Lot 1 DP 707300, Lot 5 DP 740252, Part Lot 101 DP 1077617, Part Lot 102 DP 1077617, Lot 8 DP 258605 and part of unnamed road reserve, Saddleback Mountain Road and Weir Street, Kiama

Flora and Fauna Assessment

Prepared for
White Constructions Pty Ltd

DOCUMENT TRACKING

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Methodology
BC Act	*Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
BOS	Biodiversity Offsets Scheme
DEE	Department of Environment and Energy (Commonwealth)
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FMA	*Fisheries Management Act 1994* (NSW)
ISR	Illawarra Subtropical Rainforest in the Sydney Basin Bioregion
KMC	Kiama Municipal Council
KTP	Key Threatening Process
LEP	Local Environment Plan
LGA	Local Government Area
PCT	Plant Community Type, from the NSW Vegetation Information System
PMST	Protected Matters Search Tool
TAP	Threat Abatement Plan
TEC	Threatened Ecological Community
VRZ	Vegetated Riparian Zone

Executive summary

Eco Logical Australia Pty Ltd (ELA) was engaged by Unicomb Development Pty Ltd to undertake a Flora and Fauna Assessment for the proposed rezoning of the nominated Lot 1 DP 707300, Lot 5 DP 740252, Part Lot 101 DP 1077617, Part Lot 102 DP 1077617, Lot 8 DP 258605 and part of unnamed road reserve, Saddleback Mountain Road and Weir Street, Kiama.

Ecological survey and identification of potential impacts on threatened ecological values is required as part of a planning proposal to Kiama Municipal Council to allow rezoning of the study area to permit future residential subdivision. The indicative development footprint assessed is expected to evolve in cognisance of constraints identified in this and other related assessments supporting the Planning Proposal.

The study area falls on the eastern mid to foot slopes of a ridgeline in the eastern Saddleback Mountain area, which rises to the west to about 150 m above sea level; and includes part of Munna Munnora Creek and several first order tributaries to this creek in the southeast to east. Another unnamed second order watercourse with a large dam in its upper extent upslope and just off site also occurs in the northeast; with another tributary in the northern end.

The subject site has long been largely cleared for pastoralism supporting possibly dairy and later beef cattle, with extensive improved pasture dominating. Remnant native vegetation on site appears to have been left only on the steepest and rockiest slopes associated with the highway, and rocky outcrops. Fences (which include historic stone walls) show maintenance has declined over the last decade or more, which has possibly facilitated some regrowth and expansion of *Lantana camara* (Lantana) in the eastern and southern areas.

Upslope to the west is a significant rainforest remnant on the crest to upper slopes, bound by cleared rural land with associated dwellings in all directions. This landscape character generally dominates the locality outside the residential areas to the east, south and north of the site. The vegetation on site was predominantly pasture, dams, rainforest remnants, rainforest regrowth, stone walls and rocky outcrops, and freshwater wetland vegetation.

Two threatened ecological communities were identified in the study area during survey. *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* (Freshwater Wetlands) was present as a thin ribbon of remnant vegetation along Munna Munnora Creek, and the channel of an unnamed watercourse in the north. Freshwater Wetlands is an endangered ecological community under the *Biodiversity Conservation Act 2016* (BC Act).

Illawarra Subtropical Rainforest of the Sydney Basin Bioregion was present in numerous remnant patches throughout the subject site. Illawarra Subtropical Rainforest is listed as an endangered ecological community under the BC Act.

One threatened flora species, *Zieria granulata,* was found on a rocky outcrop adjacent to a patch of Illawarra Subtropical Rainforest. This was the only threatened plant found in the subject site. *Circus assimilis* (Spotted Harrier) was the only threatened fauna species observed as an incidental fly over.

The proposal would result in a change in rezoning from RU2 – Rural Landscape to a residential zoning. Impacts associated with this change in land use would include loss of the pasture, scattered trees, and dams and some Illawarra Subtropical Rainforest removed. No direct impacts on Freshwater Wetlands are expected to occur. The *Z. granulata* would likely be retained. Potential impacts on foraging habitat

for 11 threatened fauna (including migratory species) would be likely to occur. These impacts are unlikely to constitute a significant impact.

1 Introduction

1.1 Background

Eco Logical Australia has been engaged by Unicomb Development Pty Ltd to undertake a Flora and Fauna Assessment (FFA) for the proposed rezoning and future residential development of the nominated Lot 1 DP 707300, Lot 5 DP 740252, Part Lot 101 DP 1077617, Part Lot 102 DP 1077617, Lot 8 DP 258605 and part of unnamed road reserve, Saddleback Mountain Road and Weir Street, Kiama.

The objectives of this assessment were to:

- identify and describe the vegetation communities present in the study area and their conservation significance;
- identify and describe the fauna habitats present in the study area and their condition;
- identify the flora and fauna species of conservation significance which are present or likely to occur in the study area;
- identify the potential impacts of the proposal on vegetation, fauna, habitats, and other environmental features as necessary;
- identify likely requirements of the potential approval pathways for the proposed development at subdivision stage
- make recommendations regarding any environmental management and impact mitigation/amelioration measures, which can be implemented to limit the effects of the proposal on vegetation, fauna, habitats, and other environmental features as necessary.
- address the required statutory assessments to support the Planning Proposal.

1.2 Subject site, study area and locality

The study area is located approximately 150 km south of the Sydney Central Business District, to the south-west of Kiama in the Municipality of Kiama.

The location of the study area is shown in Figure **1**. Access is via an underpass off South Kiama Drive.

The study area is defined as Lot 1 DP 707300, Lot 5 DP 740252, Part Lot 101 DP 1077617, Part Lot 102 DP 1077617, Lot 8 DP 258605 and part of unnamed road reserve, Saddleback Mountain Road and Weir Street, Kiama(Figure 2).

The *subject site* is the indicative development footprint (Figure 2).

The locality is defined in this report (unless otherwise specified) for the purpose of database searches is the area of land within a 10 km radius of the subject site.

1.3 The proposal

The proposal seeks to rezone the subject site from RU2 Rural Landscape to allow a future residential development of potentially over 400 lots ranging in size from around 450m^2 to 3,929m^2. An indicative development footprint is provided in **Figure 2**. This indicative development footprint is expected to evolve responding to constraints identified in this and other related assessments supporting the Planning Proposal.

Asset Protection Zones (APZs) in accordance with *Planning for Bushfire Protection* (RFS 2006) would need to be established at the subdivision stage. Asset Protection Zones are not discussed as part of this planning proposal.

1.4 Topography, geology and soils

The subject site falls on the eastern mid to foot slopes of a ridgeline in the eastern Saddleback Mountain area, which rises to the west to about 150 m above sea level; and includes part of Munna Munnora Creek and several first order tributaries to this creek in the southeast to east. Another unnamed second order watercourse with a large dam in its upper extent upslope and just off site also occurs in the northeast; with another tributary in the northern end.

Slope ranges from gentle to moderate (steep on the inner slopes of the incised watercourses), with drainage east to where both creeks exit the site under the Princes Highway.

Troedson and Hashimoto (2008) map Quaternary floodplains (alluvial plains) associated with both the unnamed watercourse and Munna Munnora Creek, as shown in **Figure 3**. The remainder of the site is mapped under the Kiama soil landscape, which are erosional soils (krasnozems on higher slopes to prairie soils on lower slopes) derived from Blow Hole latite of the Gerringong Volcanics (Hazelton 1992).

1.5 Disturbances and historical land use

The study area is part of an originally larger holding which has long been cleared for pastoralism supporting possibly dairy and later beef cattle, with extensive improved pasture dominating. Fencing on site ranges from historic rock walls to barbed wire with star pickets due to the shallow bedrock. The site is divided into several fenced paddocks, with a stockyard.

Remnant native vegetation on site remains on the steepest and rockiest slopes. Most of the site has been destocked, with a few horses and cows occupying paddocks in the north, and a few cows and calves in the southern end. Fences show maintenance has declined over the last decade or more, which has possibly facilitated some regrowth and expansion of lantana in the eastern and southern areas.

The site also encloses the historic Kendall Cemetery. This is infrequently maintained by mowing, with access via a reserve to the underpass under the Princes Highway.

Figure 1**: Location of the study area and subject site**

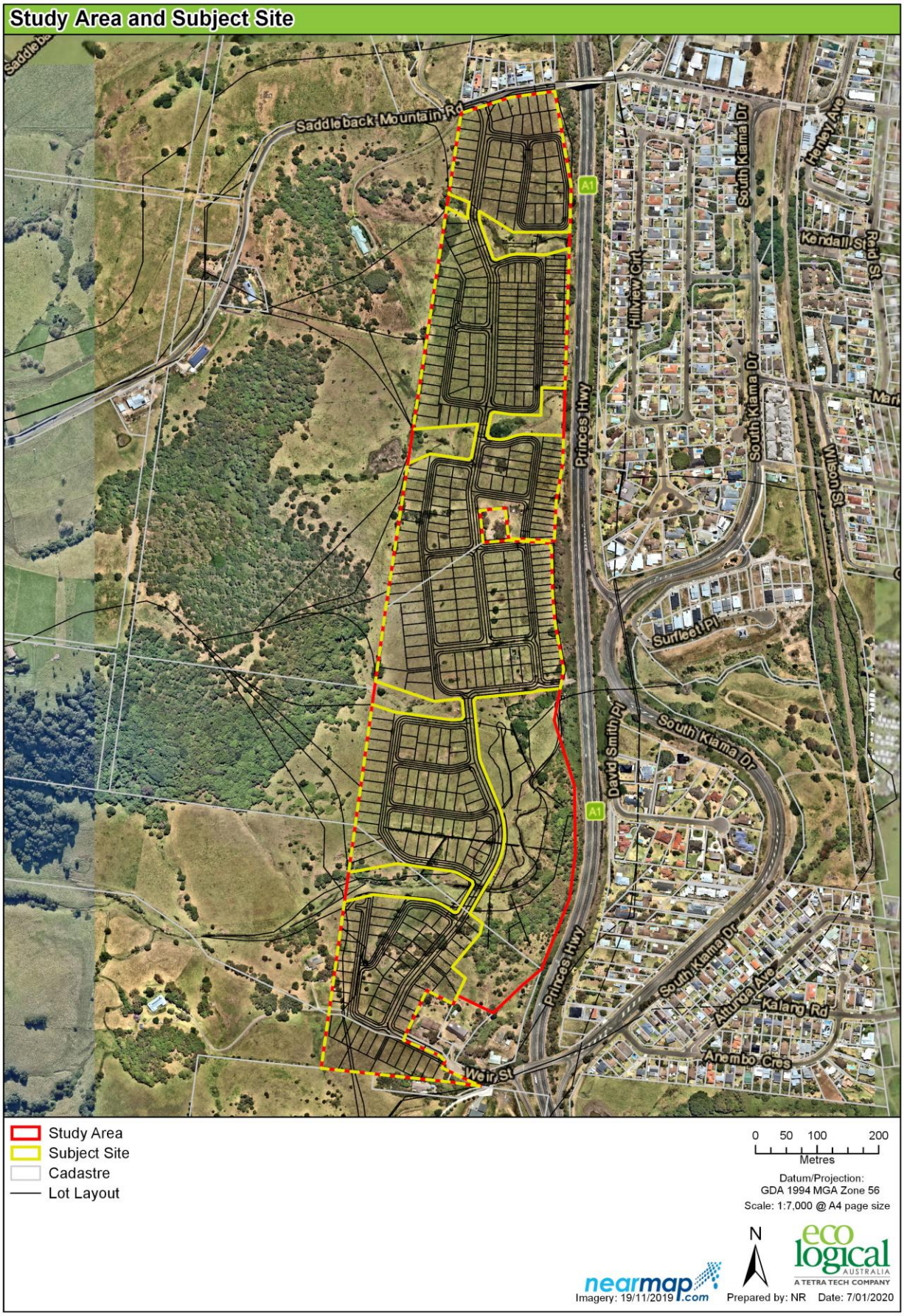

Figure 2: Indicative development footprint (subject site)

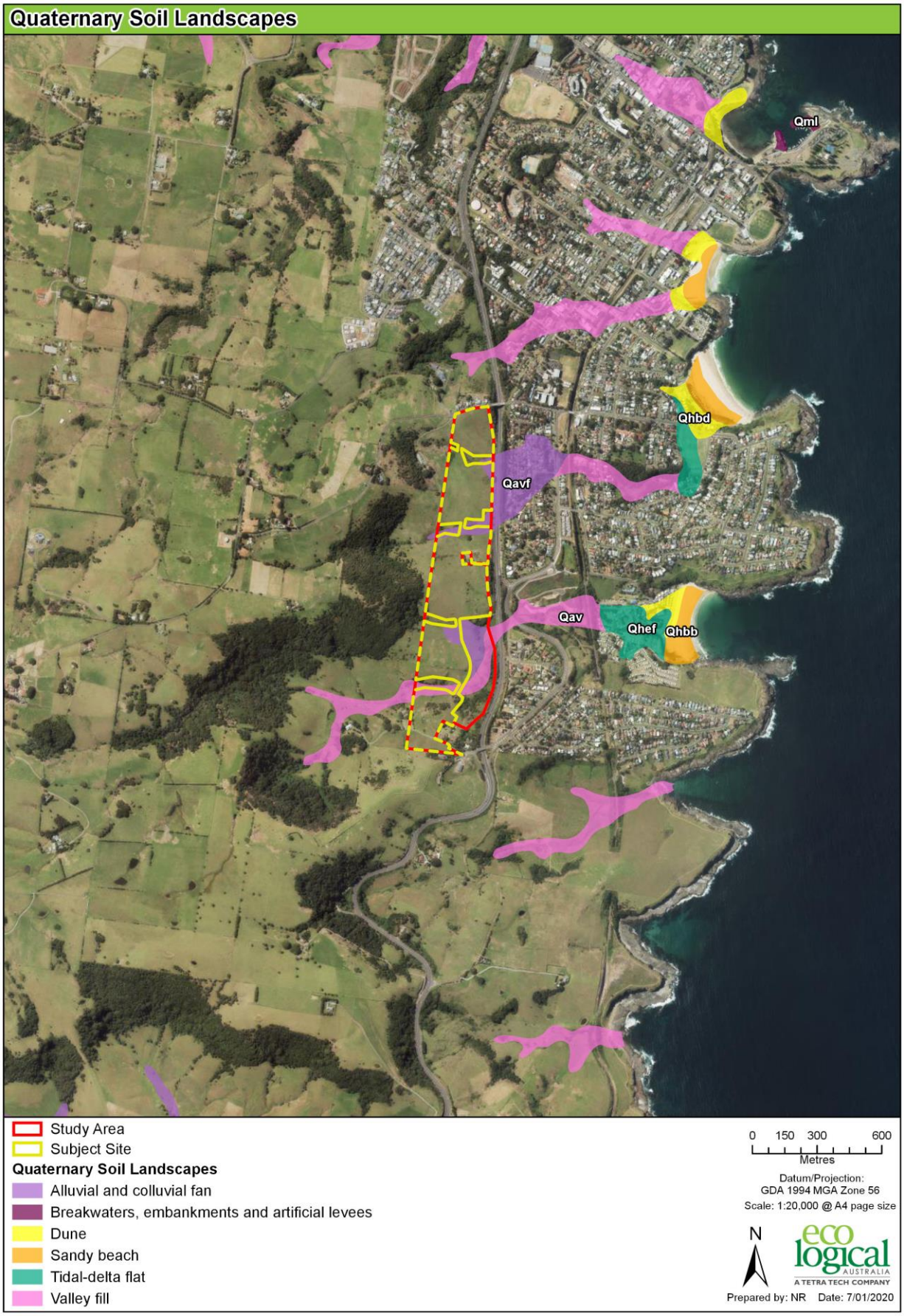

Figure 3: Quaternary soil landscapes in the study area

2 Legislative context

Commonwealth and State legislation and policies, as well as local policies apply to the assessment, planning and management of ecological issues within the study area. The relevant Commonwealth and State Acts and Policies (and local policies where relevant) assessed in this report are provided below (**Table 1**).

Table 1: Legislative context

Name	Relevance to the project	Section
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999	The site is not located within an area that has been the subject of a Strategic Assessment under the EPBC Act. The Commonwealth Minister for the Environment will need to be notified of all actions associated with the development that may significantly impact upon Matters of National Environmental Significance (MNES). A MNES assessment would be required for the submission of a Part 4 Development Application.	**Section 5**
State		
Environmental Planning and Assessment Act 1979	The proposal is to be considered as a component for a Gateway Proposal to Kiama Municipal Council (KMC) and requires consideration under Division 4 of Part 3 the EP&A Act, especially matters relevant to Section 56. Consideration of impacts on matters listed under the BC Act would be required for submission of a Part 4 Development Application.	**Section 6**
Biodiversity Conservation Act 2016	The land on which the development is proposed is not biodiversity certified under the BC Act, and therefore impacts to threatened species and ecological communities listed under the BC Act would require assessment at the time of submission of a Part 4 Development Application. Consideration of potential triggers of the Biodiversity Offset Scheme would be required.	**Section 5** and **Section 6**
Fisheries Management Act 1994	No fauna listed under the FM Act are known or likely to occur on site, hence assessment as per section 221ZV of the FM Act would not be required. The development does not impact upon mangrove vegetation or algae. Any impacts to aquatic ecological values protected under the FM Act would require assessment.	**N/A**
Planning Instruments		
Kiama Municipal Council LEP 2011	The subject site is zoned RU2 Rural Landscape, E2 Environmental Conservation and E3 Environmental Management under the Kiama LEP. A small portion of SP2 Special Infrastructure is present within the study area. This land is excluded from considerations in this study as it is not part of the planning proposal. The main watercourses are mapped on the Riparian Land and Watercourses maps. An area of rainforest vegetation in the south-eastern portion of the study area is identified on the Terrestrial Biodiversity. Impacts on such mapped areas would require Council to consider matters listed in section 6.4 of the LEP.	**Section 5**

Name	Relevance to the project	Section
Kiama Municipal Council DCP 2012	The stone walls on site are listed in Schedule 5 of the KMC LEP 2011. Retention, demolition and/or management of these walls within a subdivision would need to be considered.	**Section 5**
Coastal Management SEPP	The aim of this Policy is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016, including the management objectives for each coastal management area. The proposed development is not located on land mapped under the SEPP.	**N/A**

3 Methods

3.1 Database and literature review

The following information and databases were reviewed prior to field survey:

- BioNet Atlas Database (OEH 2018a)
- Southeast NSW Native Vegetation Classification and Mapping (SCIVI 2010)
- Southeast NSW Native Vegetation Classification and Mapping VIS ID 2230 (OEH 2016)
- EPBC Act Protected Matters Search Tool (DEE 2018a)
- Kiama LEP 2011
- aerial photographs
- site plans
- Technical references to mapped vegetation communities in the Kiama area (Mills 2006) (for 2016 ELA mapping only).

A search of Bionet (OEH 2018a) and the EPBC Act *Protected Matters Search Tool* (Environment Australia 2016a) was performed on 3 October 2018, using a radius of 10 km around the coordinates -34.69512; 150.83964.

3.2 Field survey

3.2.1 Vegetation validation

The subject site was surveyed by ELA ecologist / botanist Greg Steenbeeke on 26 July 2016 for a total of 8 person hours and a total distance of 8.4 km. Temperatures ranged from 14.4-16.9° C during the survey period and conditions were clear with no rain but windy (average wind speeds 25-30 km/h from the west (BOM 2016).

A second survey was undertaken on 14 September 2016 by ELA ecologist Jason Berrigan for a total of 8 hrs. Weather was fine with some light rain the evening before. Temperatures ranged from 14-20° C during the survey period and conditions with 2-30 km/h from the west-northwest to north (BOM 2016).

Given the limited extent of native vegetation and evidently significant disturbance history, the subject site was traversed on foot via random meanders, as opposed to a quadrat-based survey which is more vulnerable to influences of disturbance. Each traverse included an assessment of observed vegetation communities, condition and floristic structure. Where vegetation communities differed from those previously mapped, or where vegetation had not been previously mapped it was modified using hard copy maps. Flora species recorded within the subject site are provided in **Appendix B**.

