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339 Tarean Rd Karuah Preliminary Ecological Constraints Assessment

Oracle Investment

339 Tarean Rd, Karuah, NSW, 2324

22 May 2019

339 Tarean Rd Karuah Preliminary Ecological Constraints Assessment

339 Tarean Rd, Karuah, NSW, 2324

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Prepared for:

ORACLE INVESTMENT

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Contents

1. PROJECT OVERVIEW

Kleinfelder understand that Oracle Investment require a Preliminary Ecological Assessment to determine the feasibility of rezoning Lot 52 DP 735066 339 Tarean Rd, Karuah NSW from RU2 – Rural Landscape to R2 Low Density Residential, B2 – Local Centre and E2 – Environmental Conservation. (**Figure 1**). This assessment will outline the known development constraints of potential development on the site.

The following terms are used throughout this report to describe particular geographical areas:

- **Locality** – land within a 5 kilometre radius of the study area (**Figure 1**);
- **Study area** – Lot 52 DP 735066 339 Tarean Rd, Karuah NSW (**Figure 1**).

1.1 SCOPE OF WORKS

This initial assessment is the first stage (Stage 1) of an Ecological Assessment which identifies key constraints within the site. If Oracle Investments decides to proceed with a full ecological assessment (Stage 2) this will be in accordance with the Biodiversity Assessment Method (*Biodiversity Conservation Act 2016*).

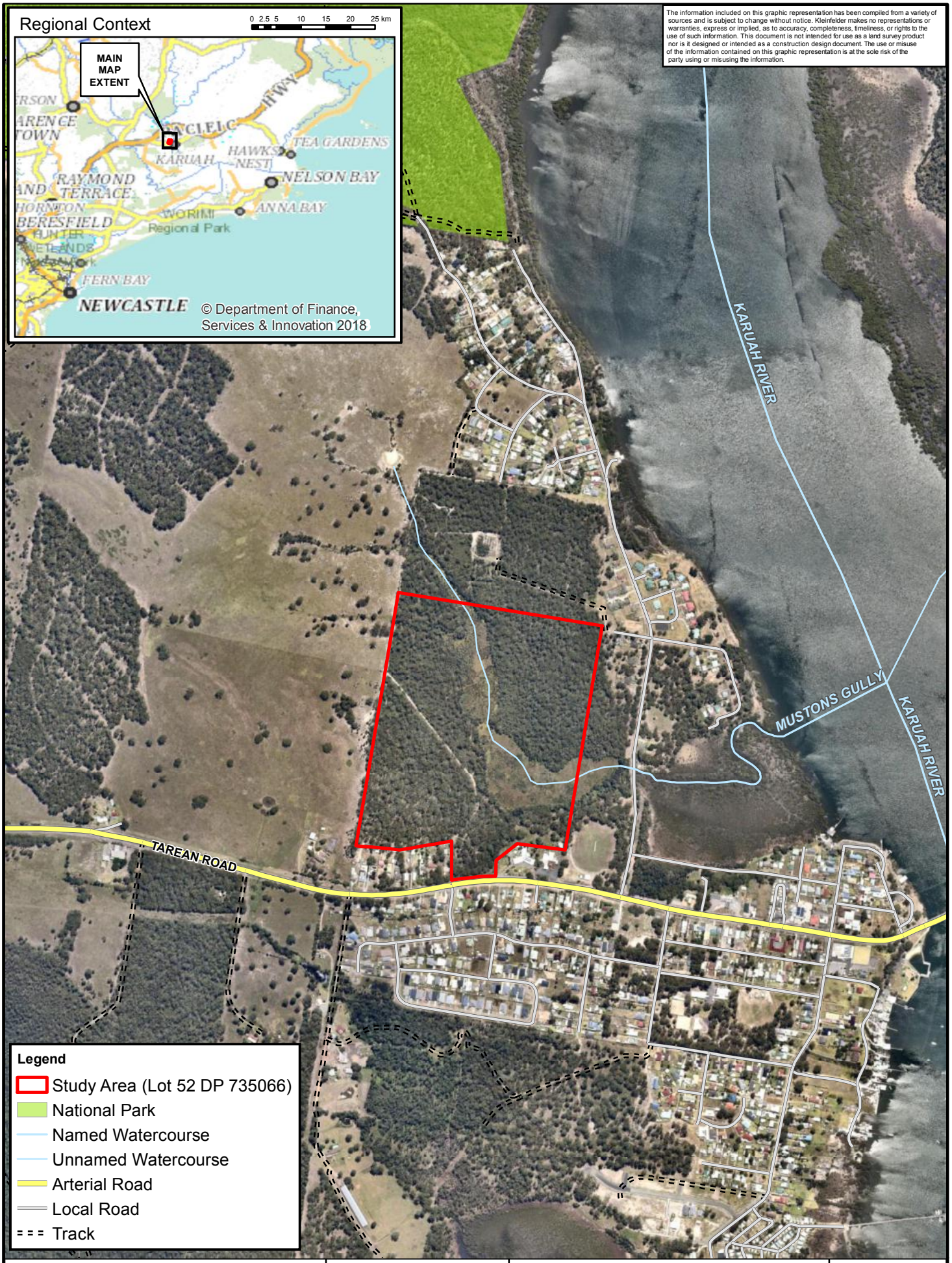
This constraints assessment involved a desktop flora and fauna assessment in conjunction with a site walkover, for the purpose of informing the client of any ecological constraints and possible solutions. This report identifies flora, fauna and threatened species likely to occur within the study area based on species and/or habitats detected during the site visit and threatened flora and fauna records from the locality. A preliminary likelihood of occurrence assessment for identified threatened flora and fauna has been provided (**Appendix 1**), as well as a brief description of vegetation and fauna habitat occurring on the site.

1.2 LOCAL CONTEXT

The site is zoned RU2 – Rural Landscape and is located on the western bank of the Karuah River within the Port Stephens Local Government Area. It is bound by Tarean Road and residential development to the south, residential development to the northeast, open pasture land to the west and by Lionel Morten oval to the southeast (**Figure 1**). The site is connected

to a bush block to the north and a bush block to the east which loosely connects the vegetation with estuarine vegetation dominated by mangroves on the eastern side of Mustons Rd. The section of Mustons Road bordering the site is single lane and is a barrier to the saline tidal flow from the estuarine area which has altered the natural hydrology of the wetland present within the study site.

The majority of the study area is comprised of native bushland with a freshwater wetland traversing over the centre of the site from the southeast to the northwest, which is a mapped watercourse (Mustons Gully). Most of the vegetation within the study area is intact, however, the vegetation adjoining the residential areas in the south is disturbed and lacks a midstorey, and the ground layer consists of mostly mown exotic grasses. A large portion of the vegetation in the south and southwest of the site has been actively managed with fire and under scrubbing. Multiple tracks have been cleared in this area and a significant amount of ongoing dumping and disturbance occurs. The main track crossing the southwest corner of the site is well maintained and used.



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PROJECT REFERENCE: 20200364

DATE DRAWN: 6/05/2019 14:51 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2019
Nearmap - 2019

Locality

AO Farm Holdings Pty Ltd
Preliminary Ecological Investigation
339 Tarean Road, Karuah NSW

FIGURE:

1

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2. RELEVANT LEGISLATION AND GUIDELINES

This constraints assessment was undertaken in accordance with and/or in consideration of the following Acts, Policies and Guidelines:

Commonwealth:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

State:

- *Biodiversity Conservation Act 2016* (NSW) (BC Act);
- *Biodiversity Conservation Regulation 2017*;
- *Biodiversity Conservation (Savings and Transitional) Regulation 2017*;
- *National Parks and Wildlife Act 1974* (NP&W Act);
- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *Biosecurity Act 2015*;
- Biodiversity Assessment Method (2017);
- *Coastal Management Act 2016*;
- *State Environmental Planning Policy - Coastal Management 2018* (SEPP Coastal Management); and
- *State Environmental Planning Policy 44 - Koala Habitat Protection* (SEPP 44).
- *NSW Planning and Environment Hunter Regional Plan 2036*

Local:

- *Port Stephens Council Development Control Plan 2014* (Port Stephens DCP 2014); and
- *Port Stephens Local Environmental Plan 2013* (Port Stephens LEP 2013).

