Annex N – BAR Ecological Assessment

BIODIVERSITY ASSESSMENT

REPORT

for a proposed

Sand Mine

at

Lot 10 DP 1071458, Lot 51 DP 1015671
Lot 245 DP 753204
Nelson Bay Road
BOBS FARM
NSW

Prepared by: WILDTHING **Environmental Consultants**
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Job No. 12111 ***November 2018***

5 November 2018

This Biodiversity Assessment has been prepared for Ammos Resource Management Pty Ltd to accompany a development Application for a proposed sand mine within Lot 10 DP 1071458, Lot 51 DP 1015671 and Lot 245 DP 753204 Nelson Bay Road, Bobs Farm NSW. I Daryl Harman, of Wildthing Environmental Consultants, Wallsend, hereby certify that this Biodiversity Assessment has been prepared from historical data and data gathered by myself and other consultants working under my direction.



Daryl Harman BAppSc (Env)
Senior Ecologist - Principal Author

Reviewed by



Mungo Worth

I, Robert Lander on behalf of Ammos Resource Management Pty Ltd, being the applicant for the development consent for a proposed sand mine Lot 51 DP 1015671 and Lot 245 DP 753204 Nelson Bay Road, Bobs Farm NSW have read and understood this Biodiversity Assessment Report. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal.



Robert Lander

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EXECUTIVE SUMMARY

Flora, fauna and habitat studies for a Biodiversity Assessment Report have been undertaken within Lot 10 DP 1071458, Lot 11 DP 1071458, Lot 51 DP 1015671 and Lot 245 DP 753204 Nelson Bay Road, Bobs Farm NSW for a proposed sand mine. The proposed sand mine is being assessed as State Significant Development (SSD) under the Environmental Planning & Assessment Act (1979). These studies have been undertaken to ascertain whether or not the proposed sand mine would have a significant effect upon any populations, ecological communities, or habitats of threatened flora and fauna species.

Description of study area

The 50.06 ha study area was largely located on stable Aeolian Holocene transgressive dunes on the north-eastern side of Stockton Bight. Smaller areas of lower poorly drained ground were present in the north-east in the far west of the study area consisted of a flat, swampy, Holocene estuarine plain of Tilligerry Creek.

The irregularly shaped study area was composed of four parcels of land:

- Lot 10 DP 1071458 (2.53 ha)
- Lot 11 DP 1071458 (2.9 ha)
- Lot 51 DP 1015671 (6.63 ha)
- Lot 254 DP 753204 (40.9 ha)

The Proposal

The proposed sand mining footprint will have a direct impact on approximately 38ha of the 50.06 ha study area. This will involve the clearing of native vegetation in a staged or incremental fashion. Large scale clearing would not be undertaken.

Vegetation

A large portion of the study area occurring on Aeolian Holocene transgressive dunes was undeveloped and consisted of uncleared tall dry open sclerophyll forest dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). An area within Lot 254 contained an Olive and Fig Orchard plus a residence, gardens and associated buildings. The lower flat ground in the north-east of Lots 10, 11 and 51 has had a long history of disturbance and largely consisted of grassland/pasture. Smaller areas of Swamp Forest and Freshwater Wetland were also present on areas of low poorly drained flat land. Vegetation types were classified based on the 'best fit' vegetation type listed in the Plant Communities Types (PCT's) Database (OEH 2009). Parameters used to choose the 'best fit' Vegetation Type included over-storey and understorey floristics, soil landscape, location and topographic position. A total of three vegetation types were delineated within the study area:

- **Vegetation Type 1 -** HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate/Good High Condition)(35.41ha). An area of derived grassland (0.9ha) was also consistent with Vegetation Type 1;
- **Vegetation Type 2 –** HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast(Moderate/Good)(1.15ha);
- **Vegetation Type 3** – HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good Poor)(0.32ha).

Two additional vegetated areas were highly altered and could not be assigned a community Vegetation Type:

- Orchard, Cleared/Modified (9.6ha);
- Grassland/Pasture (4.0ha).

Endangered Ecological Communities (EEC) TSC Act

The study area was found to contain two Endangered Ecological Communities (EEC's):

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions - Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast 1.15ha
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - Coastal freshwater lagoons of the Sydney Basin Bioregion and South-East Corner Bioregion 0.32ha.

The areas of Swamp Sclerophyll Forest and Freshwater Wetland are located outside the proposed mining footprint and will have a buffer of at least 15m. Taking the recommendations for these two EEC's into consideration the proposal is unlikely to have an adverse effect that their composition or local occurrence such that they will be placed at extinction.

Groundwater Dependent Communities

Identified vegetation communities within the study area that are exclusively reliant on groundwater were Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest and Coastal freshwater lagoon. One community, Smooth-barked Apple - Blackbutt - Old Man Banksia woodland which contains species which obtain groundwater in the capillary fringe; occurs within the proposed mining footprint. The proposed sand mine will require excavation below the groundwater level within the study area. An assessment undertaken (Martins, 2015) found drawdown of the permanent groundwater system at these vegetation communities is modelled to be a maximum of approximately 0.07 m. Based on the NSW Aquifer Interference Policy (Department of Primary Industries Office of Water, 2012) and the post Water Sharing Plan the local groundwater natural level range is of the order of 3 m (or more). The adopted permissible drawdown at a 40 m buffer from the GDEs is 0.30 m (i.e. 10% x 3.00). This drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, based on modelling results, the proposed development does not exceed the drawdown impact criterion set out in the NSW Aquifer Interference Policy (NOW, 2012).

Threatened Flora Species

A total of 108 individual specimens of *Diuris arenaria* (Tomaree Doubletail) were recorded within the study area as a result of targeted surveys. With the exception of one plant occurring approximately 6m to the north of the electrical easement, the remaining specimens of *D. arenaria* were found to be confined to the maintained electrical easement in the far west of the study area. Outside the study area *D. arenaria* also occurs within the same electricity easement to the west and east (ERM, 2003 & Wildthing Environmental Consultants, 2018). Within the study area the orchids were located within native derived grassland with no canopy which has been created and maintained as an electrical easement by Ausgrid. No other occurrences of *D. arenaria* were recorded over the remainder of the study area during targeted surveys. The absence of *D. arenaria* over the remainder of the study area is likely to be attributed to the density of trees and shrubs shading suitable habitat. However, suitable habitat was considered to be present within other areas of Coastal Sand Apple Blackbutt Forest with a sparse canopy cover.

No specimens of *D. arenaria* are required to be removed as a result of the proposal. The 15m buffer to the north of the electrical easement to the extraction zone will also offer protection from secondary impacts such as increased weed incursion and dust. It is recommended that there is a no-go zone below the extraction zone to avoid any unintended removal/disturbance of these orchids. This will require the erection of a barrier fence on the boundary of the extraction zone. It will also be important to

liaise with Ausgrid regarding maintenance of their easements to minimise impacts and support the protection of *D. arenaria*.

Despite targeted searches no additional threatened flora species were recorded within the study area during fieldwork. The study area was considered to contain potential habitat for an additional 11 of the 30 threatened flora species addressed in the report:

- *Diuris praecox* (Newcastle Doubletail);
- *Corybas dowlingii* (Red Helmet Orchid);
- *Cryptostylis hunteriana* (Leafless Tongue Orchid);
- *Rhizanthella slateri* (Eastern Underground Orchid);
- *Pterostylis chaetophora* (Tall Rustyhood);
- *Maundia triglochinoides* (Maundia);
- *Persicaria elatior* (Tall Knotweed);
- *Zannichellia palustris* (Horned Pondweed);
- *Eucalyptus parramattensis* subsp. *decadens* (Drooping Red Gum);
- *Melaleuca biconvexa* (Biconvex Paperbark);
- *Syzygium paniculatum* (Magenta Lilly Pilly);

Of these threatened flora species, the most likely habitat within the study area was considered to be present for *D. praecox*. Specimens of *D. praecox* are known to be present approximately 200m to the south-west within the same electrical easement which runs through the study area. Due to the absence of preferred habitat and lack of nearby local records the study area was only considered to provide marginal habitat for the remaining flora species.

Threatened Fauna

A total of eight threatened fauna species were recorded within the study area during fieldwork:

- *Glossopsitta pusilla* (Little Lorikeet)
- *Haliaeetus leucogaster* (White-bellied Sea Eagle);
- *Petaurus norfolcensis* (Squirrel Glider)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)
- *Falsistrellus tasmaniensis* (Eastern Falsistrelle)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus schreibersii oceanensis* (Large Bentwing-bat)

As a result of secondary evidence an additional two threatened fauna species were also noted within the study area:

- *Ninox strenua* (Powerful Owl)
- *Phascolarctos cinerea* (Koala)

Of the remaining 90 assessed threatened fauna species the study area was found to contain suitable habitat for 43. Taking the habitat and local records into consideration the most likely of these 43 species to utilise the study area would include *Daphoenositta chrysoptera* (Varied Sittella), *Tyto novaehollandiae* (Masked Owl), *Dasyurus maculatus maculatus* (Tiger Quoll), *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat) and *Mormopterus norfolkensis* (Eastern Freetail-bat). The proposal will result in a significant loss of habitat for a number of the addressed species particularly species such as *P. norfolcensis.* However, taking into consideration the relatively large amount of similar habitat in the local area and given the recommendations the proposal is unlikely to disrupt the life cycle the addressed threatened species such that local extinction would occur.

Endangered Populations

Within the NSW North Coast Bioregion and Port Stephens LGA the population of the Emu has been listed as Endangered. The Emu was not recorded within the study area during the survey. Open

Forest vegetation that covers the majority of the study area would provide some habitat for this species, which prefers more open habitat. Taking into consideration the large amount of suitable habitat along Stockton Bight and lack of recent local records the proposal is unlikely to result in the local extinction of a viable local population of the Emu.

Habitat types within the study area

The main habitat types within the study area were:

- Dry Sclerophyll Forest (34.5 ha);
- Swamp Sclerophyll Forest (1.15 ha);
- Freshwater Wetland (0.32 ha);
- Orchard (9.6 ha);
- Cleared Open Areas (4 ha).

In general, the habitats within the study area offer a wide range of habitat opportunities for a range of native species. The habitats proposed to be affected by the proposal range from less ecologically significant areas such as cleared areas and orchards to relatively intact Dry Sclerophyll Forest that is capable of offering suitable resources to both resident and transitory species.

Habitat Fragmentation and Corridors

The study area forms part of a significant ecological corridor that runs down the coast from the Tomago Sandbeds in the south along the Stockton Bight to the Tomaree Peninsula in the north. The ecological corridor occurring along Stockton Bight is restricted by the bare shifting sand dunes to the east and largely cleared agricultural land to the west. The Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (House, 2003) also identifies the Coastal Sand Apple – Blackbutt Forest occurring along the Stockton Bight dune system as a regionally significant habitat linkage. The Hunter Regional Plan 2036 (NSW Government, 2016) also shows the site to occur within a Biodiversity Corridor. The fragment of vegetation that the study area is situated has also been mapped as a key habitat (NPWS 2002). The proposal will result in the removal of approximately 25.90ha of key habitat largely consisting of Coastal Sand Apple Blackbutt Forest from the north-east section of the corridor. The section of the corridor where the study area is located is approximately 1.5km wide.

The proposal will result in the reduction in the width of the corridor by approximately 600m (the majority of habitat occurring on the northern side of the dual carriage way of Nelson Bay Road). The wider southern portion of the regional corridor occurring south of Nelson Bay Road is located on the protected Worimi Conservation Lands. Within the vicinity of the study area the ecological corridor is traversed by the dual carriage way of Nelson Bay Road to the immediate south-east and a power easement which runs east-west through the southern portion of the study area. Cleared agricultural land also bordered parts of the north-east boundary. The proposal will result in a reduction in connectively to smaller areas of open forest habitat contained within Lots 1, 2 & 521 to the immediate north of the study area. Considering the presence of the dual carriageway of Nelson Bay Road (without a treed traffic island) the proposal will also result in a reduction in connectivity for open forest areas within Lot 10 and the adjoining crown reserve (Lot 7374). A 15m vegetated buffer zone around the sand mine footprint together with adjoining habitat such as the road reserve along Nelson Bay Road will still provide connectivity to these areas of habitat outside the permanent artificial lake. The connectivity to these areas will also improve after the mine site has been progressively revegetated.

Hollow-bearing Tree Survey

A total of 1217 habitat (hollow-bearing) trees were identified within the study area as a result of a hollow-bearing tree survey. The vast majority of hollow-bearing trees were present within Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands assemblage. Many of these trees were considered to be significant as a result of their very large size as well as the variety and

number of hollows they contained. Hollows were available for roosting or nesting avifauna species, arboreal mammals, reptiles and tree roosting microchiropteran bat species.

Considerations under the Port Stephens Comprehensive Koala Plan of Management CKPoM)

The Port Stephens CKPoM assessment found the study area was largely composed of Supplementary Koala habitat and to a lesser extent Mainly Cleared Land. Two smaller areas of preferred Koala habitat occupied the areas of Swamp Sclerophyll Forest located within the north and north-east of the study area within Lot 10 and 254. *Eucalyptus robusta* (Swamp Mahogany) was the only preferred Koala Feed Tree Species recorded within the study area. A total of 19 individual specimens of *E. robusta* were found to be confined to two areas of Swamp Sclerophyll Forest within the study area. No Koalas were recorded within the study area during the survey period. A small number of specimens of *E. robusta* within Lot 10 had scratches and characteristic 'pock marks' consistent with that of the Koalas although no faecal pellets were found under the trees. According to database records contained in the NSW Wildlife Atlas (OEH, 2015) and Hunter Koala Preservation Society (2015) a small number of records of Koalas occur within proximity to the study area. The evidence suggests that the study area particularly the area of Swamp Sclerophyll Forest in the far north is utilised infrequently by a small number of Koalas. The CKPoM requires a 50m buffer from the areas of Preferred Koala Habitat over Supplementary and Mainly Cleared habitat. The proposal will result in the loss of Supplementary Koala Habitat however no areas of Preferred Koala Habitat will be removed.

Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act (1999).

Consideration has been given to the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act (1999). No nationally threatened communities were present within the study area. One nationally threatened species *Pteropus poliocephalus* (Grey-headed Flying-fox) was recorded foraging within the site during fieldwork. An additional threatened species *Phascolarctos cinereus* (Koala) was also identified as utilising the study area from the presence of scratches on preferred feed tree species. The proposal will result in a reduction in habitat for both these two nationally threatened species however is unlikely to have a significant impact.

Three listed migratory species; White-bellied Sea-Eagle, Rufous Fantail and Cattle Egret were recorded within the study area during fieldwork. Considering the relative commonality of these three migratory species and large amount of suitable habitat in the locality it is unlikely that these species or any of the addressed listed migratory species would be significantly impacted by the proposal.

Impact Assessment

The proposed Sand Mine will result in the following direct and potential impacts or losses:

- Approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- Approximately 9.5ha of Orchard;
- Approximately 25.90ha of Supplementary Koala Habitat;
- Approximately 25.90ha of known habitat for ten affected threatened fauna species; *Glossopsitta pusilla* (Little Lorikeet), *Ninox strenua* (Powerful Owl), *Haliaeetus leucogaster* (White-bellied Sea Eagle), *Petaurus norfolcensis* (Squirrel Glider), *Scoteanax rueppellii* (Greater Broad-nosed Bat), *Falsistrellus tasmaniensis* (Eastern Falsistrelle), *Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Large Bentwing-bat), *Phascolarctos cinereus* (Koala) and *Pteropus poliocephalus* (Grey-headed Flying-fox);
- Suitable habitat for a number of additional threatened and other flora and fauna species likely to utilise the study area;
- Approximately 877 hollow-bearing trees;
- Habitat Fragmentation;
- Injury/Mortality to native fauna during felling of trees.

The proposed Sand Mine will result in the following potential indirect impacts;

- Increased spread of noxious weeds;
- Increased spread of pest fauna species;

- Edge effects;
- Impact on Groundwater Dependent Ecosystems (GDE's) through changes to groundwater levels;
- Increase in noise from machinery;
- Increase in artificial lighting. Increased lighting may be the result of security lighting.

Mitigation Measures

A number of mitigation measures have been specified to minimise the impact of the loss of habitat. The measures will include:

- Provision of compensatory habitat (Offsetting) using the Biobanking Assessment Methodology (DECC, 2009);
- Protection of remaining habitat/vegetation;
- Protection of fauna during habitat removal;
- Provision of mitigation measures for affected species such as translocation of specimens of *Diuris arenaria* (Tomaree Doubletail);
- Rehabilitation of extraction area;
- Monitoring of groundwater levels and groundwater dependant ecosystems within proximity to the extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.

To help ensure these measures are carried out a detailed vegetation/habitat management plan will need to be developed to address any impacts associated with the proposed sand mine to ensure the long-term viability of remaining and rehabilitated habitat.

Offset Requirements using the Biobanking Assessment Methodology (DECC, 2009)

The FBA Credit Calculator generated a Credit Profile for the Development Area. The Development Biobank Credit Reports generated by the Credit Calculator are provided below.

Plant Community Type	Area (ha)	Credits
HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	35.41	1681
HU938 - Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.15	8.17
HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South-East Corner Bioregion	0.32	1.31

Conclusion

The proposed sand mine will result in an incremental loss of habitat for a number of the addressed threatened species occurring within the local area. Taking into account the relatively large amount of similar habitat along Stockton Bight and given the recommendations which include a Biobanking Offset it is believed that the proposal is unlikely to disrupt the life cycle of any addressed threatened species, endangered population or endangered ecological community such that local extinction would occur.

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1.0 INTRODUCTION

This Biodiversity Assessment Report (BAR) has been undertaken to seek approval for a proposed sand mine within Lots 10 & 11 DP 1071458, Lot 51 DP 1015671 and Lot 245 DP 753204 Nelson Bay Road, Bobs Farm NSW. This BAR addresses the specific matters raised in the Secretary's Environmental Assessment Requirements (SEARs) that are relevant to biodiversity. In accordance with the SEARs, the BAR uses the Framework for Biodiversity Assessment (FBA) to quantify the project's impacts and the BioBanking Assessment Methodology (BBAM) to determine suitable offsets in accordance with the NSW Biodiversity Offsets Policy for Major Projects. Considerations have also been given to the Fisheries Management Act 1994 (FM Act), Port Stephens Comprehensive Koala Plan of Management 2002 (CKPoM) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). This report forms part of the Environmental Impact Statement (EIS) undertaken for this proposal.

1.1 DEFINITION OF THE STUDY AREA

The 50.06 ha irregularly shaped study area was composed of four parcels of land:

- Lot 10 DP 1071458 (2.53ha);
- Lot 11 DP 1071458 (2.9ha);
- Lot 51 DP 1015671 (6.63ha);
- Lot 254 DP 753204 (40.9ha).

1.2 LOCATION OF STUDY AREA

The study area was located at Bobs Farm NSW within the Port Stephens LGA approximately 27km north-east of Newcastle and 14km south-west of Nelson Bay (Figures 1 & 2). The study area was situated between Nelson Bay Road and Marsh Road. Nelson Bay Road formed the southern boundary of the study area.

1.3 TOPOGRAPHY AND SOILS

The majority of the study area occurs on stable, often steep sided Aeolian Holocene transgressive dunes composed of quartz sands. Soils consisted of deep, very well drained, weakly developed Podzols (Murphy, 1995). Lower ground in the far north-west of the study area consisted of a flat, swampy, Holocene estuarine plain. Soils within this lower area consisted of very poorly drained Humic Gleys (Murphy, 1995). A detailed plan showing the topography of the study area is shown in Figure 3.

1.4 DRAINAGE

No watercourses or drainage features were noted onsite. Lower lying poorly drained areas of ground in the far north of the study area contained some surface water, particularly after heavy rains. These poorly drained regions of surface water were associated with areas of Swamp Forest and Freshwater

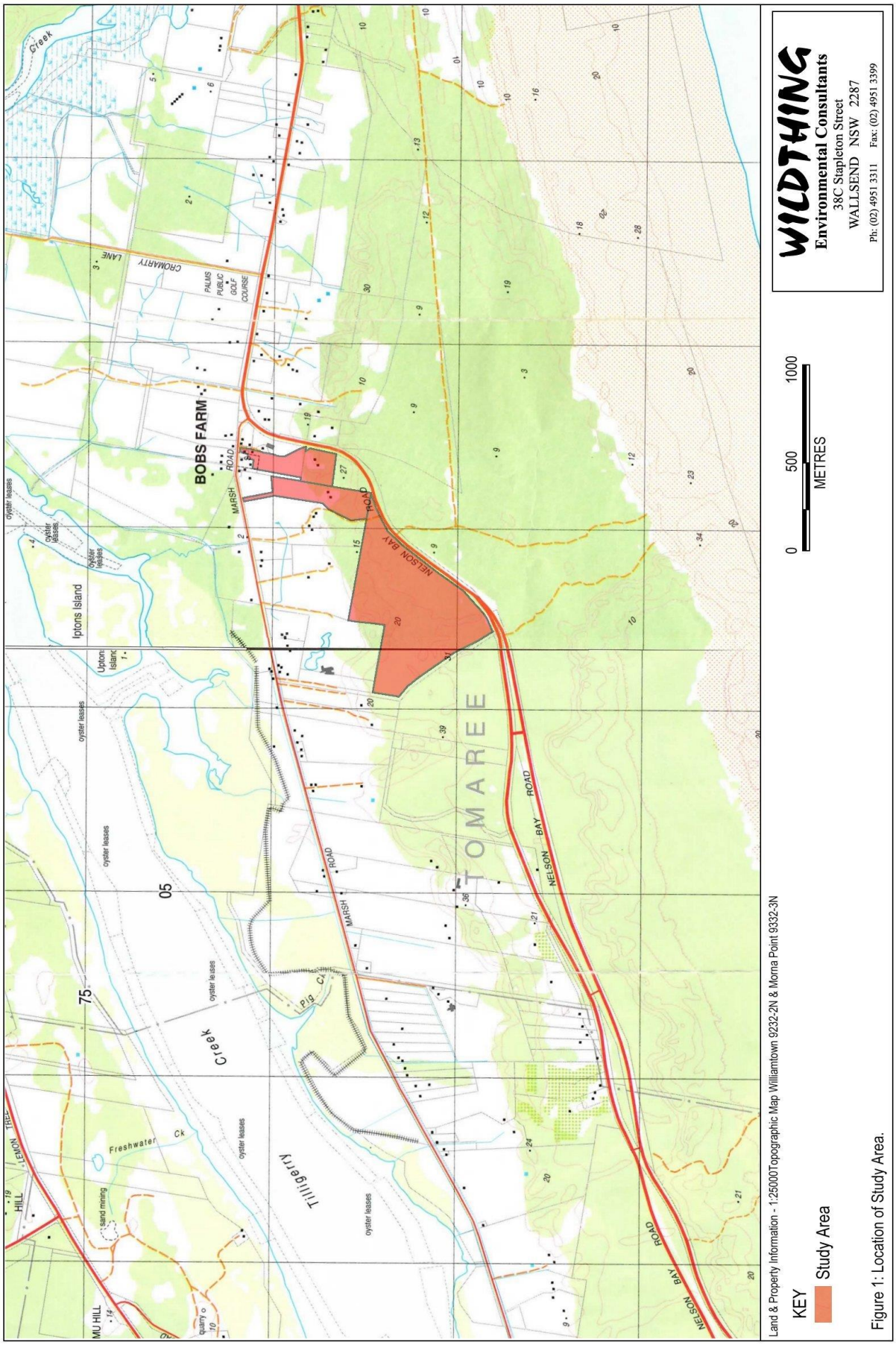


Figure 1: Location of Study Area.

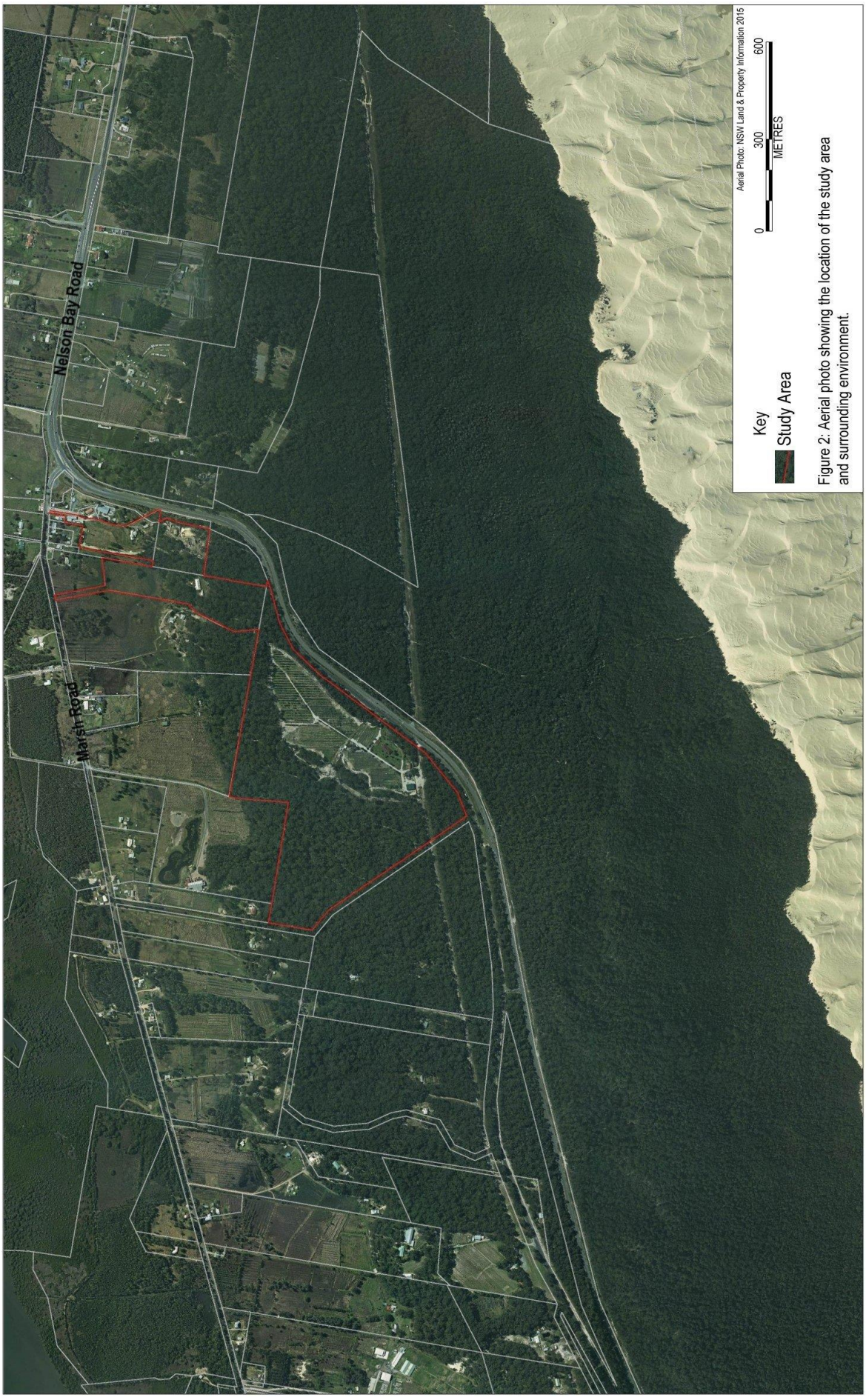


Figure 2: Aerial photo showing the location of the study area and surrounding environment.

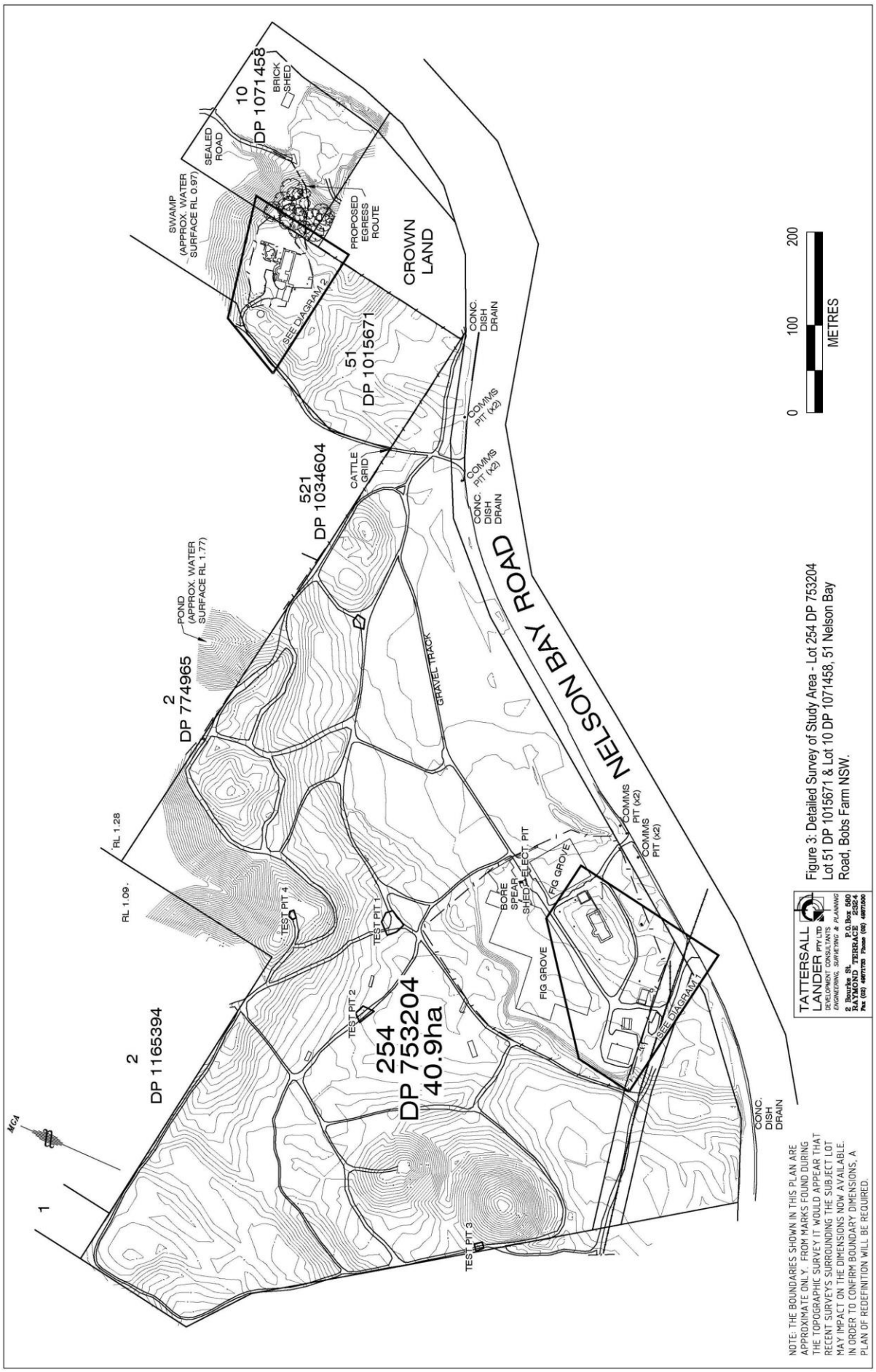


Figure 3: Detailed Survey of Study Area - Lot 254 DP 753204 Lot 51 DP 1015671 & Lot 10 DP 1071458, 51 Nelson Bay Road, Bobs Farm NSW.

Wetland. The majority of the site drains east into Worimi National Park. The north-west portion drains north-west into a large dam on the neighbouring Shark and Ray Centre property or into the drainage network of Tilligerry Creek, located approximately 1km north-west of the study area (Martens, 2015).

1.5 VEGETATION

A large portion of Lots 51, 254 and to a lesser extent Lot 10 occurring on Aeolian Holocene transgressive dunes was undeveloped and consisted of uncleared tall dry open sclerophyll forest dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). Coastal Sand Apple Blackbutt Forest composed of *E. pilularis* and *A. costata* was the dominant vegetation community on the Holocene sand dunes along Stockton Bight from Fern Bay to Anna Bay. Approximately 10ha within Lot 254 had been cleared and was occupied by an Olive and Fig Orchard. The cleared orchard area also contained a residence and maintained gardens. The lower-lying flat ground in the north of Lots 10, 11 & 51 has had a long history of disturbance and largely consisted of grassland/pasture. Two smaller areas of Swamp Forest dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark) were present in the far north and west of the study area. An area of Freshwater wetland dominated by sedges was also present in the far north of the study area.

1.6 ZONING OF STUDY AREA UNDER THE PORT STEPHENS LEP (2013)

The entire study area is zoned RU2 Rural Landscape. The objective of this direction is to protect the agricultural production value of rural land.

1.7 LAND TENURE INFORMATION

The study area consisted of a number of parcels of land under a number of tenures. Lot 254 DP 753204 and Lot 51 DP 1015671 which made up the majority of the study area is owned by the proponent. The remaining two lots were also in private ownership. Table 1 below shows the land tenure across the study area.

Table 1: Land tenure within the Study Area.

Land Parcel	Land Holder
Lot 10 DP 1071458 (2.53ha)	Allan Hay
Lot 11 DP 1071458	Allan Hay
Lot 51 DP 1015671 (6.63ha)	Ammos Resource Management Pty Ltd
Lot 254 DP 753204 (40.9ha)	Ammos Resource Management Pty Ltd

2.0 PROPOSAL

The proposed Sand Mine will have a disturbance zone whole area including vegetation of 38ha (Figure 4). The proposed sand mining operations will have several stages of development and operations. These are likely to be:

a. Development Stage – installation of Nelson Bay access location, initial part-clearing of mine site, setting up screening operations, loading ramp and storage shed and the construction of the main exit road onto the existing bitumen sealed road within Lot 10 DP 1071458.
b. Operational Stage 1 – Part Staged clearing and stockpiling of topsoil and production of initial sand material that is likely to be processed into landscape soil base and sports field top-dress material.
c. Operational Stage 2 – Part staged clearing and processing of the blonde sand material for all products range.
d. Operational Stage 3 – Part staged clearing and setting up of dredge operations and winning of sand material for the processing of all products range.

Within all operational stages the main activities will be the bulk handling of sand material, utilising front end loaders and trucks and dogs for the transport of the material to the required markets. Operational hours for extraction, loading of vehicles and transportation of materials out of the site area requested to be 6.00am – 6.00pm Monday to Saturday. No work on Sundays or Public Holidays.

With regards to the processing of the site material for the various applications that could be commercially supplied, the following processes are expected to be undertaken:

1. Vegetation Clearing – logging and mulching. This process would be undertaken in a staged or incremental fashion that would be tailored to specific commercial markets. Large scale clearing would not be undertaken.
2. Screening – This process involves the separating of the sand into certified material and would be undertaken throughout the whole mining process. The extent of the activity will be dependent on the product specification that will be required.
3. Washing – It is expected that some of the sand material will require washing to clean the material for a certification that will be required.
4. Sizing – Sand material will need to be sized. This process is essential for the production of fracking sand, glass, construction sand and high-end sports field top dress materials.
5. Separating of non-silica material - process undertaken generally for the production of glass and sand specification.
6. Dredging – process is for the recovery of material that is below the economic reach of mechanical equipment. Approximately 50% of the recoverable resource would be dredged.

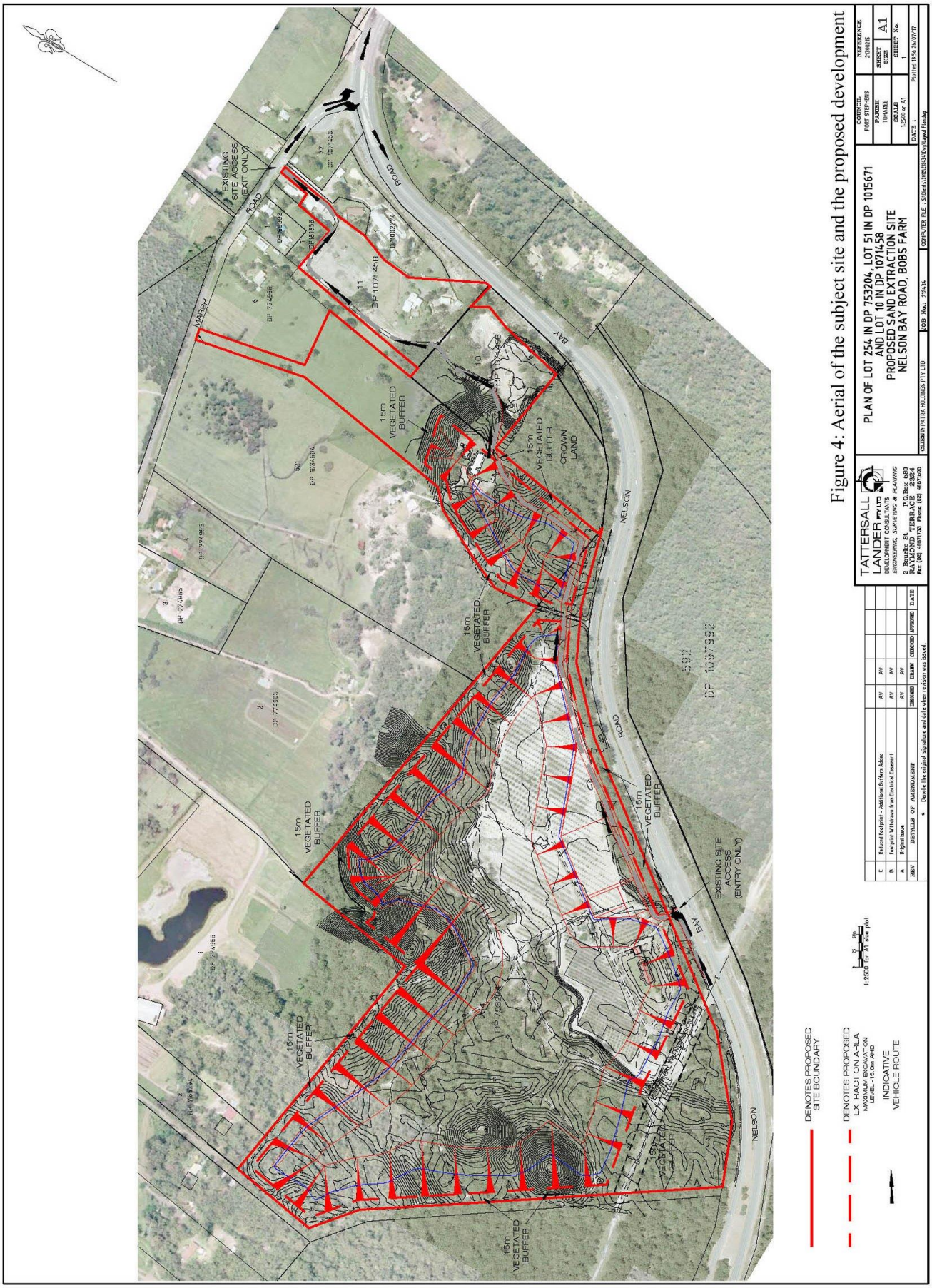


Figure 4: Aerial of the subject site and the proposed development

Wastes from these processes are expected to be:

1. All organic material processed on the site would be either used for rehabilitation of the land or sold to local garden suppliers. It would also be expected that some of the trees would be processed for saw logs. Tub ground mulch would also be stockpiled and used in local rehabilitation projects.
2. Heavy Metals – this product has been identified in very low concentrations of 0.18 to 2% within the 5 boreholes that have been undertaken. It would be initially proposed that this material would be stockpiled and then relocated to a heavy earth processor.
3. Water – sourced from site bores, this water would be returned to the groundwater via infiltration and settlement ponds.
4. Organic Soils – the current boreholes have indicated that organic soils are banded at layers of around 1-2 metres and located around the current site water table. It would be expected that these materials would be processed as landscaping supplies.

Approximately 12ha extraction area will be rehabilitated back to forest. The remaining 24.8ha of the extraction area will become an artificial lake.

3.0 LEGISLATIVE REQUIREMENTS

3.1 LEGISLATIVE CONTEXT & SEARS

Environmental impact statements (EIS's) are prepared to assess the impacts of major projects, including State Significant Development (SSD) projects, under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Biodiversity Assessment Report (BAR) forms part of the EIS being prepared for the Bobs Farm Sand Mine and assesses the biodiversity impacts of the project.

3.2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

EIS's are subject to a range of legislative and policy requirements as set out in the Secretary's Environmental Assessment Requirements (SEARs) (issued 12 April 2017).

The SEARs require the BAR to address the following:

- The likely biodiversity impacts of the development, having regard to OEH's requirements.
- Details of the biodiversity offsets to compensate for significant residual impacts required to offset the development in accordance with the Framework for Biodiversity Assessment (FBA) (OEH 2014).

A copy of the SEARs for the Bobs Farm Sand Mine are contained in Appendix A. In accordance with the SEARs, this BAR has been prepared to quantify the project's impacts and to determine suitable offsets in accordance with the NSW Biodiversity Offsets Policy for Major Projects and Framework for Biodiversity Assessment.

Taking the Biodiversity Conservation (Savings and Transitional) Regulation 2017 - Major projects (state significant development/state significant infrastructure) - Other development applications (or modification applications) can be considered under the previous legislation if:

- environmental assessment requirements were issued before 25 August 2017 and the application is made before 25 February 2019. If the environmental assessment requirements are reissued, the application must instead be made within 18 months of the reissue, but no later than 24 August 2020.

3.2.1 MATTERS FOR FURTHER CONSIDERATION

The NSW OEH provided project specific SEARs (Attachment B to the SEARs) which outlined 'Project Specific Requirements' in addition to the project SEARs. The following additional requirements were made by OEH in respect to the project:

"Impacts on the following species will require further consideration and provision of the information specified in section 9.2 of the Framework for Biodiversity Assessment:

- ***Pterostylis chaetophora* (Tall Rustyhood)** - given its known habitat preferences and known occurrence within the LGA, OEH is of the opinion this species has the potential to occur on the proposed development site. As such OEH expects appropriately targeted sampling to be undertaken during its known flowering period (September to November) (Bishop, 2000) and samples sent to the NSW Herbarium for identification and/or confirmation. OEH will provide assistance with details of the nearby location to assist with the targeted sampling.
- ***Uperoleia mahonyi* (Mahoney's Toadlet)** – as suitable habitat exists on the subject site, OEH considers any potential loss of known habitat could significantly reduce the viability and genetic diversity of this species, and therefore OEH specifically requires that this species is considered (in accordance Section 9 of the FBA)."

Detailed Project Specific Requirements' in addition to the project SEARs is contained in Appendix A.

3.3 ADDITIONAL LEGISLATIVE REQUIREMENTS

This Report has taken into consideration the following additional legislation, Acts and Policies:

- Commonwealth Environment Protection and Biodiversity Conservation Act 1999) (EPBC Act);
- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Threatened Species Conservation Act 1995 (TSC Act);
- Biodiversity Conservation Act 2016 (BC Act);
- Biodiversity Conservation (Savings and Transitional) Regulation 2017
- Water Management Act 2000 (WM Act);
- Biosecurity Act 2015 (BS Act);
- Fisheries Management Act 1994 (FM Act);
- Coastal Management SEPP
- State Environmental Planning Policy 44 (SEPP 44) Koala Habitat Protection;
- Port Stephens Comprehensive Koala Plan of Management 2002 (CKPoM);
- NSW Biodiversity Offsets Policy for Major Projects (Biobanking);
- NSW Groundwater Dependent Ecosystem Policy.

3.3.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places which are defined in the EPBC Act as matters of national

environmental significance. The EPBC Act comes into play when a proposal has the potential to have a significant impact on a matter of national environmental significance. The nine matters of national environmental significance to which the EPBC Act applies are:

- world heritage properties;
- national heritage places;
- wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed);
- nationally threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining);
- a water resource, in relation to coal seam gas development and large coal mining development.

In addition, the EPBC Act confers jurisdiction over actions that have a significant impact on the environment where the actions affect, or are taken on, Commonwealth land, or are carried out by a Commonwealth agency (even if that significant impact is not on one of the nine matters of 'national environmental significance'). Matters under the EPBC Act are addressed in Section 11 of the report.

3.3.2 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 (EP&A ACT)

The provisions of the EP&A Act enable the preparation of local environmental plans, development control plans, regional environmental plans and State Environmental Planning Polices (SEPP's) to control development at the local, regional and state level. The proposed sand mine is being assessed as State Significant Development (SSD). The SSD assessment system has been established to guide planning decisions on large-scale industrial, resource and other proposals which the proposed sand mine is classed. Considerations of the effects of the proposal on threatened species, endangered populations and communities under the guidelines of Section 5A of the Environmental Planning and Assessment Act (1995) are addressed in Sections 7 and Appendix A of this report.

3.3.3 THREATENED SPECIES CONSERVATION ACT 1995 (TSC ACT)

The TSC Act provides for the conservation of threatened species, populations and ecological communities of animals and plants. The Act sets out a number of specific objectives relating to the conservation of biological diversity and the promotion of ecologically sustainable development. Schedules 1 & 2 of the TSC Act contain lists of flora and fauna species, population and communities that have been determined by the NSW Scientific Community. These species have been determined as being under threat of serious decline that could ultimately lead to extinction. Schedule 3 of the Act also contains a list of "Key Threatening Processes" which have been determined to have a detrimental

impact on threatened species, populations or communities. Under Section 5A of the EP&A Act an assessment of significance (Seven Part Test) is applied to species, populations and ecological communities listed on Schedules 1, 1A and 2 of the TSC Act which may be affected directly or indirectly by the proposed action (Section 7 and Appendix A of the report).

3.3.4 BIODIVERSITY CONSERVATION ACT 2016

The Biodiversity Conservation Act replaces the Threatened Species Conservation Act 1995, Nature Conservation Trust Act 2001, and parts of the National Parks & Wildlife Act 1974. The BC Act and supporting regulations establish a modern and integrated legislative framework for land management and conservation in NSW. The purpose of the BC Act is to establish a pathway to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity and to establish a scientific method for assessing the likely impacts on biodiversity values of proposed development and land use change, for calculating measures to offset those impacts and for assessing improvements in biodiversity values.

Under the Biodiversity Conservation (Savings and Transitional) Regulation 2017 - Major projects (state significant development/state significant infrastructure) - development applications (or modification applications) the proposal is to be submitted under the previous legislation.

3.3.5 LOCAL LAND SERVICES ACT 2013

The LLS Act repeals the Native Vegetation Act 2003 (NSW). The amendments to the LLS Act have resulted in a change to the criteria for native vegetation clearing. A Native Vegetation Regulatory Map (Regulatory Map) will identify three different land categories for clearing on rural land:

Category 1 – 'Exempt land' which will not be subject to clearing approval;
Category 2 – 'Regulated Land' on which clearing of native vegetation may be carried out with or without approval in accordance with an 'allowable activity' or 'code' under the LLS Act, and
'Excluded Land' – Land not categorised in the Regulatory Maps and to which the LLS Act does not apply.

The Regulatory Map will not apply to land urban land, national parks or state forestry land. As the proposal is assessed as State Significant Development an authorisation under the LLS Act is not required.

3.3.6 WATER MANAGEMENT ACT 2000 (WM ACT)

The objectives of this Act are to provide for the sustainable and integrated management of the water sources of the state for the benefit of both present and future generations. The NSW Office of Water administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying

out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. No area of Waterfront Land occurs within proximity to the study area therefore an assessment under the WM Act is not required.

3.3.7 BIOSECURITY ACT 2015

The primary object of the Biosecurity Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers. The broad objectives for biosecurity in NSW are to manage biosecurity risks from animal and plant pests and diseases, weeds and contaminants by:

- preventing their entry into NSW;
- quickly finding, containing and eradicating any new entries;
- effectively minimising the impacts of those pests, diseases, weeds and contaminants that cannot be eradicated through robust management arrangements.

The Biosecurity Act has been addressed in Section 6.1.4.

3.3.8 FISHERIES MANAGEMENT ACT 1994 (FM ACT)

The FM Act aims 'to conserve, develop and share the fishery resources of the State for the benefit of present and future generations and, in particular to:

- conserve fish stocks and key fish habitats;
- conserve threatened species, populations and ecological communities of fish and marine vegetation;
- promote ecologically sustainable development, including the conservation of biological diversity, and, consistently with those objectives;
- promote viable commercial fishing and aquaculture industries;
- promote quality recreational fishing opportunities;
- appropriately share fisheries resources between the users of those resources;
- provide social and economic benefits for the wider community of New South Wales.

To meet these objectives, Part 7 of the FM Act outlines legislative provisions to protect fish habitat and Part 7A outlines provisions to conserve threatened species of fish and marine vegetation and their habitat. Aquatic habitat within the study area would likely be defined as intermittent wetlands filled from localised runoff and not otherwise hydrologically connected to other permanent habitats such as rivers, creeks, estuaries and ocean. An assessment of the development under the FM Act is contained within Section 10 of the report.

3.3.9 COASTAL MANAGEMENT SEPP

The State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5. of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed.

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, by:

- managing development in the coastal zone and protecting the environmental assets of the coast, and
- establishing a framework for land use planning to guide decision-making in the coastal zone, and
- mapping the 4 coastal management areas that comprise the NSW coastal zone for the purpose of the definitions in the Coastal Management Act 2016.

These coastal management areas are:

- the coastal wetlands and littoral rainforests area,
- the coastal vulnerability area,
- the coastal environment area, and
- the coastal use area.

The study area was not located within littoral rainforests/coastal wetlands, coastal vulnerability or coastal use management areas however the study area is located within a mapped coastal environment area. Further information on this matter is provided in Section 9.0 of this report.

3.3.10 SEPP 44 - KOALA HABITAT PROTECTION

The aims of SEPP 44 are: "to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline:

(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat;

(b) by encouraging the identification of areas of core koala habitat;

(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

State Environmental Planning Policy No.44 – Koala Habitat Protection (SEPP 44) applies to the proposed development. The Port Stephens Comprehensive Koala Plan of Management (CKPoM) operates under the provisions of SEPP 44.

3.3.11 PORT STEPHENS COMPHREHENSIVE KOALA PLAN OF MANAGEMENT CKPOM

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) has been prepared for the Port Stephens LGA in accordance with SEPP 44 - 'Koala Habitat Protection'. The aim of the CKPoM is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline. An assessment under the Port Stephens CKPoM has been undertaken in Section 8.0 of the report.

3.3.12 NSW BIODIVISITY OFFSETS POLICY FOR MAJOR PROJECTS

An offsetting strategy will be undertaken using the Biobanking Assessment Methodology (DECC, 2009). A biobank site will be created with the resultant credit generation/retirement. As the project is a SSD the assessment process will follow the Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects. A provision for compensatory habitat (Offsetting) is contained in Section 15.0.

3.3.13 NSW GROUNDWATER DEPENDENT ECOSYSTEM POLICY

The state Groundwater Dependent Ecosystems Policy supports the requirements of the Water Management Act 2000 and is specifically designed to protect valuable ecosystems which rely on groundwater for survival so that, wherever possible the ecological processes and biodiversity of these dependent systems are maintained or restored, for the benefit of present and future generations. An assessment under the NSW Groundwater Dependent Ecosystem Policy is contained in Section 6.1.2.

3.4 LICENCING

Fieldwork undertaken by Wildthing Environmental Consultants was carried out under NPWS Scientific Investigation Licence S10475 and under Animal Care and Ethics Approval: Animal Research Authority Issue by the Director General of NSW Agriculture (File No. 13 – 251) for the Fauna Survey for Biodiversity and Impact Assessment. The Biobanking Assessment was undertaken by Daryl Harman – BioBanking Assessor Accreditation Number – 159.

4.0 INITIAL ASSESSMENT

The flora and fauna within the study area and adjacent land has been subject to a small number of previous ecological investigations (Table 2). These past studies are considered to be the initial assessment.

Table 2: Previous Ecological studies undertaken within the study area and adjacent lands.

Environmental Consultant	Area Surveyed	Survey/Study Type
Wildthing Environmental Consultants (2005).	Lot 10 DP 1071458 Nelson Bay Road, Bobs Farm NSW (northern portion of study area).	Targeted Flora Survey Targeted Fauna searches including fauna trapping.
ERM (2003). Environmental Impact Statement for the Electricity Supply Upgrade from Tomago to Tomaree. Energy Australia.	Areas of habitat within the vicinity of the electrical easement.	Targeted Flora Survey Targeted Fauna searches including fauna trapping.
Ecotone (2008).	Vertebrate Fauna Survey Worimi Conservation Lands. EEC Project No. 0583CW. Prepared for NSW Department of Environment and Climate Change.	Targeted Fauna searches including fauna trapping.
Bell, S.A.J. & Driscoll (2010).	Vegetation of the Worimi Conservation Lands Port Stephens, New South Wales: Worimi NP, Worimi SCA & Worimi RP. Report to Department of Environment, Climate Change & Water, Hunter Regional Parks & Wildlife Group.	Vegetation and targeted Flora Survey.

4.1 INDENTIFYING SUBJECT SPECIES AND ENDANGERED ECOLOGICAL COMMUNITIES

The following threatened species, endangered populations and communities listed in Table 3 have been recorded on the Atlas of NSW Wildlife (OEH, 2017) and the Department of the Environment and Energy (DoEE) databases for within 10km of the study area.

Table 3: Threatened species, endangered populations and ecological communities considered.

Scientific Name	Common Name	TSC Act 1995	EPBC Act 1999
Flora			
Corybas dowlingii	Red Helmet Orchid	E	
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V
Diuris arenaria	Tomaree Doubletail	E	
Diuris praecox	Newcastle Doubletail	V	V
Genoplesium baueri	Bauer's Midge Orchid	V	
Phaius australis	Lesser Swamp Orchid	E	E
Rhizanthella slateri	Eastern Underground Orchid	E	E
Pterostylis chaetophora	Tall Rustyhood	V	
Grevillea parviflora subsp. *parviflora*	Small-flowered Grevillea	V	V
Allocasuarina defungens	Dwarf Heath Casuarina	E	E
Allocasuarina simulans	Nabiac Casuarina	V	V
Angophora inopina	Charmhaven Apple	V	V
Callistemon linearifolius	Netted Bottle Brush	V	
Eucalyptus camfieldii	Camfield's Stringybark	V	
**Eucalyptus glaucina*	Slaty Red Gum	V	V
Eucalyptus parramattensis subsp. *decadens*	Drooping Red Gum	V	V
Melaleuca biconvexa	Biconvex Paperbark	V	
Melaleuca groveana	Grove's Paperbark	V	
Syzygium paniculatum	Magenta Lillypilly	E	V
Tetratheca juncea	Black-eyed Susan	V	V
Prostanthera densa	Villous Mintbush	V	
Asperula asthenes	Trailing Woodruff	V	

Scientific Name	Common Name	TSC Act 1995	EPBC Act 1999
Galium australe	Tangled Bedstraw	E	
Lindernia alsinoides	Noah's False Chickweed	E	
Chamaesyce psammogeton	Sand Spurge	E	
Senecio spathulatus	Coastal Fireweed	E	
Streblus pendulinus	Siah's Backbone		E
Maundia triglochinoides		V	
Cynanchum elegans	White-flowered Wax Plant	E	E
Persicaria elatior	Tall Knotweed	V	V
Zannichellia palustris		E	
Invertebrates			
Petalura gigantea	Giant Dragonfly	E	
Amphibians			
Crinia tinnula	Wallum Froglet	V	
Uperoleia mahonyi	Mahony's Toadlet	E	
Litoria aurea	Green and Golden Bell Frog	E	V
Litoria brevipalmata	Green-thighed Frog	V	
Mixophyes balbus	Stuttering Frog	V	V
Mixophyes iteratus	Giant Barred Frog	E	E
Reptiles			
Caretta caretta	Loggerhead Turtle	V	M
Chelonia mydas	Green Turtle	V	M
Dermochelys coriacea	Leatherback Turtle	E	E
Eretmochelys imbricata	Hawksbill Turtle		V
Natator depressus	Flatback Turtle		V
Hoplocephalus bitorquatus	Pale-headed Snake	V	
Hoplocephalus stephensii	Stephen's Banded Snake	V	
Birds			
Macronectes giganteus	Southern Giant Petrel	E	E & M
Macronectes halli	Northern Giant Petrel	E	M
Pterodroma leucoptera leucoptera	Gould's Petrel	E	
Pterodroma neglecta	Kermadec Petrel	V	
Fregetta grallaria grallaria	White-bellied Storm Petrel	V	V
Pterodroma nigripennis	Black-winged Petrel	V	
Pterodroma solandri	Providence Petrel	V	
Calonectris leucomelas	Streaked Shearwater		M
Puffinus carneipes	Flesh-footed Shearwater	V	
Puffinus tenuirostris	Short-tailed Shearwater		M
Limicola falcinellus	Broad-billed Sandpiper	V	
Limosa lapponica	Bar-tailed Godwit		M
Limosa limosa	Black-tailed Godwit	V	M
Arenaria interpres	Ruddy Turnstone		M
Xenus cinereus	Terek Sandpiper	V	M
Heteroscelus brevipes	Grey-tailed Tattler		M
Sterna albifrons	Little Tern	E	M
Onychopriom fuscata	Sooty Tern	V	
Actitis hypoleucos	Common Sandpiper		M
Calidris acuminata	Sharp-tailed Sandpiper		M
Calidris canutus	Red Knot		M
Calidris ferruginea	Curlew Sandpiper	E	M
Calidris ruficollis	Red-necked Stint		M
Calidris tenuirostris	Great Knot	V	M
Tringa stagnatilis	Marsh Sandpiper		M
Numenius madagascariensis	Eastern Curlew		M
Numenius minutus	Little Curlew		M
Numenius phaeopus	Whimbrel		M
Charadrius bicinctus	Double-banded Plover		M

Scientific Name	Common Name	TSC Act 1995	EPBC Act 1999
Charadrius leschenaultii	Greater Sand-plover	V	
Charadrius mongolus	Lesser Sand-plover	V	M
Pluvialis fulva	Pacific Golden Plover		M
Pluvialis squatarola	Grey Plover		M
Diomedea antipodensis	Antipodeam Albatross	V	V & M
Diomedea gibsoni	Gibson's Albatross	V	V & M
Thalassarche bulleri	Buller's Albatross		V & M
Thalassarche cauta cauta	Shy Albatross	V	V & M
Thalassarche cauta salvini	Salvin's Albatross		V & M
Thalassarche cauta steadi	White-capped Albatross	V	V & M
Thalassarche melanophris impavida	Campbell Albatross		V & M
Haematopus fuliginosus	Sooty Oystercatcher	V	
Haematopus longirostris	Pied Oystercatcher	E	
Esacus neglectus	Beach Stone-curlew	E4A	
Gallinago hardwickii	Latham's Snipe		M
Rostratula benghalensis australis	Australian Painted Snipe	E	V & M
Botaurus poiciloptilus	Australian Bittern	E	E
Ixobrychus flavicollis	Black Bittern	V	
Ardea alba	Great Egret		M
Ardea ibis	Cattle Egret		M
Ephippiorhynchus asiaticus	Black-necked Stork	E	
Irediparra gallinacea	Comb-crested Jacana	V	
Turnix maculosa	Red-backed Button-quail	V	
Burhinus grallarius	Bush Stone-curlew	E	
Ptilinopus magnificus	Wompoo Fruit-Dove	V	
Ptilinopus regina	Rose-crowned Fruit-Dove	V	
Ptilinopus superbus	Superb Fruit-Dove	V	
Lathamus discolor	Swift Parrot	E	E
Neophema pulchella	Turquoise Parrot	V	
Glossopsitta pusilla	Little Lorikeet	V	
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	
Callocephalon fimbriatum	Gang Gang Cockatoo	V	
Apus pacificus	Fork-tailed Swift		M
Hirundapus caudacutus	White-throated Needletail		M
Monarcha melanopsis	Black-faced Monarch		M
Monarcha trivirgatus	Spectacled Monarch		M
Merops ornatus	Rainbow Bee-eater		M
Rhipidura rufifrons	Rufous Fantail		M
Epthianura albifrons	White-fronted Chat	V	
Petroica boodang	Scarlet Robin	V	
Petroica phoenicea	Flame Robin	V	
Climacteris picumnus victoriae	Brown Treecreeper	V	
Anthochaera phrygia	Regent Honeyeater	E4A	E & M
Daphoenositta chrysoptera	Varied Sittella	V	
Melithreptus gularis gularis	Black-chinned Honeyeater	V	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	
Dasyornis brachypterus	Eastern Bristlebird	E1	E
Circus assimilis	Spotted Harrier	V	
Pandion cristatus	Eastern Osprey	V	
Lophoictinia isura	Square-tailed Kite	V	
Erythrotriorchis radiatus	Red Goshawk	E4A	V
Hieraaetus morphnoides	Little Eagle	V	
Haliaeetus leucogaster	White-bellied Sea Eagle		M
Ninox connivens	Barking Owl	V	
Ninox strenua	Powerful Owl	V	
Tyto longimembris	Eastern Grass Owl	V	

Scientific Name	Common Name	TSC Act 1995	EPBC Act 1999
Tyto novaehollandiae	Masked Owl	V	
Tyto tenebricosa	Sooty Owl	V	
Mammals			
Planigale maculata	Common Planigale	V	
Dasyurus maculatus maculatus	Tiger Quoll	V	V
Phascogale tapoatafa	Brush-tailed Phascogale	V	
Phascolarctos cinereus	Koala	V	
Macropus parma	Parma Wallaby	V	
Petrogale penicillata	Brush-tailed Rock-wallaby	E1	V
Potorous tridactylus tridactylus SE Mainland	Long-nosed Potoroo	V	V
Aepyprymnus rufescens	Rufous Bettong	E1	
Cercartetus nanus	Eastern Pygmy-possum	V	
Petaurus australis	Yellow-bellied Glider	V	
Petaurus norfolcensis	Squirrel Glider	V	
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	
Psuedomys novaehollandiae	New Holland Mouse		V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Syconycteris australis	Common Blossom-bat	V	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	
Mormopterus norfolkensis	Eastern Freetail-bat	V	
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	
Miniopterus australis	Little Bentwing-bat	V	
Miniopterus schreibersii oceanensis	Large Bentwing-bat	V	
Kerivoula papuensis	Golden-tipped Bat	V	
Myotis macropus	Southern Myotis	V	
Scoteanax rueppellii	Greater Broad-nosed Bat	V	
Chalinolobus dwyeri	Large Pied Bat	V	V
Vespadelus troughtoni	Eastern Cave Bat	V	
Endangered Populations			
Dromaius novaehollandiae (Emu) – population in the NSW North Coast Bioregion and Port Stephens LGA.			
Hawks Nest and Tea Gardens Endangered Koala (*Phascolarctos cinereus*) Population			
Endangered Ecological Communities			
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South-East Corner Bioregions.			
Littoral Rainforest in the NSW North Coast, Sydney Basin and South-East Corner Bioregions.			
River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.			
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions.			
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.			
Freshwater wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.			

E=Endangered Species V=Vulnerable Species E4A=Critically Endangered M=Migratory Species

5.0 SURVEY TECHNIQUES

The survey techniques employed in the production of this flora and fauna report are discussed below. Details of the survey effort including dates, times on site and hours of survey effort are presented in tabular form in Appendix E.

5.1 VEGETATION SURVEY METHODOLOGY

Surveys were conducted from February 2013 to November 2017. The initial determination of the basic vegetation community boundaries was undertaken through the review of an orthophoto covering the study area. Random meander searches were conducted in areas of native vegetation to determine the plant species present. Data on geology, dominant canopy species, native diversity, vegetation structure and condition were collected across the study area to determine the classification as Plant Community Types (PCTs) required to be used by BioBanking Assessment Methodology (BBAM). The plot/transect based surveys were conducted in accordance with the BioBanking Assessment Methodology (BBAM) (Office of Environment and Heritage 2014a).

5.1.1 BIOBANKING PLOT/TRANSECT SURVEYS

Eight quantitative (plot/transect) site surveys were completed within the study area as outlined in the methodology contained in the BioBanking Assessment Methodology (Office of Environment and Heritage 2014a) and described below Figure 5 illustrates the plot layout that was used at each site.