A third survey was undertaken by ELA ecologists Nicole McVicar and Alex Gorey on 27 and 28 September 2018 for a total of 32 person hours. The vegetation mapping prepared by ELA in 2016 was validated and changes to the vegetation mapping was undertaken as required and modified using hard copy maps. The validated vegetation map was used to stratify the site into vegetation zones which are areas of vegetation of a certain type and condition. Vegetation integrity plots were undertaken in accordance with the Biodiversity Assessment Method (BAM). Each vegetation zone was surveyed consistent with the number of plots required. The plot survey effort was based on the area of each vegetation zone to be affected as per the indicative layout (Table 2). Seven vegetation integrity plots were undertaken. One 10 x 100 plot was undertaken in one patch where a 20 m x 50 m plot was not suitable.

Field survey was not conducted over part lot 102 DP 1077617 and Lot 8 DP 258605. The vegetation has not been field validated. Field validation would be required to accompany the submission of a development application. A desktop assessment of this lot was conducted to identify any vegetation communities or threatened flora and fauna species that have been previously recorded.

Table 2: Amount of each vegetation community in the indicative development footprint and number of plots required

Vegetation zone	Amount (ha) in indicative development footprint	Number of plots undertaken
Vegetation Zone 1: Illawarra Subtropical Rainforest good condition	0.17	1
Vegetation Zone 2: Illawarra Subtropical Rainforest poor condition	1.36	2
Vegetation Zone 3: Cleared land	28.44	4
Total	**29.97**	**7**

3.2.2 Threatened flora survey

Searches for the threatened flora recorded within a 5 km radius of the subject site (see **Appendix B**), were undertaken during a general survey (June 2016) and a targeted survey (September 2016). Additional targeted survey through all patches of native vegetation were conducted on 27 and 28 September 2018. The species requiring survey was determined by using the results of the BioNet search and the type of vegetation present. Where there were recent records and the vegetation community present could provide potential habitat, these species were surveyed for. These are listed below.

The first 2016 survey consisted of random meanders throughout the site's limited vegetation targeting species with nearby records and those that are known to occur in similar habitats. The second and third surveys included a more intensive search of the rainforest vegetation targeting:

- *Zieria granulata* (Illawarra Zieria) – endangered under the BC Act and EPBC Act
- *Cynanchum elegans* (White-flowered Wax Plant) – endangered under the BC Act and EPBC Act
- *Daphnandra johnsonii* (Illawarra Socketwood) - endangered under the BC Act and EPBC Act
- *Solanum celatum* – endangered under the BC Act
- *Syzygium paniculatum* (Magenta Lilly Pilly) – endangered under the BC Act and vulnerable under the EPBC Act
- *Gossia acmenoides* (Scrub Ironwood) endangered population under the BC Act.

Where physical access was impractical due to dense *Lantana camara* (Lantana) infestations in rainforest outside of the subject site, native shrubs, trees and vines were scanned with binoculars from the edge of the remnant seeking target threatened species.

Threatened flora survey was not conducted in over part lot 102 DP 1077617 and Lot 8 DP 258605.

Nomenclature

Most of the plant species names in this report are the current names published in the Flora of NSW (Harden 1990-1993). The taxonomic names have been supplemented with common names obtained from various sources. The scientific and conservation significance of individual plant species was

established with reference to Briggs and Leigh (1996) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* in the national context; and to the NSW *Biodiversity Conservation Act 2016* in the state context.

3.2.3 Threatened fauna habitat assessment

Threatened fauna habitat assessment was conducted in September 2016. Fauna occurrence is influenced by vegetation type, physiognomy and *in situ* substrates, as well as disturbance history and connectivity (DEC 2004, Davey 1984, Recher *et al* 1995, Barret *et al* 1994, Watson *et al* 2003, etc.), and hence an analysis of habitat components can indicate habitat quality and support value, and thus likely fauna assemblages.

The habitat components targeted for census include the type of vegetation present, the presence/absence of rock habitats, tree hollows, ponds, streams, wetlands, foraging substrates and other features likely to attract threatened fauna. The site and immediate surrounds were searched to identify habitat components, which were recorded and described.

The threatened fauna habitat assessment was not conducted over part lot 102 DP 1077617 and Lot 8 DP 258605.

Diurnal opportunistic surveys

Diurnal mammal searches were conducted in areas of potential habitat across the subject site, with emphasis on searches for scats, tracks, burrows, diggings and scratchings. Birds were surveyed by detecting calls and searching by binoculars during area searches over the whole site and actively listening/searching for birds and identifying calls. Reptiles and frogs were targeted for observation at likely basking sites, with any frogs calling identified by comparison to a reference library to confirm the species.

Diurnal surveys were not conducted over part lot 102 DP 1077617 and Lot 8 DP 258605.

Herpetofauna and secondary evidence searches

Physical habitat searches of the site were undertaken during the survey, specifically targeting species such *as Litoria aurea* (Green and Golden Bell Frog), gliders and forest owls. Survey involved:

- lifting up of debris to search for reptiles and frogs.
- inspection of dense vegetation for bird nests.
- observation of likely basking sites (i.e. reptiles and frogs).
- searches for scats, tracks, digging, sap incisions and scratches (e.g. Koala, gliders, etc.) over the site.
- searches for chewed Allocasuarina cones, indicative of foraging by the Glossy Black Cockatoo.
- searches for scats, owl regurgitation pellets and guano deposits.

Additional searches for habitat trees (trees containing hollows, fissures or nests) was undertaken in the subject site during the 2018 survey period.

Herpetofauna and secondary evidence searches were not conducted over part lot 102 DP 1077617 and Lot 8 DP 258605.

3.2.4 Aquatic ecological values

All watercourses mapped under the 1:25,000 hydroline were walked to identify the condition of each watercourse. This assessment did not include top of bank mapping nor did it include an assessment as to whether each watercourse met the definition of a "river" under the *Water Management Act 2000* (WM Act). Indicative Vegetated Riparian Zones were mapped based on the hydroline data and the Strahler Stream Order Classification of each watercourse.

One watercourse (watercourse nine) was not surveyed as part of the aquatic survey.

3.2.5 Survey limitations

Flora

The floristic survey undertaken provides a comprehensive but not definitive species list for the subject site. The total species list of an area is usually much greater than can be detected in such a short time and it can be influenced by factors such as: size of the property, fire history, time since disturbance, life cycle stage/dormancy (particularly orchids and annuals), and presence of reproductive material (DEC 2004).

Nevertheless, the techniques used in this investigation are considered adequate and relevant to gather the data necessary to identify constraints of the proposal on threatened flora and their habitat; and the identified limitations are offset by objectively considering the potential for species to occur when suitable habitat, connectivity, local recordsoccur, as per DEC (2004).

Fauna

The results of fauna surveys can be optimised by conducting investigations over a long period to compensate for the effect of unfavourable weather, seasonal changes, lifecycle stage and climatic variation (DEC 2004). Fauna survey results can also be improved by using a wide range of techniques at the right life cycle stage or conditions (e.g. call playback after heavy rain in summer for frogs), since some species are more likely to be detected by a particular method and time (DEC 2004).

However, all ecological surveys are subject to constraints that determine the amount of time allocated, the methods used, and the timing of the work. Thus the results should be viewed in the light of these limitations.

The fauna detected during the survey period are a guide to the native fauna present, but are by no means a definitive list of all the species occurring in the study area. In particular, the conditions during the survey period were not suitable for active reptile searches, being in winter, when reptile activity is typically low. Some species group specific methods (e.g. call detection of microchiropteran bats) were also not employed.

Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to identify potential ecological constraints to the proposal; and the identified limitations are offset by objectively considering the potential for species to occur when suitable habitat, connectivity, local records, etc., occur, as per DEC (2004).

It is noted that the vegetation and potential habitat features in part lot 102 DP 1077617 and Lot 8 DP 258605 would need to be ground-truthed for the preparation of the Part 4 DA submission.

Aquatic

Top of bank mapping or validation of whether each watercourse mapped under the 1:25,000 hydroline data met the definition of a 'river' was not undertaken as part of this assessment. It is hard to determine whether the indicative development footprint overlaps with any riparian corridors prior to mapping top of bank. In this assessment any consideration of riparian corridors has been assumed from the 1:25,000 hydroline data.

4 Results

4.1 Database and literature review

4.1.1 Threatened ecological communities, flora, fauna and migratory species

A review of the BioNet Atlas and EPBC Act protected matters search tool identified four threatened ecological communities, 26 threatened flora and 61 threatened fauna (including migratory species) either known or considered likely to occur in the subject site (**Appendix A**). No threatened flora or fauna species have been previously recorded within part lot 102 DP 1077617 and Lot 8 DP 258605 (Figure 4).

A large number of the threatened flora and fauna species excluded from further consideration are purely marine (e.g. fish and marine mammals) or estuarine to shoreline (e.g. waders) species that are not capable of utilising the site or study area, and thus are not likely to be affected by the development. The likelihood of the remaining species to occur is reviewed in **Appendix A**.

Threatened ecological communities either known or considered likely to occur include:

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (EPBC Act); Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions (BC Act).
- Subtropical and Temperate Coastal Saltmarsh (Vulnerable - EPBC Act); Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act).
- Freshwater wetlands on coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act).
- Illawarra Subtropical Rainforest in the Sydney Basin Bioregion (BC Act).

4.1.2 Vegetation communities mapping (SCIVI 2010)

Southeast NSW Native Vegetation Classification and Mapping 2010 identified one vegetation community in the subject site (Figure 5):

- Subtropical Dry Rainforest.

No vegetation communities were previously mapped in part lot 102 DP 1077617 and Lot 8 DP 258605 (Figure 6).

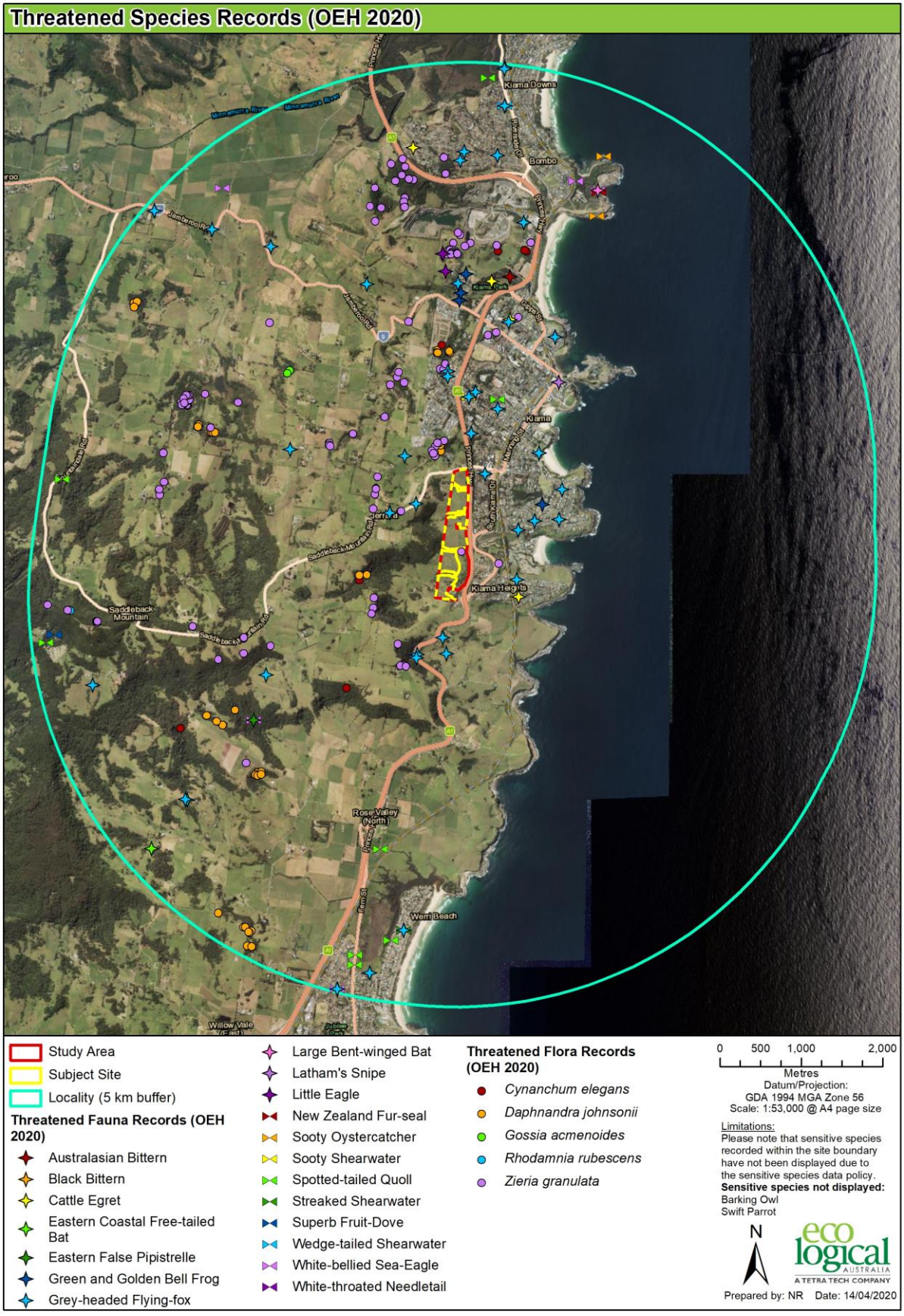

Figure 4: Threatened flora and fauna records within a 5 km radius of the subject site (EES 2020)

4.2 Field survey

4.2.1 Vegetation communities

The results of the 2016 survey conducted by ELA mapped six vegetation communities in the subject site (Figure 7):

- Remnant rainforest areas
- Rainforest regrowth or scattered trees (mostly poor quality)
- Depauperate rainforest on stone walls and rock outcrop
- Freshwater wetlands
- Instream wetland areas
- Exotic or mostly exotic pasture.

Remnant rainforest areas and Rainforest regrowth or scattered trees were found to meet the definition of *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion*, an endangered ecological community under the BC Act.

Freshwater Wetlands met the definition of *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions*, an endangered ecological community under the BC Act.

The remainder of the vegetation communities in the subject site did not form part of a threatened ecological community.

The results of the 2018 vegetation survey conducted by ELA refined the vegetation mapping completed by ELA in 2016 based on the elapsed time and the application of vegetation zones. Three vegetation communities were present in the study area (**Figure 8**)

- Illawarra Subtropical Rainforest
- Freshwater Wetlands
- Cleared land.

These vegetation communities were mapped into vegetation zones. Four vegetation zones were identified in the study area during survey:

- Zone 1: Illawarra Subtropical Rainforest – good condition
- Zone 2: Illawarra Subtropical Rainforest – poor condition
- Zone 3: Freshwater Wetlands
- Zone 4: Cleared land

Vegetation Zone 1: Illawarra Subtropical Rainforest – good condition

Vegetation Zone 1 contained native species in all structural layers and a diverse groundcover layer. The canopy contained *Elaeodendron australe*, *Diospyros australis* (Black Plum), *Acacia mearnsii* (Black Wattle), *Acacia longifolia* (Sydney Golden Wattle), *Pittosporum undulatum* (Native Daphne) and *Melicope micrococca* (Hairy-leaved Doughwood). The midstorey contained shrubs and climbers including, *Pittosporum multiflorum* (Orange thorn), *Streblus brunonianus* (Whalebone Tree), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Geitonoplesium cymosum* (Scrambling Lily) and *Stephania japonica* (Snake Vine). The groundcover was diverse and contained native forbs, grasses and ferns including *Pellaea falcata* (Sickle Fern), *Asplenium flabellifolium* (Necklace Fern), *Dichondra repens* (Kidney Weed), *Eragrostis leptostachya* (Paddock Lovegrass), *Microlaena stipoides* (Weeping Grass) and *Oxalis*

perennans. Good patches of the community showed less signs of disturbance and typically contained a lower proportion of weeds.

Vegetation Zone 2: Illawarra Subtropical Rainforest – poor condition

The patches of poor condition Illawarra Subtropical Rainforest contained a limited diversity of native species in the canopy including *Wilkiea huegeliana* (Veiny Wilkiea), *Pittosporum undulatum*, *Glochidion ferdinandi* (Cheese Tree), *Maclura cochinchinensis* (Cockspur Thorn) and *Melia azedarach* (White Cedar). The midstorey was dominated by *Lantana camara* (Lantana). Some scattered occurrences of *Pittosporum multiflorum* and *Hibbertia scandens* (Climbing Guinea Flower) were present with vines and scramblers including *Streblus brunonianus* and *Geitonoplesium cymosum*. The abundance of native species in the groundcover fluctuated in response to the present of Lantana in the midstorey. The groundcover typically included *Asplenium flabellifolium, Glycine tabacina* and *Microlaena stipoides*.

Vegetation Zone 3: Freshwater Wetlands

The Freshwater Wetlands in the study area were located adjacent to the Princes Highway below the patch of Illawarra Subtropical Rainforest in good condition. To qualify as the EEC *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*, the vegetation community must match both the floristic and geomorphological criteria listed in the Final Determination (NSWSC 2004a).

In the following table, the site wetland vegetation is reviewed in reference to:

i. The Final Determination floristic criteria

ii. The Final Determination habitat criteria

iii. Coastal Quaternary Geology mapping by Troedson and Hashimoto (2008)

iv. Contour and (if available) 1:100 ARI data

i. Legal precedents (*Gales Holdings Pty Limited v Tweed Shire Council [2008] NSWLEC 209, Motorplex (Australia) Pty Limited v Port Stephens Council [2007] NSWLEC 7*, *Motorplex (Australia) Pty Limited v Port Stephens Council [2007] NSWLEC 74)*.

Table 3: Freshwater Wetlands on Coastal Floodplains EEC analysis

Final Determination Criteria Component	Evaluation
Occurs in relevant bioregion, LGA?	Yes
Occurs in specific geomorphological landscape context?	**Figure 3** overlays the 1:25 000 Quaternary soil landscape mapping with the mapped wetland vegetation. Acknowledging the limitations of the mapping scale, the actual extent of alluvial floodplain may be more or less than shown. Regardless, the geomorphological criteria is satisfied. Dams on previously dry land are excluded as per the Final Determination (NSWSC 2004a).
Below the 1: 100 ARI?	Data not available, however the two largest watercourses include mapped alluvial soil landscapes hence are clearly subject to periodic flooding and processes associated with a coastal floodplain as defined in the Final Determination.
Floristic criteria met?	Only in the channel and banks of Munna Munnora Creek, and marginally the foot of the northern creekline. The other areas and floodplain associated with the creeks have been effectively converted to pasture with wetland species completely absent, or limited to <1%

Final Determination Criteria Component	Evaluation
	density. The latter are thus not effectively functioning as a community and hence not considered to qualify the area as an EEC. This EEC may also be derived from the clearing of the original rainforest which would've overshadowed the watercourses.

The analysis above confirms the presence of Freshwater Wetlands in the subject site.

Vegetation zone 4: Cleared land

Cleared land in the subject site consisted of pasture improved paddocks that were dominated by exotic groundcover species including *Cenchrus clandestinus* (Kikuyu), *Paspalum dilatatum* (Paspalum) and *Gomphocarpus fruiticosus* (Narrow-leaved Cotton Bush). The patches of the subject site previously mapped as instream wetland areas were found to be highly disturbed first or second order creeklines that were dominated by *Cenchrus clandestinus* (Kikuyu). These creeklines showed high disturbance level caused by grazing cattle and horses. Native species occurred infrequently and were generally *Juncus usitatus*.

Using aerial photography, a majority of part lot 102 and lot 8 is likely to be comprised of this vegetation zone. However, this must be field validated for the submission of a DA under part 4 of the EP&A Act.

4.2.2 Threatened flora survey

A total of 174 flora species were identified within the study area during the field investigations, of which 66 are exotic species. Six species of plants declared priority weeds of the Illawarra, of which Kiama Municipal Council LGA forms a part of were found in the study area during the 2016 surveys (Table 4 **Appendix B**).