3. METHODOLOGY

3.1 DESKTOP ASSESSMENT

A list of threatened species, populations and ecological communities that have been reported or modelled to occur within a five- kilometre radius of the study area was obtained from the following databases:

- NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife: (http://www.bionet.nsw.gov.au/); and
- Department of Environment and Energy (DoTEE) Protected Matters search tool: (www.environment.gov.au/erin/ert/epbc/index.html).

3.2 LIKELIHOOD OF OCCURRENCE

An assessment was then made of the likelihood of the threatened species, populations, and / or ecological communities reported or modelled to occur in the locality occurring within the study area or using the habitat within the study area as an essential part of a foraging range (refer to **Appendix 1**). This assessment was based on available habitat requirement data for each threatened species, populations, and ecological communities using the following sources:

- Harden, G.J. (ed) (1992, 1993, 2000, 2002). Flora of New South Wales Volume 1-4. NSW University Press: Sydney;
- OEH threatened species website database:
- http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx;
- Van Dyke, S. and Strahan, R. (eds) (2008). The Complete Book of Australian Mammals. Reed New Holland Publishers, Australia;
- Cogger, H.A (ed) (2000). Reptiles and Amphibians of Australia. Reed New Holland Publishers, Australia; and
- Higgins, P. J. et al. (1990-2007). Handbook of Australian, New Zealand & Antarctic Birds. Volumes 1 to 7. Oxford University Press Publishers, Melbourne.

4. FIELD SURVEYS

4.1 SITE INSPECTION

Two Ecologists conducted field surveys on 30 April and 2 May 2019. Surveys conducted included, a site walkover to identify potential threatened species habitat, map plant community types (PCTs) and floristic plots were completed to assist in the determination of PCTs and to provide baseline data for the initial constraints assessment (Stage 1).

4.2 FLORA SURVEY

4.2.1 Vegetation Mapping Surveys

The boundaries of each of the identified vegetation communities within the study area were mapped using a combination of rapid data points (RDP) and walking transects, using the polygons produced through aerial photo interpretation (API) to assist in targeting survey effort. RDPs involved collecting waypoints over the study area using a hand held Trimble™ GPS unit and recording dominant species, structure and condition. Walking transects involved verifying polygons where homogenous in floristic composition and condition, as well as walking vegetation ecotones and using the recorded tracks to define vegetation community boundaries. The RDPs and survey tracks were then overlaid on an aerial photograph and used to delineate and/or clarify vegetation boundaries.

4.2.1.1 Linework and Attribution

RDPs and plots were classified and tagged with a PCT by field surveyors. Polygons produced from the API work adopted the PCT of the sample point that they intersected.

4.2.1.2 Plant Community Type Determination

Each vegetation community identified within the study area was assigned to the closest equivalent PCT from those listed in the BioNet Vegetation Classification database (OEH, 2019). The closest equivalent PCT for each vegetation community was determined through a comparison of the floristic descriptions of PCTs in the database with the plot / transect data collected from the site. In addition to floristic and structural similarity, the landscape position, soil type and other diagnostic features of the vegetation communities on the sites were also

compared to the descriptions in the database in order to determine the most suitable PCT. Threatened ecological communities (TECs) as defined in NSW and Commonwealth legislation were also identified if present.

4.2.1.3 Vegetation Zones

Vegetation zones were identified and delineated on the Development Footprint in accordance with Section 5.3 of the BAM (2017). A vegetation zone is defined in the BAM (2017) as a relatively homogenous area that is the same vegetation type and broad condition.

4.2.1.4 Assessing Vegetation Integrity (Site Condition)

Following stratification of the Development Footprint into vegetation zones, plots/transects were undertaken to collect site condition data for the composition, structure and function attributes listed in **Table 1** in accordance with Section 5.3 of the BAM (2017). The location of the plots/transects were selected through stratified random sampling to provide a representative sample of the variation in vegetation composition and condition within each vegetation zone.

Table 1: Composition, Structure and Function components of vegetation integrity

Growth form groups used to assess composition and structure	Function attributes
• Tree (TG) • Shrub (SG) • Grass and grass-like (GG) • Forb (FG) • Fern (EG) • Other (OG)	• Number of large trees • Tree regeneration (presence/absence) • Tree stem size class (presence/absence) • Total length of fallen logs • Litter cover • High threat exotic vegetation cover (HTE) • Hollow-bearing trees (HBT)

At this stage, a total of three plots/transects were undertaken across the site. The locations of the plots/transects undertaken within the Study Area are shown on Error! Reference source n ot found..

4.2.2 Floristic Identification and Nomenclature

Floristic identification and nomenclature was based on Harden (1992, 1993, 2000 and 2002) with subsequent revisions as published on PlantNet (The NSW Plant Information Network System). If a plant was unable to be identified using these references or a specimen was potentially rare or threatened, a sample was sent to the National Herbarium of New South Wales.

4.3 FAUNA HABITAT ASSESSMENT

Fauna habitat values observed during inspections of the study area were recorded. Attributes considered important to fauna include: hollow-bearing trees, nests, fallen timber/hollow logs, abundance of nectar and fruit resources, water bodies, vegetation cover and structural complexity, fallen timber, and leaf litter. Suitability of habitat for threatened fauna species occurring in the locality was also assessed during the survey.

4.4 SURVEY LIMITATIONS

This survey does not fulfil the requirements of a Biodiversity Development Assessment Report (BDAR) as required by the NSW BC Act.

This survey and preliminary report does not fulfil the requirements of a Commonwealth significant impact assessment of relevant Matters of National Environmental Significance (namely, 'Listed threatened species and ecological communities' and 'Migratory species' which have the potential to occur on the study area). The likelihood of the species identified during the desktop assessment have been considered as part of the Assessment of Likelihood of Occurrence in **Appendix 1**. Additional field survey and impact assessment will be required as part of Stage 2 works.