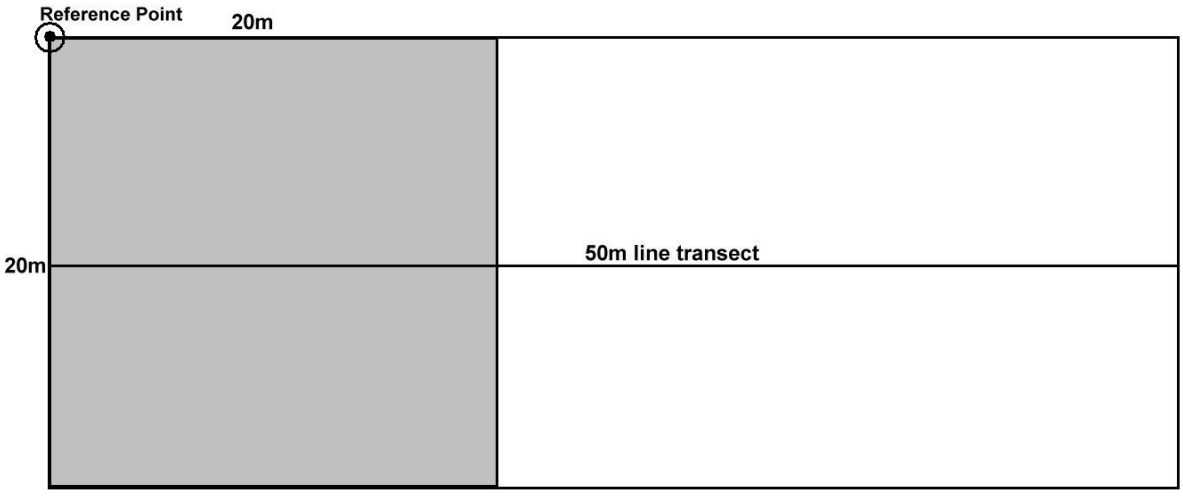


Figure 5: Diagram illustrating the layout of the nested 20 m x 50 m and 20 m x 20 m quadrats used for the assessment of condition attributes at each site

The following site attributes were recorded at each site:

- Location (easting – northing grid type MGA 94, Zone 56).
- Vegetation structure and dominant species and vegetation condition.
- Native and exotic species richness (within a 400 m^2 quadrat): this consisted of recording all species by systematically walking through each 20m x 20m quadrat. The cover abundance of each species was estimated.
- Number of trees with hollows (1,000 m2 quadrat): this was the frequency of hollows within living and dead trees within each 50m x 20m quadrat. A hollow was only recorded if:
  - the entrance could be seen;
  - the estimated entrance width was at least 5 cm across;
  - the hollow appeared to have depth;
  - the centre of the tree was located within the sampled quadrat.
- Total length of fallen logs (1,000 m^2 quadrat): this was the cumulative total of logs within each 50m x 20 m quadrat with a diameter of at least 10 cm and a length of at least 0.5 m.
- Native over-storey cover: this consisted of estimating the percentage cover of the tallest woody stratum present (>1 m and including emergents). The woody stratum included species that were native to NSW and not necessarily those that were locally endemic;
- Native mid-storey cover: this involved estimating the cover of vegetation between the over-storey stratum and a height of one m (i.e. tall shrubs, under-storey trees and tree regeneration).
- Ground cover: this comprised estimating the cover of plants below 1 m in height. The following categories of plants were recorded:
  - native ground cover (grasses): native grasses (Poaceae family native to NSW);
  - native ground cover (shrubs): all woody vegetation below one m in height and native to NSW
  - native ground cover (other): non-woody vegetation (i.e. vascular plants–ferns and herbs) below one m in height and native to NSW
  - exotic plant cover: vascular plants not native to Australia.
  - Evaluation of regeneration: this was estimated as the proportion of over-storey species present at the site that was regenerating (i.e. saplings with a diameter at breast height ≤5 cm). The maximum value for this measure was one.

5.1.2 TARGETED THREATENED FLORA SURVEYS

The objective of the targeted threatened-flora surveys is to establish, with a high level of confidence, the presence or absence of a threatened flora species within the study area. If any threatened flora species are recorded then data including number of individuals and the habitat area is also to be determined. Flora species targeted included those threatened species identified in Table 3 as having potential habitat within the study area as a result of the Assessment of Significant Species within Table 10 of this report. All 'species credit' flora species were also subject to targeted searches (See Section 12.1 for list of flora species which are classed as species credit species requiring targeted surveys with an accompanying survey time matrix).

Targeted surveys were used in accordance with the NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (Department of

Environment and Conservation 2004), NSW Guide to Surveying Threatened Plants State of New South Wales (OEH, 2016a) and the Draft survey guidelines for Australia's threatened orchids (DoEE, 2013). Each target threatened flora species was allocated areas of potential habitat. All vegetation communities considered to be habitat for the target species were searched. Due to the relatively large size of the study area, areas of potential habitat were broken up into smaller sections such as the internal network of vehicle tracks. A parallel field traverse (i.e. parallel transects, as used by Cropper 1993) was undertaken within each of these smaller sections. Surveys were conducted along parallel line transects approximately 10 metres apart. Transects were conducted along a straight path using the tracks on a GPS to guide the surveyors.

Threatened flora species such as trees and shrubs that could be identified by for example from their leaves were not subject to specific survey timings. Species such as terrestrial orchids were surveyed during their flowering period as the presence of flowers makes the species easier to locate and the flowers also enable positive identification. Optimal flowering times were determined by BBAM and FBA (section 6.6.1.4), publications such as A Complete Guide to Native Orchids of Australia including the Island Territories (Jones, 2006) and online Threatened Biodiversity Profile Searches. The most reliable way to demonstrate that the surveys were conducted at an appropriate time included visiting nearby known populations (Done for *Diuris arenaria* and *Diuris praecox* (Newcastle Doubletail) and *Corybas dowlingi* (Red Helmet Orchid) and/or getting first-hand knowledge from experts (Done for *Pterostylis chaetophora* – OEH) to ascertain if they were flowering.

The survey effort and times of the targeted threatened flora species are shown in Table 4. Remaining threatened flora species were also surveyed opportunistically during incidental and targeted and surveys within the study area.

Table 4: Targeted surveys for subject threatened flora species.

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
Targeted Threatened Flora Surveys	*Corybas dowlingii* Red Helmet Orchid	Random meander surveys	4 person hours	28/06/13	June - August
	Cryptostylis hunteriana Leafless Tongue Orchid	Walking parallel transects across the entire study area, spaced at approximately 15m intervals	18 person hours	04/02/13, 06/02/13, 13/11/14	November - February
	Diuris arenaria Tomaree Doubletail	Walking parallel transects across the entire study area, spaced at approximately 15m intervals	46 person hours	13/08/13, 21/08/13, 13/09/13, 25/09/13, 05/09/16	August - September
	Diuris praecox Newcastle Doubletail			13/08/13, 21/08/13, 13/09/13, 05/09/16	July - August
	Genoplesium baueri Bauer's Midge Orchid	Walking parallel transects across the entire study area, spaced at approximately 15m intervals	18 person hours	04/02/13, 06/02/13	February- March
	Phaius australis Lesser Swamp Orchid	Random meander surveys	28 person hours	04/02/13, 06/02/13, 13/11/13	Spring
	Pterostylis chaetophora Tall Rustyhood	Walking parallel transects across the entire study area, spaced at approximately 15m intervals	28 person hours	10/10/17, 11/10/17 & 13/10/17	September - November
	Callistemon linearifolius Netted Bottle Brush	Random meander surveys	20 person hours	04/02/13, 06/02/13, 13/11/13	All year
	Eucalyptus parramattensis subsp. *decadens* Drooping Red Gum				All year
	Melaleuca biconvexa Biconvex Paperbark				All year
	Syzygium paniculatum Magenta Lilly Pilly				All year

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
	Grevillea parviflora subsp. *parviflora* Small-flowered Grevillea				All year
	Lindernia aslinoides Noah's False Chickweed				November to February
	Allocasuarina defungens Dwarf Heath Casuarina				All year
	Allocasuarina simulans Nabiac Casuarina				All year
	Angophora inopina Charmhaven Apple				All year
	Eucalyptus camfieldii Camfield's Stringybark				All year
	Eucalyptus glaucina Slaty Red Gum				All year
	Melaleuca groveana Grove's Paperbark				All year
	Prostanthera densa Villous Mintbush				All year
	Rhizanthella slateri Eastern Underground Orchid	Walking parallel transects across the entire study area, spaced at approximately 15m intervals	46 person hours	13/08/13, 21/08/13, 13/09/13, 25/09/13, 05/09/16	September October November
	Tetratheca juncea Black-eyed Susan	Walking parallel transects across the entire study area, spaced at approximately 15m intervals	46 person hours	13/08/13, 21/08/13, 13/09/13, 25/09/13, 05/09/16	August to November
	Maundia triglochinoides Maundia	Random meander surveys	4.5 person hours	04/02/13, 06/02/13, 13/11/13	November to March
	Cynanchum elegans White-flowered Wax Plant	Random meander surveys	20 person hours	04/02/13, 06/02/13, 13/11/13	All year
	Persicaria elatior Tall Knotweed	Random meander surveys	4.5 person hours	17-04-15	December to June

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
	Zannichellia palustris	Random meander surveys	4.5 person hours	17-04-15	March to November
	Asperula asthenes Trailing Woodruff	Random meander surveys	20 person hours	04/02/13, 06/02/13, 13/11/13	All year

5.2 HABITAT APPRAISAL METHODOLOGY

Habitat may be defined as the physical and biological environment required for the survival of a specific population of a species. In modern usage habitat has also come to be regarded as an association of landform and plant life, which provides sustenance and shelter for a particular fauna assemblage.

The methodology of the habitat appraisal used the vegetation community data combined, where relevant, with geomorphological features and the occurrence of particular plant species or forms (i.e. tree hollows) to provide a basis for a subjective habitat assessment aimed at placing the ecological status of the site within a local perspective.

5.2.1 GENERAL HABITAT FOR NATIVE SPECIES

From the vegetation appraisal and a general inspection of the study area and surrounds, a subjective assessment of the general habitat value of this site was made. Considered in this assessment were:

- occurrence of that habitat type in the general vicinity;
- degree of disturbance and degradation;
- area occupied by that habitat on site;
- continuity with similar habitat adjacent to the site, or connection with similar habitat off site by way of corridors; and
- structural and floral diversity.

5.2.2 INVENTORY OF HOLLOW BEARING TREES

A hollow-bearing tree survey was conducted over the entire study area. The ground-based survey recorded the details of each hollow-bearing tree within the study area including height, diameter at breast height (dbh), hand held GPS coordinates and fauna habitat attributes such as hollows. The presence of activity in the form of scratches, scats on the trunks of trees and scats around the base were also noted. Each of the trees were tagged and numbered with yellow cattle tags. It must be noted that observations made from ground level may fail to record a small number of hollows that are obscured. Some entrances may also not lead to a cavity. The internal dimensions of the hollows are also impossible in many cases to determine from the ground.

5.2.3 HABITAT FOR SIGNIFICANT SPECIES

This study area was evaluated as potential habitat for each of the threatened species reported on the Office of Environment and Heritage (OEH), the federal Department of the Environment (DoEE) and Sydney Botanic Gardens databases from within 10km of the site. This evaluation was based on home-range, feeding, roosting, breeding, movement patterns and corridor requirements for fauna and hydrology, soil types, aspect and structural formation for flora species.

5.3 FAUNA SURVEY METHODOLOGY

The fauna survey was initiated with an assessment of the potential use of the study area by any threatened species identified in the OEH and DoEE database searches. Subsequently, the confirmation of the fauna species list, by way of on-site observation, trapping and recording, was carried out as described below. The survey was carried out using the Department of Environment and Conservation's (NSW) Threatened Biodiversity Survey and Assessment Guidelines – Working Draft (Department of Environment and Conservation, 2004).

5.3.1 SMALL TERRESTRIAL MAMMAL TRAPPING

Small terrestrial mammal trapping was undertaken using 90 Elliott Type A traps (8x10x33cm) within the study area in April 2013 (40 traps) and May 2014 (50 Traps). The traps were left in place for four consecutive nights during April 2013 and May 2014 giving a total of 360 small terrestrial trap nights. The traps were hidden in thick grass, under shrubs or near fallen logs and were camouflaged with vegetation where the ground cover was sparse. The baits used for the traps were a mixture of rolled oats and honey, Good-O's (dry dog food) and peanut butter. The traps were checked early each morning and, where necessary, reset and rebaited. The location of the small terrestrial traps lines is shown in Figure 6.

A small terrestrial mammal trapping program had also been previously undertaken within Lot 10 DP 1071458 in the far north of the study area (Wildthing Environmental Consultants, 2008).

5.3.2 MEDIUM TERRESTRIAL MAMMAL TRAPPING

Medium terrestrial mammal trapping was undertaken using 40 cage traps (60×35×40cm) within the study area in April 2013 (20 traps) and May 2014 (20 Traps). The traps were left in place for four consecutive nights during April 2013 and May 2014 giving a total of 160 medium terrestrial trap nights. The traps were hidden in thick grass, under shrubs or near fallen logs and were camouflaged with vegetation where the ground cover was sparse. The bait used for the traps were raw chicken wings. The traps were checked early each morning and where necessary, reset and rebaited. The traps were checked early each morning and, where necessary, reset and rebaited. The location of the medium terrestrial trap lines is shown in Figure 6.

A medium terrestrial mammal trapping program had also been previously undertaken within Lot 10 DP 1071458 in the far north of the study area (Wildthing Environmental Consultants, 2008).

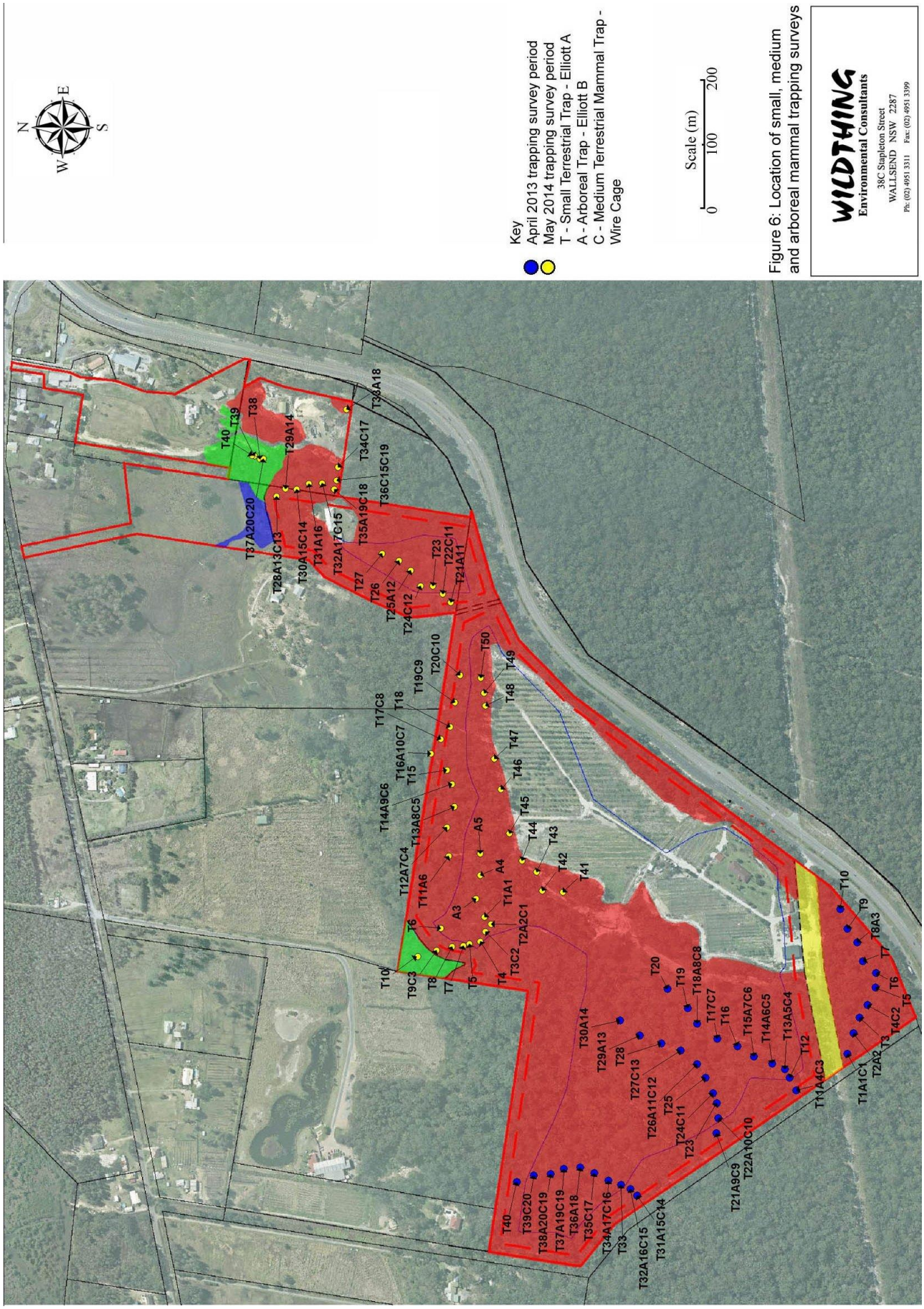


Figure 6: Location of small, medium and arboreal mammal trapping surveys

5.3.3 ARBOREAL MAMMAL TRAPPING

Arboreal mammal trapping was undertaken using 40 Elliott Type B traps (15 × 15 × 46cm) within the study area in April 2013 (20 traps) and May 2014 (20 Traps) to determine the presence of arboreal mammals, particularly *Petaurus norfolcensis* (Squirrel Glider) which is known to occur in similar habitats in the local area (OEH, 2015). The traps were left in place for four consecutive nights during April 2013 and May 2014 giving a total of 160 arboreal trap nights. The traps were placed around 3 - 4 metres above the ground on platforms mounted on tree trunks. The targeted trees contained hollows, were flowering or had scratches present on the boles. The baits used consisted of a rolled oats and honey mixture, peanut butter and an aniseed ring (sugar coated sweet). The traps were sprayed with honey mixed in water before being placed in the trees to attract fauna and mask the smell of humans. The tree trunks were also sprayed with this mixture each day. In all cases the traps were checked early each morning and, where necessary, reset and rebaited. The position of the arboreal traps within the study area can be seen in Figure 6.

An arboreal mammal trapping program had also been previously undertaken within Lot 10 DP 1071458 in the far north of the study area (Wildthing Environmental Consultants, 2008).

5.3.4 MICROCHIROPTERAN BAT HARP TRAPPING

Two monofilament harp traps were set over 5 nights within the study area on 21 May & 13 November 2013, 29 April & 27 November 2014 and 27 January 2015 giving a total of 10 harp trap nights within the study area. The harp trapping was undertaken in order to sample the use of the site by sub-canopy microchiropteran bat species. Traps were positioned in potential flyways and were checked early each morning, with any captures being identified. Harp Trap locations are shown in Figure 7.

Harp trapping program had also been previously undertaken within Lot 10 DP 1071458 in the far north of the study area (Wildthing Environmental Consultants, 2008).

5.3.5 MICROCHIROPTERAN BAT CALL SURVEY

Bat echo-location calls were recorded using an Anabat detector in areas which were considered likely to be used by bats. These positions were selected to sample potential hunting sites for bats, including flyways, clearings and ecotones. Echolocation surveys used a combination of stationary and hand-held mobile surveys. Hand-held surveys were undertaken during spotlighting. Stationary call activated microchiropteran bat detection was undertaken from dawn to dusk for six nights.

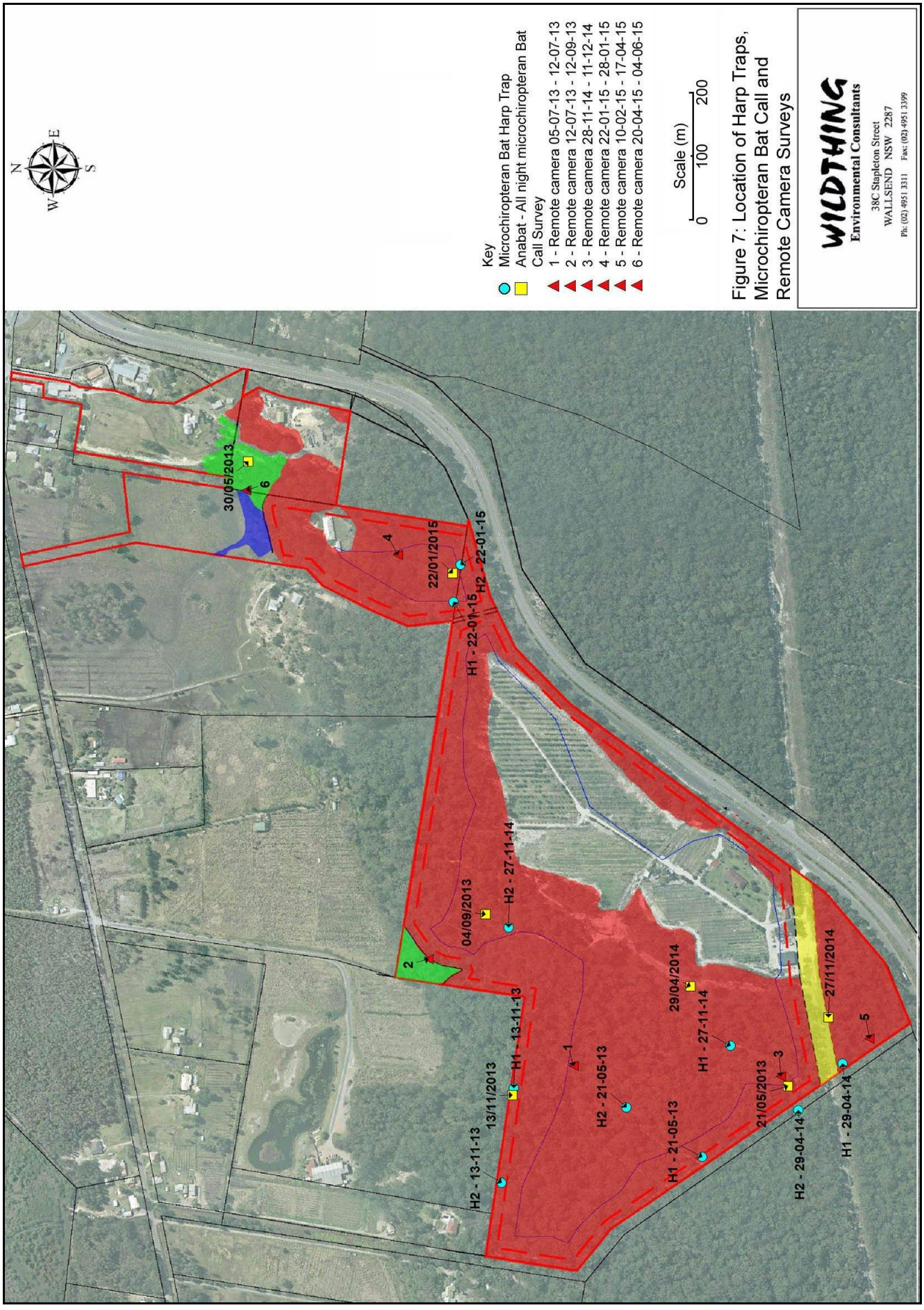


Figure 7: Location of Harp Traps, Microchiropteran Bat Call and Remote Camera Surveys

WILDTHING
Environmental Consultants
38C Stapleton Street
WALLSEND NSW 2287
Ph: (02) 4951 3311 Fax: (02) 4951 3399

The bat calls recorded by Wildthing Environmental Consultants were analysed in-house by Mungo Worth. The locations of the bat call surveys are shown in Figure 7. A microchiropteran bat call survey had also been previously undertaken within Lot 10 DP 1071458 within the far north of the study area (Wildthing Environmental Consultants, 2008).

5.3.6 AMPHIBIAN SURVEY

The amphibian survey included a combination of diurnal and nocturnal census methods. Diurnal searches involved systematic searches within appropriate habitat for basking or sheltering individuals. Any appropriate cover such as logs were turned over for resting individuals.

Nocturnal surveys were undertaken within areas of suitable habitat (lower lying poorly drained area in the north and west of the study area) and involved listening for the characteristic call of male frogs. Playback of frog calls was undertaken in an attempt to elicit a response from threatened amphibian species in particular *Crinia tinnula* (Wallum Froglet) and *Litoria aurea* (Green and Golden Bell Frog).

Calls broadcast included:

- *Litoria aurea* (Green and Golden Bell Frog)
- *Crinia tinnula* (Wallum Froglet)
- *Litoria brevipalmata* (Green-thighed Frog)

In accordance with the Matters for Further Consideration within the updated SEARS additional targeted surveys were conducted for the recently described *Uperoleia mahonyi* (Mahony's Toadlet). The surveys were undertaken by Dr Simon Clulow from Newcastle University who discovered and described the species (Clulow *et al.* 2016). The survey involved an initial visit to the site to ascertain suitable survey locations. Nocturnal surveys were undertaken in November 2017 following rain over two nights for three hours duration and were located within areas of Freshwater Wetland and Swamp Sclerophyll Forest in the north-east of the site which were considered to be the most likely habitat. The survey involved a visit to a reference site at Oyster Cove (type locality for *U. mahonyi*) on both nights to ascertain if *U. mahonyi* was calling at the time.

The location of the frog census conducted is shown in Figures 8 & 9.

5.3.7 REPTILE SURVEY

Searches for reptiles involved a combination of diurnal and nocturnal searches. Diurnal searches for reptiles involved searching in likely habitat (i.e. leaf litter, dead logs and long grass) during the morning and afternoon survey period. Nocturnal searches were conducted for reptile species active at night such as geckos and some species of snakes and involved searching in likely habitats with the aid of a spotlight. The location of the reptile surveys is shown in Figure 8.

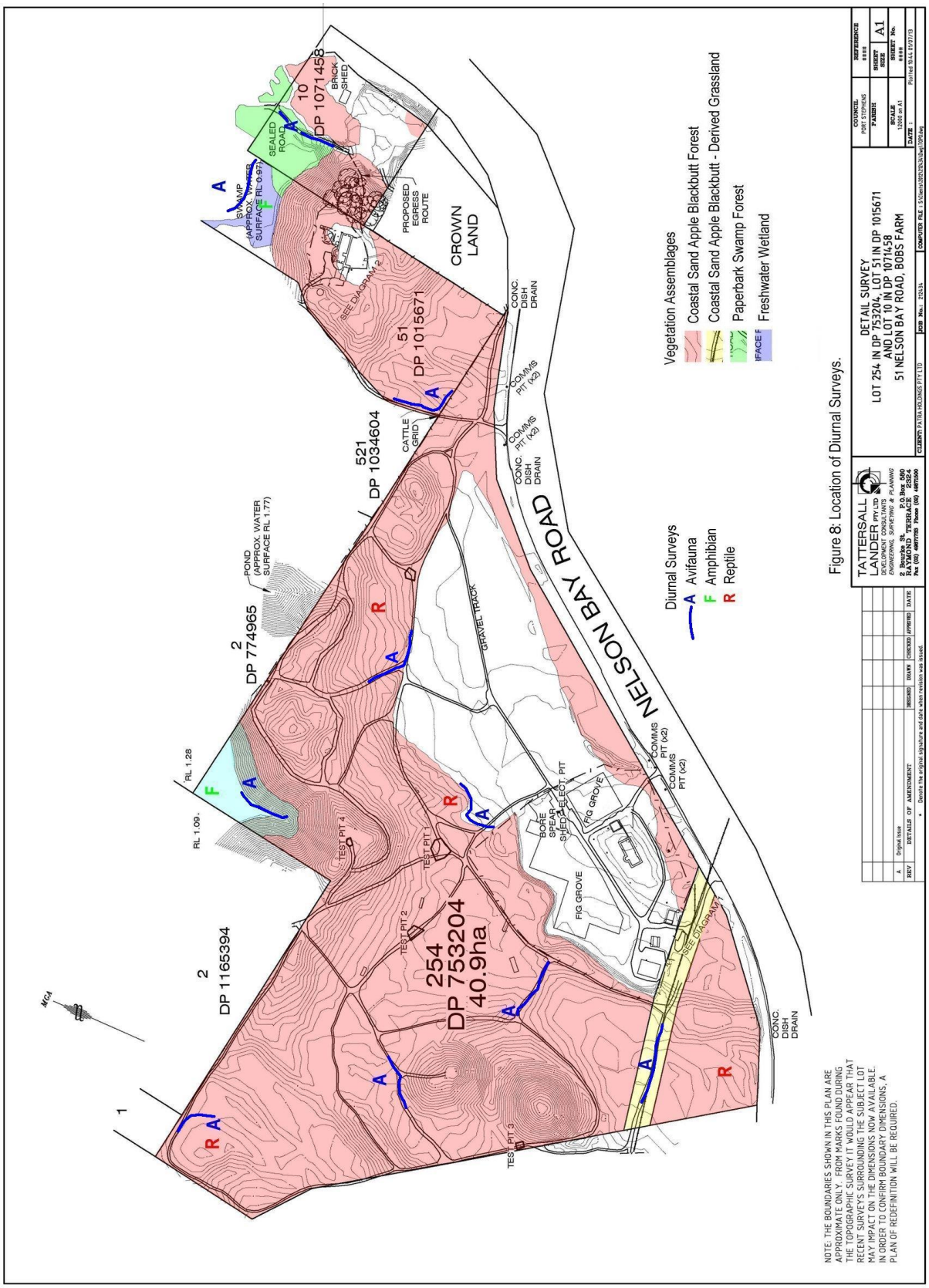
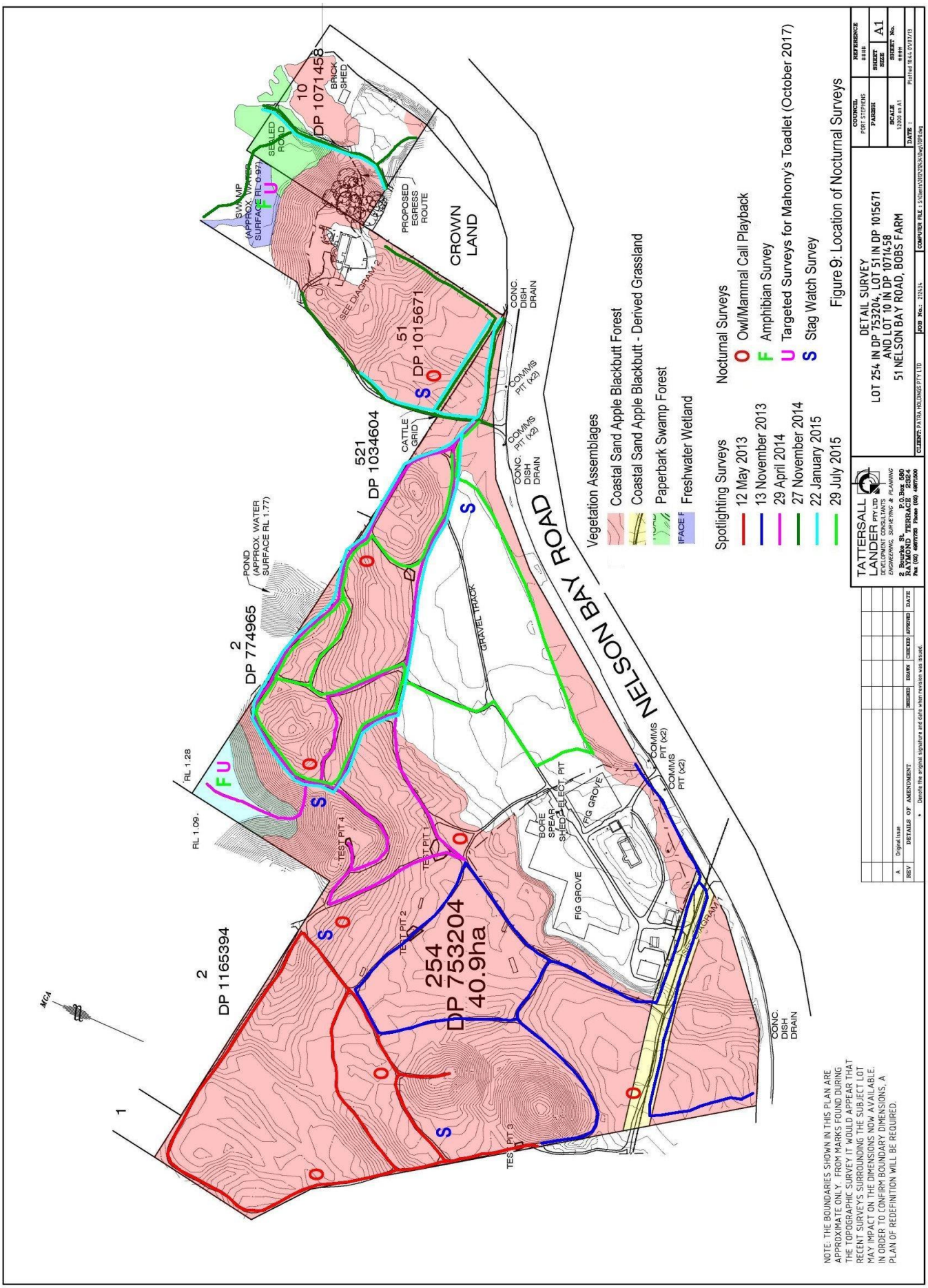


Figure 8: Location of Diurnal Surveys.


NELSON BAY ROAD
CROWN LAND
254 DP 753204 40.9ha
2 DP 1166394
2 DP 774965
521 DP 1034604
51 DP 1015671
10 DP 1071458
POND (APPROX. WATER SURFACE RL 1.77)
SWAMP (APPROX. WATER SURFACE RL 0.97)
SEALED ROAD
BRICK SHED
PROPOSED EGRESS ROUTE
SEE DIAGRAM 2
CATTLE GRID
CONC. DISH DRAIN
COMMS PIT (x2)
GRAVEL TRACK
FIG GROVE
BORE
SPEAR SHED
TEST PIT 1
TEST PIT 2
TEST PIT 3
TEST PIT 4
RL 1.28
RL 1.09.
Vegetation Assemblages
Coastal Sand Apple Blackbutt Forest
Coastal Sand Apple Blackbutt - Derived Grassland
Paperbark Swamp Forest
Freshwater Wetland
Spotlighting Surveys
12 May 2013
13 November 2013
29 April 2014
27 November 2014
22 January 2015
29 July 2015
Nocturnal Surveys
O Owl/Mammal Call Playback
F Amphibian Survey
U Targeted Surveys for Mahony's Toadlet (October 2017)
S Stag Watch Survey
Figure 9: Location of Nocturnal Surveys
TATTERSALL LANDER PTY LTD
DETAIL SURVEY
LOT 254 IN DP 753204, LOT 51 IN DP 1015671
AND LOT 10 IN DP 1071458
51 NELSON BAY ROAD, BOBS FARM
CLIENT: PATRA HOLDINGS PTY LTD
NOTE: THE BOUNDARIES SHOWN IN THIS PLAN ARE APPROXIMATE ONLY. FROM MARKS FOUND DURING THE TOPOGRAPHIC SURVEY IT WOULD APPEAR THAT RECENT SURVEYS SURROUNDING THE SUBJECT LOT MAY IMPACT ON THE DIMENSIONS NOW AVAILABLE. IN ORDER TO CONFIRM BOUNDARY DIMENSIONS, A PLAN OF REDEFINITION WILL BE REQUIRED.

5.3.8 DIURNAL AVIFAUNA SURVEY

The diurnal avifauna survey involved walking along a pre-determined 100m transect for 30 minutes. Every 20m a point survey was undertaken which involved observation and listening for calls. Birds targeted included species such as *Daphoenositta chrysoptera* (Varied Sittella). Surveys were conducted at peak activity periods (i.e. dawn and dusk). A total of 5.0 hours of targeted diurnal bird surveys were undertaken. A number of incidental observations of avifauna were also made as a result of a relatively long time spent within the study area conducting other surveys. Observations were also made of secondary indications (i.e. distinctive feathers and nests) of avifauna were also recorded. The location of the diurnal avifauna surveys are shown in Figure 8.

5.3.9 NOCTURNAL AVIFAUNA AND MAMMAL CALL PLAYBACK SURVEY

During the nocturnal avifauna and mammal survey pre-recorded calls of *Ninox connivens* (Barking Owl), *Ninox strenua* (Powerful Owl), *Tyto novaehollandiae* (Masked Owl), *Tyto tenebricosa* (Sooty Owl), *Tyto capensis* (Grass Owl), *Petaurus australis* (Yellow-bellied Glider), *Petaurus norfolcensis* (Squirrel Glider) and *Phascolarctos cinereus* (Koala) were broadcast through an amplification system designed to project the sound for at least 1km under still night conditions. An initial listening period of 10 minutes was undertaken, followed by 5 minutes of calls (repeated in four different directions). A period of two minutes of quiet listening was then employed after each 5-minute bracket of calls. At the conclusion of the call playback survey, spotlighting was carried out in the vicinity of the call playback site. The locations of the call playback are shown in Figure 9.

5.3.10 SPOTLIGHTING SURVEY

Spotlighting was undertaken on foot using 100watt hand-held spotlights. The spotlighting undertaken was completed by at least two persons and involved walking at a slow pace around the study area and stopping every 2 minutes, allowing the observer to hear movements of animals. A total of 18-person hours of spotlighting was conducted during the survey. The spotlight routes are shown in Figure 9.

5.3.11 STAG WATCHING SURVEY

The stag watching survey involved watching significant hollow-bearing trees, 20 minutes prior to sunset and continuing until 20 minutes after sunset. The person was in a position to allow a good view of the tree to be obtained, preferably with the tree silhouetted against the sky. The required listening period and stag watching were undertaken concurrently. Hollow trees targeted were those suitable for *Petaurus norfolcensis* (Squirrel Glider) and owl species such as *Tyto novaehollandiae* (Masked Owl) and *Ninox strenua* (Powerful Owl). The location of the watched stag trees is shown in Figure 9.

5.3.12 REMOTE CAMERA SURVEY

A remote camera was set up in six different locations within the study area from 2013 - 2015 to survey for threatened fauna species, particularly the threatened *Dasyurus maculatus* (Tiger Quoll). The remote camera was set up along tracks and areas of high animal usage. Bait such as chicken necks was placed in front of the camera to lure animals into range. The locations of the remote camera surveys within the study area are shown in Figure 6.

5.3.13 SUMMARY OF FAUNA SURVEY EFFORT

The survey effort and times of the targeted threatened fauna species are shown in Table 5.

Table 5: Targeted surveys for subject threatened fauna species.

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
Targeted Threatened Fauna Surveys	*Petalura gigantea* Giant Dragonfly	Random meander surveys around swampy areas Observation for flying/perching adults Searching for diagnostic nymphal skins from emerged adults.	Targeted and incidental surveys.	13/11/13,	October – February
	Crinia tinnula Wallum Froglet	Targeted nocturnal Spotlighting searches wetland areas and vegetation, frog call detection and frog call playback.	Four nights for two hours.	13/11/13, 03-06-14, 17-04-15, 28-04-15,	Autumn
	Litoria aurea Green and Golden Bell Frog				Spring, Summer
	Litoria brevipalmata Green-thighed Frog				Spring, Summer
	Uperoleia mahonyi Mahony's Toadlet	Targeted nocturnal Spotlighting searches wetland areas and vegetation, frog call detection and frog call playback.	Two nights one for three and one four hours duration following rain.	07-11-17 & 09-11-17	October - November
	Xenus cinereus Terek Sandpiper	Point Surveys over wetland.	Two nights for half hour duration.	03-06-14, 17-04-15,	All year
	Limicola falcinellus Broad-billed Sandpiper				
	Ephippiorhynchus asiaticus Black-necked Stork				
	Ixobrychus flavicollis Black Bittern				
	Rostratula benghalensis australis *Australian Painted Snipe*				

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
	Anthochaera phrygia Regent Honeyeater	Winter surveys targeting flowering trees particularly specimens of Swamp Mahogany.		27/05/14, 29/07/15	Winter
	Lathamus discolor Swift Parrot				
	Turnix maculosa Red-backed Button-quail	Point surveys Incidental Observations	5 - person hours	18/04/13, 21/05/13, 22/05/13, 04/09/13, 29/04/14, 27/05/14, 27/11/14, 28/11/14, 28/04/15, 29/07/15	All year
	Neophema pulchella Turquoise Parrot				
	Glossopsitta pusilla Little Lorikeet				
	Calyptorhynchus lathami Glossy Black-Cockatoo				
	Callocephalon fimbriatum Gang-gang Cockatoo				
	Epthianura albifrons White-fronted Chat				
	Petroica boodang Scarlet Robin				
	Petroica phoenicea Flame Robin				
	Climacteris picumnus victoriae Brown Treecreeper				
	Daphoenositta chrysoptera Varied Sittella				
	Melithreptus gularis gularis Black-chinned Honeyeater				
	Pomatostomus temporalis temporalis Grey-crowned Babbler				
	Circus assimilis Spotted Harrier				
	Pandion cristatus Eastern Osprey				

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
	Hieraaetus morphnoides Little Eagle				
	Ninox connivens Barking Owl	Call playback, Listening, Spotlight surveys	12 - person hours	21/05/13, 13/11/13, 29/04/14, 12/06/14, 22/01/15, 29/07/15.	All year
	Ninox strenua Powerful Owl				
	Tyto longimembris Eastern Grass Owl				
	Tyto novaehollandiae Masked Owl				
	Tyto tenebricosa Sooty Owl				
	Planigale maculata Common Planigale	Spotlight surveys Mammal Trapping Motion sensitive camera.	Trapping 4 nights over two-week periods (2013 & 2014). Spotlighting At least 20 hours of spotlighting.	Trapping 4 nights over two periods (2013 & 2014). Spotlighting. 21/05/13, 13/11/13, 29/04/14, 12/06/14, 22/01/15, 29/07/15 Motion sensitive camera. 05-07-13 – 12-07-13 12-07-13 – 12-09-13 28-11-14 – 11-12-14 22-01-15 – 28-01-15 10-02-15 – 17-04-15 30-04-15 – 04-06-15	All year
	Dasyurus maculatus maculatus Tiger Quoll				
	Phascogale tapoatafa Brush-tailed Phascogale				
	Aepyprymnus rufescens Rufous Bettong				
	Potorous tridactylus tridactylus Long-nosed Potoroo				
	Cercartetus nanus Eastern Pygmy-possum				
	Petaurus australis Yellow-Bellied Glider				
	Petaurus norfolcensis Squirrel Glider				
	Pseudomys gracilicaudatus Eastern Chestnut Mouse				

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
	Phascolarctos cinereus Koala	Spotlighting. Mapping Preferred Feed Trees under CKPoM (Thorough search of these trees for secondary indications of Koalas such as scats & scratches on tree trunks). Habitat tree surveys (All habitat trees were inspected for presence of Koalas & secondary indications).	Spotlighting At least 20 hours of spotlighting. Habitat tree survey conducted over nine days.	Spotlighting. 21/05/13, 13/11/13, 29/04/14, 12/06/14, 22/01/15, 29/07/15 Searches 20/10/15, 03/06/14, 17/04/15, 20/10/16.	All year
	Syconycteris australis Common Blossom-bat *Kerivoula papuensis* Golden-tipped Bat *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat *Mormopterus norfolkensis* East Coast Freetail-bat *Falsistrellus tasmaniensis* Eastern False Pipistrelle *Miniopterus australis* Little Bentwing-bat *Miniopterus schreibersii oceanensis* Large Bentwing-bat *Myotis macropus* Eastern Myotis *Scoteanax rueppellii* Greater Broad-nosed Bat *Chalinolobus dwyeri* Large-eared Pied Bat	Harp Trapping Bat Call Survey	Harp Trapping 10 Harp Trapping Nights Bat Call Survey 7 Nights	Harp Trapping 21/05/13, 13/11/13, 29/04/14, 27/11/14, 22/01/15. Bat Call Survey 21/05/13, 30/05/13, 03/09/13, 13/11/13, 29/04/14, 7/11/14, 22/01/15.	

SURVEY TECHNIQUE	TARGET SPECIES	SURVEY TYPE	SURVEY EFFORT	DATE CARRIED OUT	IDEAL SURVEY DETECTION PERIOD
	Vespadelus troughtoni Eastern Cave Bat				
	Pteropus poliocephalus Grey-headed Flying-Fox	Spotlighting, Listening	Spotlighting At least 20 hours of spotlighting.	Spotlighting. 21/05/13, 13/11/13, 29/04/14, 12/06/14, 22/01/15, 29/07/15	All year, Tree flowering periods.
	Emu population in the NSW North Coast Bioregion and Port Stephens LGA.	Incidental observations.			All year

6.0 RESULTS

6.1 VEGETATION SURVEY

A large portion of the study area occurring on Aeolian Holocene transgressive dunes was undeveloped and consisted of uncleared tall dry open sclerophyll forest dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). An area of aeolian sand within Lot 254 contained an Olive and Fig Orchard plus a residence, gardens and associated buildings. Other cleared areas occurring on aeolian sands included a residence on Lot 51 and an Earthmoving Business within Lot 10. The lower flat ground in the north of Lot 51 has had a long history of disturbance and largely consisted of grassland/pasture. One smaller area of Swamp Forest and an area of Freshwater Wetland was present in this NE region of the study area. An additional area of swamp forest was also present on lower ground in the far north-west of Lot 254.

Vegetation types were classified based on the 'best fit' vegetation type listed in the Plant Communities Types (PCT's) Database (OEH 2009). Parameters used to choose the 'best fit' Vegetation Type included over-storey and understorey floristics, soil landscape, location and topographic position. A total of three vegetation types were delineated within the study area:

- **Vegetation Type 1 -** HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate/Good High Condition)(35.41ha);
- **Vegetation Type 2 –** HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast(Moderate/Good)(1.15ha);
- **Vegetation Type 3** – HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good Poor)(0.32ha).

Two additional vegetated areas were highly altered and could not be assigned a community Vegetation Type:

- Orchard, Cleared/Modified (9.6ha);
- Grassland/Pasture (4.0ha).

A description of the three PCT's is shown below. A vegetation map of the study area showing the location of the quadrat/transect surveys is shown in Figure 9. A full list of the flora species recorded during the fieldwork is listed in Appendix B. The results of the plot/transect based surveys can be seen in Appendix C.

*Note on Vegetation Community Distribution Map. A map of vegetation of any area seeks to describe the distribution of the plant species in that area by defining a number of vegetation units (assemblages or communities), which are relatively internally homogenous. Whilst such mapping is a convenient tool, it greatly oversimplifies the real situation. Plants rarely occur in defined communities with distinct boundaries. Accordingly vegetation units used for the accompanying map should be viewed as indicative of their extent rather than being precise edges of communities.

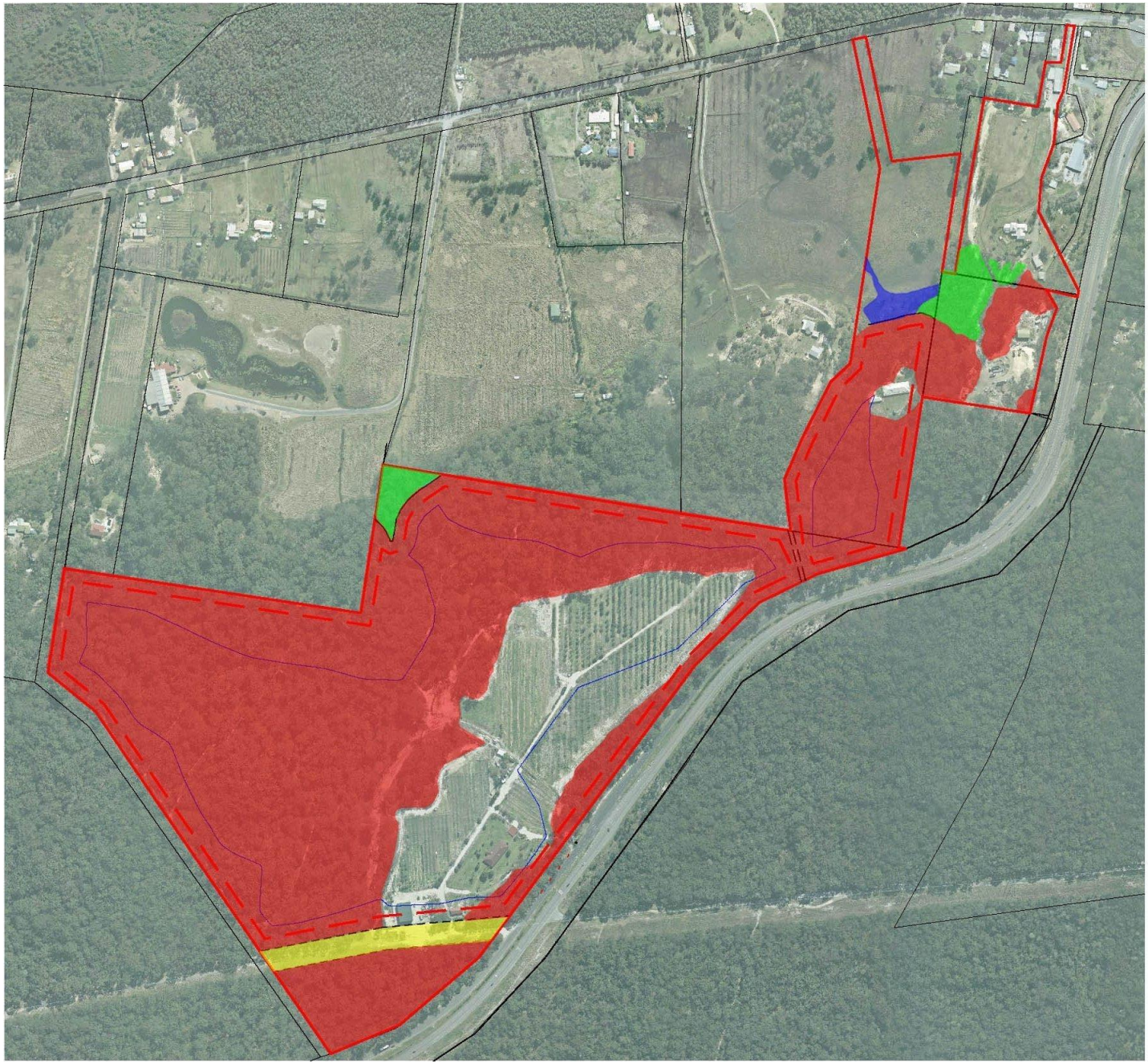


Figure 10: Vegetation Map of study area.

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Vegetation Type 1 – PCT 1646 HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast occupied 35.41ha of the study area and was located on the well-drained Holocene sand dunes (Plates 1 – 5). This community was dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). The majority of this community was present within Lot 254, although adjoining areas of this community were also present within Lots 10 and 51. Coastal Sand Apple Blackbutt Open Forest within the study area was found to be generally intact. The main disturbances to this community were from the construction of internal access roads and weed incursion primarily from *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Lantana camara* (Lantana). Ongoing Cattle grazing has also had a minor impact on the understorey of Coastal Sand Apple Blackbutt Open Forest within Lot 51.

More sheltered (associated with steep-sided dunes) occurrences of Smooth-barked Apple - Blackbutt - Old Man Banksia woodland occupied small areas of the study area. These areas contained species adapted to more moist areas such as *Livistona australis* (Cabbage Tree Palm), *Glochidion ferdinandi* (Cheese Tree), *Synoum glandulosum* (Scentless Rosewood) and *Myrsine howittiana* (Brush Muttonwood). The canopy species *Eucalyptus grandis* (Flooded Gum) was also noted in one of these areas in the far north-west (Plate 6).

Coastal Sand Apple Blackbutt Open Forest within the study area formed part of a much larger area of this assemblage located on Holocene sand dunes along Stockton Bight from Fern Bay to Anna Bay. 1924.1ha of Coastal Sand Apple Blackbutt Open Forest has been mapped within the nearby Worimi Conservation Lands (Bell & Driscoll, 2010).

Similar Vegetation Types

NPWS, (2000)	Map Unit 33 – Coastal Sand Apple – Blackbutt Forest
Bell & Driscoll (2010)	Map Unit 3 - Frontal Dune Blackbutt-Apple Forest.

Structure

Stratum	**Height Range**	**Canopy Cover**
Canopy	20 - 35m	20-35%
Small Tree	10 - 20m	5-40%
Shrub	1.5 – 4m	10-30%
Ground	<1m	5 – 60%



Plate 1: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland within Lot 254.



Plate 2: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland within Lot 254.



Plate 3: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland within Lot 254.



Plate 4: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on higher sand hill - Lot 254.



Plate 5: Smooth-barked Apple - Blackbutt - Old Man Banksia woodland within Lot 51.



Plate 6: Area of more sheltered Smooth-barked Apple-Blackbutt-Old Man Banksia woodland Lot 254.



Plate 6: Coastal Sand Apple Blackbutt (Derived Grassland) within electrical easement.

Species Composition
Canopy - *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Smooth-barked Apple).

Mid -storey
Banksia serrata (Old Man Banksia), *Endiandra sieberi* (Corkwood), *Monotoca elliptica* (Tree Broom-heath).

Shrub Layer
Leucopogon margarodes, *Leucopogon lanceolatus* (Lance Beard-heath), *Acacia longifolia* (Sydney Golden Wattle), *Acacia suaveolens* (Sweet Scented Wattle), *Breynia oblongifolia* (Breynia), *Dodonaea triquetra* (Common Hop Bush), *Monotoca elliptica* (Tree Broom-heath), *Pimelea linifolia* (Rice Flower), *Ricinocarpus pinifolius* (Wedding Bush), *Leucopogon margarodes*.

Ground Layer
Pteridium esculentum (Bracken Fern), *Themeda triandra* (Kangaroo Grass), *Imperata cylindrica* var. *major* (Blady Grass), *Lomandra longifolia* (Spiny Mat Rush), *Dianella caerulea* var. *producta* (Blue Flax Lily), *Gonocarpus teucrioides* (Germander Raspwort).

Climbers
Parsonsia straminea (Common Silkpod), *Kennedia rubicunda* (Kennedia) *Pandorea pandorana* (Wonga Wonga Vine).

A Derived Grassland form of Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast was mapped within the electricity easement in the south of the study area (Plate 6). This easement area had been previously cleared of trees and shrubs

and is maintained as a lower ground cover by Ausgrid. The most common native groundcovers within this community were *Themeda australis* (Kangaroo Grass) and *Pteridium esculentum* (Bracken Fern). Other species noted within this vegetation type included *Pimelea linifolia* (Rice Flower). A number of orchid species were found to be present within this area including the threatened *Diuris arenaria* (Tomaree Doubletail). Introduced species, particularly perennial grasses such as *Andropogon virginicus* (Whisky Grass), *Melinis repens* (Red Natal Grass) and *Eragrostis curvula* (African Love Grass) were also becoming prevalent within parts of the easement.

Species Composition

Native Ground Layer

Pteridium esculentum (Bracken Fern), *Themeda triandra* (Kangaroo Grass), *Imperata cylindrica* var. *major* (Blady Grass), *Lomandra longifolia* (Spiny Mat Rush), *Dianella caerulea* var. *producta* (Blue Flax Lily), *Gonocarpus teucrioides* (Germander Raspwort).

Vegetation Type 2 – HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast

Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast occupied 1.15ha of the lower lying poorly drained land within the study area. Based on canopy species two variations of Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast were found to be present. They were:

- 0.8ha of Swamp Forest dominated by a canopy of *Melaleuca quinquenervia* (Broad-leaved Paperbark) in the north of the study area. Other canopy species were *Eucalyptus robusta* (Swamp Mahogany) and *Casuarina glauca* (Swamp Oak). The ground layer was generally dominated by fern and sedge species (Plates 7 & 8).
- 0.35ha of Swamp Forest dominated by a canopy of *Melaleuca quinquenervia* (Broad-leaved Paperbark) with a number of specimens of *Eucalyptus grandis* (Flooded Gum) in the north-west of the study area (Plates 9 & 10). This community also had some similarities to the Wet Sclerophyll Forests Vegetation Type PCT 1569 Flooded Gum - Brush Box - Tallowwood mesic tall open forest on ranges of the lower North Coast. Due to the dominance of *M. quinquenervia* this community was more aligned with a forested wetland structure.



Plate 7: Swamp Forest within north-east of study area (Lot 10).



Plate 8: Swamp Forest within north-east of study area (Lot 10).



Plate 9: Swamp Forest with Broad-leaved Paperbark & Flooded Gum (Lot 254).



Plate 10: Swamp Forest with Broad-leaved Paperbark & Flooded Gum (Lot 254).

Similar Vegetation Types

NPWS, (2000)	Map Unit 37 - Swamp Mahogany – Paperbark Forest
Bell & Driscoll (2006)	Map Unit 17. - Paperbark Swamp Forest
Bell & Driscoll (2010)	Map Unit 6 – Paperbark-Mahogany Wet Swamp Forest

Structure

Stratum	**Height Range**	**Canopy Cover**
Canopy	15 - 25m	15-45%
Small Tree	10 - 15m	40-85%
Shrub	1.5 – 4m	5-20%
Ground	<1m	5 – 40%

Species Composition

Canopy

Melaleuca quinquenervia (Broad-leaved Paperbark), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus grandis* (Flooded Gum), *Livistona australis* (Cabbage Tree Palm), *Casuarina glauca* (Swamp Oak).

Mid-storey Layer

Livistona australis (Cabbage Tree Palm), *Glochidion ferdinandi* (Cheese Tree),

Shrub Layer

Breynia oblongifolia (Breynia), *Omalanthus populifolius* (Bleeding Heart).

Ground Layer

Gahnia clarkei (Sword Grass), *Histiopteris incisa* (Batswing Fern), *Cyclosorus interruptus*, *Enydra fluctuans.*

Climbers

Parsonsia straminea (Common Silkpod).

Vegetation Type 3 – HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South-East Corner Bioregion

Approximately 0.32ha of Coastal freshwater lagoons of the Sydney Basin Bioregion and South-East Corner Bioregion occupied a lower lying poorly drained area in the north of the study area (Lot 51) (Plates 13 & 14). This wetland assemblage may have been derived from the past removal of Paperbark Swamp Forest which occurs adjacent to this area. The area of wetland has been subject to disturbance from ongoing grazing and trampling by cattle. The edges of the wetland were found to have been subject to the greater disturbance. Common flora species noted included *Schoenoplectus validus* and *Eleocharis equiseta*. Common introduced flora species were *Paspalum urvillei* (Vasey Grass) and *Hydrocotyle bonariensis* (Kurnell Curse).

Similar Vegetation Types

NPWS, (2000) Map Unit 46 – Freshwater Wetland Complex
HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion



Plate 11: Freshwater Wetland within the north of the study area (Lot 51).



Plate 12: Freshwater Wetland within the north of the study area (Lot 51).

Structure

Stratum	**Height Range**	**Canopy Cover**
Canopy	<10m	<5%
Ground	<1m	60 - 100%

Species Composition

Canopy

Melaleuca quinquenervia (Broad-leaved Paperbark).

Ground Layer

Schoenoplectus validus, *Ludwigia peploides* subsp. *montevidensis* (Water Primrose), *Eleocharis equiseta*, *Paspalum distichum* (Water Couch), *Philydrum lanuginosum* (Woolly Frogmouth), *Persicaria decipens* (Slender Knotweed), *Persicaria strigosa* (Spotted Knotweed), *Ranunculus inundatus* (River Buttercup), *Cyperus polystachyos*, **Paspalum urvillei* (Vasey Grass), ***Hydrocotyle bonariensis* (Kurnell Curse).

Orchard, Cleared Modified Vegetation

Approximately 9.6ha of the study area consisted of Orchards and Cleared/Modified Vegetation (Plates 15 & 16). The largest area was located in the south-eastern area of Lot 254 where the area contains fruit trees. Fruit trees largely consisted of *Olea europaea* subsp. *europaea* (Common Olive) and *Ficus carica* (Fig). The ground cover within the orchards were largely dominated by introduced grasses particularly *Anthoxanthum odoratum* (Sweet Vernal Grass), *Melinis repens* (Red Natal Grass) and *Eragrostis curvula* (African Love Grass). Other common introduced species included *Bidens pilosa* (Cobblers Pegs) and *Solanum nigrum* (Blackberry Nightshade).

Grassland/Pasture

Approximately 4ha of Grassland/Pasture was present on lower lying ground within Lots 10, 11 and 51 in the north of the study area (Plates 17 & 18). Within Lots 10 & 11 this assemblage was maintained by regular mowing. Ongoing cattle grazing within Lot 51 has also kept this assemblage close to the ground. The dominant flora species within the Grassland/Pasture assemblage were exotic grasses such as *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Paspalum dilatatum* (Paspalum) and *Pennisetum clandestinum* (Kikuyu). Other common introduced flora species included *Senecio madagascariensis* (Fireweed), *Hypochaeris radicata* (Flatweed) and *Trifolium repens* (White Clover). The few native species within this assemblage included *Cynodon dactylon* (Couch Grass) and *Commelina cyanea* (Scurvy Weed). A number of scattered remnant and planted trees were present within this assemblage. Trees within Lot 10 & 11 tended to be largely planted and introduced and included *Pinus elliotii* (Slash Pine), *Phoenix canariensis* (Canary Island Date Palm) and *Cinnamomum camphora* (Camphor Laurel). Within Lot 51 *Melaleuca quinquenervia* (Broad-leaved Paperbark) was present as a remnant trees.



Plate 13: Orchard/Cleared Modified Vegetation within the study area (Lot 254).



Plate 14: Orchard/Cleared Modified Vegetation within the study area (Lot 254).



Plate 15: Grassland/Pasture within Lot 11.



Plate 16: Grassland/Pasture within Lot 51.

6.1.1 ENDANGERED ECOLOGICAL COMMUNITIES

Seven Endangered Ecological Communities are known to occur within the local area:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Subtropical Coastal Floodplain Forest of the NSW North Coast, Sydney Basin and South-East Corner bioregions (SCFF);
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South-East Corner Bioregions;
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions.

Two areas of Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast were found to be consistent with the Endangered Ecological Community Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions (NPWS, 2001). The 0.35ha area identified as Swamp Sclerophyll Forest in the north-west of the study area containing specimens of the canopy species *Eucalyptus grandis* (Flooded Gum) was found to have some similarities to the EEC River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions. As a result of the drainage, position in the landscape, understorey species and dominance of the canopy species *Melaleuca quinquenervia* (Broad-leaved Paperbark) it was considered to be closer to Swamp Sclerophyll Forest.

The area mapped as Freshwater Wetland was also considered to be a representation of Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions.

The impact of the proposal on these Endangered Ecological Communities has been detailed in Section 7 and Appendix E of this report.

6.1.2 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater Dependent Ecosystems (GDE's) are ecosystems that are fully or partially dependent on groundwater to maintain ecosystem function. These ecosystems occur across both surface and subsurface landscapes and are highly variable.

Groundwater Dependent Ecosystems present in the Study Area

The groundwater dependency of the native vegetation of the Tomago and Tomaree Sandbeds has been previously determined and mapped (Driscoll & Bell, 2006). Although the study area lies outside the assessed areas contained within the Driscoll & Bell (2006) report the vegetation assemblages and landform were largely consistent with those considered in the report.

A number of GDE's were found to be present within the study area and ranged from those which contain species that rely exclusively on groundwater to survive to those which have no reliance on groundwater reserves. A list of GDE's present in the study area and there groundwater dependency is shown in Table 6.

Identified vegetation communities within the study area that are exclusively reliant on groundwater; Swamp Sclerophyll Forest and Freshwater Wetland are located outside the proposed mining footprint (Figure 9 vegetation map). Coastal Sand Apple Blackbutt Forest contains species which obtain groundwater in the capillary fringe. Approximately 25.90ha of Coastal Sand Apple Blackbutt Forest will be required to be removed for the sand mine. Areas of Coastal Sand Apple Blackbutt Forest will remain around the edge of the mining footprint and to the west below the easement.

Table 6: Groundwater Dependent Ecosystems present in the study area.

Ecosystem	Ecosystem Type	Groundwater System	Groundwater Dependency
Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest	Terrestrial Vegetation	Coastal Sandbed	Obligate
Freshwater Wetland	Terrestrial Vegetation	Coastal Sandbed	Obligate
Coastal Sand Apple Blackbutt Forest	Terrestrial Vegetation	Coastal Sandbed	Facultative
Derived Grassland - Coastal Sand Apple Blackbutt Forest	Terrestrial Vegetation	Coastal Sandbed	Facultative (likely)

Key to Groundwater Dependency
Obligate - Contain species which rely exclusively on groundwater to survive
Facultative - Contain species which retrieve groundwater located in the capillary fringe or area above the saturated zone
Non Groundwater Dependent - Have no reliance on groundwater reserves

The proposed sand mine will require excavation below the groundwater level within the study area. An assessment undertaken (Martins, 2015) found drawdown of the permanent groundwater system at this vegetation communities is modelled to be a maximum of approximately 0.07 m. Based on the NSW Aquifer Interference Policy (Department of Primary Industries Office of Water, 2012) and the post Water Sharing Plan the local groundwater natural level range is of the order of 3 m (or more). The adopted permissible drawdown at a 40m buffer from the GDEs is 0.30 m (i.e. 10% x 3.00). This drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, based on modelling results, the proposed development does not exceed the drawdown impact criterion set out in the NSW Aquifer Interference Policy (NOW, 2012).

6.1.3 THREATENED AND RARE FLORA SPECIES

Field surveys identified 191 plant species occurring within the Study Area. Thirty threatened and rare plant species (ROTAP - Briggs & Leigh, 1996) were considered to have potential habitat as a result of a 10km search of the study area of the OEH Wildlife Atlas and the Department of the Environment & Energy (DoEE) databases (Table 7).

Table 7: Threatened and Rare Flora species recorded within the locality.