Table 4: Priority weed species identified in the study area

Priority weed	Locations in subject site
Lantana camara (Lantana)	Mainly in southern half, along walls, the faces of the slopes supporting the Pacific Highway, on outcrops, and in degraded rainforest patches. Also found on the edge of more intact rainforest
Asparagus aethiopicus (Ground Asparagus)	Found in walls, outcrops and rainforest patches.
Asparagus plumosus (Climbing Asparagus Fern)	Mainly in rainforest patches in the south-east portion of the study area.
Asparagus asparagoides (Bridal Creeper)	Only identified in walls and outcrops in the southern half of the study area.
Rubus fruticosus sp. agg (Blackberry)	Widespread but generally localised, in all habitats of the study area, most common along rock walls.
Senecio madagascariensis (Fireweed)	Widespread in pasture areas across the study area.

One threatened species was recorded on site in 2016 and 2018; *Zieria granulata* (Illawarra Zieria). The individual was found on the rocky outcrop near the access to the underpass on a stone outcrop. The single plant was mature, about 2.5 m tall and profusely flowering during both site visits. No additional *Zieria granulata* or threatened flora species were identified during the 2018 survey.

There are shows 121 records for this species in the locality (Bionet OEH 2016a). There is a well known population along Saddleback Mountain Rd and Old Saddleback Mountain Rd within 1km of the subject site. The nearest suitable habitat off-site is close to or perhaps beyond the range of genetic dispersal vectors (e.g. invertebrate and vertebrate pollinators and seed dispersers, gravity, wind and water), there is doubt that it could be considered to constitute a viable local population in the long term as per the BC Act (DECC 2007).

The Illawarra Zieria Recovery Plan (DEC 2005a) uses an arbitrary distance of 200 m between plants or groups of plants to define the local population, but also notes Keith *et al* (1997) 'rule of thumb' for genetic discontinuity between populations of >1 km apart. As noted above, the nearest plants are <1 km to the east and north, but pollination between the site plant and these other plants would be a low likelihood given insects would have to cross upslope and over a ridgeline to reach known plants to the north, and up a slope and over the highway to the east against a range of barriers (e.g. turbulence, prevailing winds) and threats.

The single plant is poorly connected to the currently known local occurrences, and could be considered as either a single plant population if the 200 m rule is applied; or part of a sparsely but widely distributed local population to the north and east if using the 1 km 'rule of thumb'.

Despite this, the plant is clearly very attractive to insect pollinators and a limited abundance and diversity of other species were noted flowering in the local landscape (e.g. Pittosporum and Kurrajong, *Pandora pandorana,* as well as lantana). European Bees were noted inspecting flowers on this plant (see photo 13) as well as a range of flies and native bees, suggesting insect vector options are good.

The large patch of remnant rainforest to the west of the subject site may have been the source population for the individual within the subject site in which case it would form part of that local population. Perusal of the eastern edges of this remnant with binoculars failed to detect any plants, but it is possible that they may occur elsewhere.

4.2.3 Threatened fauna habitat assessment and opportunistic sightings

A total of 38 fauna species were detected over the 2016 survey period (**Appendix C**). This is likely to be a result of the identified survey limitations as well as the ecological constraints of the study area i.e. disturbance history, fragmentation and edge effects.

What appeared to be an immature *Circus assimilis* (Spotted Harrier - vulnerable under the BC Act) was once observed flying over and being harassed by magpies. A small group of *Ardea alba* (Cattle Egret – marine under the EPBC Act) were also noted foraging amongst the few grazing stock on site.

The potential habitat assessment identified the presence of features that would provide habitat for threatened fauna species (Table 5). All threatened and migratory fauna recorded or predicted to occur in the locality were reviewed for potential to occur in **Appendix A** as per DECC (2007) requirements.

Based on the review and the availability of habitat resources within the study area, 11 threatened species and 8 migratory species have potential to occur on site due to the presence of suitable habitat (Table 6). The species predicted as having potential to occur would not rely on the site, nor would the site form a significant part of a life cycle for any threatened species.

Table 5: Fauna habitat evaluation

Habitat Component	Evaluation	Habitat Values/Limitations
Logs and debris	No significant logs. Minor debris field around stockyard (few posts, etc.) but does not provide significant shelter. Cemetery has some broken concrete with burrows evident.	Lack of logs providing potential wintering refugia for Green and Golden Bell Frog; and dens for mammals and reptiles. Artificial structures in cemetery used by native and possibly exotic wildlife.

Habitat Component	Evaluation	Habitat Values/Limitations
Leaf litter and groundcover	Leaf litter present under rainforest patches and dense lantana. Provides good cover and habitat for frogs, reptiles and invertebrates, as well as fungi habitat. Absent in other areas. Groundcover best developed in pasture. Rank in central area due to destocking, where it offers excellent cover for invertebrates, reptiles and frogs, as well as some small mammals and birds. Limited seed producing species however hence poor for granivores. Limited cover in wetland in stream, but dams generally very well vegetated, offering excellent frog habitat.	Sedgeland in dams offers potential habitat for common rodents, frogs and some granivorous birds. No grassy woodland habitats for dependant birds. Leaf litter noted to be used by common reptiles.
Scree slopes, rocky outcrops, sandstone ledges, etc	Rock walls: Generally about 1m high and wide, some have collapsed and are overgrown with lantana. Numerous cavities ideal for reptiles, invertebrates, frogs and small mammals. Where vegetation present this enhances refuge and foraging values. Rocky outcrops: Common, but not characterised by deep or extensive crevices or boulder piles. Scree slopes within remnant rainforest patches offer better potential shelter for small reptiles and mammals. These are limited to the east-southeast. Scree slopes: Small areas in parts of rainforest remnants have a scree cover. These contain small crevices and copious leaf litter, offering excellent reptile and invertebrate habitat.	Rock walls noted to be alive with skinks to dragons in all areas, particularly where adjunct to remnant rainforest. Likely to provide prey habitat as well as basking sites and refuge for range of common species. No suitable structures for denning by Quoll.
Culverts, caves, cliffs, abandoned structures	Underpass appears to have no cavities suitable for bat roosting. Culverts provided for Munna Munnora Creek and unnamed watercourse to north not explored but may have cavities for roosting.	Possibly potential for microchiropteran bat roosts in culverts if crevices present.
Nectar sources (shrub to canopy)	Limited. Only eucalypts in study area are handful of Forest Red Gums (*Eucalyptus tereticornis*) within the cemetery. Wattles in south and southeast are prolific flowerers, but have limited value to arboreal mammals. Excellent insect attractants. Some rainforest species may also be nectar sources of nectarivorous birds e.g. *Pittosporum* and *Syzygium*. Excellent insect attractants.	Insufficient abundance and extent of nectar sources preferred by arboreal mammals including threatened species such as Yellow-bellied Glider and Squirrel Glider, as well as the Grey-headed Flying Fox. Insufficient forage resources to attract non-breeding migratory species such as the Swift Parrot and Regent Honeyeater. Good seasonal insect attractants for insectivorous birds and bats.

Habitat Component	Evaluation	Habitat Values/Limitations
Sap and gum sources	Forest Red Gums are only eucalypt and are preferred by Yellow Bellied Glider and Squirrel Glider, with no signs of usage. Several wattles which form larger understory trees are potential gum sources for gliders, but lack of use. Isolation from preferred habitat also precludes potential use.	No significant potential habitat for Yellow-bellied and Squirrel Gliders. No active incisions noted, and isolated from other likely habitat.
Fruiting species	Figs and number of fruiting trees and vines offer known and potential food sources for frugivorous birds and the Grey Headed Flying Fox.	The patches of rainforest on site form part of the local network of remnants which are likely to be seasonally used by the Grey-headed Flying Fox and threatened frugivorous birds such as the Superb Fruit Dove. The Flying Fox would also use scattered trees in the paddock if sufficiently fruiting.
Tree hollows and decorticating bark	Tree hollows limited to two confirmed small hollows in a Forest Red Gum in the cemetery, with several limbs on other trees having long term potential to develop small hollows. However, this resource is extremely rare in the landscape due to vegetation type i.e. rainforest. Some cavities may occur in larger figs, but as these do not usually develop into deep cavities, unlikely to be used by arboreal mammals and medium to large hollow-obligate birds, or bats. Forest Red Gum is only tree with decorticating bark, with no significant accumulations noted.	Significant limitation on potential occurrence in study area by hollow-obligate vertebrates. Hollows in cemetery expected to be dominated by common woodland birds e.g. lorikeets and rosellas, as suggested by chewed edges and active excavation.
Passerine bird habitat	Very good in and around forest remnants in southeast due to connectivity and dense cover provided by lantana which interconnects the three key remnants. Small birds noted to be using rank Kikuyu in central area of pasture, but lacks preferred granivorous species. This grass also hosted an abundance of Grasshoppers and moths, offering excellent prey. Forest remnants contain good insect and some nectar sources, likely to support birds, but gap between east to southeast remnants and major remnant upslope is a key barrier for smaller passerines.	Some generic potential for threatened species such as Varied Sittella via moving across landscape using larger remnants as stepping stones and core habitat, but edge effects are a key limitation.
Aquatic	Munna Munnora Creek is permanent and likely to flow most times, maintaining water quality. Stream varies from 1-3 wide (generally narrow), with depth	Dams offer marginal habitat for Green and Golden Bell Frog as free water constrained by very dense emergent

Habitat Component	Evaluation	Habitat Values/Limitations
	0.3-1m. Water quality appears very good although filamentous algae is widespread; with very high clarity. Native fish up to 100 cm long noted, and no Plague Minnow. Dams generally heavily vegetated. Most about 10 m wide, with no open water. Offer excellent frog habitat but poor waterfowl habitat other than for tall waders. Remainder of watercourses dominated by dense, rank pasture with high moisture, offering very good frog refuge and foraging habitat.	vegetation. Common frogs heard and observed. Munna Munnora Creek unsuitable for Green and Golden Bell Frog due to constantly flowing and subject to peak flood flows. Unlikely to support *Mixophyes* as riparian zone is extensively cleared in study area. No known threatened native fish in locality, although Munna Munnora Creek is good native fish habitat. Habitats considered unsuitable bitterns due to insufficient extent and not proximate to a sizeable wetland or other suitable habitat to attract these birds.
Prey abundance and diversity	*Terrestrial*: Reptiles noted to be common. Disturbance history and poor connectivity suggests small to medium mammal diversity likely to be dominated by exotic rodents. *Passerine*: Limited connectivity but sufficient extent of prey habitat for raptors. *Arboreal*: Likely to be very low abundance and diversity over site due to lack of canopy connectivity and habitat modification, and rarity of hollow-bearing trees.	Site may at best form small part of territory of foraging territory of common diurnal and nocturnal raptors. Poor arboreal prey potential precludes threatened forest owls (Powerful Owl, Masked Owl, Sooty Owl).

Table 6: Potentially occurring threatened and migratory species

Name	Common Name	BC Act	Occurrence and Local Population
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	Possible: Some generic potential for foraging over rainforest remnant in study area, but only marginal habitat as prefers larger tracts of forest. Unlikely to breed given limited roost options. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Lophoictinia isura	Square-tailed Kite	V	Likely: Generic potential habitat – at most used as minute fraction of expansive territory of a local pair. Would need to spend most of life cycle outside study area to meet ecological requirements due to ecology and study area limitations.
Miniopterus australis	Little Bent-wing Bat	V	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local

Name	Common Name	BC Act	Occurrence and Local Population
			population would meet most of its needs beyond study area.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Mormopterus norfolkensis	Eastern Coastal Free-tailed Bat	V	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Myotis (Macropus) macropus	Southern Myotis	V	Possible – low value potential habitat in Munna Munnora Creek, but could use as small part of non-breeding range. Marginal potential to roost in culverts. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Pteropus poliocephalus	Grey-headed Flying Fox	V	Likely: Forest on site and in study area contains preferred forage species likely to be used by a few individuals during flowering season as part of local range. Not potential roosting habitat. Would need to spend most of life cycle outside study area to meet ecological requirements due to ecology and study area limitations.
Ptilinopus superbus	Superb Fruit-dove	V	Potential non-breeding migrants may use upslope habitat and remnants in east to southeast of site as part of network of remnants in locality. Unlikely to breed. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.

4.2.4 Aquatic ecological values

The subject site has a number of watercourses (creeks to drainage lines) running across from west to east, from the elevated lands towards the coast. The subject site contains eight streams, with one stream immediately adjacent to the footprint at part lot 102 DP 1077617 (**Figure 8**). Munna Munnora Creek is

the largest and is a Strahler 3rd order stream. It is considered a Type 1 Class 2 Fish Habitat as both native aquatic vegetation and rocks >500 mm in two dimensions are present and it has permanent pools and connected wetland areas (Fairfull 2013). Only common species of fish such as gudgeons and eels are expected to utilise this watercourse, with no records of any species listed under the *Fisheries Management Act 1994* in the Kiama LGA (DPIW 2016).

The other watercourses have discontinuous vegetation (often converted to creeklines dominated by exotic flora species), are likely to be ephemeral, and provide some limited habitat features. These habitat features include presence of rocks, some small pools of stagnant water and in some cases fringing vegetation.

4.2.5 Site Connectivity

Regional corridors

Regional corridors are typically >500 m wide and provide a link between major and/or significant areas of habitat in the region. Ideally they are of sufficient size to provide habitat in their own right and at least twice the width of the average home range area of fauna species identified as likely to use the corridor (Scotts 2002).

Review of the aerial photo in shows that the site habitat is not part of a regional corridor. The nearest significant body of habitat is remnant rainforest upslope of the site, which is isolated from non-flying species by pastoralism in all directions.

Local corridors and habitat links

Local corridors provide connections between remnant patches of habitat and landscape features. Due to their relatively small area and width (they may be <50 m), these corridors are subject to edge effects (Scotts 2002, Lindenmayer and Fisher 2006). Habitat links are evaluated in this report as links from habitat on-site directly to similar habitat on adjacent land. These would be used by fauna, which depend solely or at least partially on the site for all of their lifecycle requirements, and/or dispersal (Lindenmayer and Fisher 2006).

The nearest remnants are smaller and to the south of this remnant, with gaps up to about 150 m. These have potential to act as 'stepping stones' to a linear remnant further south which eventually links west to Barren Grounds Nature Reserve. This linkage would be usable by mobile species such as bats, some birds, some insects, and larger macropods which are capable of using such landscape mosaics (Lindenmayer and Fisher 2006).

The riparian zones running across the site, especially along Minna Munnora Creek, offer some connectivity across the landscape, however most of the current riparian zone is cleared of forest to the banks. Sedges and tussocks of grass may provide some support for frogs, small reptiles and small mammals albeit, at very high risk of predation. Restoration of these areas would substantially support biodiversity connectivity in the local landscape.

The rainforest remnants and regrowth along the eastern side of the site form part of a discontinuous local corridor of mostly exotic vegetation on the western side of the Princes Highway. Lack of continuity and connectivity with any significant remnant, edge effects (e.g. highway noise and nutrient inputs from runoff), and likely presence of a number of exotic mammals currently render this vegetation of limited inherent habitat value. However with augmented riparians zones and potential connection to other patches along the highway to the south, these vegetation could benefit local biodiversity.

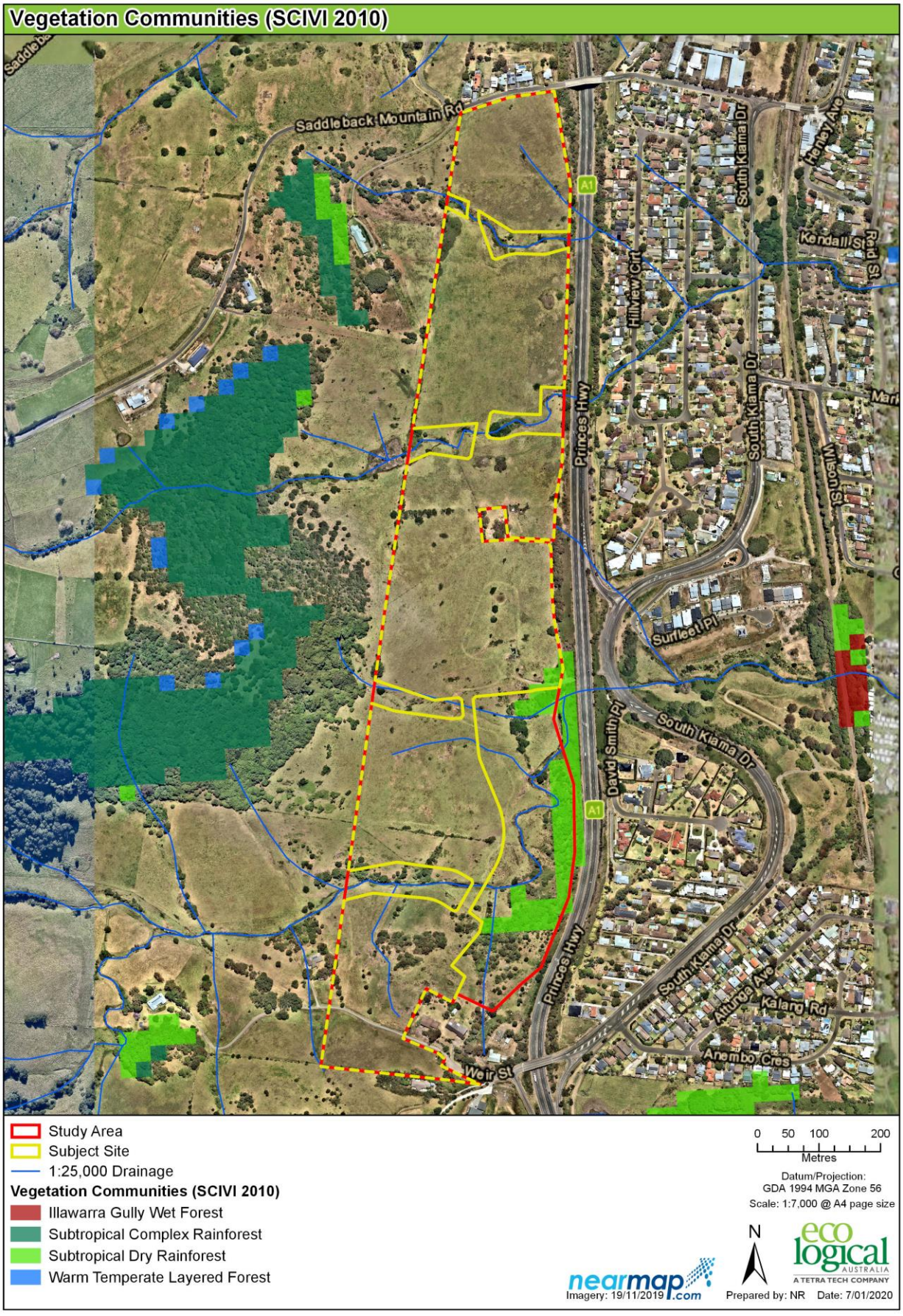

Figure 5: SCIVI 2010 vegetation mapping of the subject site and surrounding landscape

