecological assessment and deliver technical reports in a timely manner. Alex's experience spans across a variety of key industry sectors including conservation, carbon, residential development, infrastructure and mining. He has extensive experience working on impact assessments and monitoring on multiple State Significant Infrastructure and Mining projects.

Emily Benn is an Ecologist with extensive experience in the greater Sydney region. She specialises in conducting flora and fauna surveys within Greater Sydney and has experience conducting fauna surveys interstate often in remote areas. Emily is experienced at using Geographic Information Systems (ArcGIS).

Nathan Banks is an Ecologist who has developed a good working knowledge and gained experience in the planning and undertaking of ecological surveys for both private and public industry clients. He demonstrates a strong knowledge for flora and fauna within the Greater Sydney region and is experienced in the application and management of Geographic Information Systems (GIS).

Kurtis Lindsay

Senior Project Ecologist

Qualifications and Accreditations

Bachelor of Science (Biodiversity and Conservation) Honours Class 1, Macquarie University
Introduction to Animal Ethics Course, Sydney University
WH&S General Induction Card-White Card
BioBanking Assessor Course (CERT00185) Accredited BioBanking Assessor (No. 224)

Licenses

New South Wales Open Drivers License
New South Wales Animal Research Authority (ARA)
New South Wales National Parks and Wildlife Act 1979 Section 132c Wildlife License No. SL101036

Expertise

Kurtis is a Senior Ecologist with extensive experience in ecological survey and project management for private and public industry clients. He has advanced knowledge of fauna and flora ecology, skills in the application and management of Geographic Information Systems (GIS) and excellent working knowledge of New South Wales planning and environmental legislation.

Kurtis has strong project management experience built over several years working as a professional Environmental Consultant in New South Wales and Queensland. He has delivered multiple ecological reports for a wide range of infrastructure projects for public agencies and the private sector.

Relevant Project Experience

Sydney German International School

- Project Ecologist for school development, Terrey Hills

Wyvern Private Hospital

- Project Ecologist for private hospital development, Terrey Hills

4 Jacana Close Wharoonga

- Project Ecologist for DA in Wharoonga, Sydney

9 Cadwells Road, Kenthurst

- Project Ecologist for DA in Kenthurst, Sydney

LB Group Homes

- Project Ecologist for DA in Scofield's, Sydney

EnviroPacific

- Project Ecologist for Astrolabe Park Stormwater Restoration Project, Daceyville Sydney

Statewide Civil

- Project Ecologist for Subdivision 68 Hezlett Drive, Kellyville Sydney

Sydney Water

- Review of Environmental Factors (REF), Hornsby Heights Track Waste Water Treatment Plan Upgrade
- Vegetation Management Plan (VMP), Hornsby Heights Track Waste Water Treatment Plan Upgrade
- Flora and Fauna Assessment, Hornsby Heights Track Waste Water Treatment Plan Upgrade

Commonwealth of Australia, Murray-Darling Basin Long Term Intervention Monitoring Program

- Waterbird and frog monitoring Warrego - Darling River Confluence, Toorale National Park
- Macroinvertebrate, microinvertebrate and water quality monitoring, Warrego - Darling River, Toorale National Park

Impregilo Salini Joint Venture North West Rail Link

- Vegetation Management Plans for North-west Rail Link
- Project Ecologist for Balmoral Road road upgrade and stormwater works

North-west Property Development

- Vegetation Management Plan (VMP), Chisholm Road, Catherine Field

University of New South Wales

- Flora and Fauna Impact Assessment, Cliffbrook Campus DA

Office of Environment and Heritage

- Leacock Park and Edmondson Park Bush Regeneration Monitoring
- Targeted Survey for *Asterolasia buxifolia*

Office of Environment and Heritage and Southern Cross University

- Fauna Ecologist for Broad-headed Snake targeted survey
- Fauna Ecologist for Eastern Pygmy Possum targeted survey

Central Tablelands Local Land Services

- Convened and presented wildlife information workshop "Wildlife of the Capertee Valley" including nest box design/installation, fauna habitat creation and fauna survey

Private Development Applications

- Project Ecologist for multiple residential Development Applications (DA) across Sydney

BHP

- Targeted species-credit fauna assessment of proposed BioBanking sites, Caroona Coal Project

Whitehaven Coal

- BioBanking site Biometric Vegetation Plot annual monitoring
- BioBanking site targeted species credit monitoring (Regent Honeyeater and Swift Parrot)
- Ecological impact assessment flora and fauna study
- Mine site rehabilitation monitoring and assessment, Rocglen Mine
- Pre-clearing vegetation and threatened species surveys, Tarrawonga Mine (*Tylophora linearis, Bertya opponens, Pterostylis cobarensis*)

Mid-Western Regional Council

- Review of Environmental Factors (REF) and Flora and Fauna Assessment, Caerleon Development vital infrastructure installation
- Flora and Fauna Assessment, water mains pipeline
- Targeted threatened flora survey (*Leucochrysum albicans var. tricolor*)

Peabody Energy, Wambo

- Fauna Assessment for underground mine expansion Environmental Impact Statement

KEPCO / Cockatoo Coal

- Flora and Fauna Assessment for exploration program REF

Energy Australia

- EPBC MNES (Purple Copper Butterfly *Paralucia spinifera*) targeted survey and monitoring,

Pinedale Coal Mine

Yancoal Australia, Moolarben Coal

- Nest hollow density survey, Stage 1 and Stage 1 Mod 9
- Stage 1 expansion Environmental Impact Statement (EIS), terrestrial flora and fauna assessment
- Mine rehabilitation landscape function analysis (LFA), flora and fauna monitoring
- Targeted EPBC MNES survey for Spot-tailed Quoll, Regent Honeyeater and Swift Parrot
- Vegetation mapping and validation
- Aquatic ecology, stream health and stability monitoring
- Biodiversity Offset Area flora and fauna Monitoring

Centennial Coal

- EPBC MNES Compensatory Habitat Offset, fauna and flora monitoring, Charbon Coal Mine
- Environmental Impact Study, terrestrial flora and fauna assessment, Charbon Coal Mine

Glencore Xstrata, Ulan Coal

- Targeted threatened flora (*Pomaderris queenslandica* and *Acacia ausfeldii*) survey and management plans
- Goulburn River Diversion, Vegetation Rehabilitation Plan
- Biodiversity Offset Area flora and fauna monitoring and EPBC Act MNES monitoring annual reporting
- Pre-clearing surveys and clearing supervision for mine operations
- Biodiversity Offset Area Flora Monitoring

Glenrock Station

- Ecosystem and species credit surveys BioBanking assessment, Glenrock Station, New South Wales

Alexander Graham

Ecologist

Qualifications and Accreditations

- Bachelor of Science (Biology), Macquarie University
- WHandS General Induction Card-White Card
- Occupational First Aid Certification
- Wilderness First Aid Certification
- Formal 4WD Training
- Asbestos Identification Training

Licenses

- New South Wales Open Drivers License
- New South Wales Department of Primary Industries Animal Research Authority (ARA)
- New South Wales Department of Primary Industries Fisheries Scientific Collection Permit P16/0014-1.0
- New South Wales National Parks and Wildlife Act 1979 Section 132c Wildlife License No. SL101036

Expertise

Alex is an Ecologist with extensive working experience in New South Wales, Queensland and the Northern Territory. With over 5 years of experience working on a range of small and large scale projects, Alex has developed the skills required to conduct high quality ecological assessment and deliver technical reports in a timely manner. Alex's experience spans across a variety of key industry sectors including conservation, carbon, residential development, infrastructure and mining. He has extensive experience working on impact assessments and monitoring on multiple State Significant Infrastructure and Mining projects.

Alex specializes in conducting flora and fauna surveys within Greater Sydney and Regional New South Wales, and has experience conducting fauna surveys interstate often in remote areas. Alex has experience using Geographic Information Systems (GIS – Map Info). Alex's experience includes monitoring on offset properties and impact assessment of proposed railways, powerlines, road widening, residential development and mines.