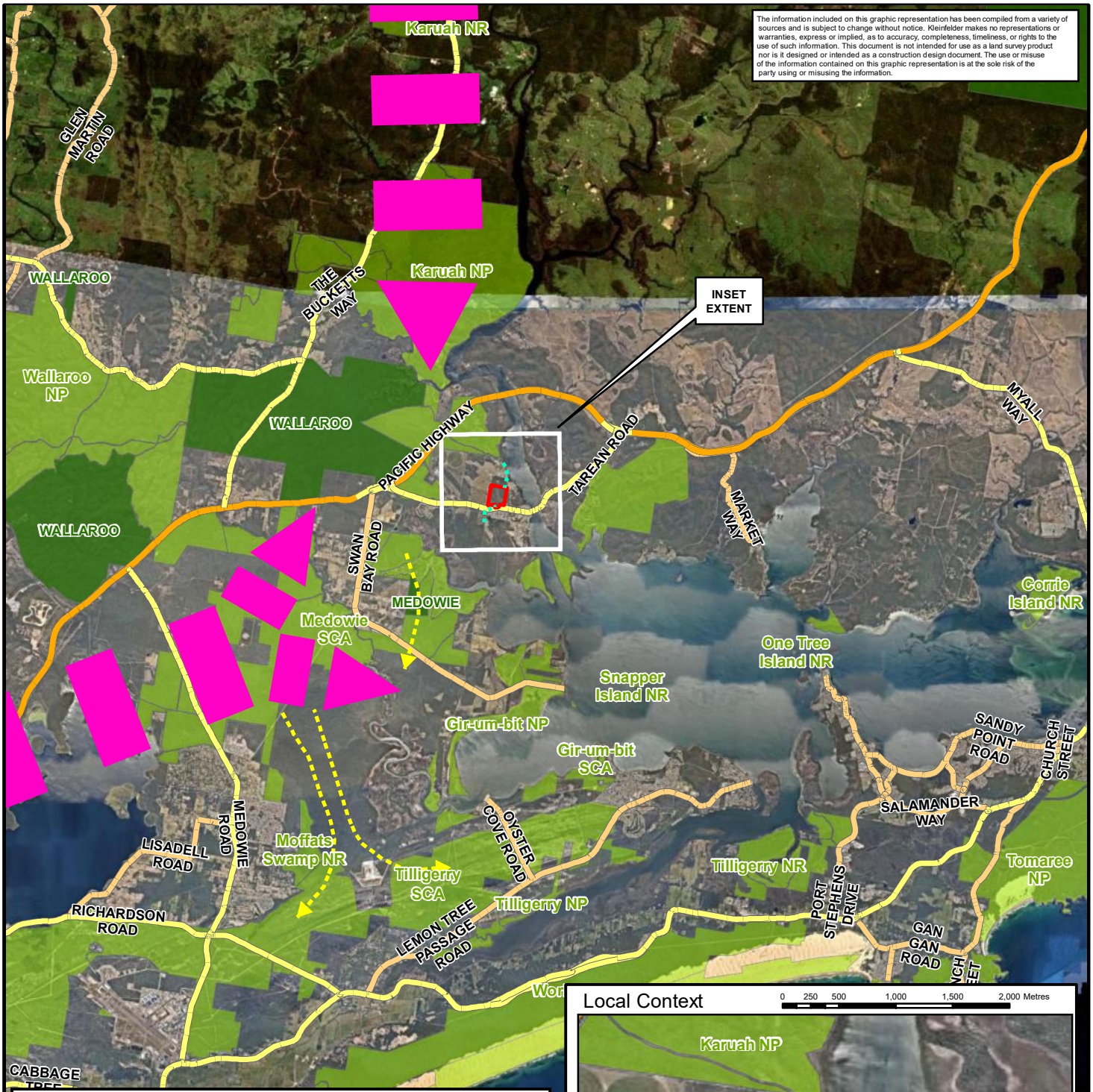
5. RESULTS

5.1 BIODIVERSITY CORRIDORS

The NSW Planning and Environment's Hunter Regional Plan (2036) has mapped the vegetation to the north and west of the township of Karuah as part of a landscape scale Biodiversity Corridor. This plan supersedes the Lower Hunter Regional Conservation Plan (DECCW 2009). Goal two, one of the four main goals under the 2036 Regional Plan is to maintain a 'biodiversity-rich natural environment'. This is to be achieve via three main directions, "Protect and connect areas"; "Sustain water quality and security", and "Increase resilience to hazards and climate change". Action 14.5 under Goal two is 'to secure the long-term protection of regionally significant biodiversity corridors.' The large tracks of intact vegetation to the north and west of the township of Karuah are important to this action.

It is unlikely that the study site would be a significant inclusion to this regional corridor due to the presence of large areas intact of native vegetation to the north and west, (**Figure 2**) including: Medowie Nature Reserve, Medowie State Conservation Area, Karuah National Park, Wallaroo Swamp, Race Course Swamp and Scobies Hill. The subject site is isolated from these large tracks of intact vegetation to the north, west and south by either existing residential developments or cleared grazing land. Only a narrow-fragmented corridor to the north east of the site, along the Karuah River maintains any form of connectivity. This narrow connectivity, does not affect the large regional corridors functionality in any way, and the development of the subject site, would be unlikely to affect the regional functionality of the identified movement corridors.

On a local scale the less modified remnant vegetation in the northern portion of the site adjoins an intact bush block and is connected by a narrow riparian corridor to the east to Wallaroo Swamp in the north. This corridor is broken twice by Mustons Rd and by a boat shed however the distance in both cases is less than 30 m which will allow the movement of a limited range of fauna species. Additionally, the southern portion of the site is loosely connected by canopy trees to Scobies Hill and Medowie Nature reserve. It should be noted that this connection to the south of the site has the potential to be cut-off by a Subdivision Application currently be determined by Council (290 and 308 Tarean Road). This subdivision will provide a hard barrier for movement of terrestrial fauna due to the requirement for fencing to be installed around this subdivision for the exclusion of Koalas. Additionally, this subdivision would increase the separation distance of vegetation to the south of the site to over 100 m.



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DRAWN BY: BDeane

DATA SOURCE:
NSW DFSI - 2019
Nearmap - 2019
NSW DPE - 2016

Biodiversity Corridors

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FIGURE:

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Neither of these localised corridors are significant to the movement of fauna species due to their disconnected narrow nature, limited range of flora species, high levels of continued disturbance from the residential area and the large intact areas of native vegetation, located to the west of the study site (**Figure 2**).

5.2 DATABASE REVIEW

A total of 36 threatened species or communities have previously been recorded or are modelled to occur within a 5 km radius of the study area (**Appendix 1**). These include six flora, 14 bird, 14 mammal and two reptile species.

Additionally, seven migratory species were modelled to occur within a 5 km radius of the study area (**Appendix 1**).

5.3 FIELD SURVEYS

5.3.1 Threatened Flora Species

During the field surveys, two threatened flora species were identified; *Callistemon linearifolius* (Nettled Bottle-brush) listed as Vulnerable under the BC Act, and *Tetratheca juncea* (Black-eyed Susan) listed as Vulnerable under the BC Act and the EPBC Act. Both of these species were identified in the Smooth-barked Apple Forest in the eastern portion of the site, and both species have database records (BioNet) within and adjacent to the study area.

Population counts were not conducted as part of the assessment, however, it was noted that a large number of *Callistemon linearifolius* were identified on the north-western edge of the wetland and as a common understorey species in the eastern portion of the study area within the Smooth-barked Apple Forest. While the species was identified during field surveys, this species is closely related to other *Callistemon* species, and as such, it is required that samples to be sent to the NSW herbarium to confirm the identification. One *Tetratheca juncea* specimen was identified in the eastern Smooth barked apple vegetation. Field surveys were conducted outside the known flowering period of this species (July to December), and as such, it is likely to be a larger occurrence of this species within the study area. Indicative locations of threatened flora species (i.e. those recorded during field surveys) are shown on **Figure 3**.

Additionally, *Asperula asthenes* (Trailing Woodruff) and *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea) were assessed as having potential habitat within the study area (**Appendix 1**).

5.3.2 Vegetation Communities

Four native vegetation communities (in various states of modification) were identified within the study area. These communities are briefly outlined below and mapped in **Figure 3**.

5.3.2.1 PCT 1590 – Spotted gum – Broad-leaved Mahogony – Red Ironbark Shrubby Forest

Plate 1: **Spotted gum – Broad-leaved Mahogony – Red Ironbark Shrubby Forest – Good (PCT 1590) in the northwest of study area.**

This community was mapped as PCT 1593 - Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter particularly due to the presence of *Melaleuca nodosa* in the midstorey however this community is located much further north than where PCT 1593 normally occurs and therefore PCT 1590 was selected based on the canopy trees and the similarity of the species arrangement and composition.

On the site, this community has been modified to various extents across the Lot (**Figure 3**). The portion of this community in the north is relatively intact (PCT 1590 - Good) with a native canopy, shrub and ground layer observed while in the south-west and south it occurs as intact