FLORA SPECIES	TSC	EPBC	ROTAP
Corybas dowlingii (Red Helmet Orchid)	E		
**Cryptostylis hunteriana* (Leafless Tongue Orchid)	E	V	3VC-
Diuris arenaria (Tomaree Doubletail)	E		Recommend 2VC
Diuris praecox (Newcastle Doubletail)	V	V	2VC-
Genoplesium baueri (Bauer's Midge Orchid)	V		3RC-
Rhizanthella slateri (Eastern Underground Orchid)	E	E	3KC-
Phaius australis (Lesser Swamp Orchid)	E	E	3VCa
Pterostylis chaetophora (Taree Rustyhood)	V		
**Persicaria elatior* (Tall Knotweed)	V	V	3V
Zannichellia palustris	E		
Grevillea parviflora subsp. *parviflora* (Small-flowered Grevillea)	V	V	
Allocasuarina defungens (Dwarf Heath Casuarina)	E	E	2E
Allocasuarina simulans (Nabiac Casuarina)	V	V	
Angophora inopina (Charmhaven Apple)	V	V	2R-
Callistemon linearifolius (Netted Bottle Brush)	V		2RCi
Eucalyptus fergusonii subsp. *fergusonii* (Ferguson's Ironbark)			3KC-
Eucalyptus glaucina (Slaty Red Gum)	V	V	3VCa
Eucalyptus parramattensis subsp. *decadens* (Drooping Red Gum)	V	V	2V
Eucalyptus rudderi (Rudder's Box)			3RC
Melaleuca biconvexa (Biconvex Paperbark)	V		
Melaleuca groveana (Grove's Paperbark)	V		3RC-
Syzygium paniculatum (Magenta Lillypilly)	E	V	3VCi
**Tetratheca juncea* (Black-eyed Susan)	V	V	3VCa
Prostanthera densa (Villous Mintbush)	V	V	3VC-
Cynanchum elegans (White-flowered Wax Plant)	V	V	3ECi
Asperula asthenes (Trailing Woodruff)		V	3VC-
Galium australe (Tangled Bedstraw)	E		
Lindernia alsinoides (Noah's False Chickweed)	E		
Streblus pendulinus (Siah's Backbone)		E	
Maundia triglochinoides	V		
Chamaesyce psammogeton (Sand Spurge)	E		
Senecio spathulatus (Coastal Fireweed)	E		
Macrozamia flexuosa			2K

Of the abovementioned threatened flora species one species *Diuris arenaria* (Tomaree Doubletail) was recorded within the study area during targeted surveys. A total of 108 specimens of *D. arenaria* were found within the study area (Figures 11 & 12). With the exception of one individual plant (No. 14) all of the specimens of *D. arenaria* were found to be present within the electricity easement in the far south-west of the study area. Specimens of *D. arenaria* as well as *Diuris praecox* (Newcastle Doubletail) were also found to occur outside the study area to the west within the same electricity easement (Figure 11).

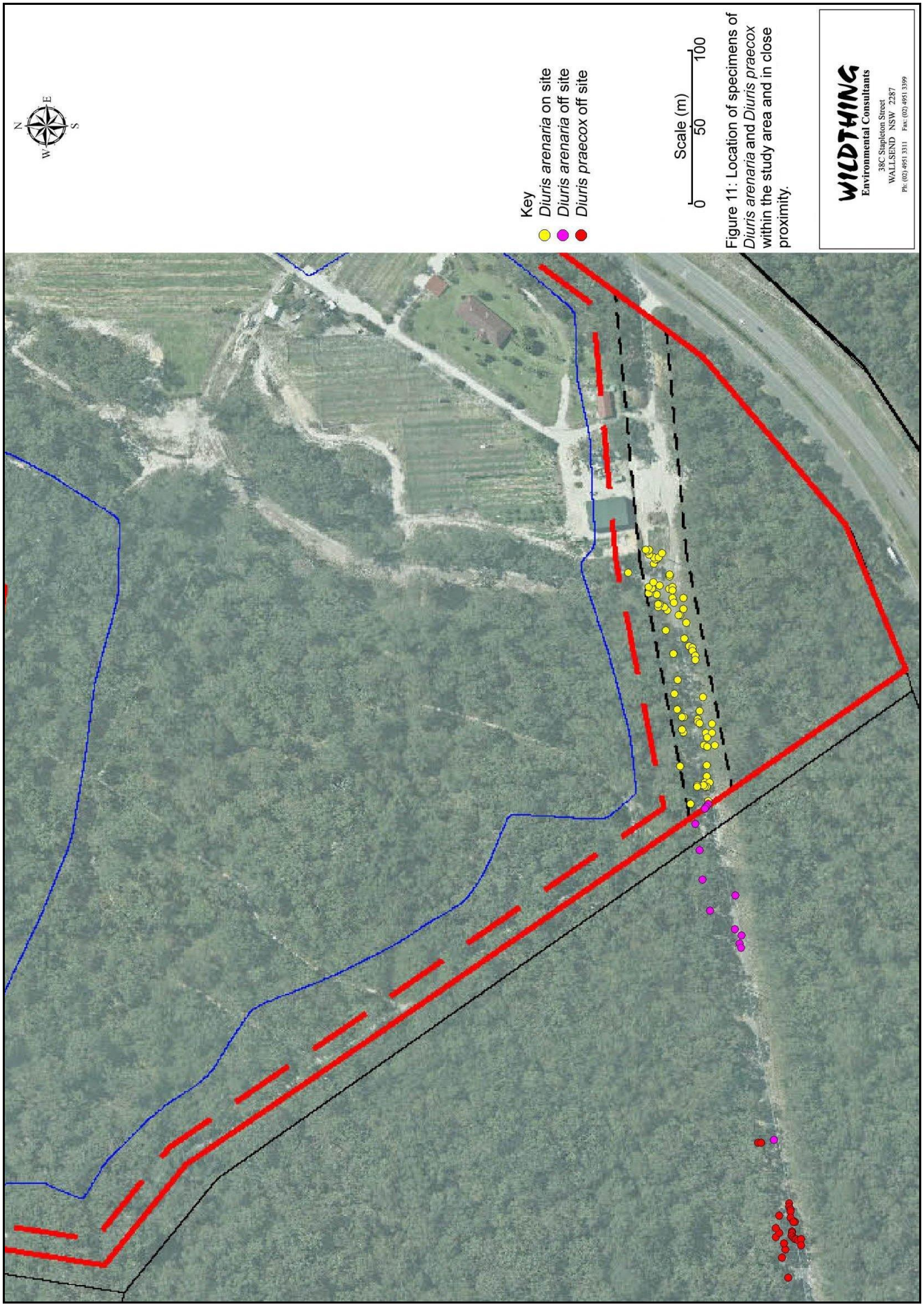


Figure 11: Location of specimens of *Diuris arenaria* and *Diuris praecox* within the study area and in close proximity.

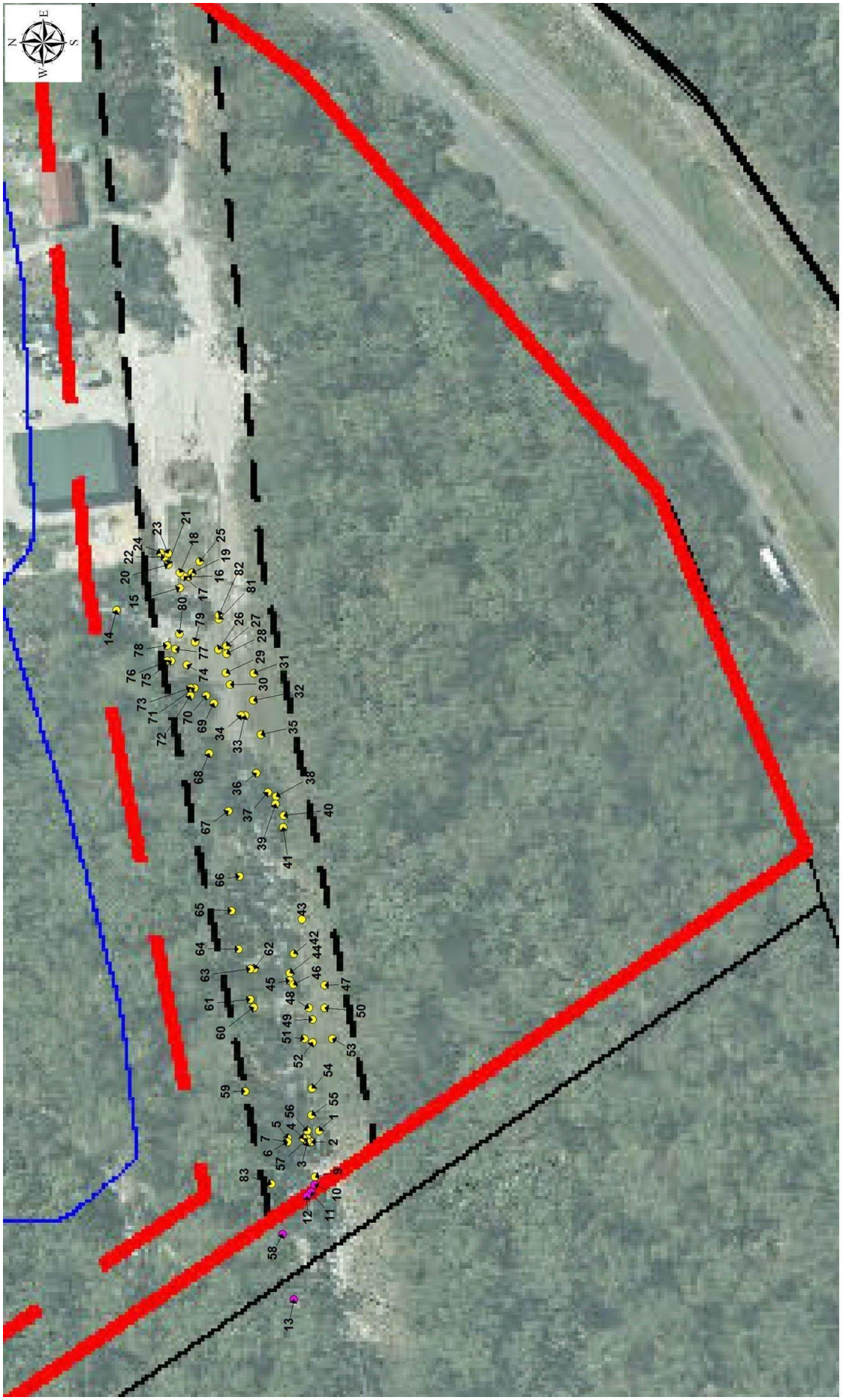


Figure 12: Location of individual specimens of *Diuris arenaria* within the study area and nearby adjacent areas.

The nearest specimens of *D. praecox* were approximately 200m away from the study area boundary (Wildthing Environmental Consultants, 2018). The occurrence of these two threatened orchid species were largely consistent with the mapping completed for the Electricity Supply Upgrade from Tomago to Tomaree (ERM, 2003). The mapping contained within the ERM, 2003 report showed populations of *D. arenaria* and *D. praecox* occurring within the electricity easement to the west of the study area and within the easement on the southern side of Nelson Bay Road to the south-east.

No additional threatened flora species were recorded within the study area during fieldwork. The study area was considered to contain low quality habitat for *C. dowlingii, C. hunteriana, P. chaetophora, P. elatior, Z. palustris C. linearifolius, E. parramattensis subsp. decadens, M. biconvexa, S. paniculatum, M. triglochinoides, C. elegans* and *L. alsinoides.*

A species-specific habitat assessment for the addressed threatened flora species has been provided in Section 5.2.4 of this report.

No ROTAP species were recorded within the study area.

6.1.4 BIOSECURITY ACT 2015

Two priority weed species listed under the Biosecurity Act 2015 were identified on site and are listed below in Table 8. The site lies within the Hunter Regional Weed Committee (HRWC).

Table 8: Priority Weed species found within the subject site.

WEED SPECIES	LEGAL REQUIREMENTS	ADDITIONAL SIGNIFICANCE
Senecio madagascariensis Fireweed	General Biosecurity Duty Prohibition on dealings	N
Rubus fruticosa Blackberry	General Biosecurity Duty Prohibition on dealings Regional Recommended Measure	N
Lantana camara Lantana	General Biosecurity Duty Prohibition on dealings	T, N
Chrysanthemoides monilifera subsp. *rotundata* Bitou Bush	Prohibition on dealings, General Biosecurity Duty Biosecurity Zone	T, N

T – Listed as a Threatening Process under the NSW BC Act 2016.
N –Weed of National Significance.

***Priorities under the Biosecurity Act 2015**

General Biosecurity Duty - any person dealing with plant matter must take measures to prevent, minimise or eliminate the biosecurity risk (as far as is reasonably practicable).

Prohibition on dealings - Must not be imported into the State or sold.

Regional Recommended Measure - Land managers mitigate the risk of the plant being introduced to their land. Land managers reduce impacts from the plant on priority assets. Land managers prevent spread from their land where feasible. The plant or parts of the plant are not traded, carried, grown or released into the environment.

Another weed species *Alternanthera philoxeroides* (Alligator Weed) which has the potential to invade low lying poorly drained parts of the study area has been recorded nearby to the within low table drains alongside Nelson Bay Road to the nearby east. The control of listed noxious and other invasive

weeds within the study area is to be included within the Vegetation Management Plan recommended for the proposal.

6.2 HABITAT APPRAISAL

6.2.1 HABITAT DESCRIPTION AND DISTRIBUTION IN THE VICINITY

The vegetation and landforms present within the study area offered habitat for a variety of native species. The main habitat types within the study area were Dry Sclerophyll Forest, Swamp Forest, Freshwater Wetland, Orchard and Cleared open areas.

Dry Sclerophyll Forest

Dry Sclerophyll Forest in the form of Coastal Sand Smooth-barked Apple Blackbutt Forest occupied 35.83ha of the study area and was the largest habitat class present. Coastal Sand Apple Blackbutt Forest is also the dominant habitat type along the dunal forests of Stockton Bight. Dry Sclerophyll Forest occurring within the study area would provide suitable habitat opportunities for a variety of species. Frugivorous, nectivorous, granivorous and insectivorous birds and microchiropteran bat species would all find potential foraging resources within this complex. The large number of hollow-bearing trees would provide nesting and roosting sites for a variety of avifauna and other hollow dependant species such as arboreal mammals and tree-roosting bats. Hunting opportunities exist for birds of prey, given that the variable tree coverage and understorey vegetation has created a myriad of ecotones and habitat densities. Such habitat is suitable for terrestrial species including small and medium sized mammals, macropods, reptiles and potentially for some frog species adapted to drier areas. No preferred species of Koala feed trees listed under the Port Stephens CKPoM were recorded within this area of habitat.

Swamp Sclerophyll Forest

Swamp Sclerophyll Forest habitat totalling 1.15ha occupied two areas of the poorly drained lower lying regions of the study area. These areas provided suitable habitat opportunities for a variety of species. Frugivorous, nectivorous, granivorous and insectivorous birds and microchiropteran bat species would all find potential foraging resources within this complex. Flowering specimens of *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus grandis* (Flooded Gum) would provide a seasonal food source for Flying-Foxes and nectivorous bird species. Due to the lack of hollow-bearing trees only limited nesting and roosting opportunities were present for hollow dependent species such as arboreal mammals, tree-roosting bats and nesting avifauna. Water within the low-lying areas of swamp forest was found to be ephemeral in nature and would dried out during extended periods of low rainfall. This area contained habitat for amphibians and limited habitat for waterbird species. *Eucalyptus robusta* is listed as a preferred feed tree species under the Port Stephens CKPoM and was present within this area of habitat.

Freshwater Wetland

Freshwater Wetland habitat composed of sedges, rushes and other flora adapted to periods of inundation occupied 0.32ha of poorly drained land in the north of the study area. Surface water within this area was found to be ephemeral in nature and would be absent during extended periods of low rainfall. This area contained preferred habitat for a number of amphibian species although only marginal habitat was likely to be present for a few species of freshwater fish. Suitable habitat was present for a number of reptile and waterbird species. Periodic surface water would act as a water source for other native animals such as macropods and offer limited habitat for bats that prefer to hunt above or around water bodies.

Cleared Open Areas

The cleared highly disturbed open areas of habitat provide opportunity for a variety of avifauna, including predominantly terrestrial species preferring open spaces, seed eating birds and several birds of prey, which may hunt over this area in search of potential prey species. Macropods may also frequent such areas whilst grazing. Some species of bats may also forage over this cleared area for insects. However, the lack of vegetative cover often limits the value of such areas as this for many species, particularly reptiles and small mammals which are vulnerable to predation in open spaces.

In general, the habitats within the study area offer a wide range of habitat opportunities for a range of native species. The habitats proposed to be affected by the proposal range from less ecologically significant areas such as orchards to relatively intact Dry Sclerophyll Forest that is capable of offering suitable resources to both resident and transitory species.

6.2.2 INVENTORY OF HOLLOW BEARING TREES

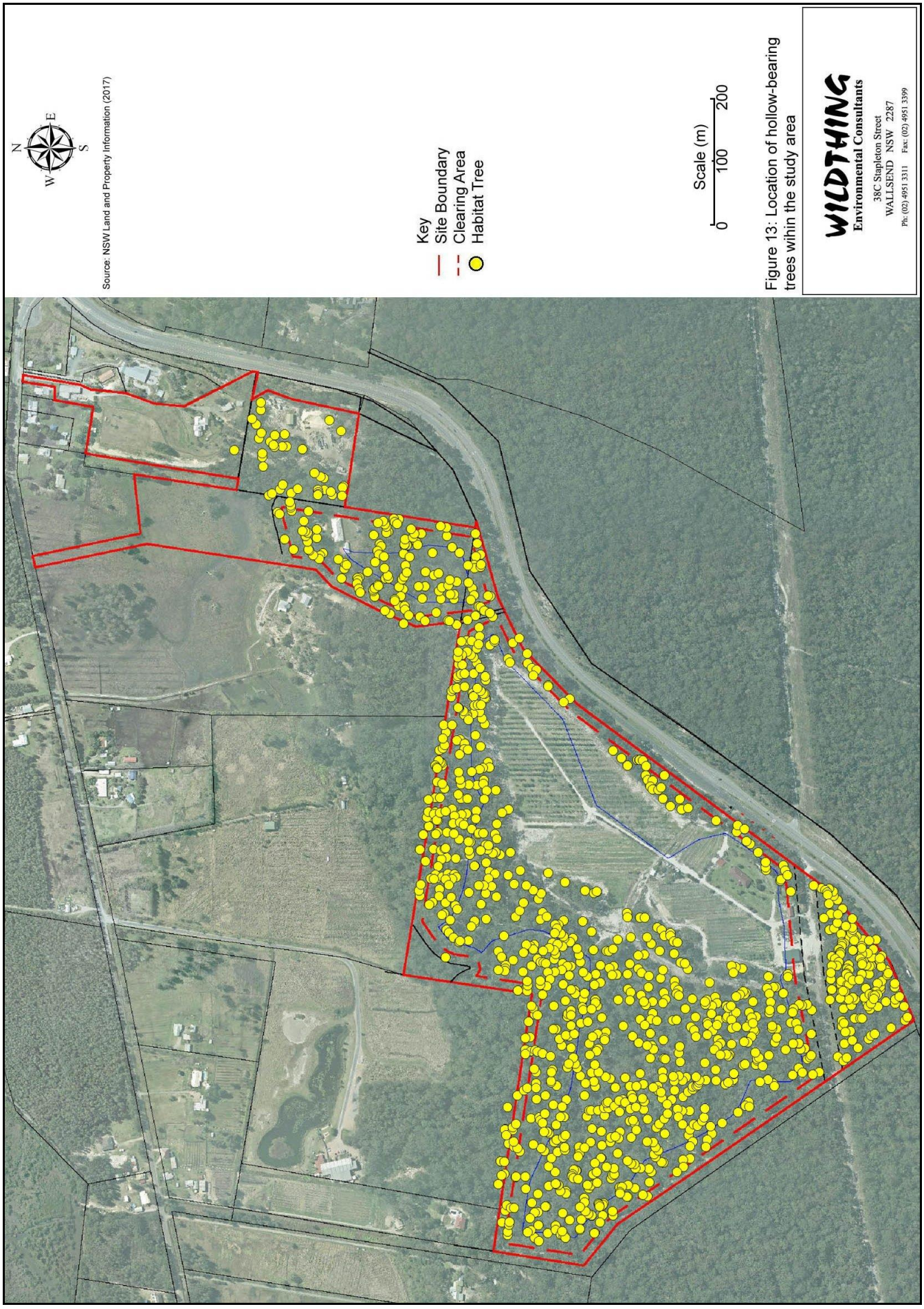
A total of 1217 habitat (hollow-bearing) trees were identified within the study area as a result of a hollow-bearing tree survey. A summary of the significant tree survey is shown in Table 9 and the locations of each tree are shown in Figure 13. Detailed results of the significant tree survey are contained in Appendix F.

Table 9: Summary of Hollow-bearing Tree Survey

	Hollow-bearing Tree No.	Class 1 Hollow No.	Class 2 Hollow No.	Class 3 Hollow No.	Class 4 Hollow No.	Total Hollows
Lot 254	1058	411	705	976	944	3035
Lot 51	118	18	53	136	183	390
Lot 10	40	36	45	73	55	209
Lot 11	1	0	0	0	2	2
Study Area	1217	465	803	1184	1184	3636

The classification system employed involved three classes:

Class 1 –very large sized hollow openings (i.e. >20cm) suitable for species such as Owls
Class 2 – large sized hollow openings (i.e. 15-20cm) suitable for species such as Possums
Class 3 –medium sized hollow-openings (i.e. 5-15cm) suitable for species such as Gliders and Possums
Class 4 – small sized hollow openings (i.e. <5cm) suitable for species such as microchiropteran bats


N
E
S
W
Source: NSW Land and Property Information (2017)
Key
Site Boundary
Clearing Area
Habitat Tree
Scale (m)
0
100
200
Figure 13: Location of hollow-bearing trees wihin the study area
WILDTHING
Environmental Consultants
38C Stapleton Street
WALLSEND NSW 2287
Ph: (02) 4951 3311 Fax: (02) 4951 3399

The proposed sand mine will result in the removal of approximately 877 of the 1217 hollow-bearing trees from within the study area. The vast majority of hollow-bearing trees were present within Coastal Sand Apple Blackbutt Forest assemblage. Many of these trees where considered to be significant as a result of their very large size, the variety and number of hollows they contained. Hollows were available for roosting or nesting avifauna species, arboreal mammals, reptiles and tree roosting microchiropteran bat species. A number of potential roost trees for large owls such as the threatened *Ninox strenua* (Powerful Owl) were also present. Six hollow-bearing trees were found to contain introduced *Apis mellifera* (Feral Honey Bee) hives. Competition from the Feral Honey Bees is a threatening process under Schedule 3 of the TSC Act 1995.

The loss of hollow-bearing trees is a Key Threatening Process under Schedule 3 of the TSC Act 1995. The removal of 877 hollow-bearing trees would be a significant loss of this resource in the local area. It would be likely that similar densities and sizes of hollows occurring within the study area would be present within adjoining areas of Coastal Sand Apple Blackbutt Forest which is the dominant vegetation assemblage along the sand dunes of Stockton Bight from Fern Bay to Anna Bay. Hollow-bearing tree frequency however would be expected to be lower within the more exposed stunted form of Coastal Sand Apple Blackbutt Forest closer to the waters of Stockton Bight.

6.2.3 HABITAT FRAGMENTATION & CORRIDORS

The study area forms part of a significant ecological corridor that runs down the coast from the Tomago Sandbeds in the south along the Stockton Bight to the Tomaree Peninsula in the north. The ecological corridor occurring along Stockton Bight is restricted by the bare shifting sand dunes to the east and largely cleared agricultural land to the west. The Lower Hunter Regional Strategy (Planning 2006) identifies this area as part of a key green corridor linking large vegetated areas, allowing the movement and dispersal of biodiversity within the region. This corridor links the Watagans and Yengo National Parks with the coastal plains of the Tomago Sand beds, Stockton Bight and Port Stephens. The Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy (House, 2003) also identifies the Coastal Sand Apple – Blackbutt Forest occurring along the Stockton Bight dune system as a regionally significant habitat linkage. The Hunter Regional Plan 2036 (NSW Government, 2016) also shows the site to occur within a Biodiversity Corridor.

The fragment of vegetation that the study area is situated has also been mapped as a key habitat (NPWS 2002). Key habitats define areas identified as centres of high native species diversity for a range of fauna assemblages (NPWS 2002). The proposal will result in the removal of approximately 25.90ha of key habitat largely consisting of Coastal Sand Apple Blackbutt Forest from the north-east section of the corridor. The section of the corridor where the study area is located is approximately 1.5km wide. The proposal will result in the reduction in the width of the corridor on the western side of the dual carriage way of Nelson Bay Road by approximately 540m at its widest point (not taking

planted orchard into account). The wider southern portion of the regional corridor occurring east of Nelson Bay Road is located on the protected Worimi Conservation Lands. An aerial photo of the surrounding habitat is shown in Figure 14.

The dual carriage way is approximately 40 to 50m (without a treed traffic island) wide and would create a significant barrier for the movement of a number of native fauna species such as arboreal mammals. Taking into consideration the presence of the dual carriage way the proposal will result in a reduction in the width of connectivity to the east of the study area to open forest areas within Lot 10 and the adjoining crown reserve (Lot 7374). A 15m vegetated buffer zone around the proposal together with adjoining habitat within the road reserve along Nelson Bay Road (varying between 10m & 15m) will still provide connectivity to these areas of habitat. Considering the current presence of a planted orchard within the study area this constriction is already present along parts of the eastern boundary.

Cleared agricultural land also bordered parts of the north-west boundary. The proposal will narrow the connectivity to adjoining areas of native open forest habitat contained within Lot 2 DP774965, Lot 251 DP 1034604 and Lot 1 DP 774965 on the north-western side of the study area to a minimum of 15m in the far north (Lot 51 – small section) and 170m in the west (Lot 1).

The existing electrical easement within the far west of the study area was approximately 30m wide. This area was composed of derived native groundcovers and would unlikely currently pose a significant movement barrier for any native species.

The connectivity to these areas will improve after the mine site has been progressively revegetated to the edge of a resulting permanent artificial lake. Proposed revegetation of Swamp Forest within the northern portion of Lot 51 within the study area towards Marsh Road will also greatly increase the width of the resulting 15m corridor in the north.

The artificial lake will remain permanently within the ecological corridor and will be approximately 680m at its widest point. The proposal will result in a reduction in the function and quality of the ecological corridor. Taking into consideration revegetation of impacted areas to the resulting artificial lakes edge and further revegetation within the northern portion of Lot 51 the proposal is unlikely to significantly impact the integrity of the ecological corridor. A plan of the study area showing the proposal, surrounding habitat and artificial lake is shown in Figure 15.


Source: NSW Land and Property Information
Key
Site Outline
Worimi Conservation Lands
Tilligerry State Conservation Area
Figure 14: Aerial photo study area and surrounds showing the presence of surrounding habitat and conservation reserves.
N
E
S
W
Scale (m)
0
500
1000
WILDTHING
Environmental Consultants
38C Stapleton Street
WALLSEND NSW 2287
Ph: (02) 4951 3311 Fax: (02) 4951 3399

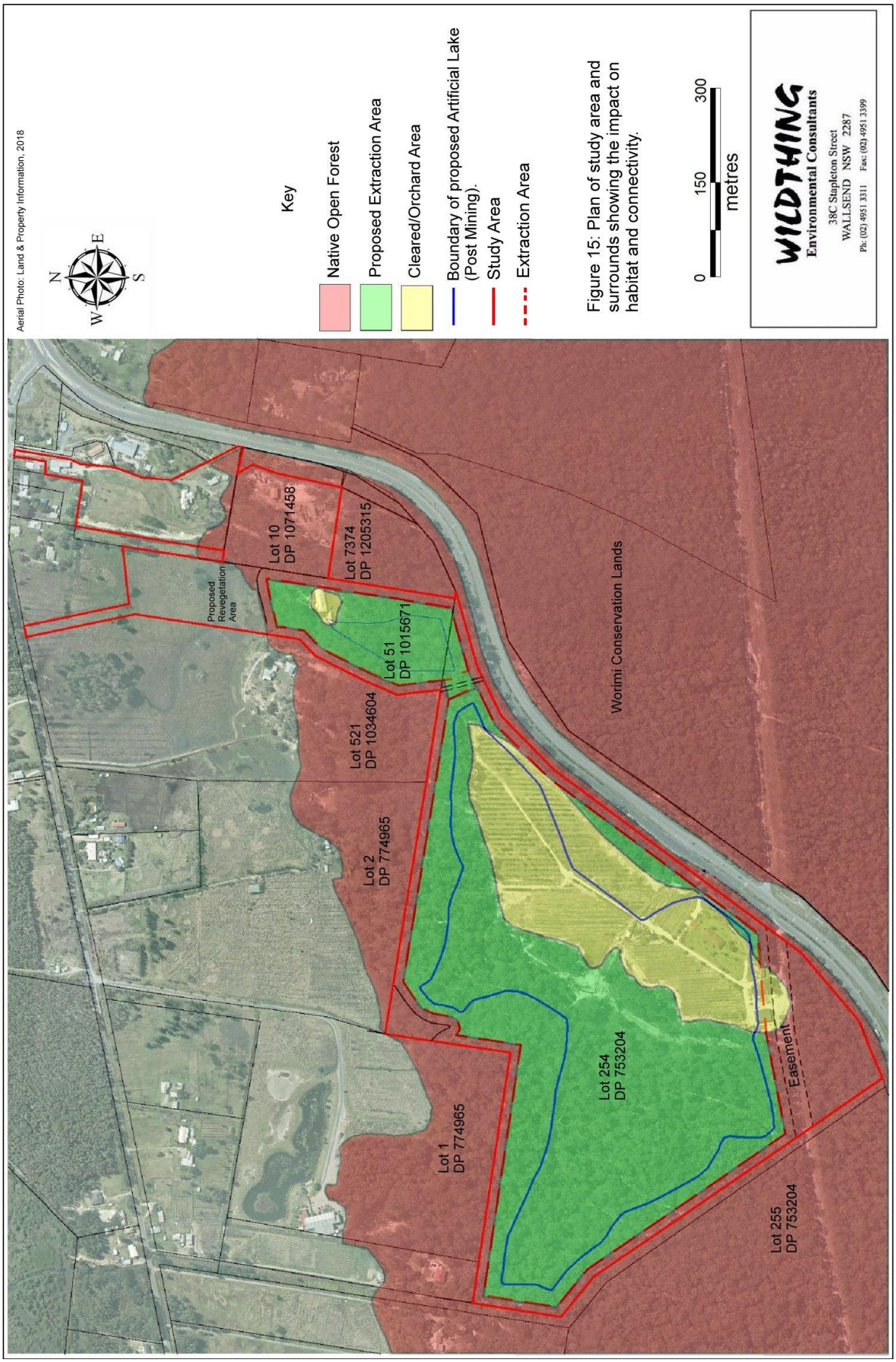


Figure 15: Plan of study area and surrounds showing the impact on habitat and connectivity.

6.2.4 HABITAT FOR SIGNIFICANT SPECIES

An assessment of habitat attributes on site has been undertaken for the threatened species listed in Section 3.5. The results of the assessment are displayed in Table 8. Those species identified in this assessment as having potential habitat available on site have been considered further under Section 5A of the EPA Act in Section 7.0 of this report. The description of the ecology of each species is contained in Appendix E.

Table 10: Habitat Assessment for Significant Species

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
Corybas dowlingii Red Helmet Orchid	TSC Act-E	Forms colonies and typically grows in gullies in tall open forest on well-drained gravelly soil at elevations of 10-200m. Is restricted to New South Wales where it is currently known from 4 localities including Port Stephens (2 localities), Bulahdelah and Freemans Waterhole south of Newcastle. A population is known from Stoney Ridge Reserve on Soldiers Point on the southern shore of Port Stephens.	**Low** No preferred habitat in the form of areas of well drained gravelly soil was present within the sandy study area.	**Yes**
Cryptostylis hunteriana Leafless Tongue Orchid	TSC Act-E EPBC Act-E ROTAP – 3VC-	This species is a saprophyte, which grows in small, localised colonies on flat plains close to the coast. This species has also been recorded in mountainous areas growing in moist depressions as well as in swampy habitats.	**Low** Suitable habitat was considered to be present within the study area.	**Yes**
Diuris arenaria Tomaree Doubletail	TSC Act – E ROTAP – Recommend 2VC	Coastal heath, Dry Sclerophyll Forest with patches of *Themeda australis* (Kangaroo Grass) on sandy flats (Bishop, 1996). This species is only known from the Tomaree Peninsula on the southern side of Port Stephens.	**High-Recorded within the study area.** Suitable habitat was considered to be present over the majority of the study area.	**Yes**
Diuris praecox Newcastle Doubletail	TSC Act - V EPBC Act – V ROTAP – 2VC-	Found in eucalypt forests on hilltops or slopes and is widespread in grassy habitats. Large populations have been recorded within power line easements at Anna Bay and Bobs Farm (ERM, 2003).	**High** Suitable habitat was considered to be present over the majority of the study area. Recorded a short distance outside the study area.	**Yes**
Genoplesium baueri Bauer's Midge Orchid	TSC Act – V ROTAP – 3RC-	Grows in sparse sclerophyll forest and moss gardens over sandstone.	**Unlikely** No suitable habitat was considered to be present for this orchid species. No local records exist for this species.	**No**
Phaius australis Lesser Swamp Orchid	TSC Act - E EPBC Act – E ROTAP – 3VCa	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas. Occurs in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie.	**Unlikely** Suitable habitat was present within the two areas of Swamp Sclerophyll Forest. However, the study area occurs well south of known distribution of the orchid	**No**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
			species.	
Rhizanthella slateri Eastern Underground Orchid	TSC Act - E EPBC Act – E ROTAP – 3KC-	Habitat requirements are poorly understood and no particular vegetation type has been associated with this species, although it is known to occur in sclerophyll forest. This species is highly cryptic as it grows almost completely below the soil. It flowers from September to November. This orchid species has not been recorded on the Tomaree Peninsula. The nearest known local record of this species is Bulahdelah (Jones, 2006).	**Low** Only marginal habitat was present.	**Yes**
Pterostylis chaetophora Taree Rustyhood	TSC Act-V	The preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey. In NSW, it is currently known from 18 scattered locations in a relatively small area between Taree and Kurri Kurri, extending to the south-east towards Tea Gardens and west into the Upper Hunter, with additional records near Denman and Wingen. This species has also been recorded near Grahamstown Dam near Medowie (Pers.com. Steve Lewer OEH).	**Low** Suitable habitat was found to be present over a large portion of the study area containing Dry Sclerophyll Forest.	**Yes**
Grevillea parviflora subsp. *parviflora* Small-flowered Grevillea	TSC Act-V EPBC Act-V	This species of Grevillea occurs in light clayey soils in woodlands. This species grows chiefly in south-western Sydney. Disjunct populations occur near Cessnock, Putty and Cooranbong (Fairley, 2004). A record from Oyster Bay was present on the OEH BioNet database (OEH, 2017).	**Unlikely** No known soil types or associated flora species were present. The study area is not composed of older Pleistocene-aged sands.	**No**
Allocasuarina defungens Dwarf Heath Casuarina	TSC Act-E EPBC Act-E ROTAP – 2E	A small erect shrub occurring on sand in the Nabiac area and farther north in the NSW North Coast Region. Grows mainly in tall heath on sand, but can also occur on clay soils and sandstone (DEC, 2005). It is found in coastal areas of wet to dry, dense, low, closed heath land growing on Pleistocene-aged marine aeolian derived soils (Wilson & Johnson, 1989).	**Unlikely** The study area is not composed of Pleistocene-aged sands. The study area is also located outside the know distribution of this species.	**No**
Allocasuarina simulans *Nabiac Casuarina*	TSC Act-V EPBC Act-V	The Nabiac Casuarina is restricted to the mid-north coast of NSW, from Nabiac to Forster and is very rare. The Nabiac Casuarina grows in heathland on coastal sands.	**Unlikely** The study area is also located outside the know distribution of this species.	**No**
Angophora inopina Charmhaven Apple	TSC Act-V EPBC Act-V ROTAP – 2R-	Found in shallow sandy soils within open woodland/forest assemblages in co-dominant distribution with *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red	**Unlikely** No associated woodland/forest assemblages were present.	**No**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
		Bloodwood) and *Eucalyptus capitellata* (Brown Stringybark), as well as within wet-dry heath, and swamp forest communities. The main occurrences of this species are in the Wyong and Lake Macquarie LGA. Disjunct populations have also been found south of Karuah in the Port Stephens LGA and north of Karuah in the Great Lakes LGA.		
Callistemon linearifolius Netted Bottle Brush	TSC Act-V ROTAP – 2RCi	Grows in dry sclerophyll forest on the coast and adjacent ranges from the Georges River to the Hawkesbury River in the Sydney area, and north to Nelson Bay. This species is known to occur within Stoney Ridge Reserve at Soldiers Point.	**Low** Suitable habitat was found to be present over a large portion of the study area containing Dry Sclerophyll Forest.	**Yes**
Eucalyptus camfieldii Camfield's Stringybark	TSC Act – V EPBC Act – V	Records from Tanilba Bay on Shrubby Wallum Heath on a ridge with sandy soil with *Corymbia gummifera* and *Eucalyptus piperita.*	**Unlikely** The site lacks Wallum Heath.	**No**
Eucalyptus glaucina Slaty Red Gum	TSC Act – V EPBC Act – V ROTAP – 3VCa	The Slaty Red Gum principally occurs in the Casino area in northern NSW and from Gloucester to Broke, in mid-northern NSW. It grows mostly on gentle slopes near drainage lines in alluvial and clayey soils, in open forest.	**Unlikely** No suitable habitat was present.	**No**
Eucalyptus parramattensis subsp. *decadens* Drooping Red Gum	TSC Act - V EPBC Act – V ROTAP – 2V	Occurs in woodland on sandy soils in wet sites. In the Port Stephens area, the Drooping Red Gum occurs in open wet sclerophyll woodland on heavy, often waterlogged, inter-barrier depression soils. This species is present within Mambo Swamp on the southern shore of Port Stephens.	**Low** Marginal habitat was considered to be present on lower areas of ground in the far north of the study area.	**Yes**
Melaleuca biconvexa Biconvex Paperbark	TSC Act - V	May occur in dense stands adjacent to watercourses, in association with other *Melaleuca* species or as an understorey species in wet forest.	**Low** No suitable habitat was considered to be present. No nearly local records.	**Yes**
Melaleuca groveana Grove's Paperbark	TSC Act-V ROTAP – 3RC-	This species is generally found in north eastern NSW and South East Queensland in heath, often in exposed sites and mainly at higher altitude. In Tomaree National Park, *Melaleuca groveana* occurs in closed heath communities on rhyodacite volcanic rock.	**Unlikely** The study area lacked associated geology, soil and vegetation types.	**No**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
Syzygium paniculatum Magenta Lilly Pilly	TSC Act - E EPBC Act – V ROTAP 3VCi	Occurs in coastal rainforests on sandy soils or stabilised coastal dunes from Jervis Bay to Bulahdelah in NSW.	**Low** Suitable habitat was considered to be present in the more sheltered areas of sclerophyll forest.	**Yes**
Tetratheca juncea Black-eyed Susan	TSC Act-V EPBC Act-V ROTAP - 3VCa	Heath and Dry Sclerophyll Forests on low nutrient soil with a dense understorey of grasses. Is most commonly found associated with species including, *Angophora costata* (Smooth-barked Apple), *Eucalyptus globoidea* (White Stringybark), *Corymbia gummifera* (Red Bloodwood) and *Acacia myrtifolia* (Myrtle Wattle).	**Unlikely** The study area lacked associated soil and vegetation types. No nearby local records (OEH, 2017).	**No**
Prostanthera densa Villous Mintbush	TSC Act - V EPBC Act – V ROTAP – 3VC-	This species is known to occur on clay soils on volcanic hills and on sandy soils occurring as a shallow mantle over volcanic hills. It has been reported generally from sclerophyll forest and shrubland on coastal headlands and near-coastal ranges, chiefly on sandstone. The closest records are likely to occur on Gang Gang Hill, Nelson Bay well to the north of the study area.	**Unlikely** The study area lacked associated geology, soil and vegetation types.	**No**
Asperula asthenes Trailing Woodruff	TSC Act - V ROTAP – 3VC-	Damp Sites, often along riverbanks (DEC, 2006). The major portion of the distribution of this species occurs in the Great Lakes LGA. Populations are known from North Karuah and The Branch areas (Great Lakes Council, 2003).	**Unlikely** The study area lacked associated drainage lines and vegetation types.	**No**
Galium australe Tangled Bedstraw	TSC Act-E	Found in moist gullies of tall forest, *Eucalyptus tereticornis* (Forest Red Gum) forest, coastal Banksia shrubland, and *Allocasuarina nana* heathland.	**Unlikely** This species is unlikely to be present due to the lack of associated vegetation and local records.	**No**
Lindernia alsinoides Noah's False Chickweed	TSC Act-E	Grows in swampy sites in sclerophyll forests and coastal heath.	**Low** Suitable habitat was considered to be present in the south of the study area on the edges of the Swamp Mahogany/Paperbark Forest assemblage. The study area would be considered to be	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
			south of the known distribution of this species.	
Chamaesyce psammogeton Sand Spurge	TSC Act-E	This prostrate perennial herb grows on foredunes and exposed sites on headlands.	**Unlikely** No suitable habitat was present.	**No**
Senecio spathulatus Coastal Fireweed	TSC Act-E	Confined to areas of unstabilised sand on coastal dunes.	**Unlikely** No suitable habitat was present.	**No**
Streblus pendulinus Siah's Backbone	EPBC Act - E	Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest.	**Unlikely** No suitable habitat was present.	**No**
Maundia triglochinoides	TSC Act - V	Grows in swamps, creeks or shallow freshwater 30-60cm deep on heavy clay with low nutrients. Is known to occur within drainage channels around Williamtown to the south of the study area.	**Low** The area of wetland contains suitable habitat.	**Yes**
Cynanchum elegans White-flowered Wax Plant	TSC Act – E1 EPBC Act – E ROTAP 3ECi	This species occurs in scattered coastal localities from the QLD-NSW border south to Wollongong. Found in dry, littoral or subtropical rainforest, and occasionally in scrub and woodland from sea level to about 600m ASL. Records are known from Ash Island, Kooragang Wetlands.	**Low** Marginal habitat would be confined to the more sheltered areas of the study area.	**Yes**
Persicaria elatior Tall Knotweed	TSC Act - V EPBC Act – V ROTAP – 3V	Grows in damp sites, especially beside streams, lakes, margins of dams and occasionally in swamp forest.	**Low** Habitat was considered to be present within the lower lying areas of ground containing wetland in the north of the study area. The occurrence of this species is marginalised by the lack of nearby local records.	**Yes**
Zannichellia palustris	TSC Act-E1	Grows in fresh or slightly saline stationary or slowly flowing water.	**Low** Habitat was considered to be present within the lower lying areas of ground containing	**Yes**

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			wetland in the north of the study area. The occurrence of this species is marginalised by the lack of nearby local records.	
Petalura gigantea Giant Dragonfly	TSC Act-E	Permanent wetlands both coastal and upland. Larvae occupy permanent long chambered burrows built under swamps. According to the OEH database this Dragonfly has been recorded within Mambo Swamp on the southern side of Port Stephens in 2006 (OEH, 2017).	**Low-Moderate** Swamps and wetland within the study area contain suitable habitat for this Dragonfly species.	**Yes**
Crinia tinnula Wallum Froglet	TSC Act-V	Shallow acid swamps (temporary / semi-permanent) and associated connecting channels and deeper water holes (permanent) consisting of hard-leafed heaths, shrubs and woodland on coastal plains and dunes and associated sedgelands and swamps in low lying areas collectively known as wallum.	**Moderate** Suitable habitat was found to occur within the area of wetland and swamp forest within the north of the study area.	**Yes**
Uperoleia mahonyi Mahony's Toadlet	TSC Act-E	Inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range. Records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. This species has also been recorded on more recent Holocene Dunes (Dr Simon Clulow *pers.com*). Commonly associated with acid paperbark swamps, is also known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species. Endemic to the mid-north coast of New South Wales (NSW) and to date has been found between Kangy Angy and Seal Rocks.	**High** Suitable habitat was found to occur within the area of wetland and swamp forest within the north of the study area.	**Yes**
Litoria aurea Green and Golden Bell Frog	TSC Act-E EPBC Act-E	This frog species inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins.	**Low** Suitable habitat was found to occur within the area of lower lying wetland within the north of the study area. No nearby local records (OEH, 2017).	**Yes**
Litoria brevipalmata	TSC Act-V	Open Forest, rainforest bordering cleared areas.	**Low**	**Yes**

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Green-thighed Frog			Only marginal habitat was present within the study area for this frog species. No nearby local records (OEH, 2017).	
Mixophyes balbus Stuttering Frog	TSC Act-V EPBC Act-V	Occurs in wet forest regions of south-eastern Queensland, Eastern NSW and Victoria. In late spring, eggs are deposited among leaf litter on the banks of streams and subsequently are washed into the water during heavy rain.	**Unlikely** No suitable habitat was present.	**No**
Mixophyes iteratus Great Barred Frog	TSC Act-E EPBC Act-E	Occurs on forest slopes of the Great Dividing Range, generally between 20-800m A.S.L. It appears to prefer riparian vegetation or other moist vegetation communities, generally on rich organic soils. Deep leaf litter and/or thick cover is necessary for this species. Water quality must be of a high standard, and the species occurs in 1st to 3rd order streams (i.e. 'young' streams), and is absent from ponds and ephemeral pools. Graded banks with undercuts and steep edges are favourable haunts of this frog.	**Unlikely** No suitable habitat was present.	**No**
Caretta caretta Loggerhead Turtle	TSC Act-E EPBC Act-E	Ocean dwellers foraging in deeper water for fish, jellyfish and bottom dwelling animals. The female comes ashore to layer her eggs in a hole dug on the beach in tropical regions during the warmer months.	**Unlikely** No habitat was present.	**No**
Chelonia mydas Green Turtle	TSC Act-V EPBC Act-V	Occurs in shallow seas where there is sufficient light to ensure an abundant growth of marine grasses. When resting this species searches out an appropriate rest area i.e. rock overhang, rocky pothole, which gives some protection from predators.	**Unlikely** No habitat was present.	**No**
Dermochelys coriacea Leatherback Turtle	TSC Act-V EPBC Act-E	The Leatherback Turtle is a pelagic feeder, found in tropical, subtropical and temperate waters throughout the world. It has been recorded feeding in the coastal waters of all Australian States.	**Unlikely** No habitat was present.	**No**
Eretmochelys imbricata Hawksbill Turtle	EPBC Act-V	Hawksbill turtles typically occur in tidal and sub-tidal coral and rocky reef habitats throughout tropical waters, extending into warm temperate areas as far south as northern New South Wales.	**Unlikely** No habitat was present.	**No**
Natator depressus Flatback Turtle	EPBC Act-V	Although found in open seas, they prefer inshore waters and bays where their feeding ground is the shallow, soft-bottomed seabed.	**Unlikely** No habitat was present.	**No**
Hoplocephalus bitorquatus Pale-headed Snake	TSC Act-V	Rainforest to the drier sclerophyll forests.	**Low** Suitable habitat was considered	**Yes**

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			to be present within the study area. There was a lack of local records for this species (OEH, 2017).	
Hoplocephalus stephensii Stephen's Banded Snake	TSC Act-V	Partly arboreal found in wet sclerophyll forest or rainforest.	**Low** Suitable habitat was considered to be present within the study area. There was a lack of local records for this species (OEH, 2017).	**Yes**
Macronectes giganteus Southern Giant Petrel	TSC Act – E EPBC Act-E	The Southern Giant Petrel ranges from deep circumpolar waters from Antarctica across the entire length of the New South Wales coast.	**Unlikely** No suitable habitat was present.	**No**
Macronectes halli Northern Giant Petrel	TSC Act - E	Inhabits subtropical waters in winter and early spring. Potential foraging resources in N.S.W. are regarded as significant during the winter months although representing a small proportion of the total foraging area for this species.	**Unlikely** No suitable habitat was present.	**No**
Pterodroma leucoptera leucoptera Gould's Petrel	TSC Act - E	Lives pelagic life, nests on Cabbage Tree Island.	**Unlikely** No suitable habitat was present.	**No**
Pterodroma neglecta Kermadec Petrel	TSC Act-V	It is a pelagic species inhabiting the subtropical and tropical waters of the Pacific Ocean, rarely reaching mainland.	**Unlikely** No suitable habitat was present.	**No**
Pterodroma nigripennis Black-winged Petrel	TSC Act-V	Pelagic species	**Unlikely** No suitable habitat was present.	**No**
Pterodroma solandri Providence Petrel	TSC Act-V	Pelagic species	**Unlikely** No suitable habitat was present.	**No**
Calonectris leucomelas Streaked Shearwater	EPBC-Migratory	Pelagic species	**Unlikely** No suitable habitat was present.	**No**
Ardenna carneipes Flesh-footed Shearwater	TSC Act-V	Lives pelagic life, nests on Lord Howe Island.	**Unlikely** No suitable habitat was present.	**No**
Puffinus tenuirostris Short-tailed Shearwater	EPBC-Migratory	Pelagic species	**Unlikely** No suitable habitat was present.	**No**
Limicola falcinellus Broad-billed Sandpiper	TSC Act-V	Habitat utilised by this species includes tidal mudflats, reefs, salt marshes, freshwater wetlands and sewage farms. Favours muddy	**Unlikely** No suitable habitat was present.	**No**

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		ooze.		
Limosa lapponica Bar-tailed Godwit	EPBC-Migratory	Tidal mudflats, estuaries, sewerage ponds, shallow river margins, brackish or saline inland lakes and flooded pastures (Pizzey & Knight, 2001).	**Unlikely** No suitable habitat was present.	**No**
Limosa limosa Black-tailed Godwit	TSC Act-V	Habitat utilised by this species includes tidal mudflats, river edges, sandy beaches, brackish swamps as well as the shallows of lakes, reservoirs and sewage farms.	**Unlikely** No suitable habitat was present.	**No**
Arenaria interpres Ruddy Turnstone	EPBC-Migratory	Tidal reefs and pools; weed-covered rocks; pebbly, shelly and sandy shores with stranded seaweed; mudflats; occasionally inland shallow waters; sewage ponds and open or ploughed ground.	**Unlikely** No suitable habitat was present.	**No**
Xenus cinereus Terek Sandpiper	TSC Act-V	Tidal Mudflats, estuaries, shores, reefs and coastal swamps.	**Unlikely** No suitable habitat was present.	**No**
Heteroscelus brevipes Grey-tailed Tattler	EPBC-Migratory	Estuaries, tidal mudflats, mangroves, wave-washed rocks, and reefs; shallow river margins, coastal and inland.	**Unlikely** No suitable habitat was present.	**No**
Sterna albifrons Little Tern	TSC Act - E	Little Terns nest only on or near the coast in N.S.W. The typical features of the nesting area are a sandy substrate, flat or gently sloping topography, abundant shells and pebbles and little vegetation.	**Unlikely** No suitable habitat was present.	**No**
Sterna fuscata Sooty Tern	TSC Act-V	A pelagic species, does not nest in the area.	**Unlikely** No suitable habitat was present.	**No**
Actitis hypoleucos Common Sandpiper	EPBC-Migratory	Shallow pebbly, muddy or sandy edges of rivers and streams, coastal and inland; dams, lakes, sewage ponds, margins of tidal rivers, waterways in mangroves or saltmarsh; mudflats; rocky or sandy beaches.	**Unlikely** No suitable habitat was present.	**No**
Calidris acuminata Sharp-tailed Sandpiper	EPBC-Migratory	Tidal mudflats, saltmarshes, mangroves; shallow fresh, brackish or saline inland wetlands; sewage ponds and irrigated pastures.	**Unlikely** No suitable habitat was present.	**No**
Calidris canutus Red Knot	EPBC-Migratory	Tidal mudflats, sandflats, beaches, saltmarshes, flooded pastures, ploughed lands.	**Unlikely** No suitable habitat was present.	**No**
Calidris ferruginea Curlew Sandpiper	TSC Act-E EPBC-Migratory	Tidal mudflats; saltmarsh; fresh, brackish or saline wetlands; sewage ponds.	**Unlikely** No suitable habitat was present.	**No**
Calidris ruficollis Red-necked Stint	EPBC-Migratory	Tidal mudflats; saltmarsh; fresh, brackish or saline wetlands; sewage ponds.	**Unlikely** No suitable habitat was present.	**No**
Calidris tenuirostris Great Knot	TSC Act-V	Inhabits beaches, coastal mudflats, bay shores, estuarine environments; sometimes freshwater wetlands.	**Unlikely** No suitable habitat was present.	**No**

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Tringa stagnatilis Marsh Sandpiper	EPBC-Migratory	Salt; fresh, brackish or saline wetlands; sewage ponds, mangroves, tidal flats and estuaries.	**Unlikely** No suitable habitat was present.	**No**
Numenius madagascariensis Eastern Curlew	EPBC-Migratory	Estuaries, tidal mudflats, sandspits, saltmarshes, mangroves; occasionally fresh or brackish lakes.	**Unlikely** No suitable habitat was present.	**No**
Numenius minutus Little Curlew	EPBC-Migratory	Dry grasslands, floodplains, margins of drying swamps; tidal mudflats, crops and sewage ponds.	**Unlikely** No suitable habitat was present.	**No**
Numenius phaeopus Whimbrel	EPBC-Migratory	Estuaries, tidal flats, coral cays, exposed reefs, flooded paddocks, sewage ponds and lawns.	**Unlikely** No suitable habitat was present.	**No**
Charadrius bicinctus Double-banded Plover	EPBC-Migratory	Wide beaches, tidal mudflats, saltmarsh, sparsely vegetated margins of shallow saline and freshwater.	**Unlikely** No suitable habitat was present.	**No**
Charadrius leschenaultii Greater Sand-plover	TSC Act-V	Inhabits sheltered bays, harbours and estuaries with large intertidal sandflats mudflats or bare paddocks.	**Unlikely** No suitable habitat was present.	**No**
Charadrius mongolus Lesser Sand-plover	TSC Act-V	Inhabits sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats.	**Unlikely** No suitable habitat was present.	**No**
Pluvialis fulva Pacific Golden Plover	EPBC-Migratory	Estuaries, tidal mudflats, saltmarshes, mangroves; rocky reefs, margins of shallow open inland swamps, sewage ponds.	**Unlikely** No suitable habitat was present.	**No**
Pluvialis squatarola Grey Plover	EPBC-Migratory	Mudflats, saltmarsh, tidal reefs and estuaries.	**Unlikely** No suitable habitat was present.	**No**
Diomedea antipodensis Antipodeam Albatross	TSC Act-V EPBC Act-V & M	Lives a pelagic life.	**Unlikely** No suitable habitat was present.	**No**
Diomedea gibsoni Gibson's Albatross	TSC Act-V EPBC Act-V & M	Lives a pelagic life.	**Unlikely** No suitable habitat was present.	**No**
Thalassarche bulleri Buller's Albatross	EPBC Act-V EPBC Act-V & M	Lives a pelagic life.	**Unlikely** No suitable habitat was present.	**No**
Thalassarche cauta cauta Shy Albatross	TSC Act-V EPBC Act-V & M	Lives a pelagic life.	**Unlikely** No suitable habitat was present.	**No**
Thalassarche cauta salvini Salvin's Albatross	EPBC Act-V & M	Lives a pelagic life.	**Unlikely** No suitable habitat was present.	**No**
Thalassarche cauta steadi White-capped Albatross	TSC Act-V EPBC Act-V & M	Lives a pelagic life.	**Unlikely** No suitable habitat was present.	**No**
Thalassarche melanophris impavida Campbell Albatross	EPBC Act-V & M	Lives a pelagic life.	**Unlikely** No suitable habitat was present.	**No**

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Haematopus fuliginosus Sooty Oystercatcher	TSC Act-V	Prefer rocky intertidal shorelines and sandy beaches.	**Unlikely** No suitable habitat was present.	**No**
Haematopus longirostris Pied Oystercatcher	TSC Act-E	Prefer rocky intertidal shorelines and sandy beaches.	**Unlikely** No suitable habitat was present.	**No**
Esacus neglectus Beach Stone-Curlew	TSC Act–E4A	Inhabits undisturbed sandy beaches, especially those with extensive mangrove-backed sandflats, mudflats or reefs exposed at low tide. It has also been recorded utilising cane fields that are located in proximity to tidal areas.	**Unlikely** No suitable habitat was present.	**No**
Gallinago hardwickii Latham's Snipe	EPBC Act-M	Utilises a variety of habitats, such as soft wet ground or shallow water with tussock and other green and dead vegetation, and scrub or open wetland from sea-level to alpine bogs (Pizzey & Knight, 2001).	**Low** Suitable habitat was present within areas of freshwater wetlands in the north of the study area.	**Yes**
Rostratula benghalensis australis Australian Painted Snipe	TSC Act-E EPBC Act-V & M	Margins of swamps and streams, chiefly those covered with low and stunted vegetation.	**Low** Suitable habitat was present within areas of freshwater wetlands in the north of the study area.	**Yes**
Botaurus poiciloptilus Australasian Bittern	TSC Act-E EPBC Act-E	Favours permanent fresh-waters dominated by sedges, rushes, reeds or cutting grasses (eg. Phragmites, Scirpus, Eleocharis, Juncus, Typha, Baumea and Gahnia).	**Low - Moderate** Suitable habitat was present within areas of freshwater wetlands in the north of the study area.	**Yes**
Ixobrychus flavicollis Black Bittern	TSC Act-V	Near water in mangroves and other trees, often forming only a narrow fringe of cover.	**Low** Suitable habitat was present around areas of freshwater wetlands in the east of the study area.	**Yes**
Ardea alba Great Egret	EPBC Act-M	Inhabits shallows of rivers, larger dams, freshwater wetlands and irrigation areas.	**Low - Moderate** Suitable habitat was present around areas of freshwater wetlands in the east of the study area.	**Yes**
Ardea ibis	EPBC Act-M	Inhabits stock paddocks, pastures, croplands, wetlands and drains.	**High – Recorded within the**	**No – Not listed**