Relevant Project Experience

Rizzani-Leighton

- Conducted fauna surveys on Westconnex (M4 road widening)
- Targeted frog surveys at Kogarah Golf Course and assisting with Impact assessment

Impregilo Salini Joint Venture North West Rail Link

- Mapping and writing Vegetation Management Plans for North-west Rail Link
- Fauna habitat surveys for North West Rail Link
- Conducted annual nest-box monitoring North West Rail Link

Leightons

- Impact assessment and frog surveys for M2 Upgrade Road Widening
- Vimiera Road embankment stabalisation
- Conducted annual nest-box monitoring for M2 Upgrade

Dam Dewatering

- Project ecologist for a countless Dam Dewatering jobs across Sydney.

Office of Environment and Heritage and Southern Cross University

- Fauna Ecologist for Broad-headed Snake targeted survey
- Fauna Ecologist for Eastern Pygmy Possum targeted survey

Shenhua Watermark

- Conducted Koala SAT surveys on offset sites

Yancoal Australia, Moolarben Coal

- Biodiversity Offset Area flora and fauna Monitoring

Whitehaven

- Conducting targeted surveys for diurnal and nocturnal fauna
- Targeted surveys for threatened fauna
- Supervised a team of spotter-catchers during clearing operations

BHP Billiton

- Conducted diurnal bird and insect surveys on Groote Eylandt Manganese Mine

Anglo-American – Drayton South

- Biodiversity Offset Area flora and fauna Monitoring

Zinfra

- South West Growth Centre Wastewater Pipeline – Fauna surveys and clearance supervision

AbiGroup

- Project Ecologist for North West Growth Centre Pipeline
- Conducted fauna surveys and relocation

Lend Lease

- Project Ecologist for North West Growth Centre Pipeline
- Project Ecologist for Epping to Thornleigh Third Track
- Nelsons Ridge Development – Species Impact Statement

Burtons

- Impact assessment for Richmond Road Widening

Leightons

- M2 Upgrade – Road Widening and Vimiera Rd. Stabalisation

Australian Defence Organisation

- Orchard Hills Defence Establishment – Macropod monitoring and relocation

Celestino

- Box Hill North – Extensive targeted fauna surveys
- Assisting the preparation of a Species Impact Statement

Private Development Applications

- Project Ecologist for multiple residential Development Applications (DA) across Sydney

GreenCollar

- Field Ecologist in Cobar, Bourke and Lightening Ridge areas conducting biomass, allometry and destructive sampling to determine carbon content

Emily Benn

Ecologist

Qualifications and Accreditations

Bachelor of Science, Macquarie University
Bachelor of Science (Ecology), Honours Class 1, The University of Sydney
Introduction to Animal Ethics Course, Sydney University
WHandS General Induction Card-White Card

Licenses

New South Wales Open Driver's License
New South Wales Animal Research Authority (ARA)
New South Wales National Parks and Wildlife Act 1979 Section 132c Wildlife License No. SL101036

Expertise

Emily is an ecologist with experience in ecological survey for private and public industry clients. She has strong knowledge of fauna and flora ecology, skills in the application and management of Geographic Information Systems (GIS) and working knowledge of New South Wales planning and environmental legislation.

Relevant Project Experience

Veolia Water

- Grey-headed Flying-fox demographic monitoring at Sydney Water Desalination Plant

Fairfield City Council

- Bushland Management Strategy

City of Ryde Council

- Review of Environmental Factors and Flora and Fauna Assessment

Lake Macquarie City Council

- Grey-headed Flying-Fox monitoring

Wood Street, Manly

- Terrestrial Biodiversity Impact Assessment andThreatened Fauna Assessment of Significance Report for Long-nosed Bandicoot

30 Myee Road, Macquarie Fields NSW

- Ecological Constraints Assessment

31 Willows Park Grove, Cattai NSW

- Vegetation Management Plan

7 Yarbon Street, Wentworthville

- Flora and Fauna Impact Assessment

MACH Energy Australia

- Ground Disturbance Permits

MB Town Planning

- Ecological Constraints Assessment

Opus International Consultants (Australia) Pty Ltd

- RMS Biodiversity Assessment

Playoust Churcher Architects

- Ecological Constraints Assessment

Australian Wildlife Conservancy, Field Ecologist

- Fauna reintroductions
- Small mammal trapping
- Fauna handling and specialist skills (microchipping and euthanasia)
- Camera trapping
- Habitat assessments
- Animal husbandry

The University of Sydney, Field Ecologist

- Research into the nutritional ecology of Australasian gannets (Morus serrator)
- Species identification
- Handling of large birds (gannets) and specialist skills (collecting tissue samples and diet samples)
- DNA analysis of tissue samples
- GPS tracking of gannets

AusTurtle, Research Assistant

- Research into the life history of Flatback turtles in Northern Territory
- Species identification
- Animal handling
- Nest site identification and analysis

9.2 Other approvals required for the development or activity

Commonwealth Legislation

Actions that have a significant impact on 'matters of national environmental significance' are regulated by the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). If an action is likely to have an impact on a matter of national environmental significance, it should be referred for approval to the Minister of the Department of Environment, Water, Heritage and the Arts. Matters that are relevant to the Proposal include species and ecological communities that are listed as threatened under the EPBC Act and migratory species listed under the EPBC Act. There are a number of species that have been recorded in the locality or are predicted to occur in the locality and are listed as threatened or endangered under the EPBC Act.

According to the Matters of National Environmental Significance, Significant Impact Guidelines (Department of the Environment, 2009), an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population;
- reduce the area of occupancy of the species;
- fragment an existing population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of a population;
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

Under the EPBC Act, a 'population of a species' is defined as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

An 'invasive species' is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.

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

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.
- such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

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

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

Many of the species and all of the threatened ecological communities with potential to occur on the subject site that are listed as threatened on the EPBC Act are also listed on the TSC Act and have been assessed in Sections 6 and 10 under TSC Act criteria. The assessments concluded that no significant impacts are likely to occur on those species as a result of the Proposal and a similar conclusion is reached after consideration of the Commonwealth criteria. No nationally threatened ecological communities occur in the study area, and no nationally threatened plants are likely to be impacted by the Proposal (EPBC Assessments included within FFA) (Narla Environmental 2017).

9.3 Licencing matters relating to conducting surveys

The survey work performed for this assessment was carried out under OEH Scientific Licence number SL101036.

9.4 Section 110 (5) reports

Relevant threatened species profiles, threatened species survey guidelines and environmental impact assessment guidelines were consulted in the compilation of this report.

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Appendices

APPENDIX A: CHIEF EXECUTIVE'S REQUIREMENTS

APPENDIX B: LANDSCAPE PLAN (CARMICHAEL 2017)

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Appendix A: Chief Executive's requirements

NSW GOVERNMENT | Office of Environment & Heritage

Our ref: SF17/7364
Your ref:

Wyvern Health Pty Ltd (ACN 610 129 667; ABN: 48 610 129 667)

Attention: Ian Campbell, Director

Dear Mr Campbell

Request for Chief Executive's requirements for preparation of a species impact statement for construction of a private hospital on Lot 2 in DP 1145029 Myoora Road Terrey Hills NSW

Thank you for your email correspondence of 13 November 2017 to the Office of Environment and Heritage (OEH) requesting the requirements of the Chief Executive for a species impact statement (SIS) for proposed development for a private hospital on Lot 2 DP 1145029 Myoora Road Terrey Hills NSW 2084 (also known as 4A Larool Road Terrey Hills), as described in development application DA2017/0385 to Northern Beaches Council.

Attached are the Chief Executive's requirements, issued to Wyvern Health Pty Ltd (ACN 610 129 667; ABN: 48 610 129 667) as the applicant for development.

Because the development application was submitted prior to the commencement of the *Biodiversity Conservation 2017* (BC Act), OEH understands that the previous planning provisions under the *Environmental Planning and Assessment Act 1979* continue to apply until 24 February 2018 in accordance with the savings and transitional regulations under the BC Act. Accordingly, the CERs includes references to the *Threatened Species Conservation Act 1995* which is still in force subject to those regulations.

Please note that issuing of CERs is a statutory requirement for OEH and should not be construed as support for or endorsement of the proposed development.

Should you require any further information about these requirements please contact Nick Corkish on 9585 6826 or at nick.corkish@environment.nsw.gov.au.