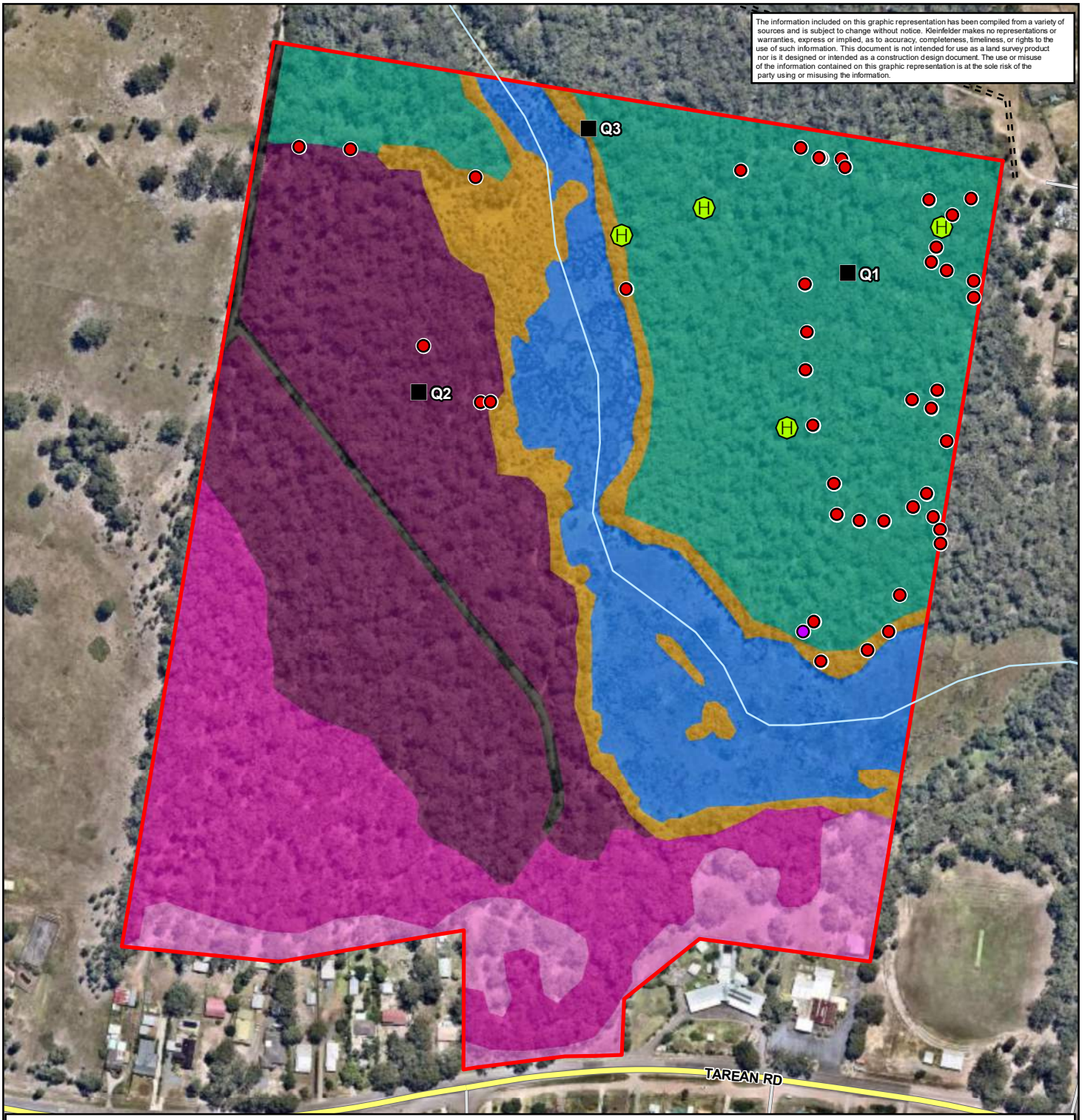
canopy trees over a thinned understorey with a denser ground layer of native grasses such as *Imperata cylindrica* and *Themeda australis* (PCT 1590 - Moderate) and within the southern portion there are areas where the canopy has been thinned, the midstorey is largely absent or exotic and the ground layer is largely exotic grasses (PCT 1590 - Poor). One plot was undertaken within the good portion the PCT within the study area (Q2).

This community is dominated by *Corymbia maculata, Eucalyptus fibrosa* and co-dominated in the south and south-western sections by *Eucalyptus punctata* and *Eucalyptus tereticornis*. The mid-storey is dominated by *Melaleuca nodosa.* Dominant shrub species included *Bursaria spinosa, Acacia ulicifolia* and *Pulteneae paleacea.* The ground layer was dominated by *Ptilothrix deusta, Entolasia stricta, Microlaena stipoides* var. *stipoides, Imperata cylindrica, Dianella caerulea* and *Themeda australis.* The portion in moderate condition is dominated also contains *Breynia oblongifolia, Pittosporum undulatum* and *Exocarpos cupressiformis* in the midstorey.

This vegetation community does not constitute any Threatened Ecological Community (TEC) listed under the BC Act or the EPBC Act.

5.3.2.2 PCT 1619 Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

Plate 2: **Smooth-barked Apple – Red bloodwood – Brown Stringybark – Hairpin Banksia Heathy Open Forest of the Coastal Lowlands – Good (PCT 1619) in the north-east of study area.**



Legend

- Study Area (Lot 52 DP 735066)
- Plot Transect
- Hollow-bearing Tree (Large Hollows)

Threatened Flora Species

- *Callistemon linearifolius*
- *Tetratheca juncea*
- Arterial Road
- Local Road
- Track
- Named Watercourse
- Unnamed Watercourse

Plant Community Type and Condition

- 1590 – Spotted gum – Broad-leaved Mahogony – Red Ironbark Shrubby Forest – Good
- 1590 – Spotted gum – Broad-leaved Mahogony – Red Ironbark Shrubby Forest – Moderate
- 1590 – Spotted gum – Broad-leaved Mahogony – Red Ironbark Shrubby Forest - Poor
- 1619 – Smooth-barked Apple – Red bloodwood – Brown Stringybark – Hairpin Banksia Heathy Open Forest of the Coastal Lowlands – Good
- 1729 – Swamp Oak Swamp Forest on Coastal Lowlands of the Central Coast and Lower North Coast - Good
- 1742 – Jointed Twig-rush Sedgeland – Poor/Moderate
- Cleared

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DATE DRAWN: 20/05/2019 17:58 Version 1
DRAWN BY: BDeane
DATA SOURCE:
NSW DFSI - 2019
Nearmap - 2019

Plant Community Types, Threatened Flora and Habitat Features

AO Farm Holdings Pty Ltd
Preliminary Ecological Investigation
339 Tarean Road, Karuah NSW

FIGURE:
3

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The native vegetation present in the north and the north western portions of the study area most closely resembles the Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands (PCT 1619). The structure and the dominant species present on site are clear indicators of this determination. This community had all strata present and was largely undisturbed therefore it was classed as being in good condition. One plot was undertaken within this zone (Q1).

This community was dominated by *Eucalyptus globoidea, Corymbia gummifera,* and *Angophora costata.* Dominant midstorey species included *Leptospermum polygalifolium, Melaleuca nodosa, Melaleuca sieberi, Exocarpos cupressiformis* with patches of *Callistemon linearifolius, Allocasuarina littoralis, Dodonaea triquetra* and *Hakea teretifolia.*

The ground layer was dominated by *Hibbertia aspera, Phyllanthus hirtellus, Ptilothrix deusta, Pratia purpurascens, Lomandra* sp*., Microlaena stipoides* var. *stipoides, Imperata cylindrica* and *Entolasia stricta.*

This vegetation community does not constitute any Threatened Ecological Community (TEC) listed under the BC Act or the EPBC Act.

5.3.2.3 PCT 1742 Jointed Twig-rush Sedgeland

Plate 3: **Jointed Twig-rush Sedgeland – Poor/Moderate (PCT 1742) in the centre of study area.**

The drainage line running through the central portion of the study area has been modified since the installation of Mustons Road. This road has limited the freshwater flushing into the Karuah River, and impeded the estuarine influence from the Karuah River within the wetland vegetation in the study area. In turn this has modified the floristic and structural occurrence of the wetland vegetation within the study area.

The open Freshwater Wetland areas of the study area have been mapped as PCT 1742 as the closest equivalent PCT, due to the dominance of *Baumea articulata* and the emergent *Melaleuca* midstorey species. This community is largely dominated by the exotic species *Salvinia molesta* in the open water areas. There is scattered occurrence of *Casuarina glauca*, *Melaleuca linearifolia* and *Melaleuca quinquenervia* within this community. The ground layer is dominated by patches of *Baumea articulata*, *Bolboschoenus* sp., *Persicaria* sp., *Cyperus* sp. and *Juncus usitatus*.

This vegetation community is consistent with the *Freshwater Wetland on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* Endangered Ecological Community (EEC) listed under the BC Act.

5.3.2.4 PCT 1729 Swamp Oak Swamp Forest on Coastal Lowlands of the Central Coast and Lower North Coast

Plate 4: **Swamp Oak Swamp Forest on Coastal Lowlands of the Central Coast and Lower North Coast – Good (PCT 1729) in the centre of the study area.**

This community is dominated by *Casuarina glauca, Melaleuca linearifolius* and *Melaleuca styphelioides.* The mid stratum contains scattered *Parsonsia straminea*. The ground strata is dominated by *Gahnia clarkei*, *Baumea juncea* and *Entolasia marginata*. Due to its proximity to the freshwater wetland and the dominance of *Casuarina glauca* this community was determined to have a structure most similar to a swamp forest and therefore was considered to be most similar to PCT 1729 based on the species present. One plot (Q3) was located within this community during the surveys. The condition of this vegetation overall was classed to be good as the community had all strata present, however the exotic species, *Salvinia molesta* was present in the wetter areas.

This vegetation community is consistent with the *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions* EEC listed under the BC Act, and the *Coastal Swamp Oak* (Casuarina glauca) *Forest of South-east Queensland and New South Wales* EEC listed under the EPBC Act.