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Cattle Egret			**study area.** Suitable habitat was present for this species within the area of pasture/Grassland in the north of the study area.	**under TSC Act. Assessed in Section 11.**
Ephippiorhynchus asiaticus Black-necked Stork	TSC Act-E	Inhabits swamps associated with river systems and large permanent pools but sometimes appears on the coast or in estuaries. It has also been recorded on farm dams and sewage treatment ponds.	**Unlikely** No habitat was considered to be present due to the lack of larger areas of permanent waterbodies.	**No**
Irediparra gallinacea Comb-crested Jacana	TSC Act-V	Inhabits mostly deep permanent freshwater wetlands, which are abundant with floating aquatic vegetation that forms dense mats or rafts on the surface of the water (eg. *Nymphaeaceae, Myriophyllum lacifolium, Marsilea* and *Riccia*).	**Unlikely** No habitat was considered to be present due to the lack of deep freshwater and floating aquatic vegetation.	**No**
Turnix maculosa Red-backed Button-quail	TSC Act-V	Grasses, sedges near water, grassy woodlands, rainforest edges; black soil plains, spinifex, cereal crops and gardens.	**Unlikely** Study area occurs below the known distribution of this species.	**No**
Burhinus grallarius Bush Stone-curlew	TSC Act-E	This species inhabits dry open forest and woodland with an open grassy understorey that has not been overgrazed. It prefers woodland with many fallen branches where it roosts during the day. It has also been known to utilise coastal scrub, mangrove fringes, golf courses and plantations. This species has been recorded within the adjoining property (Lot 3) to the east (NPWS, 2011).	**Low-moderate** Suitable habitat was present for this species within the more open areas of woodland.	**Yes**
Ptilinopus magnificus Wompoo Fruit-Dove	TSC Act-V	This frugivorous Rainforest specialist inhabits the canopy of Sub-tropical, Warm-temperate and Littoral Rainforests. Favoured feed trees include Figs, Laurels, Myrtles and native Tamarind. The females lay one egg on a flimsy platform of vine tendrils on a slender horizontal branch.	**Low** Areas of secondary habitat were present within the study area.	**Yes**
Ptilinopus regina Rose Crowned Fruit-dove	TSC Act-V	Inhabits rainforest, though it also frequents nearby drier forests as well as mangroves. It usually feeds on Figs or other fruit and berry-bearing trees.	**Low** Areas of secondary habitat were present within the study area.	**Yes**
Ptilinopus superbus Superb Fruit Dove	TSC Act-V	Lives mainly in Rainforest but will feed in adjacent Mangroves or Eucalypt forest, venturing into coastal habitats. The nest is a platform	**Low** Areas of secondary habitat were	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
		built in a small tree on a horizontal fork situated in Open Forest at the edge of scrub.	present within the study area.	
Lathamus discolor Swift Parrot	TSC Act-E EPBC Act- Crit-E & M	Open Forest to Woodland, also street trees and in parks and gardens, winter flowering eucalypts for feeding. This species nests in Tasmania during the summer months.	**Low – Moderate** Suitable foraging habitat was present in the form of winter flowering species particularly *Eucalyptus robusta* (Swamp Mahogany).	**Yes**
Neophema pulchella Turquoise Parrot	TSC Act-V	Lives on the edges of Eucalypt woodland adjoining clearings and on timbered ridges and creeks in farmland. It has also been recorded utilising roadside verges and orchards. Nests in small hollow branches of Eucalypts.	**Low** Only marginal habitat was considered to be present within the study area. This parrot would be an infrequent visitor to the local area.	**Yes**
Glossopsitta pusilla Little Lorikeet	TSC Act-V	Tall Open Forests, woodlands, orchards, parks and street trees.	**High – recorded on site.** Suitable foraging and nesting habitat was considered to be present over much of the study area.	**Yes**
Calyptorhynchus lathami Glossy Black-Cockatoo	TSC Act-V	Lowland coastal forests, dense mountain forests, semi-arid woodland and trees bordering watercourses, with (Allo)Casuarina trees for foraging.	**Low** Only marginal transitory habitat is present within the study area. A small number of *Casuarina glauca* (Swamp Oak) trees a suitable foraging species was present.	**Yes**
Callocephalon fimbriatum Gang-gang Cockatoo	TSC Act-V	Tall montane forests and woodlands in mature wet sclerophyll forests. Requires hollows in which to breed between October and January. This Cockatoo species would be an infrequent visitor to the local area.	**Low** Suitable foraging habitat was present. This species is unlikely to nest within the local area.	**Yes**
Apus pacificus Fork-tailed Swift	EPBC Act-M	Inhabits the airspace over open country from semi deserts to coasts.	**Moderate** Due to the non-specific habitat requirements habitat was present	**No**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
			within airspace above the study area.	
Hirundapus caudacutus White-throated Needletail	EPBC Act-M	Inhabits the airspace above forests, woodlands, farmlands, plains, lakes, coasts and towns.	**Moderate** Due to the non-specific habitat requirements habitat was present within airspace above the study area.	**No**
Monarcha melanopsis Black-faced Monarch	EPBC Act-M	Utilises a range of habitats including rainforests, eucalypt woodlands, coastal scrubs (Pizzey & Knight, 2001).	**Low-Moderate** Suitable habitat was present over the majority of the study area.	**No**
Monarcha trivirgatus Spectacled Monarch	EPBC Act-M	Wet forests, thickly wooded gullies, waterside vegetation and mangroves.	**Moderate** Suitable habitat was present within more thickly wooded parts of the study area.	**No**
Merops ornatus Rainbow Bee-eater	EPBC Act-M	Inhabits areas such as open woodlands with sandy soils, sand ridges, riverbanks, beaches, dunes, cliffs and rainforests.	**Low-Moderate** Suitable foraging habitat was present over the majority of the study area. No preferred nesting habitat was present.	**No**
Rhipidura rufifrons Rufous Fantail	EPBC Act-M	Utilises a range of habitats including rainforests, wet sclerophyll forests, monsoon forests, scrubs, mangroves, watercourses, parks and gardens. During migration this species also utilises farms, street trees and buildings (Pizzey & Knight, 2001).	**High – recorded within study area.** Suitable foraging and nesting habitat was considered to be present.	**No**
Epthianura albifrons White-fronted Chat	TSC Act-V	Occurs mostly in the southern half of NSW, occurring in damp open habitats along the coast, and near waterways in the western part of the state	**Low** Marginal habitat was present within the north of the study area.	**Yes**
Petroica boodang Scarlet Robin	TSC Act-V	The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its	**Low** Only marginal habitat was considered to be present within areas of open forest. This	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
		habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees.	species is more commonly found inland from the coast.	
Petroica phoenicea Flame Robin	TSC Act-V	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes and prefers clearings or areas with open understoreys. In winter, birds migrate to drier more open habitats in the lowlands including dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees.	**Low** Only marginal habitat was considered to be present within areas of open forest. This species is more commonly found inland from the coast.	**Yes**
Climacteris picumnus victoriae Brown Treecreeper	TSC Act-V	Occupies Eucalypt woodlands, particularly open woodlands lacking a dense understorey, River Red Gums on watercourses and around lakeshores. It is sedentary and nests in tree hollows within permanent territories.	**Unlikely** This Treecreeper species is more commonly found inland from the coast and would be unlikely to be present within the study area.	**No**
Anthochaera phrygia Regent Honeyeater	TSC Act-Crit-E EPBC Act- Crit-E & M	Temperate woodlands and open forest, including forest edges, preferring to forage on large-flowered Eucalypts. Was recorded in June 2014 feeding on flowering specimens of *Eucalyptus robusta* (Swamp Mahogany) at Tanilba Bay Sailing Club (Port Stephens Examiner, 2014).	**Low-Moderate** Suitable foraging habitat was present in the form of flowering myrtaceous species particularly the winter flowering *Eucalyptus robusta* (Swamp Mahogany).	**Yes**
Daphoenositta chrysoptera Varied Sittella	TSC Act-V	Open eucalypt woodland/forest, mallee, inland acacia, coastal tea-tree scrubs, golf courses, orchards and parks.	**High** Suitable foraging habitat and nesting habitat was present.	**Yes**
Melithreptus gularis gularis Black-chinned Honeyeater	TSC Act-V	Usually found on the western side of the Great Dividing Range in dry sclerophyll forests and woodlands containing box-ironbark associations and River Red Gum. In the Hunter Valley this species is known to utilise drier coastal woodlands. Usually found in open woodlands.	**Low** Only marginal habitat was considered to be present for this woodland bird.	**Yes**
Pomatostomus temporalis temporalis Grey-crowned Babbler	TSC Act-V	Open forest, woodland, scrubland, farmland and outer suburbs. Prefers woodlands with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. One old record from 1978 exists within the Worimi Conservation Areas in the vicinity of	**Low** Marginal habitat occurs within the cleared grassy area with scattered trees in the far north-	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
		Boyces Track.	east of the study area.	
Dasyornis brachypterus Eastern Bristlebird	TSC Act-E EPBC Act-E	Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey.	**Unlikely** No known local records.	**No**
Circus assimilis Spotted Harrier	TSC Act-V	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	**Unlikely** This species is not usually associated with forested habitat of the coast.	**No**
Pandion cristatus Eastern Osprey	TSC Act-V	Open and swamp forest adjacent to the coast or estuaries, fishing mainly in brackish or salt water. This species is known to inhabit the Port Stephens area.	**Low** Hunting habitat was absent. Large trees within the study area may provide suitable nesting habitat.	**Yes**
Lophoictinia isura Square-tailed Kite	TSC Act-V	The Square-tailed Kite inhabits Open Forests and Woodlands, particularly those on fertile soils with abundant passerines. They may also range into nearby open habitats but not into extensive treeless regions.	**Moderate** Due to the generalist habitat requirements of this species habitat was considered to be present.	**Yes**
Erythrotriorchis radiatus Red Goshawk	TSC Act-E4A EPBC Act - V	In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers.	**Low** Suitable habitat was present.	**Yes**
Hieraaetus morphnoides Little Eagle	TSC Act-V	The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993; Aumann 2001a). For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	**Moderate** Due to the generalist requirements of this species habitat was considered to be present within the site.	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
Haliaeetus leucogaster White-bellied Sea Eagle	TSC Act-V EPBC Act-M	Occupies habitat characterised by the presence of large areas of open water and feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans. The nests are built in a variety of sites including tall trees, bushes, mangroves, cliffs, rocky outcrops, caves, crevices, on the ground or even in artificial structures.	**High – Recorded flying over study area.** Nesting habitat was present. No preferred hunting habitat was present.	**Yes**
Ninox connivens Barking Owl	TSC Act-V	This species is found in forest and woodland, encountered most commonly in savanna and paperbark woodlands. It sometimes roosts in rainforests, but it requires the more open country for hunting and hollow Eucalypts for breeding.	**Moderate** Suitable hunting and limited roosting habitat was present within the study area.	**Yes**
Ninox strenua Powerful Owl	TSC Act-V	Inhabits a wide range of vegetation types from wet Eucalypt forests with a Rainforest understorey to Dry Open Forests and Woodlands. The species has been recorded utilising disturbed habitats such as exotic pine plantations and large trees in parks and gardens. Powerful Owls nest in a slight depression in the wood-mould on the base of a cavity in a large old tree, sometimes in excess of 25 metres above the ground.	**High – Likely pellet found within the study area.** Suitable hunting, roosting and nesting habitat was present.	**Yes**
Tyto longimembris Eastern Grass Owl	TSC Act-V	This species roost and nest on the ground, in crops or in thick grass tussock often associated with swamps.	**Low** Marginal hunting and roosting habitat was present in the north of the study area.	**Yes**
Tyto novaehollandiae Masked Owl	TSC Act-V	A range of wooded habitats that contain mature trees with large hollows for roosting and nesting, and more open areas for hunting.	**Moderate-High** Suitable hunting, roosting and nesting habitat was present.	**Yes**
Tyto tenebricosa Sooty Owl	TSC Act-V	Prefers dense dimly-lit forests, inhabiting pockets of rainforest and wet sclerophyll forest mainly in mountainous areas, often in south-east facing gullies.	**Unlikely** Due to the lack of rainforest and tall wet sclerophyll forest the Sooty Owl would be considered unlikely to be present.	**No**
Planigale maculata Common Planigale	TSC Act-V	In NSW it is found along the coastal strip, occupying a variety of habitats ranging from rainforest, wet and dry sclerophyll forests to grasslands, marshlands and rocky areas.	**Low** Suitable habitat was present within the study area. Few records for this species are known from the locality.	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
Dasyurus maculatus maculatus Tiger Quoll	TSC Act-V	Inhabits sclerophyll forests, rainforests and coastal woodlands. Nests are made in rock caves and hollow logs or trees, and basking sites are usually found nearby.	**Moderate - High** Suitable habitat was present over a large portion of the study area.	**Yes**
Phascogale tapoatafa Brush-tailed Phascogale	TSC Act-V	Sparsely distributed outside the semi-arid zone in dry sclerophyll forest and monsoonal forest and woodland.	**Low** Foraging and nesting habitat was present over much of the study area. Locally this species prefers rough barked (Woodland containing Ironbark species).	**Yes**
Phascolarctos cinereus Koala	TSC Act-V EPBC Act – V (NSW & Qld)	Coastal woodland and open forest containing suitable food trees.	**High – Some evidence of Koala activity.** Preferred feed tree, *Eucalyptus robusta* (Swamp Mahogany) was present within the north of the study area.	**Yes**
Macropus parma Parma Wallaby	TSC Act-V	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	**Unlikely** Suitable habitat was considered to be present, however due to the lack of local records this species would be unlikely to be present.	**No**
Petrogale penicillata Brush-tailed Rock-wallaby	TSC Act – E1 EPBC Act – E	Found in steep rocky sites in sclerophyll forests with a grassy understorey.	**Unlikely** No suitable habitat was present.	**No**
Aepyprymnus rufescens Rufous Bettong	TSC Act-V	Occupies a variety of habitats ranging from coastal Eucalypt forests to tall Wet Sclerophyll Forests along the east coast of Australia. West of the Great Dividing Range it occupies Low Open Woodland. It tends to favour those areas where there is a sparse or grassy understorey.	**Low** Suitable habitat was considered to be present. Due to the absence of local records the occurrence of this species would be low.	**Yes**
Potorous tridactylus tridactylus Long-nosed Potoroo	TSC Act-V	This species is known from a variety of habitats, including Rainforest, Open Forests and Woodlands with dense groundcover, and dense, wet coastal heathlands. Soft (often sandy) substrates are preferred by this species.	**Low - Moderate** Suitable habitat was available within the study area. Records known from Williamtown (RPS Harper Somers O'Sullivan,	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
			2009).	
Cercartetus nanus Eastern Pygmy-possum	TSC Act-V	Feeds mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit. Hollow bearing trees are favoured for shelter and nesting although spherical nests constructed of short shredded bark have been found between the wood and bark of eucalypts. This species has been recorded north of Fern Bay within Coastal Sand Blackbutt Forest (Umwelt, 2004).	**Low - Moderate** Foraging and nesting habitat was present.	**Yes**
Petaurus australis Yellow-Bellied Glider	TSC Act-V	This species occupies tall, mature wet eucalypt forest.	**Low** Foraging and nesting habitat was present. No known local records.	**Yes**
Petaurus norfolcensis Squirrel Glider	TSC Act-V	Dry sclerophyll forests and woodlands with exudates for foraging and hollows for nesting.	**High – Recorded within Study Area.** Foraging and nesting habitat was present over a large portion of the study area.	**Yes**
Pseudomys gracilicaudatus Eastern Chestnut Mouse	TSC Act-V	Found in heathland, wet heathland and swamps.	**Low** Only marginal habitat was present. No known local records.	**Yes**
Psuedomys novaehollandiae New Holland Mouse	EPBC Act – E	Known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes.	**Moderate - High** Suitable habitat was present within the more open sandy vegetated parts of the study area.	**No – Not listed under TSC Act. Assessed in Section 11.**
Pteropus poliocephalus Grey-headed Flying-Fox	TSC Act-V EPBC Act-V	Wet and Dry Sclerophyll Forests, Rainforest, Mangroves and Paperbark swamps and Banksia Woodlands.	**High – Recorded within study area.** Seasonal foraging habitat was present over the majority of the study area. Roosting habitat was also likely to be present.	**Yes**
Syconycteris australis	TSC Act-V	Occurs within coastal areas of northeast NSW and eastern	**Low**	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
Common Blossom-bat		Queensland. Often roost in littoral rainforest and feed on flowers in adjacent heathland and paperbark swamps. Has been recorded just north of Hawks Nest (Wildthing Environmental Consultants, 2012).	Suitable habitat was present within the study area. The study area would be considered to be outside the southern limit of the distribution of this species.	
Kerivoula papuensis Golden-tipped Bat	TSC Act-V	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. It is also recorded in tall open forest. This species roosts mainly in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests, also in tree hollows, dense foliage and epiphytes; located in rainforest gullies on small first and second-order streams. There is a paucity of local record of this species.	**Low** Suitable hunting and roosting habitat was present.	**Yes**
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	TSC Act-V	This microchiropteran bat species occupies a range of habitats including eucalypt forests, Mallee or open country. Roosts in tree hollows, animal burrows, dry clay cracks, under rock slabs and in abandoned Sugar Glider nests.	**Moderate** Suitable hunting and roosting habitat was present.	**Yes**
Mormopterus norfolkensis East Coast Freetail-bat	TSC Act-V	This species appears to live in Sclerophyll Forests and Woodland. Roosts in tree hollows or under loose bark.	**High** Suitable hunting and roosting habitat was present.	**Yes**
Falsistrellus tasmaniensis Eastern False Pipistrelle	TSC Act-V	Inhabits sclerophyll forests from the Great Divide to the east coast. A preference has been noted for wet habitats where trees are more than 20m high. It has been observed roosting in holes and hollow trunks of Eucalypts.	**High – Recorded within the study area.** Suitable hunting and roosting habitat was present.	**Yes**
Miniopterus australis Little Bentwing-bat	TSC Act-V	Tropical Rainforest to warm-temperate Wet and Dry Sclerophyll Forest; caves or similar structures for roosting.	**High – recorded within the study area.** Suitable hunting habitat was present. The study area lacked preferred roosting habitat.	**Yes**
Miniopterus schreibersii oceanensis Large Bentwing-bat	TSC Act-V	Wet and Dry Tall Open Forest, Rainforest, Monsoon Forest, Open Woodland, Paperbark Forests and Open Grasslands; caves or similar structures for roosting. It occasionally uses tree hollows.	**High – recorded within the study area.** Suitable hunting habitat was present. No preferred roosting habitat was present.	**Yes**

SPECIES	STATUS	HABITAT DESCRIPTION AND LOCALLY KNOWN POPULATIONS	LIKELYHOOD OF OCCURRENCE WITHIN THE STUDY AREA	7-PART TEST REQUIRED
Myotis macropus Eastern Myotis	TSC Act-V	Various habitats of the coast and adjacent ranges with suitable waterbodies for hunting; caves or similar structures for roosting. It occasionally uses tree hollows.	**Moderate** Suitable hunting habitat was present on site.	**Yes**
Scoteanax rueppellii Greater Broad-nosed Bat	TSC Act-V	Tree-lined creeks, woodland/clearing ecotones and rainforest creeks, roosting mainly in tree hollows.	**High – Possible calls recorded during bat call survey.** Suitable hunting and roosting habitat was present.	**Yes**
Chalinolobus dwyeri Large-eared Pied Bat	TSC Act-V	This species has been found occupying Dry Sclerophyll Forest and Woodland. Roosts in caves, abandoned mud-nests of Fairy Martins and mine tunnels.	**Low** Suitable hunting habitat was present. No roosting habitat was available.	**Yes**
Vespadelus troughtoni Eastern Cave Bat	TSC Act-V	The Eastern Cave Bat roosts in caves and occurs in wet/dry sclerophyll forests to the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally buildings.	**Low** Suitable hunting habitat was present. No roosting habitat was available.	**Yes**
Emu population in the NSW North Coast Bioregion and Port Stephens LGA.		Predominantly open habitats, including plains, grasslands, woodlands and scrubs, and may occur occasionally in forest.	**Low** Suitable habitat was present. Few local records.	**Yes**

6.3 FAUNA APPRAISAL RESULTS

A full list of fauna species observed during the survey is contained in Appendix D.

6.3.1 SMALL TERRESTRIAL MAMMAL TRAPPING

During this component of the survey four species of mammal, *Antechinus stuartii* (Brown Antechinus), *Rattus lutreolus* (Swamp Rat), *Rattus rattus* (Black Rat) and *Mus musculus* (House Mouse) were captured. Both *R. rattus* and *M. musculus* are introduced species. No specimens of the expected native *Rattus fuscipes* (Bush Rat) were captured during either trapping period. Specimens of *R. fuscipes* were captured in 2017 during a fauna survey with the adjoining Lot 255 (Wildthing Environmental Consultants, 2017). The results of the small terrestrial mammal survey are shown in Table 11.

Table 11: Small Terrestrial Mammal Trapping Results.

DATE	TRAP NO	SPECIES	SEX
Trapping period 15 – 19 April 2013			
Tuesday 16/04/13	T7	*Antechinus stuartii* (Brown Antechinus)	Male
	T14	*A. stuartii*	Male
	T15	*A. stuartii*	Male
Wednesday 17/04/13	T7	*A. stuartii*	Male
	T9	*A. stuartii*	Male
	T11	*A. stuartii*	Male
	T12	*A. stuartii*	Female
	T14	*A. stuartii*	Male
	T28	*A. stuartii*	Male
	T32	*A. stuartii*	Male
Thursday 18/04/13	T2	*A. stuartii*	Male
	T11	*A. stuartii*	Female
	T23	*A. stuartii*	Female
	T25	*A. stuartii*	Male
	T29	*A. stuartii*	Female
	T33	*A. stuartii*	Male
	T35	*A. stuartii*	Male
Friday 19/04/13	T1	*A. stuartii*	Female
	T3	*A. stuartii*	Male
	T9	*A. stuartii*	Male
	T25	*A. stuartii*	Male
	T29	*A. stuartii*	Male
	T33	*A. stuartii*	Male
Trapping period 26 – 30 May 2014			
Tuesday 27/05/14	T13	*A. stuartii*	Female
	T21	*A. stuartii*	Male
	T23	*A. stuartii*	Female
	T29	*A. stuartii*	Male
	T33	*A. stuartii*	Male
	T37	*A. stuartii*	Male
Wednesday 28/05/14	T19	*A. stuartii*	Female
	T23	*A. stuartii*	Male
	T24	*A. stuartii*	Female
	T35	*A. stuartii*	Male
	T40	*Rattus lutreolus* (Swamp Rat)	Male
	T42	*A. stuartii*	Male
Thursday 29/05/14	T37	*A. stuartii*	Male
	T39	*Rattus rattus* (Black Rat)	Male
	T48	*A. stuartii*	Male

DATE	TRAP NO	SPECIES	SEX
	T50	*A. stuartii* *Mus musculus* (House Mouse)	Male
Friday 30/05/14	T11 T12 T14 T24 T26 T29 T37 T39 T41 T42 T50	*A. stuartii* *A. stuartii* *A. stuartii* *A. stuartii* *A. stuartii* *A. stuartii* *R. rattus* *A. stuartii* *M. musculus* *A. stuartii* *A. stuartii*	Female Male Female Female Male Female Male Male Male Male Male

6.3.2 MEDIUM TERRESTRIAL MAMMAL TRAPPING

During this component of the survey no fauna species were captured. A small number of cages had been disturbed. The disturbance would likely be attributed to the European Red Fox, Feral Dogs or the Common Brushtail Possum.

6.3.3 ARBOREAL MAMMAL TRAPPING

During this component of the survey two species of mammal *Petaurus norfolcensis* (Squirrel Glider) and *Antechinus stuartii* (Brown Antechinus) were captured. *Petaurus norfolcensis* is listed as vulnerable under the TSC Act (1995) and has been further assessed within Section 7 and Appendix E of this report. The results of the arboreal mammal trapping survey are shown in Table 12. The locations of the trapped Squirrel Gliders are shown in Figure 16.

Table 12: Arboreal Mammal Trapping Results.

DATE	TRAP NO	SPECIES	SEX
Trapping period 15 – 19 April 2013			
Tuesday 16/04/13		No captures	
Wednesday 17/04/13	A7	*Antechinus stuartii* (Brown Antechinus)	Female
Thursday 18/04/13	A10	*A. stuartii*	Male
Friday 19/04/13		*A. stuartii*	Male
Trapping period 26 – 30 May 2014			
Tuesday 27/05/14	A2	*Petaurus norfolcensis* (Squirrel Glider)	Male
Wednesday 28/05/14	A4	*P. norfolcensis*	Male
Thursday 29/05/14	A2	*P. norfolcensis* *P. norfolcensis*	Male Male
Friday 30/05/14		No captures	

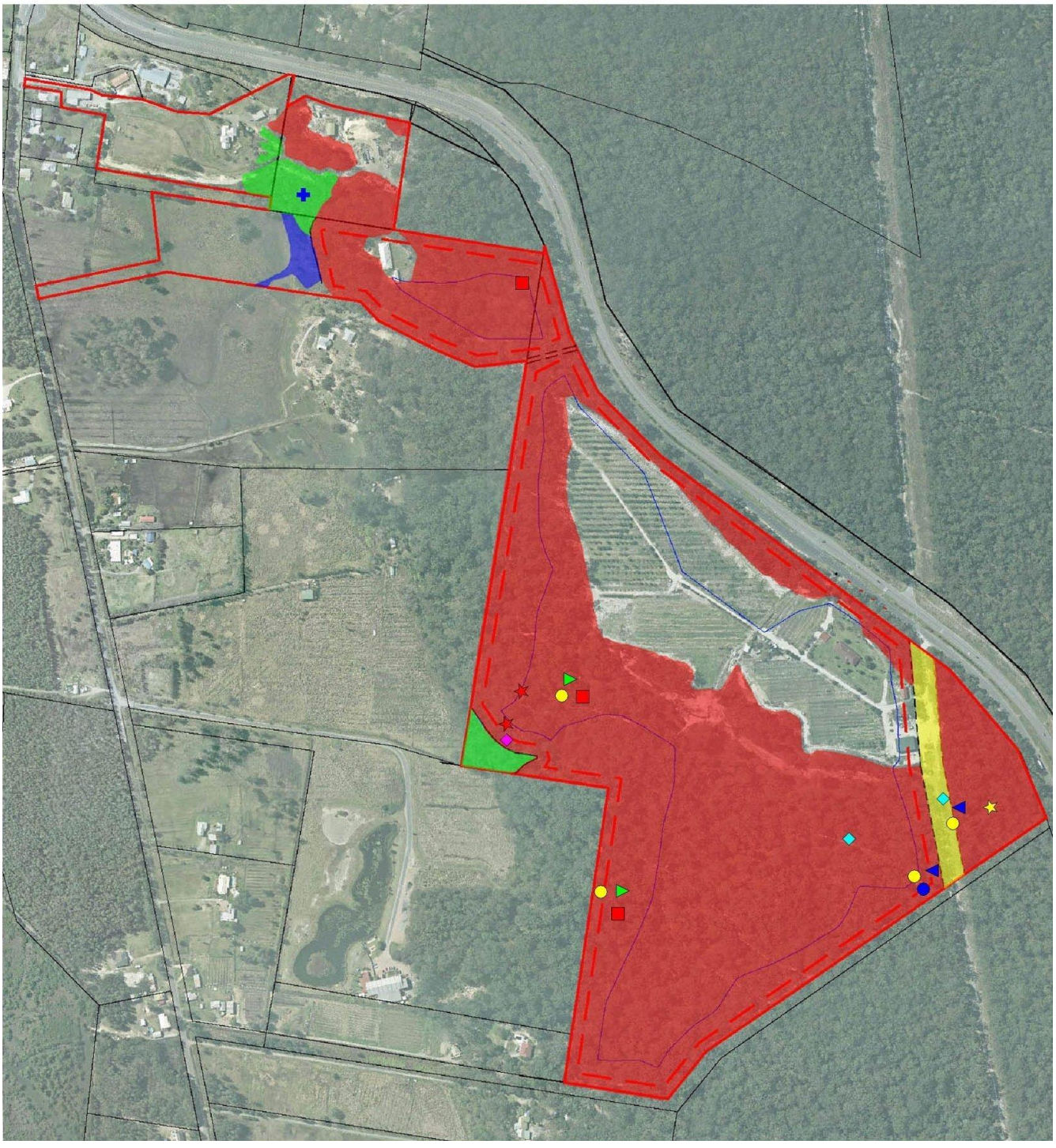


Figure 16: Location of threatened fauna species recorded within the study area during fieldwork

6.3.4 HARP TRAPPING

During the harp trapping component of the survey two species of microchiropteran bat; *Vespadelus vulturnus* (Little Forest Bat) and *Miniopterus australis* (Little Bentwing-bat) were captured. *Miniopterus australis* is listed as a Vulnerable species under the TSC Act 1995 and has been further assessed in Section 7.0 and Appendix E. The results of the harp trapping survey are shown in Table 13. The location of this threatened microchiropteran bat species is shown in Figure 16.

Table 13: Harp Trapping Results.

DATE	TRAP NO.	SPECIES	SEX
21/05/13	Trap 1	No captures	
	Trap 2	No captures	
13/11/13	Trap 1	No captures	
	Trap 2	No captures	
29/04/14	Trap 1	No captures	
	Trap 2	No captures	
27/11/14	Trap 1	No captures	
	Trap 2	*Vespadelus vulturnus* (Little Forest Bat) *V. vulturnus* *Miniopterus australis* (Little Bentwing-bat)	Female Male Female
22/01/15	Trap 1	No captures	
	Trap 2	No captures	

6.3.5 MICROCHIROPTERAN BAT CALL DETECTION

Seven species of microchiropteran bat, *Chalinolobus gouldii* (Gould's Wattled Bat), *Chalinolobus morio* (Chocolate Wattled Bat), *Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Large Bentwing-bat), *Mormopterus* sp. 2, *Austronomus australis* (White-striped Freetail Bat) and *Falsistrellus tasmaniensis* (Eastern Falsistrelle) were positively identified during the bat call survey. Probable calls from *Miniopterus schreibersii oceanensis* and possible calls from *Scoteanax rueppellii* (Greater Broad-nosed Bat) were also identified.

A number of calls attributed to the Genus *Nyctophilus* were likely to be either *N. geoffroyi* (Lesser Long-eared Bat) or *N. gouldi* (Gould's Long-eared Bat). One species, *Nyctophilus gouldii* (Gould's Long-eared Bat) was found dead within the brick building in Lot 10 during a previous survey (Wildthing Environmental Consultants, 2008). Calls attributed to the Genus Vespadelus were probably *Vespadelus vulturnus* (Little Forest Bat) which was captured during the trapping survey.

Four of these microchiropteran bat species; *F. tasmaniensis, M. australis, M. schreibersii oceanensis* and *S. rueppellii* are listed as vulnerable under the TSC Act (1995) and have been further assessed within Section 7.0 and Appendix E of this report. The results of the Bat Call Surveys survey are shown in Table 14. The locations of these threatened microchiropteran bat species are shown in Figure 16.

Table 14: Microchiropteran Bat Call Survey Results.

SPECIES	NUMBER OF CALLS		
	Definite	**Probable**	**Possible**
21/05/13 E - 406343, N - 6372986			
Chalinolobus gouldii		2	
Miniopterus schreibersii oceanensis		2	
Austronomus australis	2	1	
Miniopterus australis	1	3	
Nyctophilus sp.	4	2	
Vespadelus sp.	13	11	71
Noise	36		
Unidentifiable	4		
30/05/13 E – 407298, N - 6373820			
Chalinolobus morio	6	4	
Chalinolobus gouldii	1		2
Vespadelus sp.		2	1
Nyctophilus sp.		1	
Unidentifiable	4		
Blank	1		
Noise	3		
03/09/13 E – 406600, N - 6373460			
Chalinolobus gouldii	128	12	9
Vespadelus sp.		2	
Falsistrellus tasmaniensis	10	5	
Scoteanax rueppellii			2
Nyctophilus sp.		2	
Miniopterus australis	3		
Blank	1		
Noise	7		

SPECIES	NUMBER OF CALLS		
	Definite	**Probable**	**Possible**
13/11/13 E – 406330, N - 6373409			
Falsistrellus tasmaniensis	23	14	4
Vespadelus sp.	31	16	3
Chalinolobus gouldii	14	12	1
Chalinolobus morio		5	1
Mormopterus sp. 2		5	3
Scoteanax rueppellii			1
Miniopterus australis	1		
Unidentifiable	6		
Noise	7		
29/04/14 E – 406498, N - 6373149			
Vespadelus sp.	4	8	2
Mormopterus sp. 2	1	2	
Chalinolobus gouldii	2	1	
Noise	11		
27/11/14 E – 406438, N - 6372935			
Chalinolobus gouldii	32	7	5
Miniopterus australis	4		
Miniopterus schreibersii oceanensis	1		
Nyctophilus sp.	3		
Vespadelus sp.	10	2	
Chalinolobus morio	2	2	
Unidentifiable	12		
Noise	41		
Blank	6		
22/01/15 E – 407135, N - 6373514			
Chalinolobus gouldii	22	3	
Nyctophilus sp.	4		
Vespadelus sp.	47	15	
Chalinolobus morio	3	3	

SPECIES	NUMBER OF CALLS		
	Definite	**Probable**	**Possible**
Falsistrellus tasmaniensis	2		
Unidentifiable	10		
Noise	20		
Blank	1		

6.3.6 AMPHIBIAN SURVEY

Eight species of amphibian, *Pseudophryne bibroni* (Brown Toadlet), *Crinia signifera* (Common Eastern Froglet), *Limnodynastes peronii* (Striped Marsh Frog), *Litoria fallax* (Dwarf Green Tree Frog), *Litoria peronii* (Peron's Tree Frog), *Litoria jervisiensis* (Jervis Bay Tree Frog), *Litoria tyleri* (Tyler's Tree Frog) and *Paracrinia haswelli* (Haswell's Froglet) were recorded during targeted and incidental surveys.

None of these amphibian species are regarded as threatened according to State or National legislation.

No specimens of *Uperoleia mahonyi* (Mahony's Toadlet) were recorded within the study area during targeted surveys undertaken by Dr Simon Clulow on the evenings of 7 & 9 November 2017. The surveys were conducted following rain, within areas of Freshwater Wetland and Swamp Sclerophyll Forest in the north-east of the site, which were considered to be the most likely habitat for *U. mahonyi*. Rain was also recorded later in the evening on 7 November 2017. A visit to the reference site at Oyster Cove (type locality for *U. mahonyi*) on 7 November 2017 found no specimens of *U. mahonyi* to be calling. As a result, the second survey was conducted on the 9 November 2017 to possibly increase the chances of recording the species. A visit to the reference site at Oyster Cove on 9 November 2017 found 3-4 specimens of *U. mahonyi* to be calling intermittently. Other amphibian species recorded within the site by Dr Simon Clulow were *Limnodynastes peronii*, *C. signifera* and *L. fallax*.

6.3.7 REPTILE SURVEY

Thirteen species of reptile were identified within the study area during targeted and incidental surveys: *Dendralaphis punctulata* (Green Tree Snake), *Morelia spilota spilota* (Diamond Python), *Cryptophis nigrescens* (Small-eyed Snake), *Varanus varius* (Lace Monitor), *Lampropholis delicata* (Grass Skink), *Ctenotus robustus* (Striped Skink), *Ctenotus taeniolatus* (Copper-tailed Skink), *Anomalopus swansoni* (Swanson's Legless Lizard), *Saiphos equalis* (Three-toed Skink), *Bellatorias major* (Land Mullet), *Eulamphrus tenuis* (Bar-sided Skink), *Amphibolurus muricatus* (Jacky Lizard) and *Pogona barbata* (Bearded Dragon). One specimen of *M. spilota spilota* was observed basking in the sun on a cold morning in the far north of the study area. One specimen of *C. nigrescens* was found under a log. *Varanus varius* was commonly encountered during fieldwork and was captured on

the remote camera on many occasions. Large scratches on the trunks of trees would be largely attributed to *V. varius*. *Anomalopus swansoni* was found to be a relatively common burrowing reptile within the top layer of sandy soil within dry areas of sclerophyll forest. Two trapped specimens of *B. major* were rescued from an old brick structure in the far east of the site. A number of specimens of *Eulamphrus tenuis* were observed on the trunks of trees containing hollows and crevices. Two forms of *C. robustus* have been recorded within the study area, the typical striped patterned form and an atypical unmarked form. The unmarked form of *C. robustus* was recorded during the previous survey of Lot 10 (Wildthing Environmental Consultants, 2009).

Other common reptile species that would likely utilise the study area are *Pseudechis porphyriacus* (Red-bellied Black Snake) and *Tiliqua scincoides scincoides* (Eastern Blue-tongued Lizard). One deceased specimen of *T. scincoides scincoides* was found on the side of Nelson Bay Road adjacent to the study area.

None of these reptile species are regarded as threatened according to State or National legislation.

6.3.8 DIURNAL AVIFAUNA SURVEY

An array of avifauna species was found to be present within the various habitats across study area.

Within the Open Forest areas avifauna species commonly encountered included *Rhipidura fuliginosa* (Grey Fantail), *Malurus cyaneus* (Superb Fairy-wren), *Cracticus torquatus* (Grey Butcherbird), *Cormobates leucophaea* (White-throated Treecreeper), *Lichenostomus chrysops* (Yellow-faced Honeyeater), *Philemon corniculatus* (Noisy Miner), *Philemon corniculatus* (Noisy Friarbird), *Platycercus eximius* (Eastern Rosella) and *Todiramphus sancta* (Sacred Kingfisher).

Avifauna species commonly encountered within the more sheltered gullies and areas of swamp forest included *Meliphaga lewinii* (Lewin's Honeyeater), *Acanthiza pusilla* (Brown Thornbill) and *Columba leucomela* (White-headed Pigeon).

Common species observed within the open pasture/grassland areas in the north of the study area included *Ardea ibis* (Cattle Egret), *Egretta novaehollandiae* (White-faced Heron) and *Threskiornis spinicollis* (Straw-necked Ibis).

Birds of prey recorded included *Haliastur sphenurus* (Whistling Kite), *Accipiter novaehollandiae* (Grey Goshawk), *Haliaeetus leucogaster* (White-breasted Sea-Eagle), *Falco cenchroides* (Australian Kestrel) and *Aquila audax* (Wedge-tailed Eagle). An immature *H. sphenurus* was recorded on a remote camera on a number of occasions.

Glossopsitta pusilla (Little Lorikeet) listed as vulnerable under the TSC Act (1995) was observed on two occasions within open forest within the south of the study area. The recently listed *Haliaeetus*

leucogaster (White-bellied Sea-eagle) was also observed flying over the study area on a number of occasions. These threatened species have been further assessed within Section 7 and Appendix E of this report. The location of the Little Lorikeet within the study area is shown in Figure 13.

Rhipidura rufifrons (Rufus Fantail), *Haliaeetus leucogaster* (White-bellied Sea-eagle) and *A. ibis* are recognised as Migratory Bird species under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and have been further addressed in Section 11 of this report.

All birds observed within the study area during this and the previous surveys are indicated in the Total Fauna Species List contained in Appendix D.

6.3.9 NOCTURNAL AVIFAUNA SURVEY

Ninox boobook (Southern Boobook) was commonly heard calling during nocturnal surveys. *Podargus strigoides* (Tawny Frogmouth) was also observed and heard calling from within the site. *Podargus strigoides* was recorded within the site during a previous survey (Wildthing Environmental Consultants, 2002). There were no responses as a result of the owl calls played during the survey.

6.3.10 SPOTLIGHTING SURVEY

Four species of native mammal *Trichosurus vulpecula* (Common Brushtail Possum), *Wallabia bicolor* (Swamp Wallaby), *Acrobates pygmaeus* (Feathertail Glider) and *Pteropus poliocephalus* (Grey-headed Flying-fox) were observed within the site during the spotlighting surveys. *Trichosurus vulpecula* was found to be very common over the majority of the site. Large numbers of *P. poliocephalus* were observed to be foraging within the site during January and February 2015 when the dominant canopy species *Eucalyptus pilularis* (Blackbutt) was flowering. These Megachiropteran bats were observed to be originating from a relatively large temporary camp approximately 2km east of the study area within a heavily vegetated area near the intersection of Cromarty and Upton Lanes.

There were no responses as a result of the mammal calls played during the survey.

The Grey-headed Flying-fox is listed as 'Vulnerable' under both state and national legislation and has been further addressed in Sections 7, 11 and Appendix E of this report.

6.3.11 STAGWATCHING SURVEY

A number of specimens of *Trichosurus vulpecula* were observed during the stag watching survey.

6.3.12 PREDATOR SCAT AND OWL PELLET ANALYSIS

A small number of predator scats and owl pellets were found within the study area during the survey period. The scats were collected and sent to Barbara Triggs, an expert in the analysis of scats and their contents. The scats were found to be from a *Vulpes vulpes* (European Red Fox) and a *Canis*

lupus familiaris (Wild Dog) and contained *Trichosurus vulpecula* (Common Brushtail Possum) and *Rattus lutreolus* (Swamp Rat) fur. The Owl pellets contained the remains of *R. lutreolus* and *T. vulpecula*. The state of the bone fragments containing the remains of *T. vulpecula* were indicative of a pellet likely belonging to the threatened *Ninox strenua* (Powerful Owl). The results of the predator scat and owl pellet analysis are shown in Table 15.

Table 15: Result of the predator scat and owl pellet analysis.

Sample No.	Date	Location	Sample	Mammal ID (definite)	Mammal ID (probable)
1	13/11/2013	E-406530; N-6373530	old owl pellet	*Trichosurus vulpecula* (Brushtail Possum) Powerful Owl pellet?	
2	21/08/2013	E-406790; N-6373530	old owl pellet	*Rattus lutreolus* (Swamp Rat)	
3	21/08/2013	E-406290; N-6373310	Fox scat	*R. lutreolus*	
4	10/02/2015	E-406359; N-6372933	Dog Scat	*Wallabia bicolor* (Swamp Wallaby)	
5	02/06/15	E-406359; N-6372933	Old Scat	*Trichosurus vulpecula* (Brushtail Possum)	*Trichosurus vulpecula* (Brushtail Possum)
6	29/07/2015	E-406403; N-6373132	Dog? (old scat)	No hairs found	*Felis catus* (claw)

6.3.13 REMOTE CAMERA

A total of fourteen fauna species were positively identified within the study area during the remote camera survey conducted between July 2013 and June 2015. The most common fauna species were *Varanus varius* (Lace Monitor), *Antechinus stuartii* (Brown Antechinus), *Trichosurus vulpecula* (Common Brushtail Possum) and *Wallabia bicolor* (Swamp Wallaby). One specimen of the threatened *Petaurus norfolcensis* (Squirrel Glider) was recorded on the ground in the far west of the study area (Figure 15). Introduced species recorded were *Felis catus* (Feral Cat), *Vulpes vulpes* (European Red Fox), *Canis lupus familiaris* (Wild Dog) and *Lepus capensis* (European Hare). Predation by Feral Dogs and Cats and the European Red Fox is recognised as 'key threatening processes' under the TSC Act 1995. The results of the remote camera survey are shown in Table 16.

6.3.14 INCIDENTIAL OBSERVATIONS AND SECONDARY INDICATIONS

A number of incidental observations and secondary indications of fauna were observed during the survey and included:

- A large number of small conical diggings attributed to Bandicoot species *Perameles nasuta* (Long-nosed Bandicoot) or *Isoodon macrourus* (Northern Brown Bandicoot) were commonly found throughout the study area. Specimens of *I. macrourus* were observed within the study area during the remote camera survey;

Table 16: Fauna species detected by remote camera.

Fauna species	05-07-13 12-07-13 E – 406367 N - 6373319	12-07-13 12-09-13 E – 406529 N - 6373543	28-11-14 11-12-14 E – 406360 N - 6373000	22-01-15 28-01-15 E – 407163 N - 6373578	10-02-15 17-04-15 E – 406403 N - 6372879	20-04-15 04-06-15 E – 407260 N - 6373835
Amphibolurus muricatus (Jacky Lizard)			R			
Varanus varius (Lace Monitor),			C		C	
Tachyglossus aculeatus (Echidna)			R			
Cracticus torquatus (Grey Butcherbird)	C					
Haliastur sphenurus (Whistling Kite),					O	
Antechinus stuartii (Brown Antechinus)	C		C	O	C	
Isoodon macrourus (Northern Brown Bandicoot)		O				R
Wallabia bicolor (Swamp Wallaby)		C			C	
Petaurus norfolcensis (Squirrel Glider)					R	
Trichosurus vulpecula (Common Brushtail Possum)	O			O	C	
Lepus capensis (European Hare)		O				
Felis catus (Feral Cat)	O					
Canis lupus familiaris (Wild Dog)			R			
Vulpes vulpes (European Red Fox)	C					

C – Commonly recorded (many occasions)
O - Occasionally recorded (more than once)
R – Rarely recorded (only one record)

- Scats and footprints consistent with that of a macropod were found to be common throughout the site. These Scats and prints were most likely from *Wallabia bicolor* (Swamp Wallaby) which was observed and recorded on remote camera within the study area;
- Diggings consistent with the Echidna were found on the side of some ant nests;
- Large scratches on some of the bigger hollow-bearing trees were attributed to *Varanus varius* (Lace Monitor), and
- Scratches on the trunks of a small number of specimens of *Eucalyptus robusta* (Swamp Mahogany) were found to be consistent with these of *Phascolarctos cinereus* (Koala). The Koala is listed as threatened under state and national legislation and has been assessed in Sections 7, 8, 11 and Appendix E of this report.

6.3.15 SURVEY LIMITATIONS

As with all reports of this type the main survey limitation for the survey is considered to be the relatively short periods of time in which the fieldwork was undertaken. Fieldwork was timed to increase the likelihood of detecting certain subject species such as threatened orchids. Limitations were generally related to the detection of species with large home ranges such as *Dasyurus maculatus* (Tiger Quoll) and Large Forest Owls. Climate variability may also affect the occurrence of some species such as *Lathamus discolor* (Swift Parrot) and *Anthochaera phrygia* (Regent Honeyeater).

Limitations have been overcome by applying the precautionary principle in all cases where the survey methodology may have given a false negative result. This precautionary principle was achieved by recognising that most threatened species are rare and therefore unlikely to be encountered during a survey even if they may utilise the study area at other times. These species have been assessed on the basis of the presence of their habitat and the likely significance of that habitat to a viable local population.

7.0 CONSIDERATIONS UNDER SECTION 5A OF THE EPA ACT

Considerations of the effects of the proposal under the guidelines of Section 5A of the Environmental Planning and Assessment Act (1995) are given in Appendix A. The species, populations and communities dealt with were those species identified on site during the fieldwork and those considered to have potential habitat available within the study area as detailed in Section 5.2.4 of this report.

7.1 ENDANGERED ECOLOGICAL COMMUNITIES

The study area was found to contain two endangered ecological communities:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions.
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions.

Swamp Sclerophyll Forest

Swamp Forest (total area 1.15ha) occurring on lower lying poorly drained ground within the study area was found to be consistent with the Endangered Ecological Community Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions. The area of Paperbark Swamp Forest (0.8ha) was largely contained within Lot 10 in the north of the study area. This assemblage also pushed into the neighbouring Lots 11 and 51. This area was in generally good condition although it had been subject to a number of disturbances from surrounding development and weed incursion. The sloping edge of the access road into the earthmoving business within Lot 10 had been slowly encroaching into this assemblage. Parts of this assemblage on the other side of the access road near the residence had a maintained understorey. The area of Swamp Sclerophyll Forest within Lot 51 had been subject to some grazing and trampling by cattle. Swamp Sclerophyll Forest (0.35ha) located within the far north-west of study area (within Lot 254) was also found to be in relatively good condition. This area of Swamp Sclerophyll Forest containing specimens of *Eucalyptus grandis* (Flooded Gum) also had similarities to another EEC River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions. As a result of the drainage, position in the landscape, understorey species and dominance of the canopy species *Melaleuca quinquenervia* (Broad-leaved Paperbark) it was considered to be closer to Swamp Sclerophyll Forest.

The areas of Swamp Sclerophyll Forest are located outside the proposed mining footprint (15m buffer) and as a consequence will not be directly impacted. The proposed sand mine will require excavation below the groundwater level. An assessment undertaken (Martins, 2015) found drawdown of the permanent groundwater system for this vegetation community within the study area is modelled to be a maximum of approximately 0.07m. Swamp Sclerophyll Forest is an obligate Groundwater

Dependant Community which is exclusively reliant on groundwater. Based on the NSW Aquifer Interference Policy (Department of Primary Industries Office of Water, 2012) and the post Water Sharing Plan the local groundwater natural level range is in the order of 3 m (or more). The adopted permissible drawdown at a 40m buffer from the GDEs is 0.30m (i.e. 10% x 3.00). This drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, based on modelling results, the proposed development does not exceed the drawdown impact criterion set out in the NSW Aquifer Interference Policy (NOW, 2012).

Strict controls will have to be applied to the proposal to prevent any future degradation to the areas of Swamp Sclerophyll Forest. Long-term monitoring of the groundwater levels around the areas of Swamp Sclerophyll Forest is to be undertaken. It is recommended that a vegetation management plan be completed for these areas to ensure the long-term viability of this Endangered Ecological Community. Taking the recommendations into consideration the proposal is unlikely to have an adverse effect on Swamp Sclerophyll Forest that its composition or local occurrence is likely to be placed at extinction.

Freshwater wetlands

Approximately 0.32ha of wetland vegetation occurring on the lower lying poorly drained area in the north of Lot 51 within the study area was found to be consistent with the Endangered Ecological Community Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions. The freshwater wetland was found to intergrade with an area of Paperbark Swamp Forest which was largely contained within the adjoining Lot 10 to the east. The wetland may have originally been derived from the past clearing of Paperbark Swamp Forest. The area of wetland had been subject to disturbance from ongoing grazing and trampling by cattle, with the edges of the wetland having the most disturbance.

As with the areas of Swamp Sclerophyll Forest, the area of Freshwater Wetland is located outside the proposed mining footprint and as a consequence will not be directly impacted. The wetland will have a buffer of 15m to the proposed mining footprint. The proposal will require excavation below the groundwater level. An assessment undertaken (Martins, 2015) found drawdown of the permanent groundwater system for this vegetation community within the study area is modelled to be a maximum of approximately 0.07m. Freshwater Wetlands are an obligate Groundwater Dependant Community which are exclusively reliant on groundwater. Based on the NSW Aquifer Interference Policy (Department of Primary Industries Office of Water, 2012) and the post Water Sharing Plan local groundwater natural level range of the order of 3 m (or more), the adopted permissible drawdown at a 40m buffer from the GDEs is 0.30m (i.e. 10% x 3.00). This drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, based on modelling results, the proposed development does not exceed the drawdown impact criterion set out

in the NSW Aquifer Interference Policy (NOW, 2012).

Strict controls will have to be applied to the proposal to prevent any future degradation to the area of Freshwater Wetland. Long-term monitoring of the groundwater levels around the area of Wetland is to be undertaken. It is recommended that cattle be excluded from the area of wetland. A vegetation management plan to be completed for this area will help ensure the long-term viability of the Endangered Ecological Community within the study area. Given the fact that this relatively small wetland which has been subject to disturbance will not be directly affected, the proposal is unlikely to cause extinction of this endangered ecological community in the locality.

7.2 THREATENED SPECIES

7.2.1 THREATENED FLORA

One threatened flora species *Diuris arenaria* (Tomaree Doubletail) was found to be present within the study area.

Diuris arenaria (Tomaree Doubletail)

A total of 108 individual specimens of *Diuris arenaria* (Tomaree Doubletail) were recorded within the study area as a result of targeted surveys undertaken in 2013, 2014 & 2016 during the known flowering period (August/September) for this orchid species. With the exception of one plant (No. 14) occurring approximately 6m to the north of the electrical easement, the remaining specimens of *D. arenaria* were found to be confined to the maintained electrical easement in the far west of the study area. The locations of *D. arenaria* were largely consistent with those mapped for the Tomago to Tomaree Electricity Easement Upgrade (ERM, 2003). Some additional specimens may have been inadvertently buried in the past as a result of past earthworks within the easement closer to Nelson Bay Road. Outside the study area *D. arenaria* also occurs within the same electricity easement to the west and east (ERM, 2003). Within the study area the orchids were located within native derived grassland with no canopy which has been created and maintained as an electrical easement by Ausgrid. No other occurrences of *D. arenaria* were recorded over the remainder of the study area during targeted surveys. The absence of *D. arenaria* over the remainder of the study area is likely to be attributed to the density of trees and shrubs shading suitable habitat. However, suitable habitat was considered to be present within areas of Coastal Sand Apple Blackbutt Forest with a sparse canopy cover.

Diuris arenaria is only known to occur on the Tomaree Peninsula. A study of *D. arenaria* undertaken within the 2005 flowering season (Espallargas, 2005) found the total population of *D. arenaria* to be 2840 individuals. In view of this report the population of *D. arenaria* within the study area would equate to 1.7% of the total population of this orchid species.

No specimens of *D. arenaria* are required to be removed as a result of the proposal. The 15m buffer to the north of the electrical easement to the extraction zone will also offer protection from secondary impacts such as increased weed incursion and dust. It is recommended that there is a no-go zone below the extraction zone to avoid any unintended removal/disturbance of these orchids. This will require the erection of a barrier fence on the boundary of the extraction zone. It will also be important to liaise with Ausgrid regarding maintenance of their easements to minimise impacts and support the protection of *D. arenaria*.

Of the remaining 30 assessed flora species the study area was found to contain suitable habitat for 11:

- *Diuris praecox* (Newcastle Doubletail);
- *Corybas dowlingii* (Red Helmet Orchid);
- *Cryptostylis hunteriana* (Leafless Tongue Orchid);
- *Rhizanthella slateri* (Eastern Underground Orchid);
- *Pterostylis chaetophora* (Tall Rustyhood);
- *Maundia triglochinoides* (Maundia);
- *Persicaria elatior* (Tall Knotweed);
- *Zannichellia palustris* (Horned Pondweed);
- *Eucalyptus parramattensis* subsp. *decadens* (Drooping Red Gum);
- *Melaleuca biconvexa* (Biconvex Paperbark);
- *Syzygium paniculatum* (Magenta Lilly Pilly);

Of these threatened flora species, the most likely habitat within the study area was considered to be present for *D. praecox*. Specimens of *D. praecox* are known to be present approximately 200m to the south-west within the same electrical easement which runs through the study area (Wildthing Environmental Consultants, 2018). Previous studies (ERM, 2003) also did not find any specimens of *D. praecox* in the section of the power easement within the study area. Suitable habitat was present within areas of Coastal Sand Apple Blackbutt Forest, particularly those more open areas having less shade from overhead vegetation such as the power easement in the south. The proposal will result in the removal 25.90ha of suitable habitat from within the study area. However, considering the absence of *D. praecox* within the study area during targeted surveys and the fact that no areas of preferred habitat in the form of derived grassland within the electrical easements will required removal, the proposal is unlikely to have a significant impact on the local population of this species such that a local extinction would occur.

Corybas dowlingii (Red Helmet Orchid) is known to occur on the Tomaree Peninsula. A population of *C. dowlingii* is know from Stony Ridge Reserve at Soldiers Point and this orchid has also been recorded within bushland next to Soldiers Point Bowling Club (Wildthing Environmental Consultants, 2012). *Corybas dowlingii* typically grows in gullies in tall open forest on well-drained gravelly soils.

Taking the absence of preferred habitat in the form of well-drained gravelly soils only marginal habitat was considered to be present within the study area.

Locally *Cryptostylis hunteriana* (Leafless Tongue Orchid) is known from the Gan Gan Hill and Tomaree Headland areas and Lemon Tree Passage (Bell 2001). Suitable habitat was considered to be present within areas of Coastal Sand Apple Blackbutt Forest, however as the local populations of *C. hunteriana* are found on Carboniferous sediments associated with low hills (deLacey, et al, 2012) and taking into consideration the absence of records within similar habitat to the study area along the dunal forests of the Stockton Bight the likelihood of this orchid species being present within the study area would be reduced.

As habitat requirements are poorly understood and no particular vegetation type has been associated with *Rhizanthella slateri* (Eastern Underground Orchid) areas of sclerophyll forest were considered to contain suitable habitat for this highly cryptic orchid species. The nearest known local record of this species is Bulahdelah (Jones, 2006). Taking into consideration the current absence of records of *R. slateri* on the Tomaree Peninsula and nearby areas the likelihood of this orchid species being present within the study area would be greatly reduced.

A population of *Pterostylis chaetophora* (Tall Rustyhood) is known to occur approximately 20km to the west of the study area near Grahamstown Dam within Sclerophyll Forest containing canopy species such as *Eucalyptus fibrosa* (Broad-leaved Ironbark) and *Eucalyptus tereticornis* (Forest Red Gum), with a small tree layer of *Melaleuca nodosa* (Ball Honey-Myrtle)(pers.com Steve Lewer, OEH 2017). Considering *P. chaetophora* was not recorded within the study area during targeted and incidental surveys and taking the differences in habitat type between the study area and known local locations the likelihood of this orchid species being present within the study area would be greatly reduced.

Marginal habitat for *Maundia triglochinoides* (Maundia) was present within the area of Freshwater Wetlands. *Maundia triglochinoides* is known to occur within man-made drainage canals at Williamtown, Medowie and Campvale. No areas of suitable habitat for *M. triglochinoides* will be directly impacted by the proposed sand mine.

Suitable habitat for *Persicaria elatior* (Tall Knotweed) was present within the area of Freshwater Wetlands. Locally *P. elatior* is known from the Tomago Sandbeds. No areas of suitable habitat for *P. elatior* will be directly impacted by the proposed sand mine.

Marginal habitat for *Zannichellia palustris* (Horned Pondweed) was confined to the low-lying area of ground containing wetland in the north of the study area. As a result of the lack of nearby records the

occurrence of this species within the site would be considered to be low. No areas of suitable habitat for *Z. palustris* will be directly impacted by the proposed sand mine.

Within the study area marginal habitat for *Eucalyptus parramattensis* subsp. *decadens* (Drooping Red Gum) was considered to be present within the areas of Swamp Sclerophyll Forest. The nearest records of *E. parramattensis* subsp. *decadens* are at Williamtown (RPS Harper Somers O'Sullivan, 2009), Tilligerry Peninsula and Salamander Bay (ERM, 2005). In the Port Stephens area *E. parramattensis* subsp. *decadens* occurs in open wet sclerophyll woodland on heavy, often waterlogged, inter-barrier depression soils. No areas of suitable habitat for *E. parramattensis* subsp. *decadens* will be directly impacted by the proposed sand mine.

The closest known record of *Melaleuca biconvexa* (Biconvex Paperbark) is south-east of Moffats Swamp approximately 8km to the west (NSW Wildlife Atlas, 2017). Suitable habitat for *M. biconvexa* was considered to be present on the lower-lying, poorly drained ground to the north-east.

Suitable habitat for *Syzygium paniculatum* (Magenta Lilly Pilly) was present within more sheltered areas of Coastal Sand Apple Blackbutt Forest. Few records of this Lilly Pilly species are known from the local area according to the NSW Wildlife Atlas (OEH, 2017).

7.2.2 THREATENED FAUNA

Eight threatened fauna species were recorded within the study area as a result of fieldwork:

- *Glossopsitta pusilla* (Little Lorikeet);
- *Haliaeetus leucogaster* (White-bellied Sea Eagle);
- *Petaurus norfolcensis* (Squirrel Glider);
- *Pteropus poliocephalus* (Grey-headed Flying-fox);
- *Scoteanax rueppellii* (Greater Broad-nosed Bat);
- *Falsistrellus tasmaniensis* (Eastern Falsistrelle);
- *Miniopterus australis* (Little Bentwing-bat);
- *Miniopterus schreibersii oceanensis* (Large Bentwing-bat).

As a result of secondary evidence an additional two species were also considered to utilise the study area:

- *Ninox strenua* (Powerful Owl);
- *Phascolarctos cinereus* (Koala).

Glossopsitta pusilla (Little Lorikeet)

Glossopsitta pusilla (Little Lorikeet) was recorded within the far west of study area on two occasions. Suitable foraging and nesting habitat (tree hollows) were present over a large portion of the study

area. The proposed sand mine will result in the removal of approximately 25.90ha of habitat in the form of open forest largely composed of Coastal Sand Apple Blackbutt Forest. Approximately 877 hollow-bearing trees will also be required to be removed. This will result in a relatively large reduction in habitat within the local area for this parrot species. However, taking the presence of larger adjoining areas of similar habitat within the locality the proposal is considered unlikely to result in the extinction of any local population of this lorikeet species.

Haliaeetus leucogaster (White-bellied Sea Eagle);

Haliaeetus leucogaster (White-bellied Sea Eagle) was observed flying over the study area on a number of occasions. Juvenile White-bellied Sea Eagles also noted flying over the study area would also likely indicate nesting within the locality. Due to the relatively close proximity of Tilligerry Creek and to a lesser extent the waters of Stockton Bight, large trees within the study area would offer potential nesting habitat for the White-bellied Sea Eagle. No large nests that would be attributed to this species were within the study area. No preferred hunting habitat was present within the site. The proposal will likely result in the incremental reduction of potential nesting habitat however, it is unlikely to result in the extinction of any local population of *H. leucogaster.*

Petaurus norfolcensis (Squirrel Glider)

The Squirrel Glider was recorded within the study area as a result of targeted surveys. Four gliders were captured in arboreal mammal traps during the 2014 trapping period. An individual Squirrel Glider was also recorded on the ground by remote camera in the far south-east of the study area in early 2015. No Squirrel Gliders were captured during the 2013 trapping period. No gliders were observed during spotlighting surveys or emerging during stag-watching of hollow-bearing trees.

Despite the survey effort, the capture rate of four gliders for 160 trap nights averaged 2.5 percent. This is lower than the average capture rate at Wyong (6.5 percent) (Smith & Murray 2003) and at Port Macquarie (8 to 16 percent) (Quin, 1995). However, capture rates are lower during canopy flowering due to the excess of nectar and pollen associated with flowering eucalypts (Quin, 1995). During the trapping periods *Eucalyptus pilularis* (Blackbutt) and *Eucalyptus robusta* (Swamp Mahogany) were both flowering and may have likely reduced the chances of trapping a Squirrel Glider.

The food plants *E. pilularis* and *Banksia serrata* were very common within the study area. As winter is a time of critical food shortage for the Squirrel Glider species such as *E. robusta* are an important food resource within the local area during this period. Only 19 specimens of *E. robusta* were found to be present within the study area. Known food plants of the Squirrel Glider within the study area are shown in Table 17.

Squirrel Gliders have been recorded in a number of locations along Stockton Bight including Fern Bay; (ERM, 2002), (Wildthing Environmental Consultants, 2011, 2012 & 2013), Salt Ash (Umwelt,

2003) and the Worimi Conservations Lands (Ecotone, 2008). The monitoring of nest boxes erected by Energy Australia along the powerline easement within the Worimi Conservation Lands showed a high level of usage by gliders with 81 of 130 glider boxes showing signs of nest material and seven glider families identified (Hollow Log Homes, 2008).

Table 17: Known food plants of the Squirrel Glider within the study area

Food Plant	Food Item
Eucalyptus pilularis (Blackbutt)	Nectar
Angophora costata (Smooth-barked Apple)	Nectar
Eucalyptus robusta (Swamp Mahogany)	Nectar
Banksia serrata (Old Man Banksia)	Summer nectar & pollen
Banksia integrifolia (Coastal Silver Banksia)	Winter nectar & pollen
Melaleuca quinquenervia (Broad-leaved Paperbark)	Nectar, insect bark feed
Acacia irrorata	Gum
Acacia maideni	Gum

The study area forms part of a much larger fragment of native vegetation dominated by Coastal Sand Smooth-barked Apple Forest associated with the coastal sand dunes along Stockton Bight. This relatively large fragment (approximately 2400ha - extrapolated from The Department of Lands, 2015 Aerial Photo) is bounded by bare Holocene sand dunes to the east, cleared mostly agricultural land to the west, residential development of Fern Bay to the far south and Anna Bay to the north. The southern extent of this fragment however, occurs north of Fern Bay where shifting sand has created a barrier for the Squirrel Glider (approximately 500m wide) to a smaller fragment of known Squirrel Glider habitat (approximately 1000ha – Fern Bay Fragment) (ERM, 2005) at the southern end of Stockton Bight. The 2400ha fragment which contains the study area is comprised of both conservation lands (Worimi Conservation Lands – approximately 1750ha – extrapolated from OEH, 2013) and less secure privately-owned land (remainder of land = approximately 650ha).

The Squirrel Glider has a home range of between 1.5 and 10 hectares and a density of 0.1 to 1.9 animals per hectare, depending upon habitat quality (Smith 2002). Density of gliders in the Fern Bay fragment which contains similar habitat was estimated at 0.36 gliders per hectare (ERM, 2005). Considering the presence of approximately 36ha of suitable habitat for the Squirrel Glider within the study area at best there could be approximately 13 or more individuals utilising the study area.

Approximately 1217 hollow-bearing trees were recorded within the study area during the hollow-bearing tree survey. Many of these trees where considered to be significant as a result of their very large size and the presence of suitably sized nesting hollows for the Squirrel Glider. Large areas of adjoining and nearby open forest are likely to contain similar densities and sizes of hollows. Suitable contiguous Squirrel Glider habitat occurs on private land north of the duel carriage way (four lanes) of

Nelson Bay Road to the west of the study area. Smaller areas of adjoining privately owned habitat were also present to the east and the north. The much larger Worimi Conservation Lands were present to the south over Nelson Bay Road. No trees were present within the centre strip of the dual carriage way (Nelson Bay Road) adjacent to the study area. This gap was measured at a minimum of 40m. Trees on the side of the road should be sufficiently tall (above 25m) to allow Squirrel Gliders to glide above large trucks (~4m high) at ~6m in from a landing tree, and land ~1m above the ground to avoid predators (Ross *et al.*, 2009). Although a number of trees along the roadside would reach over 25m in height considering the frequency of vehicle movements along this road this gap would represent a considerable barrier for the Squirrel Glider. However, a long strip of remnant trees was present within the centre of the dual carriage way a short distance to the south-west of the study area which would provide a much safer link for Squirrel Gliders between habitat north and south of Nelson Bay Road.

The proposal will result in the removal of 25.90ha of Coastal Sand Apple Blackbutt Forest containing known foraging and nesting hollows. Approximately 877 hollow-bearing trees will require removal. Many of these hollow-bearing trees are significant as a result of their very large size and presence of suitably sized nesting hollows for the Squirrel Glider. The proposal will result in a reduction in connectivity smaller areas of open forest habitat contained within Lot 2 & 521 to the immediate north of the study area. Considering the presence of the dual carriageway of Nelson Bay Road (without a treed traffic island) the proposal will also result in a reduction in connectivity for open forest areas within Lot 10 and the adjoining crown reserve. An additional 15m vegetated buffer zone located around the proposal will however continue to provide connectivity to these areas of habitat for Squirrel Gliders. The connectivity to these areas will greatly improve after the mine site has been progressively revegetated. Other potential impacts include noise from the mine operation and artificial lighting.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on the Squirrel Glider. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire within the study area;
- Protection of the Squirrel Glider during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Feral Vertebrate Pest Control;
- Installation of compensatory nest boxes;
- Weed Control.

The proposal will result in a significant reduction in Squirrel Glider habitat occurring along the dune forests of Stockton Bight. However, considering the relatively large area of habitat the study area forms part of together with the given recommendations the proposed sand mine is unlikely to result in the extinction of any local population of the Squirrel Glider.

Pteropus poliocephalus (Grey-headed Flying-fox);

The Grey-headed Flying-fox was observed within the study area on a number of occasions. Large numbers of Grey-headed Flying-foxes were observed feeding on flowering *Eucalyptus pilularis* (Blackbutt) throughout the study area in February 2015. The Grey-headed Flying-fox was also recorded feeding within the study area on flowering specimens of *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark). One deceased specimen had been entangled within a barbed-wire fence surrounding the orchard. Although suitable camp sites were considered to be present within the study area no roosting individuals were observed. Grey-headed Flying-foxes in 2015 were noted to be largely originating from a large temporary camp located near the corner of Cromarty and Upton Lanes approximately 2km to the east of the study area.

The study area was found to contain seasonal foraging habitat for this highly mobile species in the form of flowering trees, in particular; *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Smooth-barked Apple) and *Banksia serrata* (Old Man Banksia). Other preferred foraging species present included *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus grandis* (Flooded Gum), *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Banksia integrifolia* (Coastal Silver Banksia). The study area was considered to contain potential camp sites, particularly within denser areas of swamp forest dominated by the canopy species *M. quinquenervia*.

The proposal will involve the removal of 25.90ha of seasonal foraging habitat resulting in a substantial reduction within the local area. No areas of habitat will become isolated for this highly mobile species. A number of mitigation measures have been given to reduce the impact of the proposed sand mine on the Grey-headed Flying-fox. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire

Taking the presence of larger adjoining areas of similar habitat within the locality including the nearby protected Worimi Conservation Lands and absence of roosting individuals within the study area the proposal is considered unlikely to result in the extinction of any local population of the Grey-headed Flying-fox.

Hollow Dependent Microchiropteran Bats: *Scoteanax rueppellii* (Greater Broad-nosed Bat) & *Falsistrellus tasmaniensis (Eastern Falsistrelle)*

Falsistrellus tasmaniensis (Eastern Falsistrelle) was positively identified within the study area during the bat call survey. Calls not inconsistent with *Scoteanax rueppellii* (Greater Broad-nosed Bat) were also identified. The majority of the study area contains suitable hunting habitat for these microchiropteran bat species. A large amount of roosting habitat was also present with 1217 hollow-bearing trees being recorded within the study area. Many of these trees where considered to be significant as a result of their very large size and the presence of suitably sized roosting hollows for these microchiropteran bat species. Approximately 877 hollow-bearing trees are proposed to be removed to make way for the sand mine footprint. This would represent a significant loss in roosting habitat within the local area for these microchiropteran bat species. The proposal will also result in a reduction in the quality of hunting habitat within the locality. Considering the recommendations and the presence of larger areas of adjoining and nearby habitat along the vegetated sand dunes of Stockton Bight from Fern Bay to Anna Bay which contain comparable foraging and similar densities and sizes of tree hollows it is considered unlikely to result in the extinction of any local population of *S. rueppellii* or *F. tasmaniensis.*

Cave-dwelling Bats Microchiropteran Bats: *Miniopterus australis* (Little Bentwing-bat) & *Miniopterus schreibersii oceanensis* (Large Bentwing-bat)

One specimen of *Miniopterus australis* (Little Bentwing-bat) was captured within the study area during the harp trapping component of the survey. Calls not inconsistent with *M. australis* and *Miniopterus schreibersii oceanensis* (Large Bentwing-bat) were also recorded during the bat call survey. A previous bat call survey (Wildthing Environmental Consultants, 2009) conducted within Lot 10 in the far east of the study area also recorded calls not inconsistent with *M. australis.* The majority of the study area contains suitable hunting habitat for this microchiropteran bat species. However, no preferred roosting habitat in the form of caves, culverts or other similar man-made structures was found to be present. Taking into consideration the relatively large amount of suitable hunting habitat in the locality and absence of preferred roosting habitat within the study area the proposal is unlikely to disrupt the life cycle of this microchiropteran bat species such that local extinction would occur.

Ninox strenua (Powerful Owl)

According to the analysis of the bone fragments by Barbara Triggs within an owl pellet containing the remains of *Trichosurus vulpecula* (Common Brushtail Possum) the fragments were indicative of a pellet belonging to the threatened *Ninox strenua* (Powerful Owl). The Powerful Owl was not observed within the study area during targeted or incidental surveys nor any response to playback calls heard. According to the NSW Wildlife Atlas (OEH, 2015) the powerful owl has been recorded south of the study area within the Worimi Conservation Lands. Suitable hunting habitat for the

powerful owl occurs within areas of Open Forest throughout the study area. The major prey item of the powerful owl is the Common Ringtail Possum and Squirrel Glider. The Squirrel Glider was recorded within the study area however the Common Ringtail Possum although likely to be present was not recorded during surveys. Considering the presence of the likely Powerful Owl Pellet containing the remains of the Common Brushtail Possum and the large number of these possums recorded within the study area the Common Brushtail Possum is a likely frequent prey species for the Powerful Owl within the local area. Nesting habitat was present in the form of large tree hollows, particularly within larger specimens of Blackbutt. The study area was likely to contain up to 200 potential nesting hollows for the Powerful Owl. Roosting habitat for this species is present within denser areas of foliage such as Swamp Sclerophyll Forest and thicker areas of Dry Sclerophyll Forest. The Powerful Owl occupies exclusive territories that can be greater than 800ha in size (Kavanagh, 2000) and would likely utilise the study area as part of a larger home range.

The proposal will result in a significant incremental reduction in habitat for the Powerful Owl. Taking into consideration the relatively large amount of suitable hunting habitat within the local area the proposal is unlikely to disrupt the life cycle of this species of owl such that local extinction would occur.