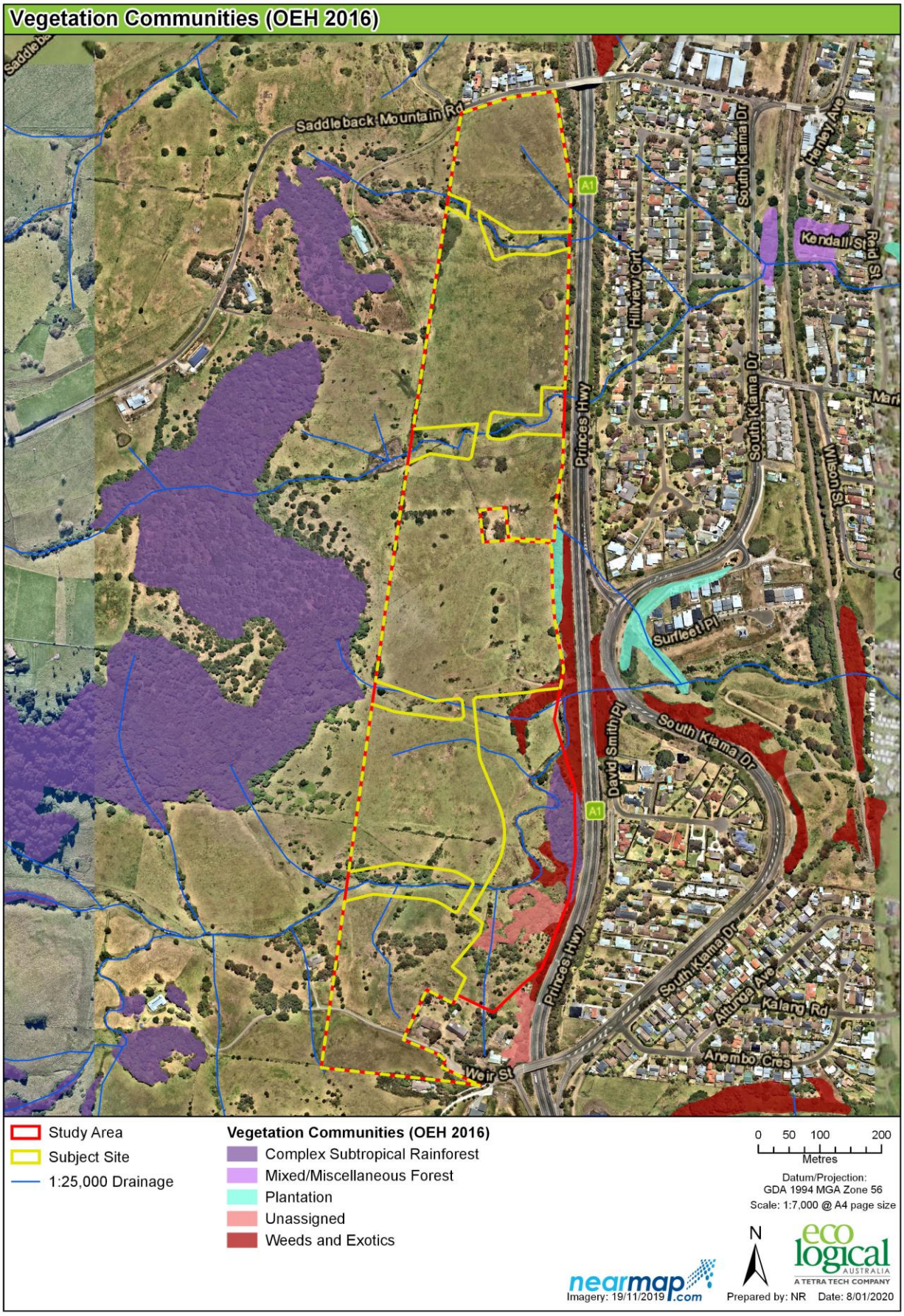

Figure 6: Vegetation communities previously mapped in the study area (OEH 2016)

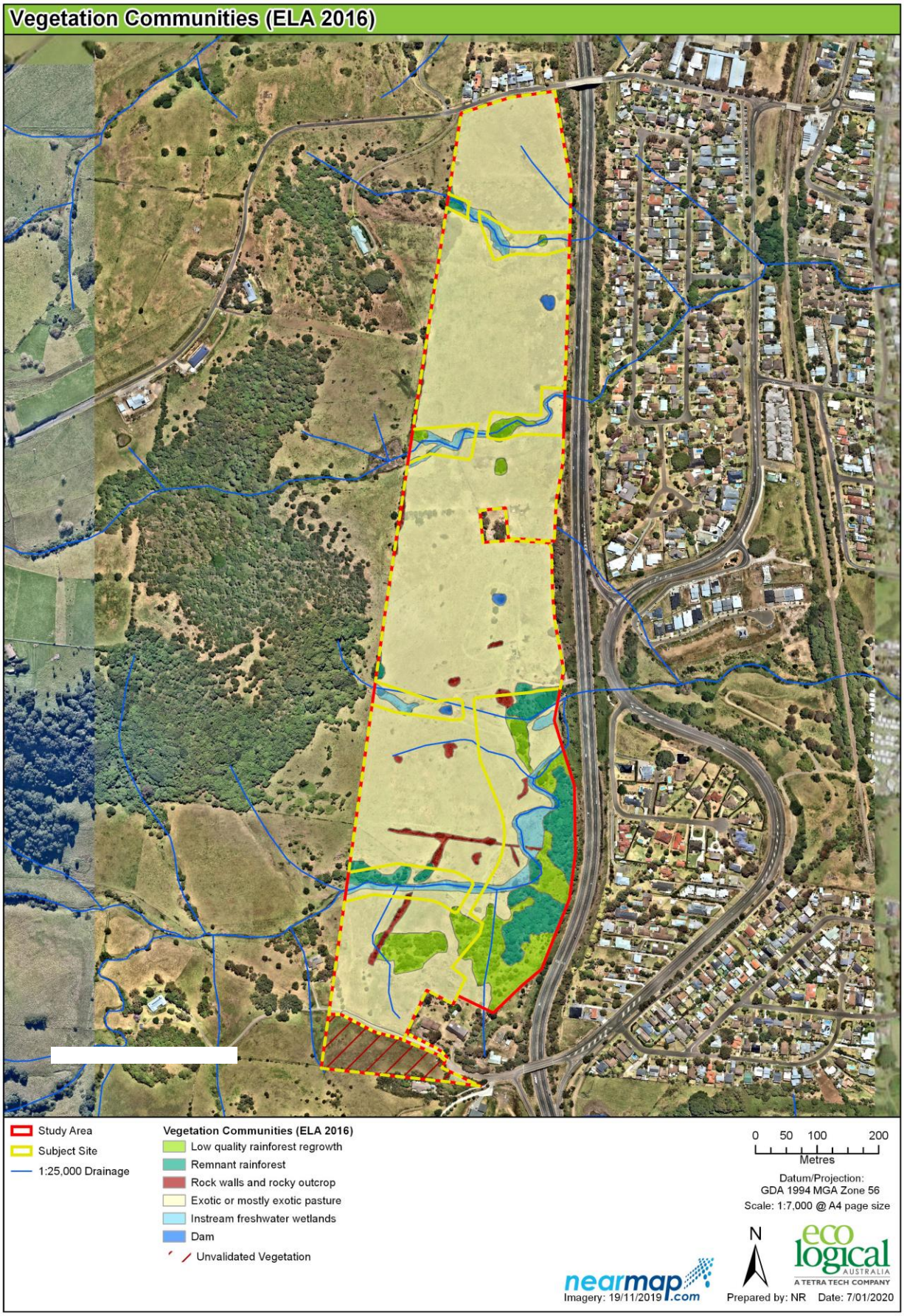

Figure 7: Validated vegetation communities (ELA 2016 – note part lot 102 and lot 8 were not surveyed)

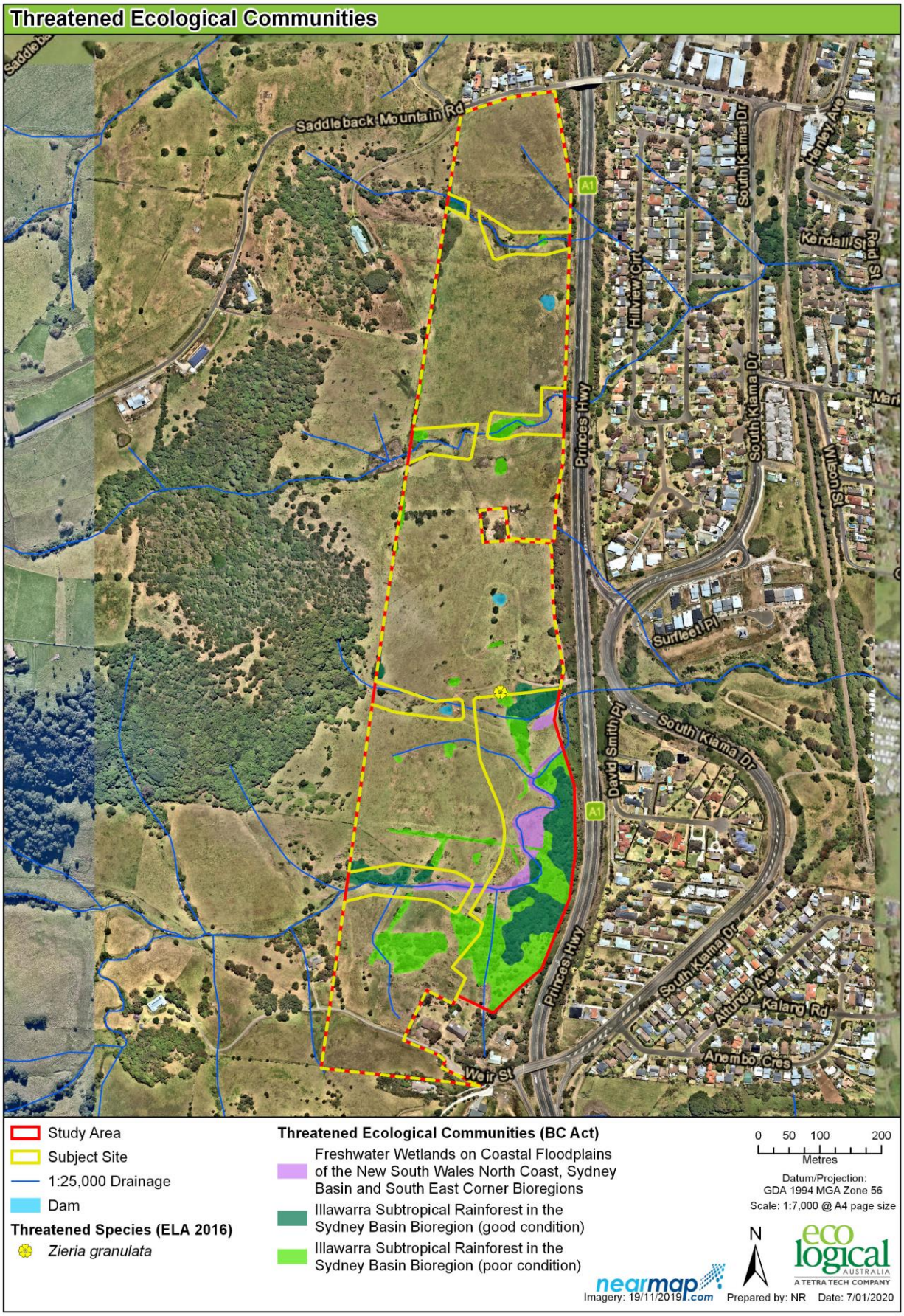

Figure 8: Validated vegetation communities (ELA 2018) and *Zieria granulata* location in the subject site

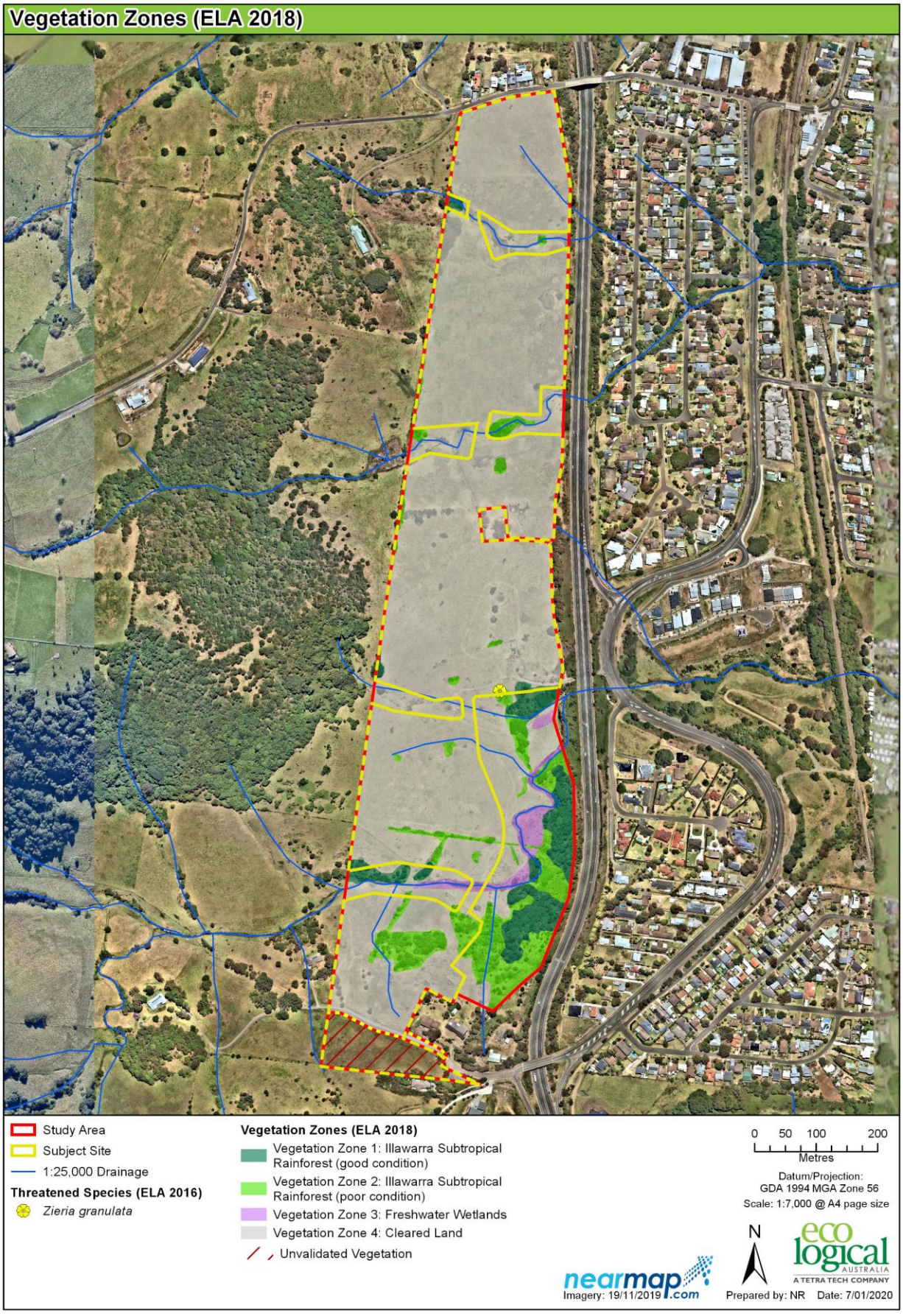

Figure 9: Vegetation zones in the study area

5 Potential impacts

5.1 Potential future direct impacts

The planning proposal would rezone land from RU2 – Rural Landscape to a residential zoning. This would change the use of the land and has the potential to affect native vegetation and cleared land (Table 7).

Table 7: Vegetation communities with potential to be affected as part of the proposed development

Vegetation community (ELA 2018)	Impact (ha)	Retain (ha)	Total (ha)
Illawarra Subtropical Rainforest (poor condition)	1.37	2.16	3.53
Illawarra Subtropical Rainforest (good)	0.17	2.01	2.18
Cleared land	28.44	4.14	32.58
Unvalidated	1.35	0.00	1.35
Total	**31.43**	**8.31**	**49.64**

The proposal currently aims to retain a majority of the rock walls within the site, with two to be removed. The rocks from the walls to be removed would be re-used to improve the condition of the walls to be retained throughout the study area.

Under the indicative development footprint no threatened flora species are likely to be directly affected. About 1.52 ha of potential foraging habitat for the fauna species listed in Table 6 has potential to be affected.

No key breeding or roosting habitat of any migratory fauna is likely to be affected, only potential foraging habitat which is locally extensive or proposed for retention or expansion.

5.2 Indirect impacts

Indirect impacts would be likely to occur to the following threatened ecological values:

- Illawarra Subtropical Rainforest
- Freshwater Wetlands
- *Zieria granulata*
- riparian corridors marked for retention.

Indirect impacts likely include the factors outlined in Table 8. A majority of these impacts would be temporary and are unlikely to significantly affect any threatened ecological values present.

Table 8: Review of indirect impacts

Threat	Assessment
Impacts on genetic dispersal of plants	As noted above, current fauna corridors are poor for non-flying species, hence pollination is most likely to be via bats, birds and insects capable of crossing gaps between forest remnants. The establishment of a subdivision will have positive and negative impacts on these pollinators. Positive impacts may include replacement

Threat	Assessment
	of pasture with its poor nectar attractants, to gardens with a range of nectar sources. This could thus provide a higher carrying capacity and enhance linkage to other areas of habitat. Conversely it may attract conspecific competitors (e.g. Noisy Miner), pose a physical and behavioural barrier (e.g. anthropogenic disturbances). Dispersal by wind and water will also be altered as physical structures will alter stormwater patterns and wind turbulence. Given the remnant vegetation will largely be incorporated in a reserve with new vegetated linkages established via the riparian zones and current barriers by the extensive pasture, any negative impacts are expected to be counter-acted by the positive impacts of more habitat diversity and extent, and better connectivity.
Mortality as a direct and indirect result of clearing	Removal of dense vegetation, rock walls and rocky outcrops has the potential to injure or kill fauna which may be nesting, denning or otherwise utilising such refuge at the time of clearing. Young can also be abandoned (e.g. nestlings) and unable to disperse or forage for themselves. Fauna may also be exposed to predation by natural and exotic predators due to loss of cover and displacement (Johnson *et al* 2007, RMS 2010). Clearing monitoring by an ecologist are recommended where appropriate to reduce the risk of fauna mortality.
Erosion and sedimentation	The soils on site are prone to erosion. This could contribute to weed invasion and turbidity impacts downslope and downstream. Crossings are also proposed over watercourses, which can destabilise the banks and bed during construction and via altered hydrology. Standard mechanisms and controls should ensure the prevention of erosion and sedimentation during construction and post-development. Statutory provisions for construction and engineered design of crossings should also mitigate the risk of erosion of banks and the bed.
Anthropogenic disturbances	Fauna potentially occurring in the study area are likely to be accustomed to elevated anthropogenic disturbances given the residential human presence, the Princes Highway, and rural activities. Thus the construction phase and addition residences is unlikely to significantly increase this threat beyond that which already occurs in the study area. Post-construction, noise levels will be typical of those at residences, with occasional higher than normal levels e.g. lawn mowing, etc.
Fencing	Fencing can pose physical barriers and injury/entanglement risks to fauna (e.g. Maclean 2007). The proposal will see limited dissection of vegetation e.g. only road crossings where vegetation is currently highly modified or limited to pasture. Re-vegetation is proposed of the riparian zones and rehabilitation of the rainforest in the south, hence fences should not pose a barrier to fauna movement along these corridors where they fall into public reserves.

Threat	Assessment
	Some fences may front native vegetation in reserves or boundaries at backyards. These fences are preferred to be barriers to fauna to minimise adverse interactions between pets and people with wildlife.
Weed invasion	The site currently contains invasive weeds (e.g. Paspalum and lantana), and all remnants have varying degrees of weed invasion or are surrounded by weeds. Soil disturbance associated with the proposal will benefit further weed invasion e.g at riparian zone crossings. Nutrient enriched runoff from roads, lawns and gardens may also support establishment of weeds on the edge of native vegetation. All vegetation falling within the development footprint is expected to be displaced during construction and replaced with lawns and gardens. Some of these plants have potential to establish on the edges and invade remnant bushland vegetation, especially via green waste dumping which is a risk where backyard fences adjoin public reserves.
Artificial lighting	Artificial lighting on the site will be typical of any residential subdivision. Light spillage currently occurs from the Princes Highway and adjacent local roads. Based on observations of Yellow-Bellied Gliders, microchiropteran bats and Grey-Headed Flying Foxes, this is not considered likely to be a major impact.
Introduction of feral/introduced species and pet predation.	Dogs and cats are likely to presently access the site from nearby residences, while foxes are also likely to occur. Feral rodents including rats, mice and rabbits also likely to occur. Cats and dogs may be allowed to roam into the remnant bushland, resulting in avoidance to predation impacts. Lack of key sensitive fauna such as bandicoots and Koala, and likely depauperate assemblage due to isolation and low carrying capacity, suggests this is a low significance threat.
Dust generation during construction	Dust can cover plants and impact photosynthesis, flowering (e.g. discouraging pollinators), and lead to impacts on aquatic ecosystems e.g. turbidity. Standard control mechanisms and compliance enforcement are expected to be a Condition of Consent at the DA stage.
Stormwater runoff and altered hydrological regimes	The proposal will see establishment of extensive hard surfaces, altered infiltration areas, and diversion and collection of stormwater and upslope runoff. This will be directed via water sensitive urban design measures ultimately to the riparian zones. The change in the local catchment is likely to see an elevation in water volume over a shorter peak in these watercourses, possibly leading to some scouring of the bed. This can be mitigated via revegetation of the disturbed riparian zones with native species and appropriate engineering design.
Risk of introduction of diseases	Plant pathogens such as Myrtle Rust and *Phytophthora cinnamomi* can be introduced to a site via contaminated construction machinery and landscape supplies (including nursery plants). Both can have potentially significant impacts on

Threat	Assessment
	rainforest ecosystems. Chytrid fungus (*Batrachochytrium dendrobatidis*) can also be introduced via contaminated machinery which has recently worked on a 'wet' site, and impact native frogs. .