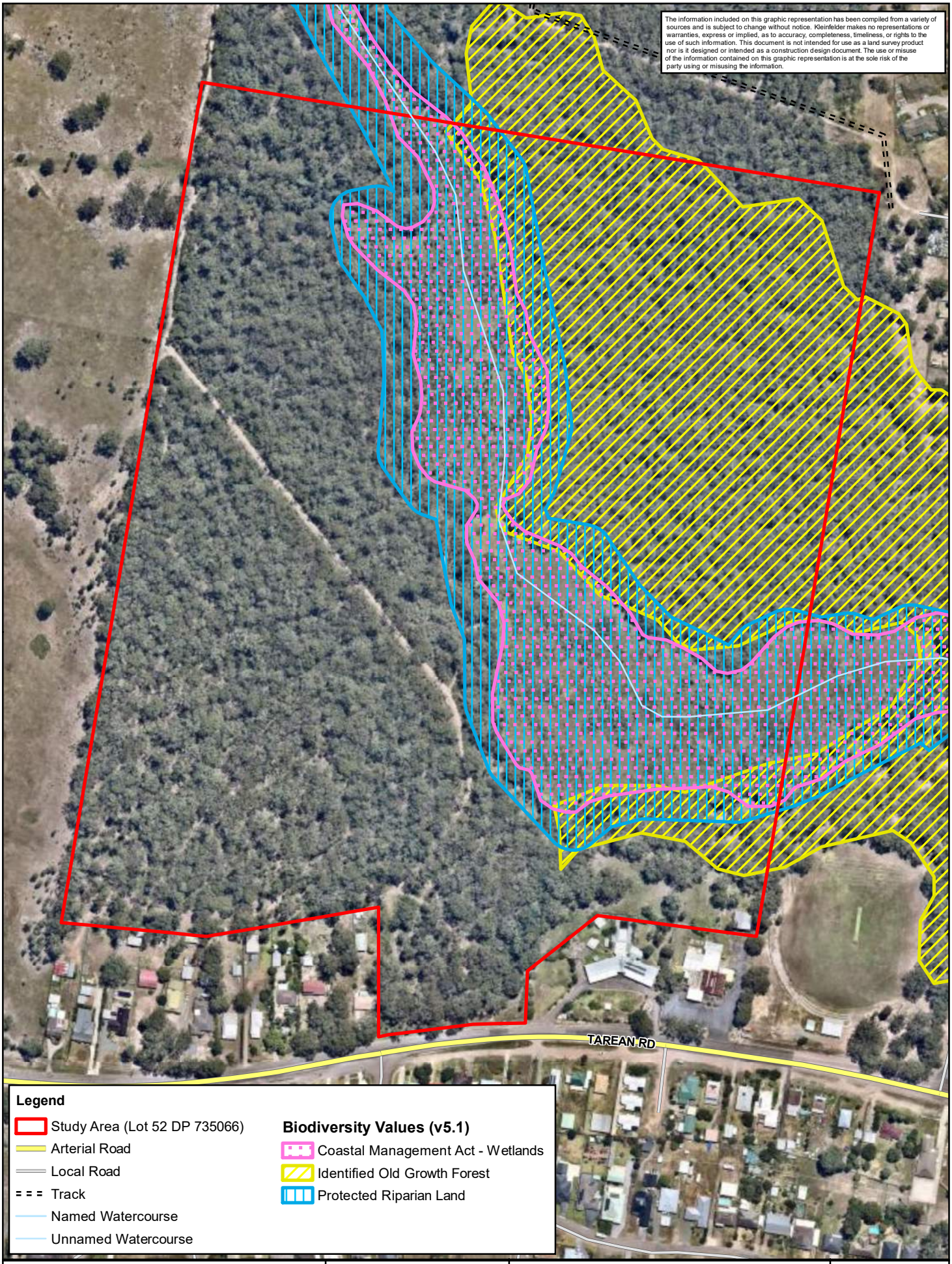
5.4 FAUNA HABITAT

The native vegetation within the study area is considered to provide moderate to high fauna habitat. The vegetation on site is largely in moderate to good condition and contains a variety of habitat features, including:

- Feed tree species for a range of fauna species: including *Corymbia maculata* (Spotted Gum), *Eucalyptus fibrosa* (Red Ironbark) and *C. gummifera* (Red Bloodwood*)* likely to be utilised as a source of nectar when flowering by local fauna;
- The following Koala feed trees were recorded during the site visits:
  - *E. tereticornis* and *E. punctata* - primary feed tree (common in PCT 1590/ moderate); and
  - *E globoidea* - supplementary feed tree
- Connectivity to reserves and intact native vegetation;
- Dense midstorey habitat in the undisturbed portion of the site which is likely to be used by a range of locally common bird and mammal species for nesting and foraging;
- Presence of hollow-bearing trees and dead stags, including large hollows (**Figure 3**). There was a higher density of hollows observed within the Smooth-barked Apple Woodland, while the Spotted Gum Forest had younger trees and hollow density was not as high.
- The following Mapped biodiversity values were mapped on the site (OEH Biodiversity Values Map 2019) (**Figure 4**)
  - Identified Old Growth Forest – eastern portion of the study area.

- Wetlands (Coastal Management Act) – central portion of the study area; and
- Protected Riparian Land – buffer off the wetlands.

The NSW Wildlife Atlas contains records of several threatened fauna species (which are target species credit species under the BAM) occurring within the site and in the local area, namely the Koala, Little Bentwing-bat, White-bellied Sea-eagle, Squirrel Glider, Masked Owl, White-bellied Sea Eagle, Eastern Osprey and the Bush-stone Curlew of which there is a known population in the Karuah area. The study area contains suitable foraging and marginal roosting/breeding habitat for these species.



Legend

- Study Area (Lot 52 DP 735066)
- Arterial Road
- Local Road
- Track
- Named Watercourse
- Unnamed Watercourse

Biodiversity Values (v5.1)

- Coastal Management Act - Wetlands
- Identified Old Growth Forest
- Protected Riparian Land

Metres
0 25 50 100 150 200
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PROJECT REFERENCE: 20200364
DATE DRAWN: 20/05/2019 17:09 Version 1
DRAWN BY: BDeane

DATA SOURCE:
NSW DFSI - 2019

Nearmap - 2019

Biodiversity Values

AO Farm Holdings Pty Ltd
Preliminary Ecological Investigation
339 Tarean Road, Karuah NSW

FIGURE:
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6. CONSTRAINTS ASSESSMENT

6.1 OUTCOMES OF THE FIELD SURVEYS

6.1.1 Threatened Flora Species

Two threatened flora species were identified during the field surveys; *Callistemon linearifolius* (Netted Bottlebrush) and *Tetratheca juncea* (Black-eyed Susan). *Callistemon linearifolius* were identified as a common understorey species within the Smooth-barked Apple Forest. While the species was identified during field surveys, it is required that samples to be sent to the NSW herbarium to confirm the identification. One *Tetratheca juncea* specimen was identified in the eastern Smooth-barked Apple Forest. Field surveys were conducted outside the known flowering period of this species (July to December), and as such, it is likely to be a larger occurrence of this species within the study area.

In addition to the threatened flora species identified within the study area, one threatened flora species, *Asperula asthenes*, was assessed has having a moderate likelihood of occurrence within the study area (**Appendix 1**).

Additional targeted surveys are required to identify the full extent of the two species identified, and surveys are required to be conducted for a range other threatened flora species (see **Section 6.4**).

6.1.2 Native Vegetation

Four native vegetation communities were identified within the study area:

- 15.04 ha of Spotted Gum Broad-leaved Mahogany Red Ironbark Shrubby Forest (PCT 1590);
- 8.31 ha of Smooth-barked Apple - Red Bloodwood Brown Stringybark Hairpin Banksia Heathy Open Forest of the Coastal Lowlands (PCT 1619);
- 4.17 ha of Jointed Twig-rush Sedgeland (PCT 1742) occurs in the centre of the site. This vegetation community is consistent with the *Freshwater Wetland on Coastal Floodplains* EEC listed under the BC Act; and
- 2.25 ha of Swamp Oak Swamp Forest on Coastal Lowlands of the Central Coast and Lower North Coast (PCT 1729) occurs around the rim of the wetland and in patches within the wetland. This vegetation community is consistent with the *Swamp Oak*

Floodplain Forest EEC listed under the BC Act, and the *Coastal Swamp Oak* (Casuarina glauca) *Forest* EEC listed under the EPBC Act.