Yours sincerely

M. S 11/12/17

MARTIN SCHWIEBERT
Senior Team Leader, Compliance and Regulation, Greater Sydney
Regional Operations
as delegate to the Chief Executive

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Contact officer: NICK CORKISH
9585 6826

Enclosure

CHIEF EXECUTIVE'S REQUIREMENTS FOR PREPARATION OF A SPECIES IMPACT STATEMENT FOR CONSTRUCTION OF A PRIVATE HOSPITAL ON LOT 2 IN DP 1145029 (MYOORA ROAD TERREY HILLS NSW)

PURPOSE

The purpose of a species impact statement (SIS) is to:

- allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration for adverse impacts resulting from the proposal
- assist consent and determining authorities in the assessment of a development application under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act)
- assist the Chief Executive in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act
- assist the Chief Executive or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act
- assist the Chief Executive in the assessment of Section 91 Licence applications lodged under the *Threatened Species Conservation Act 1995* (TSC Act).

DEFINITIONS

The definitions given below are relevant to these requirements:

development has the same meaning as in the EP&A Act.
activity has the same meaning as in the EP&A Act.
proposal is the development, activity or action proposed
threatened species, populations and ecological communities has the same meaning as in the *Threatened Species Conservation Act 1995*
subject site means the area directly affected by the proposal.
study area is the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly
local population, *local occurrence* and *locality* have the same meanings as in the Threatened Species Assessment Guidelines (DECC 2007, www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf)
subject species means those threatened species that are known or considered likely to occur in the study area.

All other definitions are the same as those contained in the TSC Act.

MATTERS WHICH CAN BE LIMITED

Recovery plans, key threatening processes and threat abatement plans need be addressed only where relevant to this proposal and the subject species. However, it is considered that the following NSW recovery plans, key threatening processes and threat abatement plans are likely to be relevant to this proposal:

Recovery plans, conservation advices and management plans

- *Grevillea caleyi* (a shrub) recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10361)
- *Grevillea caleyi* (a shrub) *Assessment of conservation status in NSW* (2013) (www.environment.nsw.gov.au/resources/threatenedspecies/Grevcalrpt.pdf, however note that a more recent update, containing some additional information, of this advice can be found on the

Commonwealth Department of Environment and Energy's website at www.environment.gov.au/biodiversity/threatened/nominations/comment/nsw-13-species.

- *Darwinia biflora* recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10202)
- *Melaleuca deanei* recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10515)
- *Microtis angusii* recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10531)
- Southern Brown Bandicoot recovery plan (via www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10439)
- Southern Brown Bandicoot *Assessment of conservation status in NSW* (2016) (www.environment.nsw.gov.au/resources/threatenedspecies/ARSBbandicoot.pdf)
- Large Forest Owls: Powerful Owl *Ninox strenua* Sooty Owl *Tyto tenebricosa* Masked Owl *Tyto novaehollandiae* approved recovery plan (via www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10562)
- Grey-headed Flying Fox recovery plan (draft) (via www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpflyingfox.pdf)

National recovery plans (that are not also NSW recovery plans) may also be relevant should the action require approval from the Federal Minister for the Environment under Commonwealth legislation (refer to section 9.2 below). National recovery plans are listed at www.environment.gov.au/cgi-bin/sprat/public/publicshowallrps.pl. Examples of national recovery plan that may be relevant to this proposal include those for *Syzygium paniculatum*, Deane's Paperbark *Melaleuca deanei*, Spotted-tailed Quoll *Dasyurus maculatus*, Swift Parrot *Lathamus discolour* and Regent Honeyeater *Anthochaera phrygia*.

Key threatening processes

- Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners (*Manorina melanocephala*)
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Anthropogenic climate change
- Bushrock removal
- Clearing of native vegetation
- Competition and grazing by the Feral European Rabbit *Oryctolagus cuniculus* (L.)
- Competition from feral honey bees (*Apis mellifera*)
- Forest eucalypt associated with overabundant psyllids and bell miners
- High frequency fires
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis
- Infection of native plants by *Phytophthora cinnamomi*
- Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae
- Invasion and establishment of exotic vines and scramblers
- Invasion of native plant communities by exotic perennial grasses
- Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)
- Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. lat)
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- Loss of hollow-bearing trees
- Predation by the European red fox (*Vulpes vulpes*)
- Predation by the Feral Cat *Felis catus* (Linnaeus, 1758)
- Removal of dead wood and dead trees.

Threat abatement plans

- Threat Abatement Plan 'Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)' (www.environment.nsw.gov.au/bitouTAP/index.htm)
- Threat Abatement Plan 'Predation by *the Red Fox* (*Vulpes vulpes*)' (www.environment.nsw.gov.au/pestsweeds/Foxes.htm)

Critical habitat

At this time, there are no areas of declared critical habitat relevant to this proposal.

The proponent should be aware that recovery plans may be approved, critical habitat may be declared and key threatening processes may be listed between the issue of these requirements and the granting of consent. Such an occurrence will require the additional matters to be addressed in the SIS and considered by the consent, determining or concurrence authority.

MATTERS TO BE ADDRESSED

The TSC Act provides that the SIS **must** meet all the matters specified in Sections 109 and 110 of the TSC Act except where those matters have been limited, as detailed above. Further requirements related to the matters specified in Sections 109 and 110 are detailed in the following sections.

1. FORM OF THE SPECIES IMPACT STATEMENT

The SIS **must** be in writing (*s.109 (1)*).

The SIS **must** be signed by the principal author of the statement and by:
(a) the applicant for the licence, or
(b) if the species impact statement is prepared for the purposes of the *Environmental Planning and Assessment Act 1979*, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) (*s.109(2)*).

The SIS must include the following declaration which must be signed by the applicant or proponent:

> "*I…[insert name], of .. [insert address], being the applicant for development consent for development application / proponent for activity… [insert DA/proposal id number and name, Lot & DP numbers, street, suburb and LGA] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal.*"

2. CONTEXTUAL INFORMATION

The description must include information of the following forms or types:

2.1 Description of proposal, subject site and study area

The following are further requirements related to your obligation under Section 110(1) to address the following:

> *A species impact statement must include a **full** description of the action proposed, including its nature, extent, location, timing and layout*

A comprehensive description of the nature, extent and timing of **all component works and associated or consequent actions** of the proposal must be provided, including works or actions that have effects both *on and off* the subject land as a result of the proposal. The works and actions

described must include, but are not to be restricted to, construction, provision or ongoing use and maintenance of proposed:

- buildings, bridges, walkways and other structures
- associated infrastructure such as utilities/amenities (e.g. access roads, sewage, electricity, gas or water)
- routes for access and egress
- any structure or activity that may change surface, ground or subterranean water movements, including dams/ponds, pipes/channels or other infrastructure for ground and surface water control and drainage, waste water/effluent management or erosion control
- wastewater disposal
- bush fire hazard reduction and protection measures, such as modified fuel zones (e.g. inner and outer protection areas of asset protection zones (APZs)), access roads or trails, water supply infrastructure, etc.
- landscaping
- ongoing maintenance and other operational activities.

2.2 Identification of the development/activity and land to which SIS applies

The SIS must identify:

- local government area
- the development application or activity proposal number and name
- the legal description of the land (lot and deposited plan numbers) and information about the land tenure and ownership

to which SIS applies.

2.3 Plans and maps

An aerial photograph or reproduction of such a photograph (preferably in colour) of the locality must be provided, indicating scale, and clearly delineating the subject site.

A map or maps must be provided, showing:

- in the general area (nominally 5 kilometres radius),
  - ➲ land tenures and uses including parks and reserves, and areas of high human activity such as townships, regional centres and major roads
  - ➲ any locally significant areas for threatened biodiversity, such as local or regional corridors
  - ➲ the locations of any previously known threatened species or endangered populations
  - ➲ the locations and types of vegetation and non-vegetated areas (with reference to the description required in section4.1).
- in the study area,
  - ➲ the location, size and dimensions of the study area.
  - ➲ the full extent of the proposed works as described in section 2.1 at a scale of not less than 1:1000
  - ➲ topography of the site and immediate surrounds at a scale of not less than 1:3000
  - ➲ the locations and types of vegetation and non-vegetated areas (with reference to the description required in section4.1)
  - ➲ the current activities/usage of this land.

All maps must indicate scale and have an explanatory legend of any symbols used.