5.3 Riparian zones

The indicative footprint indicates that some riparian corridors may require crossing to allow for vehicle access which may lead to some indirect impacts occurring. Four creeklines are marked for retention and would be managed under a Vegetation Management Plan. The Natural Resources Access Regulator guidelines apply to watercourse crossings, particularly of Munna Munnora Creek. Any impacts on waterfront land would require controlled activity approval to be issued under the WM Act.

Subject to site assessment and the condition of the watercourses, the approval may require the establishment of a vegetated riparian zone (VRZ) adjacent to the watercourses as described in Table 9. Any activities undertaken on waterfront land should be consistent with the NRAR guidelines (Table 10).

Table 9: VRZ widths per stream order

Stream order	VRZ width (each side plus channel width)	Location on site
1st order	10 metres	Two drainage lines in northern end of site; four associated with Munna Munnora Creek
2nd order	20 metres	Unnamed watercourse in central north
3rd order	30 metres	Munna Munnora Creek
4th order	40 metres	Not present in the subject site

Table 10: Riparian Corridor Matrix under the WM Act

Stream Order	Vegetated Riparian Zone (VRZ)	RC off-setting for non RC uses	Cycleways and paths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	online			Any	Culvert	Bridge
1st	10 m	●	●	●	●	●	●	●		
2nd	20 m	●	●	●	●	●		●		
3rd	30 m	●	●	●		●			●	●
4th +	40 m	●	●	●		●			●	●

Assuming compliance with the above, this will protect the integrity of the watercourses, retaining habitat for the EECs via maintaining the ecological processes; and maintaining the fisheries habitat.

5.4 Kiama LEP / DCP

5.4.1 Terrestrial biodiversity

Under the Kiama LEP 2011 some portions of the subject site are mapped as part of the terrestrial biodiversity layer (Figure 10). Under the indicative development footprint, these patches are marked for retention. Any impacts on vegetation mapped under the indicative development footprint would need to consider if it:

- is likely to have any adverse impact on the condition, ecological value and significance of the fauna and flora on the land,
- is likely to have any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna,
- has any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and
- is likely to have any adverse impact on the habitat elements providing connectivity on the land.

If impacts on biodiversity land are expected, the proponent must be able to demonstrate that the development has been designed to avoid any significant adverse impacts, any impacts would be managed and if impacts cannot be avoided they would be mitigated.

5.4.2 Riparian land and watercourses

Under the Kiama LEP 2011 some watercourses in the subject site are mapped as part of the riparian land and watercourses layer (Figure 11). Under the indicative development all watercourses in the subject site are mapped under this layer. One watercourse mapped under this layer may be extinguished. Any impacts on lands mapped under this layer would need to consider whether the development:

- is likely to have any adverse impact on the following:
    - the water quality and flows within the watercourse
    - aquatic and riparian species, habitats and ecosystems of the watercourse
    - the stability of the bed and banks of the watercourse
    - the free passage of fish and other aquatic organisms within or along the watercourse
    - any future rehabilitation of the watercourse and its riparian areas
- is likely to increase water extraction from the watercourse.

If impacts on riparian lands and watercourses are expected, the proponent must be able to demonstrate that the development has been designed to avoid any significant adverse impacts, any impacts would be managed and if impacts cannot be avoided they would be mitigated.

Figure 10: Terrestrial biodiversity and riparian lands and watercourses in the study area (Kiama LEP 2011)

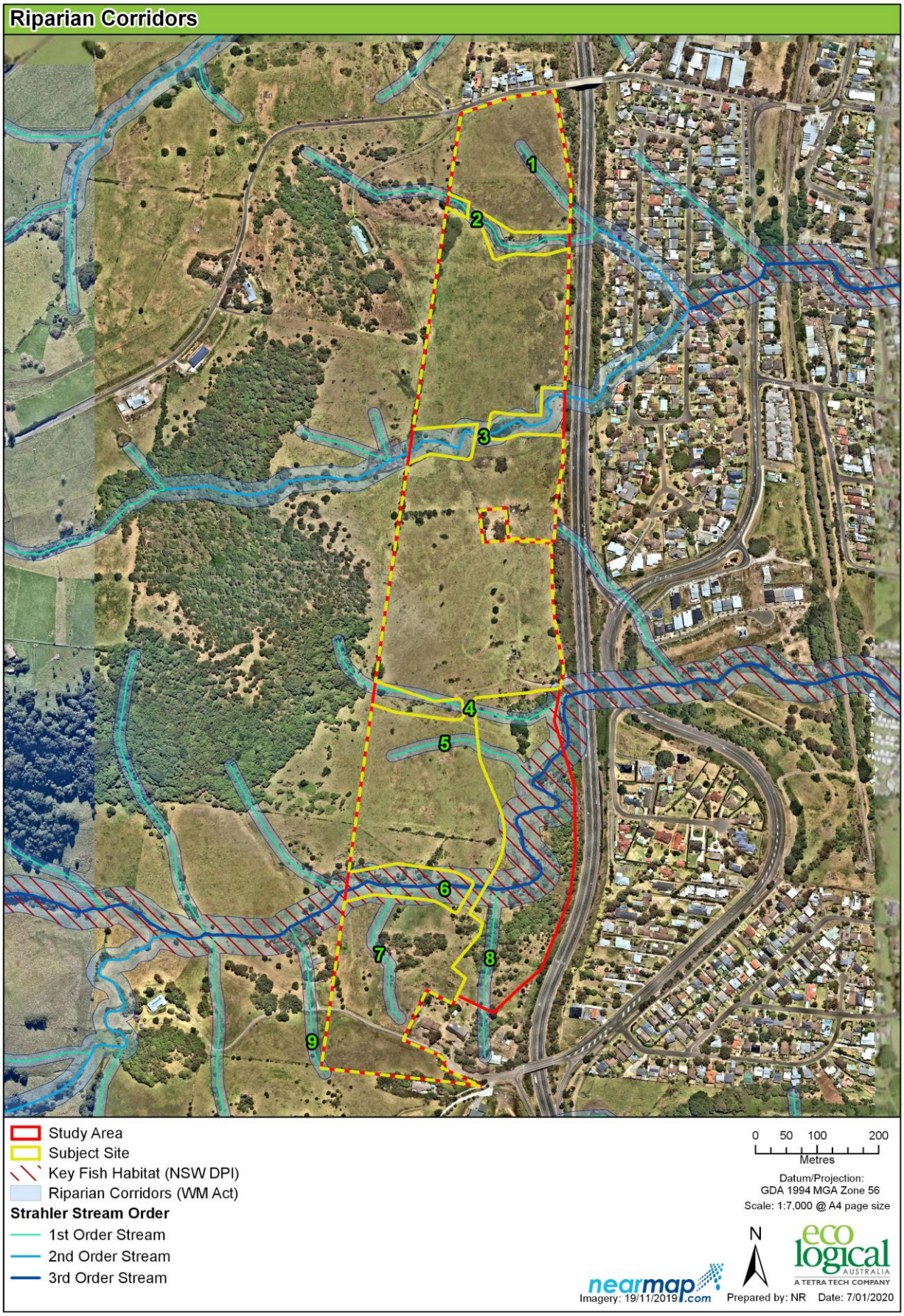

Figure 11: Watercourses and associated Strahler stream order classification in the study area

6 Approvals pathways

Future subdivision and development of the site would require the submission of a Development Application under Part 4 of the EP&A Act. The development would be subject to the BC Act, EPBC Act, WM Act, EP&A Act and the Kiama LEP.

6.1 BC Act

The proposed development would be subject to assessment under the BC Act. Under the BC Act, there are three triggers for the Biodiversity Offset Scheme (BOS):

- clearing to native vegetation above the clearing threshold, dependent on lot size
- impacts on land mapped under the Biodiversity Values Map (BVM)
- determination of a significant impact to a threatened ecological value through the application of s7.3 of the BC Act (test of significance).

Under the indicative development footprint, about 1.56 ha of native vegetation would be removed. Assuming that the site is rezoned to low density residential, which has a minimum lot size of 0.045 ha (Kiama LEP 2011), any clearing above 0.25 ha would trigger the BOS. Therefore, development resulting from this proposed rezoning would trigger the BOS. A Biodiversity Development Assessment Report would need to be prepared at the subdivision DA stage.

The riparian corridor along the southern extent of the site is mapped under the BVM. This is currently proposed for retention, however impacts associated with the implementation of a Vegetation Management Plan, bridgings or crossing for vehicle access would need to be considered and could also trigger the BOS.

There are no known matters subject to SAII in the subject site. The application of tests of significance is discussed below.

6.2 BC Act and EPBC Act

An indicative assessment of threatened flora, fauna and ecological communities either known or likely to occur has identified 13 tests of significance under the BC Act and two EPBC Act impact assessments that are likely to be required (Table 11). An updated assessment of threatened ecological values requiring assessment at the DA stage would need to be completed to capture any values that may be listed or up-listed. Detailed assessment of the Illawarra Subtropical Rainforest present in the study area meets the EPBC Act definition of the community.

Tests of significance would likely conclude no significant impacts on the matters listed in Table 11. It should be noted that any changes to the proposed layout may result in a change of potential impacts on threatened ecological values which may influence the outcome of this assessment.

Table 11: Threatened ecological values requiring test of significance

Name	Common Name	BC Act	EPBC Act	Occurrence and Local Population
Threatened ecological communities				
Illawarra Subtropical Rainforest in the Sydney Basin Bioregion / Illawarra–Shoalhaven subtropical		E	CE	Known. Clearing would trigger the BOS threshold. Clearing would be unlikely to trigger a significant impact

Name	Common Name	BC Act	EPBC Act	Occurrence and Local Population
Threatened ecological communities				
rainforest				on this community. Detailed assessment of the Illawarra Subtropical Rainforest present in the study area meets the EPBC Act definition of the community.
Freshwater Wetlands on coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.		E		Known. Potential indirect impacts. Unlikely to constitute a significant impact to this community.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Possible: Some generic potential for foraging over rainforest remnant in study area, but only marginal habitat as prefers larger tracts of forest. Unlikely to breed given limited roost options. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Lophoictinia isura	Square-tailed Kite	V	-	Likely: Generic potential habitat – at most used as minute fraction of expansive territory of a local pair. Would need to spend most of life cycle outside study area to meet ecological requirements due to ecology and study area limitations.
Miniopterus australis	Little Bent-wing Bat	V	-	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Miniopterus orianae oceanensis	Eastern Bent-winged Bat	V	-	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Mormopterus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would

Name	Common Name	BC Act	EPBC Act	Occurrence and Local Population
Threatened ecological communities				
				meet most of its needs beyond study area.
Myotis (Macropus) macropus	Southern Myotis	V	-	Possible – low value potential habitat in Munna Munnora Creek, but could use as small part of non-breeding range. Marginal potential to roost in culverts. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	Likely: Forest on site and in study area contains preferred forage species likely to be used by a few individuals during flowering season as part of local range. Not potential roosting habitat. Would need to spend most of life cycle outside study area to meet ecological requirements due to ecology and study area limitations.
Ptilinopus superbus	Superb Fruit-dove	V	Marine	Potential non-breeding migrants may use upslope habitat and remnants in east to southeast of site as part of network of remnants in locality. Unlikely to breed. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Possible – known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Given ecology and limitations of study area, local population would meet most of its needs beyond study area.

6.3 Kiama LEP

The patch of native vegetation mapped under the terrestrial biodiversity overlay is currently proposed for retention. Any impacts on this vegetation would need to consider the avoid, minimise and mitigate principles.

All watercourses in the subject site are mapped under the riparian lands and watercourses layer with stream 1 proposed for removal (Figure 11). The proponent would need to undertake an assessment to determine whether the watercourse meets the definition of a river and an application to NRAR would need to be made. NRAR would then need to grant approval for extinguishing of this watercourse. In addition, under the LEP any impacts to values under this layer would need to consider the avoid, minimise and mitigate principles.

6.4 WM Act

Under the WM Act, all watercourses are required to be retained, unless it can be demonstrated that the watercourse is no longer functional and does not meet the definition of a river. Watercourses that do not meet the definition of a river can be extinguished by applying to NRAR.

All watercourses mapped for retention would need appropriate riparian buffers mapped using the Strahler stream order classification system. Any impacts to waterfront land would require a controlled activity approval from NRAR.

7 Mitigation measures

To further manage the potential impacts of the proposal and to improve environmental outcomes, the following measures are suggested as modifications to the proposal and/or as conditions of consent.

7.1 Threatened ecological communities

The patches of Illawarra Subtropical Rainforest and Freshwater Wetlands to be retained should be managed under a Vegetation Management Plan (VMP). The VMP is to be securely funded for its timeframe to achieve a self-sustaining natural community under an appropriate planning mechanism such as a Voluntary Planning Agreement.

The core objectives of the VMP would be to:

- Reduce key weeds (e.g. transformers) to an appropriate indicator by the end of the management period.
- Encourage regeneration of the rainforest from the seedbank, supplemented with plantings characteristic of the EEC and local rainforest ecosystems.
- Revegetate the riparian zones in accordance with the Vegetated Riparian Zones (VRZ) specifications of the *Guidelines for Controlled Activities on Waterfront Land* (NRAR 2018).

7.2 Threatened flora

7.2.1 *Zieria granulata* (Illawarra Zieria)

The single plant may potentially be a single plant local population and hence unviable in the long term, depending on success of pollination by insect pollinators such as nectar seeking flies which are hypothesized to be the key pollinators given observations on other *Zieria* spp. (DEC 2005a). These vectors are known to cross open spaces, hence the current gap between the locally known plants may not pose an effective barrier, especially with the proposed revegetation enhancing both carrying capacity and connectivity. Some (albeit low probability) cross pollination could occur with the plants approximately 800 m east and north, or other potential plants in the upslope rainforest. However, the lack of on-site recruitment suggests the site population has dubious longevity.

Notwithstanding the above, as a precautionary approach to both avoid a significant impact and enhance the long term viability of the local population, it is recommended that the site population be expanded via propagation via cuttings from the site and other local plants, and these planted within the public reserve system on site to establish a larger site population. The plant is known to readily strike from cuttings (http://anpsa.org.au/zgra.html), hence 50 plants could be established on site, significantly expanding both the population size and the local genetic diversity.

Propagation and planting of these plants would form part of the VMP.

7.3 Fauna welfare during clearing

A qualified ecologist should be onsite during the removal of rock walls and dewatering of the artificial dams to manage fauna welfare and interactions. This would minimise mortality of native species both directly (e.g. being crushed) and indirectly (i.e. exposure to predators).

7.4 Habitat augmentation

Any large surface rocks moved from the proposed impact area can be retained and placed in the adjacent retained vegetation to maintain the level of shelter resource for invertebrates, reptiles and mammals that may occur in the area; and limit public access e.g. prevent parking of cars, trailers or other vehicles.

These elements should not be placed into the identified highest flow limits for any of the streams, particularly not for Munna Munnora Creek, to ensure that the passage of water along the streams and through the culverts under the Princes Highway is not affected.

7.5 Erosion and sedimentation

A Sediment and Erosion Control Plan should be developed to control dust and sediments during works. This will be particularly critical to protect the aquatic ecosystems of the creek.

7.6 Pathogen and noxious management

Appropriate wash down and weed-propagule removal should occur with vehicles being moved onto site, off-site and after travelling through or working in areas of high noxious weed infestation. Any machinery which has worked in a 'wet' site such as a wetland, stormwater treatment structure or floodplain should similarly be washed down with water containing anti-fungal chemicals (e.g. bleach).

Imported landscaping materials and plants used for revegetation must be tested to ensure no exotic species or disease is contained within the material.

7.7 Artificial lighting

Residential lighting is to avoid excessive light spill into areas of retained trees or other vegetation to reduce impacts to nocturnal fauna.

This can be achieved via not directing external lighting towards retained habitat.

7.8 Green wastes and invasive horticultural plants

Appropriate signage should be required to indicate dumping of greenwastes in adjacent reserves is prohibited and subject to infringement notices.

Landscaping provisions are not to include horticultural plants recognised as invasive.

8 Conclusion

Eco Logical Australia was engaged by Unicomb Development Pty Ltd to undertake a Flora and Fauna Assessment (FFA) for the proposed rezoning and future residential development of the nominated Lot 1 DP 707300, Lot 5 DP 740252, Part Lot 101 DP 1077617, Part Lot 102 DP 1077617, Lot 8 DP 258605 and part of unnamed road reserve, Saddleback Mountain Road, Kiama.

A range of ecological values were identified in the subject site or were considered likely to occur (Table 12).

Table 12: Threatened ecological values either identified or likely to occur in the subject site

Name	Common Name
Threatened ecological communities	
Illawarra Subtropical Rainforest in the Sydney Basin Bioregion	
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	
Threatened flora	
Zieria granulata	Illawarra Zieria
Threatened fauna and migratory species	
Falsistrellus tasmaniensis	Eastern False Pipistrelle
Lophoictinia isura	Square-tailed Kite
Miniopterus australis	Little Bent-wing Bat
Miniopterus orianae oceanensis	Eastern Bent-wing Bat
Mormopterus norfolkensis	Eastern Coastal Free-tailed Bat
Myotis (Macropus) macropus	Southern Myotis
Pteropus poliocephalus	Grey-headed Flying Fox
Ptilinopus superbus	Superb Fruit-dove
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat
Scoteanax rueppellii	Greater Broad-nosed Bat

At the submission of a development application for subdivision under Part 4 of the EP&A Act, the proponent would be required to prepare a Biodiversity Development Assessment Report, as the proposed development is likely to trigger the Biodiversity Offsets Scheme.

Any future development application would need to consider impacts on vegetation mapped under the terrestrial biodiversity overlay and impacts on watercourses mapped under the riparian lands and watercourses map in the Kiama LEP.

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Motorplex (Australia) Pty Limited v Port Stephens Council [2007] NSWLEC 74.

Murlan Consulting Pty Limited v Ku-ring-gai Council [2007] NSWLEC 374

Appendix A - Likelihood of occurrence table

As per DECC (2007), threatened flora and fauna are considered for potential to occur based on the following:

- Local records.
- Regional distribution.
- Preferred habitat and ecology.
- Site/study area habitat (condition, carrying capacity, extent and connectivity).
- Disturbance history, recovery actions and threats.

Five categories for the likelihood of occurrence of species are used in this report, as defined below:

- “yes” = the species was or has been observed on the subject land and/or study area.
- “likely” = a medium to high probability that a species uses the study area or immediate surrounds due to suitable habitat, connectivity and local records.
- “possible” = some suitable habitat (often a remnant or degraded area) for a species occurs on the site and/or study area, but is insufficient to meet the species needs for more than short term opportunistic foraging or marginal fringe of home range; or is very degraded/disturbed often with high levels of threat, and hence likelihood of occurrence is thus low.
- “unlikely” = a very low to unlikely probability that a species uses the study area or immediate surrounds due to a combination of habitat condition, threats, poor connectivity and/or lack of habitat suitability.
- “no” = habitat within the study area or immediate surrounds is completely unsuitable for the species.