Phascolarctos cinereus (Koala)

No Koalas were directly observed within the study area during fieldwork completed for this report or previous reports (Wildthing Environmental Consultants, 2009). However, evidence of Koala activity in the form of characteristic scratches on the trunks of a very small number of specimens of *Eucalyptus robusta* (Swamp Mahogany), a preferred feed tree species under the Port Stephens Comprehensive Koala Plan of Management CKPoM, was present within the area of Swamp Forest in the far east of the study area. *Eucalyptus robusta* was the only preferred Koala Feed Tree Species recorded within the study area. No Koala faecal pellets were found within the study area despite a search beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey.

Review of the Koala Habitat Planning Map showed the site to be largely composed of Supplementary Koala Habitat with smaller areas of mainly cleared land. However, the CKPoM assessment found although the study area was largely composed of Supplementary habitat two smaller areas of preferred Koala habitat consisting of Swamp Sclerophyll Forest were located within the north and north-east of the study area. According to the CKPoM the area of Preferred Koala Habitat will require a 50m buffer over supplementary habitat.

No records of the Koala occurring within the study area were present on either the BioNet Atlas of NSW Wildlife (OEH, 2017) or Hunter Koala Preservation Society (2015) databases. According to

database records contained in the BioNet NSW Atlas (OEH, 2017) and Hunter Koala Preservation Society (Hunter Koala Preservation Society, 2015) a small number of records of Koalas occur within proximity to the study area. Relatively recent records of Koalas have been recorded from 2015 & 2016 within the vicinity of the Shark & Ray Centre approximately 200m to the north-west of the site (OEH, 2017). Koalas have also been killed on Nelson Bay Road 200m south of Marsh Road and in the front of Murrays Brewery (no dates given). The evidence suggests that the study area particularly the area of Swamp Sclerophyll Forest in the far-east is utilised infrequently by a small number of Koalas.

The proposal sand mine will require the removal of 25.90ha of native vegetation resulting in a significant reduction in Supplementary habitat within the local area. No areas of Preferred Koala Habitat will require removal. A number of recommendations have been given to reduce the impact of the proposal on the local population of Koalas in the local area. These recommendations are:

- specimens of *Eucalyptus robusta* are to be planted into the cleared areas of pasture/grasses within the far north of the study area (Lot 51) to enhance the adjoining existing area of Preferred Koala habitat within Lot 10 and to provide a better linkage to larger areas of preferred Koala to the north over Marsh Road;
- It is recommended that the sand mine disturbance area be cordoned off by the use of Koala barrier fencing to prevent any Koalas straying into the path of machinery/trucks or drowning in pools of steep banked surface water;
- It is recommended that low speed limits and Koala warning signage be placed along the internal access roads to reduce the chance of vehicle collision;
- Dogs are to be controlled within the study area;
- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting;
- Removal and non-use of barbed-wire within the study area;
- Protection of the Koala during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Feral Vertebrate Pest Control;
- Weed Control.

The proposal will result in a significant reduction of supplementary Koala habitat within the local area. As no areas of Preferred Koala Habitat or known Preferred Koala Feed Tree Species will be removed and given the lack of Koala sightings and low level of Koala activity, plus taking the recommendations into consideration the proposed sand mine is unlikely to have an adverse effect on the life cycle of the species such that the local population of Koalas may be placed at risk of extinction.

Of the remaining 90 assessed fauna species the study area was found to contain suitable habitat for 43:

- *Petalura gigantea* (Giant Dragonfly);
- *Crinia tinnula* (Wallum Froglet);
- *Uperoleia mahonyi* (Mahony's Toadlet);
- *Litoria aurea* (Green & Golden Bell Frog);
- *Litoria brevipalmata* (Green-thighed Frog);
- *Hoplocephalus bitorquatus* (Pale-headed Snake);
- *Hoplocephalus stephensii* (Stephen's Banded Snake);
- *Rostratula benghalensis australis* (Australian Painted Snipe);
- *Botaurus poiciloptilus* (Australasian Bittern);
- *Ptilinopus magnificus* (Wompoo Fruit-dove);
- *Ptilinopus regina* (Rose-crowned Fruit-Dove);
- *Ptilinopus superbus* (Superb Fruit Dove);
- *Callocephalon fimbriatum* (Gang Gang Cockatoo);
- *Calyptorhynchus lathami* (Glossy Black- Cockatoo);
- *Lathamus discolor* (Swift Parrot);
- *Neophema pulchella* (Turquoise Parrot);
- *Melithreptus gularis gularis* (Black-chinned Honeyeater);
- *Anthochaera phrygia* (Regent Honeyeater);
- *Daphoenositta chrysoptera* (Varied Sittella);
- *Epthianura albifrons* (White-fronted Chat);
- *Petroica boodang* (Scarlet Robin);
- *Petroica phoenicea* (Flame Robin);
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler);
- *Burhinus grallarius* (Bush Stone-curlew;
- *Hieraaetus morphnoides* (Little Eagle);
- *Lophoictinia isura* (Square-tailed Kite);
- *Erythrotriorchis radiatus* (Red Goshawk);
- *Ninox connivens* (Barking Owl);
- *Tyto novaehollandiae* (Masked Owl);
- *Planigale maculata* (Common Planigale);
- *Phascogale tapoatafa* (Brush-tailed Phascogale);
- *Dasyurus maculatus maculatus* (Tiger Quoll);
- *Potorous tridactylus tridactylus* (Long-nosed Potoroo);
- *Aepyprymnus rufescens* (Rufous Bettong);
- *Cercartetus nanus* (Eastern Pigmy Possum);
- *Petaurus australis* (Yellow-bellied Glider);
- *Syconycteris australis* (Common Blossom Bat);
- *Kerivoula papuensis* (Golden-tipped Bat);
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat);
- *Myotis macropus* (Southern Myotis);
- *Mormopterus norfolkensis* (Eastern Freetail-bat);
- *Vespadelus troughtoni* (Eastern Cave Bat);
- *Chalinolobus dwyeri* (Large-eared Pied Bat);

Taking the habitat and local records into consideration the most likely of these species to utilise the study area would include *Uperoleia mahonyi* (Mahony's Toadlet), *Crinia tinnula* (Wallum Froglet), *Daphoenositta chrysoptera* (Varied Sittella), *Tyto novaehollandiae* (Masked Owl), *Dasyurus maculatus maculatus* (Tiger Quoll), *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat) and

Mormopterus norfolkensis (Eastern Freetail-bat). The proposal will result in an incremental loss of potential habitat for these addressed threatened fauna species, however taking into consideration the relatively large amount of suitable habitat in the local area the proposal is unlikely to disrupt the life cycle the addressed threatened species such that local extinction would occur.

7.3 ENDANGERED POPULATIONS

One endangered population *Dromaius novaehollandiae* (Emu) in the NSW North Coast Bioregion and Port Stephens LGA was present on the NPWS Wildlife Atlas as occurring within 10km of the study area. The Emu was not recorded within the study area during fieldwork. The study area contains suitable habitat for the Emu however, due to the density of vegetation no preferred habitat was considered to be present. Taking into consideration the paucity of recent local records and the relatively large amount of suitable surrounding habitat it is considered unlikely to cause extinction of any local population of the Emu.

7.4 KEY THREATENING PROCESSES

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

Clearing of Native Vegetation

The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The proposed sand mine will result in the removal of approximately 25.90ha of Coastal Sand Apple Blackbutt Forest. Coastal Sand Apple Blackbutt Forest is the dominant vegetation assemblage along the sand dunes of Stockton Bight from Fern Bay to Anna Bay. Approximately 1924.1ha of Coastal Sand Apple Blackbutt Forest is present within the nearby Worimi Conservation Lands (Bell & Driscoll, 2010).

Loss of Hollow-bearing Trees

The proposed sand mine will result in the removal of approximately 877 of the 1217 hollow-bearing trees from within the study area. The vast majority of hollow-bearing trees were present within Coastal Sand Apple Blackbutt Forest assemblage. Many of these trees were considered to be significant as a result of their very large size and variety and number of hollows they contained. Hollows were available for roosting or nesting avifauna species, arboreal mammals, reptiles and tree roosting microchiropteran bats species. A number of potential roost trees for large owls such as *Ninox strenua* (Powerful Owl) were also present. It would be likely that similar densities and sizes of hollows occurring within the study area would be present within adjoining areas of Coastal Sand Apple Blackbutt Forest which is the dominant vegetation assemblage along the sand dunes of Stockton Bight from Fern Bay to Anna Bay.

Removal of dead wood and dead trees

The proposal will result in the removal of a considerable amount of dead wood and trees from within the study area. Many of the standing dead trees and fallen hollow logs were considered to be significant as they offer potential nesting, roosting and denning habitat for a number of fauna species such as the *Dasyurus maculatus maculatus* (Tiger Quoll).

Predation by the European Red Fox *Vulpes vulpes*

The European Red Fox was recorded within the study area a number of times as a result of the remote camera surveys. Tracks and a number of scats consistent with this species were also found over a wide area of the study area. Given the high frequency of European Red Foxes noted, the fox would likely have a significant impact on native fauna within the local area. The proposal may result in an increase in the number of this introduced species, however, it is recommended that fox control be undertaken as part of ongoing management of the sand mine site.

Predation by the Feral Cat *Felis catus*

The Feral Cat was recorded within the study area as a result of the remote camera surveys. The Feral Cat would have an impact on native fauna within the local area. The proposal may result in an increase in the number of this introduced species, however, it is recommended that Feral Cat control be undertaken as part of ongoing management of the sand mine site.

Predation and hybridisation of Feral Dogs *Canis lupis famililaris*

The Feral Dog was recorded within the study area as a result of the remote camera surveys. A number of tracks and scats consistent with the Feral Dog were also commonly observed within the study area. The proposal may result in an increase in the number of this introduced species however, it is recommended that Feral Dog control be undertaken as part of ongoing management of the sand mine site.

Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush)

Chrysanthemoides monilifera (Bitou Bush)

Bitou Bush was found to be present within the study area and formed small thickets in some areas. Bitou Bush has the potential for further infestation within the study area regardless of the proposal. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.

Invasion, establishment and spread of *Lantana camara* (Lantana)

Lantana was found to be present within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within the study area regardless of the proposal. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.

Invasion of native plant communities by exotic perennial grasses

A number of exotic perennial grasses particularly *Eragrostis curvula* (African Love Grass), *Andropogon virginicus* (Whiskey Grass), *Anthoxanthum odoratum* (Sweet Vernal Grass), *Melinis repens* (Red Natal Grass), *Paspalum urvillei* (Vasey Grass) and *Axonopus affinis* (Narrow-leaved Carpet Grass) were present within the study area. Exotic grasses pose a threat to endangered ecological communities and threatened species within the study area particularly the area of Freshwater Wetland and the threatened *Diuris arenaria* (Tomaree Doubletail) occurring within the electrical easement. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.

High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition

Evidence of past fire such as blackened tree trunks was present within the study area. It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Frequent fire has the potential to impact the ability of species to maintain life cycle processes and may result in a change in vegetation structure resulting in habitat becoming more or less favourable for some species. Fire also reduces the amount of fallen timber and hollow bearing trees. The proposal is unlikely to have any impact on the frequency of fire within the local area.

Competition from feral honeybees *Apis mellifera*

Six hollow-bearing trees were found to contain introduced *Apis mellifera* (Feral Honey Bee) hives as a result of the habitat tree survey. The Feral Honeybee competes with a number of native fauna species for nectar and tree hollows. The proposal is unlikely to have any impact on the Feral Honeybee occurrence within the local area.

Competition and grazing by the feral European Rabbit *Oryctolagus cuniculus*

The Feral European Rabbit was recorded within the study area during fieldwork. Grazing and burrowing by rabbits can cause massive erosion problems, reduce recruitment and survival of native plants, and alter entire landscapes. The Feral European Rabbit may also have an impact on species such as *Diuris arenaria* (Tomaree Doubletail). The presence of Rabbits may also attract more introduced predators such as the European Red Fox. The proposal may result in an increase in the number of this introduced species. It is recommended that Feral European Rabbit control be undertaken as part of ongoing management of the sand mine site.

Aggressive exclusion of birds by Noisy Miners *Manorina melanocephala*

The Noisy Miner was found to be common within the study area. The proposed sand mine is unlikely to increase numbers of Noisy Miners.

Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants

Few escaped garden plants recorded within the study area. One example is the occurrence of *Zantedeschia aethiopica* (Arum Lily) within the area of Swamp Sclerophyll Forest within Lot 10. The proposal may result in an increase in the number of escaped garden plants into adjoining vegetation. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.

Bushrock Removal

As the study area was largely situated on sand dunes no areas of bush rock were found to be present.

Predation by *Gambusia holbrooki* Mosquito Fish or Plague Minnow

Specimens of *G. holbrooki* were recorded during periods of higher water levels after rain within the vicinity of the freshwater Wetland. The proposal is unlikely to increase numbers if this introduced fish species.

Forest Eucalypt dieback associated with over abundant psylids and Bell Miners

No Bell Miners were recorded within the study area during the survey period.

Invasion and establishment of exotic vines and scramblers

Few exotic vines and scramblers were recorded within the study area. Disturbance to the study area as a result of the sand mine has the potential to promote the establishment of species such as *Ipomoea indica* (Morning Glory) and *Lonicera japonica* (Japanese Honeysuckle). Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.

Predation, habitat degradation, competition and disease transmission by Feral Pigs *Sus scrofa*

No evidence of Feral Pigs was recorded within the study area.

Herbivory and Environmental Degradation caused by Feral Deer

No evidence of the Feral Deer was recorded within the study area.

Competition and habitat degradation by Feral Goats *Capra hircus*

No Feral Goats were recorded within the study area during fieldwork.

Loss or degradation (or both) of sites used for hill-topping by Butterflies

A small number of low sand hills were present within the study area. These sand hills occur within the sand mine extraction area and will be removed as a result of the proposal. No currently listed threatened Butterflies are known to occur within the local area. It is difficult to ascertain the impact the removal of these sand hills will have on the local population of Butterflies, however considering the presence of

other sand hills within the dunal forest of Stockton Bight the removal of these low hills is unlikely to be significant.

Invasion of native plant communities by African Olive

The African Olive was not recorded within the study area during fieldwork. This invasive plant is not known as a serious weed along the dunal forests of Stockton Bight.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The proposal is unlikely to have any impact on any rivers or streams in the area.

Infection of frogs by amphibian Chytrid causing the disease Chytridiomycosis

It is possible that this fungus has an impact on frogs in the local area. However, the proposal is unlikely to have any significant impact on this threatening process.

Infection of native plants by *Phytophthora cinnamomi*

No evidence of infection by *Phytophthora cinnamomi* was noted within the study area.

Infection by psittacine circoviral (beak & feather) disease affecting endangered psittacine species and populations

The proposal is unlikely to increase infection by this disease.

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

Although having the potential to infect the study area evidence of this recent fungus infection was not observed during fieldwork.

8.0 CONSIDERATIONS UNDER THE PORT STEPHENS COMPREHENSIVE KOALA PLAN OF MANAGEMENT

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) has been prepared for the Port Stephens LGA in accordance with SEPP 44 – 'Koala Habitat Protection'. The principal aim of the Port Stephens CKPoM is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and to reverse the current trend of Koala population decline.

Koala Habitat Assessments under the Port Stephens CKPoM involve four stages: preliminary assessment, vegetation mapping, Koala habitat identification and assessment of the proposal. A Koala habitat assessment has been completed below specifically for the development of this site.

8.1 PRELIMINARY ASSESSMENT

The preliminary assessment for the study area involves reviewing the Koala Habitat Planning Map for the area as contained in the CKPoM and undertaking a site inspection to determine whether the study area contains individuals of Koala trees outside areas marked as 'Preferred Koala Habitat'. Review of the Koala Habitat Planning Map (Figure 17) showed the site to contain two Koala habitat categories:

- 'Supplementary Koala Habitat';
- 'Mainly Cleared'

The majority of the site has been designated as 'Supplementary Koala Habitat' with a small patch designated as 'Mainly Cleared' in the north-east.

Within the CKPoM there are three species of Eucalypt identified as Koala food trees, being *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus parramattensis* subsp. *decadens* (Drooping Red Gum) and *Eucalyptus tereticornis* (Forest Red Gum). *Eucalyptus robusta* was found to be present within two smaller vegetation assemblages within the study area; Paperbark Swamp Forest and Flooded Gum – Paperbark Swamp Forest. No other feed tree species were recorded within the study area.

8.2 VEGETATION MAPPING

As the survey of the site has identified a number of Swamp Mahogany present on site the next step in the Koala Habitat Assessment is to provide a description of the vegetation assemblages present within the study area and to compare the results of the vegetation survey conducted for this report with the LGA wide vegetation map (Figure 2.5 - 'Eastern Section Vegetation' in Part 2 of the Port Stephens CKPoM).

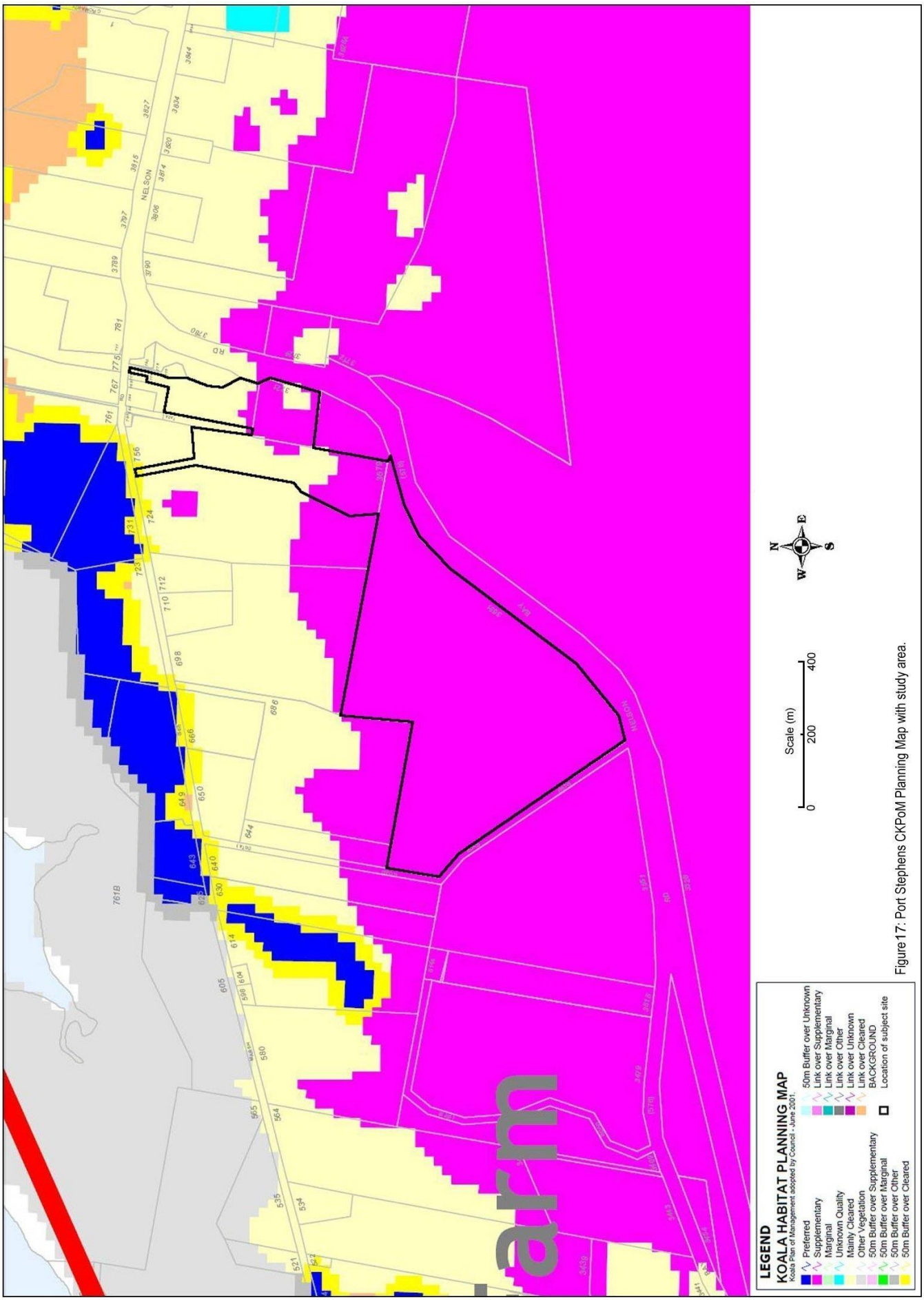


Figure 17: Port Stephens CKPoM Planning Map with study area.

As detailed in Section 5.1 six vegetation assemblages were found to be present on site as a result of an on-ground assessment:

- Coastal Sand Apple Blackbutt Open Forest (34.93ha);
- Coastal Sand Apple Blackbutt Forest (Derived Grassland)(0.9ha);
- Swamp Sclerophyll Forest (1.15ha);
- Freshwater Wetland (0.32ha);
- Orchard, Cleared/Modified (9.6ha);
- Grassland/Pasture (4.0ha).

Review of the relevant LGA vegetation map (Figure 2.5 in Part 2: CKPoM Resource Document) showed vegetation on the site as being composed of two vegetation assemblages:

- 3 – Blackbutt and Smooth-barked Apple Open Forest
- 25 – Mainly cleared

Blackbutt and Smooth-barked Apple Open Forest was mapped over the majority of the study area. Smaller areas of Mainly Cleared vegetation were present in the northern areas. A large portion of the field survey map was consistent with the LGA vegetation map however the LGA map neglects the presence of two smaller areas of Swamp Sclerophyll Forest and one area of Freshwater Wetland. Figure 18 shows vegetation assemblages located on site and within at least 100m of the boundary.

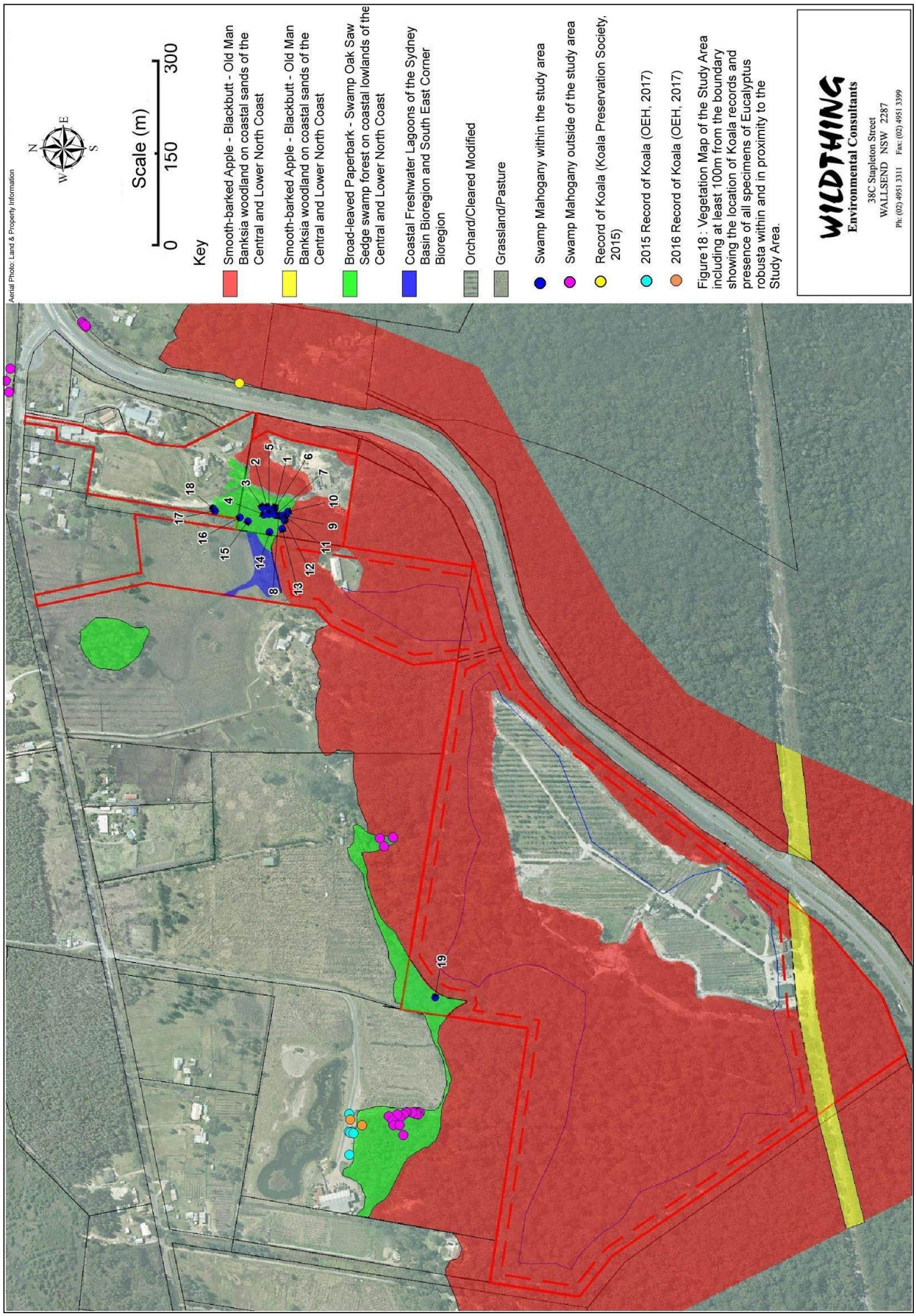
8.3 KOALA HABITAT IDENTIFICATION

Koala Habitat Identification involves:

- the application of the definitions of Preferred and Supplementary Koala Habitat detailed by Lunney *et al.* (1998) to the study area;
- the application of Habitat Buffers to all areas of Preferred Koala Habitat; and
- approximation of Habitat Linking Areas between all patches of Preferred Koala Habitat that occur within 800m of each other.

Under the definitions provided by Lunney *et al.* (1998):

- Preferred Koala Habitat is defined as a combination of the all field survey Primary, Secondary and Community Survey category A/B (regardless of whether or not they overlap);
- Supplementary Habitat – where field survey Marginal and Community Survey Category C/D overlap;
- Marginal Koala Habitat – where field survey Marginal and Community Survey Category E overlap.


Aerial Photo: Land & Property Information
N
E
S
W
Scale (m)
0
150
300
Key
Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast
Broad-leaved Paperbark - Swamp Oak Saw Sedge swamp forest on coastal lowlands of the Central and Lower North Coast
Coastal Freshwater Lagoons of the Sydney Basin Bioregion and South East Corner Bioregion
Orchard/Cleared Modified
Grassland/Pasture
Swamp Mahogany within the study area
Swamp Mahogany outside of the study area
Record of Koala (Koala Preservation Society, 2015)
2015 Record of Koala (OEH, 2017)
2016 Record of Koala (OEH, 2017)
Figure 18 : Vegetation Map of the Study Area including at least 100m from the boundary showing the location of Koala records and presence of all specimens of Eucalyptus robusta within and in proximity to the Study Area.
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Field Survey

The larger area of Coastal Sand Apple Blackbutt Open Forest (34.93ha) was found to be most consistent with the Community Survey Category C - Tall Open Blackbutt and Sydney Red Gum Forest. The description of the map-based habitat category based on field work is most likely to be Marginal Koala Habitat – Vegetation associations containing low densities of species known to be preferred by Koalas. Where field survey Marginal and Community Survey Category C/D overlap Supplementary Habitat is obtained.

The smaller areas of Swamp Sclerophyll Forest were found to be most consistent with the Community Survey Category C – Open Swamp Mahogany and Swamp Oak with Paperbark. The description of the map-based habitat category based on field work is most likely to be Secondary Koala Habitat – Vegetation associations on Aeolian or Transferral Soil Landscapes of Quaternary origin supporting *E. robusta* and/or *E. parramattensis* as subdominant components of the overstorey. When the field survey Secondary and Community Survey - C overlap, under the definitions provided by Lunney *et al.* (1998), Preferred Koala Habitat is obtained.

Review of the Koala Habitat Planning Map showed the site to be largely composed of Supplementary Koala Habitat with smaller areas of mainly cleared land. However, the CKPoM assessment found although the study area was largely composed of Supplementary habitat two smaller areas of preferred Koala habitat consisting of Swamp Forest were located within the far north-east and north of the study area. According to the CKPoM the area of Preferred Koala Habitat will also require a 50m buffer over supplementary habitat.

Accordingly, an assessment was conducted in the study area to assess the level of current koala activity. *Eucalyptus robusta* was the only preferred Koala Feed Tree Species recorded within the study area. No Koala faecal pellets were found within the study area despite a search beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey. Trees were also searched for koalas and trunks inspected for the presence of the characteristic 'pock mark' scratches made by koalas. A small number of specimens of *E. robusta* and *Melaleuca quinquenervia* (Broad-leaved Paperbark) within the northern area of Paperbark Swamp Forest (Lot 10) had scratches on the trunks consistent with those of the Koala. A small number of specimens of *E. robusta* and *M. quinquenervia* occurring outside the study area to the north-east also had scratches likely to be those of Koalas. Details of the Preferred Koala Feed Tree Species - *E. robusta* occurring within the study area are shown in Table 18. The locations of individual specimens of *E. robusta* occurring within and in proximity to the study area are shown in Figure 17.

Table 18: Preferred Koala tree species within study area listed under the Port Stephens CKPoM.

Tree No.	Tree species	Location GDA 94 E	Location GDA 94 N	DBH (M)	Height (M)	Evidence of Koala Activity
1	*Eucalyptus robusta* Swamp Mahogany	407295	6373797	0.5	20	
2	*E. robusta*	407296	6373809	0.35	17	
3	*E. robusta*	407296	6373817	0.45	20	
4	*E. robusta*	407284	6373814	0.50	22	
5	*E. robusta*	407285	6373806	0.40	18	
6	*E. robusta*	407290	6373799	0.40	20	
7	*E. robusta*	407283	6373796	0.35	20	
8	*E. robusta*	407283	6373790	0.5	20	
9	*E. robusta*	407283	6373785	0.45	17	
10	*E. robusta*	407289	6373777	0.40	20	
11	*E. robusta*	407281	6373781	0.5	20	
12	*E. robusta*	407275	6373782	0.5	20	Scratches on trunk consistent with that of a Koala. Tree has a lean.
13	*E. robusta*	407262	6373785	0.7	20	Scratches on trunk consistent with that of a Koala.
14	*E. robusta*	407256	6373805	0.5	18	
15	*E. robusta*	407273	6373839	0.5	20	Scratches on trunk consistent with that of a Koala. Likely Koala pock marks on nearby Paperbarks.
16	*E. robusta*	407279	6373851	0.55	20	
17	*E. robusta*	407289	6373890	0.50	18	
18	*E. robusta*	407293	6373893	0.60	20	
19	*E. robusta*	406519	6373538	0.25	16	

No Koalas were recorded within the study area during the survey period. According to database records contained in the BioNet NSW Atlas (OEH, 2017) and Hunter Koala Preservation Society (Hunter Koala Preservation Society, 2015) a small number of records of Koalas occur within proximity to the study area. Relatively recent records of Koalas have been recorded from 2015 & 2016 within the vicinity of the Shark & Ray Centre approximately 200m to the north-west of the site (OEH, 2017). Koalas have also been killed on Nelson Bay Road 200m south of Marsh Road and in the front of Murrays Brewery (no dates given).

According to the CKPoM Koala Habitat Planning Map habitat within the vicinity of the Shark and Ray Centre has been mapped as Secondary Habitat, however given the presence of Swamp Sclerophyll Forest containing specimens of *E. robusta* this area should be mapped as Preferred Koala Habitat.

8.4 ASSESSMENT OF THE PROPOSAL

There are eight performance criteria applied to developments proposed on sites that contain or are adjacent to 'Preferred Koala Habitat', Supplementary Koala Habitat', 'Habitat Buffers', 'Habitat Linking Areas' or areas that contain preferred Koala feed tree species. Each criterion is displayed in italics followed by the site-specific answer.

The proposed development must:

a) Minimise the removal or degradation of native vegetation within Preferred Koala Habitat or Habitat Buffers.

Preferred Koala Habitat occupied two relatively small areas of Swamp Sclerophyll Forest within the study area. A 50m buffer over supplementary habitat would also need to be put in place around these areas of Preferred Koala Habitat. The proposed sand mine will not directly impact on these two areas of Preferred Koala Habitat. As stated in Section 5.1.2 the areas of preferred Koala Habitat may be subject to secondary impacts as the proposal will require excavation below the groundwater level potentially affecting the groundwater dependent Swamp Sclerophyll Forest Assemblage. An assessment undertaken (Martins, 2015) found the drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, the change in groundwater levels should not significantly impact on the areas of Preferred Koala Habitat.

b) Maximise retention and minimise degradation of native vegetation within Supplementary Koala Habitat and Habitat Linking Areas;

Approximately 25.90ha of Supplementary Koala Habitat will be required to be removed for the proposed sand mine. No Habitat Linking Areas are required to be removed. Staged remediation of the impact area will over time restore areas of Supplementary Habitat lost as a result of sand mining.

c) Minimise the removal of any individuals of preferred Koala food trees, wherever they occur on a development site. In the Port Stephens LGA these tree species are Eucalyptus robusta (Swamp Mahogany), Eucalyptus parramattensis (Parramatta Red Gum) and Eucalyptus tereticornis (Forest Red Gum);

One species of recognised Preferred Koala Food Tree, *Eucalyptus robusta* (Swamp Mahogany) was found to be present within the study area. Areas of Swamp Sclerophyll Forest within the study area

were found to contain a total of 19 specimens of *E. robusta.* None of these species are required to be removed as a result of the proposal.

d) Make provisions, where appropriate, for restoration or rehabilitation of areas identified as Koala Habitat including Habitat Buffers and Habitat Linking Areas over Mainly Cleared Land;

Staged remediation of the impact area will over time restore areas of Supplementary Habitat lost as a result of sand mining. Specimens of *Eucalyptus robusta* are also to be planted into the cleared areas of pasture/grasses within the far north-east of the study area (Lot 51) to enhance the adjoining area of Preferred Koala habitat within Lot 10 and to provide a better linkage to larger areas of preferred Koala to the north over Marsh Road.

e) Make provisions for long term management and protection of Koala habitat including both existing and restored habitat;

Native vegetation occurring outside the proposed areas of disturbance will be protected and enhanced. Weeds such as Bitou Bush and Lantana will be controlled. Staged remediation of the impact area will over time restore areas of Supplementary Habitat lost as a result of sand mining. A habitat management plan will be implemented to assist in the long-term management of areas of habitat within the study area.

f) Not compromise the potential for safe movement of Koalas across the site. This should include maximising tree retention generally and minimising the likelihood that the proposal would result in the creation of barriers to Koala movement, such as would be imposed by certain types of fencing;

To allow for the safe movement of Koalas it is recommended that:

- The sand mine disturbance area be cordoned off by the use of Koala barrier fencing to prevent any Koalas straying into the path of machinery or trucks;
- Removal of unwanted fences and non-use of barbed-wire within the study area;
- Weed Control.

g) Be restricted to identified envelopes which contain all buildings and infrastructure and fire fuel reduction zone;

The footprint of the proposal is to be limited to the extraction area and associated infrastructure such as access roads.

h) Include measures to effectively minimise the threat posed by Koalas by dogs, motor vehicles and swimming pools.

A number of measures will be implemented within the development to minimise the threat to Koalas. These measures will include:

- The sand mine disturbance area be cordoned off by the use of Koala barrier fencing to prevent any Koalas straying into the path of machinery/trucks or drowning in steep sided ponds;
- It is recommended that low speed limits and Koala warning signage be placed along the internal access roads to reduce the chance of vehicle collision;
- Dogs are to be restricted within the mine site;
- Feral Dogs are to be controlled within the study area (will require co-operation from surrounding landholders).

9.0 COASTAL MANAGEMENT SEPP

A key aim of the Coastal Management SEPP (CM SEPP) 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, by:

- managing development in the coastal zone and protecting the environmental assets of the coast;
- establishing a framework for land use planning to guide decision-making in the coastal zone, and
- mapping the 4 coastal management areas that comprise the NSW coastal zone for the purpose of the definitions in the Coastal Management Act 2016.

The Coastal Management SEPP identifies four coastal management areas that comprise the coastal zone. These are:

- the coastal wetlands and littoral rainforests area,
- the coastal vulnerability area,
- the coastal environment area, and
- the coastal use area.

The CM SEPP imposes targeted development controls for these areas to guide appropriate development within the coastal zone.

The study area was not located within littoral rainforests/coastal wetlands, coastal vulnerability or coastal use management areas. However, a small portion of the highly disturbed north-west of the site (Lot 51) was located within a mapped Coastal Environment and Coastal Wetland Proximity areas (Figure 19).

Development on land in proximity to coastal wetlands:
(1) Development consent must not be granted to development on land identified as "proximity area for coastal wetlands" or "proximity area for littoral rainforest" on the Coastal Wetlands and Littoral Rainforests Area Map unless the consent authority is satisfied that the proposed development will not significantly impact on:
(a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or
(b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.
(2) This clause does not apply to land that is identified as "coastal wetlands" or "littoral rainforest" on the Coastal Wetlands and Littoral Rainforests Area Map.

Legend
Study Area
Cadastre
Coastal Management SEPP
Coastal Wetlands
Coastal Wetlands Proximity Area
Coastal Use Area
Coastal Environment Area
0 100 200 300 m
Map Projection GDA94 MGA Zone 56
Data Sources: LPI (2018).
Job Ref 12111
A4 Scale 1:6,000
Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarentee is given that the information protrayed is free from error or omission. In addition the spatial accuracy of the map is wholly dependant on source data. Please verify the accuracy of all information prior to use. Development footprint areas should be used for indicative areas only.
Figure19: Study Area and surrounds showing location of Coastal Management SEPP areas.
Nelson Bay Road
Bobs Farm, NSW
10 September 2018
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Environmental Consultants
(a Division of Tattersall Lander Pty Ltd)
ABN 41 003 509 215

The portion of the study area within the north of Lot 51 was also found to contain a "Proximity Area" for coastal wetlands (No. 808a) which occurs along Tilligerry Creek to the north over Marsh Road. As this portion of the study area occurs well outside the development footprint the proposal is unlikely to impact the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or effect quantity and quality of surface and ground water flows to and from the adjacent coastal wetland. The proposal to enhance this highly disturbed area though planting of native vegetation will further enhance this area.

As the study area is located within a mapped area of "Coastal Environment Area", the development controls for this area, as listed within Division 4 of the CM SEPP have been addressed below.
(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:

- the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,
- coastal environmental values and natural coastal processes,
- the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,
- marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,
- existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
- Aboriginal cultural heritage, practices and places; and
- the use of the surf zone.

As this portion of the study area occurs well outside the development footprint the proposal is unlikely to have an adverse impact on the above points. The proposal to enhance this highly disturbed area though planting of native vegetation will further enhance this area.

10.0 AQUATIC ECOLOGY

10.1 AQUATIC HABITAT WITHIN THE STUDY AREA

No watercourses were noted onsite, however lower lying poorly drained areas of ground in the far north of the study area contained some surface water particularly after heavy rains. These poorly drained regions of surface water were associated with areas of Swamp Forest and Freshwater Wetland. The north-west portion drains to the north-west via small narrow constructed drains into a large dam on the neighbouring Shark and Ray Centre property or into the drainage network of Tilligerry Creek.

10.2 AQUATIC SURVEY & ASSESSMENT

10.2.1 WATER QUALITY

Water quality was assessed within the wetland in the north-west and a small narrow constructed drain within Swamp Sclerophyll Forest in the north of the study area. Physical water quality measurements were sampled in situ at each site on 30 May 2014. Water quality was measured using a Horiba U 50 Water Meter. Parameters measured included pH, temperature, Oxidation Reduction Potential (ORP), Dissolved Oxygen (mg/L DO), Dissolved Oxygen (DO%), Conductivity (dS/m), Turbidity TDU, Total Dissolved Solids (TDS) and Salinity. The water parameters are shown in Table 19.

Table 19: Surface water quality measurements within the study area.

Water parameter	Wetland GDA 94 E – 407136 N - 6373899	Narrow Drain GDA 94 E – 406502 N - 6373564
Temperature 0C	16.93	16.8
pH	6.22	5.90
Oxidation Reduction Potential (ORP) pHmV	-3.9	-58
Dissolved Oxygen (mg/L DO)	7.21	0.92
Dissolved Oxygen (DO%),	74.4	9.8
Conductivity (dS/m),	0.414	0.321
Turbidity TDU	92	11
Total Dissolved Solids g/L TDS	0.269	0.212
Salinity ppt	0.2	0.2

The areas of surface water quality were found to be in relatively good condition.

10.3 FISHERIES MANAGEMENT ACT (FM ACT)

The objectives of the Fisheries Management Act (FM Act) are to conserve, develop and share the fishery resources of the state for the benefit of present and future generations. Part 7A of the Fisheries Management Act 1994 (FM Act 1994) provides for the listing of threatened species, populations and endangered ecological communities. Table 20 lists the threatened species and endangered populations that may occur in the local area.

Table 20: Threatened Species and Populations that may occur within 10km of the proposal.

SPECIES	FM ACT 1994	HABITAT PREFERRED	HABITAT PRESENT
Macquaria australasica (Macquarie Perch)	E	Occurs naturally in western flowing drainages from the Lachlan River southward into Victoria.	No suitable habitat was present.
The Darling River Hardyhead (*Craterocephalus amniculus*) population in the Hunter River catchment	EP	They are usually found in slow flowing, clear, shallow waters or in aquatic vegetation at the edge of such waters. The species has also been recorded from the edge of fast flowing habitats such as the runs at the head of pools.	No suitable habitat was present.
Mogurnda adspersa (Purple Spotted Gudgeon)	EP	Rivers Creeks and billabongs, usually in quite or slow flowing sections over rocks or among vegetation.	No suitable habitat was present.
Carcharias taurus Greynurse Shark -	CE	Temperate waters of all oceans except the eastern Pacific. Habitat along the length of the NSW coast.	No suitable habitat was present.
Epinephelus daemelii Black Rockcod	V	Found in warm temperate and subtropical parts of the south-western Pacific.	No suitable habitat was present.
Austrocordulia leonardi Sydney Hawk Dragonfly -	V	Known only from the Hawkesbury-Nepean, Georges River and Port Hacking drainages.	No suitable habitat was present.
Archaeophya adamsi Adam's emerald dragonfly	E	Narrow, shaded riffle zones with moss and abundant riparian vegetation	No suitable habitat was present.

CE= Critically Endangered E=Endangered Species V=Vulnerable Species EP=Endangered Population

10.3.1 SEVEN-PART TEST FOR THREATENED AQUATIC SPECIES

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

No suitable habitat was considered to be present for any of the currently listed threatened aquatic species. Only a small amount of freshwater habitat was present in the form of an area of freshwater wetland in the north-west and a narrow drain within swamp sclerophyll forest in the north of the study

area. The proposal is not likely to have a significant impact on any listed threatened species under the FM Act.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No habitat was available for any endangered populations listed under the FM Act.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No Endangered ecological community listed under the FM Act is likely to be impacted by the proposal.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No area of aquatic habitat will be directly impacted by the proposed sand mine. No areas of aquatic habitat are considered likely to become fragmented or isolated as a result of the proposal.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat'.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery or threat abatement plan is pertinent to the proposed action.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed on the schedules of the FM Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal:

- The introduction of fish to fresh waters within a river catchment outside their natural range.

Specimens of *Gambusia holbrooki* (Plague Minnow) were recorded during periods of higher water levels after rain within the vicinity of the freshwater Wetland. The proposal is unlikely to increase numbers if this introduced fish species or result in any new introductions.

11.0 CONSIDERATIONS UNDER THE COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

Considerations have been made to the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999. Assessments have been made to determine whether or not the proposal or activity has, will have, or is likely to have a significant impact on a matter of National Environmental Significance. The matters of National Environmental Significance and the appropriate responses are listed below:

- *World Heritage properties;*

The proposed development is not considered to affect any World Heritage properties.

- *wetlands recognised under the Ramsar convention as having international significance;*

The Hunter Estuary Wetland Ramsar site is located approximately 18km to the south-west of Bobs Farm. There is no likely hydrological connection between the study area and the Hunter Estuary.

- *listed threatened species and communities;*

No nationally threatened communities were considered to be present within the study area. There was one EPBC Act Listed Threatened Species, *Pteropus poliocephalus* (Grey-headed Flying-fox) listed as Vulnerable, recorded within the study area. An additional species, *Phascolarctos cinereus* (Koala) also listed as Vulnerable was identified as utilising the study area from the presence of secondary evidence in the form of scratches on trees in the north-east of the study area.

- listed as Vulnerable was recorded foraging within the site during fieldwork, and

No other nationally threatened species were recorded on site during the survey, however 36 nationally threatened species were recorded on the DoEE database as occurring or having potential habitat available within 10km of the site, these being:

- *Cryptostylis hunteriana* (Leafless Tongue Orchid)
- *Allocasuarina defungens* (Dwarf Heath Casuarina)
- *Diuris praecox* (Newcastle Doubletail)
- *Angophora inopina* (Charmhaven Apple)
- *Eucalyptus parramattensis* subsp. *decadens* (Drooping Red Gum)
- *Melaleuca biconvexa* (Biconvex Paperbark)
- *Prostanthera densa* (Villous Mintbush)
- *Tetratheca juncea* (Black-eyed Susan)
- *Litoria aurea* (Green and Golden Bell Frog)
- *Mixophyes balbus* (Stuttering Frog)
- *Caretta caretta* (Loggerhead Turtle)
- *Chelonia mydas* (Green Turtle)
- *Dermochelys coriacea* (Leatherback Turtle)
- *Eretmochelys imbricate* (Hawksbill Turtle)
- *Natator depressus* (Flatback Turtle)
- *Diomedea antipodensis* (Antipodean Albatross)
- *Diomedea gibsoni* (Gibson's Albatross)

- *Lathamus discolor* (Swift Parrot)
- *Macronectes giganteus* (Southern Giant-Petrel)
- *Macronectes halli* (Northern Giant-Petrel)
- *Pterodroma neglecta neglecta* (Kermadec Petrel) (Western)
- *Thalassarche bulleri* (Buller's Albatross)
- *Thalassarche cauta cauta* (Shy Albatross)
- *Thalassarche salvini* (Salvin's Albatross)
- *Thalassarche steadi* (White-capped Albatross)
- *Thalassarche impavida* (Campbell Albatross)
- *Rostratula benghalensis australis* (Australian Painted Snipe)
- *Anthochaera phrygia* (Regent Honeyeater)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Phascolarctos cinereus* (Koala)
- *Dasyurus maculatus maculatus* (Tiger Quoll)
- *Potorous tridactylus tridactylus* (Long-nosed Potoroo)
- *Pteropus poliocephalus* (Grey-headed Flying Fox)
- *Pseudomys novaehollandiae* (New Holland Mouse)
- *Eubalaena australis* (Southern Right Whale)
- *Megaptera novaeangliae* (Humpback Whale)

With the exception of the sea bird species, marine mammals and reptiles and the flora species *P. densa, A. defungens* and *T. juncea* the study area was considered to contain suitable habitat of varying quality for the remainder of the listed species. Of the remaining listed species those species most likely to occur/utilise the study area were *D. praecox, P. novaehollandiae* and *D. maculatus maculatus*. All nationally listed threatened species found within the site and considered most likely to occur within the site are assessed below.

11.1 *PTEROPUS POLIOCEPHALUS* (GREY-HEADED FLYING-FOX)

The Grey-headed Flying-fox was observed within the study area on a number of occasions. Large numbers of Grey-headed Flying-foxes were observed feeding on flowering *Eucalyptus pilularis* (Blackbutt) throughout the study area in February 2015. The Grey-headed Flying-fox was also recorded feeding within the study area on flowering specimens of *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark). One deceased specimen had been entangled within a barbed-wire fence surrounding the orchard. Although suitable camp sites were considered to be present within the study area no roosting individuals were observed. Grey-headed Flying-foxes were noted to be largely originating from a large temporary camp located near the corner of Cromarty and Upton Lanes approximately 2km to the east of the study area.

An assessment in accordance with the DoEE principal significant impact guidelines is provided below for the Grey-headed Flying-fox.

Under the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DoE, 2013) an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*

The site does not support an important population of this species. Although the proposal will involve the removal of 25.90ha of seasonal foraging habitat, the proposal is unlikely to decrease the size of an important population.

- *reduce the area of occupancy of an important population*

The proposal will result in the removal of 25.90ha of seasonal foraging habitat for the Grey-headed Flying-fox resulting in a reduction within the local area. No known camp sites will be impacted. Despite the loss of seasonal foraging habitat, the proposal is unlikely to significantly reduce the area occupancy of an important population of the Grey-headed Flying-fox.

- *fragment an existing important population into two or more populations*

The study area forms part of a significant ecological corridor that runs down the coast from the Tomago Sandbeds in the south along the Stockton Bight to the Tomaree Peninsula in the north. The proposal will result in the removal of 25.90ha of seasonal foraging habitat for the Grey-headed Flying-fox resulting in a substantial reduction within the local area. However, no areas of habitat will become isolated for this highly mobile species.

- *adversely affect habitat critical to the survival of a species*

The proposal will result in the removal of 25.90ha of seasonal foraging habitat resulting in an incremental reduction within the local area. No known camp sites were noted within the study area. Whilst resulting in a loss of seasonal foraging habitat the proposal is unlikely to adversely affect habitat critical to the survival of the Grey-headed Flying-fox.

- *disrupt the breeding cycle of an important population*

The study area was not found to support camps belonging to this species, therefore proposal is not expected to result in any actions that would disrupt the breeding cycle of these species.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal will result in the removal of 25.90ha of seasonal foraging habitat resulting in a substantial reduction within the local area. However, the proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The proposal is unlikely to result in an invasive species that is harmful to the Grey-headed Flying-fox from becoming established in the vulnerable species habitat.

- *introduce disease that may cause the species to decline, or*

The proposal is unlikely to result in the introduction of disease that may cause the Grey-headed Flying-fox to decline.

- *interfere substantially with the recovery of the species.*

A number of mitigation measures have been given to reduce the impact of the proposed sand mine on the Grey-headed Flying-fox. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire

The proposal is unlikely to interfere substantially with the recovery of the Grey-headed Flying-fox.

Conclusion

The proposal will result in the removal of seasonal foraging and areas of suitable roosting habitat for *P. poliocephalus.* Given the absence of known camp sites within the study area and relative abundance of similar food resources in the local area for this highly mobile species the proposal is unlikely to significantly impact upon *P. poliocephalus*.

11.2 *PHASCOLARCTOS CINEREUS* (KOALA)

No Koalas were directly observed within the study area during fieldwork completed for this report or previous reports (Wildthing Environmental Consultants, 2009). However, evidence of Koala activity in the form of characteristic scratches on the trunks of a very small number of specimens of *Eucalyptus robusta* (Swamp Mahogany), a preferred feed tree species under the Port Stephens Comprehensive Koala Plan of Management CKPoM, was present within the area of Swamp Forest in the far east of the study area. *Eucalyptus robusta* was the only preferred Koala Feed Tree Species recorded within the study area. No Koala faecal pellets were found within the study area despite a search beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey.

An assessment in accordance with the DoEE principal significant impact guidelines is provided below for the Koala. Referral Assessment of the Koala under the EPBC Act can be found in Section 11.1 of this report.

Under the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DoE, 2013) an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of a population*

No Koalas were directly observed within the study area during fieldwork completed for this report or previous reports (Wildthing Environmental Consultants, 2009). However, evidence of Koala activity in the form of characteristic scratches on the trunks of a small number of specimens of *Eucalyptus robusta* (Swamp Mahogany) a preferred feed tree species under the Port Stephens Comprehensive Koala Plan of Management CKPoM and *Melaleuca quinquenervia* (Broad-leaved Paperbark) were present within the area of Swamp Forest in the north of the study area. Accordingly, a Koala assessment was conducted in the study area to assess the level of current koala activity. *Eucalyptus robusta* was the only preferred Koala Feed Tree Species recorded within the study area. No Koala faecal pellets were found within the study area despite a search beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey. The proposal will result in an incremental reduction of secondary habitat within the local area, however given the fact that no Preferred Koala Feed Tree Species are required to be removed and lack of Koala sightings within the study area the development is unlikely to lead to a long term decrease in the size of a Koala population.

- *reduce the area of occupancy of the species*

The proposal will result in the removal of approximately 25.90ha of Supplementary Koala Habitat largely resulting in an incremental reduction of secondary habitat within the local area, however given the fact that no Preferred Koala Feed Tree Species are required to be removed and lack of Koala sightings within the study area the development is unlikely to significantly reduce the area occupancy of the Koala.

- *fragment an existing population into two or more populations*

The site is part of a large, connected area of native vegetation. The proposal will result in the removal of approximately 25.90ha of Supplementary Koala Habitat largely consisting of Coastal Sand Apple Blackbutt Forest from the north-east section of the corridor. The section of the corridor where the study area is located is approximately 1.5km wide. The proposal will result in the reduction in the width of the corridor by approximately 600m (the majority of habitat occurring on the northern side of the dual carriage way of Nelson Bay Road). The wider southern portion of the regional corridor occurring south of Nelson Bay Road is located on the protected Worimi Conservation Lands. No Habitat Linking Areas under the CKPoM are required to be removed.

During all ecological surveys within the site no Koalas were observed within the site however, secondary evidence in the form of scratches on a small number of specimens of *Eucalyptus robusta* (Swamp Mahogany) were recorded in the far north-east of site outside development area. Despite targeted searches beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey, no Koala faecal pellets were found within the study area. As a precaution any similar sized scats were sent for analysis to Barbara Triggs, but were identified as belonging to Common Brushtail Possum. The proposal will require the clearing of 25.90ha of Secondary Koala habitat. However, Preferred Koala Habitat under the definition of the CKPoM occupied two relatively small areas of Swamp Sclerophyll Forest within the study area. A 50m buffer over supplementary habitat would also need to be put in place around these areas of Preferred Koala Habitat. The proposed sand mine will be situated within part of the buffer of these two areas. The proposal is unlikely to fragment an existing population of Koala.

- *adversely affect habitat critical to the survival of a species*

A total of 19 specimens of one Koala Food Tree Species *Eucalyptus robusta* (Swamp Mahogany) were found to be present within the smaller vegetation assemblage within the study area; Swamp Sclerophyll Forest. These 19 specimens occur outside the development footprint and will not be impacted. No habitat critical to the survival of the Koala will likely be removed.

- *disrupt the breeding cycle of a population*

The proposal is not expected to result in any actions that would disrupt the breeding cycle of the Koala.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal will result in the removal of approximately 25.90ha of Supplementary Koala Habitat. No Preferred Koala Habitat will be removed. Whilst resulting in a decline in secondary habitat the proposal is unlikely to significantly modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Koala is likely to decline

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

Due to the nature of the proposal it is unlikely that the proposal will result in an increase in harmful invasive species within the site.

- *introduce disease that may cause the species to decline, or*

Due to the nature of the proposal, it is unlikely to further facilitate the introduction or spread of disease or pathogens. If during the clearance phase a Koala is located and observed to be displaying evidence of disease then the Koala is to be taken for a thorough veterinary health examination.

- *interfere with the recovery of the species.*

A number of recommendations have been given to reduce the impact of the proposal on the local population of Koalas in the local area. These recommendations are:

- specimens of *Eucalyptus robusta* are to be planted into the cleared areas of pasture/grasses within the far east of the study area to enhance the adjoining area of Preferred Koala habitat within Lot 10 and to provide a better linkage to larger areas of preferred Koala to the north over Marsh Road.
- It is recommended that the sand mine disturbance area be cordoned off by the use of Koala barrier fencing to prevent any Koalas straying into the path of machinery or trucks.
- It is recommended that low speed limits and Koala warning signage be placed along the internal access roads to reduce the chance of vehicle collision.
- Dogs are to be controlled within the study area.
- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire within the study area;
- Protection of the Koala during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Feral Vertebrate Pest Control;
- Weed Control.

Conclusion

The proposal will result in the removal of 25.90ha of Coastal Sand Apple Blackbutt Forest which was identified as Supplementary Koala Habitat under the Port Stephens CKPoM. Two areas of Swamp Sclerophyll Forest identified as preferred Koala Habitat lie outside the sand mine footprint and will not be directly impacted. No preferred Koala Feed Tree Species will be removed as a result of the proposal. Taking the recommendations pertaining to the Koala into consideration the proposal is unlikely to have a significant impact on the Koala.

11.2.1 EPBC ACT REFERRAL GUIDELINES FOR THE VULNERABLE KOALA

Action: Proposed sand mine within Lots 10 & 11 DP 1071458, Lot 51 DP 1015671 and Lot 245 DP 753204 Nelson Bay Road, Bobs Farm NSW.

Context: Coastal.

Associated infrastructure: Access roads.

Primary impacts: Habitat loss (clearing), habitat fragmentation, habitat degradation, vehicle strike, dog attack.

Impact area size: 25.90ha

Table 21: EPBC Act Referral Guidelines - Koala Habitat assessment tool.

Attribute	Score	Habitat Appraisal	
Koala Occurrence	**+1 (Medium)**	Desk Top	According to database records contained in the BioNet NSW Atlas (OEH, 2017) and Hunter Koala Preservation Society (Hunter Koala Preservation Society, 2015) a small number of records of Koalas occur within proximity to the study area. Relatively recent records of Koalas have been recorded from 2015 and 2016 within the vicinity of the Shark & Ray Centre approximately 200m to the north-west of the site (OEH, 2017). Koalas have also been killed on Nelson Bay Road 200m south of Marsh Road and in the front of Murrays Brewery (no dates given).
		On Ground	Secondary evidence of Koala activity in the form of scratches on specimens of *Eucalyptus robusta* (Swamp Mahogany) were recorded in far north-east of site outside development area. However, no Koala faecal pellets were found within the study area despite a search beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey. Potential Koala scats located within the site were sent for analysis but were identified as belonging to Common Brushtail Possum.
Vegetation Composition	**+1 (Medium)**	Desk Top	According to Port Stephens CKPoM the majority of the study area was mapped as Blackbutt and Smooth-barked Apple Open Forest (Figure 2.5 in Part 2: CKPoM Resource Document). Smaller areas of Mainly Cleared vegetation were present in the northern areas. A large portion of the field survey map was consistent with the LGA vegetation map however the LGA map neglects the presence of Swamp Sclerophyll Forest and Freshwater Wetland.
		On Ground	A total of 19 specimens of one Koala Food Tree Species *Eucalyptus robusta* (Swamp Mahogany) were found to be present within the smaller vegetation assemblage within the study area; Swamp Sclerophyll Forest. No other feed tree species were recorded within the study area.
Habitat Connectivity	**+2 (High)**	Area is part of a contiguous ≥500ha. The study area forms part of a significant ecological corridor that runs down the coast from the Tomago Sandbeds in the south along the Stockton Bight to the Tomaree Peninsula in the north.	
Key Existing Threats	**0**	Desk Top	Ten Koala records within the vicinity of the study area were logged by Hunter Koala Preservation Society (Hunter Koala Preservation Society, 2015). Of these records four were found dead and one died within 24 hours of care from vehicle strike. Two of these Koalas were killed on Nelson Bay Road 200m south of Marsh Road and in the front of

Attribute	Score	Habitat Appraisal	
			Murrays Brewery (no dates given). One Koala was killed on Nelson Bay Road about 500m East Cromarty Lane and another at 3551 Nelson Bay Road in sand hills near first u-turn bay. The koala that died in care was hit at Nelson Bay Road about 200m West Helenvale Lane. Another Koala was also hit by a vehicle on Nelson Bay Road at the junction of Cromarty Lane and recovered in care. This Koala was then released. Also, according to records from the Koala Preservation Society (2015) one Koala was located at 3819 Nelson Bay Road, Bobs Farm and relocated due to the threat of dog attack.
		On Ground	Video footage of *Canis lupus familiaris* (Wild Dog), *Felis catus* (Feral Cat) and *Vulpes vulpes* (European Red Fox) utilising the site has been recorded within the study area (Table 16). Faecal pellets have also been identified from these species within the site (Table 15). Domestic dogs are also kept within the study area.
Recovery Value	**+1 (Medium)**	The site is part of a large, connected area of native vegetation. The proposal will result in the removal of approximately 25.90ha of Supplementary Koala Habitat largely consisting of Coastal Sand Apple Blackbutt Forest from the north-east section of the corridor. The section of the corridor where the study area is located is approximately 1.5km wide. The proposal will result in the reduction in the width of the corridor by approximately 600m (the majority of habitat occurring on the northern side of the dual carriage way of Nelson Bay Road). The wider southern portion of the regional corridor occurring south of Nelson Bay Road is located on the protected Worimi Conservation Lands. No Habitat Linking Areas under the CKPoM are required to be removed. It is therefore uncertain whether the habitat is important for achieving the interim recovery objectives.	
Total	**5**	**Decision: Habitat critical to the survival of the koala—assessment of significance required (sections 7 and 8).**	

11.2.2 SECTION 7 - WILL YOUR ACTION ADVERSELY AFFECT HABITAT CRITICAL TO THE SURVIVAL OF THE KOALA?

Impacts uncertain, referral decision depends on the nature of the action:

• *The score calculated for the impact area (higher score = greater risk of significant impact).*

Score = 5.

• *Amount of koala habitat being cleared (more habitat cleared = greater risk of significant impact).*

Proposed amount of Secondary Koala Habitat being cleared = 25.90ha.

• *Method of clearing (i.e. clear-felling has greater risk of significant impact than selective felling with understorey and koala food tree retention).*

Method of clearing will involve clear-felling of the designated clearance zone, which will be clearly marked (no large-scale tree felling will take place). All trees to be removed will be clearly marked. Koala surveys are to be undertaken prior to any clearance within the site. If a Koala is observed within the site then a 100m radius exclusion zone is to be implemented and a spotter to be stationed observing the koala's movements. The clearance zone will firstly be underscrubbed, then all non-habitat trees will be felled. Habitat trees will be the last to be cleared with the presence of a suitably qualified ecologist inspecting all trees prior and immediately after felling of the habitat tree. Rescued fauna is to be relocated outside of the clearance zone into adjoining habitat.

• *The density or abundance of koalas (relatively high density or abundance for the region means greater risk of significant impact).*

During all ecological surveys within the site no Koalas were observed within the site however, secondary evidence in the form of scratches on specimens of *Eucalyptus robusta* (Swamp Mahogany) was recorded in the far north-east of site outside development area. Despite targeted searches beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey, no Koala faecal pellets were found within the study area. As a precaution any similar sized scats were sent for analysis but were identified as belonging to Common Brushtail Possum. It can be assumed that the density of Koalas occurring within the locality would be low.

• *Level of fragmentation caused by the clearing (greater degree of fragmentation has greater risk of significant impact).*

The proposal will require the clearing of 25.90ha of Secondary Koala habitat. However, Preferred Koala Habitat under the definition of the CKPoM occupied two relatively small areas of Swamp Sclerophyll Forest within the study area.

DECISION: Although a score of 5 was given, the outcome of the assessment was deemed – Referral Not Recommended.

11.2.3 SECTION 8 - COULD YOUR ACTION INTERFERE SUBSTANTIALLY WITH THE RECOVERY OF THE KOALA?

Impacts which are likely to substantially interfere with the recovery of the koala may include one or more of the following:

• *Increasing koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities.*

Proposed mitigating measure: It is unlikely the proposal will increase the presence of dogs within the vicinity of the sand mine. Employees of the sand mine should not be permitted to bring dogs to work.

Effectiveness = High

• *Increasing koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities.*

Proposed mitigating measure: Low speed limits and Koala warning signage be placed along roads within the development. It is also recommended the sand mine disturbance area be cordoned off by the use of Koala proof barrier fencing to prevent any Koalas straying into the path of machinery or trucks

Effectiveness = High

• *Facilitating the introduction or spread of disease or pathogens for example Chlamydia or Phytophthora cinnamomi, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat.*

The proposal is unlikely to further facilitate the introduction or spread of disease or pathogens. Proposed mitigating measure: If during the clearance phase a Koala is located and observed to be displaying evidence of disease then the Koala is to be taken for a thorough veterinary health examination.

Effectiveness = High

• *Creating a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala.*

Proposed mitigation measure: Planting of specimens of *Eucalyptus robusta* (Swamp Mahogany) within the northern portion of Lot 51 to enhance Koala habitat within the study area and increase the connectivity for Koalas between preferred Koala Habitat within the study area to areas of Preferred Koala Habitat over Marsh Road.

Effectiveness = Moderate

• *Changing hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term.*

As stated in Section 5.1.2 of this report the areas of preferred Koala Habitat may be subject to secondary impacts as the proposal will require excavation below the groundwater level potentially affecting the groundwater dependent Swamp Sclerophyll Forest Assemblage. An assessment undertaken (Martins, 2015) found the drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, the change in groundwater levels should not significantly impact areas of Preferred Koala Habitat.

DECISION: Given the mitigating measures are implemented the outcome of the assessment was deemed – Referral Not Recommended.

11.2.4 SECTION 9 - COULD YOUR ACTION REQUIRE A REFERRAL TO THE MINISTER FOR SIGNIFICANT IMPACTS ON THE KOALA?

The decision as to whether your proposed action will have or is likely to have a significant impact on the koala will come down two key considerations outlined in these guidelines:

• *Adversely affecting habitat critical to the survival of the koala (section 7) AND/OR*

DECISION: Although a score of 5 was given, the outcome of the assessment it was deemed – Referral Not Recommended.

• *Interfering substantially with the recovery of the koala through the introduction or exacerbation of key threats in areas of habitat critical to the survival of the koala (section 8).*

DECISION: Given the mitigating measures are implemented the outcome of the assessment was deemed – Referral Not Recommended.