3 INITIAL ASSESSMENT

The following are further requirements related to your obligation under Section 110(2)(a) to address the following:

- *a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action.*

and the requirements under Section 110(3)(a) to address the following:

- *a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action*

3.1 Assessment of available information

In determining the subject threatened species, populations and ecological communities likely to be present in the study area (the *subject species*), a full list of threatened species, populations and ecological communities that potentially occur must first be compiled. In doing this records in flora and fauna from databases such as the OEH Atlas of NSW Wildlife[1], and those held by local governments, the Australian Museum, the CSIRO, Forests NSW and the Botanic Gardens Trust Sydney must be considered and documented in compiling the list. The distance from which existing records must be considered must be at least 5 km from the boundary of the study area, but may need to be greater depending on the type of organism, its potential habitats and the level of past survey that has been conducted for it.

Even if not required to offset impacts (see section 7.1.2), use of the *Biodiversity Assessment Method (BAM) Calculator* (www.lmbc.nsw.gov.au/bamcalc) to predict species from identified plant community types is also recommended to supplement the list of threatened species that possibly occur in the study area.

Assessment of habitat and habitat features in accordance with guidance in section 3 of the *Field survey methods* (www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/about-threatened-species/surveys-and-assessments/field-survey-methods) should also be undertaken. The habitat assessment should identify the types, locations and conditions of vegetation and key habitat features for both flora and fauna in the study area to assist with predicting the occurrence of threatened species in the study area and to guide the location for subsequent targeted surveys. DECC's Rapid *Fauna Habitat Assessment of the Sydney Metropolitan CMA Area* (DECC 2008, www.environment.nsw.gov.au/surveys/SMCMAFaunaAssessSydMetro.htm) may be of use.

The SIS must include the compiled list of candidate threatened species, populations and ecological communities that were considered likely to be present in the locality.

3.2 Identifying subject threatened species, populations and ecological communities

A list of subject threatened species, populations and ecological communities likely to be present in the study area (*the subject species*) must then be developed from recent records obtained from the data sources above, as well as any other species likely to be present that may not have been recorded. In developing the list of subject species, populations and ecological communities, consideration must be given to the habitat types present within the study area and the known distribution of threatened species, populations and ecological communities in the locality.

The following species, populations and ecological communities *must* be considered for inclusion in the list of subject threatened species, populations and ecological communities:

[1] Contact the OEH Wildlife Data Unit to obtain a full Atlas report under licence for the locality around the study site. Note that the OEH Atlas only holds records for which the OEH is the custodian and does not include records held in other databases where the conditions of data licences or data exchange agreements prevent the OEH from distributing such information. As a result the OEH Atlas may only contain a small subset of the available data for a particular search. Hence, other databases must also be consulted to assist in making an adequate determination of subject species.

Threatened species: fauna

Scientific name	**Common name**	**NSW TSC Act conservation status**	**Comments** e.g. recent reliable records
Anthochaera phrygia	Regent Honeyeater	Critically Endangered*	**Considered to have potential to occur by pre-DA EIA. several recent records within 4.5 km**
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	**Records within 2.5–4 km**
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	**Recorded on/over site in pre-DA surveys**
Lathamus discolor	Swift Parrot	Endangered*	**Considered to have potential to occur by pre-DA EIA**
Daphoensitta chrysoptera	Vareid Sitella	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Glossopsitta pusilla	Little Lorikeet	Vulnerable	**Considered likely to occur by pre-DA EIA**
Lophoictinia isura	Square-tailed Kite	Vulnerable	**Recorded on/over site in pre-DA surveys**
Haliaeetus leucogaster	White-bellied Sea-eagle	Vulnerable	**Relatively recent record within 700 m**
Hieraaetus morphnoides	Little Eagle	Vulnerable	**Relatively recent record within 1.7 km**
Ninox connivens	Barking Owl	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Ninox strenua	Powerful Owl	Vulnerable	**Considered likely to occur by pre-DA EIA. Relatively recent records as close as 200 m (31 Myoora Rd in 2007)**
Tyto novaehollandiae	Masked Owl	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Tyto tenebricosa	Sooty Owl	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable*	**Considered to have potential to occur by pre-DA EIA**
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	**Recorded on site in pre-DA surveys**
Petaurus norfolcensis	Squirrel Glider	Vulnerable	**Considered to have potential to occur by pre-DA EIA. Reliable? 2008 record from 1.2 km NE**
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Endangered*	**Considered to have potential to occur by pre-DA EIA. Recent reliable records within 900 m**
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable*	**Recorded on/over site in pre-DA surveys**
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable*	**Considered to have potential to occur by pre-DA EIA**
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Miniopterus australis	Little Bentwing-bat	Vulnerable	**Considered to have potential to occur by pre-DA EIA. Recent records within 3.3 km**
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable	**Recorded on/over site in pre-DA surveys. Other recent records within 900 m**
Mormopterus norfolkensis	Eastern Freetail-bat	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Saccolaimus flaviventris	Yellow-bellied Sheathtail-Bat	Vulnerable	**Recorded on/over site in pre-DA surveys. Recent records within 3.3 km**
Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable*	**Considered to have potential to occur by pre-DA EIA**
Pseudophryne australis	Red-crowned Toadlet	Vulnerable	**Considered to have potential to occur by pre-DA EIA**
Varanus rosenbergi	Rosenberg's Goanna	Vulnerable	**Recorded on/over site in pre-DA surveys. >10 records within 2 km**

Threatened species: flora

Scientific name	**Common name**	**NSW TSC Act conservation status**	**Comments** e.g. recent reliable records
Callistemon linearifolius	Netted Bottle Brush	Vulnerable	
Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable*	**Considered to have potential to occur by pre-DA EIA**
Diuris bracteata		Endangered*	**Atlas record within 3.1 km**
Epacris purpurascens var. purpurascens		Vulnerable	**Reliable records within 500 m on Somersby soil landscape**
Eucalyptus camfieldii	Camfield's Stringybark	Vulnerable*	**Considered to have potential to occur by pre-DA EIA. Atlas records in locality are pre-1986**
Genoplesium baueri	Bauer's Midge Orchid	Endangered*	**Considered to have potential to occur by pre-DA EIA. Recent record from Belrose.**
Grevillea caleyi	Caley's Grevillea	Critically Endangered*	**Recorded on site in earlier surveys and in pre-DA surveys**
Haloragodendron lucasii		Endangered*	**1986 Atlas record within 2 km**
Lasiopetalum joyceae		Vulnerable*	**Considered to have potential to occur by pre-DA EIA**
Melaleuca deanei	Deane's Paperbark	Vulnerable*	**Considered to have potential to occur by pre-DA EIA**
Microtis angusii	Angus's Onion Orchid	Endangered*	**Considered to have potential to occur by pre-DA EIA**
Persoonia hirsuta	Hairy Geebung	Endangered*	**Recorded on site in earlier surveys**
Pimelea curviflora var. *curviflora*		Vulnerable	**Considered to have potential to occur by pre-DA EIA. Several reliable records within 1.2 km on Somersby soil landscape**
Syzygium paniculatum	Magenta Lilly Pilly	Endangered*	**Recent records within 700 m & 1200 m**
Tetratheca glandulosa		Vulnerable	**Considered to have potential to occur by pre-DA EIA. >25 records within 1.2 km**

Those marked with an asterisk (*) are a species that is also listed as threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Endangered populations

There are no endangered populations likely to occur in the local area.

Endangered or critically endangered ecological communities

The following threatened ecological communities *must* be considered as subject threatened ecological communities:

Duffys Forest Ecological Community in the Sydney Basin Bioregion (endangered)
Coastal Upland Swamp in the Sydney Basin Bioregion (endangered) *

Those marked with an asterisk (*) are an ecological community that is also identified (although possibly under a different name) as a threatened ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Given the limitations of existing databases, these lists must not be taken to be exhaustive. One of the roles of the SIS is to determine which species may be utilising and/or be affected within the study area.