Those species with potential to occur are required to be subject to impact assessment as per DECC (2007) guidelines.

FLORA

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Acacia baueri subsp. *baueri*	-	V	-	*Acacia baueri* subsp. *aspera* is restricted to the Sydney region, occurring on the Kings Tableland in the central Blue Mountains and with sporadic occurrences on the Woronora Plateau in the Royal National Park, Mt. Keira district and at Wedderburn. It occurs in low, damp heathlands, often on exposed rocky outcrops (DECC 2007).	No. No tests of significance required.
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	E	V	*Acacia bynoeana* is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains, and has recently been found in the Colymea and Parma Creek areas west of Nowra. It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (DECC 2007).	No. No tests of significance required.
Arthropteris palisotii	Lesser Creeping Fern	E	-	*Arthropteris palisotii* occurs in rainforest, mainly on tree trunks in north-eastern NSW and also in Queensland, however may now be extinct in NSW (DECC 2007).	Unlikely. No local records and site vegetation has a significant disturbance history. No tests of significance required.
Boronia deanei	Deane's Boronia	V	V	*Boronia deanei* occurs as scattered populations between the far south-east of NSW and the Blue Mountains (including the upper Kangaroo River near Carrington Falls, the Endrick River near Nerriga and Nalbaugh Plateau). It grows in wet heath, often at the margins of	No. No tests of significance required.

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				open forest adjoining swamps or along streams (DECC 2007).	
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	*Cryptostylis hunteriana* is known from a range of vegetation communities including swamp-heath and woodland (DECC 2007), where it appears to prefer open areas in the understorey of this community.	No. No tests of significance required.
Cynanchum elegans	White-flowered Wax Plant	E	E	*Cynanchum elegans* occurs in dry rainforest gullies, scrub and scree slopes, and prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest (NPWS 1997). The species has also been found in littoral rainforest; *Leptospermum laevigatum – Banksia integrifolia* subsp. *integrifolia* coastal scrub; *Eucalyptus tereticornis* open forest/ woodland; *Corymbia maculata* open forest/woodland; and *Melaleuca armillaris* scrub to open scrub (DECC 2007).	No. not identified in the subject site or study area during survey (ELA 2016; 2018) .. No tests of significance required.
Daphnandra johnsonii	Illawarra Socketwood	E	E	*Daphnandra* sp. C Illawarra is restricted to the Illawarra region in NSW. It grows in subtropical rainforest on laterite usually on rocky hillsides and gullies (Floyd 2008). Listed on EPBC as *Daphnandra johnsonii*.	No. not identified in the subject site or study area during survey (ELA 2016; 2018) .. No tests of significance required.
Genoplesium baueri	Yellow Gnat-orchid	E	E	*Genoplesium baueri* is known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils.	No. No tests of significance required.
Gentiana wingecarribiensis	Wingecarribee Gentian	CE	E	*Gentiana wingecarribiensis* is known only from Hanging Rock Swamp and Wingecarribee Swamp on the	No. No tests of significance required.

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				Southern Highlands, where it grows in bogs, in Sphagnum Moss humps and in sedge communities (DECC 2007).	
Gossia acmenoides population	*Gossia acmenoides* population in the Sydney Basin Bioregion south of the Georges River	Endangered population	-	The endangered population of *Gossia acmenoides* is found in subtropical and dry rainforest on the ranges and coastal plain of the Illawarra, in particular from Shellharbour, Wollongong and Kiama LGAs, and encompasses all occurrences south of the Georges River. This population is the southernmost occurrence of the species and is approximately 175 km from the nearest population to the north in the Hunter region of NSW.	No. Not identified in the study area or subject site during targeted survey (ELA 2016; 2018). No tests of significance required.
Haloragis exalata subsp. exalata	Wingless Raspwort, Square Raspwort	V	V	*Haloragis exalata* has been recorded in 4 widely scattered localities in eastern NSW; the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW; where it appears to require protected and shaded damp situations in riparian habitats (DECC 2007).	Unlikely – too disturbed and no local records. No tests of significance required.
Hibbertia stricta subsp. *furcatula*	Menai Guinea-flower	E	-	*Hibbertia stricta* subsp. *furcatula* (formerly *Hibbertia* sp. nov. 'Menai') is known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. The Southern Sydney population occurs on both sides of the Woronora River gorge, near Loftus and in Royal National Park. The southern population is mainly in the vicinity of Nowra. Habitat of the South Coast population is poorly recorded, but appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone.	No. No tests of significance required.

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Irenepharsus trypherus	Illawarra Irene	E	E	*Irenepharsus trypherus* typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines (DECC 2007). The vast majority of sites are recorded from the upper slopes of the ridge systems that extend south and east of the Illawarra escarpment, although the species has also been recorded from the deep sandstone gorges of the Shoalhaven River, and associated vegetation includes moist sclerophyll forest, *Backhousia myrtifolia* thicket, and rainforest (DECC 2007).	Unlikely – some low value generic habitat, but not true scree slopes this species is associated with. No. No tests of significance required.
Lastreopsis hispida	Bristly Shield Fern	E	-	*Lastreopsis hispida* grows in moist humus-rich soils in wet forest and rainforest gullies, and at Mt Wilson, associated species include *Ceratopetalum apetalum, Elaeocarpus holopetalus, Fieldia australis, Cyathea australis, Blechnum nudum, B. patersonii* and *Leptopteris fraseri (*DECC 2007).	Unlikely – not preferred habitat type (not preferred association) and no local records. No tests of significance required.
Melaleuca biconvexa	Biconvex Paperbark	V	V	*Melaleuca biconvexa* occurs in coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district. It grows in damp places often near streams (PlantNet 2011).	No. No tests of significance required.
Pelargonium sp. Striatellum (G.W.Carr 10345)	Omeo Stork's-bill	E	E	It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	No. No tests of significance required.

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Pimelea spicata	Spiked Rice-flower	E	E	In western Sydney, *Pimelea spicata* occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (Ibid.). Has been located in disturbed areas that would have previously supported CPW (Ibid.). On the Illawarra floodplain this species is found in the coastal lowlands between Landsdowne to Shellharbour and in northern Kiama. It favours coast banksia open woodland with a shrub and grassy understorey.	No. No tests of significance required.
Prasophyllum affine	Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid	E	E	*Prasophyllum affine* is known only from a few small populations to the south-east of Nowra on the NSW South Coast. Grows in heathy areas on poorly drained clay soils (DECC 2007).	No. No tests of significance required.
Pterostylis gibbosa	Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	E	E	*Pterostylis gibbosa* is known from a small number of populations in the upper Hunter Valley (Milbrodale), the Illawarra region (Albion Park and Yallah) and near Nowra (DECC 2007). Plants grow in a variety of woodland and open forest communities with shallow rocky soils.	No. No tests of significance required.
Pterostylis pulchella	Waterfall Greenhood	V	V	*Pterostylis pulchella* is known only from a small number of populations along the Illawarra Escarpment e.g. Fitzroy, Belmore and Munnamurra Falls. Plants grow in shallow, moist soils close to sandstone ledges and cliffs.	No. No tests of significance required.

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Pultenaea aristata	Prickly Bush-pea	V	V	*Pultenaea aristata* is restricted to the Woronora Plateau, in a small area between Helensburgh, south of Sydney, and Mt Keira above Wollongong (DECC 2007). It is associated with scrub and heath on sandstone ridge tops and upper slopes of large upland swamps on shallow sandy loams (Keith 1994).	No. No tests of significance required.
Solanum celatum	-	E	-	*Solanum celatum* is restricted to an area from Wollongong to just south of Nowra and west to Bungonia, on the Central Coast and South Coast. Majority of records are prior to 1960. It grows on hills and slopes in eucalypt woodland, rainforest clearings and wet sclerophyll forest. It is commonly found after fire or disturbance (DECC 2007; PlantNet 2011).	No. Not identified during targeted survey (ELA 2016; 2018). No tests of significance required.
Syzygium paniculatum	Magenta Lilly Pilly	E	V	*Syzygium paniculatum* naturally occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW.	No. Not identified during targeted survey (ELA 2016; 2018). No.
Thelymitra kangaloonica	Kangaloon Sun Orchid	CE	CE	*Thelymitra kangaloonica* is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. These swamps are a part of the ecological community "Coastal Upland Swamp" which is listed under the NSW *Threatened Species Conservation Act* 1995 as an Endangered Ecological Community, also known as “Temperate Highland Peat Swamps on Sandstone” which is listed under the *Environment Protection and Biodiversity Conservation Act* 1999. It is likely that the number of mature	No. No tests of significance required.

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				individuals of *Thelymitra kangaloonica* is very low, with less than 250 plants known	
Thesium australe	Austral Toadflax	V	V	*Thesium australe* is widespread throughout the eastern third of NSW but most common on the North Western Slopes, Northern Tablelands and North Coast. Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (*Themeda triandra*) (DECC 2007). The preferred soil type is a fertile loam derived from basalt or argillaceous sediment (e.g. shale) although it occasionally occurs on metasediments and granite.	No. No tests of significance required.
Triplarina nowraensis	Nowra Heath Myrtle	E	E	*Tripladenia nowraensis* is confined to the Nowra district on the Central and South Coasts of NSW. It grows in moist heath close to stream channels or swampy slopes (PlantNet 2011).	No. No tests of significance required.
Wilsonia backhousei	Narrow-leafed Wilsonia	V	-	In NSW, *Wilsonia backhousei* is found on the coast between Mimosa Rocks National Park and Wamberal north of Sydney (Nelson's Lake, Potato Point, Sussex Inlet, Wowly Gully, Parramatta River at Ermington, Clovelly, Voyager Point, Wollongong and Royal National Park). It grows on the margins of salt marshes and lakes (DECC 2007).	No. No tests of significance required.
Wilsonia rotundifolia	Round-leafed Wilsonia	E	-	In NSW, *Wilsonia rotundifolia* is known from several sites in the Jervis Bay area, Royal National Park, near Deniliquin and on the lakebeds of Lake George and Lake Bathurst when these are exposed. Grows in mud in coastal saltmarsh and inland saline or brackish lake beds (DECC 2007).	No. No tests of significance required.

Flora					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Zieria granulata	Illawarra Zieria	E	E	*Zieria granulata* is known from a number of sites in the Illawarra region of the Central Coast, mainly between Oak Flats and Toolijooa. It usually grows in shrubland on rocky outcrops with shallow volcanic soils. Less frequently found on moist slopes of the escarpment and in low-lying areas on Quaternary sediments in sclerophyll forest and on rainforest margins (DECC 2007).	Yes. Single plant recorded. AoS and SIC would be required to assess potential indirect impacts
Zieria tuberculata	Warty Zieria	V	V	*Zieria tuberculata* is known from a number of sites in the Mt Dromedary and Tilba Tilba area on the NSW far South Coast. It grows in heath amongst rocky outcrops on rain forest edges and in tall forest and shrubland (DECC 2007).	No. No tests of significance required.

FAUNA

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
AVES					
Anthochaera phrygia	Regent Honeyeater	CE	CE	Occurs mostly in dry box-ironbark eucalypt woodland and dry sclerophyll forest associations, wherein they prefer the most fertile sites available. The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995).	No. No tests of significance required.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Eastern Australian population found in open eucalypt forests and woodlands, also uses shrublands, heathlands and modified habitats such as roadside vegetation and golf courses; less often in wet sclerophyll and rainforest. Prefers open canopy and sparse canopy. In western NSW, more associated with larger wooded riparian zones. Roost communally and may form flocks of 20-30 birds (up to 300 in abundant food areas e.g. grasshopper swarms and flowering trees). Insectivorous taking prey on the wing, in the air and on the ground; but also eating foliage and grassy materials. Also demonstrates kleptoparasitism. Resident or nomadic species with a large home range depending on conditions and regional location, migrating to north NSW and SE Qld in autumn; and south in spring (Sept-Nov) to breed. Nests colonially and vigorously protect young and drive away competitors and predators, with stick bowl nests in tree forks to small vertical hollows (including in fence posts) 1-10m above ground in August to January (NSWSC 2016, Higgins and Peter 2002).	Unlikely. Lack of suitable habitat type (i.e. *Eucalyptus* spp. in open woodland). No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Botaurus poiciloptilus	Australasian Bittern	E	E	Favours permanent shallow waters, edges of pools and waterways, with tall dense vegetation such as sedges, rushes and reeds on muddy or peaty substrate.	No – too small and not proximate to any significant potential habitat. No tests of significance required.
Burhinus grallarius	Bush Stone-curlew	E	-	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000; Marchant & Higgins 1993).	Unlikely – too modified. No tests of significance required.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Generally found in NSW from the southeast coast to the Hunter region, and inland to the Central Tablelands and southwest slopes. During summer, inhabits heavily timbered and mature wet sclerophyll forests and alpine woodlands; wintering at lower altitudes in drier more open eucalypt forests and woodlands, particularly box-ironbark assemblages. Often found in woodland, farms and suburbs in autumn/winter.	Unlikely – lacks preferred habitat. No tests of significance required.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Associated with a variety of forest types containing *Allocasuarina* species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; DECC 2007). Nests in trees with large hollows (Environment Australia 2000).	No. No tests of significance required.
Daphoenositta chrysoptera	Varied Sittella	V	-	Sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter 2002; Barrett *et al.* 2003). It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-	Unlikely: Not a true rainforest bird – prefers open forests and woodlands, hence very low chance may occur in adjacent remnant and hence on site. No preferred habitat nearby.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				barked gums with dead branches, mallee and *Acacia* woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	No tests of significance required.
Dasyornis brachypterus	Eastern Bristlebird	E	E	Associated with dense, low vegetation including sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest, as well as open woodland with a healthy understorey.	No. No tests of significance required.
Glossopsitta pusilla	Little Lorikeet	L	-	Gregarious, usually foraging in small flocks, often with other species of lorikeet feeding primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. Mostly occurs in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. In south-east Queensland (Smyth *et al*. 2002), were more likely to occupy forest sites with relatively short to intermediate logging rotations (15–23 years) and sites that have had short intervals (2.5– 4 years) between fires.	Unlikely – only handful of preferred food trees on site, and not preferred forest type on or adjacent. Few potential nest hollows likely to be dominated by common woodland species. No tests of significance required.
Hieraaetus morphnoides	Little Eagle	V		Associated with woodland, forested lands and open country, extending into the arid zone.	Unlikely – not preferred habitat for foraging or nesting. No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Ixobrychus flavicollis	Black Bittern	V	-	Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (DECC 2007). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECC 2007).	Unlikely - too small and not proximate to any significant potential habitat. No tests of significance required.
Lathamus discolor	Swift Parrot	E	CE, Marine	Migrates to mainland in autumn, where it forages on eucalypts. Box-ironbark habitat in drainage lines, and coastal forest in NSW is thought to provide critical food resources during periods of drought or low food abundance elsewhere (MacNally et al. 2000).	Unlikely – only <6 potential food trees on site and in study area. No tests of significance required.
Lophoictinia isura	Square-tailed Kite	V	-	Open forests and woodlands in coastal and sub-coastal areas. Forages low over, or in, canopy for eggs, nestlings, passerines, small vertebrates and invertebrates. Large home range (>100km^2). Large stick nest in high fork of living tree. Breeds July-December. Lays 2-3 eggs with 1-2 birds fledging after 100days. Appears to be adapting to an abundance of passerines in well-vegetated outer fringes of cities. Observed foraging in residential areas of Port Macquarie. Probably migrates to northern Australia in winter. (Debus 1998, NSW NPWS 2000)	Potential. Potential foraging habitat within a landscape similar to habitats this species has been recorded in, but only 2 local records hence only low potential to occur. Tests of significance required.
Ninox connivens	Barking Owl	V	-	Well-forested hills and flats, eucalypt savannah (especially), and riverine woodland in coastal and subcoastal areas. Prefers hunting in more open country for mammals (rabbits, rats, mice, small bats and small marsupials) and birds (small up to Frogmouths and Magpies). Large territories. Nest in hollows.	Unlikely – lack of preferred habitat, low prey diversity and no potential nest sites. No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Ninox strenua	Powerful Owl	V	-	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes. Large trees with hollows at least 0.5m deep are required for shelter and breeding. Very large territory (500-5000ha).	Unlikely – lack of preferred habitat, low prey diversity and no potential nest sites. No tests of significance required.
Neophema chrysogaster	Orange-bellied Parrot	CE	CE, Marine	Nests in hollows in eucalypt trees growing adjacent to feeding plains. Feeds in sedgelands, coastal saltmarshes and dunes, or beach-front vegetation.	No No tests of significance required.
Numenius madagascariensis	Eastern Curlew	-	CE, M, Marine	Intertidal coastal mudflats, coastal lagoons and sandy spits (DEH 2005a).	No No tests of significance required.
Pandion cristatus	Eastern Osprey	V	-	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995).	No. No tests of significance required.
Petroica boodang	Scarlet Robin	V	-	Found in southeastern Australia. There may be two disjunct breeding populations in NSW on the Northern Tablelands and the Central–Southern Tablelands (Barrett *et al.* 2003). In NSW, it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains (Higgins and Peter 2002). Forages from low perches, feeding on invertebrates taken from	Unlikely: Site is coastal and species is more likely to occur in hinterland. No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				the ground, tree trunks, logs and other coarse woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank. Abundant logs and fallen timber are important habitat components. In autumn and winter, may join mixed flocks of other small insectivorous birds.	
Ptilinopus superbus	Superb Fruit-dove	V	-	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms (DECC 2007). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (ibid.). Part of the population is migratory or nomadic (ibid.). At least some of the population, particularly young birds, moves south through Sydney, especially in autumn (ibid.). Breeding takes place from September to January (ibid.). Will feed in adjacent mangroves or eucalypt forests (Blakers et al. 1984).	Potential– may use habitat upslope as part of southern range. Small potential to occur on east to southeast when suitable fruiting periods. Unlikely to breed due to limited abundance of habitat in locality. Test of significance required.
Rostratula australis (*Rostratula benghalensis* (*sensu lato*)	Australian Painted Snipe	E	E, Marine	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation such as grasses, tussocks or reeds.	No No tests of significance required.
Tyto novaehollandiae	Masked Owl	V	-	The Masked Owl is associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland and especially the ecotone between wet and dry forest, and non forest habitat. It is known to utilise forest margins and isolated stands of trees within agricultural land and heavily disturbed forest where its	Unlikely – limited preferred habitat, low prey diversity and no potential nest sites. No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				prey of small and medium sized mammals can be readily obtained.	
Tyto tenebricosa	Sooty Owl	V	-	Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species. Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows.	Unlikely – lack of preferred habitat, low prey diversity and no potential nest sites. No tests of significance required.
AMPHIBIA					
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest. Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy (Environment Australia 2000).	No No tests of significance required.
Litoria aurea	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DEC 2007). Fast flowing streams are not utilised for breeding purposes by this species. Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DEC 2007). Large permanent swamps and ponds exhibiting well-established fringing	Unlikely: Site has marginal potential breeding habitat and other microhabitat features; but heavily disturbed and not connected to known or significant potential habitat. Connectivity poor and subject to long term decline due to zoning. No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1994). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (*Gambusia holbrooki*) (DEC 2007).	
Litoria littlejohni	Littlejohn's Tree Frog, Heath Frog	V	V	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	No No tests of significance required.
Mixophyes balbus	Stuttering Frog	E	V	Occurs in a variety of habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (DECC 2007) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997).	Unlikely - not proximate to any source habitat and locality highly modified. No nearby records. No tests of significance required.
Pseudophryne australis	Red-crowned Toadlet	V	-	Associated with steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECC 2007).	No No tests of significance required.
MAMMALIA					
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V	V	Occurs in a variety of habitats, including dry sclerophyll forests, woodland, sub-alphine woodland, edges of rainforersts and wet sclerophyll forests (Churchill 1998; DECC 2007). Roosts in caves, rock overhangings and disused mine shafts, and is associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	Unlikely – broad generic potential foraging habitat, but only potential roosts may be in culverts. More likely to be hinterland species were sandstone escarpments predominate. No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Dasyurus maculatus maculatus	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	V	E	Inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests, more frequently recorded near the ecotones of closed and open forest within 200km of the coast.	Unlikely – remnants in study area have long been poorly interconnected, and likely to be dominated by fox and feral cats. Rarity of tree hollows in study area also a key limitation. No tests of significance required.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	A large vespertilionid which feeds on moths and insects. Known to roost in caves, abandoned buildings, but mostly in trees hollows in higher rainfall forested areas. It is suspected that some populations migrate in winter from higher altitudes to coastal areas, or may simply enter torpor. Prefers tall forests (>20 m high) and extensive movements (e.g. 12 km recorded between foraging and roost sites).	Pottential. foraging over rainforest remnant in study area, but only marginal habitat as prefers larger tracts of forest. Tests of significance required
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E	Associated with heath, coastal scrub, sedgeland, heathy forests, shrubland and woodland on well drained, infertile soils, within which they are typically sound in areas of dense ground cover.	No No tests of significance required.
Kerivoula papuensis	Golden-tipped Bat	V	-	Favours moist closed forests often with a rainforest influence, although it may occur in dry forests away from rainforest (Lunney *et al*. 1986; Parnaby and Mills, 1994).	Unlikely – locality lacks preferred habitat which is a mosaic of moist and dry forest types. No tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Miniopterus australis	Little Bent-wing Bat	V	-	Prefers well-timbered areas including rainforest, wet and dry sclerophyll forests, *Melaleuca* swamps and coastal forests (Churchill 1998). This species shelter in a range of structures including culverts, drains, mines and caves (Environment Australia 2000).	Potential. known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Test of significance required
Miniopterus orianae oceanensis	Eastern Bent-wing Bat	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). Will utilise caves, old mines and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Potential. known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Test of significance required.
Mormopterus norfolkensis	East-coast Freetail-bat	V	-	Associated with dry eucalypt forest and woodland, but may occur over rocky rivers in rainforest and wet sclerophyll forest. Primarily roosts in hollows or behind loose bark in mature eucalypts, but also found in disused buildings and other novel roost sites (Environment Australia 2000; Allison & Hoye 1998).	Potential. known to forage in similar habitats within range. Marginal potential to roost in culverts if cavities present. Test of significance required.
Myotis (Macropus) macropus	Southern Myotis	V	-	Occurs in a range of habitats including mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodlands, as long as they are close to water (Churchill 1998). Roosting is most commonly associated with caves but often found in culverts and under bridges (wooden and other).	Potential. low value potential habitat in Munna Munnora Creek, but could use as small part of non-breeding range. Marginal potential to roost in culverts. Test of significance required.
Petauroides volans	Greater Glider	-	V	The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising	No Test of significance not required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				eucalypt leaves, and occasionally flowers (Kehl & Borsboom 1984; Kavanagh & Lambert 1990; van der Ree *et al*., 2004). It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (Andrews *et al*., 1994; Smith *et al*., 1994, 1995; Kavanagh 2000; Eyre 2004; van der Ree *et al*., 2004; Vanderduys *et al*., 2012). The distribution may be patchy even in suitable habitat (Kavanagh 2000). The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (Kavanagh 1984).	
Petaurus australis	Yellow-bellied Glider	V	-	This species is restricted to tall mature forests, preferring productive tall open sclerophyll forests with a mosaic of tree species including some that flower in winter (Environment Australia 2000, Braithwaite 1984, Davey 1984, Kavanagh 1984; DECC 2007). Large hollows within mature trees are required for shelter, nesting and breeding (Henry and Craig 1984; DECC 2007). Sap trees utilised include: *E. propinqua, E. tereticornis, E. microcorys, & E. resinifera* (NPWS 2000). Home range of 30-65ha (NPWS 1999).	No Test of significance not required.
Petaurus norfolcensis	Squirrel Glider	V	-	Associated with dry hardwood forest and woodlands (Menkhorst et al. 1988; Quin 1995). Most common in floriferous sub-coastal and coastal forests with winter flowering trees and shrubs and some smooth barked eucalypts. Most commonly recorded along the coastal margin where Banksias dominate the understory. Home range 0.6-9ha, family groups of 2-10 (NSW NPWS 1999). Habitats typically include gum barked and high nectar producing species, including winter	No Test of significance not required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				flower species (Menkhorst et al. 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995).	
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).	No Test of significance not required.
Phascolarctos cinereus	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	V	V	Associated with both wet and dry eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% with eucalyptus food trees (Reed et al. 1990).	No. Test of significance not required.
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	V	V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004).	No Test of significance not required.
Pseudomys novaehollandiae	New Holland Mouse, Pookila	-	V	Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes (Listing Advice)	No Test of significance not required.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998; Eby 1998). Camps are often located in gullies, typically	Likely: abundant potential foraging habitat in study area. Tests of significance required.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				close to water, in vegetation with a dense canopy (Churchill 1998).	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Found in most habitats, and is dependent on suitable hollow-bearing trees to provide roost sites (Environment Australia 2000).	Potential. Some generic but low value non-breeding foraging habitat along edges of forest and over remnants in study area. Unlikely to roost due to lack of resources. Tests of significance required
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Associated with moist gullies in mature coastal forest or rainforest, east of the Great Dividing Range (Churchill 1998) tending to be more frequently located in more productive forests (Hoye & Richards 1998).	Potential. Some generic but low value non-breeding foraging habitat along edges of forest and over remnants in study area. Unlikely to roost due to lack of resources. Tests of significance required
Listed migratory species					
Apus pacificus	Fork-tailed Swift	-	M	Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas (Simpson & Day 1999).	Likely to forage over locality as part of wider range. Tests of significance required
Cuculus optatus (*Cuculus saturatus*)	Oriental Cuckoo, Horsfield's Cuckoo	-	M	Monsoon forests, rainforest edges, leafy trees in paddocks, river flats, roadsides, mangroves and islands are all listed as habitat utilised by the species.	Potential to occur utilising rainforest upslope and less so forest in south east. Tests of significance required
Hirundapus caudacutus	White-throated Needletail	-	M	Prefers wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Roosts in dense foliage of canopy trees and may seek refuge in tree hollows during inclement weather (Marchant & Higgins 1993).	Likely to forage over locality as part of wider range. Tests of significance required