Hence referral is not recommended for adversely affecting habitat critical to the survival of the Koala.

11.3 CRITICALLY ENDANGERED SPECIES CONSIDERED TO HAVE POTENTIAL HABITAT WITHIN THE STUDY AREA

The following EPBC Act listed endangered and critically endangered species respectively are considered in this assessment:

- *Lathamus discolor* (Swift Parrot)
- *Anthochaera phrygia* (Regent Honeyeater)

The Swift Parrot is generally more commonly recorded inland from the coast, however, is known to come to the coast during drier inland periods or as a result of seasonal movements. Specimens of the large flowered *Eucalyptus robusta* (Swamp Mahogany) which were present within the study area would provide seasonal preferred coastal foraging habitat for the Swift Parrot. There is a National Recovery Plan for the Swift Parrot (Saunders & Tzaros, 2011). Overall objectives include:

- To prevent further decline of the Swift Parrot population; and to
- To achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat to increase carrying capacity.

Although the Regent Honeyeater is usually recorded within inland area it is also known to come to the coast during events such as drier inland weather periods. This honeyeater has been recorded nearby to

the study area at Tanilba Bay on 8 June 2014 feeding on flowering specimens of *Eucalyptus robusta* (Swamp Mahogany) (Port Stephens Examiner, 2014). There is a National Recovery Plan for the Regent Honeyeater (DoE, 2016). The Recovery plan objectives include:

- Reverse the long-term population trend of decline and increase the numbers of regent honeyeaters to a level where there is a viable, wild breeding population, even in poor breeding years; and to
- Enhance the condition of habitat across the regent honeyeaters range to maximise survival and reproductive success, and provide refugia during periods of extreme environmental fluctuation.

The strategies to achieve the recovery plan's objectives are to:

- Improve the extent and quality of regent honeyeater habitat;
- Bolster the wild population with captive-bred birds until the wild population becomes self-sustaining;
- Increase understanding of the size, structure, trajectory and viability of the wild population;
- Maintain and increase community awareness, understanding and involvement in the recovery program.

Under the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DoE, 2013) an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of a population*

Neither the Swift Parrot nor the Regent Honeyeater were recorded within the study area, however there is potential for these species to occur. According to the National Recovery Plan for the Swift Parrot (Saunders & Tzaros, 2011) two key foraging tree species within the Hunter-Central Rivers natural resource management region for the Swift Parrot, *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus pilularis* (Blackbutt) are present within the site. Although the proposal will not require the removal of any of the 19 *E. robusta* present within the site, it will result in the removal of a large number of *E. pilularis*, within 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest. Although this is viewed as not complying with the National Recovery Plan, given the relatively the high mobility of these birds, large amount of similar surrounding habitat the proposal is unlikely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long-term survival of the Swift Parrot.

According to the National Recovery Plan for the Regent Honeyeater (DoE, 2016) the probable major cause of long-term decline is the clearing and fragmentation of woodland and forest habitat containing the bird's preferred eucalypt species. Preferred foraging habitat within the study area would largely be confined to the small number of specimens of large flowering *Eucalyptus robusta* (Swamp Mahogany) occurring within the two areas of swamp sclerophyll forest. Although not listed as a key species utilised by the Regent Honeyeater under the National Recovery Plan, winter flowering specimens of *Eucalyptus pilularis* (Blackbutt) may also provide suitable transitory foraging habitat. No preferred foraging habitat in the form of *E. robusta* is required to be removed for the proposed sand mine. The proposal will result in a reduction in secondary seasonal foraging habitat within the local area, however it is unlikely to result in the extinction of any local population of this species.

- *reduce the area of occupancy of the species*

The proposal will result in the removal of 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest which contains a key foraging tree species *Eucalyptus pilularis* (Blackbutt) for the Swift Parrot and may act as seasonal transitory foraging habitat for the Regent Honeyeater. However, no Swift Parrots or Regent Honeyeaters were recorded during fieldwork undertaken within the study area.

- *fragment an existing population into two or more populations*

No areas of habitat will become isolated for these highly mobile species as a result of the proposal.

- *adversely affect habitat critical to the survival of a species*

According to the National Recovery Plan for the Swift Parrot (Saunders & Tzaros, 2011) two key foraging tree species within the Hunter-Central Rivers natural resource management region for the Swift Parrot, *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus pilularis* (Blackbutt) are present within the site. Although the proposal will not require the removal of any of the 19 Swamp Mahogany specimens present within the site, it will result in the removal of a large number of Blackbutt, with 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest requiring removal. The site is also part of a large, connected area of native vegetation that contains similar floristic components to the study area, including specimens of Blackbutt that runs down the coast from the Tomago Sandbeds in the south along the Stockton Bight to the Tomaree Peninsula in the north. Therefore, although there will be an incremental loss of habitat the proposal is unlikely to result in adversely affecting habitat critical to the survival of the Swift Parrot.

According to the National Recovery Plan for the Regent Honeyeater (DoE, 2016) forest types regularly utilised by regent honeyeaters include wet lowland coastal forest dominated by *Eucalyptus robusta* (Swamp Mahogany). There are 19 Swamp Mahogany specimens located within the site. Preferred foraging habitat within the study area would largely be confined to the small number of specimens of large flowering *Eucalyptus robusta* (Swamp Mahogany) occurring within the two areas

of swamp sclerophyll forest. However, the proposal will not result in the removal of this preferred foraging habitat. The proposal will result in the removal of 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest which may act as seasonal transitory foraging habitat for the Regent Honeyeater. Regent honeyeaters also prefer taller and larger diameter trees for foraging, as these typically produce more nectar. Although a number of larger diameter trees (>80cm) will require removal as a result of the proposal, it is not likely to significantly affect habitat critical to the survival of the Regent Honeyeater.

- *disrupt the breeding cycle of a population*

The Swift Parrot breeds in Tasmania during the austral summer and the entire population migrates north to mainland Australia for the austral winter. The proposal is therefore unlikely to disrupt the breeding cycle of the population of Swift Parrots.

For the Regent Honeyeater, according to 'Figure 1: Regent Honeyeater Distribution' within the National Recover Plan (DoE, 2016) the study area is located within an area the species is likely to occur, but it outside of key and other breeding areas. According to the National Recovery Plan (DoE, 2016) the timing of breeding varies between regions, and appears to correspond with the flowering of key eucalypt and mistletoe species. The site contains 19 specimens of one key species being *Eucalyptus robusta* (Swamp Mahogany). The proposal will not result in the removal of any Swamp Mahogany specimens and is therefore unlikely to disrupt the breeding cycle of a population of Regent Honeyeaters.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

No areas of habitat will become isolated for the highly mobile Swift Parrot and Regent Honeyeater.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The Regent Honeyeater also faces increased competition from larger, more aggressive nectivores, such as *Manorina melanocephala* (Noisy Miner), which is listed as a Key Threatening Process (Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)). The proposal is not likely to increase the presence of this species.

- *introduce disease that may cause the species to decline, or*

The proposal is unlikely to result in the introduction of disease that may cause the Swift Parrot or Regent Honeyeater to decline.

- *interfere with the recovery of the species.*

A National Recovery Plan has been completed for the Swift Parrot (Saunders & Tzaros, 2011). The plan recommends the retention of foraging species such as *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus pilularis* (Blackbutt).

A National Recovery Plan has been completed for the Regent Honeyeater (DoE, 2016). The plan recommends the retention of preferred foraging trees and Mistletoe.

A number of mitigation measures have been given to reduce the impact of the proposed sand mine on the Swift Parrot and Regent Honeyeater. These include:

- Retention of preferred foraging habitat with the retention of the 19 specimens of Swamp Mahogany.
- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire
- Loss of habitat will be offset.

Conclusion: *Lathamus discolor* (Swift Parrot)

A National Recovery Plan has been development for the Swift Parrot (Saunders & Tzaros, 2011). The plan recommends the retention of foraging species such as *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus pilularis* (Blackbutt). The proposal will involve the removal of specimens of *E. pilularis* however no E. *robusta* are required to be removed. The proposal although not complying with the recommendations it is unlikely to significantly compromise the recovery plan.

Conclusion: *Anthochaera phrygia* (Regent Honeyeater)

A National Recovery Plan has been completed for the Regent Honeyeater (DoE, 2016). The plan recommends the retention of preferred foraging trees and Mistletoe. As specimens of *E. robusta* a preferred foraging resource in the local will not be removed the proposal is unlikely to significantly compromise the Recovery Plan.

EPBC Act Listed Vulnerable Species considered to have potential habitat within the study area:

The following EPBC Act listed endangered and critically endangered species respectively are considered in this assessment:

- *Diuris praecox* (Newcastle Doubletail)
- *Pseudomys novaehollandiae* (New Holland Mouse)
- *Dasyurus maculatus maculatus* (Tiger Quoll)

Although not recorded within the study area a number of flowering specimens of *D. praecox* were found to occur outside the study area approximately 200m to the west within the electricity easement (Wildthing Environmental Consultants, 2018).

Records of *P. novaehollandiae* are known from the nearby Worimi Conservation Lands (Ecotone, 2008). This species has also been recorded from Salt Ash (Umwelt, 2009) and Tomago (Wildthing Environmental Consultants, 2013). Areas of Coastal Sand Apple Blackbutt Forest within the study area contained suitable habitat for this native rodent.

The Tiger Quoll was not recorded within the study area despite targeted surveys. The Atlas of NSW Wildlife database (OEH, 2015) contained a small number of local records of the Tiger Quoll within the local area. Open Forest habitat within the study area contains suitable hunting and roosting habitat for this Quoll species. A relatively large number of suitable roosts in the form of hollow logs or tree hollows were present. Spotted-tailed quolls occupy extensive home ranges which may be in excess of 580 hectares and up to 875 hectares (Watt 1993). Considering the large area of adjoining habitat along Stockton Bight it is likely that the Tiger Quoll would utilise habitat within the study area as part of a much larger home range.

An assessment in accordance with the DoEE principal significant impact guidelines is provided below for these species.

Under the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DoE, 2013) an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*

Specimens of *D. praecox* were found to occur outside the study area approximately 200m to the west within the electricity easement (Wildthing Environmental Consultants, 2018). Populations of *D. praecox* were also present within the electricity easement to the east of the study area and to the west over Nelson Bay Road (ERM, 2003). The proposed sand mine will result in the removal of areas of suitable habitat for *D. praecox*, however considering the absence of this species within the study area and during targeted searches, in particular habitat within the easement, and that the easement will be retained within the scope of the development, the proposal is unlikely to cause extinction of the local population of *D. praecox*.

Pseudomys novaehollandiae was not recorded during all surveys undertaken within the study area. However, records of *P. novaehollandiae* are known from the nearby Worimi Conservation Lands (Ecotone, 2008). This species has also been recorded from Salt Ash (Umwelt, 2009) and Tomago (Wildthing Environmental Consultants, 2013). The absence of this species during trapping may be

due to the lack of preferred habitat in the form of open sandy heath. The proposal is unlikely to decrease the size of an important population of this species.

The Tiger Quoll was not recorded within the study area despite targeted surveys, which involved trapping, scat analysis, spotlighting and remote camera surveys. Considering the relatively large area of remaining habitat together with the given recommendations the proposed sand mine is unlikely to result in the extinction of any local population of the Tiger Quoll.

- *reduce the area of occupancy of an important population*

The proposed sand mine will result in the removal of areas of suitable habitat for *D. praecox,* however considering the absence of this species within the study area during targeted searches, in particular habitat within the easement, and that the easement will be retained within the scope of the development, the proposal is unlikely to cause extinction of the local population of *D. praecox*.

The proposal may result in the removal of suitable habitat for *P. novaehollandiae,* however areas of early succession revegetation after sand mining would also provide suitable habitat for this species.

The proposal will result in a significant reduction in Tiger Quoll habitat occurring along the dune forests of Stockton Bight. Considering the relatively large area of remaining habitat together with the given recommendations the proposed sand mine is unlikely to result in the extinction of any local population of the Tiger Quoll.

- *fragment an existing important population into two or more populations*

The proposal has been deigned to retain the electrical easement along the southern boundary of the study area in order to avoid isolating individuals of *D. praecox* to the west of the study area with known occurrences to the east over Nelson Bay Road. The proposal is unlikely to affect ecological processes such as pollination between sub-populations of *D. praecox*.

The New Holland Mouse and Tiger Quoll were not recorded within the study area despite targeted surveys, which involved trapping, scat analysis, spotlighting and remote camera surveys. The site is part of a large, connected area of native vegetation. The section of the corridor where the study area is located is approximately 1.5km wide. The proposal will result in the reduction in the width of the corridor by approximately 600m (the majority of habitat occurring on the northern side of the dual carriage way of Nelson Bay Road). Considering the large area of adjoining habitat along Stockton Bight the proposal is unlikely to fragment and existing population of New Holland Mouse or Tiger Quoll.

- *adversely affect habitat critical to the survival of a species*

Within the study area preferred habitat was present within open areas dominated by native grasses with no canopy or shrub layer. The area of most suitable habitat was contained within the maintained electrical easement. Habitat was also considered to be present within areas of Coastal Sand Apple Blackbutt Forest with a sparse canopy and understorey cover. The proposed sand mine will result in the removal of areas of suitable habitat for *D. praecox*.

The proposal may result in the removal of suitable habitat for *P. novaehollandiae*, however areas of early succession revegetation after mining would also provide suitable habitat for this species.

The proposal will result in the removal of 25.9ha of Coastal Sand Apple Blackbutt Forest containing likely hunting and denning habitat for the Tiger Quoll.

- *disrupt the breeding cycle of an important population*

The proposal is unlikely to affect ecological processes such as pollination between sub-populations of *D. praecox* due to the retention of the easement which will avoid isolating individuals of *D. praecox* to the west of the study area with known occurrences to the east over Nelson Bay Road.

The absence of *P. novaehollandiae* during trapping may be due to the lack of preferred habitat in the form of open sandy heath. However, areas of Coastal Sand Apple Blackbutt Forest within the study area contained suitable habitat for this native rodent. Although the proposal will result in a reduction in width of a vegetated corridor along Stockton Bight by approximately 600m, the proposal is unlikely to fragment an existing population of New Holland Mouse. The proposal is not expected to result in any actions that would disrupt the breeding cycle of this species.

A relatively large number of suitable roosts in the form of hollow logs or tree hollows were present. Tiger quolls occupy extensive home ranges which may be in excess of 580 hectares and up to 875 hectares (Watt 1993). Considering the large area of adjoining habitat along Stockton Bight it is unlikely the proposal will disrupt the breeding cycle of an important population of Tiger Quoll.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

No areas of habitat are likely to become fragmented or isolated for these three species. The proposal will result in the incremental reduction in of a relatively large fragment of adjoining habitat occurring along Stockton Bight. However no area of habitat important to the long-term survival of the these species is likely to be removed, fragmented or isolated.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Due to the nature of the proposal it is unlikely that the proposal will result in the colonisation of invasive species within the site.

- *introduce disease that may cause the species to decline, or*

The proposal is unlikely to result in the introduction of disease that may cause any of these three species to decline.

- *interfere substantially with the recovery of the species.*

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on these three species. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to original forest type);
- Reduction of ongoing mine impacts such as noise and artificial lighting;
- Protection of these species during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Relocation of hollow logs and tree hollows into remaining habitat;
- Feral Vertebrate Pest Control;
- Weed Control.

Conclusion: *Diuris praecox* (Newcastle Doubletail)

Considering the absence of this species within the study area during targeted searches the action is unlikely to have a significant impact on this orchid species.

Conclusion: *Pseudomys novaehollandiae* (New Holland Mouse)

The absence of this species during trapping may be due to the lack of preferred habitat in the form of open sandy heath. The proposal may result in the removal of suitable habitat for *P. novaehollandiae*, however areas of early succession revegetation after mining would also provide suitable habitat for this species. The proposed action is unlikely to have a significant impact on *P. novaehollandiae.*

Conclusion: *Dasyurus maculatus maculatus* (Tiger Quoll)

Open Forest habitat within the study area contains suitable hunting and roosting habitat for this Quoll species. A relatively large number of suitable roosts in the form of hollow logs or tree hollows were also present. Spotted-tailed quolls occupy extensive home ranges which may be in excess of 580 hectares and up to 875 hectares (Watt 1993). Considering the large area of adjoining habitat along Stockton Bight it is likely that the Tiger Quoll would utilise habitat within the study area as part of a much larger home range. The proposal will result in a reduction in Tiger Quoll habitat occurring

along the dune forests of Stockton Bight. Considering the relatively large area of remaining habitat together with the given recommendations the proposed sand mine is unlikely to significantly impact on the Tiger Quoll.

- *migratory species protected under international agreements;*

Forty-two nationally listed migratory species were recorded on the DoEE on-line database as occurring or having potential habitat available within 10km of the study area, these being:

Migratory Terrestrial Species:

- *Haliaeetus leucogaster* (White-bellied Sea-Eagle)
- *Hirundapus caudacutus* (White-throated Needletail)
- *Merops ornatus* (Rainbow Bee-eater)
- *Monarcha melanopsis* (Black-faced Monarch)
- *Monarcha trivirgatus* (Spectacled Monarch)
- *Myiagra cyanoleuca* (Satin Flycatcher)
- *Rhipidura rufifrons* (Rufous Fantail)
- *Anthochaera phrygia* Regent Honeyeater

Migratory Wetland Species:

- *Actitis hypoleucos* (Common Sandpiper)
- *Ardea alba* (Great Egret)
- *Arenaria interpres* (Ruddy Turnstone)
- *Calidris canutus* (Red Knot)
- *Calidris ferruginea* (Curlew Sandpiper)
- *Calidris ruficollis* (Red-necked Stint)
- *Calidris tenuirostris* (Great Knot)
- *Charadrius bicinctus* (Double-banded Plover)
- *Charadrius mongolus* (Lesser Sand Plover)
- *Gallinago hardwickii* (Latham's Snipe)
- *Heteroscelus brevipes* (Grey-tailed Tattler)
- *Limosa limosa* (Black-tailed Godwit)
- *Numenius madagascariensis* (Eastern Curlew)
- *Numenius minutus* (Little Curlew)
- *Numenius phaeopus* (Whimbrel)
- *Pluvialis fulva* (Pacific Golden Plover)
- *Pluvialis squatarola* (Grey Plover)
- *Rostratula benghalensis* (Painted Snipe)
- *Tringa stagnatilis* (Marsh Sandpiper)
- *Xenus cinereus* (Terek Sandpiper)

Migratory Marine Birds

- *Apus pacificus* (Fork-tailed Swift)
- *Ardea alba* (Great Egret)
- *Ardea ibis* (Cattle Egret)
- *Calonectris leucomelas* (Streaked Shearwater)
- *Sterna albifrons* (Little Tern)
- *Diomedea antipodensis* (Antipodean Albatross)
- *Diomedea gibsoni* (Gibson's Albatross)
- *Macronectes giganteus* (Southern Giant-Petrel)

- *Macronectes halli* (Northern Giant-Petrel)
- *Thalassarche bulleri* (Buller's Albatross)
- *Thalassarche cauta cauta* (Shy Albatross)
- *Thalassarche salvini* (Salvin's Albatross)
- *Thalassarche steadi* (White-capped Albatross)
- *Thalassarche impavida* (Campbell Albatross)

Under the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DoE, 2013) an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.*
- *Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*
- *Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

Three listed migratory species, the White-bellied Sea-Eagle, Rufous Fantail and Cattle Egret were recorded within the study area during fieldwork.

Haliaeetus leucogaster (White-bellied Sea-Eagle)

The White-bellied Sea Eagle was observed flying over the study area on a number of occasions. Juvenile White-bellied Sea Eagles noted flying over the study area would also likely indicate nesting within the area. Due to the relatively close proximity of Tilligerry Creek and to a lesser extent the waters of Stockton Bight large trees within the study area would offer potential nesting habitat for the White-bellied Sea Eagle. No large nests that would be attributed to this species were noted within the study area or in close proximity.

Rhipidura rufifrons (Rufous Fantail)

The Rufus Fantail was observed within an area of Coastal Sand Apple Blackbutt Forest on one occasion during fieldwork. The Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as *Eucalyptus pilularis* (Blackbutt).

Ardea ibis (Cattle Egret)

A number of specimens of Cattle Egret were observed forging next to cattle within the area of pasture grassland in the far north-east of the study area.

Considering the relative commonality of the three-migratory species recorded within local area and the impact on habitat in the locality it is unlikely that these species or any of the listed migratory species would be significantly impacted by the proposed sand mine.

- *nuclear activities;*

The proposal does not involve any type of nuclear activity.

- *the Commonwealth marine environment;*

The proposal does not involve the modification of the Commonwealth marine environment.

12.0 BIODIVERSITY ASSESSMENT (STAGE 1)

12.1 IDENTIFIED LANDSCAPE FEATURES

The FBA requires the assessment of landscape features to help describe the biodiversity values of the study area and assess the impacts of the proposed sand mine. A large portion of Lots 51, 254 and to a lesser extent Lot 10 occurring on Aeolian Holocene transgressive dunes was undeveloped and consisted of uncleared tall dry open sclerophyll forest dominated by the canopy species *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). Coastal Sand Apple Blackbutt Forest composed of *E. pilularis* and *A. costata* was the dominant vegetation community on the Holocene sand dunes along Stockton Bight from Fern Bay to Anna Bay. Approximately 10ha within Lot 254 had been cleared and was occupied by an Olive and Fig Orchard. The cleared orchard area also contained a residence and maintained gardens. The lower-lying flat ground in the north of Lots 10, 11 & 51 has had a long history of disturbance and largely consisted of grassland/pasture. Two smaller areas of Swamp Forest dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark) were present in the far north and west of the study area. An area of Freshwater wetland dominated by sedges was also present in the far north of the study area.

12.1.1 BIOREGION AND IBRA SUBREGION

The proposed sand mine site is located within the Sydney Basin IBRA Bioregion and the Karuah-Manning IBRA Subregion (Figure 20). The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 hectares which includes about 4.53 per cent of NSW. The bioregion extends from north of Batemans Bay to Nelson Bay and West to Mudgee and includes a significant proportion of the catchments of the Hawkesbury- Nepean, Hunter and Shoalhaven river systems.

12.1.2 NSW LANDSCAPE REGIONS (MITCHELL LANDSCAPES)

The study area is located within the 'Sydney-Newcastle Barriers and Beaches' Mitchell Landscape. 'Sydney-Newcastle Barriers and Beaches' are composed of Quaternary coastal sediments on long recurved quartz sand beaches between rocky headlands backed by sand dunes and intermittently closed and open lagoons. Includes areas of more extensive high dunes often located on top of the headlands. General elevation 0 to 30m, local relief 10m. Cliff top dunes may be found as high as 90m above sea level. Distinct zonation of vegetation and increasing soil development from the beach to the inland dunes. At the beach; *Spinifex hirsutus* Spinifex, *Lomandra longifolia* (Spiky mat-rush), *Acacia longifolia* subsp. s*ophorae* (Coastal Wattle) and *Leptospermum laevigatum* (Coast Tea Tree) colonise the frontal dune in which there is little soil development. *Banksia integrifolia* (Coastal Banksia) and *Banksia serrata* (Old Man Banksia) are found on the second dunes and these merge with more complex forest containing *Eucalyptus pilularis* (Blackbutt), *Corymbia gummifera* (Red Bloodwood), *Xanthorrhoea* sp. (Grass Trees) and numerous understorey shrubs on deep sands that have an organic

Figure 20: Development site showing the IBRA Region, IBRA Subregion and Mitchell Landscape.

rich A horizon, a bleached A2 horizon and the initial development of weak iron or organic pans in the sandy subsoil. Well-developed, deep podsol profiles are present in cliff top dunes with swampy swales indicating that these forms are probably older than the coastal dunes. Vegetation of *Banksia aemula* heathland and open scrub of *B. integrifolia*), *Westringia fruticosa* (Coastal Rosemary), coast tea-tree and grass tree, with dwarfed *Angophora costata* (Smooth-barked Apple) and *C. gummifera*. Freshwater sedge swamps in larger areas of sand. In the lagoons, salinity varies depending on tidal flushing and they are often surrounded by *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Casuarina glauca* (Swamp Oak). Water margins are occupied by *Juncus* sp. and *Phragmites australis* (Common Reed) in fresh water areas. *Avicennia marina* (Grey mangrove) may occur in some tidal inlets.

12.2 LANDSCAPE VALUE ASSESSMENT

The Project Site Landscape Value is scored based on several variables including:

- Percentage (%) Native Vegetation Cover;
- Connectivity Values; and
- Patch Size.

12.2.1 PERCENTAGE NATIVE VEGETATION COVER

Two landscape assessment circles, 100ha and 1000ha were centred over the proposed mine site using an aerial photo and GIS software (Figure 21). The current and future percentage native vegetation cover after development was assessed for both circles. The 1000-hectare assessment circle was used to assess any loss (or negative impacts) of the proposed development on the percent native vegetation cover in the 'locality' and to identify threatened species that may occur on the Project Site. The smaller 100-hectare circle was used to assess the loss of surrounding vegetation cover at an even more local scale as a result of the proposed development.

<u>1000ha Assessment Circle</u>

- Before development – Approximately 705.80ha = 70.58% (71 – 75%).
- After development – Approximately *678.50ha – 67.8% (66 – 70%).

*705.80 – 27.30 = 678.50ha

After development, resulting in a downward change or 'jump' of one native vegetation cover classes.

<u>100ha Assessment Circle</u>

- Before development – Approximately 63.18ha = 63.18% (61 – 65%).
- After development – Approximately 37.34ha* = 37.34% (36 – 40%).

*63.18 – 27.30 – 1.46 = 37.34ha

After development, resulting in a downward change or 'jump' of five native vegetation cover classes.

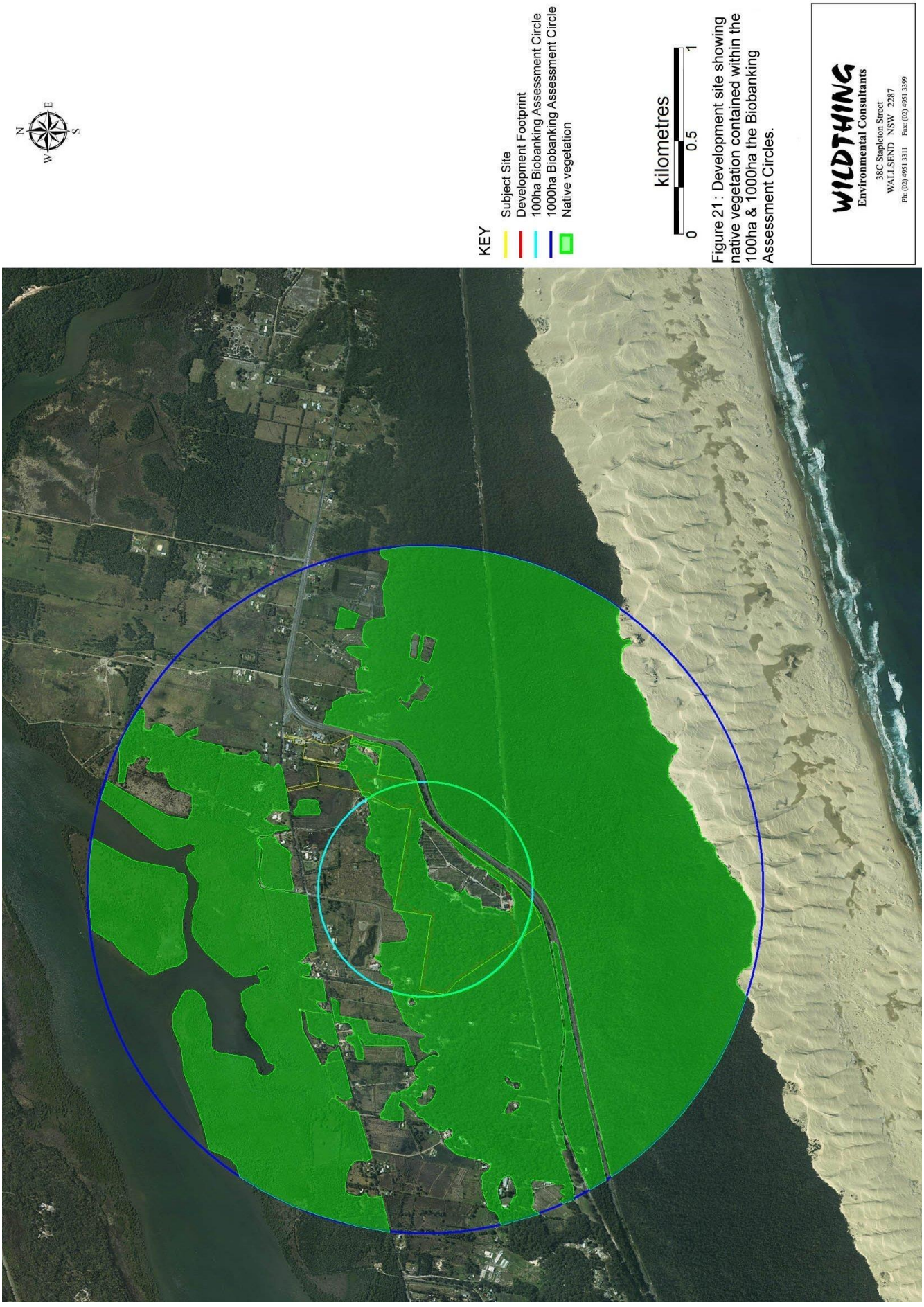


Figure 21 : Development site showing native vegetation contained within the 100ha & 1000ha the Biobanking Assessment Circles.

12.2.2 CONNECTIVITY VALUE

A desktop Connectivity Condition assessment was undertaken by assessing the average condition of native vegetation across the Project Site's 'Primary' linkages to adjoining vegetation. Primary linkages are defined as native vegetation that:

- Is in moderate to good condition;
- Has a patch size > 1 hectare in area;
- Is separated by a distance of <100 metres; and
- Is not separated by a dual carriageway or wider highway or similar hostile link.

It is clear that the Project Site is a part of a connecting link of native vegetation. However, the site did not form part of a State Significant Biodiversity Link or Regionally Significant Biodiversity Link in a plan approved by the Chief Executive of OEH. The site did not form part of a Riparian Buffer.

Site based assessment for connectivity

Taking the dual carriageway of Nelson Bay Road into consideration the connectivity of the site only involved native vegetation occurring to the west of the duel carriageway lanes of Nelson Bay Road.

Connectivity Before Development - >100 – 500m.
Connectivity After Development - >30 – 100m.

The Development Area has connectivity score of 2.

12.2.3 PATCH SIZE

To assess the Patch Size, the assessment must:

- Determine the percent native vegetation cleared in the Mitchell Landscape in which most of the development occurs. In this case the Mitchell Landscape is 'Sydney-Newcastle Barriers and Beaches' and this landscape is 50% cleared.
- Determine the Patch size class, which in this instance is 'extra-large'. Based on the above, the derived Patch Size Score is 12.
-

12.2.4 DERIVED LANDSCAPE VALUE

Data for Percentage Native Vegetation Cover, Connectivity and Patch Size is combined to give the proposed Development Area a Landscape Score of 16.40.

12.3 ASSESSING NATIVE VEGETATION

12.3.1 VEGETATION ZONES

A total of four Vegetation Zones were found to be present on the development site (Figure 22). Vegetation types were classified based on the 'best fit' vegetation type listed in the Plant Communities Types Database (OEH 2009). Parameters used to choose the 'best fit' Vegetation Type included over-storey and understorey floristics, soil landscape, location and topographic position. One vegetation zone was created for each plant community type (PCT) and broad condition state in the sand mine footprint. The area of each zone was calculated using GIS. The four native vegetation zones assessed in the credit calculator are:

Vegetation Zone 1 – HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate/Good_High Condition)(34.51ha);

Vegetation Zone 2 – HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate/Good Derived Grassland)(0.9ha);

Vegetation Zone 3 – HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast(Moderate/Good)(1.15ha);

Vegetation Zone 4 – HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor)(0.32ha).

Vegetation Zone 1

PCT - 1646

BVT - HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast

Vegetation Formation – Dry Sclerophyll Forest (Shrubby sub-formation)

Vegetation Class – Coastal Dune Dry Sclerophyll Forest

Extent in study area – 34.51ha

Vegetation Zone 2 - HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate/Good Derived Grassland)

PCT - 1646

BVT - HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast

Vegetation Formation – Dry Sclerophyll Forest (Shrubby sub-formation)

Vegetation Class – Coastal Dune Dry Sclerophyll Forest

Extent in study area – 0.9ha (occurs within electricity easement)

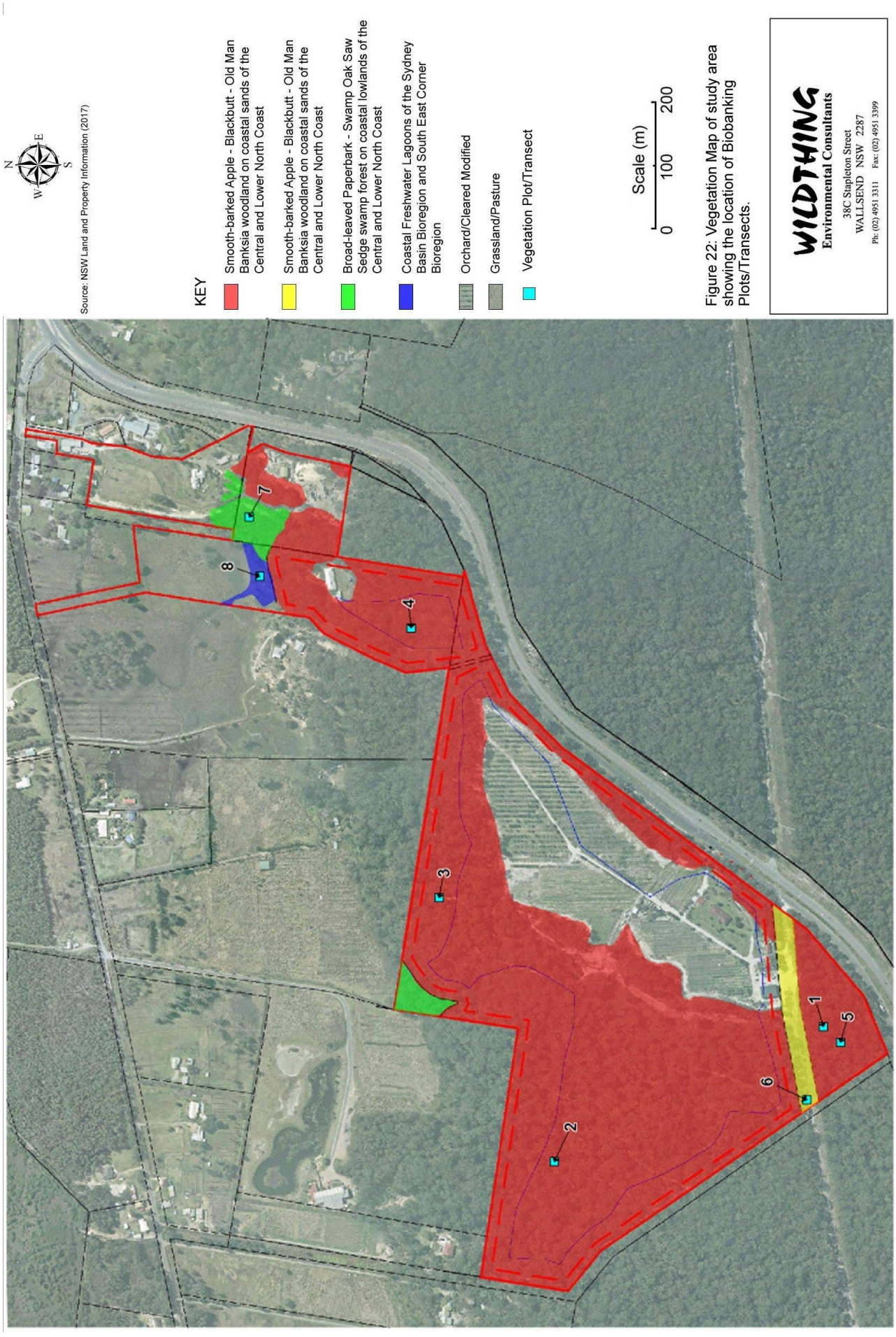


Figure 22: Vegetation Map of study area showing the location of Biobanking Plots/Transects.

Vegetation Zone 3 – HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast(Moderate/Good)

PCT - 1724

BVT - HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate/Good)

Vegetation Formation – Forested Wetlands

Vegetation Class – Coastal Swamp Forests

Extent in study area – 0.9ha

Vegetation Zone 4 – HU533 Coastal freshwater lagoons of the Sydney Basin Bioregion and South-East Corner Bioregion (Moderate/Good_Poor).

Vegetation Formation – Forested Wetlands

Vegetation Class – Coastal Swamp Forests

Extent in study area – 0.32ha

Full descriptions of these communities are shown in Section 6.1 of this report.

12.3.2 ENDANGERED & CRITICALLY ENDANGERED ECOLOGICAL COMMUNITIES

Final Scientific Committee Determinations under the TSC Act were reviewed to assess whether any of the Vegetation Zones were classified as Endangered or Critically Endangered Ecological Communities (EECs). Two Vegetation Zones we found to be consistent with Endangered Ecological Communities, Swamp sclerophyll forest on coastal floodplains and Freshwater wetlands on coastal floodplains (Table 202).

Table 22: Endangered Ecological Communities within the subject site.

Vegetation Zone	Endangered Ecological Community
Vegetation Zone 3 - HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Moderate/Good 1.15ha)	Swamp sclerophyll forest on coastal floodplains.
Vegetation Zone 4 – HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor)(0.32ha).	Freshwater wetlands on coastal floodplains

12.4 SITE SURVEY DETAILS

Survey Time Matrix

The Credit Calculator listed a total of 38 threatened flora and fauna species which are classed as species credit species requiring targeted survey on the site with an accompanying survey time matrix (Table 23). All threatened species and endangered populations were surveyed during the correct time of the year. Refer to Tables 4 & 5.

Table 23: Species credit species requiring targeted survey within the study area with an accompanying survey time matrix

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Austral Toadflax	Thesium australe	Yes	Yes							Yes	Yes	Yes	Yes
Australasian Bittern	Botaurus poiciloptilus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biconvex Paperbark	Melaleuca biconvexa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Black Bittern	Ixobrychus flavicollis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Black-eyed Susan	Tetratheca juncea							Yes	Yes	Yes	Yes	Yes	Yes
Black-necked Stork	Ephippiorhynchus asiaticus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Broad-billed Sandpiper	Limicola falcinellus	Yes	Yes	Yes						Yes	Yes	Yes	Yes
Brush-tailed Phascogale	Phascogale tapoatafa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Camfield's Stringybark	Eucalyptus camfieldii	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Charmhaven Apple	Angophora inopina	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Common Planigale	Planigale maculata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eastern Australian Underground Orchid	Rhizanthella slateri									Yes	Yes	Yes	
Eastern Chestnut Mouse	Pseudomys gracilicaudatus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eastern Pygmy-possum	Cercartetus nanus												
Emu population, NSW North Coast Bioregion and Port Stephens Local	Dromaius novaehollandiae - endangered	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Government Area	population												
Giant Dragonfly	Petalura gigantea	Yes											Yes
Golden-tipped Bat	Kerivoula papuensis	Yes	Yes	Yes							Yes	Yes	Yes
Green and Golden Bell Frog	Litoria aurea	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes
Green-thighed Frog	Litoria brevipalmata	Yes	Yes	Yes							Yes	Yes	Yes
Grove's Paperbark	Melaleuca groveana	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Koala	Phascolarctos cinereus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Koala population, Hawks Nest and Tea Gardens	Phascolarctos cinereus - endangered population Hawks Nest and Tea Gardens	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Leafless Tongue Orchid	Cryptostylis hunteriana	Yes	Yes									Yes	Yes
Maundia triglochinoides	Maundia triglochinoides	Yes	Yes	Yes								Yes	Yes
Nabiac Casuarina	Allocasuarina simulans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Narrow-leaved Red Gum population, Greater Taree Local Government Area	Eucalyptus seeana - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Netted Bottle Brush	Callistemon linearifolius	Yes	Yes	Yes						Yes	Yes	Yes	Yes
Noah's False Chickweed	Lindernia alsinoides	Yes	Yes									Yes	Yes
Red-backed Button-quail	Turnix maculosus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Common name	Scientific name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Regent Honeyeater	Anthochaera phrygia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rough Doubletail	Diuris praecox							Yes	Yes				
Sand Doubletail	Diuris arenaria								Yes	Yes			
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tall Knotweed	Persicaria elatior	Yes	Yes	Yes	Yes	Yes							Yes
Terek Sandpiper	Xenus cinereus	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes
Trailing Woodruff	Asperula asthenes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Villous Mint-bush	Prostanthera densa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wallum Froglet	Crinia tinnula	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zannichellia palustris	Zannichellia palustris			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

12.4 SITE VALUES

12.4.1 VEGETATION TRANSECTS/PLOTS

A Biobank field survey of the Development Area was undertaken in February 2016 and November 2016 by Wildthing Environmental Consultants. A total of eight Biobank biometric plots were carried out within the Development Area where native vegetation is present (Figure 22). As a separate Transect/Plot was completed in the far south-west of the site (No. 5) as part of an offset for the sand mine development it was added to the development calculations.

Transect/plot data for the Development Area was entered into the 'Site Values' section of the Credit Calculator and is reproduced below in Table 24. The Credit Calculator requires that a minimum number of Biometric plots be carried out for each Vegetation Zone based on the Zone's extant area. The number of plots undertaken meets the Biobank assessment minimum survey effort requirements.

Table 24: Vegetation Transect/Plot results.

Transect/ Plot Number	Native plant No.	Over-storey Cover (%)	Mid-storey Cover (%)	Native Ground Cover (Grasses) (%)	Native Ground Cover (Shrubs)(%)	Native Ground Cover (Other)(%)	Exotic Plant Cover (%)	Number of trees with hollows	Over-storey Regeneration	Total length of fallen logs (m)	Easting	Northing
1	23	35	12	28	14	80	8	8	0.8	55.75	406478	6372909
2	26	27	7	26	42	78	0	4	0.8	27.8	406254	6373333
3	33	36	29.5	34	14	84	4	3	0.8	35	406681	6373521
4	27	36	8	10	6	94	0	6	0.8	28.1	407119	6373570
5	26	34	8.5	26	10	84	6	3	0.8	27	406453	6372882
6	23	0	0	72	6	86	8	0	0	5.6	406359	6372934
7	18	42.5	14.5	2	2	96	0	0	0.25	32.1	407295	6373830
8	13	0	1.5	0	6	100	0	0	0	0	407200	6373812

Predicted Threatened Species

The Predicted Threatened Species were modified by the selection of the *Tyto tenebricosa* Sooty Owl to not occur on site. Due to the lack of rainforest and tall wet sclerophyll forest the Sooty Owl would be considered unlikely to be present. No local records of this Owl species were found occurring along the Dunal Forests of Stockton Bight.

12.4.2 VEGETATION MANAGEMENT ZONES

A total of six Vegetation Management Zones were delineated and are shown in Table 25 and Figure 23.

Table 25: Vegetation Management Zones.

Vegetation type listed in the Plant Communities Types Database (OEH 2009).	**Management Zones**
HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (24.38ha).	HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (**Clearing**) (25.90ha).
	HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (MZ1)(3.44ha) **MZ1 – Areas south of electricity easement, areas within Lot 10.**
	HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (MZ2)(5.17ha) **MZ2 – 15m Buffer around clearance line.**
HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate/Good – derived Grassland)(0.9ha)	HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast (Moderate/Good – derived Grassland) **MZ3** (0.9ha).
HU938 - Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (1.15ha).	HU591 - Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (**MZ4**)(1.15ha).
HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor)(0.32ha).	HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor)(0.32ha).(**MZ5**)

12.5 THREATENED SPECIES SURVEY RESULTS

Threatened Fauna

A total of eight threatened species were recorded within the study area during fieldwork:

- *Diuris arenaria* (Tomaree Doubletail)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)
- *Falsistrellus tasmaniensis* (Eastern Falsistrelle)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus schreibersii oceanensis* (Large Bentwing-bat)

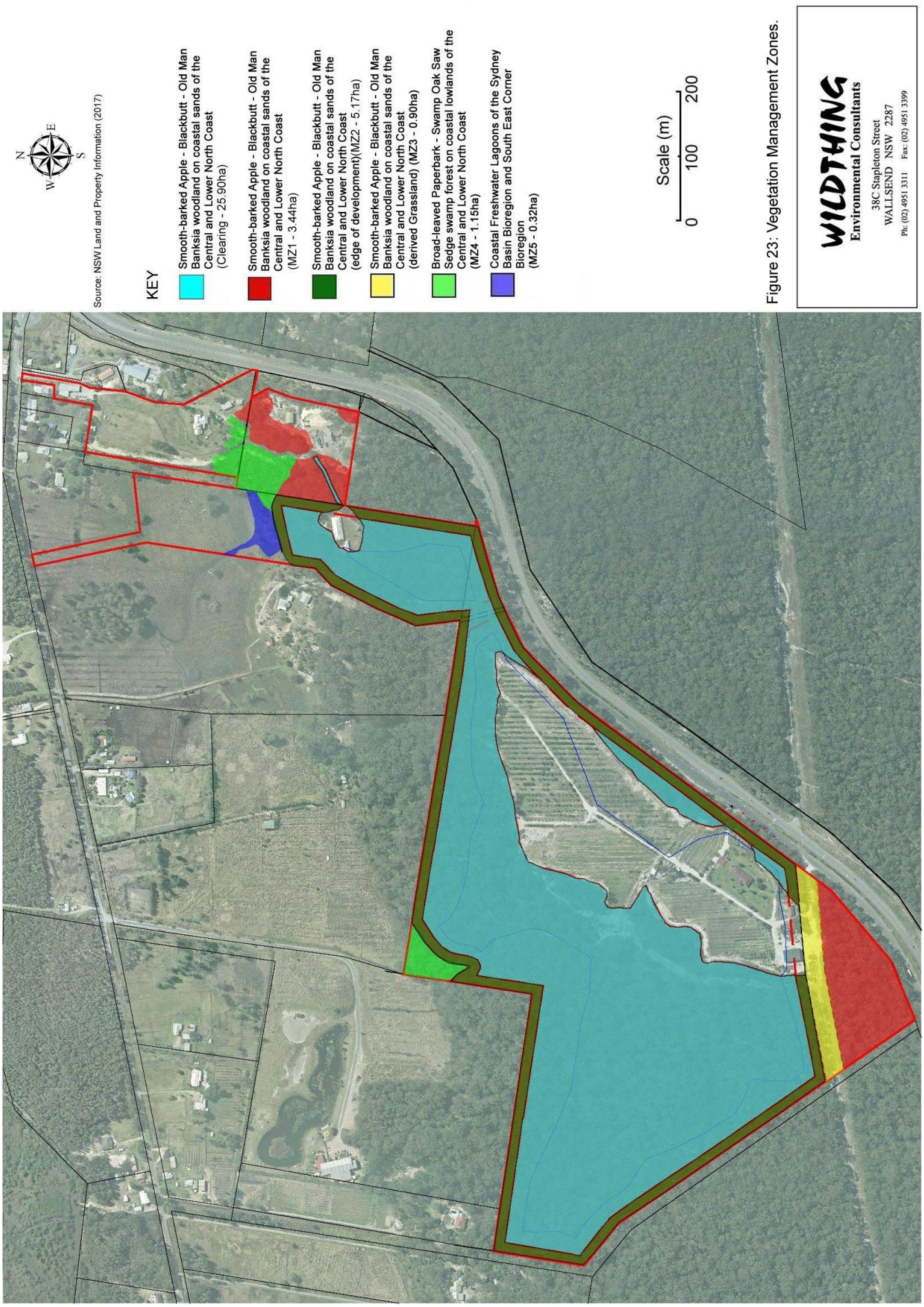


Figure 23: Vegetation Management Zones.

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As a result of secondary evidence an additional two threatened fauna species were also noted within the study area:

- *Ninox strenua* (Powerful Owl)
- *Phascolarctos cinerea* (Koala)

The survey locations of these threatened species within the site are shown in Figures 12 & 15. Of these threatened species *Diuris arenaria* is the only species credit species.

13.0 STAGE 2 – IMPACT ASSESSMENT (BIODIVERSITY VALUES)

13.1 POTENTIAL IMPACTS

13.1.1 AVOID AND MINIMISE IMPACTS

The current development proposal has been designed to avoid directly impacting on two Endangered Ecological Communities, Swamp Sclerophyll Forest and Freshwater Wetlands in the north-east of the site. Given the need for a minimum footprint area to achieve a viable economic development, impacts on Ecological Communities have been minimised as far as possible. There is no other part of the site where the development could be feasibly sited. The conceptual sand mine plan has undergone a number of revisions since its inception. The electrical easement in the south-west containing 108 recorded specimens of the threatened *Diuris arenaria* (Tomaree Doubletail) has been subsequently removed from the development area to avoid all of these orchids. A 15m buffer between the easement and the development has also been put in place. The omission of this area has also removed an area of Coastal Sand Smooth-barked Apple Blackbutt Forest to the south of the easement outside the development plan. This area will be used as an offset as part of the mitigation measures.

13.1.2 DIRECT IMPACTS

The proposed Sand Mine will result in the following direct and potential impacts/losses:

- Approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- Approximately 9.5ha of Orchard;
- Approximately 25.90ha of Supplementary Koala Habitat;
- Approximately 25.90ha of known habitat for eight affected threatened fauna species; *Glossopsitta pusilla* (Little Lorikeet), *Ninox strenua* (Powerful Owl), *Petaurus norfolcensis* (Squirrel Glider), *Scoteanax rueppellii* (Greater Broad-nosed Bat), *Falsistrellus tasmaniensis* (Eastern Falsistrelle), *Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Large Bentwing-bat) and *Pteropus poliocephalus* (Grey-headed Flying-fox);
- Suitable habitat for a number of additional threatened and other flora and fauna species likely to utilise the study area;
- Approximately 877 hollow-bearing trees;
- Habitat Fragmentation;
- Injury/Mortality to native fauna during felling of trees.

The proposal will result in a significant incremental reduction in habitat occurring along the dune forests of Stockton Bight. However, considering the relatively large area of habitat the study area forms part of together with the given recommendations the proposed direct impacts are unlikely to result in the extinction of any Endangered Ecological Community, local population or threatened species.

13.1.3 INDIRECT IMPACTS

The proposed Sand Mine will result in the following indirect and potential impacts;

- Increased spread of noxious weeds;
- Increased spread of pest fauna species;
- Edge effects;
- Impact on Groundwater Dependent Ecosystems (GDE's) through changes to groundwater levels;
- Increase in noise from machinery;
- Increase in artificial lighting. Increased lighting may be the result of security lighting.

These indirect impacts have the potential to have a significant impact on the local ecology. Given recommendations the proposed indirect impacts are unlikely to result in the extinction of any Endangered Ecological Community, local population or threatened species.

13.1.4 MITIGATION MEASURES

A number of mitigation measures have been specified to minimise the impact of the loss of habitat. The measures will include:

- Provision of compensatory habitat (Offsetting);
- Protection of remaining habitat/vegetation;
- Protection of fauna during vegetation removal;
- Provision of mitigation measures for affected species;
- Rehabilitation of part of the extraction area (approximately 12ha) being rehabilitated back to forest (24.8ha - remaining area of extraction area will become an artificial lake);
- Monitoring of groundwater levels and groundwater dependant ecosystems within proximity to the extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.

Provision of Compensatory Habitat (Offsetting)

An offsetting strategy will be undertaken using the Biobanking Assessment Methodology (DECC, 2009). Two offset sites; one site forming part of the Bobs Farm study area and adjoining area, and two sites at Nerong are proposed to be created with the resultant credit generation/retirement.

Protection of Remaining Native Vegetation/Habitat

To protect and enhanced native vegetation occurring within the study area that occurs outside the sand mine footprint the following measures are required to be implemented:

- Clearance of native vegetation should be minimised as far as is practicable. The extent of vegetation clearing is to be clearly identified on construction plans and accurately and

visibility marked on the ground. This will help to ensure areas of native vegetation occurring outside the area of disturbance will remain untouched;

- Weed Control – periodic weed control is to be undertaken within areas of remaining native vegetation;
- The electricity easement will be required to be managed by Ausgrid and be subject to their ongoing management regimes.

Protection of fauna during vegetation removal

The removal of vegetation for the sand mine will be undertaken in a staged or incremental fashion. No large-scale clearing is to be carried out. The following measures are required to be implemented during vegetation clearing works:

- Vegetation clearance is to be undertaken in the non-breeding period (autumn-winter) for most native fauna species;
- Preclearance surveys will be required to be undertaken for Powerful and Masked Owl nesting sites during the breeding season. If a nesting tree is located then a 100m no go zone is to be put in place around this tree until the young have fledged the nest;
- The extent of vegetation clearing is to be accurately and clearly marked on the ground prior to the commencement of works;
- A qualified, licenced and experienced fauna ecologist is to be present during vegetation clearance operations;
- Identification of habitat (hollow-bearing) trees which require removal. These trees will be clearly marked prior to any vegetation removal (These hollow-bearing trees have been numbered and tagged;
- Immediately prior to removal the fauna ecologist is to thoroughly inspect all areas to be cleared for fauna particularly species such as Koala;
- A number of compensatory nest boxes particularly those designed for the Squirrel Glider will be installed around the clearance area to aid those Gliders that have been displaced;
- Feral animals particularly Feral Cats, Foxes and Wild Dogs are to be controlled as part of a Feral Animal Management Plan. Any Feral Animal control will be required to be undertaken with the co-operation of neighbouring land owners including the board of the Worimi Conservation Lands.

Mitigation Measures for affected species

***Diuris arenaria* (Tomaree Doubletail)**

All specimens of *Diuris arenaria* (Tomaree Doubletail) within the subject site are to be protected from unintended removal/disturbance during construction and other associated activities. This will require the erection of a barrier fence to prevent delineate and protect the 15m wide vegetated buffer

zone between the development and the buffer zone. As Ausgrid are responsible for the easement it will also be important to liaise with Ausgrid regarding maintenance of the easements to minimise impacts and support the protection of *D. arenaria*.

Hollow Dependant Fauna

Affected hollow-dependant threatened fauna are *Petaurus norfolcensis* (Squirrel Glider), *Scoteanax rueppellii* (Greater Broad-nosed Bat) and *Falsistrellus tasmaniensis* (Eastern Falsistrelle). Refer to - Protection of fauna during vegetation removal.

Koala

Planting of specimens of *Eucalyptus robusta* (Swamp Mahogany) within the northern portion of Lot 51 to enhance Koala habitat within the study area and increase the connectivity for Koalas between preferred Koala Habitat within the study area to areas of Preferred Koala Habitat over Marsh Road.

Rehabilitation of extraction area

Rehabilitation within the extraction area will be undertaken in stages as the sand mine progresses. The rehabilitation will be required to conform to an approved vegetation management plan completed for the proposal.

Monitoring of Groundwater Levels and Groundwater Dependant Ecosystems within proximity to the Extraction Area

Groundwater levels are to be monitored within and around the study area. Groundwater dependent communities particularly the two areas of swamp forest will be monitored to access any changes in the health of these communities.

Ongoing Site Operation

Noise

A 4m high acoustic barrier has been proposed along both sides of the haul road at the Marsh Road exit, with the eastern barrier to be an absorbent barrier. Additionally, a 6m high noise bund is proposed to run the length of the western boundary of the sand mine, along the northern boundary and down to join the 4m noise barrier at Marsh Road. These noise bunds are proposed to be constructed prior to any other works being carried out within the study area. All of the bunds will be positioned inside the extraction footprint. The 6m barrier is a temporary feature only, needed for Phase 1 extraction only and will be removed again prior to the commencement of Phase 2. The 6m bund will be constructed out of sand and stabilised using matting and mulch. A sturdy constructed silt fence will be positioned inside the extraction footprint on the outer edge of the acoustic barriers within to avoid any sand moving past this point. The noise bunds and silt fences will be required to be inspected regularly to ensure they are functioning property.

Artificial Lighting

Artificial lighting used to operate at night or used for security may influence nocturnal fauna. It is recommended that lighting be minimised and confined wherever possible.

Traffic

It is recommended that low speed limits be set along the haul road to help avoid collision with any native fauna.

To help ensure these mitigation measures are carried out, a vegetation management plan is to be developed to address any likely impacts during construction and ensure the long-term viability of the nearby surrounding environment.

14.0 OFFSET REQUIREMENTS

The FBA Credit Calculator generated a Credit Profile for the Development Area. The Development Biobank Credit Reports generated by the Credit Calculator are provided in Appendix I. A summary of Ecosystem Credits Required is shown in Table 26.

Table 26: Summary of Ecosystem Credits Required.

Plant Community Type	Area (ha)	Credits
HU860 – Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	35.41	1681
HU938 - Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.15	8.17
HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South-East Corner Bioregion	0.32	1.31

No species credits are required.

15.0 STAGE 3 - BIODIVERSITY OFFSET STRATEGY

The Biodiversity Offset Strategy proposes to utilise three parcels of land.

- Part Lot 254 DP 753204 (forms part of the proposed Bobs Farm Sand Mine study area)
- Part Lot 255 DP 753204 (Adjoins the proposed Bobs Farm Sand Mine study area)

The other parcel of land is situated at Nerong.

- Lot 32 DP 880637 (Two sites within lot)

15.1 BIOBANKING OFFSET SITES – BOBS FARM

As previously mentioned both Part Lots 254 and 255 DP 753204 adjoin the proposed Bobs Farm Sand mine proposal. Part Lot 254 (2.33ha) also occurs within the same lot as the majority of the sand mine development and is separated from the proposal by an electricity easement which is approximately 25m wide. Part Lot 255 DP 753204 (10.55ha) occurs to the west of Part Lot 254 and is separated by a 20m unformed road. The offset area within Part Lot 255 consists of two sections of land (1.11ha & 7.06ha) separated by the 25m electrical easement. Although the landowner owns the land within the electrical easement, easements are excluded from Biobank sites due to the fact that the landowner has no control over their management (easement is managed by Ausgrid). The 1.11ha section of land has been placed along the northern section of the easement as a buffer and future protection for two threatened orchid species, *Diuris arenaria* (Tomaree Doubletail) and *Diuris praecox* (Newcastle Doubletail) which are known to occur within the easement (Wildthing Environmental Consultants, 2018). The proposed Bobs Farm offset site is located in the Sydney Basin IBRA Bioregion and the Karuah-Manning IBRA Subregion.

15.2 BIOBANKING OFFSET SITES – NERONG

The proposed Nerong offset sites were located approximately 2.5km to the south-east of the settlement of Nerong. The site was composed of two parcels of land within the 905ha Lot 32 DP 880637. Both proposed offset areas border Myall Lakes National Park. The two proposed offset sites occur within the North Coast IBRA Bioregion and the Karuah-Manning IBRA Subregion. The offset is located within the ‘‘Newcastle Coastal Ramp’ and ‘Myall Foster Barrier System’ Mitchell Landscapes.

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APPENDIX A

SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*

Application Number	SSD 6395
Proposal	The Bobs Farm Sand Project, which involves: • establishing a quarry to extract and process sand at a rate of 750,000 tonnes per annum, from a total resource of 10 million tonnes; • constructing extractive materials processing and transport infrastructure; • transporting extractive material off-site via public road; and • rehabilitating the site.
Location	Adjacent to Nelson Bay Road, Bobs Farm, approximately 15 kilometres southwest of Nelson Bay (Lots 10 & 11 DP1071458)
Applicant	Ammos Resource Management Pty Ltd
Date of Issue	12 April 2017
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a full description of the development, including: – the need for the development; – the resource to be extracted, including the amount, type and composition; – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process); – a waste (overburden, rejects, tailings etc) management strategy; – a water management strategy; – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any existing, approved or proposed development in the vicinity of the site; • a list of any approvals that must be obtained before the development may commence; • an assessment of the likely impacts of the development on the environment, focussing on the key issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: ○ whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; ○ the likely effectiveness of these measures; and

Director General's Environmental Assessment Requirements

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*

State Significant Development

Application Number	SSD-6395
Development	Bobs Farm Sand Project, which includes: • establishment of a quarry to extract and process sand at a rate of approximately 750,000 tonnes per annum, from a total sand resource of 10 million tonnes; • construction of extractive materials processing and transport infrastructure; • transportation of extractive materials off-site via roads; and • rehabilitating the site.
Location	Adjacent to Nelson Bay Road, Bobs Farm, approximately 15 kilometre southwest of Nelsons Bay
Applicant	Ammos Resource Management Pty Ltd
Date of Issue	21 March 2014
General Requirements	The Environmental Impact Statement (EIS) for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. In addition, the EIS must include a: • detailed description of the development, including: – need for the proposed development; – alternatives considered; – likely components and staging of the development - including construction, operational stage/s and rehabilitation; and – plans of any proposed building works; • consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments; • a risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment; • detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: – a description of the existing environment, using sufficient baseline data; – an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes; and – a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment; and • a statement of commitments, outlining all the proposed environmental management and monitoring measures included in the EIS. The EIS must be accompanied by a report from a qualified quantity surveyor providing: • a detailed calculation of the capital investment value (as defined in clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the proposal, including details of all the assumptions and components from which the CIV calculation is derived; • a close estimate of the jobs that will be created by the development during the construction and operational phases of the development; and • certification that the information provided is accurate at the date of preparation.

Key Issues	The EIS must address the following specific issues: • **Land Resources** – including a detailed assessment of the potential impacts on: - soils (including any acid sulfate soils) and land capability (including land contamination); - landforms and topography; - land use, including conservation and recreational use; - extractive material resources, including assessment of the size and quality of the resource and description of the methods used to assess the resource and its suitability for the intended applications; and - agricultural resources and/or enterprises in the local area, including: ○ any change in land-use arising from requirements for biodiversity offsets; and ○ a detailed description of the measures that would be implemented to avoid and/or minimise the potential impacts of the project on agricultural resources and/or enterprises; • **Water Resources** – including: - detailed assessment of potential impacts on the quality and quantity of existing surface and ground water resources including: ○ impacts on the existing sand aquifer; ○ impacts groundwater and surface water resources; ○ detailed modelling of potential groundwater impacts; ○ impacts on existing user entitlements; and ○ impacts on groundwater-dependent and riparian ecology; - a detailed assessment of the potential impacts of the project on: ○ the quantity and quality of regional water supplies; ○ regional water supply infrastructure; and ○ affected licensed water users and basic landholder rights; - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - a detailed consideration of maintenance of an adequate buffer between all excavations and the highest predicted groundwater table; - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP) or water source embargo; - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP and the *Hunter Water Regulation 2000*; and - a detailed description of the proposed water management system (including upgraded sewage system), water monitoring program and other measures to mitigate surface and groundwater impacts; • **Biodiversity** – including: - a detailed description of the measures taken to avoid, reduce or mitigate impacts on biodiversity; - accurate estimates of proposed vegetation clearing and impacts on regional significant remnant vegetation, or vegetation corriders; - a detailed assessment of potential impacts of the development on any: ○ terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; ○ migratory bird species listed under CAMBA, JAMBA and/or ROKAMBA; and ○ regionally significant remnant vegetation, or vegetation corridors; - a comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term; • **Heritage** – including: - an Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must:

	○ demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting mitigation options and measures; and ○ outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures); and - a Historic heritage assessment (including archaeology) which must: ○ include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items; and ○ outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures); • **Traffic & Transport** – including: - accurate predictions of project-related traffic and a detailed assessment of the potential impacts of project-related traffic on the capacity, safety and efficiency of road networks; and - a detailed description of the measures that would be implemented to upgrade and/or maintain the capacity, efficiency and safety of effected roads and intersections over the life of the project; • **Air Quality** – including a quantitative assessment of potential: - construction and operational impacts; - reasonable and feasible mitigation measures to minimise dust emissions; and - monitoring and management measures, in particular real-time air quality monitoring; • **Greenhouse Gases** – including: - a quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions; - a qualitative assessment of the potential impacts of these emissions on the environment; and - an assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency; • **Noise** – including a quantitative assessment of potential: - construction, operational and transport noise impacts; - off-site road noise impacts; - reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed; and - monitoring and management measures, in particular real-time and attended noise monitoring; • **Visual** – including: - a detailed assessment of the: ○ changing landforms on site during the various stages of the project; and ○ potential visual impacts of the project on private landowners in the surrounding area as well as key vantage points in the public domain; and - a detailed description of the measures that would be implemented to minimise the potential visual impacts of the project; • **Waste** – including: - accurate estimates of the quantity and nature of the potential waste streams of the proposal; and - a description of measures that would be implemented to minimise production of other waste, and ensure that that waste is appropriately managed; • **Hazards** – paying particular attention to public safety, and including bushfires; • **Social & Economic** – including an assessment of the: - potential impacts on local and regional communities, including impacts on social amenity; - a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the project, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism; and - a detailed assessment of the costs and benefits of the development as

	a whole, and whether it would result in a net benefit for the NSW community; and • **Rehabilitation** – including the proposed rehabilitation strategy for the site, having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Plans and Documents	The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with the: • Commonwealth Department of the Environment; • Office of Environment and Heritage (including the Heritage Branch); • Environment Protection Authority; • Division of Resources and Energy within P&I of Trade and Investment, Regional Infrastructure and Services; • Department of Primary Industries (including the NSW Office of Water, NSW Forestry, Agriculture and Fisheries sections, Catchments and Lands (Crown Lands Division); • NSW Health; • Transport for NSW (including the Centre for Transport Planning, Roads and Maritime Services); • Hunter Local Land Services; • Hunter Water; and • Port Stephens Council. The EIS must: • describe the consultation process used and demonstrate that effective consultation has occurred; • describe the issues raised by public authorities, service providers, community groups and landowners; • identify where the design of the development has been amended in response to issues raised; and • otherwise demonstrate that issues raised have been appropriately addressed in the assessment.
Further consultation after 2 years	If you do not lodge a DA and an EIS for the development within 2 years of the issue date of these DGRs, you must consult further with the Director-General in relation to the requirements for lodgement.
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, Attachment 1 contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this development.