The proponent should also be aware that additional species, populations and ecological communities could be added to the schedules of the TSC Act between the issue of these requirements and the granting of consent. Any entities listed as 'critically endangered' or 'endangered'[2] in a final determination by the NSW Scientific Committee made after lodgement of an application for a development under Part 4 or an activity under part 5 of the EP&A Act or for a licence under s.91 of

[2] Species, populations or ecological communities listed after lodgement as 'vulnerable' are not subject to impact assessment so long as the application is determined within 12 months of lodgement (s.113C TSC Act, ss.105A and 110D EP&A Act).

the TSC Act needs to be addressed in the SIS and considered by the consent or determining and concurrence authorities. Proponents are therefore advised to take note of preliminary determinations by the Scientific Committee. The NSW legislation website (www.legislation.nsw.gov.au/) provides the most up-to-date information on what is listed in the schedules of the TSC Act.

4 SURVEY

4.1 Requirement to survey vegetation and ecological communities

4.1.1 General survey requirements

Vegetation and ecological communities must be surveyed, described (including documentation of the areal extent of each vegetation community) and accurately mapped. This should include areas with both introduced and native species, and areas with the potential to regenerate, either naturally or with assistance, to native vegetation.

Vegetation classifications must have regard to both structural and floristic elements and be supported by quantitative data from 0.04 ha plots, in accordance with Appendix 4 Modules 1 'Minimum requirements' and Module 2 'Floristics' of the *Native Vegetation Interim Type Standard* (DECCW, January 2010) (www.environment.nsw.gov.au/resources/nativeveg/10060nvinttypestand.pdf). Prior to sampling the study area should be stratified, if required, taking into account any *a priori* variation in composition, structure, condition and disturbance. These stratification units should then be sampled using 400 m^2 quadrats. Quadrats should be placed as randomly as possible, given study area constraints.

Vegetation communities identified must be discussed in relation to:

- *The Native Vegetation of the Sydney Metropolitan Area* (*Version 3.0)* (OEH, 2016), a classification and mapping of vegetation within the former Sydney Metropolitan Catchment Management Authority area, that is available from OEH's website at http://data.environment.nsw.gov.au/dataset/the-native-vegetation-of-the-sydney-metropolitan-area-oeh-2016-vis-id-4489 [3] Any differences between this mapping/classification and those determined by the SIS must be discussed and explained.
- the plant community type (PCT) classification from the VIS Classification Database (www.environment.nsw.gov.au/research/Visclassification.htm)
- any recent vegetation mapping by Randwick Council
- the descriptions of endangered or critically endangered ecological communities (EECs/CEECs), as determined by the Scientific Committee and any mapping of these EECs/CEECs in relevant recovery plans
- condition and the potential of degraded areas to regenerate, either naturally or with assistance, to native vegetation, taking into account site disturbance history (*e.g.* fire, logging, grazing, hydrology) and environmental factors (*e.g.* flooding, drought, extreme heat or cold).

4.1.2 Additional survey requirements for specific ecological communities or vegetation types

None

[3] Version 3.0 updates the plant community type (PCT) and biometric vegetation type (BVT) to which the map units relate, but made no changes to the vegetation community descriptions or areal extent of the communities documented in version 2.0.

4.2 Requirement to survey for species

4.2.1 General survey requirements for species

Targeted surveys for subject species and their habitats must be undertaken

- within the study area to provide information on distribution, population/sub-population sizes and density, and area of habitat (known and potential), noting variations across the study area.
- across the local extent of the population(s) to provide information on distribution, population/sub-population sizes, and area of habitat (known and potential).

This data is necessary to support the impact assessment requirements of section 5 and of the assessment of significance.

The techniques and timing of these surveys should be commensurate with the biology/ecology of these species and ecological communities in order to maximise the likelihood and accuracy of detection. Guidance on appropriate methodologies and level and timing of survey efforts can be obtained from OEH's website www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm, including requirements for some groups of species detailed in

- the *Threatened species survey and assessment guidelines - field survey methods for fauna: amphibians* (2009)
- the *Guide to Surveying Threatened Plants* (2016), and
- section 3.1.19 and section 5 of OEH's *Threatened Species Survey and Assessment Guidelines* (draft, 2004, www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm).

Environmental impact assessment guidelines and draft or approved recovery plans (see section 9.4) must also be consulted for specific survey requirements for species and ecological communities. Scientific or environmental management journals, biodiversity surveys and other sources. Additional specific survey requirements for certain species, populations and ecological communities are identified in section 4.3.

The key determinant for the level of survey effort required is the information required to identify the size and extent of local population(s) of threatened species and local occurrence(s) of threatened ecological communities and their habitat(s).

Any modifications to the recommended or required survey methods or levels of survey effort require justification of their adequacy. This justification should be scientifically valid and refer to relevant scientific literature. Previous surveys (yours or others) can contribute to fulfilling the requirements of section 4, but only if they have been conducted and documented in accordance with the provisions specified in that section, e.g. with respect to the type, location, duration, spacing/density, appropriate season and weather conditions, etc. of the surveys. Documentation and mapping of these attributes, as required by section 4.2, applies equally to any previous surveys used. The currency of any previous surveys used to fulfill these requirements is a matter that will need to be considered by the consent authority in determining the adequacy of the SIS.

Species of taxonomic uncertainty must have their identification confirmed by a recognised authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.

4.2.2 Additional survey requirements for specific species

Eastern Pygmy-possum

It is noted that BioNet Atlas of NSW Wildlife holds no records closer to the site than 1,300 metres and these are from the Tumbledown Dick Hill section of Mona Vale Road. There are no records of the species from Dundundra Falls Reserve; beyond that there are records within Ku-ring-gai Chace national park, however the closest of these is more than 1,980 metres from the edge of the subject site. Surveys must be undertaken to support the assumption in the assessment supporting the development application that the Eastern Pygmy-possums recorded on the site are part of a larger local population that exhibits has interconnectivity between the site and adjoining areas of habitat.

Tree-roosting microchiropteran bats

There may be suitable feeding, roosting and possibly breeding habitat at the site for threatened tree-dwelling microchiropteran bats within the locality. Survey is to be undertaken focusing on the identification of potential and actual roost sites of these and other tree-dwelling microchiropteran bats by:

- mapping the distribution of potential roosts sites (e.g. dead stags, live trees with hollows, trees with loose bark; buildings; Yellow-bellied Sheathtail-bat is even known to utilise mammal burrows); recording their habitat characteristics (e.g. size and number of tree hollows, type of bark) across the whole subject site; and identifying which will be destroyed and which retained
- carrying out replicated surveys (using echolocation detection and harp trapping) during the *breeding* season – the period when most likely to encounter foraging bats – relevant to the targeted species
- if these or other tree-roosting species are detected, then methods such as radio-tracking are to be used to identify where the maternity roosts are located.

The location of traps and ultrasonic detectors must be in the areas of greatest potential activity (e.g. roost sites or potential flyways). Echolocation surveys must use a combination of set point and hand-held detectors and be conducted for a minimum of 4 hours per night, since different species display activity peaks at various times during the night.

Cave-, tunnel- or culvert-roosting microchiropteran bats

Atlas of NSW Wildlife holds recent observations of both *Miniopterus schreibersii oceanensis* and *Miniopterus australis* in the locality. While the subject site is unlikely to have roost sites for these species (although *M. australis* has been recorded roosting within tree hollows), it could constitute foraging resource. Hence, replicated surveys (using echolocation detection and harp trapping) targeting these species are to be carried out from February to September when locally these species occur in larger numbers (G. Hoye, pers. comm.).

Persoonia hirsuta and *Pimelea curviflora* var. *curviflora*

Persoonia hirsuta has been previously recorded within the subject site. Both of these species are difficult to detect, particularly when not in flower, so surveys must be undertaken whilst the species is flowering, based on flowing of known populations at other indicator sites, or during know flowering periods.

Grevillea caleyi

Grevillea caleyi (Critically Endangered) was recorded from the subject site in the flora assessment carried out prior to the development application. Targeted surveys must be undertaken for this species.

4.3 Documentation

4.3.1 Description of survey techniques and survey locations

Survey technique(s) must be described and, where possible, a reference supporting the survey technique employed is to be provided.

The size, orientation and dimensions of quadrats or length of transects should be clearly documented for each type of survey technique undertaken. Full AMG grid references for the survey site(s) should be noted. Survey site(s) should be shown on a map or maps, which indicate scale and have an explanatory legend of any information showing symbols used.