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
Monarcha melanopsis	Black-faced Monarch	-	M, Marine	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	Potential to occur utilising rainforest upslope and less so forest in south east. Tests of significance required
Monarcha trivirgatus	Spectacled Monarch	-	M, Marine	Associated with wet forests and mangroves (Simpson & Day 1999).	Potential to occur utilising rainforest upslope and less so forest in south east. Tests of significance required
Myiagra cyanoleuca	Satin Flycatcher	-	M, Marine	Associated with drier eucalypt forests and open forests, often at height (Simpson & Day 1999).	No. Tests of significance not required
Rhipidura rufifrons	Rufous Fantail	-	M, Marine	Occurs in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe 2004).	Potential to occur utilising rainforest upslope and less so forest in south east. Tests of significance required
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	-	M, Marine	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1999).	No Tests of significance not required.
Pandion haliaetus	Osprey	-	M, marine	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). Osprey may nest on the ground, on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995).	No – creek too small and lacks preferred prey. No potential nest sites. Tests of significance not required.
Bubulcus ibis/Ardea ibis	Cattle Egret	-	M	Widespread, occurring in mostly agricultural areas associated with grazing stock along the coast,	Yes: recorded on site No. No assessment required for marine species listed under EPBC Act.

Fauna					
Scientific Name	Common Name	NSW BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence/Statutory Assessment Required.
				especially where poor drainage or modified wetlands. Roosts along watercourses.	
Ardea alba	Great Egret, White Egret	-	Marine	Occurs in a variety of habitats. It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pastures and estuarine mangroves and mudflats (McKilligan 2005).	Likely to forage as single birds along Munna Munnora Creek. No assessment required for marine species listed under EPBC Act.
Cuculus saturatus	Oriental Cuckoo, Himalayan Cuckoo	-	Marine	Monsoon forests, rainforest edges, , leafy trees in paddocks, river flats, roadsides, mangroves and islands are all listed as habitat utilised by the species.	Potential to occur utilising rainforest upslope and less so forest in south east. No assessment required for marine species listed under EPBC Act.
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	Marine	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	No – creek too small and lacks preferred prey. No potential nest sites. Test of significance not required.
Merops ornatus	Rainbow Bee-eater	-	Marine	Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs. Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting.	Potential to occur as foraging transient in southeast. No assessment required for marine species listed under EPBC Act.

Appendix B - Flora species identified in the study area

Numbers in the various cells relate to the frequency with which a species was recorded during the traverse and does not relate to importance or relative frequency. Exotic species are identified with an asterisk (*) (noxious species declarations with *[N]) and identified threatened species with [+]. Species present in the Final Determination of Illawarra Subtropical Rainforest have been marked with ([RF]). Note that this list is not conclusive for each patch of vegetation visited and reflects a list of those prominent and important species noted in each assessment unit to determine if the community present was likely to indicate a native ecological community, and guide identification.

Units of the study area are combined where multiple occurrences of the same or similar environmental conditions occur, except where identified separately in existing planning (E2, E3) or where notable floristic differences occur (as with the separately identified rainforest patches). 'Gully' includes areas mostly too small to discretely map that would be considered to be Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions. The units identified as RF - E2, RF - E3, RF – South, RF – SE, RF – NW and RF – Poor likely comprise elements of the Illawarra Subtropical Rainforest community, with the lowest condition ('Poor') community having little typical rainforest diversity and a canopy largely formed of exotic species (*Lantana*, *Senna*) and adventitious wattles.

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF-W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Pteridophytes (Ferns)													
Aspleniaceae													
Asplenium australasicum			1										
Asplenium flabellifolium	2	1	1	1	1			1		1			
Blechnaceae													
Doodia aspera [RF]	1	1		1	1		1	1		1			
Polypodiaceae													
Microsorum scandens				1									

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Pteridaceae													
Adiantum formosum [RF]										1			
Adiantum hispidulum		1		1	1			1					
Cheilanthes austrotenuifolia	1												
Cheilanthes distans	1		1		1				1				
Cheilanthes sieberi			1										
Pellaea falcata		1	2		1				1				
Tectariaceae													
Arthropteris tenella				1	1				1				
Thelypteridaceae													
Cyclosorus dentatus										2			
Dicotyledonae													
Acanthaceae													
Pseuderanthemum variabile		1	1	1				1					
Aphanopetalaceae													
Aphanopetalum resinosum			1			1			1				
Apiaceae													

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Centella asiatica										1			1
Apocynaceae													
*Araujia sericifera**		2	1										1
Cynanchum elegans [+]		1											
*Gomphocarpus fruticosus**	1	1	1						2				1
Marsdenia rostrata		2				1							
Parsonsia straminea		2	1		1			1					
Asteraceae													
*Ageratina adenophora**					1								
*Ageratina riparia**	2	1	1	1	1			1	1	3			2
*Aster subulatus**													1
*Bidens pilosa**	1								1				
*Cirsium vulgare**					1								1
*Conyza bonariensis**													1
*Conyza sp**			1						1	1			
Cotula australis	1												
*Delairea odorata**		2	1	1	1								

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
*Euryops chrysanthemoides**									1				
*Hypochaeris radicata**	1		1							1			
*Senecio madagascariensis**[N]	1		1						2	1			2
Sigesbeckia orientalis		1						1	1				
*Sonchus oleraceus**	1		1										
*Taraxacum officinale**													1
Bignoniaceae													
Pandorea pandorana	1	4	2		1			1					
Campanulaceae													
Wahlenbergia communis	1		1										
Caprifoliaceae													
*Lonicera japonica**		1											
Caryophyllaceae													
*Cerastium glomeratum**	1		1										
*Paronychia brasiliana**	1												
*Stellaria media**			1										
Celastraceae													

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Denhamia silvestris								1					
Elaeodendron australe RF			1	1									
Convolvulaceae													
Dichondra repens		1	1		1				1				
Crassulaceae													
Crassula sieberi	1												
Dilleniaceae													
Hibbertia scandens	2	3						1	3	3			1
Ebenaceae													
Diospyros australis			1										
Ericaceae (Styphelioideae)													
Leucopogon juniperinus					1					1			
Euphorbiaceae													
Baloghia inophylla RF		1					1						
*Euphorbia peplus**													1
Homalanthus populifolius		2					1		1	1			
Fabaceae Caesalpinioideae													

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
*Senna pendula**	1				1	1		1	4				
Fabaceae Faboideae													
*Erythrina crista-galli**		1					1		1			1	1
Glycine microphylla		1											
Glycine tabacina		1											
*Medicago minima**										1			
*Trifolium repens**										1			
Vicia sp*		1								1			
Fabaceae Mimosoideae													
Acacia implexa					1				1				
Acacia longifolia		2	1		1	1		1	5	2			1
Acacia mearnsii			1		1								
Acacia obtusifolia									1				
Pararchidendron pruinosum var. *pruinosum*				1					1				
Flacourtiaceae													
Scolopia braunii [RF]								1					

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Geraniaceae													
Geranium solanderi	2	3						1	1	1			1
Lamiaceae													
Gmelina leichhardtii				1									
Plectranthus parviflorus	1		1						1				
Lauraceae													
Cryptocarya microneura				1					1				
Linaceae													
*Linum trigynum**										1			
Malaceae													
Cotoneaster sp*	1				1				1				
Malaceae sp (*Cydonia*?)*		1											
*Pyracantha crenatoserrata**									1				
Malvaceae													
Brachychiton acerifolius [RF]				1									
*Sida rhombifolia**	1								1	1			2
Meliaceae													

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Melia azedarach									1				
Menispermaceae													
Legnephora moorei RF			1										
Sarcopetalum harveyanum		1					1						
Stephania japonica		1	1				1						
Monimiaceae													
Wilkiea huegeliana RF				1									
Moraceae													
Ficus coronata RF				1		1							
Ficus macrophylla RF									1				
Ficus superba subsp. *henneana* RF			1	1	1	1							
Maclura cochinchinensis RF	1	3		1	1	1		1	3				
Streblus brunonianus RF	2	5	2	1	1	1	1		4	1		1	
Trophis scandens RF			1	1					1				
Myrsinaceae													
*Anagallis arvensis**										1			1

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF-W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Myrsine variabilis	1	1	1	1	1	1		1	1			1	
Myrtaceae													
Acmena smithii				1	1								
Eucalyptus botryoides										1			
Syzygium australe					1								
Ochnaceae													
*Ochna serrulata**			1	1					2				
Oleaceae													
*Ligustrum lucidum**	1												
*Ligustrum sinense**									1				
Notelaea longifolia				1	1								
Olea europaea subsp. *cuspidata**	2												2
Onagraceae													
Epilobium billardierianum													2
Oxalidaceae													
Oxalis perennans			1						1				

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF-W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Passifloraceae													
*Passiflora subpeltata**		1		1					1				
Phyllanthaceae													
Breynia oblongifolia	1	1	1		1				1				
Glochidion ferdinandi		1			1	1			3				
Phytolaccaceae													
*Phytolacca octandra**								1					1
Piperaceae													
Piper hederaceum var. *hederaceum* RF				1									
Pittosporaceae													
Pittosporum multiflorum RF	2	2	1	1	1		1		2			1	
Pittosporum revolutum		1							1				
Pittosporum undulatum	1	3	1		1	1		1	5	2			
Plantaginaceae													
*Plantago lanceolata**	1		1							1			2
Polygonaceae													

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF-W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
*Acetosa sagittata**									1				
Persicaria lapathifolia											2		
Persicaria strigosa											1		
*Rumex crispus**									1	1			1
Rhamnaceae													
Emmenosperma alphitonioides		1		1		1							
Rosaceae													
*Rubus fruticosus**[N]		2			1			1	1	1			2
Rubus parviflorus		2							1				
Rubiaceae													
Coprosma repens													1
*Galium aparine**									1				
Galium sp			1										
Morinda jasminoides				1									
Rutaceae													
Acronychia oblongifolia				1									
Melicope micrococca			1										

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF-W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Sarcomelicope simplicifolia subsp. *simplicifolia*				1									
Zieria granulata [+]	1												
Sapindaceae													
Alectryon subcinereus [RF]				1									
Cupaniopsis anacardioides	1	1	1	1	1	1			3				
Guioa semiglauca [RF]						1							
Solanaceae													
*Solanum mauritianum**			1					1	3				
Urticaceae													
Urtica incisa			1		1								1
Verbenaceae													
Clerodendrum tomentosum	1		1						1				
*Lantana camara**[N]	2	2	1	1	1	1		1	3	3			1
*Verbena bonariensis**		1						1					1
*Verbena rigida**									1				1
Violaceae													

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Viola hederacea		1											
Vitaceae													
Cayratia clematidea [RF]	1												
Cissus antarctica [RF]			1										
Monocotyledonae													
Allliaceae													
*Agapanthus africanus**			1										
Anthericaceae													
*Chlorophytum comosum**			1										
Araceae													
*Arum italicum**									1				
Gymnostachys anceps	1			1									
Arecaceae													
Livistona australis				1									
Asparagaceae													
*Asparagus aethiopicus**[N]	2		1	1	1				1				
*Asparagus asparagoides**[N]	1	1											

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
*Asparagus plumosus**[N]				1					1				
Commelinaceae													
Commelina cyanea	1	1											
*Tradescantia fluminensis**			1	1	1				1				
Cyperaceae													
Carex longebrachiata				1		1							
Cyperus sp		1								1			
Cyperus eragrostis										1			
Eleocharis acuta											1		
Eleocharis sphacelata										1	2		
Schoenus sp										1	1		
Liliaceae													
*Lilium formosanum**			2										
Luzuriagaceae													
Eustrephus latifolius			1			1			1				
Geitonoplesium cymosum	2	3	1	1	1	1				1			
Phormiaceae													

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
Dianella longifolia		1			1								
Poaceae													
*Andropogon virginicus**								1		1			
*Axonopus fissifolius**	1		1					1		1			1
Bothriochloa decipiens	1		1							1			
Bothriochloa macra													1
Cynodon dactylon			1						1				
*Ehrharta erecta**		1	2	1	1		1	1					
Eragrostis leptostachya	1		1							1		1	
*Holcus lanatus**													1
Imperata cylindrica													1
*Melinis repens**									2				
Microlaena stipoides		3	1				1		1				
Oplismenus aemulus	2	2			1		1			1			
Paspalidium ?gracile		1											
*Paspalum dilatatum**		1	1										1
*Pennisetum alopecuroides**		1						1		1		1	2

Division / Family / Species	outcrop	wall	RF - E3	RF - E2	RF - South	RF - SE	RF- W	RF - NW	RF - Poor	Gully	dam	Coral tree	Pasture
*Pennisetum clandestinum**	1	1	1		1				3	3	1	1	2
*Phalaris aquatica**	1	1											1
*Setaria parviflora**										1			
Sporobolus creber										1			
Tripogon loliiformis			1										
Typhaceae													
Typha orientalis										1	1		

Appendix C - Fauna species identified in the study area

Table 13: Fauna species recorded at the study area

Class	Family	Scientific name	Common name
Aves	Ardeidae	[1]*Ardea ibis*	Cattle Egret
	Anatidae	*Anas superciliosa*	Pacific Black Duck
	Accipitridae	[2]*Circus assimilis*	Spotted Harrier
	Falconidae	*Falco longipennis*	Australian Hobby
	Turnicidae	*Turnix varia*	Painted Button Quail
	Psittacidae	*Calyptorhynchus funereus*	Yellow-tailed Black Cockatoo
		Trichoglossus haematodus	Rainbow Lorikeet
		Platycercus elegans	Crimson Rosella
	Meliphagidae	*Anthochaera carunculata*	Red Wattlebird
		Philemon corniculatus	Noisy Friarbird
		Manorina melanocephala	Noisy Miner
	Cinclosomidae	*Psophodes olivaceus*	Eastern Whipbird
	Artamidae	*Cracticus nigrogularis*	Pied Butcherbird
		Strepera graculina	Pied Currawong
		Gymnorhina tibicen	Australian Magpie
	Corvidae	*Corvus coronoides*	Australian Raven
	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra
	Hirundinidae	*Hirundo neoxena*	Welcome Swallow
	Zosteropidae	*Zosterops lateralis*	Silvereye
	Pycnonotidae	*Pycnonotus jocosus**	Red-whiskered bulbul
	Monarchidae	*Myiagra inquieta*	Restless Flycatcher
		Rhipidura leucophrys	Willie Wagtail
		Grallina cyanoleuca	Australian Magpie-lark
	Maluridae	*Malurus cyaneus*	Superb Fairy-wren
	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
	Columbinae	*Phaps chalcoptera*	Common Bronzewing
		Geophaps lophotes	Crested Pigeon

Class	Family	Scientific name	Common name
Amphibia	Myobatrachidae	*Crinia signifera*	Common Eastern Froglet
		Uperoleia sp. (likely *U. laevigata*)	Smooth Toadlet
		Litoria fallax	Dwarf Tree Frog
		Pseudophryne bibroni	Bibron's Toadlet
Reptilia	Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake
		Notechis scutatus	Eastern Tiger Snake
	Agamidae	*Amphibolurus muricatus*	Jacky Lizard
	Scincidae	*Ctenotus* spp.	-
		Lampropholis delicata	Grass Skink
		Eulamprus quoyii	Eastern Water Skink
Mammals	Vombatidae	*Vombatus ursinus*	Wombat
	Macropodae	*Macropus giganteus*	Eastern Grey Kangaroo

* Exotic species

[1] EPBC Act Migratory

[2] BC Act threatened.