6.1.3 Fauna and Fauna Habitat

The fauna habitat (predominantly canopy trees and shrubs) observed is likely to provide foraging habitat for a range of bird species, the Grey-headed Flying-fox, arboreal mammals, and microchiropteran bat species. A habitat tree survey was not completed at this preliminary stage, however, it was noted that some hollow-bearing trees and dead stags do occur, albeit at low densities. These habitat trees will need further surveys to ascertain the suitability of the hollows as nesting habitat for large forest owls. The majority of these habitat trees occur in the areas identified as old Growth Forest on the biodiversity values map (**Figure 4**). The wetland provides foraging habitat for coastal birds and a water source for a range of fauna species.

Due to the quality and variety of habitat present on site the following threatened bat species were assessed as moderately likely to occur: Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail- bat, Greater Broad- nosed Bat and Southern Myotis.

The threatened mammal species; Yellow- bellied Glider, Squirrel Glider, Brush-tailed Phascogale, Koala, Long-nosed Potoroo and Grey-headed Flying-fox, also have potential habitat present.

The Glossy Black-Cockatoo, Varied Sittella, Emu, Black-necked Stork, Little Lorikeet, White-bellied Sea-Eagle, Little Eagle, Powerful Owl, Masked Owl, and the Eastern False Pipistrelle all threatened birds which may potentially use the habitat present on site and therefore are moderately likely to occur.

The following migratory bird species were considered to have seasonal foraging habitat present on site; Caspian Tern and Rainbow Bee-eater.

Future surveys at the appropriate time of year will be required to determine whether this species (and any of the other target threatened species) are present on the site.

6.2 ASSESSMENT REQUIREMENTS UNDER THE BC ACT

The *Biodiversity Conservation Act 2016* (BC Act) will be applicable to any future subdivision, or development applications within the study area. Under the BC Regulation, for the purposes

of the proposed development, there are four potential triggers for the development to be assessed under the Biodiversity Offset Scheme (BOS), and require the submission of the Biodiversity Development Assessment Report (BDAR) along with the proposal. These triggers and the potential for any future proposals to exceed one, or more, and therefore require assessment under the BOS, is outlined below:

Clearing on land mapped on the Biodiversity Land Values Map (Section 7.3 of the BC Regulation).

Part 7 of the Act states that 'a proposed development exceeds the biodiversity offsets scheme threshold for the purposes of if it is or involves:

(b) the clearing of native vegetation, or other action prescribed by clause 6.1, on land included on the Biodiversity Values Map published under clause 7.3.

As shown on **Figure 4**, the central wetland within the study area, and a buffer off this wetland (Protected riparian land), along with the eastern portion of the study area (old growth forest) are mapped on the Biodiversity Values Map.

Impacting the prescribed biodiversity features listed under Section 6.1 of the BC Regulation, on land included on the Biodiversity Values Map.

Any future proposal has the potential to impact on prescribed matters (e.g. connectivity, movement corridors), however, all areas mapped on the Biodiversity Values Map contain native vegetation, and as such any work within the central and eastern portion of the study area would trigger the BOS by exceeding the above threshold (clearing native vegetation on land mapped on the Biodiversity Values Map)

Clearing native vegetation above the thresholds (outlined in Section 7.2 of the BC Regulation).

The allotment proposed for development has a minimum lot size of 20 ha, as such according to Section 7.2 of the BC Regulation, an area of native vegetation clearing of 0.5 ha or more exceeds the clearing threshold and the BOS would be triggered.

The total clearing area of the final design of the proposal will dictate if the clearing thresholds are exceeded.

Significant impact on a threatened species (determined through a 5-part test set out in the BC Act).

If none of the above triggers are exceeded by the proposed development, then assessments of significance (5-part test) would be conducted for all species known or likely to occur within the study area. If the proposal was deemed to have a significant impact on any threatened species, populations or ecological communities, then the BOS would be triggered. Further survey work within the study area would be required to inform these assessments.

6.3 BAM SURVEY REQUIREMENTS

6.3.1 Recommended Fieldwork Timing

Preliminary data relating to the PCTs occurring on the site was entered into the BioNet database to produce a list of target species credit species that would require survey as part of Stage 2 (**Table 1**). These surveys recommended in the following table would comply with the requirements of the BAM if the BOS is triggered.

Table 2: Preliminary list of target threatened species requiring future survey as per the BAM

Species Class	Recommended Fieldwork Period	Methods
Flora		
Angophora inopina *Callistemon linearifolius* *Cynanchum elegans* *Eucalyptus glaucina* *Grevillea guthrieana* *Grevillea parviflora* subsp. *parviflora* *Melaleuca biconvexa* *Melaleuca groveana*	September - March	Targeted threatened species search
Tetratheca juncea *Diuris praecox*	July- September	
Maundia triglochinoides *Zannichellia palustris*	November (Wetlands Habitat)	
Asperula asthenes *Rhizanthella slateri* *Pterostylis chaetophora*	November	
Persicaria elatior *Thesium australe* *Lindernia alsinoides* *Cryptostylis hunteriana*	December - January	

Species Class	Recommended Fieldwork Period	Methods
Fauna		
Large Forest Owls Barking Owl Masked Owl Powerful Owl	May - August	Owl call playback Spotlighting Stag watching Hollow-bearing tree survey
Birds Gang-gang Cockatoo	October - January	Diurnal Bird survey
Eastern Osprey Little eagle Square-tailed Kite White-bellied Sea-Eagle	September – November	Nest searches
Glossy Black-Cockatoo	March-August	Bird survey
Bats Eastern Bentwing-bat Eastern Cave Bat Large-eared Pied Bat Little Bentwing-bat Southern Myotis	December	Anabat recording Harp trapping
Amphibians Green and Golden Bell Frog Green-thighed Frog Mahony's Toadlet Wallum Froglet	November - March	Diurnal and nocturnal amphibian survey Call playback Spotlighting
Mammals, Nocturnal Birds and Reptiles Brush-tailed Phascogale Common Planigale Eastern Pygmy-possum Grey-headed Flying-fox Koala Squirrel Glider Bush Stone-curlew Red-backed Button-quail Pale-headed Snake	November – December	Scat searches Trapping (terrestrial and arboreal) Remote cameras Call playback Spotlighting Searches for camps (flying-fox)
Invertebrates Giant Dragonfly	December - January	Targeted Survey

6.3.2 Species which do not require survey

Seven species requiring assessment within the study area under the BAM do not require surveys, rather important areas of habitat for these are mapped by OEH across NSW. For the site, these species include; Swift Parrot, Regent Honeyeater, Great Knot, Curlew Sandpiper,

Broad-billed Sandpiper, Black-tailed Godwit and Terek Sandpiper. Mapped areas for these species do not require survey as it is presumed that the species are present.

The mapping for the above seven species within the study area has been requested from OEH. Kleinfelder have received confirmation that the site is not mapped as important habitat for the Swift Parrot or Regent Honeyeater. Kleinfelder is still waiting on a response regarding the other five species.

If any areas of important habitat for the above species are mapped within the study area, any impacts on these areas will generate the requirement for species credits (offsets).

6.3.3 Serious and Irreversible Impacts

Four species requiring assessment within the study area under the BAM have the potential to trigger a serious and irreversible impact (SAII); these species include, Swift Parrot, Regent Honeyeater, Great Knot and Curlew Sandpiper. For all of these species impacting on mapped areas of important habitat for these species has the potential to be a SAII. As outlined above, there is no important habitat mapping for the Swift Parrot and Regent Honeyeater within the study area. Kleinfelder are waiting for a response from OEH regarding the mapping for the Great Knot and Curlew Sandpiper.

6.4 OFFSETTING CONSIDERATIONS

A future development application should consider the following implications of potential offsetting requirements under both the Biodiversity Offsets Scheme and relevant Port Stephens Council planning and management guidelines:

If the BOS is triggered, ecological impacts of the proposal on native vegetation and threatened species (species credit species) must be offset in accordance with the BAM, including the potential removal of:

- Threatened species habitat; and
- Hollow-bearing trees.