4.3.2 Documenting survey effort and results

OEH has survey proformas for a range of standard fauna survey techniques. Digital copies of these proformas are available by electronic mail and should be obtained from the nominated contact officer. These proformas should be used by field staff when undertaking fauna surveys and completed data sheets are to be included as an appendix to the SIS.

Name(s) and contact phone number(s) of surveyor(s) and other personnel must be recorded. Other persons who identified records (e.g., by analysis of Anabat recordings, hair tubes, scats) should also be named.

The date and time and environmental conditions experienced during each survey must be documented.

The time invested for each survey technique must be summarised in the SIS, based on completed proformas, e.g. - number of person hours/transect, duration of call playback, number of nights traps set. **It is not sufficient to aggregate all time spent on all survey techniques. Effort must be expressed each time a survey technique is applied.**

Any limitations (e.g. denied access to private land) to sampling across the study area are to be documented.

4.3.3 Description and mapping of results of vegetation, flora and fauna surveys

The locations of any newly recorded threatened species, endangered populations or endangered or ecological communities resulting from additional surveys must be mapped and described.

5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS

Assessment of impacts must include the assessment of all components and associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed:

- buildings, bridges, walkways and other structures
- associated infrastructure such as for access roads, sewage, drainage, electricity, gas or water
- any structure or activity that may change surface, ground or subterranean water movements, including dams/ponds, pipes/channels or other infrastructure for ground and surface water control and drainage, waste water/effluent management or erosion control
- wastewater disposal
- drainage infrastructure and changes made to surface water flows
- bush fire hazard reduction and protection measures, such as modified fuel zones (e.g. inner and outer protection areas of asset protection zones (APZs)), access roads or trails, water supply infrastructure, etc.
- landscaping
- ongoing maintenance and other operational activities.

Assessment must consider the nature, extent, timing (including duration) and intensity of those components. Assessment must include the **direct and indirect** impacts of these activities which may occur either **on or off** the subject site. The impact on populations or habitats in any proximate reserved lands must be specifically discussed.

Among other possible causes, the impacts on threatened species and populations from the proposed development may arise from:

- direct injury and deaths of individual plants or fauna
- disturbances that affect breeding success and survival of fauna

- loss or modification causing decline in its quality and extent of habitat for plants and fauna through:
  - clearing
  - fragmentation and isolation
  - edge effects
  - overshadowing
  - changes to the hydrological regime resulting from altered surface and subterranean flows and groundwater levels
  - increased susceptibility to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetative cover;
  - deterioration in water quality
  - weed invasion
- indirect effects of ongoing and increased human use of the new infrastructure (e.g. rubbish, vegetation and soil damage.

5.1 Assessment of species likely to be affected

The following are further requirements related to your obligation under Section 110(2)(b) to address the following:

an assessment of which threatened species or population known or likely to be present in the area are likely to be affected by the action.

This requires you to refine the list of subject threatened species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or endangered populations may be affected directly or indirectly (including cumulatively), by the proposal. This is to be done taking account of the requirements outlined previously in section 4 above and information in any relevant Scientific Committee determinations, conservation or assessment advices, OEH threatened species profiles, recovery plans and draft recovery plans, and vegetation assessment and mapping. Detailed rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the species does not occur in the study area, or if not resident, will not utilise habitats on site on occasion, or if off-site, be influenced by off-site impacts of the activity, that species does not have to be considered further. Otherwise all species/populations likely to occur in the study area (based on general species distribution information), and known to utilise those habitat types, should be assessed as if present.

The requirements in the remainder of this section need only be addressed for those species that are likely to be affected by the proposal. Subsequently this information should be used in an Assessment of Significance (as required in section 8) for each of those species or populations.

5.2 Discussion of local and regional abundance and distribution

The following are further requirements related to your obligation under Section 110(2)(d) to address the following:

an estimate for the local and regional abundance of those species or populations

5.2.1 Discussion of regional occurrences and the local population

A discussion of the occurrences of each threatened species or endangered population in the region must be provided and include:

- which occurrences are considered to constitute part of the *local population* and why
- an estimate of the number of individuals of each species in the region, and a comparison of the part of the local population utilising the study area to those outside
- the relative significance of the subject site for each species or population in the *locality* and in the region.

5.3 Assessment of habitat

The following are further requirements related to your obligation under Section 110(2)(f) to address the following:

a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region.

5.3.1 Description of habitat values

Different types of habitats (e.g. breeding, sheltering, foraging) must be distinguished.

Specific habitat features (frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks, etc.) and the density of understorey vegetation and groundcover must be described in relation to the habitat needs of each species.

The quality and conditions of habitats within the study area for the species must be discussed, and must include:

- remnant sizes, shape, area to perimeter ratio, and connectivity
- species abundances
- disturbances, including:
  - fire (including details of fire history (e.g. frequency, time since last fire, intensity) and the source of such information (e.g. observation, local records), must be provided.
  - weed types and abundances/cover in each vegetation community,
  - trampling or grazing
  - erosion
  - rubbish dumping
  - proximity to disturbances.

5.3.2 Discussion of habitat utilisation

A discussion of how individuals use the area (e.g. residents, transients, adults, juveniles, nesting, foraging) and discussion of the significance of the habitat of the study area to the viability of the threatened species or endangered population *in the locality* must be included.

5.4 Discussion of conservation status

The following are further requirements related to your obligation under Section 110(2)(c) to address the following:

for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it

and to your obligation under Section 110(2)(e) to address the following:

an assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region

and to your obligation under Section 110(2)(e1) to address the following:

an assessment of whether any of those species or populations is at the limit of its known distribution

The relative significance of the study area for the threatened species or endangered population must be discussed. Such an assessment must consider and compare the differences in the type, quality, and long-term security with other occurrences and their habitats elsewhere in the *locality* and the region.

The assessment should document and consider other now-extinct or diminished populations of each threatened species or endangered population in the locality and region and the fragmentation, decrease in extent or degradation of their habitats.

5.5 Discussion of the likely effect of the proposal at local and regional scales

The following are further requirements related to your obligation under Section 110(2)(g) to address the following:

a full assessment of the likely effect of the action on those species and populations, including, if possible, the quantitative effect of local populations in the cumulative effect in the region

5.5.1 Significance within a local context

Provision of information to allow adequate determination of the significance of the effect of the proposal in accordance with Section 5A of the EP&A Act (see section 8 of these requirements below) is required. For each affected threatened species or endangered population the impacts of the proposal on that part of the *local population* within the study area must be considered in determining the significance of effect on the *local population* and this must take into account the differences between the type, condition and long-term security of local populations and habitats within the study area to those elsewhere within the *locality*.

5.5.2 Extent of habitat removal or modification

The assessment must consider the location, nature, extent and proportion of removal and modification of habitat of the *local population* and the effects of this on its viability. Consideration must include the cumulative impacts which will or may result from the proposal or any other approved or identified developments, activities or actions.

5.5.3 Discussion of connectivity

The impact of the proposal on connectivity must also be discussed. This must include examination of the potential of the proposal to:

- increase fragmentation
- reduce remnant size of the habitat
- decrease the ability for movement of individuals and/or gene flow between habitats or within the local population (or sub-populations) or between the local population and other populations.

5.5.4 Consideration of threatening processes

Assessment of effects must not be limited to threats that are recognised as key threatening processes, but must include other threatening processes that affect the species or population and are likely to be caused or exacerbated by the proposal. Assessment should include consideration of information in the NSW Biodiversity Conservation Program (www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/programs-legislation-and-framework/biodiversity-conservation-program) and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.

5.6 Description of feasible alternatives and measures taken to avoid impacts

The following are further requirements related to your obligation under Section 110(2)(h) to address the following:

a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.

In accordance with the Principle 9 of the *OEH Principles for the Use of Biodiversity Offsets in NSW* (http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm) the proponent must demonstrate in the SIS what alternatives have been considered, efforts made and measures committed to in order to purposefully avoid and minimise the impacts on a local occurrence of any threatened species, population or ecological community to ensure that it remains viable in the long term.

The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.

Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF, as long as the document referred to is provided with the SIS.