ATTACHMENT 1
Technical and Policy Guidelines

The following guidelines may assist in the preparation of the Environmental Impact Statement. This list is not exhaustive and not all of these guidelines may be relevant to your proposal.

Many of these documents can be found on the following websites:
http://www.planning.nsw.gov.au
http://www.bookshop.nsw.gov.au
http://www.publications.gov.au

Policies, Guidelines & Plans

Risk Assessment	
	AS/NZS 4360:2004 Risk Management (Standards Australia)
	HB 203: 203:2006 Environmental Risk Management – Principles & Process (Standards Australia)
Land Resources	
	Draft Agricultural Impact Assessment Guidelines 2011 (DP&I)
	Agfact AC25: Agricultural Land Classification (NSW Agriculture)
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Water Resources	
Surface Water	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Use of Reclaimed Water (ARMCANZ/ANZECC)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC)
	State Water Management Outcomes Plan
	Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009
	NSW Government Water Quality and River Flow Objectives (DECC)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries.
	Managing Urban Stormwater: Treatment Techniques (DECC)
	Managing Urban Stormwater: Source Control (DECC)
	Floodplain Development Manual (DIPNR)
	Floodplain Risk Management Guideline (DECC)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	Technical Guidelines: Bunding & Spill Management (DECC)
	Environmental Guidelines: Use of Effluent by Irrigation (DECC)
	Office of Water Guidelines for Controlled Activities (2012)
Groundwater	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	NSW State Groundwater Policy Framework Document (DLWC, 1997)
	NSW State Groundwater Quality Protection Policy (DLWC, 1998)
	NSW State Groundwater Quantity Management Policy (DLWC, 1998)
	Murray-Darling Basin Groundwater Quality. Sampling Guidelines. Technical Report No 3 (MDBC)
	Murray-Darling Basin Commission. Groundwater Flow Modelling Guideline (Aquaterra Consulting Pty Ltd)
	Guidelines for the Assessment & Management of Groundwater Contamination (DECC, 2007)

	Any relevant Water Sharing Plan for groundwater and surface water resources
	NSW Aquifer Interference Policy (2012)
Biodiversity	
	Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECCW 2009)
	Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DECC 2004)
	Guidelines for Threatened Species Assessment (DoP 2005)
	BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECCW 2008)
	The Threatened Species Assessment Guideline – The Assessment of Significance (DECC 2007)
	NSW State Groundwater Dependent Ecosystem Policy (DLWC)
	Policy & Guidelines - Aquatic Habitat Management and Fish Conservation (NSW Fisheries)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
	Principles for the Use of Biodiversity Offsets in NSW (OEH)
Heritage	
Aboriginal	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DEC 2005)
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
Historic	NSW Heritage Manual (NSW Heritage Office)
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
Traffic & Transport	
	Guide to Traffic Generating Development (RTA)
	Road Design Guide (RTA)
Air Quality	
	Protection of the Environment Operations (Clean Air) Regulation 2002
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)
Greenhouse Gases	
	National Greenhouse Accounts Factors (Australian Department of Climate Change (DCC))
	Guidelines for Energy Savings Action Plans (DEUS)
Noise	
	NSW Industrial Noise Policy (DECC)
	Environmental Noise Management – Assessing Vibration: a technical guide (DEC)
	NSW Road Noise Policy (DECCW)
	Interim Guidelines for the Assessment of Noise From Rail Infrastructure Projects (DECC)
Waste	
	Waste Classification Guidelines (DECC)
Hazards	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines - Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis

Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Socio-Economic	
	Draft Economic Evaluation in Environmental Impact Assessment (DoP)
	Techniques for Effective Social Impact Assessment: A Practical Guide (Office of Social Policy, NSW Government Social Policy Directorate)
	NSW Government Guidelines for Economic Appraisal

ATTACHMENT 2
Agency Input into Key Assessment Issues

NSW GOVERNMENT | Planning & Environment

4 April 2017

Sarah Fabian
Student Planner – Resource Assessments
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Emailed: Sarah.Fabian@planning.nsw.gov.au

Your Reference: SSD 6395
Our Reference: OUT17/13772

Dear Ms Fabian,

Re: Request for revised Secretary's Environmental Assessment Requirements Proposal – Bobs Farm Sands Project (SSD 6395)

Thank you for the opportunity to provide advice for the revised Secretary's Environmental Assessment Requirements for Bobs Farm Sand Project (SSD 6395) by Tattersall Lander Pty Ltd on behalf of Ammos Resource Management Pty Ltd (the proponent). This is a response from New South Wales Department of Planning & Environment – Division of Resources & Mining – Geological Survey of New South Wales (GSNSW).

The building and construction industries in NSW require ongoing replacement of supplies as sources are exhausted. The development of new quarries, subject to environmental assessment, helps to ensure a continued supply of material for a range of building and construction uses in NSW.

It is in the best interests of both the proponent and the community to fully assess the resources which are to be extracted. This means that a thorough geological assessment should be undertaken to determine the nature, quality and extent of the resource. Failure to undertake such an assessment could lead to operational problems and possibly even failure of the proposal.

Background
The project area is located 28km north east of Newcastle and 17 km south west of Port Stephens within the Port Stephens LGA. The proponent proposes to extract 750,000 tonnes per annum of sand for construction purposes with the potential to provide fracking sand for coal seam methane extraction and an export resource for glass manufacturing.

The subject site overlies Pleistocene marine sands and is located in the central east portion of Exploration Licence (EL) 8254 (held by the proponent for exploration of Group 10 Minerals). Past exploration in the area has confirmed that these units host variable amounts of heavy minerals including rutile, zircon, ilmenite and leucoxene which *are* prescribed minerals under the *Mining Act 1992*. The proposed extractive operation has the potential to produce by-product heavy

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mineral sands. Production of these minerals **would** require a Mining Lease under the *Mining Act 1992*.

Construction sand is **not** a prescribed mineral under the *Mining Act 1992*. Therefore, the Department has no statutory role in authorising or regulating the extraction of this commodity, apart from its role under the *Work Health and Safety Act 2011* and associated regulations and the *Work Health and Safety (Mine and Petroleum Sites) Act 2013* and associated regulations, for ensuring the safe operation of mines and quarries. However, the Department is the principal government authority responsible for assessing the State's resources of construction materials and for advising State and local government on their planning and management.

All environmental reports, (EIS or similar) accompanying a Development Applications for extractive industry lodged under the *Environmental Planning & Assessment Act* should include a resource assessment **(as detailed in Attachment A)**. Specifically, the Environmental Assessment should:

- Document the size, and quality of the resource and demonstrate that both have been adequately assessed; and
- Document the methods used to assess the resource and its suitability for the intended applications (eg. grainsize, components for construction sand, fracking sand, heavy minerals); and
- Should include resource estimates for construction materials, industrial uses and for heavy mineral sands
- Provide representative cross-sections through the deposit showing the key geological units and the water table.

If heavy minerals are *not* to be extracted, then the possibility of their sterilisation should be addressed. The proposed handling/stockpiling and any end uses for sand known to contain heavy minerals should be detailed.

If heavy minerals *are* to be extracted the proposed mineral separation methods, including flow charts should be provided. The treatment and handling of monazite should be described in detail to address any radiation concerns.

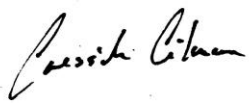
The above information should be summarised in the EIS, with full documentation appended. If deemed **commercial-in-confidence**, the resource assessment summary included in the EIS should commit to providing the Department with full resource assessment documentation separately. Applications to modify, expand, extend or intensify an existing consent that has already been adequately reported using the above protocol in publicly available documents, may restrict detailed documentation to the additional resources to be used, if accompanied by a summary of past resource assessments and of past production.

The Department collects data on the quantity of construction materials produced annually throughout the State. Forms are sent to all operating quarries at the end of each financial year for this purpose. The statistical data collected is of great value to Government and industry in planning and resource management, particularly as a basis for analysing trends in production and for estimating future demand for particular commodities or in particular regions. Production data may be published in aggregated form, however production data for individual operations is kept strictly confidential.

In order to assist in the collection of construction material production data, the proponent should be required to provide annual production data for the subject site to the Department as a condition of any new or amended development consent.

Queries regarding the above information, and future requests for advice in relation to this matter, should be directed to the Division of Resources & Mining – Geological Survey of New South Wales Land Use team at landuse.minerals@industry.nsw.gov.au.

Yours sincerely



Cressida Gilmore
Manager - Land Use

Encl. Attachments "A"

ATTACHMENT A

NSW Department of Planning & Environment
RESOURCES & ENERGY DIVISION

ENVIRONMENTAL and WORK HEALTH & SAFETY ASSESSMENT REQUIREMENTS FOR CONSTRUCTION MATERIAL QUARRY PROPOSALS

It is in the best interests of both the proponent and the community to fully assess the resources which are to be extracted. This means that a thorough geological assessment should be undertaken to determine the nature, quality and extent of the resource. Failure to undertake such an assessment could lead to operational problems and possibly even failure of the proposal.

The following issues need to be addressed when preparing an environmental assessment (EA) or environmental impact statement (EIS) for a proposed construction materials (extractive materials) quarry:

Resource Assessment

1. A summary of the regional and local geology including information on the stratigraphic unit or units within which the resource is located.

2. The amount of material to be extracted and the method or methods used to determine the size of the resource (e.g. drilling, trenching, geophysical methods). Plans and cross-sections summarising this data, at a standard scale, showing location of drillholes and/or trenches, and the area proposed for extraction, should be included in the EA or EIS. Relevant supporting documentation such as drill logs should be included or appended. Major resource proposals should be subject to extensive drilling programs to identify the nature and extent of the resource.

3. Characteristics of the material or materials to be produced:
   a) For structural clay/shale extraction proposals, ceramic properties such as plasticity, drying characteristics (e.g. dry green strength, linear drying shrinkage), and firing characteristics (e.g. shrinkage, water absorption, fired colour) should be described.
   b) For sand extraction proposals, properties such as composition, grainsize, grading, clay content and contaminants should be indicated. The inclusion of indicative grading curves for all anticipated products as well as the overall deposit is recommended.
   c) For hard rock aggregate proposals, information should be provided on properties such as grainsize and mineralogy, nature and extent of weathering or alteration, and amount and type of deleterious minerals, if any.
   d) For other proposals, properties relevant to the range of intended uses for the particular material should be indicated.

Details of tests carried out to determine the characteristics of the material should be included or appended. Such tests should be undertaken by NATA registered testing laboratories.

4. An assessment of the quality of the material and its suitability for the anticipated range of applications should be given.

5. The amount of material anticipated to be produced annually should be indicated. If the proposal includes a staged extraction sequence, details of the staging sequence needs to be provided. The intended life of the operation should be indicated.

6. If the proposal is an extension to an existing operation, details of history and past production should be provided.

7. An assessment of alternative sources to the proposal and the availability of these sources. The impact of not proceeding with the proposal should be addressed.

8. Justification for the proposal in terms of the local and, if appropriate, the regional context.

9. Information on the location and size of markets to be supplied from the site.

10. Route(s) used to transport quarry products to market.

11. Disposal of waste products and the location and size of stockpiles.

12. Assessment of noise, vibration, dust and visual impacts, and proposed measures to minimise these impacts.

13. Proposed rehabilitation procedures during, and after completion of, extraction operations, and proposed final use of site.

14. Assessment of the ecological sustainability of the proposal.

Health and Safety Issues

In relation to the health and safety of mining and quarrying operations, the following must be addressed:

1. All mining operations are to comply with the following legislation:
    a. *Work Health and Safety Act 2011*
    b. *Work Health and Safety Regulation 2011*
    c. *Work Health and Safety (Mine and Petroleum Sites) Act 2013*
    d. *Work Health and Safety (Mine and Petroleum Sites) Regulation 2014*
    e. *Explosives Act 2003*
    f. *Explosives Regulation 2013*.

2. The mine holder must appoint a mine operator and notify the Department in writing as required by clause 7 of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* before commencing any mining operations.

3. Other duties and notification and reporting requirements exist under the WHS laws and duty holders must ensure they understand and comply with these requirements.

Mineral Ownership

The *Mining Act 1992* applies to those commodities prescribed by the regulations of the Act (Schedule 2, *Mining Regulation 2016*). Most construction materials are not prescribed minerals under the *Mining Act 1992*. In general terms, this means these materials are owned by the Crown where they occur on Crown land and by the landowner in the case of freehold land. A Mining Title is not required for their extraction although a Crown Lands licence is required where they occur on Crown land.

Construction materials such as s*and (other than marine aggregate), loam, river gravel, and coarse aggregate materials such as basalt, sandstone, and granite* are not prescribed minerals under the *Mining Act 1992*. Therefore, NSW Division of Resources & Mining has no statutory responsibility for authorising or regulating the extraction of these commodities, apart from its role under the WHS laws with respect to the safe operation of mines and quarries. However, the Department is the principal government authority responsible for assessing the State's resources of construction materials and for advising State and local government on their planning and management.

Some commodities, notably *structural clay (ie clay for brick, tile and pipe manufacture), dimension stone (except for sandstone), quartzite, kaolin, limestone and marine aggregate* are prescribed minerals under the *Mining Act 1992*. Minerals which are prescribed as minerals under the terms of the Mining Act may, in some cases belong either to the Crown or to an individual, depending on a number of factors including the date on which the mineral was proclaimed and the date of alienation of the land.

The proponent needs to determine whether the material is privately owned or Crown mineral (publicly owned). If it is privately owned, then either a mining lease or mining (mineral owner) lease would be required. If it is a Crown mineral, an application for a mining lease will have to be lodged.

If you are unsure whether a mining title is required for your proposal you should contact NSW Department of Planning & Environment, Resources & Mining Division.

NSW GOVERNMENT Department of Primary Industries

OUT17/13820

Ms Sarah Fabian
Resource Assessments
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Dear Ms Fabian

Bobs Farm Sand Project (SSD 6395)
Request for Secretary's Environmental Assessment Requirements (SEARs)

I refer to your email of 21 March 2017 to the Department of Primary Industries (DPI) in respect to the above matter. Comment has been sought from relevant divisions of DPI. Views were also sought from NSW Department of Industry - Lands that are now a division of the broader Department and no longer within NSW DPI.
Any further referrals to DPI can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

DPI has reviewed the application and the original Director General's Environmental Assessment Requirements issued for the project and recommends that the revised SEARs should also require the Environmental Impact Statement to include the following:

Land Resources:

- A biosecurity risk assessment outlining the likely plant, animal and community risks as well as detailed biosecurity response and contingency plans including monitoring and mitigation measures for weed and pest management.

Water Resources:

- Detail on predicted generation and disposal methods of tailings and potential acid forming (PAF) material such as pyrite and whether oxidisation may pose a potential acid sulfate soils risk.
- Groundwater baseline information must be obtained for a minimum 2 years, as per AIP. This baseline information should consider water level and water quality analysis in line with any proposed water uses.

Policies, Guidelines & Plans:

- Reference to *Draft Agricultural Impact Assessment Guidelines 2011 (DP&I)* should be removed as this document has been superseded.
- The section Land Resources should include the following:
  - *Agricultural Impact Statement technical notes (2013)*
  - *Land Use Conflict Risk Assessment Guide (2011)*
  - *Agricultural Issues for Extractive industry Development (2012)*

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- The section Water Resources should include *NSW Aquifer Interference Policy (2012)*

Yours sincerely



Mitchell Isaacs
Director, Planning Policy & Assessment Advice
4 April 2017

DPI appreciates your help to improve our advice to you. Please complete this three minute survey about the advice we have provided to you, here:
https://goo.gl/o8TXWz

NSW GOVERNMENT | Office of Environment & Heritage

DOC17/178087-1
SSD 6395

Ms Sarah Fabian
Student Planner, Resource Assessments
Department of Planning and Environment
sarah.fabian@planning.nsw.gov.au

Dear Ms Fabian

Input into Secretary's Environmental Assessment Requirements for Bobs Farm Sand Project, Bobs Farm (SSD 6395)

I refer to your email dated 21 March 2017 inviting the Office of Environment and Heritage (OEH) to provide input into the Secretary's Environmental Assessment Requirements (SEARs) for the proposed Bobs Farm Sand Project. The project is located on Nelson Bay Road, at Bobs Farm within the Port Stephens local government area. OEH has previously issued Director General Requirements to the Department of Planning and Environment in correspondence dated 24 February 2014. However, rather than re-issue our previous response, OEH is of the view that the project should be compliant with current NSW Government guidelines and policies and as such we recommend that the new Standard SEARs be applied, which for biodiversity incorporate NSW Biodiversity Offsets Policy for Major Projects and the requirement to comply with the Framework for Biodiversity Assessment.

OEH understands that the proposal is State Significant Development under the *Environmental Planning and Assessment Act 1979*, and it includes:

- establishment of a quarry to extract and process sand at a rate of approximately 750,000 tonnes per annum, from a total sand resource of 10 million tonnes;
- construction of extractive materials processing and transport infrastructure;
- transportation of extractive materials off-site via roads; and
- rehabilitation of the site following post-quarrying.

OEH has reviewed the Preliminary Environmental Assessment Report prepared by Tattersall Lander Pty Ltd on behalf of Ammos Resource Management Pty Ltd (dated 13 February 2014) and has prepared Standard SEARs which are presented in **Attachment A**. OEH acknowledges that this information is generic and some sections may not be relevant to the proposal. There are Project Specific SEARs provided for this project for biodiversity matters as per **Attachment B**. **Attachment C** provides guidance material to assist with addressing the SEARs.

This project is to be assessed under the Framework for Biodiversity Assessment (FBA) and must be conducted by a person accredited in accordance with section 142B(1)(c) of the *Threatened Species Conservation Act 1995* (TSC Act). Please note, the FBA does not provide an exemption for removal of the Biodiversity Assessment Report (BAR) where a proponent deems the site (or parts thereof) to be

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Attachment A – Standard Environmental Assessment Requirements

Biodiversity
1. Biodiversity impacts related to the proposed development are to be assessed and documented in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995.*
Aboriginal cultural heritage
2. The EIS must identify and describe Aboriginal cultural heritage values that exist across the whole area that will be affected by the development and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW, 2011) and consultation with OEH regional officers.
3. Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.
4. Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. The EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.
Historic heritage
5. The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall: a. outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996), b. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria), c. include a statement of heritage impact for all heritage items (including significance assessment), d. consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant), and e. where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.

Water and soils
6. The EIS must map the following features relevant to water and soils including: a. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map). b. Rivers, streams, wetlands, estuaries (as described in Appendix 2 of the Framework for Biodiversity Assessment. c. Groundwater. d. Groundwater dependent ecosystems. e. Proposed intake and discharge locations.
7. The EIS must describe background conditions for any water resource likely to be affected by the development, including: a. Existing surface and groundwater. b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations. c. Water Quality Objectives (as endorsed by the NSW Government www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters. d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.
8. The EIS must assess the impacts of the development on water quality, including: a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the development protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction. b. Identification of proposed monitoring of water quality.
9. The EIS must assess the impact of the development on hydrology, including: a. Water balance including quantity, quality and source. b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas. c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems. d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches). e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water. f. Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options. g. Identification of proposed monitoring of hydrological attributes.

Flooding and coastal erosion
10. The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including: a. Flood prone land b. Flood planning area, the area below the flood planning level. c. Hydraulic categorisation (floodways and flood storage areas). These should be mapped for both current conditions and for those applying with a projected sea level rise equivalent to that adopted by the relevant council for the year 2100 or if the council has not adopted a sea level rise planning level, for a sea level rise of 0.9 metre above the 1990 level.
11. The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100 year flood levels and the probable maximum flood, or an equivalent extreme event for current conditions and for the sea level rise referred to in 10), above.
12. The EIS must model the effect of the proposed development (including fill) on the flood behaviour under the following scenarios: a. Current flood behaviour for a range of design events as identified above. The 1 in 200 and 1 in 500 year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change. b. For a projected sea level rise as described in 10), above..
13. Modelling in the EIS must consider and document: a. The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood. b. Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories. c. Relevant provisions of the NSW Floodplain Development Manual 2005.
14. The EIS must assess the impacts on the proposed development on flood behaviour, including: a. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure. b. Consistency with Council floodplain risk management plans. c. Compatibility with the flood hazard of the land. d. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land. e. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site. f. Whether, having regard to the existing and proposed topography of the land, assess the impact of the proposed development on the capacity for ecosystem migration for mean sea levels equivalent to council's sea level rise planning level for the year 2100 or if the council has not adopted a sea level rise planning level, for a sea level rise of 0.9 metre above the 1990 level. g. Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses. h. Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council.

i. Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council.

j. Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES.

k. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.

Attachment B – Project Specific Requirements

1. Biodiversity

A. Impacts on the following species will require further consideration and provision of the information specified in s9.2 of the Framework for Biodiversity Assessment:

***Pterostylis chaetophora* (Tall Rustyhood)** – This is a widespread, though rarely recorded, vulnerable orchid species, which has been recently listed. It is known from Taree to the Hunter Valley, including the Port Stephens local government area; where it is currently known from *c.* 18 scattered locations: in an area between Taree and Kurri Kurri, extending to the south-east towards Tea Gardens and west into the Upper Hunter, with additional records near Denman and Wingen. Specific details on its habitat and distribution are poorly known, though it is known from seasonally moist, dry sclerophyll forest with a grass and shrub understorey. The species has been recorded to the north-west of the proposal within the Grahamstown Dam catchment area; which represents the largest known population ('*hundreds of plants*') and its current most easterly limit of the its geographic range in NSW. However, given that it has been poorly recorded there is the possibility it occurs elsewhere within its broad geographic range, such as Port Stephens. As such any potential loss could significantly reduce the viability and genetic diversity of this species, and therefore OEH specifically requires that this species is considered (in accordance Section 9 of the FBA).

Given its known habitat preferences and known occurrence within the local government area, OEH is of the opinion this species has the potential to occur on the proposed development site. As such OEH expects appropriately targeted sampling to be undertaken during its known flowering period (September to November [Bishop 2000]) and samples sent to the NSW Herbarium for identification and/or confirmation. OEH will provide assistance with details of the nearby location to assist with the targeted sampling.

Mahoney's Toadlet (*Uperoleia mahonyi*) – This species has recently (10 March 2017) listed as an endangered species on an emergency basis as set out in Part 2, Division 4 of the *NSW Threatened Species Conservation Act 1995.* Mahoney's Toadlet is a newly described species of Australian frog (as described in Clulow *et al.* 2016) which has the potential to occur on the subject site. This species was recently discovered at Oyster Cove and inhabits coastal sandplains of the mid-north NSW coast, from the Port Stephens area to the Central Coast. The species is known to from a number of locations in Port Stephens: Fingal Bay, Grahamstown, Oyster Cove (type location), Medowie, Nelson Bay (golf club) Tomago and Williamtown; including nearby sand mine developments. It is closely related to *U. laevigata,* which was widely recorded in the Port Stephens area and to which it is easily mistaken with. Clulow *et al.* (2016) describe this species as a *"a habitat specialist, inhabiting coastal ephemeral and semi-permanent swamps and swales, and occasionally man made dams, in heath or wallum habitats almost exclusively on a substrate of white/leached sand".* As such suitable habitat exists on the subject site. Given its recently listing and potential confusion with more commonly related taxa, coupled with suitable habitat on the subject site, OEH considers any potential loss of known habitat could significantly reduce the viability and genetic diversity of this species, and therefore OEH specifically requires that this species is considered (in accordance Section 9 of the FBA).

Although, the potential habitat on the subject site (i.e. swamp forest) is likely to be retained, it has been recorded away from water (as detailed in Clulow *et al.* 2016), and there is community concern regarding the impacts on this species associated with sand mining (e.g. Cabbage Tree Road, to the west of this proposal). As such OEH recommends that targeted surveying be undertaken to determine absence or presence. Surveying should be carried out during its breeding season (i.e. spring: October to November [Clulow *et al.* 2106]), and following rain, over two consecutive nights, and for three hours duration (as per OEH 2009 guidelines). Furthermore, OEH recommends surveying should be conducted by a suitable qualified amphibian specialist who is familiar with the species, given that it is easily confused with closely allied taxa.

References:

Bishop, T. (2000) *Field Guide to the Orchids of New South Wales and Victoria*. Second Edition, University of New South Wales Press Ltd., UNSW, Sydney.

Clulow, S., Anstis, M., Scott Keogh, J. and Catullo, R.A. (2016) A new species of Australian frog (Myobatrachidae: *Uperoleia*) from the New South Wales mid-north coast sandplains. *Zootaxa*, **4184 (2)**: 285-315.

DECC (2009) *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians*. April 2009. Department of Environment and Climate Change (NSW), Goulburn Street, Sydney.

Attachment C – Guidance material

Title	Web address
Relevant Legislation	
Coastal Protection Act 1979	www.legislation.nsw.gov.au/maintop/view/inforce/act+13+1979+cd+0+N
Commonwealth Environment Protection and Biodiversity Conservation Act 1999	www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
Marine Parks Act 1997	www.legislation.nsw.gov.au/maintop/view/inforce/act+64+1997+cd+0+N
National Parks and Wildlife Act 1974	www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Threatened Species Conservation Act 1995	www.legislation.nsw.gov.au/maintop/view/inforce/act+101+1995+cd+0+N
Water Management Act 2000	www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Wilderness Act 1987	www.legislation.nsw.gov.au/viewtop/inforce/act+196+1987+FIRST+0+N
Biodiversity	
NSW Biodiversity Offsets Policy for Major Projects (OEH, 2013)	www.environment.nsw.gov.au/resources/biodiversity/140672biopolicy.pdf
Framework for Biodiversity Assessment (OEH, 2013)	www.environment.nsw.gov.au/resources/biodiversity/140675fba.pdf
Fisheries NSW policies and guidelines	www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation
List of national parks	www.environment.nsw.gov.au/NationalParks/parksearchatoz.aspx
Revocation, re-categorisation and road adjustment policy (OEH, 2012)	www.environment.nsw.gov.au/policies/RevocationOfLandPolicy.htm
Guidelines for developments adjoining land and water managed by OEH (DECCW, 2010)	www.environment.nsw.gov.au/resources/protectedareas/10509devadjdeccw.pdf
Heritage	
The Burra Charter (The Australia ICOMOS charter for places of cultural significance)	http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf
Statements of Heritage Impact 2002 (HO & DUAP)	www.environment.nsw.gov.au/resources/heritagebranch/heritage/hmstatementsofhi.pdf
NSW Heritage Manual (DUAP) 1996	www.environment.nsw.gov.au/Heritage/publications/index.htm#G-I

Aboriginal Cultural Heritage	
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	www.environment.nsw.gov.au/resources/cultureheritage/commconsultation/09781ACHconsultreq.pdf
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011)	www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf
Aboriginal Site Recording Form	www.environment.nsw.gov.au/resources/parks/SiteCardMainV1_1.pdf
Aboriginal Site Impact Recording Form	www.environment.nsw.gov.au/resources/cultureheritage/120558asirf.pdf
Aboriginal Heritage Information Management System (AHIMS) Registrar	www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Care Agreement Application form	www.environment.nsw.gov.au/resources/cultureheritage/20110914TransferObject.pdf
The Burra Charter and Indigenous Cultural Heritage Management Practice Notes available at:	http://australia.icomos.org/publications/burra-charter-practice-notes
Water and Soils	
Acid sulphate soils	
Acid Sulfate Soils Planning Maps via 'The NSW Natural Resource Atlas'	www.nratlas.nsw.gov.au/
Acid Sulfate Soils Manual (Stone et al. 1998)	www.planning.nsw.gov.au/rdaguidelines/documents/NSW%20Acid%20Sulfate%20Soils%20Planning%20Guidelines.pdf
Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004)	http://www.advancedenvironmentalmanagement.com/Reports/Savannah/Appendix%2015.pdf This replaces Chapter 4 of the Acid Sulfate Soils Manual above.
Flooding and Coastal Erosion	
Reforms to coastal erosion management	www.environment.nsw.gov.au/coasts/coastalerosionmgmt.htm
Floodplain development manual	www.environment.nsw.gov.au/floodplains/manual.htm
Guidelines for Preparing Coastal Zone Management Plans	Guidelines for Preparing Coastal Zone Management Plans www.environment.nsw.gov.au/resources/coasts/130224CZMPGuide.pdf
NSW Climate Impact Profile	NSW Climate Impact Profile
Climate Change Impacts and Risk Management	Climate Change Impacts and Risk Management: A Guide for Business and Government, AGIC Guidelines for Climate Change Adaptation
Water	
Water Quality Objectives	www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	www.environment.gov.au/water/publications/quality/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf

Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

DOC17/204436, EF14/502

NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Ms Sara Fabian

Dear Ms Fabian

STATE SIGNIFICANT DEVELOPMENT 6395 - PROPOSED BOB'S FARM SANDS PROJECT
NO AMMENDMENTS TO PREVIOUS ADVICE

Reference is made to your email and attachments dated 21 March 2017 seeking any revision of the Environment Protection Authority's (EPA) Director General's Requirements (DGR's) as provided for the above proposal on 20 February 2014.

The EPA note that no further information is provided regarding the proposal, accordingly the EPA rely on the previous DGR's provided to the Department of Planning and Environment for the proposal dated 20 February 2014.

If you require further information regarding this matter please contact Steve Clair on (02) 4908 6850.

Yours sincerely

STEVE CLAIR
Regional Operations Officer - Hunter
ENVIRONMENT PROTECTION AUTHORITY

Contact officer: STEVE CLAIR
02 4908 6850

Click here to enter text.

PO Box 488G Newcastle NSW 2300
117 Bull Street, Newcastle West NSW 2302
Tel: (02) 4908 6800 Fax: (02) 4908 6810
ABN 43 692 285 758
www.epa.nsw.gov.au

Sarah Fabian

From:	Brett Gardiner <Brett.Gardiner@portstephens.nsw.gov.au>
Sent:	Thursday, 6 April 2017 4:11 PM
To:	Sarah Fabian
Subject:	FW: Request for Secretary's Environmental Assessment Requirements - Bob Farm Sands Project (SSD 6395)
Attachments:	PEA.pdf; 21400005 - Local Context Plan.pdf; 21400004 - Regional Context Plan.pdf; Bobs Farm Sand Project - DGRs.pdf; Port Stephens.pdf

Hi Sarah,

I apologise for the late response from Council. For some reason I had it in my head that this was not due until the end of this week.

Council has reviewed the proposal and provides the following additional input to the preparation of revised SEARs:

1. Council considers that the proposal could have a negative impact on local biodiversity and that a Biodiversity Assessment Report should be prepared to inform the assessment process. The biodiversity report should include:
    - A detailed assessment of measures to avoid and minimise impacts to flora and fauna.
    - A detailed assessment of proposed mitigation measures and biodiversity offsets proposed for residual impacts. A legally binding mechanism is required to secure biodiversity offsets in perpetuity. Details are required as to the funding mechanism proposed to fund management of the biodiversity offset in perpetuity.
    - Accurate mapping and estimates of native vegetation clearance. Based on Council's review, it appears Swamp Sclerophyll Forest and River-flat Eucalypt Forest, both endangered ecological communities listed on the NSW TSC Act, occur at the site. (Note: River-flat Eucalypt Forest is uncommon in Port Stephens Local Government Area).
    - Accurate mapping and estimates of hollow-bearing trees at the site, including number and size class of hollows present.
    - An assessment of impacts to corridors and fauna movement through the site pre and post development. An assessment of location and width of retained native vegetation corridors for fauna movement post development. Retained native vegetation should include the areas of Swamp Sclerophyll Forest and River-flat Eucalypt Forest endangered ecological communities.
    - The site is mapped as supplementary koala habitat in the Port Stephens Comprehensive Koala Plan of Management. An assessment of the application under the Port Stephens Comprehensive Koala Plan of Management is required, including the performance criteria for development applications.
    - A detailed assessment of impacts to threatened species, communities and their habitats listed on the TSC Act and/or EPBC Act.
    - A detailed assessment of impacts to groundwater dependant ecosystems at the site.
    - Targeted surveys for threatened orchids during the peak flowering period for *Cryptostylis hunteriana, Diuris arenaria, Diuris praecox, Genoplesium bauera, Phaius australis* and *Rhizanthella slateri*. Targeted surveys for other threatened flora where suitable habitat occurs.
    - Surveys for threatened fauna in accordance with Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities (DEC 2004), including

1

targeted surveys for koala, squirrel glider, brush-tailed phascogale, wallum froglet, New Holland mouse, threatened owls and microbats.
- Development of a progressive Rehabilitation Strategy including staging of works, stockpiling of cleared native vegetation and staged rehabilitation to maintain viability of the stockpiled material.
- Undertake an assessment to determine an appropriate buffer width to neighbouring properties so that they don't experience wind-blown sand.

2. The proposal is likely to have social impacts and as a result, a Social Impact Assessment should be provided with the application.

I would like to confirm that the above items are in addition to the matters provided in the previous input to the preparation of SEARS.

Please let me know if you have any questions and I will be happy to help.

Regards,

PORT STEPHENS COUNCIL

Brett Gardiner | Senior Executive Planner
p (02) 49800213
m 0417474901
w www.portstephens.nsw.gov.au

From: Sarah.Fabian@planning.nsw.gov.au [mailto:Sarah.Fabian@planning.nsw.gov.au]
Sent: Thursday, 23 March 2017 10:38 AM
To: SwitchPC
Cc: genevieve.seed@planning.nsw.gov.au
Subject: Request for Secretary's Environmental Assessment Requirements - Bob Farm Sands Project (SSD 6395)

Good Morning

Bob Farm Sands Project (SSD 6395)

Tattersall Lander Pty Ltd on behalf of Ammos Resource Management Pty Ltd is currently preparing an Environmental Impact Statement for the Bobs Farm Sands Project in Port Stephens local government. Director-Generals Requirements were issued in March 2014 for this project. However as two years has passed, the Department is preparing revised SEARs for the project.

The Department requests your input on the revised SEARs for the project.

I have attached documents from the DGRs for your reference, including:
- previous Port Stephen Council comments;
- the Preliminary Environmental Assessment;
- local and regional plans; and
- the Director General Requirements issued March 2014.

It would be greatly appreciated if we could receive your revised advice by **Tuesday 4 April 2017.**

If you have any queries, please contact me on the details below.

Kind Regards

APPENDIX B

TOTAL FLORA LIST

Introduced species are indicated by an asterisk ("*").

The following standard abbreviations are used to indicate subspecific taxa:

subsp. - subspecies
var.- variety
× - hybrid between the two indicated species

National Parks and Wildlife Act 1974

P13 Protected Native Plants

Threatened Species Conservation Act 1995 (TSC Act)

V Vulnerable
E1 Endangered
E2 Endangered Population
E4A Critically Endangered Population

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

V Vulnerable
E Endangered

ROTAP (Rare or Threatened Australian Plants) – Briggs & Leigh (1996).

Distribution

1. – Known from only one collection
2. – Geographic range in Australia less than 100km
3. – Geographic range in Australia greater than 100km.
+ - Also occurs overseas.

Conservation Status

E. – Endangered. Species at risk of disappearing from the wild within 20 years. Includes populations of 100 or less individual plants.
V. – Vulnerable. Species not presently endangered, but at risk over 20-50 years.
R. – Rare in Australia, but not currently under threat. Includes species within a very restricted area or small populations over a wide range.
K. – Poorly known. Accurate knowledge is inadequate.
C. – Reserved. The species has at least one population within a national park or other reserve.

Size of Reserved Populations

a. – 1000 plants or more known within a conservation reserve.
i. – Less than 1000 plants known within a conservation reserve.
- - Reserved population size not accurately known.
t - Total known population reserved.

Regional Significance (Hunter Rare Plants Database – Version 1 2003)

L endemic to Hunter Region
DA disjunct in the Hunter Region, rare or localized (aggregated)
DB disjunct in the Hunter Rgwgion, widespread and uncommon (broad)
R rare but extends beyond the Hunter Region
U everywhere uncommon
N at northern distributional limit in the Hunter
E at eastern distributional limit in the Hunter
S at southern distributional limited in the Hunter
W at western distributional limited in the Hunter
T may be threatened in the Hunter Region
S Probably secure in the Hunter Region

Vegetation Community Types within the study area

1. Coastal Sand Apple Blackbutt Forest
2. Coastal Sand Apple Blackbutt (derived grassland)
3. Paperbark Swamp Forest
4. Freshwater Wetland
5. Orchard, Cleared/Modified
6. Grassland/Pasture

FLORA LIST FOR THE STUDY AREA

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
CLASS FILICOPSIDA (Ferns)						
Blechnaceae						
Blechnum indicum	Swamp Water Fern					3
Davalliaceae						
**Nephrolepis cordifolia*	Fishbone Fern					3
Dennstaedtiaceae						
Histiopteris incisa	Batswing Fern					3
Hypolepis muelleri	Harsh Ground Fern					
Pteridium esculentum	Bracken					1, 2, 3, 5
Dicksoniaceae						
Calochlaena dubia	Soft Bracken Fern					1
Thelypteridaceae						
Cyclosorus interruptus						3
CYCADOPSIDA (Cycads)						
Zamiaceae						
Macrozamia communis	Burrawang					1
CONIFEROPSIDA (Conifers)						
Araucariaceae						
Araucaria bidwillii	Bunya Pine					5
Pinaceae						
**Pinus elliotii*	Slash Pine					6

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
MAGNOLIOPSIDA: Magnoliidae						
LILOPSIDA: (Monocotyledons)						
Anthericaceae						
Tricoryne elatior	Yellow Rush-lily					
Araceae						
**Monstera deliciosa*	Fruit Salad Plant					5
**Zantedeschia aethiopica*	Arum Lily					3
Arecaceae						
Livistona australis	Cabbage-tree Palm					1, 3
**Phoenix canariensis*	Canary Island Date Palm					6
Commelinaceae						
Commelina cyanea	Scurvy Weed					1, 2, 3, 5
Cyperaceae						
Baumea juncea						
Carex appressa	Saw Sedge					3, 4
Cyperus difformis	Dirty Dora					4, 6
**Cyperus eragrostis*	Umbrella Sedge					5
Cyperus polystachyos						4, 5
Eleocharis equisita						4
Gahnia clarkei	Sword Grass					3, 4
Schoenoplectus validus						4
Juncaceae						
Juncus prismatocarpus						
Juncus usitatus	Common Rush					4, 6
Lemnaceae						
Lemna disperma	Duckweed					3

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
Lomandraceae						
Lomandra longifolia	Spiny Mat Rush					1, 2, 3
Orchidaceae						
Acianthus caudatus syn. Nemacianthus caudatus	Mayfly Orchid					1
Acianthus fornicatus	Pixie Orchid					1, 2
Caleana major	Large Duck Orchid					1
Calochilus sp	Bearded Orchid					1
Corysanthes pruinosa	Toothed Helmet Orchid					1
Cryptostylis sp.	Tongue-orchid					1
Dipodium variegatum						
Diuris arenaria	**Tomaree Doubletail**	**V**				2
Lyperanthus suaveolens	Brown Beaks					2
Myrmechila formicifera syn. *Chiloglottis formicifera*	Common Ant Orchid					1
Petalochilus pictus syn. Caladenia picta	Painted Fingers					1, 2
Petalochilus quadrifarius syn. Caladenia quadrifaria	Large Pink Fingers					1, 2
Pterostylis nutans	Nodding Greenhood					1, 2
Thelymitra sp.	Sun Orchid					2
Philesiaceae						
Eustrephus latifolius	Wombat Berry					1
Geitonoplesium cymosum	Scrambling Lily					
Philydraceae						
Philydrum lanuginosum	Woolly Frogmouth					4
Phormiaceae						
Dianella caerulea var. *producta*	Blue Flax-lily					1, 2, 3
Poaceae						
**Andropogon virginicus*	Whisky Grass					1, 2, 5, 6
**Anthoxanthum odoratum*	Sweet Vernal Grass					5, 6
**Axonopus fissifolius*	Narrow-leaved Carpet Grass					1, 5, 6

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
**Briza maxima*	Quaking Grass					5
Cynodon dactylon	Common Couch					2, 4, 5, 6
Digitaria parviflora	Smallflower Fingergrass					1, 2,5
Entolasia marginata	Bordered Panic					1
**Eragrostis curvula*	African Love Grass					1, 2, 5
Eragrostis sororia						
Imperata cylindrica var. *major*	Blady Grass					1, 2, 5
**Melinis repens*	Red Natal Grass					1, 2, 5
Microlaena stipoides var. *stipoides*	Weeping Meadow Grass					1, 2, 5, 6
Oplismenus aemulus	Basket Grass					1
Oplismenus imbecillis	Basket Grass					1
**Panicum maximum* var. *maximum*	Guinea Grass					1, 5
Paspalidium distans	Spreading Panic Grass					
**Paspalum dilatatum*	Paspalum					4, 5, 6
Paspalum distichum	Water Couch					4
**Paspalum urvillei*	Vasey Grass					4, 5, 6
**Pennisetum clandestinum*	Kikuyu					5, 6
Phragmites australis	Native Reed					3
**Setaria gracilis*	Slender Pigeon Grass					5, 6
**Stenotaphrum secundatum*	Buffalo Grass					5, 6
Themeda australis	Kangaroo Grass					1, 2, 5
Smilacaceae						
Smilax australis	Smilax					1
Smilax glyciphylla	Native Sarsaparilla					1, 2
MAGNOLIIDAE (Dicotyledons)						
Amaranthaceae						
Alternanthera denticulata	Lesser Joyweed					4
Apiaceae						
**Foeniculum vulgare*	Fennel					5
**Hydrocotyle bonariensis*	Kurnell Curse					1, 3
Platysace lanceolata	Native Parsnip					1, 2

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
**Scandix pecten-veneris*	Shepherd's Needle					5
Apocynaceae						
Parsonsia straminea var. *straminea*	Common Silkpod/Monkey Rope					1, 2, 3
Araliaceae						
Polyscias sambucifolia	Elderberry Panax					1, 2
Asteraceae						
**Ambrosia artemisiifolia*	Annual Ragweed					1, 2, 5, 6
**Ageratina adenophora*	Crofton Weed				Class 4 Noxious Weed	3, 6
**Bidens pilosa*	Cobblers Pegs					1, 2, 5, 6
**Cirsium vulgare*	Spear Thistle					1, 5, 6
**Conyza bonariensis*	Flax-leaved Fleabane					1, 5, 6
**Conyza parva*	Whorled Fleabane					1, 2, 5
**Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush				Class 4 Noxious Weed	1, 2
**Crassocephalum crepidioides*	Thickhead					5
Enydra fluctuans						3
**Facelis retusa*	Facelis					5, 6
**Gamochaeta spicata*	Spiked Cudweed					5, 6
**Hypochaeris glabra*	Smooth Catsear					1, 5, 6
**Hypochaeris radicata*	Catsear					1, 5, 6
**Osteospermum ecklonis*	South African Daisy					5
**Senecio madagascariensis*	Fireweed					1, 5, 6
**Sonchus oleraceus*	Common Sow Thistle					1, 5, 6
**Tagetes minuta*	Stinking Roger					6
**Taraxacum officinale*	Dandelion					6
Bignoniaceae						
Pandorea pandorana	Wonga-wonga Vine					1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
Caesalpiniaceae						
Senna pendula var. *glabrata*						1
Campanulaceae						
Wahlenbergia gracilis	Sprawling Bluebell					1, 2
Wahlenbergia stricta subsp. stricta	Tall Bluebell					1, 2
Caryophyllaceae						
**Petrorhagia nanteuilii*	Proliferous Pink					2, 5
**Silene gallica* var. *gallica*	French Catchfly					5
Cassythaceae						
Cassytha glabella	Slender Devil's Twine					1, 2
Casuarinaceae						
Casuarina glauca	Swamp She-oak					3
Cucurbitaceae						
**Citrullus lanatus*	Bitter Melon					5
Cunoniaceae						
Callicoma serratifolia	Black Wattle					1
Dilleniaceae						
Hibbertia linearis						1, 2
Hibbertia scandens	Climbing Guinea Flower					
Droseraceae						
Drosera peltata subsp. *peltata*	Sundew					1, 2
Elaeocarpaceae						
Elaecarpus reticulatus	Blueberry Ash					1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
Epacridaceae						
Brachyloma daphnoides subsp. *daphnoides*	Daphne Heath					1, 2
Leucopogon lanceolatus	Lance Beard-heath					1
Leucopogon margarodes	Pink Bearded Heath					1
Monotoca elliptica	Tree Broom-heath					1
Styphelia viridis	Green Five-corners					1
Euphorbiaceae						
Breynia oblongifolia	Coffee Bush					1, 2, 3
Glochidion ferdinandi var. *ferdinandi*	Cheese Tree					1, 2, 3
Omalanthus populifolius	Bleeding Heart					1, 3
Poranthera ericifolia						1, 2
Poranthera microphylla						1, 2
Ricinocarpus pinifolius	Wedding Bush					1, 2
**Ricinus communis*	Castor Oil Plant					5, 6
Fabaceae (Faboideae)						
Aotus ericoides	Heath Aotus					1, 2
Bossiaea rhombifolia						1, 2
Desmodium rhytidophyllum	Tick-treefoil					1, 2
Desmodium varians	Tick-treefoil					1, 2
Daviesia corymbosa						1
Dillwynia glaberrima	Smooth Parrot-pea					1
Dillwynia retorta subsp. *retorta*	Heathy Parrot Pea					1, 2
Glycine clandestina sp. complex	Love Creeper					1, 2, 5
Hardenbergia violacea	False Sarsaparilla					1, 2
Indigofera australis	Austral Indigo					1
Kennedia rubicunda	Dusky Coral Pea					1, 2,5
**Trifolium repens*	White Clover					1, 5, 6
Fabaceae (Mimosoideae)						
Acacia irrorata subsp. *irrorata*						1
Acacia longifolia	Sydney Golden Wattle					1, 2
Acacia maidenii	Maiden's Wattle					1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
Acacia myrtifolia	Myrtle Wattle					1, 2
Acacia saligna	Golden Wreath Wattle					1
Acacia suaveolens	Sweet-scented Wattle					1, 2
Acacia terminalis	Sunshine Wattle					1
Acacia ulicifolia	Prickly Moses					1, 2
**Paraserianthes lophantha* subsp. *lophantha*	Cape Leeuwin Wattle					1
Fumariaceae						
**Fumaria bastardii*	Bastard's Fumitory					5
Haloragaceae						
Gonocarpus teucrioides	Germander Raspwort					1, 2
Lamiaceae						
Plectranthus parviflorus						
Lauraceae						
**Cinnamomum camphora*	Camphor Laurel					1, 3, 6
Endiandra sieberi	Corkwood					1
Loranthaceae						
Dendrophthoe vitellina	Apostle Mistletoe					1
Loranthus celastroides	Coastal Mistletoe					1
Lythraceae						
Lythrum hyssopifolia	Hyssop Loosestrife					4
Malvaceae						
**Sida rhombifolia*	Paddys Lucerne					5, 6
Meliaceae						
Melia azedarach var. *australasica*	White Cedar					1
Synoum glandulosum subsp. *glandulosum*	Scentless Rosewood					1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
Menispermaceae						
Sarcopetalum harveyanum	Pearl Vine					1
Stephania japonica var. *japonica*	Snake Vine					1, 3
Moraceae						
**Ficus carica*	Fig					6
Myrsinaceae						
Myrsine howittiana	Brush Muttonwood					1
Myrtaceae						
Angophora costata	Smooth-barked Apple					1, 2,
Eucalyptus grandis	Flooded Gum					1, 3
Eucalyptus pilularis subsp. *pilularis*	Blackbutt					1, 2
Eucalyptus robusta	Swamp Mahogany					3
Melaleuca quinquenervia	Broad-leaved Paperbark					1, 3
Oleaceae						
Notelea longifolia	Mock Olive					1
**Olea europaea* subsp. *europaea*	Common Olive					5
Onagraceae						
Ludwigia peploides subsp. *montevidensis*	Water Primrose					4
Oxalidaceae						
Oxalis corniculata	Creeping Oxalis					1, 2, 5
Phytolaccaceae						
**Phytolacca octandra*	Inkweed					5
Pittosporaceae						
Billardiera scandens	Apple Dumplings					1, 2
Pittosporum revolutum	Rough-fruit Pittosporum					1
Pittosporum undulatum	Sweet Pittosporum					1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
Plantaginaceae						
**Plantago lanceolata*	Plantain					1, 2, 5, 6
Polygonaceae						
Persicaria decipens	Slender Knotweed					4
Persicaria strigosa	Spotted Knotweed					4
Primulaceae						
**Anagallis arvensis* var. *arvensis*	Scarlet Pimpernel					5, 6
Proteaceae						
Banksia integrifolia	Silver Banksia					1
Banksia serrata	Old Man Banksia					1
Conospermum taxifolium	Variable Smoke-bush					
Persoonia levis	Broad-leaved Geebung					1
Ranunculaceae						
Clematis aristida	Old Man's Beard					1, 2
Ranunculus inundatus	River Buttercup					4
Rubiaceae						
Pomax umbellata	Pomax					1, 2
Santalaceae						
Exocarpus cupressiformis	Cherry Ballart					1
Sapindaceae						
Dodonea triquetra	Hop Bush					1, 2
Solanaceae						
Duboisia myoporoides	Corkwood					1
**Solanum mauritianum*	Wild Tobacco					
**Solanum nigrum*	Blackberry Nightshade					

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	ROTAP	REGIONALLY SIGNIFICANT	VEGETATION COMMUNITY
Thymelaeaceae						
Pimelea linifolia	Rice Flower					1, 2
Tremandraceae						
Tetratheca thymifolia	Thyme Pink-bells					1,2
Verbenaceae						
Clerodendrum tomentosum	Hairy Clerodendrum					1
**Lantana camara*	Lantana				Class 4 Noxious Weed	1, 3
**Verbena bonariensis*	Purple Top					1, 5, 6
Vitaceae						
Cayratia clematidea	Slender Grape					1
Cissus hypoglauca	Native Grape					1
Violaceae						
Viola hederacea	Native Violet					1

APPENDIX C

PLOT SPECIES RICHNESS

1.0 PLOTS – SPECIES COMPOSITION

The species richness was measured within a 20 x 20m area contained within the transect/plot.

Plot 1
Community – PCT – 1646, HU860 – Smooth-barked Apple, Blackbutt, Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast

*Geology - Aeolian Holocene transgressive sand dunes
*Soils – Soils consisted of deep very well drained weakly developed Podzols (Murphy, 1995).
*AMG Reference. E – 406478, N – 6372909
*Date – 15 February 2016

*Species Recorded

Pteridium esculentum	Bracken
Eucalyptus pilularis	Blackbutt
**Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush
Banksia serrata	Old Man Banksia
**Lantana camara*	Lantana
Bossiaea rhombifolia	
Lomandra longifolia	Spiny Mat Rush
Dianella caerulea var. *producta*	Blue Flax Lily
Monotoca elliptica	Tree Broom Heath
Acacia longifolia	Sydney Golden Wattle
Imperata cylindrica var. *major*	Blady Grass
Pandorea pandorana	Wonga Wonga Vine
Hardenbergia violacea	False Sarsaparilla
Leucopogon lanceolatus	Lance Beard Heath
Aotus ericoides	Aotus
Angophora costata	Smooth-barked Apple
Acacia suaveolens	Sweet-scented Wattle
Dodonaea triquetra	Common Hop Bush
Gonocarpus teucrioides	Germander Raspwort
Persoonia levis	Broad-leaved Geebung
Ricinocarpus pinifolius	Wedding Bush
Themeda australis	Kangaroo Grass
Tricoryne elatior	Yellow Rush Lily
Eragrostis sororia	
Panicum sp.	

23 indigenous plants



Figure C1: Vegetation within Plot/Transect 1.

Plot 2

Community – PCT – 1646, HU860 – Smooth-barked Apple, Blackbutt, Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast

*Geology - Aeolian Holocene transgressive sand dunes
*Soils – Soils consisted of deep very well drained weakly developed Podzols (Murphy, 1995).
*AMG Reference. E – 406254, N – 6373333
*Date – 15 February 2016

*Species Recorded

Pteridium esculentum	Bracken
Eucalyptus pilularis	Blackbutt
Angophora costata	Smooth-barked Apple
Leucopogon margarodes	
Leucopogon lanceolatus	Lance Beard Heath
Acacia longifolia	Sydney Golden Wattle
Lomandra longifolia	Spiny Mat Rush
Banksia serrata	Old Man Banksia
Persoonia levis	Broad-leaved Geebung
Acacia ulicifolia	Prickly Moses
Bossiaea rhombifolia	
Monotoca elliptica	Tree Broom Heath
Dianella caerulea var. *producta*	Blue Flax Lily
Imperata cylindrica var. *major*	Blady Grass
Pandorea pandorana	Wonga Wonga Vine
Gonocarpus teucrioides	Germander Raspwort
Pomax umbellata	Pomax
Ricinocarpus pinifolius	Wedding Bush

Hardenbergia violacea	False Sarsaparilla
Aotus ericoides	Aotus
Themeda australis	Kangaroo Grass
Dodonaea triquetra	Common Hop Bush
Tricoryne elatior	Yellow Rush Lily
Cassytha glabella	Slender Devil's Twine
Billardiera scandens	Apple Berry
Hibbertia linearis	Showy Guinea Flower

26 indigenous plants



Figure C2: Vegetation within Plot/Transect 2.

Plot 3

Community – PCT – 1646, HU860 – Smooth-barked Apple, Blackbutt, Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast

*Geology - Aeolian Holocene transgressive sand dunes
*Soils – Soils consisted of deep very well drained weakly developed Podzols (Murphy, 1995).
*AMG Reference. E – 406681, N – 6373521
*Date – 16 February 2016

*Species Recorded

Dodonaea triquetra	Common Hop Bush
Leucopogon lanceolatus	Lance Beard Heath
**Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush
Pteridium esculentum	Bracken
Bossiaea rhombifolia	
Pandorea pandorana	Wonga Wonga Vine
Banksia serrata	Old Man Banksia
Eucalyptus pilularis	Blackbutt
Angophora costata	Smooth-barked Apple
Pomax umbellata	Pomax
Gonocarpus teucrioides	Germander Raspwort
Monotoca elliptica	Tree Broom Heath
Breynia oblongifolia	Breynia
Aotus ericoides	Aotus
Lomandra longifolia	Spiny Mat Rush
Livistona australis (young specimen)	Cabbage Tree Palm
Ricinocarpus pinifolius	Wedding Bush
Glochidion ferdinandi	Cheese Tree
Imperata cylindrica var. *major*	Blady Grass
Dianella caerulea var. *producta*	Blue Flax Lily
**Lantana camara*	Lantana
Acacia longifolia	Sydney Golden Wattle
Desmodium rhytidophyllum	Tick-treefoil
Hibbertia linearis	Showy Guinea Flower
Billardiera scandens	Apple Berry
Leucopogon margarodes	
Hardenbergia violacea	False Sarsaparilla
Acacia suaveolens	Sweet-scented Wattle
Polyscias sambucifolia	Elderberry Panax
Tetratheca thymifolia	Thyme Pink-bells
Kennedia rubicunda	Dusky Coral Pea
Desmodium varians	Tick-treefoil
Endiandra sieberi	Corkwood
Themeda australis	Kangaroo Grass
Acacia maidenii	Maidens Wattle

33 indigenous plants



Figure C3: Vegetation within Plot/Transect 3.

Plot 4

Community – PCT – 1646, HU860 – Smooth-barked Apple, Blackbutt, Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast

*Geology - Aeolian Holocene transgressive sand dunes
*Soils – Soils consisted of deep very well drained weakly developed Podzols (Murphy, 1995).
*AMG Reference. E – 407119, N – 6373570
*Date – 16 February 2016

*Species Recorded

Pteridium esculentum	Bracken
Pandorea pandorana	Wonga Wonga Vine
Gonocarpus teucrioides	Germander Raspwort
Pomax umbellata	Pomax
Breynia oblongifolia	Breynia
Hardenbergia violacea	False Sarsaparilla
Dianella caerulea var. *producta*	Blue Flax Lily
Banksia serrata	Old Man Banksia
Angophora costata	Smooth-barked Apple
Eucalyptus pilularis	Blackbutt
Imperata cylindrica var. *major*	Blady Grass
Kennedia rubicunda	Dusky Coral Pea
Lomandra longifolia	Spiny Mat Rush
Leucopogon margarodes	
Monotoca elliptica	Tree Broom Heath
Bossiaea rhombifolia	

Leucopogon lanceolatus	Lance Beard Heath
Parsonsia straminea var. *straminea*	Monkey Rope
Livistona australis (young specimen)	Cabbage Tree Palm
Themeda australis	Kangaroo Grass
Acacia ulicifolia	Prickly Moses
Aotus ericoides	Aotus
Billardiera scandens	Apple Berry
Paspalidium sp.	
Digitaria parviflora	Smallflower Fingergrass
Billardiera scandens	Apple Berry
Glycine clandestina sp. complex	Love Creeper

27 indigenous plants



Figure C4: Vegetation within Plot/Transect 4.

Plot 5

Community – PCT – 1646, HU860 – Smooth-barked Apple, Blackbutt, Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast

*Geology - Aeolian Holocene transgressive sand dunes
*Soils – Soils consisted of deep very well drained weakly developed Podzols (Murphy, 1995).
*AMG Reference. E – 406453, N – 6372889
*Date – 10 November 2016

<u>*Species Recorded</u>

Eucalyptus pilularis	Blackbutt
Angophora costata	Smooth-barked Apple
Banksia serrata	Old Man Banksia

Monotoca elliptica	Tree Broom Heath
Leucopogon lanceolatus	Lance Beard Heath
Ricinocarpus pinifolius	Wedding Bush
Bossiaea rhombifolia	
Acacia ulicifolia	Prickly Moses
Acacia longifolia	Sydney Golden Wattle
Dianella caerulea var. *producta*	Blue Flax Lily
Pteridium esculentum	Bracken
Persoonia levis	Broad-leaved Geebung
Lomandra longifolia	Spiny Mat Rush
Imperata cylindrica var. *major*	Blady Grass
Pomax umbellata	Pomax
Tetratheca thymifolia	Thyme Pink-bells
Aotus ericoides	Aotus
Gonocarpus teucrioides	Germander Raspwort
Billardiera scandens	Apple Berry
Desmodium varians	Tick-treefoil
Pandorea pandorana	Wonga Wonga Vine
Parsonsia straminea var. *straminea*	Monkey Rope
Eragrostis sororia	
Acianthus fornicatus	Pixie Orchid
Hibbertia linearis	Showy Guinea Flower
**Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush
Dipodium variegatum	

26 indigenous plants

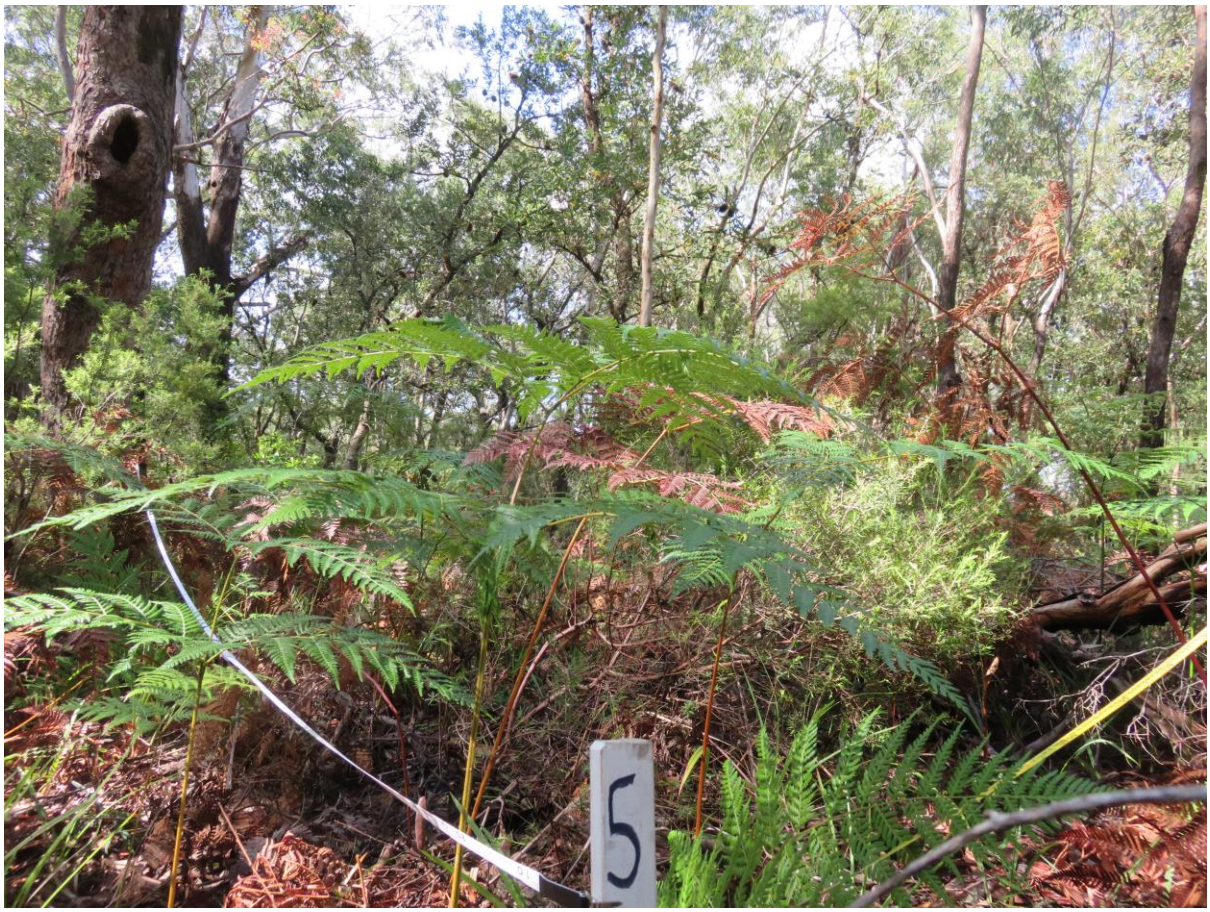


Figure C5: Vegetation within Plot/Transect 5.

Plot 6

Community – PCT – 1646, HU860 – Smooth-barked Apple, Blackbutt, Old Man Banksia Woodland on Coastal Sands of the Central and Lower North Coast (Mod/Good Derived)

*Geology - Aeolian Holocene transgressive sand dunes
*Soils – Soils consisted of deep very well drained weakly developed Podzols (Murphy, 1995).
*AMG Reference. E – 406359, N – 6372934
*Date – 17 February 2016

*Species Recorded

Pteridium esculentum	Bracken
**Andropogon virginicus*	Whiskey Grass
Gonocarpus teucrioides	Germander Raspwort
Themeda australis	Kangaroo Grass
**Hypochaeris radicata*	Cats Ear
Hibbertia linearis	Showy Guinea Flower
Leucopogon margarodes	
**Chrysanthemoides monilifera* subsp. *rotundata*	Bitou Bush
Tricoryne elatior	Yellow Rush Lily
Angophora costata	Smooth-barked Apple (Seedling)
Poranthera ericifolia	
Pomax umbellata	Pomax
Lomandra longifolia	Spiny Mat Rush
Pimelea linifolia	Rice Flower
Eragrostis sororia	
Bossiaea rhombifolia	
Dianella caerulea var. *producta*	Blue Flax Lily
Aotus ericoides	Aotus
Brachyloma daphnoides subsp. daphnoides	Daphne Heath
Ricinocarpus pinifolius	Wedding Bush
Monotoca elliptica	Tree Broom Heath
Acacia longifolia	Sydney Golden Wattle
**Briza maxima*	Quaking Grass
Dillwynia retorta subsp*. retorta*	Heathy Parrot Pea
Leucopogon lanceolatus	Lance Beard Heath
**Conyza parva*	
Imperata cylindrica var*. major*	Blady Grass
Cynodon dactylon	Common Couch

23 indigenous plants



Figure C6: Vegetation within Plot/Transect 6.

Plot 7

Community – PCT – 1724, HU938 – Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast

*Soils – Soils consisted of deep very well drained weakly developed Podzols (Murphy, 1995).
*AMG Reference. E – 407295, N – 6373830
*Date – 16 February 2016

*Species Recorded

Enydra fluctuans	
Persicaria strigosa	Spotted Knotweed
Phragmites australis	Native Weed
Melaleuca quinquenervia	Broad-leaved Paperbark
Commelina cyanea	Scurvy Weed
Histiopteris incisa	
Cyclosorus interruptus	
Blechnum indicum	Swamp Water Fern
Eucalyptus robusta	Swamp Mahogany
Casuarina glauca	Swamp Oak
**Lantana camara*	Lantana
Stephania japonica var. *japonica*	Snake Vine
Carex appressa	Saw Sedge
Gahnia clarkei	Sword Grass
Hypolepis muelleri	Harsh Ground Fern
Myrsine howittiana	Brush Muttonwood
Livistona australis	Cabbage Tree Palm
Persicaria decipens	Slender Knotweed
Carex sp.	