Offsetting the loss of habitat at the ecosystem and species level can be achieved under the BAM either by:

1. The creation of ecosystem and species credits from an on-site or off-site offset (i.e. establishment of a Biodiversity Stewardship Site Agreement);

2. Purchase of available credits from the market; or
3. By paying into the Biodiversity Conservation Trust Fund.

6.4.1 Preliminary Offset Calculations

6.4.1.1 Ecosystem Credits

It is understood that any future proposal would not directly impact on Forested Wetland or Freshwater Wetland Vegetation, with the central portion of the study area being retained. As such, any future development would directly impact on the areas of Dry Forest; PCT 1590 (Spotted Gum – Ironbark Forest) and/or PCT 1619 (Smooth-barked Apple Forest). Within the study area there was a total of 15.04 ha of PCT 1590 identified, and 8.31 ha of PCT 1619.

Based on an average credit generation per hectare of between 20 to 30 credits per ha; impacting on all areas of PCT 1590 and 1619 within the study area would generate a total credit requirement of:

- 300 – 451 credits of PCT 1950; and
- 166 – 249 credits of PCT 1619.

Based on the current offset payment calculator, within the Karuah-manning IBRA Subregion of the NSW North Coast IBRA Region, final credit prices to pay into the Biodiversity Conservation Fund to fulfil credit requirements is:

- $1,651.98 per credit for PCT 1590; and
- $2,209.11 per credit for PCT 1619.

As such, impacting on all Dry Forest vegetation within the study area would generate a fund payment between $862,306.80 to $1,295,112.19 (excluding GST). Note: credit pricing is based on the most recent version of the payment calculator, which is updated every 3-months based on historic transactions. Credit yield is based on an average credit generation per hectare. Additionally, offsetting through payment into the fund incurs a risk premium (19.99%).

6.4.1.2 Species Credits

The total number of species credits required for any future development within the study area would be dependent upon further survey work to identify any potentially occurring species credit species. Both of the threatened flora species identified within the study area are species credit species, and will require offsetting.

The unit of measure for *Callistemon linearifolius* is a count, as such credit requirements for impacts on this species are directly related to the number of individuals impacted upon. For this species, impacts one individual generates two species credits. Based on the current offset payment calculator, within the Karuah-manning IBRA Subregion of the NSW North Coast IBRA Region, *Callistemon linearifolius* species credits are $207.24 (excluding GST)

The unit of measure for *Tetratheca juncea* is an area based assessment, as such credit requirements for impacts on this species are determined through impacts on area of suitable habitat. Additionally, the condition of the habitat is a factor in the calculation of credit requirements. As such, estimating the credit yield per hectare cannot be accurately determined until the full BAM survey work has completed. Based on the preliminary field work, all areas of PCT 1619 would form the species polygon for this species (i.e. 8.31 ha). Indicatively, in a previous assessment Kleinfelder has conducted impacts on *Tetratheca juncea* generated approximately 36 credits per hectare. As such, impacting on all areas of PCT 1619, could generate a species credit requirement in the order of 300 credits. Based on the current offset payment calculator, within the Karuah-manning IBRA Subregion of the NSW North Coast IBRA Region, *Tetratheca juncea* species credits are $210.35. In turn the total fund payment for impacting on all areas of *Tetratheca juncea* habitat would be $63,105 (excluding GST).

6.4.2 Constraints Assessment Conclusion

Summarising the constraints assessment section of the report, the subject site did not support any obvious Serious and Irreversible Impacts (SAII), which is the first risk that must be assessed. Kleinfelder are still waiting for a response from OEH regarding two SAII entities, however, based on a habitat assessment, there is a low likelihood of important habitat for these species occurring within the study area. However, a constraints assessment will not identify every potential SAII, because full survey results are required to ascertain the likelihood of SAII's.

The threatened species identified onsite, although present, can be offset under the BOS. Therefore, the constraint here is a financial one. If any other threatened species are identified during the targeted field surveys, offsets for these impacts will also be required.

There are two Threatened Ecological Communities identified within the study area, however, both of these are contained within the central wetland area within the study area, and are intended to be retained as part of any future development. The two dry forest vegetation

communities identified on site are not Threatened Ecological Communities, and as with the threatened species impacts, they can be offset under the BOS and the constraint is a financial one.

Therefore, the subject site, has no glaring reason not to proceed from any ecological constraint's perspective (i.e. no SAIIs identified at this stage, which could stop a Part 4 development). Financial impacts are not taken into consideration in this opinion. It is recommended that milestones, be established should the rezoning process proceed, to ensure risks are managed, and if a potential refusal level constraint presents itself, it is discussed as soon as it's found, and no additional works progress until the risks have been assessed and fully understood with a s solution to continue to move forward.

While no SAIIs have been identified at this stage, any future proposal for the study area will need to take the Avoid and Minimise principles of the BAM (Section 8) into consideration. The Avoid and Minimise principles are one of the key aspects of the BAM and all development applications are required to outline how the proposal has been located and designed to avoid and minimise impacts on native vegetation and threatened species habitat.

7. REFERENCES

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APPENDIX 1. ASSESSMENT OF LIKELIHOOD OF OCCURRENCE

The table below summarises the likelihood of threatened species and EPBC Act listed migratory species occurring within the study area based on the habitat requirements of each species. A brief definition of the likelihood of occurrence criteria is provided below:

Known – species identified within the site during surveys;
High – species known from the area (OEH Wildlife Atlas records), suitable habitat (such as roosting and foraging habitat) present within the site;
Moderate – species may be known from the area, potential habitat is present within the site;
Low – species not known from the area and/or marginal habitat is present within the site; and
Nil – habitat requirements not met for this species within the site.

An assessment of the likelihood of threatened species, populations and ecological communities occurring within the study area

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
	Flora						
1.	*Angophora inopina* Charmhaven Apple	V	V	22	NSW Atlas, PMST	It is generally found growing in open dry sclerophyll woodland in association with *Eucalyptus haemastoma* and *Corymbia gummifera* and with a dense shrub understorey occurring on deep white sandy soils over sandstone and often accompanied with gravelly laterite. **Marginal habitat within the subject site.**	Low
2.	*Asperula asthenes* Trailing Woodruff	V	V	4	NSW Atlas, PMST	Occurs in damp sites, often along river banks. **Potential habitat along the ecotone with dry forest and forested wetland and wetter areas of the dry forests.**	**Low - Moderate**

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
3.	*Callistemon linearifolius* Netted Bottlebrush	V	-	16	NSW Atlas	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Grows in dry sclerophyll forest on the coast and adjacent ranges. The species flowers during spring – summer. Recorded species are present within the study site. **Multiple individuals identified during initial field visits (confirmation of species identification required from NSW herbarium).**	**Known**
4.	*Grevillea parviflora* subsp. *parviflora* Small-flower Grevillea	V	V	3	NSW Atlas, PMST	The species occurs in heath and shrubby woodland, in sandy or lightly clay soils usually over thin shales. **Potential habitat within the subject site.**	**Moderate**
5.	*Rhodamnia rubescens* Scrub Turpentine	CE	-	2	PMST	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. **Unsuitable habitat within the subject site.**	Low
6.	*Tetratheca juncea* Black-eyed Susan	V	V	28	NSW Atlas PMST	Grows in sandy, occasionally swampy heath and in dry sclerophyll forest; chiefly in coastal districts from Bulahdelah to Lake Macquarie. **Species detected within the subject site during initial field investigations.**	**Known**
	Birds						
1.	*Burhinus grallarius* Bush Stone-curlew	E	-	12	NSW Atlas	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. **Potential habitat within open areas of the Spotted Gum Forest within the subject site. Population known from Karuah.**	**Moderate**
2.	*Calyptorhynchus lathami* Glossy Black-Cockatoo	V	-	8	NPWS Atlas	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of she oak occur. **Suitable foraging habitat present within the subject site due to presence of *Allocasuarina littoralis* in the midstorey.**	**Moderate**

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
3.	*Daphoenositta chrysoptera* Varied Sittella	V	-	2	NPWS Atlas	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. **Suitable habitat within the subject site.**	**Moderate**
4.	*Dromaius novae-hollandiae* Emu	EP	-	2	NSW Atlas	The population of Emus in the NSW North Coast Bioregion and Port Stephens LGA is of significant conservation value as the last known population in northern coastal NSW, and for the role that birds play in dispersing large seeds of native plant species, and over long distances. On the NSW north coast, Emus occur in a range of predominantly open lowland habitats, including grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities, as well as the ecotones between these habitats. **Potential foraging habitat within the subject site.**	**Moderate**
5.	*Ephippiorhynchus asiaticus* Black-necked Stork	E	-	2	NSW Atlas	Inhabits wetlands, such as floodplains of rivers with large shallow swamps and pools, and deeper permanent bodies of water. Occasionally individuals will stray into open grass, woodland areas or flooded paddocks in search of food. **Suitable habitat within subject site.**	**Moderate**
6.	*Glossopsitta pusilla* Little Lorikeet	V	-	3	NSW Atlas	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in *Angophora*, *Melaleuca* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. **Suitable foraging habitat within the subject site. Marginal nesting habitat present.**	**Moderate**
7.	*Haematopus longirostris* Pied Oystercatcher	E	-	1	NSW Atlas	Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish. **No suitable habitat within the subject site.**	Nil