6 ASSESSMENT OF LIKELY IMPACTS ON ENDANGERED ECOLOGICAL COMMUNITIES

Assessment of impacts must include the assessment of all components and associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed:

- buildings, bridges, walkways and other structures
- associated infrastructure such as for access roads, sewage, drainage, electricity, gas or water
- any structure or activity that may change surface, ground or subterranean water movements, including dams/ponds, pipes/channels or other infrastructure for ground and surface water control and drainage, waste water/effluent management or erosion control
- wastewater disposal
- drainage infrastructure and changes made to surface water flows
- bush fire hazard reduction and protection measures, such as modified fuel zones (e.g. inner and outer protection areas of asset protection zones (APZs)), access roads or trails, water supply infrastructure, etc.
- landscaping
- ongoing maintenance and other operational activities.

Assessment must consider the nature, extent, timing (including duration) and intensity of those components. Assessment must include the **direct and indirect** impacts of these activities which may occur either on or **off** the subject site. The impact on populations or habitats in any proximate reserved lands must be specifically discussed.
Among other possible causes, the impacts on threatened species and populations from the proposed development may arise from:

- direct injury and deaths of individual plants or fauna that form part of an ecological community and its habitat
- loss or modification causing decline in its quality and extent of habitat for an ecological community through:
  - clearing and other disturbances
  - fragmentation and isolation
  - edge effects
  - overshadowing
  - changes to the hydrological regime resulting from altered surface and subterranean flows and groundwater levels
  - increased susceptibility to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetative cover;
  - deterioration in water quality
  - weed invasion
- indirect effects of ongoing and increased human use of the new infrastructure (e.g. rubbish, vegetation, soil damage, disturbances).

6.1 Assessment of endangered ecological communities likely to be affected

The following are further requirements related to your obligation under Section 110(3)(a) to address the following:

a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action.

This requires you to refine the list of subject ecological communities (given the outcome of survey and analysis of likely impacts) in order to identify which EECs/CEECs may be affected, directly or indirectly (including cumulatively), by the proposal. This must include reference to the EECs/CEECs as described by the NSW Scientific Committee, and to the requirements outlined previously in section 4, and take into account information in any relevant recovery plans or draft recovery plans and vegetation assessment and mapping. This is to be done taking account of the requirements outlined previously in section 4 above and information in any relevant determinations by the NSW Scientific Committee, conservation or assessment advices, recovery plans and draft recovery plans, OEH threatened ecological community profiles, the OEH Vegetation Information System and vegetation assessment and mapping. Adequate rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the (C)EEC does not occur in the study area, or will not utilise habitats on site, or if off-site, be influenced by off-site impacts of the activity, that (C)EEC does not have to be considered further. Otherwise all EECs/CEECs likely to occur in the study area (based on general distribution information), and known to occupy those habitat types, should be assessed as if present.

The requirements in the remainder of this section need only be addressed for those EECs/CEECs that are likely to be affected by the proposal. Subsequently this information should be utilised in an Assessment of Significance (as required in section 8) for each of those EECs/CEECs.

6.2 Description of habitat

The following are further requirements related to your obligation under Section 110(3)(c) to address the following:

a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region.

6.2.1 Description of ecological community and habitat

Descriptions of occurrences of each EEC/CEEC is required and must include:

- a description of each EEC/CEEC, including:
  - ➲ comparison of the affected community with the EECs/CEECs as determined by the NSW Scientific Committee
  - ➲ reference to any relevant available recovery plans or draft recovery plans and vegetation assessment and mapping
  - ➲ maps, consistent with the descriptions provided, showing the extent and condition of the EEC/CEEC.
- location and distribution, remnant sizes, shape, area to perimeter ratio, and connectivity
- condition compared to benchmarks
- those areas where the community may only be represented by soil stored seed with no or few above-ground components
- details of disturbances, including:
  - o fire (including details of fire history (e.g. frequency, time since last fire, intensity) and the source of such information (e.g. observation, local records), must be provided.
  - o weed types and abundances/cover in each vegetation community,
  - o trampling or grazing
  - o erosion
  - o rubbish dumping
  - o proximity to disturbances.

- If the site shows signs of disturbance, details should be provided of the capacity of the EEC/CEEC to recover. This assessment will include consideration of the site's in-situ and migratory resilience and is to be accompanied by a map of the recovery capacity of the EECs/CEECs across the site. When assessing its recovery capacity consideration should be given to the results (preliminary or otherwise) of restoration projects being undertaken at other sites that contain the EECs/CEECs.

6.2.2 Discussion of regional occurrences and the local occurrence

A discussion of the occurrences of each EEC/CEEC in the region must be provided and include:

- which occurrences are considered to constitute part of the *local occurrence* and why
- the area of each EEC/CEEC in the region, and a comparison of the part of the local occurrence within the study area to that outside
- the relative significance of the subject site for each EEC/CEEC in the *locality* and in the region.

6.3 Discussion of conservation status

The following are further requirements related to your obligation under Section 110(3)(b) to address the following:

for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it.

The following are further requirements related to your obligation under Section 110(3)(b1) to address the following:

an assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region.

The following are further requirements related to your obligation under Section 110(3)(b2) to address the following:

an assessment of whether any of those ecological communities is at the limit of its known distribution.

The relative significance of the subject site for each EEC/CEEC in the locality must be discussed. Such an assessment must consider and compare the differences in the type, extent, quality and long-term security with other known occurrences and habitats in the *locality* with those in the study area.

The assessment should document and consider other now-extinct or diminished populations of each EEC/CEEC in the locality and region and the fragmentation, decrease in extent or degradation of their habitats.

6.4 Discussion of the likely effect of the proposal at local and regional scales

The following are further requirements related to your obligation under Section 110(2)(g) to address the following:

a full assessment of the likely effect of the action on those species and populations, including, if possible, the quantitative effect of local populations in the cumulative effect in the region.

6.4.1 Significance within a local context

Provision of information to allow adequate determination of the significance of the effect of the proposal in accordance with Section 5A of the EP&A Act (see section 8 of these requirements below) is required. For each affected EEC/CEEC the impacts of the proposal on that part of the *local occurrence* within the study area must be considered in determining the significance of effect on the *local occurrence* and this must take into account the differences between the type, size, connectivity,

condition and long-term security of local occurrences within the study area to those elsewhere in the *locality*.

6.4.2 Extent of habitat removal or modification

The assessment must consider the location, nature, extent and proportion of removal and modification of habitat of the *local occurrence* and the effects of this on its viability. Consideration must include the cumulative impacts which will or may result from the proposal or any other approved or identified developments, activities or actions.

6.4.3 Discussion of connectivity

The impact of the proposal on connectivity must also be discussed. This must include examination of the potential of the proposal to:

- increase fragmentation of an EEC/CEEC or fragment it from other native vegetation
- reduce remnant size
- exacerbate edge effects
- decrease the ability for movement of individual components (organisms) of the EEC/CEEC and/or decrease gene flow between occurrences or habitats (including potential habitats) of the EEC/CEEC.

6.4.4 Consideration of threatening processes

Assessment of effects must not be limited to threats that are recognised as key threatening processes, but must include other threatening processes that affect the EEC/CEEC and are likely to be caused or exacerbated by the proposal. Assessment should include consideration of information in the NSW Biodiversity Conservation Program (www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/programs-legislation-and-framework/biodiversity-conservation-program) and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.

6.5 Description of feasible alternatives and measures taken to avoid impacts

The following are further requirements related to your obligation under Section 110(3)(e) to address the following:

> *a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.*

In accordance with the Principle 9 of the *OEH Principles for the Use of Biodiversity Offsets in NSW* (http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm) the proponent must demonstrate in the SIS what alternatives have been considered, efforts made and measures committed to in order to purposefully avoid and minimise the impacts on a local occurrence of any threatened species, population or ecological community to ensure that it remains viable in the long term.

The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.

Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF as long as the document referred to is provided with the SIS.

7 AMELIORATIVE MEASURES

7.1 Description of ameliorative measures

The following are further requirements related to your obligation under Sections 110(2)(i) and 110(3)(f) to address the following:

a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations [s.110(2)(i)] [or] ecological community [s.110(3)(f)] including a compilation (in a single section of the statement) of those measures.

The SIS must next consider measures to minimise or mitigate those impacts that remain unavoided, with the purpose of ensuring that that the local occurrence of any threatened species, population or ecological community continues to remain viable in the long term.