Appendix D - Vegetation validation results ELA 2016

Depauperate Rainforest on tone walls and (0.71 ha)

Rocky outcrops

Rocky outcrops were scattered across the central and southern end of the site. Many small outcrops lacked any native or other vegetation and were not mapped.

Where present, vegetation on most of these outcrops was generally very simplistic due to the small size (<100 m^2) or weed invasion e.g. 1-3 native species with lantana and pasture. The most diverse was the largest outcrop near the site access which bordered a reasonably good patch of remnant rainforest, and supported a single Illawarra Zieria *(Z. granulata*), which is listed as threatened under NSW and Commonwealth legislation.

There were 27 native species recorded (57% of a total of 47 species) recorded occurring on rocky outcrops (most of these at the largest example of this habitat). Five of these species are listed in the Final Determination for *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (see section 4.2.2), although those species are not typically restricted to rainforest habitats e.g. *Citriobatus pauciflorus*.

No Mills (2006) vegetation community was able to be distinguished that related to this community directly, and the NSW VIS (DEC 2002) does not consider these areas either.

Stone walls

The stone walls are a novel ecological community as they are artificial habitat features related to the historical collection of rock from the paddocks presumably after clearing or as 'floaters' that have arisen during cultivation. Given the presence of the cobble scree in the remaining rainforest patches, it is presumed that prior to pastoralism, some parts of this landscape would have had a stony scree cover under the rainforest canopy – a situation suggested by the steep slopes and rocky outcrops still present in the study area.

A total of 57 species are recorded from the walls: 40 of them native, and 5 of these listed in the Final Determination for the *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (ISR) EEC, with only *Baloghia inophylla* and *Streblus brunonianus* really indicative of a rainforest habitat.

The rock walls with the highest diversity fell into larger patches of immature rainforest regrowth in the south. Those out in the open paddock were generally dominated by lantana, Mistflower (*Ageratina riparia*) and *Hibbertia scandens*, with an occasional rainforest pioneer e.g. *Pittosporum undulatum*.

Remnant rainforest areas (2.18 ha)

These areas mostly comprise those previously mapped by DEC (2002) and generally captured under Environmental zones in the KMC LEP, with some outlying patches. These comprise remnants which have largely avoided clearing or older regrowth, and generally have a lower weed and non-rainforest native tree component.

In the NSW Vegetation Information System (VIS-C), this community is recorded as PCT 1300, with subunits on site described as follows (see **Figure 7**):

- 'RF - E2' (0.632 ha) represents an area of mature, well-developed rainforest on the south-eastern margin of the study area. This area has 41 species present of which 10 are exotic. The groundcover is sparse, and tends to be dominated by cobbles and stones exposed on the surface as a scree within which the rainforest has developed.
- 'RF - E3' (0.345 ha) represents an area of lower, less mature community although it contains some mature, large trees including figs. There were 62 species recorded from this patch, of which 22 are exotic.
- 'RF - SE' (0.703 ha) is a patch to the south of the main area of RF– E2 and shares many of the same characteristics as the above patches. It is however outside the area identified in the LEP map as being subject to environmental zoning.
- 'RF - South' (0.326 ha) comprises two proximate patches of rainforest occurring around rock walls and rocky outcrops on the northern bank of Munna Munnora Creek near the southwestern boundary of the study area. It has large figs, myrtles and other typical rainforest species present.
- 'RF - W' (0.035 ha) is a small area on the western wall, dominated by a cluster of Coral Trees. It has a good rainforest understorey diversity present including trees, vines and herbaceous species. Thirteen species are recorded, of which two are exotic.
- 'RF - NW' (0.073 ha) is a similarly small patch of rainforest adjacent to a gully and rock wall on the western boundary near the northern end of the study area. It has mature plants of Flintwood (*Scolopia braunii*), which was not noticed elsewhere in the study area; as well as a range of other rainforest species. In all, 26 species are recorded from the patch.

Low Quality Rainforest regrowth (2.72 ha)

Recorded in the species table in **Appendix B** as 'RF – Poor', this mostly encompasses a number of areas mostly in the south.

In the south, these are patches of more recent regrowth (10-30 yrs old) often near rock walls or rocky outcrops which have limited maintenance, and generally have a cover dominated by wattles (e.g. *Acacia longifolia*, *A. maidenii, A. mearnsii*) with some pioneer rainforest species (most often *Pittosporum undulatum*). These areas also characterised by an edge to undergrowth of dense lantana.

These areas also include patches of Coral Trees underlain by rainforest understorey and groundcover which has recently regenerated from bird dispersal and remnant seedbanks with the lax in regrowth maintenance over the last decade.

Sixty plants were recorded from the various patches inspected. Of these, 32 are native species, with 18 typically found in rainforest habitats.

Instream freshwater wetland vegetation (1.32 ha)

These wetlands communities are distributed along the natural watercourses that flow west to east across the site.

The largest of these is the southernmost: Munna Munnora Creek. The habitat here presents as a permanent waterway with some deeper holes among rock outcrops with a variably wide floodplain. The floodplain is all but purely exotic – dominated by Kikuyu with lantana and other weeds, and was probably previously dominated by rainforest. Native wetland vegetation is limited to the bank edges itself and

consist of a limited range of wetland species, predominantly sedges. In other watercourses, the native vegetation (outside dams) is limited to the centreline and is being outcompeted by pasture in all but the wettest areas e.g. the channel. Most of the rest of the intermittent watercourses have been completely converted to pasture grasses as shown subsequently.

A total of 42 plant species were recorded in this habitat, with 22 of these being native species.

Dams (0.11 ha)

Located in all watercourses but Munna Munnora Creek, with two on the footslopes. The vegetation in the dams consists of mostly native species that are growing in an artificial situation.

One of the dams contains a good representation of Cumbungi Reedland community (Mills 2006), with others having a good representation to broad similarities with Spike-rush Sedgeland.

Exotic or mostly exotic pasture (approx. 31 ha)

There are two subunits to this dominant mapping unit. The small is where exotic Coral Trees (*Erythrina crista-galli*) dominate; the other comprises the largest proportion of the study area.

While small areas of native vegetation may occur throughout the pasture (a small area of *Imperata cylindrica* or localised plants of *Hibbertia scandens* for instance, to single or small clumps of native trees such as figs); and native species such as *Streblus, Myrsine* and *Pittosporum* occur in the lines of planted coral trees as a result of bird dispersal: the overall composition and form of the pasture and tree-lines is of exotic vegetation. Thirty-nine species were recorded in this vegetation, with only thirteen native species (33%).

Illawarra Subtropical Rainforest in the Sydney Basin Bioregion

Based on a review of the Final Determination criteria (NSWSC 2002), the rainforest remnant patches are considered to qualify as disturbed examples of this EEC to varying degrees, as follows.

Table 14: ISR EEC analysis - remnant rainforest areas

Final Determination Criteria Component	RF - E2	RF - E3	RF - SE	RF - South	RE - W	RW - NW
Occurs in relevant bioregion, Local Government Area, etc?	Yes	Yes	Yes	Yes	Yes	Yes
Found between Albion Park and Gerringong; and north of Lake Illawarra on the Berkeley Hills or Shoalhaven River and Kangaroo valley on Permian volcanics?	Yes	Yes	Yes	Yes	Yes	Yes
Occurs on coastal Permian Volcanics or other recognised geology?	Yes	Yes	Yes	Yes	Yes	Yes

Final Determination Criteria Component	RF - E2	RF - E3	RF - SE	RF - South	RE - W	RW - NW
Dominated by a floristic assemblage representing this EEC or a disturbed form?	32 native species present (76%). Twelve species characteristic of ISR. Rainforest character, and given local occurrence nearby; Final Determination acknowledges disturbed forms; meets all other criteria; and that Final Determination list not all inclusive, considered to be a derived form.	62 native species (65%). Seven of the species characteristic of ISR. Rainforest character, and given local occurrence nearby; Final Determination acknowledges disturbed forms; meets all other criteria; and that Final Determination list not all inclusive, considered to be a derived form.	Rainforest character very similar to RF – E2, and given local occurrence nearby; Final Determination acknowledges disturbed forms; meets all other criteria; and that Final Determination list not all inclusive, considered to be a derived form.	29 native species (71%) with 5 characteristic of ISR. Rainforest character, and given local occurrence nearby; Final Determination acknowledges disturbed forms; meets all other criteria; and that Final Determination list not all inclusive, considered to be a derived form.	13 native species (85%). Three species are characteristic of ISR. Based on adjacent vegetation and original habitat, considered to be a very derived form established via bird and wind dispersal from adjacent areas.	15 native species (58%), with 3 characteristic of ISR. Based on adjacent vegetation and original habitat, considered to be a very derived form; but is a very low value example due to minute patch size and high weed invasion.

Final Determination Criteria Component	RF - E2	RF - E3	RF - SE	RF - South	RE - W	RW - NW
Is it the EEC?	Yes – best example on site.	Yes, with high level of lantana on edges but would respond very well to management to restore the EEC.	Yes, with high level of lantana on edges but would respond very well to management to restore the EEC.	Yes, albeit derived and small and exposed to edge effects, but would respond very well to management.	Yes, but low value given adjacent to rock wall, very small patch size, high lantana infestation and crown dominated by Coral Trees. Will always be isolated by adjacent firebreak and pasture and exposed to edge effects.	Yes, but low value and probably not viable in long term as lantana very dense and suppressing any regeneration.

Table 15: ISR EEC analysis – other rainforest areas

Final Determination Criteria Component	Rainforest regrowth	Outcrop and Rock walls
Occurs in relevant bioregion, Local Government Area, etc?	Yes	Yes
Found between Albion Park and Gerringong; and north of Lake Illawarra on the Berkeley Hills or Shoalhaven River and Kangaroo valley on Permian volcanics?	Yes	Yes
Occurs on coastal Permian Volcanics or other recognised geology?	Yes	Yes

Final Determination Criteria Component	Rainforest regrowth	Outcrop and Rock walls
Dominated by a floristic assemblage representing this EEC or a disturbed form?	Overall dominated by exotic species or other natives (e.g. Acacias), with 32 native species (53%). characteristic of ISR, although 18 (56%) are typically found in rainforest habitats. Final Determination list is not all inclusive, and allows for highly disturbed habitats. As noted above, rainforest can recover after complete clearing over time via a successional process, if not stalled by other disturbances e.g. fire and weed invasion (NSWSC 2002, Peel 2010). This is the current situation: Lantana infestations are generally moderate to severe and hence significantly hamper the successional process. When the Acacias senesce and die, there is the risk that rainforest species will be prevented by lantana from succeeding these pioneers, and hence the succession failing.	Rocky outcrops: Only largest patch near the underpass access road could be considered a community. Only 5 of the 27 native species present, but dominated (57%) by native species. Other patches contain very simplistic stands which have some characteristic species as single plants with pasture and/or lantana. While not true assemblages themselves, these may contribute to the larger occurrence via pollen. Does not match a recognised association (Mills 2006). Rock walls: Contains 40 native species (70%) with only 5 indicative species, but these species are not restricted to rainforest habitats. However, not all walls have equal diversity, cover dominance by rainforest species, or extent of native vegetation: high diversity is limited to a few patches usually in or close to rainforest patches (hence propagule source). Much of the wall's extent are either bare, dominated by lantana, or the only native species present are not characteristic rainforest species e.g. *Hibbertia scandens*. Walls in the open pasture generally have the least diversity and often dominated by weeds e.g. lantana. Hence only small, localised areas of the rock walls may meet the floristic and structural criteria.

Final Determination Criteria Component	Rainforest regrowth	Outcrop and Rock walls
Is it the EEC?	Yes: Given habitat, likely that original vegetation was this EEC, and probably has good resilience and would respond readily to management.	Rocky outcrops**:** Only the largest patch near the underpass access qualifies in its own right as this EEC. This area is really the disturbed fringe of the adjacent rainforest remnant. Other smaller outcrops are isolated from other patches, with dubious long term viability due to competition with exotic species and edge effects. The smaller patches could be considered to be components the larger local occurrence of this EEC via pollen and fruit, but are not viable in the long term due to poor recruitment potential and extreme edge effects. Rock walls: Only localised areas in the south near Munna Munnora Creek, which are essentially extensions of the adjacent remnants, While the remaining areas of this habitat supports a few species indicative of this EEC, the predominant character is not consistent. Furthermore, although the original vegetation prior to disturbance was highly likely to have been the EEC, and the original soil is still present and the rocks used were taken from the original habitat, the *in situ* ecological functioning as a community is compromised. In terms of the BC Act definition of an ecological community as "*an assemblage of species occupying a particular area*", these smaller simplistic stands do not qualify (Preston and Adam 2004a, 2004b). These plants would however readily share pollen with nearby remnants, and hence contribute to genetic diversity, and hence could be argued to be minor components of the local occurrence of the EEC (Murlan Consulting Pty Limited v Ku-ring-gai Council [2007] NSWLEC 374, Dazdon Pty Ltd v Ku-ring-gai Council [2009] NSWLEC 1147).

Appendix E - Site photos

Photo 1: Examples of rocky outcrop vegetation

Photo 2: Weed infested rock wall in open paddock

Photo 3: Key remnant rainforest patches in southeast (surrounded by regrowth)

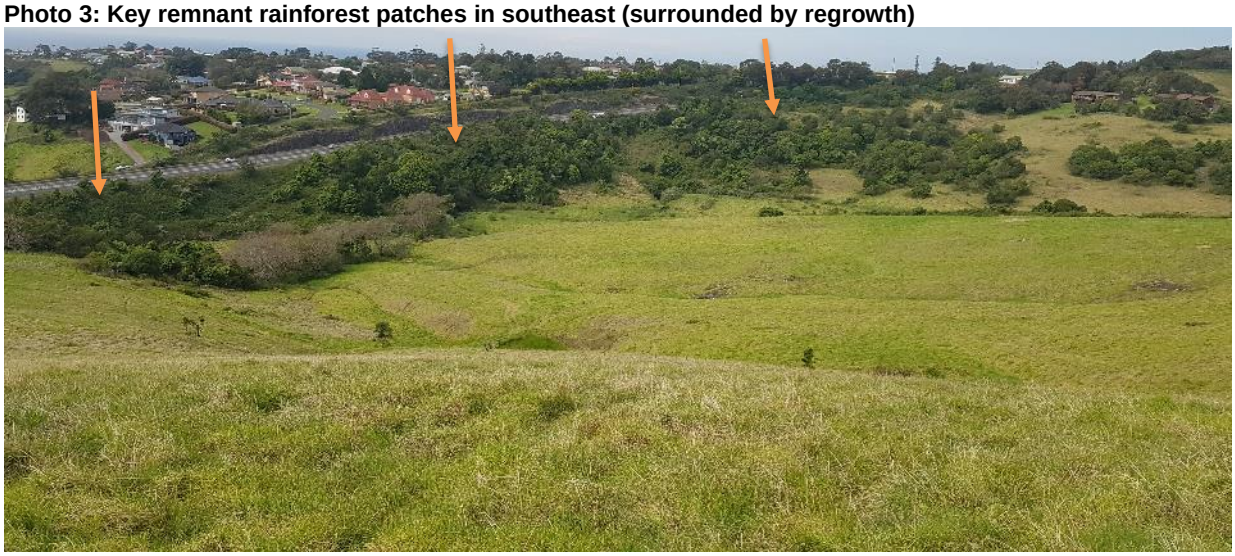


Photo 4: Higher quality rainforest near underpass access

Photo 5: RF – S

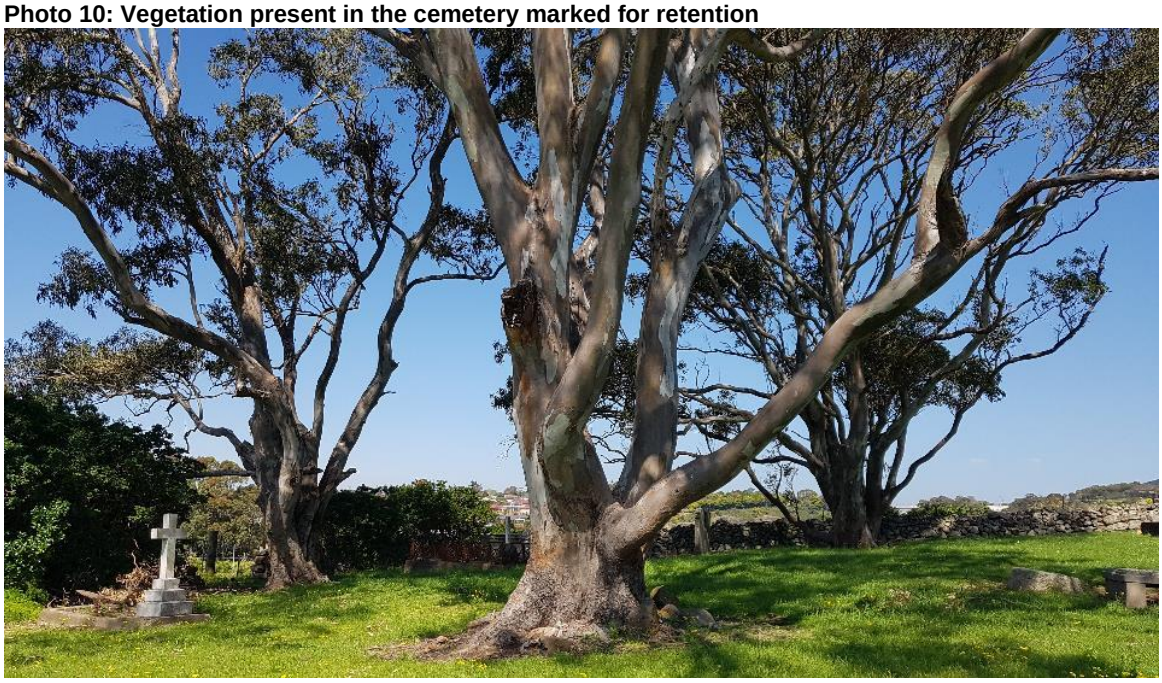
Photo 6: RF - W

Photo 7: Example of low quality rainforest regrowth in the south

Photo 8: Munna Munnora Creek riparian vegetation

Photo 9: Creek culverts (background) and freshwater wetlands (foreground)

Photo 10: Vegetation present in the cemetery marked for retention



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