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
8.	*Haliaeetus leucogaster* White-bellied Sea-Eagle	V	M	23	NSW Atlas	This species hunts for fish, turtles and sea snakes however will feed on carrion along the waterline. The White-bellied Sea-Eagle most often nests in trees 30 m above the ground. **Potential nesting habitat within the subject site.**	**Moderate**
9.	*Hieraaetus morphnoides* Little Eagle	V	-	1	NSW Atlas	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. **Potential nesting habitat within the study site.**	**Moderate**
10.	*Lathamus discolor* Swift Parrot	E	E, M	2	NSW Atlas	This migratory species has been recorded on the mainland from a variety of habitat types including dry and wet sclerophyll forest, forested wetlands, coastal swamp forests and heathlands. **Potential foraging habitat within the subject site.**	**Moderate**
11.	*Ninox strenua* Powerful Owl	V	-	1	NSW Atlas	The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine, Black She-oak, Rough-barked Apple, Cherry Ballart and a number of eucalypt species. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. **Suitable foraging habitat within the subject site.**	**Moderate**
12.	*Pandion cristatus* Eastern Osprey	V	-	3	NSW Atlas	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. **Marginal foraging habitat due to lack of clear water, potential nesting habitat within the study area.**	**Moderate**

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
13.	*Tyto longimembris* Eastern Grass Owl	V	-	1	NSW Atlas	Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. **Marginal habitat is present on site.**	Low
14.	*Tyto novaehollandiae* Masked Owl	V	-	3	NSW Atlas	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. **Possible foraging habitat within the subject site due to close proximity to larger tracts of forest. Potential nesting habitat present.**	**Moderate**
	Mammals						
1.	*Dasyurus maculatus* Spotted-tailed Quoll	V	E	5	NSW Atlas, PMST	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. **Potential foraging habitat within the subject site due to close proximity to larger tracts of forest. No breeding habitat due to a general lack of hollows and no caves.**	**Moderate**
2.	*Falsistrellus tasmaniensis* Eastern False Pipistrelle	V	-	1	NPWS Atlas	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. **Suitable foraging and roosting habitat present within the subject site. Species previously detected within the Biodiversity Offset Area.**	**Moderate - High**

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
3.	*Miniopterus australis* Little Bentwing-bat	V	-	12	NSW Atlas	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. **Suitable foraging and roosting habitat present within the subject site.**	**Moderate**
4.	*Miniopterus schreibersii oceanensis* Eastern Bentwing-bat	V	-	7	NSW Atlas	Forages in forested habitats. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. **Suitable foraging habitat present within the subject site.**	**Moderate**
5.	*Mormopterus norfolkensis* Eastern Freetail- bat	V	-	6	NSW Atlas	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. **Suitable foraging and roosting habitat present within the subject site.**	**Moderate**
6.	*Myotis macropus* Southern Myotis	V	-	5	NSW Atlas	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. **Suitable foraging and roosting habitat present within the subject site.**	**Moderate - High**
7.	*Petaurus australis* Yellow- bellied Glider	V	-	3	NSW Atlas	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. **Potential foraging and roosting habitat within the subject site.**	**Moderate**

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
8.	*Petaurus norfolcensis* Squirrel Glider	V	-	6	NSW Atlas	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. **Potential foraging and roosting habitat within the subject.**	**Moderate**
9.	*Phascogale tapoatafa* Brush-tailed Phascogale	V	-	2	NSW Atlas	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. **Suitable habitat within subject site due to a lack of suitable vegetation type.**	**Moderate**
10.	*Petauroides volans* Greater Glider	-	V	-	PMST	Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelters during the day in tree hollows. **Marginal foraging and roosting habitat within the subject site no records of the species in the locality.**	Low
11.	*Phascolarctos cinereus* Koala	V	V	109	NSW Atlas PMST	Found in a variety of forest types with suitable feed tree species. **Suitable habitat present within the subject site due to presence of preferred feed tree species *Eucalyptus tereticornis* and *Eucalyptus punctata.***	**Moderate**
12.	*Potorous tridactylus tridactylus* Long-nosed Potoroo (SE Mainland Population)	V	V	1	NSW Atlas, PMST	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. **Suitable habitat within the subject site due to dense understorey and vegetation types present.**	**Moderate**

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
13.	*Pteropus poliocephalus* Grey-headed Flying-fox	V	V	3	NSW Atlas, PMST	Occurs across a wide range of habitat types along the eastern seaboard of Australia, depending on food availability. Fruit from myrtaceous trees and rainforest trees form the major components of their diet. **Suitable foraging habitat present across the subject site when Eucalypt species are in flower.**	**Moderate**
14.	*Scoteanax rueppellii* Greater Broad- nosed Bat	V	-	3	NSW Atlas	This species occurs in a variety of habitats including rainforest, dry and wet sclerophyll forest and eucalypt woodland. **Suitable foraging and roosting habitat present within the subject site.**	**Moderate**
	Reptiles						
1.	*Chelonia mydas* Green turtle	V	V	5	Bionet database	Ocean-dwelling species spending most of its life at sea. **Unsuitable habitat within the subject site.**	Nil
2.	*Hoplocephalus stephensii* Stephen's Banded Snake	V	-	2	NWS Atlas	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Nocturnal and shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day. Marginal habitat within the subject site due to lack of suitable vegetation type. Marginal habitat within the subject site due to lack of suitable vegetation type.	Low
	Migratory /Marine Species						
1.	*Hirundapus caudacutus* White-throated Needletail	-	M	1	NSW Atlas	Forages in high open spaces over varied habitat types. **May aerially forage over the subject site.**	Low
2.	*Hydroprogne caspia* Caspian Tern	-	M	1	NSW Atlas	Their breeding habitat is large lakes and ocean coasts in Australasia (Australia and New Zealand). Australasian birds are resident or disperse over short distances. **Potential foraging habitat within the study site.**	**Moderate**

No.	Species	Legal Status*		No. records (5 km)	Source#	Habitat Preferences	Likelihood of occurrence
		BC Act	EPBC Act				
3.	*Limosa lapponica* Bar--tailed Godwit	-	M	1	NSW Atlas	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. The Bar-tailed Godwit usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. **Marginal habitat within the study area.**	Low
4.	*Merops ornatus* Rainbow Bee-eater	-	M	1	NSW Atlas	Most often recorded in open forests, woodland, shrublands, and cleared areas near water sources. It uses disturbed sites such as quarries, cuttings and mines to build its nesting tunnels. **Suitable foraging habitat within the subject site.**	**Moderate**
5.	*Numenius phaeopus* Whimbrel	-	M	2	NSW Atlas	Inhabits coasts, particularly mudflats, mangroves and beaches. Occasionally inland along rivers. Migrates from the far northern hemisphere, arriving in the wet season. Some birds remain for the dry season/winter. **Marginal foraging habitat.**	Low
6.	*Pluvialis fulva* Pacific Golden Plover	-	M	1	NSW Atlas	Is widespread in coastal regions of Australia. This species usually forages on sandy or muddy shores (including mudflats and sandflats) or margins of sheltered areas such as estuaries and lagoons, though it also feeds on rocky shores, islands or reefs. **No suitable habitat within the study area.**	Low
7.	*Thalasseus bengalensis* Lesser Crested Tern	-	M	1	NSW Atlas	Coastal dwelling species which is largely sedentary in Australia. **No suitable habitat within the study area.**	Low

* Legal Status: V = Vulnerable, E = Endangered, CE = Critically Endangered; Ex = Extinct under TSC Act and EPBC Act; M = Migratory under EPBC Act. # Source: OEH Atlas = Atlas of NSW Wildlife (OEH), BioNet = BioNet PCT database; PMST = Protected Matter Search Tool (Australian Government).