The proponent should be aware that any measures proposed in the SIS as reducing the level of impact may be formalised into the conditions of consent or approval for the proposal. Consequently, such measures should only be considered where they are practical and realistic, can be shown to have been successful in a similar situation elsewhere, and will be funded. The likely efficacy of such measures with respect to the current proposal must be assessed in detail.

7.1.1 Long term management strategies

Consideration must be given to developing long term management strategies to protect areas within the study area which are of particular importance for the threatened species or endangered populations likely to be affected. This may include proposals to restore or improve habitat on site where possible.

7.1.2 Compensatory measures

Where significant modification of the proposal to minimise impacts on threatened species or endangered communities is not possible then compensatory measures must be considered. These may include other off-site or local area proposals that contribute to long term conservation of the threatened species, population or ecological community. Compensatory measures are not considered to reduce the impact of effect of the proposal.

The proponent should be aware that any compensatory measures proposed may be formalised into the conditions of consent or approval for the proposal. Consequently, such measures should only be considered where they are practical and realistic, can be shown to have been successful in a similar situation elsewhere, and will be funded. The likely efficacy of such measures with respect to the current proposal, along with a discussion of mechanisms of how they be achieved and secured, must be assessed in detail. The tenure and current and the future use of lands proposed to support compensatory habitat must be considered.

Any proposed offsetting or other compensatory measures should be developed in accordance with the "*OEH Principles for the Use of Biodiversity Offsets in NSW*" (www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm) in order to achieve a net improvement in biodiversity over time and obtain its security.

Enhancement of biodiversity in offset areas should be equal to or greater than the loss in biodiversity from the impact site. Justification provided for any area proposed as compensatory habitat / offsets must include a comparison of the biodiversity values impacted on the subject site with those of the proposed offset area(s) and how the latter improves or maintain these values.

Principle 9 states that '*offsets must be quantifiable – the impacts and benefits must be reliably estimated*', in that offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. OEH considers that the Biodiversity Assessment Methodology (BAM) (www.environment.nsw.gov.au/biodiversity/

assessmentmethod.htm) to be the preferred methodology that ensures offsets are quantifiable and should be used to assess the adequacy of any proposed offsetting measures. If BAM is not used then OEH would expect an alternative quantitative methodology be adopted that shows that the biodiversity values of an offset site are improved or maintained.

The proponent must provide plans and survey details of any biodiversity offset areas, of quality and detail as described in sections 2.3.

To appropriately documents and guide the implementation of any compensatory offsets, any retained habitat enhancement features within the development footprint, and any impact mitigation measures (including proposed rehabilitation or monitoring programs, or both), an appropriate management plan (such as vegetation or habitat) be developed as a key amelioration measure. Where a proponent choses a biodiversity stewardship agreement, conservation agreement or similar, a management plan will be specifically developed as part of their establishment process.

Management plans should be prepared prior to any potential approval of the development. Management Plans should clearly document how any retained vegetated areas or habitat features will be managed with respect to long-term conservation and viability, including clear details on how they will be funded. They should cover (where applicable), but not be limited to, the following issues:

- weed management (both control and suppression) and monitoring
- management of retained native vegetation and habitat (including buffer zones)
- feral animal control
- fire management (including asset protection zones [APZs])
- public access (including restriction of, increased traffic, and associated impacts, such as increased refuse and pets)
- size and management of buffer zones
- minimisation of edge effects and fragmentation
- stormwater control and changes to hydrology (including stormwater / runoff control and sediment / erosion control measures)
- management of specific habitat enhancement measures (e.g. hollow / habitat trees, animal fencing to facilitate movement, artificial hollows and nest boxes etc.)
- fauna displacement and if appropriate translocation (including any licence requirements)
- proposed surveys, such as pre-extraction baseline, pre-clearance and rehabilitation surveys
- details of long-term monitoring (including proposed timing)
- details of any rehabilitation program, including details of timing (including proposed staging details), rehabilitation measures (including details of proposed revegetation and species mix), and post-rehabilitation monitoring
- measures to ensure conservation in perpetuity (e.g. transfer to OEH [NPWS] estate, conservation agreements or covenants)
- funding details of long-term financial commitment to any proposed conservation measures, including any mechanisms to be implemented to achieve this.

Where such proposals involve land under third party ownership or depend on the involvement of other parties, e.g. community groups, they should contain evidence of consultation with and support from such stakeholders.

7.1.3 Ongoing monitoring

Any proposed pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation measures must be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not been proved effective should be undertaken under experimental design conditions and appropriately monitored.

7.1.4 Translocation

The OEH does not consider that translocation of threatened species, populations and ecological communities is an appropriate ameliorative strategy for the purposes of considering impacts of a particular development/activity. OEH strongly supports the view that development proposals which may have significant impact on a local occurrence of threatened species, populations or ecological communities, as determined by the SIS, should aim to ensure that the local occurrence continues to persist and remain viable in the long term *in situ*. The translocation of threatened species, populations and ecological communities is only supported by the OEH in specific conservation programs (e.g. recovery planning) and as a last resort, and only when *in situ* conservation options have been exhausted. Such programs should only be considered following extensive investigation of a demonstrated long-term financial commitment on behalf of the applicant.

8 ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION

Based on the detailed SIS assessment and its consideration of alternatives and/or ameliorative measures (but not including compensatory), a re-assessment of the significance of impact (section 5A EP&A Act) is to be carried out for each of the threatened species, populations and ecological communities that are identified in the SIS as being likely to be affected. This assessment must be carried out in accordance with the *Threatened species assessment guidelines: the assessment of significance* (DECCW 2007, www.environment.nsw.gov.au/threatenedspecies/tsaguide.htm) and must incorporate the relevant information from sections 5.1 to 7.1.1 of these SIS requirements. For each entity an overall conclusion must be drawn as to whether the proposal is still considered likely to have a significant effect.

9 ADDITIONAL INFORMATION

9.1 Qualifications and experience

The following is your obligation under Sections *110(4)* to address the following:

a species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement

9.2 Other approvals required for the development or activity

The following are further requirements related to your obligation under Sections *110(2)(j) and 110(3)(g))* to address the following:

a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community

Other approvals under NSW law

In providing a list of other approvals the following must be included:

- where a consent is required under Part 4 of the *Environmental Planning and Assessment Act 1979*, the name of the consent authority and the timing of the development application should be included; or
- where an approval(s) is required under Part 5 of the *Environmental Planning and Assessment Act 1979*, the name of the determining authority(ies), the basis for the approval and when these approvals are proposed to be obtained should be included.

Approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

An action will require referral to, and may require the approval of, the Commonwealth Minister for the Environment (in addition to any local or state government consent or approval) if that action will have, or is likely to have, a significant impact on the environment or on a matter of National Environmental Significance (NES). Threatened species and communities listed in the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are considered to be matters of national environmental significance, as are migratory species and a number of other matters. Information regarding NES matters may be obtained from the website of the Commonwealth Department of the Environment www.environment.gov.au/epbc or by contacting that department on 1800 803 772.

9.3 Licensing matters relating to conducting surveys

Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:

National Parks and Wildlife Act 1974:

- General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna).
- Licence to pick protected native plants (Section 131).
- Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes.

Threatened Species Conservation Act 1995:

- Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91).

Animal Research Act 1985:

- Animal Research Authority to undertake fauna surveys.

9.4 Section 110 (5) reports

Section 110(5) of the Threatened Species Conservation Act 1995 has the effect of requiring OEH to provide any information regarding the State-wide conservation status of the subject species as it has available, in order to satisfy ss.110(2) & (3) of the Act. To this end, OEH has published profiles for threatened species, populations and ecological communities on the OEH website (www.environment.nsw.gov.au/threatenedSpeciesApp/). These profiles also include links to NSW Scientific Committee determinations, NSW recovery plans, environmental impact assessment guidelines and other resources. Some of these may be relevant to the subject species for this development proposal.

Proponents and consultants should note that OEH has no further published information available to satisfy s.110(5) of the Act and that use of the above profiles and linked information can be taken to have satisfied the requirements of ss.110(2) & (3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.

Appendix B: Landscape plan (Carmichael 2017)