18 indigenous plants



Figure C7: Vegetation within Plot/Transect 7.

Plot 8

HU533 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Moderate/Good_Poor)(0.32ha).

*AMG Reference. E – 407200, N – 6373812
*Date – 16 February 2016

<u>*Species Recorded</u>

Eleocharis equisita	
Philydrum lanuginosum	Woolly Frogmouth
Ludwigia peploides subsp. *montevidensis*	Water Primrose
Schoenoplectus validus	
Melaleuca quinquenervia	Broad-leaved Paperbark
Lemna disperma	Duckweed
Ranunculus inundatus	River Buttercup
Juncus usitatus	Common Rush
Juncus prismatocarpus	
Persicaria decipens	Slender Knotweed
Persicaria strigosa	Spotted Knotweed
Phragmites australis	Native Weed
Cyperus polystachyos	

13 indigenous plants



Figure C8: Vegetation within Plot/Transect 8.

APPENDIX D

TOTAL FAUNA LIST

FAUNA LIST

Family sequencing and taxonomy follow for each fauna class:
Herpetofauna
Cogger (2014).

Birds
Pizzey and Knight (2012)(9th edn).

Mammals - Van Dyck & Strahan (Ed) (2008) and Churchill (2008).

Churchill, S. (2008). *Australian Bats*. (2nd edn.). Allen & Unwin Australia.

(?) - Indicates a species identified without certainty or to a Genus level only.

* - Indicates an introduced species.

The following symbols are used to indicate species recorded during previous surveys.
@ - Previous record Lot 10 DP 1071458 (Wildthing Environmental Consultants, 2008)

Threatened species addressed within this assessment appear in **bold** font.

Introduced species are indicated by an asterisk ("*").

The following standard abbreviations are used to indicate subspecific taxa:

subsp.	- subspecies
var.-	variety
× -	hybrid between the two indicated species

Threatened Species Conservation Act 1995 (TSC Act)

V	Vulnerable
E1	Endangered
E2	Endangered Population
E4A	Critically Endangered Population

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

V	**Vulnerable**
E	**Endangered**
CE	**Critically Endangered Population**

Regionally Significant Fauna Species.

+	Region includes Gosford, Wyong, Cessnock, Maitland, Lake Macquarie, Newcastle and Port Stephens LGA's. Produced from Stage 1 of the LHCCREMS – Regional Biodiversity Conservation Strategy.

Observation Type

O - Observed (sighted)	**R** – Road Kill	**F** – Tracks, scratching
W - Heard call	**D** – Dog Kill	**Z** – In raptor/owl Pellet
OW – Observed and heard call	**Q** – Camera	**U** – Ultrasonic recording
X - In scat	**C** – Cat Kill	**M** - Miscellaneous
P – Scat	**V** – Fox Kill	**E** – Nest/roost
T - Trapped or netted	**K** – Dead	**B** - Burnt
H – Hair, feathers or skin	**S** – Shot	**Y** – Bones, teeth or shell
A - Stranded/Beached	**I** – Fossil/subfossil	**N** – Not located
G – Crushed cones	**FB** – Burrow	**AR** – Acoustic Recording

Vegetation Community Types within the study area

1. Coastal Sand Apple Blackbutt Forest
2. Coastal Sand Apple Blackbutt (derived grassland)
3. Paperbark Swamp Forest
4. Freshwater Wetland
5. Orchard, Cleared/Modified
6. Grassland/Pasture

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Phylum - Chordata						
Subphylum - Vertebrata						
Class Amphibia - Amphibians						
Order Salientia - Frogs						
Family Myobatrachidae - 'Southern Frogs'						
Crinia signifera	Common Eastern Froglet				W	4
Limnodynastes peronii	Striped Marsh Frog				W	3, 4
Paracrinia haswelli	Haswell's Frog				W	4
Pseudophryne bibronii	Brown Toadlet				W	1
Family Hylidae - Tree Frogs						
Litoria fallax	Eastern Dwarf Tree Frog				W	3, 4
Litoria peronii	Peron's Tree Frog				W	4
Litoria tyleri	Tyler's Tree Frog				W	1, 3
Order Squamata – Lizards and Snakes						
Suborder Sauria - Lizards						
Family Agamidae - Dragons						
Amphibolurus muricatus	Jacky Lizard				Q	1
Pogona barbata	Eastern Bearded Dragon			+	O	1
Family Varanidae - Monitors						
Varanus varius	Lace Monitor				O, Q, F	1
Family Scinidae - Skinks						
Anomalopus swansoni	Swanson's Legless Lizard			+	O	1
Ctenotus robustus (No pattern form)	Striped Skink				O	1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Ctenotus robustus	Striped Skink				O	1
Ctenotus taeniolatus	Copper-tailed Skink				O	1
Eulamphrus tenuis	Bar-sided Skink					
Lampropholis delicata	Grass Skink				O	1
Saiphos equalis	Three-toed Skink				O	1
Suborder Serpentes - Snakes						
Family Boidae - Pythons						
Morelia spilota spilota	Carpet (Diamond) Python				O	1
Family Colubridae						
Dendralaphis punctulata	Green Tree Snake				O	1
Family Elapidae - Venomous Snakes						
Cryptophis nigrescens	Small-eyed Snake			+	O	1
Class Aves - Birds						
Family Phasianidae						
Coturnix ypsilophora	Brown Quail				O	1
Family Anatidae - Ducks, Swans and Geese						
Anas superciliosa	Pacific Black Duck				O	6
Chenonetta jubata	Australian Wood Duck				O	5, 6
Anser anser domesticus	Domestic Goose				O	5
Family Columbidae - Pigeons, Doves						
Columba leucomela	White-headed Pigeon				O	1
Leucosarcia melanoleuca	Wonga Pigeon				W	1
Family Podargidae - Frogmouths						
Podargus strigoides	Tawny Frogmouth				O, W	1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Family Ardeidae - Herons, Egrets and Bitterns						
Ardea ibis	Cattle Egret		M		O	6
Ardea intermedia	Intermediate Egret				O	6
Egretta novaehollandiae	White-faced Heron				O	6
Family Threskiornithidae - Ibises and Spoonbills						
Threskiornis molucca	Australian Ibis				O	5, 6
Threskiornis spinicollis	Straw-necked Ibis				O	5, 6
Family Accipitridae - Osprey, Hawks, Eagles and Harriers						
Accipiter novaehollandiae	Grey Goshawk				O	1
Aquila audax	Wedge-tailed Eagle				O	1
Haliaeetus leucogaster	White-breasted Sea-Eagle		M		O	1
Haliastur sphenurus	Whistling Kite				OW	1
Family Falconidae - Falcons						
Falco cenchroides	Nankeen Kestrel				O	1
Family Cacatuidae - Cockatoos and Corellas						
Cacatua galerita	Sulphur-crested Cockatoo				OW	1
Cacatua roseicapilla	Galah				OW	1, 6
Cacatua tenuirostris	Long-billed Corella				O	6
Calyptorhyncus funereus	Yellow-tailed Black-Cockatoo				OW	1
Family Psittacidae - Parrots, Rosellas and Lorikeets						
Alisterus scapularis	King Parrot				OW	1
Glossopsitta pusilla	Little Lorikeet	**V**			OW	1, 3
Platycercus eximius	Eastern Rosella				O	1
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet				O	1
Trichoglossus haematodus	Rainbow Lorikeet				OW	1, 3

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Family Cuculidae - Cuckoos						
Chalcites lucidus	Shining Bronze-Cuckoo				W	1
Cacomantis pallidus	Pallid Cuckoo				W	1
Cacomantis flabelliformis	Fan-tailed Cuckoo				W	1
Eudynamys orientalis	Common Koel				OW	1
Scythrops novaehollandiae	Channel-billed Cuckoo				OW	1
Family Strigidae - Hawk-Owls						
Ninox boobook	Southern Boobook				W	1
Ninox strenua	Powerful Owl	V			M – Owl pellet	1
Family Halcyonidae - Tree Kingfishers						
Dacelo novaeguineae	Laughing Kookaburra				OW	1, 3
Todiramphus sanctus	Sacred Kingfisher				OW	1
Family Coraciidae - Rollers 'Dollarbirds						
Eurystomus orientalis	Dollarbird				OW	1
Family Climacteridae - Treecreepers						
Cormobates leucophaea	White-throated Treecreeper				OW	1
Family Maluridae						
Malurus cyaneus	Superb Fairy-wren				OW	1, 3
Family Pardalotidae - Pardalotes, Gerygones, Scrubwrens, Heathwrens and Thornbills						
Acanthiza nana	Yellow Thornbill				O	1
Acanthiza pusilla	Brown Thornbill				OW	1, 3
Acanthiza reguloides	Buff-rumped Thornbill				OW	1
Gerygone mouki	Brown Gerygone				W	3
Gerygone olivacea	White-throated Gerygone				OW	1
Pardalotus punctatus	Spotted Pardalote				OW	1
Pardalotus striatus	Striated Pardalote				OW	1

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Family Meliphagidae - Honeyeaters						
Acanthorhynchus tenuirostris	Eastern Spinebill				OW	1, 3
Anthrochaera carunculata	Red Wattlebird					5
Lichenostomus chrysops	Yellow-faced Honeyeater				OW	1, 3
Manorina melanocephala	Noisy Miner				OW	1
Meliphaga lewinii	Lewin's Honeyeater				OW	1, 2, 3
Philemon corniculatus	Noisy Friarbird				OW	1
Family Petroicidae - Robins and Jacky Winter						
Eopsaltria australis	Eastern Yellow Robin				OW	1, 3
Family Pachycephalidae - Whistlers, Shrike-tit and Shrike-thrushes						
Colluricincla harmonica	Grey Shrike-thrush				OW	1, 3
Pachycephala pectoralis	Golden Whistler				OW	1
Family Cinclosomatidae - Whipbird and Quail-thrushes						
Psophodes olivaceus	Eastern Whipbird				OW	1, 3
Family Dicruridae - Monarchs, Flycatchers, Fantails, Drongo and Magpie-Lark						
Myiagra inquieta	Restless Flycatcher				OW	1
Rhipidura fuliginosa	Grey Fantail				OW	1, 3
Rhipidura leucophrys	Willie Wagtail				O	5, 6
Rhipidura rufifrons	Rufous Fantail		M		O	1
Grallina cyanoleuca	Magpie-lark				OW	1, 3, 5, 6
Family Campephagidae - Cuckoo-shrikes and Trillers						
Coracina novaehollandiae	Black-faced Cuckoo-shrike				OW	1, 3, 5, 6
Family Hirundinidae - Swallows and Martins						
Hirundo neoxena	Welcome Swallow				O	1, 2, 3, 5, 6

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Family Zosteropidae - White-eyes						
Zosterops lateralis	Silvereye				OW	1, 3
Family Artamidae - Wood-swallows, Butcherbirds, Magpie and Currawongs						
Cracticus nigrogularis	Pied Butcherbird				OW	1
Cracticus torquatus	Grey Butcherbird				OW, Q	1
Cracticus tibicen	Australian Magpie				OW	1, 2, 3, 5, 6
Strepera graculina	Pied Currawong				OW	1, 5
Family Corvidae - Crows, Raven						
Corvus coronoides	Australian Raven				OW	1, 2, 3, 5, 6
Family Sturnidae - Starlings and Mynas						
**Acridotheres tristis*	Common Myna				OW	6
**Sturnus vulgaris*	Common Starling				O	6
Class Mammalia - Mammals						
Subclass Prototheria - Monotremes						
Order Monotremata						
Family Tachyglossidae - Echidna						
Tachyglossus aculeatus	Echidna				QF	1
Subclass Marsupialia - Marsupials						
Order Dasyuromorphia – Carnivorus Marsupials						
Family Dasyuridae - Dasyurids						
Antechinus stuartii	Brown Antechinus				T, Q	1, 2, 3

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Order Peramelemorphia						
Family Peramelidae - Bandicoots						
Isoodon macrourus	Northern Brown Bandicoot				Q, F, Y	1, 2, 3
Perameles nasuta	Long-nosed Bandicoot?				F	1
Order Diprotodontia						
Suborder Vombatiformes						
Family Phascolarctidae - Koala						
Phascolarctos cinereus	Koala	V	V		F	3
Suborder Phalangerida						
Superfamily - Petauroidea						
Family Petauridae						
Petaurus norfolcensis	Squirrel Glider	V			T, Q, F	1
Family - Acrobatidae						
Acrobates pygmaeus	Feathertail Glider				O	1
Superfamily - Phalangeroidea						
Family Phalangeridae - Brushtail Possums						
Trichosurus vulpecula	Common Brushtail Possum				O, F, Q, Z, X, P	1, 3
Superfamily - Macropodoidae						
Family Macropodidae - Kangaroos, Wallabies						
Macropus rufogriseus	Red-necked Wallaby				O	1
Wallabia bicolor	Swamp Wallaby				O, Q, F, P	1, 2

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Subclass Eutheria - Eutherian Mammals						
Order Chiroptera						
Suborder Megachiroptera - Megabats						
Family Pteropodidae - Fruit Bats						
Pteropus poliocephalus	Grey-headed Flying-fox	V			OW	1, 3
Suborder Microchiroptera						
Family Molossidae - Freetail-bats						
Austronomus australis syn *Nyctinomus australis, Tadarida australis*	White-striped Freetail Bat				U, W	1
Mormopterus sp. 2					U	1
Family Vespertilionidae - Plain-nosed Bats						
Chalinolobus gouldii	Gould's Wattled bat				U	1
Chalinolobus morio	Chocolate Wattled Bat				U	1
Falsistrellus tasmaniensis	Eastern Falsistrelle	V			U	1
Miniopterus australis	Little Bentwing-bat	V			U, T	1
Miniopterus schreibersii oceanensis	Large Bentwing-bat	V			U	1
Nyctophilus geoffroyi	Lesser Long-eared Bat				U?	1
@Nyctophilus gouldi	Gould's Long-eared Bat				U	1
Scoteanax rueppellii	Greater Broad-nosed Bat	V			U	1
Vespadelus vulturnus	Little Forest Bat				T, U	1
Order Rodentia						
Family Muridae - Rodents						
Rattus lutreolus	Swamp Rat				T, X	1, 3
**Rattus rattus*	Black Rat				T	3

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	REGIONALLY SIGNIFICANT	OBSERVATION TYPE	HABITAT TYPE
Order Carnivora						
Family Canidae						
**Canis familiaris*	Wild Dog				O, Q, P	1
**Vulpes vulpes*	Red Fox				O, Q, P	1
Family Felidae						
**Felis catus*	Cat				O, Q	1
Order Lagomorpha						
Family Leporidae						
**Lepus capensis*	European Hare				O, Q	1
**Oryctolagus cuniculus*	European Rabbit				O	5
Order Perissodactyla						
Family Equidae						
**Equus caballus*	Horse				O, P	1
Order Artiodactyla						
Family Bovidae						
**Bos taurus*	Cattle				O, P	1

APPENDIX E
CONSIDERATIONS UNDER SECTION 5A OF THE EPA ACT

CONSIDERATIONS UNDER SECTION 5A OF THE EPA ACT - SIGNIFICANT EFFECT ON THREATENED SPECIES, POPULATIONS OR ECOLOGICAL COMMUNITIES, OR THEIR HABITATS.

Consideration of this development under the guidelines of Section 5A of the Environmental Planning & Assessment Act (1979) as amended by the Environmental Planning and Assessment Amendment Act (1997) has been made. The heads of consideration of this Section are given in italics followed by the answers applicable to this site. Each species is dealt with separately.

Endangered ecological communities recorded within the study area:

1. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions
2. Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Threatened flora species recorded within the study area:

3.	*Diuris arenaria*	Tomaree Doubletail

Threatened fauna species recorded within the study area:

4.	*Glossopsitta pusilla*	Little Lorikeet
5.	*Haliaeetus leucogaster*	White-bellied Sea Eagle
6.	*Ninox strenua*	Powerful Owl
7.	*Petaurus norfolcensis*	Squirrel Glider
8.	*Phascolarctos cinereus*	Koala
9.	*Pteropus poliocephalus*	Grey-headed Flying-fox
10.	*Scoteanax rueppellii*	Greater Broad-nosed Bat
11.	*Falsistrellus tasmaniensis*	Eastern Falsistrelle
12.	*Miniopterus australis*	Little Bentwing-bat
13	*Miniopterus schreibersii oceanensis*	Large Bentwing-bat

Flora species considered to have potential habitat within the study area:

14.	Orchids	
	Corybas dowlingii	Red Helmet Orchid
	Cryptostylis hunteriana	Leafless Tongue Orchid
	Diuris praecox	Newcastle Doubletail
	Pterostylis chaetophora	Tall Rustyhood
15.	Wetland Plants	
	Maundia triglochinoides	Maundia
	Persicaria elatior	Tall Knotweed
	Zannichellia palustris	
16.	Shrubs and Trees	
	Callistemon linearifolius	Netted Bottlebrush
	Eucalyptus parramattensis subsp. *decadens*	Drooping Red Gum
	Melaleuca biconvexa	Biconvex Paperbark
	Syzygium paniculatum	Magenta Lilly Pilly
17.	Other flora species	
	Cynanchum elegans	White-flowered Wax Plant
	Lindernia alsinoides	Noah's False Chickweed

Fauna species considered to have potential habitat within the study area:

18.	Invertebrates	
	Petalura gigantea	Giant Dragonfly

19.	Frogs	
	Crinia tinnula	Wallum Froglet
	Litoria aurea	Green and Golden Bell Frog
	Litoria brevipalmata	Green-thighed Frog
	Uperoleia mahonyi	Mahony's Toadlet
20.	Arboreal Reptiles	
	Hoplocephalus bitorquatus	Pale-headed Snake
	Hoplocephalus stephensii	Stephen's Banded Snake
21.	Waterbirds	
	Rostratula benghalensis australis	Australian Painted Snipe
	Botaurus poiciloptilus	Australasian Bittern
	Ixobrychus flavicollis	Black Bittern
22.	Fruit Doves	
	Ptilinopus magnificus	Wompoo Fruit-Dove
	Ptilinopus regina	Rose-crowned Fruit-Dove
	Ptilinopus superbus	Superb Fruit-Dove
23.	Cockatoos & Parrots	
	Callocephalon fimbriatum	Gang-gang Cockatoo
	Calyptorhynchus lathami	Glossy Black-Cockatoo
	Lathamus discolor	Swift Parrot
	Neophema pulchella	Turquoise Parrot
24.	Woodland Birds	
	Melithreptus gularis gularis	Black-chinned Honeyeater
	Anthochaera phrygia	Regent Honeyeater
	Daphoenositta chrysoptera	Varied Sittella
	Epthianura albifrons	White-fronted Chat
	Petroica boodang	Scarlet Robin
	Petroica phoenicea	Flame Robin
	Pomatostomus temporalis temporalis	Grey-crowned Babbler
25.	*Burhinus grallarius*	Bush Stone-curlew
26.	Birds of Prey	
	Pandion cristatus	Eastern Osprey
	Hieraaetus morphnoides	Little Eagle
	Lophoictinia isura	Square-tailed Kite
	Erythrotriorchis radiatus	Red Goshawk
27.	Owls	
	Ninox connivens	Barking Owl
	Tyto longimembris	Eastern Grass Owl
	Tyto novaehollandiae	Masked Owl
28.	Medium terrestrial marsupials	
	Dasyurus maculatus maculatus	Tiger Quoll
29.	Small Marsupials	
	Planigale maculata	Common Planigale
	Phascogale tapoatafa	Brush-tailed Phascogale
30.	Potoroos and Bettongs	
	Potorous tridactylus tridactylus (SE Mainland)	Long-nosed Potoroo
	Aepyprymnus rufescens	Rufous Bettong

31. Arboreal Marsupials

Cercartetus nanus	Eastern Pygmy –possum
Petaurus australis	Yellow-bellied Glider

32. Megachiropteran Bats

Syconycteris australis	Common Blossom Bat

33. Microchiropteran Bats

Kerivoula papuensis	Golden-tipped Bat
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat
Myotis macropus	Large-footed Myotis
Mormopterus norfolkensis	Eastern Freetail Bat
Vespadelus troughtoni	Eastern Cave Bat
Chalinolobus dwyeri	Large-eared Pied Bat

34. Endangered Populations

Dromaius novaehollandiae (Emu) – population in the NSW North Coast Bioregion and Port Stephens LGA.

Endangered Ecological Communities recorded within the study area

1. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as an Endangered Ecological Community

Description
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains (New South Wales Scientific Committee, 2004). The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. The most widespread and abundant dominant trees include *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark). South from Sydney *Eucalyptus botryoides* (Bangalay) and *Eucalyptus longifolia* (Woollybut) are common. Other common trees include *Eucalyptus resinifera* (Red Mahogany), *Livistona australis* (Cabbage Gum), *Callistemon salignus* (Willow Bottlebrush) and *Casuarina glauca* (Swamp Oak).

Distribution
Found on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Paperbark Swamp Forest occurring on lower lying poorly drained ground within the study area was found to be consistent with the Endangered Ecological Community (EEC) Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. The two areas of Swamp Sclerophyll Forest occupied approximately 1.15ha of the study area.

Swamp Sclerophyll Forest occupied 1.15ha of the lower lying poorly drained land within the study area. Based on canopy species two variations of Swamp Sclerophyll Forest were found to be present. They were:

- 0.8ha of Swamp Forest dominated by a canopy of *Melaleuca quinquenervia* (Broad-leaved Paperbark) in the north of the study area. Other canopy species were *Eucalyptus robusta* (Swamp Mahogany) and *Casuarina glauca* (Swamp Oak). The ground layer was generally dominated by fern and sedge species. This EEC was largely contained within Lot 10 in the north of the study area. This assemblage also pushed into the neighbouring Lots 11 and 51. This area was in generally good condition although had been subject to a number of disturbances from surrounding development and weed incursion. The sloping edge of the access road into the earthmoving business within Lot 10 had been slowly encroaching into this assemblage. Parts of this assemblage on the other side of the access road near the residence had a maintained understorey. The area of Paperbark Swamp Forest within Lot 51 had been subject to some grazing and trampling by cattle.

- 0.35ha of Swamp Forest dominated by a canopy of *Melaleuca quinquenervia* (Broad-leaved Paperbark) with a number of specimens of *Eucalyptus grandis* (Flooded Gum) in the north-west of the study area. This area of EEC was found to be in generally good condition although it had been subject to disturbances from weed incursion from species such as *Lantana camara* (Lantana).

The areas of Swamp Sclerophyll Forest are located outside the proposed mining footprint (15m Buffer of native vegetation) and as a consequence will not be directly impacted. The proposal will require excavation below the groundwater level. An assessment undertaken (Martins, 2015) found drawdown of the permanent groundwater system for this vegetation community within the study area is modelled to be a maximum of approximately 0.07m. Swamp Sclerophyll Forest is an obligate Groundwater Dependant Community which is exclusively reliant on groundwater. Based on the NSW Aquifer Interference Policy (Department of Primary Industries Office of Water, 2012) and the post Water Sharing Plan the local groundwater natural level range is in the order of 3 m (or more). The adopted permissible drawdown at a 40m buffer from the GDEs is 0.30m (i.e. 10% x 3.00). This drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, based on modelling results, the proposed development does not exceed the drawdown impact criterion set out in the NSW Aquifer Interference Policy (NOW, 2012).

Strict controls will have to be applied to the proposal to prevent any future degradation to the areas of Swamp Sclerophyll Forest. It is recommended that a vegetation management plan be completed for these areas to ensure the long-term viability of this Endangered Ecological Community. Taking the recommendations into consideration the proposal is unlikely to have an adverse effect on Swamp Sclerophyll Forest that its composition or local occurrence is likely to be placed at extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Both areas of Swamp Sclerophyll Forest totalling 1.15ha are located are located outside the proposed mining footprint and as a consequence will not be directly impacted.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No areas of Swamp Sclerophyll Forest are likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Considering the two areas of Swamp Sclerophyll Forest will not be directly impacted by the mining footprint and that the forecast drop in the groundwater level is unlikely to have any significant impact on this endangered ecological community that an area of habitat important to the long-term survival of the ecological community will be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the study area has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for Swamp Sclerophyll Forest. However, the Department of Environment, Climate Change and Water has prepared a number of strategies to promote the recovery of this Endangered Ecological Community. Each strategy has a number of priority actions within it. Strategies most applicable to the study area would include:

- *Habitat management: Site Protection*
  Identify and prioritise other specific threats and undertake appropriate on ground site management strategies where required.
- *Habitat management weed control*
  Undertake weed control for Bitou Bush and Boneseed at priority site in accordance with the approved abatement plan and associated PAS actions.

It is recommended that a vegetation management plan be completed which will address likely impacts during construction and ensure the long-term viability of this Endangered Ecological Community.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. No areas of Swamp Sclerophyll Forest are required to be removed as a result of the proposal.
- **Invasion of native plant communities by exotic perennial grasses:** This threatening process is already present with a small number of introduced grasses such as *Paspalum urviillei* (Vasey Grass) and *Axonopus affinis* (Narrow-leaved Carpet Grass) present within the endangered community. There is the potential for further infestation however given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be reduced.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. The proposal is unlikely to result in a change in the frequency of fire in the local area.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera*: (Bitou Bush).** Bitou Bush was present within the study area and within the EEC. It is recommended that this species be controlled within the study area.

- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within this Endangered Ecological Community regardless of the proposal. However, given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.

Bibliography:

Martens (2015). *Groundwater Management Plan – proposed sand mine 3631, 3679 & 3721 Nelson Bay Rd and 774 Marsh Road, Bobs Farm, NSW.* Ammos Resource Management Pty Ltd. April 2015.

NSW Scientific Committee (2004). *Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South-East Corner bioregions – Endangered ecological community determination – final.* DEC (NSW), Sydney.

2. Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as an Endangered Ecological Community

Description
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is an ecological community associated with periodic, semi-permanent or permanent inundation by freshwater, although some may have a minor saline influence. They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains (NSW Scientific Committee, 2004). The structure of the community may vary from sedgelands and reedlands to herbfields, and woody species of plants are generally scarce.

Distribution
Found on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(ii) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Approximately 0.32ha of wetland vegetation occurring on the lower lying poorly drained area in the north of Lot 51 within the study area was found to be consistent with the Endangered Ecological Community Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. The freshwater wetland was found to intergrade with an area of Paperbark Swamp Forest which was largely contained within the adjoining Lot 10 to the east. The wetland may have originally been derived from the past removal of Paperbark Swamp Forest. The area of wetland has been subject to disturbance from ongoing grazing and trampling by cattle. The edges of the wetland had the most disturbances.

The area of Freshwater Wetland is located outside the proposed mining footprint and as a consequence will not be directly impacted (Buffer of 15m). The proposal will require excavation

below the groundwater level. An assessment undertaken (Martins, 2015) found drawdown of the permanent groundwater system for this vegetation community within the study area is modelled to be a maximum of approximately 0.07m. Freshwater Wetlands are an obligate Groundwater Dependant Community which is exclusively reliant on groundwater. Based on the NSW Aquifer Interference Policy (Department of Primary Industries Office of Water, 2012) and the post Water Sharing Plan local groundwater natural level range of the order of 3 m (or more), the adopted permissible drawdown at a 40 m buffer from the GDEs is 0.30m (i.e. 10% x 3.00). This drawdown threshold is met for vegetation communities exclusively reliant on groundwater. Consequently, based on modelling results, the proposed development does not exceed the drawdown impact criterion set out in the NSW Aquifer Interference Policy (NOW, 2012).

Strict controls will have to be applied to the proposal to prevent any future degradation to the area of Freshwater Wetland. It is recommended that a vegetation management plan be completed for these areas to ensure the long-term viability of the Endangered Ecological Community within the study area. Given the fact that this relatively small wetland which has been subject to disturbance will not be directly affected the proposal is unlikely to cause extinction of this endangered ecological community in the locality.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The 0.32ha area of Freshwater Wetland is located outside the proposed mining footprint and as a consequence will not be directly impacted.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No areas of wetland habitat are likely to become fragmented or isolated from other areas as a result of the proposed action.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Taking the current disturbances and relatively small size of the area of Freshwater Wetland and the fact that this area will not be directly impacted it is unlikely that an area of important habitat to the long-term survival of the ecological community will be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the study area has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for Freshwater Wetlands. Activities to assist the recovery of this community include;

- instigate enforcement and education campaigns to reduce dumping.
- Instigate pig control programs.
- Install stormwater control mechanisms to prevent off-site impacts from adjacent development.
- Control access of cattle to wetlands by installing fencing.

- Undertake weed control as required using removal methods that will not damage the community.
- Protect and actively manage wetlands through conservation mechanisms such as covenanting and the preparation/implementation of site-specific vegetation management plans.
- Restore natural drainage conditions.

It is recommended that a vegetation management plan be completed which will address likely impacts during construction and ensure the long-term viability of this Endangered Ecological Community.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. No areas of Freshwater Wetlands are required to be removed as a result of the proposal.
- **Invasion of native plant communities by exotic perennial grasses:** This threatening process is already present with a small number of introduced grasses such as *Paspalum urviillei* (Vasey Grass) and *Axonopus affinis* (Narrow-leaved Carpet Grass) present within the endangered community. There is the potential for further infestation, however, given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be reduced.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush).** Bitou Bush was present within the study area, however is unlikely to have a significant impact on this assemblage.
- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within this Endangered Ecological Community regardless of the proposal. However, given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.

Bibliography:

Martens (2015). *Groundwater Management Plan – proposed sand mine 3631, 3679 & 3721 Nelson Bay Rd and 774 Marsh Road, Bobs Farm, NSW*. Ammos Resource Management Pty Ltd. April 2015.

NSW Scientific Committee (2004). *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – Endangered ecological community determination – final.* DEC (NSW), Sydney.

Threatened flora species present within the study area:

3. *Diuris arenaria* (Tomaree Doubletail)

Description
Diuris arenaria is a terrestrial orchid with moderate-sized purple flowers, a darker labellum and a very narrow tubular base to the flower, the area between the callus ridges are ochre yellow and purple (Jones, 1999).

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
This species has not been ROTAP-listed.

Habitat Requirements and Ecology
Diuris arenaria is depicted to exist in a great variety of environments including coastal heath woodlands (Jones 1999), dry sclerophyll forests (Bishop 2000), open grasslands.

Distribution
Diuris arenaria is an orchid species endemic to the Tomaree Peninsula (Jones, 1999, Bishop 2000). It has a wide distribution on the Tomaree Peninsula with colonies known to occur in Nelson Bay, Shoal Bay, Anna Bay and electrical easements running through Gan Gan Army Camp site, Tomaree National Park, Worimi Conservation Lands and Bobs Farm.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Diuris arenaria (Tomaree Doubletail) was recorded within the study area as a result of targeted surveys in 2013, 2014 & 2016 undertaken during the known flowering period (August/September) for this orchid species. A total of 108 individual specimens of *D. arenaria* were found in the far south-west of the study area during the 2016 survey. With the exception of one plant (No. 14) occurring approximately 6m to the north of the electrical easement, the remaining specimens of *D. arenaria* were found to be confined to the maintained electrical easement. A small number were also present to the immediate west of the study area within the unformed road which cut across the easement. The locations of *D. arenaria* were largely consistent with those mapped for the Tomago to Tomaree Electricity Easement Upgrade (ERM, 2003). Some additional specimens may have been buried as a result of past earthworks within the easement closer to Nelson Bay Road. Other occurrences of *D. arenaria* were also present along the same electricity easement to the west and east of the study area according to the mapping contained in the ERM report (Appendix I – Bobs Farm Offset Report). Within the study area the orchids were located within derived grassland with no canopy which has been created and maintained as an electrical easement. No other occurrences of *D. arenaria* were recorded over the remainder of the study area. The absence of *D. arenaria* over the remainder of the study area is likely to be attributed to the density of trees and shrubs shading suitable habitat. Suitable habitat however, was considered to be present within areas of Coastal Sand Apple Blackbutt Forest with a more sparse mid storey and canopy cover.

Diuris arenaria is only known to occur on the Tomaree Peninsula. A study of *D. arenaria* undertaken within the 2005 flowering season (Espallargas, 2005) found the total population of *D. arenaria* to be 2840 individuals. Going off this report the population of *D. arenaria* within the study area would equate to 1.7% of the total population of this orchid species.

The proposal will result in the removal 25.90ha of suitable habitat from within the study area. No specimens of *D. arenaria* are required to be removed as a result of the proposal. The 15m buffer to the north of the electrical easement to the extraction zone will also offer protection from secondary impacts such as increased weed incursion and dust. It is recommended that there is a no-go zone below the extraction zone to avoid any unintended removal/disturbance of these orchids. This will require the erection of a barrier fence on the boundary of the extraction zone. It will also be important to liaise with Ausgrid regarding maintenance of their easements to minimise impacts and support the protection of *D. arenaria*.

Taking into consideration the recommendations the proposal is unlikely to cause extinction of the local population of this orchid species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposal will result in the removal 25.90ha of suitable habitat from within the study area. No specimens of *D. arenaria* are required to be removed as a result of the proposal. The 15m buffer to the north of the electrical easement to the extraction zone will also offer protection from secondary impacts such as increased weed incursion and dust.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Taking into consideration the locations of *D. arenaria* along the electrical easement no areas of known habitat are likely to become fragmented or isolated from other areas.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will result in an incremental loss of habitat for *D. arenaria* within the local area. Taking into consideration the recommendations it is unlikely that an area of habitat important to the long-term survival of *D. arenaria* will be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for *D. arenaria*. However, the OEH has prepared Priority Action Statements (PAS) to promote the recovery of this orchid species. A total of 7 current Priority actions have been identified to help recover these species:

- Collect propagules for NSW Seedbank in collaboration with RBG & DT. Identify single provenance seed from individual populations. Develop programs to strengthen individual populations: High priority;
- Identify road/trackside populations and avoid during roadworks. - High priority;
- Minimise further loss of habitat from clearing and fragmentation associated with urban development - High priority;
- Create management plan to address threats including illegal dumping, recreational activities, slashing and spraying - High priority;
- Improve awareness of the threat of illegal dumping and recreational activities to *D. arenaria* habitat through signage – High priority;
- Implement appropriate fire management practices – High priority;
- Control priority weeds – High priority;

The recommendation for a Vegetation Management Plan for the site will help protect this orchid species. It is important that consultation with Ausgrid who is responsible for the management of the easement be undertaken. Taking the recommendations into consideration it is unlikely that the proposal will significantly compromise the Priority Action Statements.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: According to the NSW Scientific Committees final determination of *D. arenaria* under the TSC Act (NPWS, 2005) the clearing of habitat is one of the main threats for this orchid species. A number of known colonies have been destroyed by various past developments. The proposal will result in the removal of specimens of *D. arenaria*.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: Depending on the frequency and intensity of a fire both positive and negative outcomes can result for *D. arenaria*. Regular low intensity burns outside the flowering period from winter to spring when the orchid is saprophytic (feeding on dead or decaying organic matter) can favour *D. arenaria* by

reducing weed species and opening up the surrounding habitat to reduce the orchids competition for sunlight. Infrequent high intensity burns can have a negative effect by detrimentally altering the environment for the orchid and killing orchid bulbs close to the surface. It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. The proposal is unlikely to result in a change in the frequency of fire in the local area.

- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush).** Bitou Bush was present within the study area. Bitou bush impacts on other plant species through increased competition, shade and litter level.
- ***Lantana camara* (Lantana):** Lantana was found to be present within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within the site. However, given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.
- **Invasion of native plant communities by exotic perennial grasses:** A number of exotic perennial grasses were present within the easement within the site where specimens of *D. arenaria* were recorded. Grasses of particular concern were *Andropogon virginicus* (Whiskey Grass) *Anthoxanthum odoratum* (Sweet Vernal Grass), *Eragrostis curvula* (African Love Grass) and *Melinis repens* (Red Natal Grass). Another introduced grass species *Hyparrhenia hirta* (Coolatai Grass) is becoming prevalent within the local area and has the potential to significantly impact areas of known habitat.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on this orchid species by increasing the intensity and frequency of Bushfires.
- **Competition and grazing by the feral European Rabbit *Oryctolagus cuniculus***. The Feral European Rabbit was recorded within the study area during fieldwork. The Feral Rabbit may forage on *D. arenaria*. It is recommended that the control of Rabbits be included within the management of the site.

Other threats

- **Inappropriate activities** Inappropriate slashing regimes during growing/flowering/fruiting periods.

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Threatened fauna species recorded within the study area:

4. *Glossopsitta pusilla* Little Lorikeet

Description
The Little Lorikeet is a small green bird with a black bill and red patch covering forehead/throat, but not ear-coverts. The eyes are orange yellow.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology
The Little Lorikeet forages for nectar and pollen in the canopy of eucalypts and occurs in forests, woodlands, large trees within open country, timbered watercourses, shelterbelts and street trees. This Lorikeet species nests in a small hollow within a eucalypt.

Distribution
This species is endemic to Australia and the main distribution of the Turquoise Parrot is in the grassy woodlands of the western slopes and tablelands from the Darling Downs in Queensland to northern Victoria, particularly along watercourses.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Little Lorikeet *Glossopsitta pusilla* (Little Lorikeet) was recorded in the far south-east of the study area within Coastal Sand Apple Blackbutt Forest on two occasions. Suitable foraging and nesting habitat was present across the forested habitats of the study area. The proposal will require the removal of approximately 25.90ha of seasonal foraging habitat primarily in the form of flowering specimens of *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). Approximately 877 hollow-bearing trees are proposed to be removed to make way for the sand mine footprint. Many of these trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for the Little Lorikeet. Considering the presence of larger areas of adjoining and nearby habitat (Coastal Sand Apple Blackbutt Forest which is the dominant vegetation assemblage along the sand dunes of Stockton Bight from Fern Bay to Anna Bay) which contains comparable foraging and similar densities and sizes of hollows it is considered unlikely to result in the extinction of any local population of this mobile parrot species

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts for *G. pusilla*:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees.

No areas of habitat are likely to become fragmented or isolated for this mobile bird species. The proposal will result in the incremental reduction in in a relatively large fragment of adjoining habitat occurring along Stockton Bight. However, no area of habitat important to the long-term survival of the Little Lorikeet is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the Little Lorikeet. However, the OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these species recover in NSW. Activities to assist the recovery of the Little Lorikeet include:

- Retention of large old trees, especially those that are hollow-bearing;
- Ensure recruitment of trees into the mature age class so that there is not a lag period of decades between the death of old trees and hollow formation in younger trees;
- Protect large flowering Eucalyptus trees throughout the habitats frequented by this species. Manage remnant woodlands and forest for recovery of old-growth characteristics;
- Where natural tree recruitment is inadequate, replant local species to maintain foraging habitat and breeding sites.
- Reduce the abundance of feral Honeybees and limit the exploitation of nectar by domestic bees where resources are spatially or temporally sparse (e.g. in years of drought).
- Document nest sites and ensure their protection.

The proposed sand mine is not consistent with these actions. Rehabilitation of the disturbance area and the provision of compensatory habitat (Offsetting) will reduce the impact of the mine on the Little Lorikeet.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for this bird species.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows. The proposal will result in the removal of a moderate reduction of nesting habitat within the local area.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox may have some impact on the Little Lorikeet in the local area. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the site by remote camera. The Feral Cat may have some impact on the Little Lorikeet in the local area, particularly young fledglings occurring close to the ground. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used by the Little Lorikeet. The Feral Honeybee would also compete for nectar from flowering eucalypts. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners**. The Noisy Miner was recorded within the study area during fieldwork. The proposal is unlikely to result in an increase in Noisy Miners within the study area.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush).** Bitou Bush was present within the study area and formed dense clumps in some areas. Bitou Bush has the potential to compete with small and germinating young eucalyptus. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was present within the study area and formed dense clumps in a small number of areas. Lantana has the potential to compete with small and germinating young eucalyptus. It is recommended that this species be controlled within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable nesting hollows for the Little Lorikeet. The proposal will result in the removal of a number of dead trees.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Little Lorikeet by increasing the intensity and frequency of Bushfires and droughts.

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5. *Haliaeetus leucogaster* White-bellied Sea Eagle

Description
The White-bellied Sea Eagle is a large fishing raptor with large eagle that has long broad wings and a short, wedge-shaped tail. It measures 75–85 cm in length, and has a wingspan of 180–220 cm.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).

Distribution
The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Haliaeetus leucogaster (White-bellied Sea Eagle) was observed flying over the study area on a number of occasions. Juvenile White-bellied Sea Eagles also observed flying over the study area would likely indicate nesting within the locality. Due to the relatively close proximity of Tilligerry Creek and to a lesser extent the waters of Stockton Bight, large trees within the study area would offer potential nesting habitat for the White-bellied Sea Eagle. No large nests that would be attributed to this species were identified within the study area. No preferred hunting habitat was present within the site. The proposal will likely result in the incremental reduction of potential nesting habitat however, it is unlikely to result in the extinction of any local population of *H. leucogaster*.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for these bird species:
- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest.

The proposed sand mine will result in a reduction in nesting habitat. Taking into consideration the high mobility of these birds of prey, large amount of similar surrounding habitat the proposal is unlikely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long-term survival of these birds of prey.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the White-bellied Sea Eagle although a Priority Action Statement (PAS) has been developed for each species. The objective of the PAS is to promote the recovery of threatened species, populations and ecological communities and manage key threatening processes. It is considered that the proposal does not conflict with the PAS for this bird of prey.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. Any future removal of vegetation is likely to result in a reduction in habitat for this species in the local area. It is unlikely to be considered significant in relation to this bird of prey.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. The proposal is unlikely to result in a change in the frequency of fire in the local area.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. This introduced predator would have an impact on native fauna within the locality.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. This introduced predator would have an impact on native fauna within the locality.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the

potential to cause mortality to young birds and affect the availability of food resources.

- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. The proposal will result in the removal of a number of standing dead trees and dead wood lying on the ground.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these woodland birds by increasing the intensity and frequency of Bushfires and droughts.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush).** Bitou Bush was present within the study area. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within the study area. Given the recommendation for a vegetation management plan which will include regular weed control the impact from this threatening process would be reduced.

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6. *Ninox strenua* Powerful Owl

Description
The Powerful Owl is the largest owl in Australasia. It is a typical hawk-owl, with staring yellow eyes and no facial-disc. Adults reach 60 cm in length, have a wingspan of up to 140 cm and weigh up to 1.45 kilograms.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology
The Powerful Owl inhabits a wide range of vegetation types from wet Eucalypt forests with a Rainforest understorey to Dry Open Forests and Woodlands. The species has been recorded utilising disturbed habitats such as exotic pine plantations and large trees in parks and gardens.

The Powerful Owl is the largest predator of nocturnal forest-dwelling animals in Australian forests. Major prey species in NSW forests are the Greater Glider, Common Ringtail Possum, Sugar Glider, Grey-headed Flying Fox, and several species of diurnal birds, including the Pied Currawong, Magpie and Lorikeets. It rests during the day amid thick foliage, often grasping food-remains. The male of the species employs a slow, far-carrying 'whoo-hoo' call, more deliberate than the female call, which is higher pitched with the second note slightly higher than the first.

Powerful Owls nest in a slight depression in the wood-mould on the base of a cavity in a large old tree, sometimes in excess of 25 metres above the ground. These trees are usually found growing on a hillside in heavy forest and may be utilised intermittently for several years. The breeding season of the Powerful Owl is highly synchronised, being strictly winter breeders. One or two young are produced, although some pairs do not breed in every year. Pairs appear to mate for life and occupy exclusive territories that can be greater than 800ha in size (Kavanagh, 2000).

Breeding March/April Male and Female cuddle up and share a roost;
1 May - 30 June Male and Female Call to each other;
Late May - Early June Female enters hollow, lays 2 eggs;
35 - 38 days chicks fledge;
Chicks hang around up to late December.

Distribution
The Powerful Owl is found in the coastal areas and adjacent ranges of eastern Australia from South Australia to around Rockhampton in Queensland, generally within 200km from the coast. Within N.S.W., Powerful Owls are distributed throughout the length of the Great Dividing Range, which is their stronghold, and extend from the coast to the western slopes where they occur in much lower numbers.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Analysis by Barbara Triggs of bone fragments from *Trichosurus vulpecula* (Common Brushtail Possum) contained within an owl pellet found within the study area found it to be indicative of a pellet belonging to the threatened *Ninox strenua* (Powerful Owl). The Powerful Owl was not observed within the study area during targeted or incidental surveys nor any response to playback calls heard. Suitable hunting habitat for the Powerful Owl in the form of open forest was present over a large portion of the study area. The major prey item of the powerful owl is the Common Ringtail Possum and Squirrel Glider. The Squirrel Glider was recorded within the study area however, the Common Ringtail Possum although likely to be present was not recorded during surveys. The Common Brushtail Possum is a likely frequent prey species for the Powerful Owl within the local area given the presence of the likely Powerful Owl Pellet containing the remains of the Common Brushtail Possum. There was a large number of these possums recorded within the study area. Nesting habitat is present within large hollows in trees particularly larger specimens of Blackbutt. Up to 200 suitable potential nesting hollows were considered to be present for the Powerful Owl within the study area. Roosting habitat for this species is present within denser areas of foliage such as Swamp Forest and thicker areas of Coastal Sand Apple Blackbutt Forest.

According to the NSW Wildlife Atlas (OEH, 2015) the powerful owl has been previously recorded approximately 500m to the south of the study area over Nelson Bay Road within the Worimi Conservation Lands. Other records are known within similar habitat (Coastal Sand Apple Blackbutt Forest) along the Stockton Bight from Fern Bay to Anna Bay (Umwelt, 2004) and ERM (2005). The Powerful Owl shows a high fidelity to a large territory, the size of which varies with habitat quality and thus prey densities. In good habitats a mere 400ha can support a pair; where hollow trees and prey have been depleted the owls need up to 4000 ha.

The proposal will remove 25.90ha of potential hunting and roosting habitat. Approximately 877 hollow-bearing trees will be removed. Many of these hollow-bearing trees (up to 200) being significant as a result of their very large size and presence of large potential nesting hollows for owls such as the Powerful Owl. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows. Other potential impacts include noise from the mine operation, artificial lighting.

To minimise the impact on the Powerful Owl a number of recommendations have been given:

- Preclearance surveys will be required to be undertaken for Powerful Owl nesting sites during the breeding season. If a nesting tree is located then a 100m no go zone is to be put in place around this tree until either the young have fledged the nest.
- It is recommended that lighting be minimised and confined wherever possible. This will require the use of dimmer lights and directing the beams away from areas of native habitat.
- Noise is to be minimised – An acoustic barrier is to be constructed around much of the disturbance area;
- Weeds are to be controlled within areas of habitat outside the mining footprint and those areas that have undergone restoration;
- Feral animals are to be controlled as part of a vertebrate pest animal management plan;
- Minimise the direct impact on prey species during vegetation removal. Will involve the supervision of clearance activities by suitably qualified fauna ecologists.

The proposal will result in a significant incremental reduction in habitat for the Powerful Owl. Considering the relatively large area of habitat occurring along the dune forests of Stockton Bight which would generally contain similar densities and sizes of hollows and arboreal prey species the proposed removal of hunting, roosting and nesting habitat is unlikely to result in the extinction of any local population of the Powerful Owl.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered population has been identified utilising the site.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No endangered ecological community has been identified utilising the site.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for the Powerful Owl:
- The loss of 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately977 hollow-bearing trees (up to 200 potential nesting trees);
- Reduction in prey species.

No areas of habitat are likely to become fragmented or isolated for this owl species. The proposal will result in the incremental reduction in of a relatively large fragment of habitat occurring along Stockton Bight. However, no area of habitat important to the long-term survival of the Powerful Owl is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Recovery Plan has been completed for Large Forest Owls (Powerful, Masked & Sooty Owls). The recovery plan recommends that developments containing bushland protect nest and roost sites, patches of habitat and prey bases. The proposal will result in the removal of 25.90ha of suitable hunting habitat and up to 200 potential nesting trees.

The proposed sand mine is not consistent with these actions. Rehabilitation of the disturbance area and the provision of compensatory habitat (Offsetting) will reduce the impact of the mine on the Powerful Owl.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for the Powerful Owl.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for the Powerful Owl. Up to 200 suitable nesting hollows were considered to be present. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The Red Fox would prey on this owl species is if young have inadvertently flown on to the ground and can only return to safety by branching back up a tree.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The Feral Cat would prey on this owl species when young have inadvertently flown on to the ground and can only return to safety by branching back up a tree.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The Feral Dog would prey on this owl species when young have inadvertently flown on to the ground and can only return to safety by branching back up a tree.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees and effect the density of prey species.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for nesting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners**. The Noisy Miner was recorded within the study area during fieldwork. The proposal is unlikely to result in an increase in Noisy Miners within the study area.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera*: (Bitou Bush).** Bitou Bush was present within the study area and formed dense clumps in some areas. Dense areas of Bitou Bush may have the potential to further obstruct prey from capture. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was present within the study area and formed dense clumps in a small number of areas. Lantana has the potential to compete with small and germinating young eucalyptus. It is recommended that this species be controlled within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable nesting hollows for the Powerful Owl. The proposal will result in the removal of a number of dead trees.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Powerful Owl by increasing the intensity and frequency of Bushfires and droughts.

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7. *Petaurus norfolcensis* Squirrel Glider

Description
The Squirrel Glider (*Petaurus norfolcensis*) is a medium sized arboreal gliding marsupial with long grey fur and a pronounced black dorsal strip extending from between the eyes to the base of the tail. The belly fur is white and the tail is grey and fluffy. The gliding membrane (patagium) extends from the wrist to the ankle. The Squirrel Glider is similar to the Sugar Glider (*Petaurus breviceps*) however is larger with a longer pointed face, longer and narrower ears and a much bushier furred tail.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements
Throughout its range *P. norfolcensis* is found in dry forest and woodland associations dominated by winter flowering eucalypts or with an understorey of winter flowering Banksias or gum producing Acacias (Smith, 2002). Squirrel Gliders nest in tree hollows or "dens" with a range of entrance diameters of 4-15cm. Squirrel Glider colonies and individuals may change nest sites frequently within their home range.

The Squirrel Glider eats a high proportion of invertebrates from the foliage of Eucalypts and *Acacias* supplemented by plant exudates in the form of Eucalypt and *Melaleuca* sap and *Acacia* gum. Insects (Coleoptera) and caterpillars (larval Lepidoptera) were found to be very important in its diet. The plant exudates, honeydew, pollen and nectar were considered to be more important in winter and spring. It is also likely that birds eggs are included in its diet. It is thought that a mixed stand of gum and high nectar producing Eucalypts, (including some which flower in winter) were important to support the Squirrel Glider.

Distribution
The squirrel glider is sparsely distributed along Australia's east coast from Victoria to North Queensland. The distribution extends inland up to about 300 km (NSW Office of Environment and Heritage, 2014).

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Squirrel Glider was recorded within the study area as a result of targeted surveys. Four gliders were captured in arboreal mammal traps during the 2014 trapping period. No Squirrel Gliders were captured during the 2013 trapping period. An individual Squirrel Glider was also recorded on the ground by remote camera in the far east of the study area in early 2015. No gliders were observed during spotlighting surveys or emerging during stag-watching of habitat trees.

Despite the survey effort, the capture rate of four gliders for 160 trap nights averaged 2.5 percent. This is lower than the average capture rate at Wyong (6.5 percent) (Smith & Murray 2003) and at Port Macquarie (8 to 16 percent) (Quin 1996). However, capture rates are lower during flowering due to the excess of nectar and pollen associated with flowering eucalypts (Quin (1995). During the trapping periods *Eucalyptus pilularis* (Blackbutt) and *Eucalyptus robusta* (Swamp Mahogany) were both flowering and would have likely reduced the chances of trapping a Squirrel Glider.

According to the NSW Wildlife Atlas (OEH, 2015) previous Squirrel Glider records were found within and in close proximity to the study area. Squirrel Gliders have also been recorded in a number of locations within the larger fragment including Salt Ash (Umwelt, 2003) and the Worimi Conservation Lands (Ecotone, 2008). Therefore, it can be assumed that the Squirrel Glider is likely to occur within forest habitats along the length of the sand dunes of Stockton Bight.

The study area forms part of a much larger fragment of native vegetation dominated by Coastal Sand Smooth-barked Apple Forest associated with the coastal sand dunes along Stockton Bight. This relatively large fragment (approximately 2400ha - extrapolated from The Department of Lands, 2015 Aerial Photo) is bounded by bare Holocene sand dunes to the east, cleared mostly agricultural land to the west, residential development of Fern Bay to the far south and Anna Bay to the north. The southern extent of this fragment however, occurs north of Fern Bay where shifting sand has created a barrier for the Squirrel Glider (approximately 500m wide) to a smaller fragment of known Squirrel Glider habitat (approximately 1000ha – Fern Bay Fragment)(ERM, 2005) at the southern end of Stockton Bight. The 2400ha fragment which contains the study area is comprised of both conservation lands (Worimi Conservation Lands – approximately 1750ha – extrapolated from OEH, 2013) and less secure privately owned land (remainder of land = approximately 650ha).

The Squirrel Glider has a home range of between 1.5 and 10 hectares and a density of 0.1 to 1.9 animals per hectare, depending upon habitat quality (Smith 2002). Density of gliders in the Fern Bay fragment which contains similar habitat was estimated at 0.36 gliders per hectare (ERM, 2005). Considering the presence of approximately 36ha of suitable habitat for the Squirrel Glider within the study area there could be at least 13 individuals utilising the study area.

The occurrence of Squirrel Gliders is highly localised and dependent on availability of suitable foraging habitat with tree hollows. Specific known food plants are important habitat characteristics for the Squirrel Glider. Known food plants for the Squirrel Glider that were present within the study area are shown in the table below.

Known food plants of the Squirrel Glider within the site

Food Plant	Food Item
Eucalyptus pilularis (Blackbutt)	Autumn & Winter Nectar & pollen
Eucalyptus robusta (Swamp Mahogany)	Winter Nectar nectar & pollen
Angophora costata (Smooth-barked Apple)	Early Summer
Banksia serrata (Old Man Banksia)	Summer nectar & pollen
Banksia integrifolia (Coastal Silver Banksia)	Winter nectar & pollen
Melaleuca quinquenervia (Broad-leaved Paperbark)	Nectar, insect bark feed
Acacia irrorata subsp. *irrorata*	Gum
Acacia longifolia (Sydney Golden Wattle)	Gum
Acacia maideni	Gum

The food plants *E. pilularis* and *B. serrata* were very common within the study area. As winter is a time of critical food shortage for the Squirrel Glider species such as *E. robusta* are an important food resource within the local area during this period. Only 19 specimens of *E. robusta* were found to be present within the study area.

Approximately 1217 hollow-bearing trees were recorded within the study area during the hollow-bearing tree survey. Many of these trees where considered to be significant as a result of their very large size and the presence of suitably sized nesting hollows for the Squirrel Glider. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows.

The Priorities Action Statement for the Squirrel Glider (OEH, 2013) identifies this species as a landscape managed species. These species are typically distributed widely and are most vulnerable to the threat of habitat loss or degradation. The security of these species depends more on the total extent

and condition of habitat available than particular management actions. As previously mentioned the study area forms part of a much larger fragment of known Squirrel Glider Habitat (approximately 2400ha). A large portion of this habitat fragment is protected within the Worimi Conservation Lands (approximately 80% - 1924.1ha is composed of Coastal Sand Apple Blackbutt Forest) (Bell & Driscoll, 2010). Other small patches of suitable habitat in the form of swamp sclerophyll forest were also present on these protected lands.

Suitable contiguous Squirrel Glider habitat occurs on private land north of the dual carriage way (four lanes) of Nelson Bay Road to the west of the study area. Smaller areas of adjoining privately owned habitat were present to the east and the north. The much larger Worimi Conservation Lands were present to the south over Nelson Bay Road. No trees were present within the centre strip of the dual carriage way adjacent to the study area. This gap was measured at a minimum of 40m. Trees on the side of the road should be sufficiently tall (above 25m) to allow Squirrel Gliders to glide above large trucks (~4m high) at ~6m in from a landing tree, and land ~1m above the ground to avoid predators (Ross et. al, 2009). Although a number of trees along the roadside would reach over 25m in height considering the frequency of vehicle movements along this road this gap would represent a considerable barrier for the Squirrel Glider. However, a long strip of remnant trees is present within the centre of the duel carriage a short distance to the west of the study area which would provide a much safer link for Squirrel Gliders between habitat north and south of Nelson Bay Road.

The proposal will result in the removal of 25.90ha of Coastal Sand Apple Blackbutt Forest containing known foraging and nesting hollows. Approximately 877 hollow-bearing trees will require removal. Many of these hollow-bearing trees are significant as a result of their very large size and presence of suitably sized nesting hollows for the Squirrel Glider. The proposal will result in a reduction in connectively to smaller areas of open forest habitat contained within Lot 2 & 521 to the immediate west of the study area. Considering the presence of the dual carriageway of Nelson Bay Road (without a treed traffic island) the proposal will also result in a reduction in connectivity for open forest areas within Lot 10 and the adjoining crown reserve. A 15m vegetated buffer zone located around the proposal will however will continue to provide connectivity to these areas of habitat for Squirrel Gliders. The connectivity to these areas will greatly improve after the mine site has been progressively revegetated. Other potential impacts include noise from the mine operation and artificial lighting.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on the Squirrel Glider. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire within the study area;
- Protection of the Squirrel Glider during vegetation clearance;
- Installation of compensatory nest boxes prior to habitat clearance;
- Provision of compensatory habitat (Offsetting);
- Feral Vertebrate Pest Control;
- Weed Control.

The proposal will result in a significant reduction in Squirrel Glider habitat occurring along the dune forests of Stockton Bight. However, considering the relatively large area of remaining habitat together with the given recommendations the proposed sand mine is unlikely to result in the extinction of any local population of the Squirrel Glider.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

The only two Squirrel Glider populations that have been listed as 'endangered' under the NSW Threatened Species Conservation Act 1995 are the Barrenjoey Peninsular population north of Bushrangers Hill and the Wagga Wagga local government area population. No population has been listed as 'endangered' within the Port Stephens local area.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for the Squirrel Glider:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees;
- A reduction in connectively for the Squirrel Glider to smaller areas of open forest habitat contained within Lots 2, 10 & 521 and the adjoining crown reserve.

No areas of habitat are likely to become fragmented or isolated for the Squirrel Glider. The proposal will result in a significant reduction of Squirrel Glider habitat occurring along Stockton Bight. However, no area of habitat important to the long-term survival of the Squirrel Glider is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No draft or approved recovery plan has been prepared for the Squirrel glider. The Office of Environment and Heritage refers to a number of priority actions in relation to the Squirrel Glider, to help recover the species in New South Wales. The following points are relevant to this proposal:

- Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments and other environmental planning instruments, or other land assessment tools. Medium

The proposed sand mine is not consistent with this action. Rehabilitation of the disturbance area and the provision of compensatory habitat (Offsetting) will reduce the impact of the mine on the Squirrel Glider.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for the Squirrel Glider.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for the Squirrel Glider. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox is likely to have some impact on Squirrel Gliders in the local area. Squirrel Gliders foraging close to the ground may be subject to predation. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. Squirrel Gliders foraging close to the ground may be subject to predation. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. Squirrel Gliders foraging close to the ground may be subject to predation. The proposal is unlikely to result in an increase in Feral Dog numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees and affect the availability of food resources.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for nesting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable nesting hollows for the Squirrel Glider. The proposal will result in the removal of a number of dead trees.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Squirrel Glider by increasing the intensity and frequency of Bushfires and droughts.

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8. *Phascolarctos cinereus* Koala

Description
The *Phascolarctos cinereus* (Koala) is the sole member of the family Phascolarctidae. It is a short stocky arboreal marsupial with large furry ears and a vestigial tail. The fur colour of the koala varies from pale grey in the northern parts of its range to grey-brown in the south.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Listed as Vulnerable in NSW, ACT & Qld.

Habitat Requirements
The Koala is limited to areas where there are acceptable food trees. Its diet is generally restricted to that of Eucalypt leaves and much less-often, non-Eucalypt foliage. The foliage of *Eucalyptus camaldulensis* (River Red Gum), *E. tereticornis* (Forest Red Gum), *E. punctata* (Grey Gum), *E. viminalis* (Manna Gum), and *E. robusta* (Swamp Mahogany) are some of the preferred Eucalypt species. Koalas use a wide variety of tree sizes, and do not preferentially use large or tall trees in NSW forests, although this has been listed as a habitat preference in areas where trees are generally small, stunted, or nutrient deprived.

Koalas sleep in the fork of a tree during the day and feed at night with the peak of activity just after sunset. It is generally a solitary animal with a social behaviour pattern that influences its breeding biology. Breeding biology of the Koala is characterised by the occurrence of discrete core breeding groups which are sedentary. A core group may comprise up to several dozen individuals that are usually well separated from other breeding groups. These core groups produce a continual supply of dispersing nomadic sub-adults. Individual Koalas within core breeding groups occupy semi-exclusive territories. There is interaction with and marginal overlap of territories between adjacent individual animals. The territories of breeding males generally occur within a matrix of adjacent territories of breeding females. In the overlap zones of adjacent territories of breeding Koalas, individual trees occur that are habitually used for interaction between the two animals concerned. These breeding core interaction trees (sometimes termed "home range trees") are readily identifiable by scratched "trails" up the bole and copious dung deposits at the base of the tree. Breeding occurs in summer and young females produce one young (rarely twins) each year.

Distribution
The Koala occurs along the east coast of Australia and extends into woodland, mulga and River Red Gum forests west of the Great Dividing Range. In drier forested areas, Koalas are generally observed as individuals in low densities. They are more abundant in coastal woodland and in open forest. They are rare or absent in wet forests in the south above 600 m which may be due more to distribution of Eucalypt species than climate.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

No Koalas were directly observed within the study area during fieldwork completed for this report or previous reports (Wildthing Environmental Consultants, 2009). However, evidence of Koala activity in the form of characteristic scratches on the trunks of a small number of specimens of *Eucalyptus robusta* (Swamp Mahogany) a preferred feed tree species under the Port Stephens Comprehensive

Koala Plan of Management CKPoM and *Melaleuca quinquenervia* (Broad-leaved Paperbark) were present within the area of Swamp Forest in the north of the study area. Accordingly, a koala assessment was conducted in the study area to assess the level of current koala activity. *Eucalyptus robusta* was the only preferred Koala Feed Tree Species recorded within the study area. Despite the presence of a small number of specimens of *E. robusta* having scratches and pock marks consistent with those of a Koala no Koala faecal pellets were found within the study area despite a search beneath every individual specimen of *E. robusta* (a total of 19 trees) and searches conducted over the entire study area during the hollow-bearing tree survey.

Evidence of Koala activity in the form of scratches and pock marks was also recorded outside the study area to the north-west near the Shark and Ray Centre on specimens of *E. robusta* and *M. quinquenervia* within a larger area of Swamp Forest.

Review of the Koala Habitat Planning Map showed the site to be largely composed of Supplementary Koala Habitat with smaller areas of mainly cleared land. However, the CKPoM assessment found although the study area was largely composed of Supplementary habitat two smaller areas of preferred Koala habitat consisting of Swamp Forest were located within the north and north-east of the study area. According to the CKPoM the area of Preferred Koala Habitat will require a 50m buffer over supplementary habitat.

According to database records contained in the BioNet Atlas (OEH, 2017) and Hunter Koala Preservation Society (Hunter Koala Preservation Society, 2015) a small number of records of Koalas occur within proximity to the study area. Relatively recent records of Koalas have been recorded from 2015 & 2016 within the vicinity of the Shark & Ray Centre approximately 200m to the north-west of the site (OEH, 2017). Koalas have also been killed on Nelson Bay Road 200m south of Marsh Road and in the front of Murrays Brewery (no dates given). No records of Koalas within the site were found.

The evidence suggests that the study area particularly the area of Swamp Sclerophyll Forest in the north is utilised infrequently by a small number of Koalas. Koalas may also move through supplementary habitat (particularly along the northern boundary) within the study area to access a larger area of preferred habitat to the north-east.

The proposed sand mine will require the removal of 25.90ha of native vegetation resulting in a significant reduction in Supplementary habitat within the local area. No areas of Preferred Koala Habitat will require removal. A number of recommendations have been given to reduce the impact of the proposal on the local population of Koalas in the local area. These recommendations are:

- specimens of *Eucalyptus robusta* are to be planted into the cleared areas of pasture/grasses within the far east of the study area to enhance the adjoining area of Preferred Koala habitat within Lot 10 and to provide a better linkage to larger areas of preferred Koala to the north over Marsh Road.
- It is recommended that the sand mine disturbance area be cordoned off by the use of Koala barrier fencing to prevent any Koalas straying into the path of machinery or trucks.
- It is recommended that low speed limits and Koala warning signage be placed along the internal access roads to reduce the chance of vehicle collision.
- Dogs are to be controlled within the study area.
- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area;
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire within the study area;
- Protection of the Koala during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Feral Vertebrate Pest Control;
- Weed Control.

Given the low level of Koala activity and taking the recommendations into consideration the proposed sand mine is unlikely to have an adverse effect on the life cycle of the species such that the local population of Koalas may be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Two endangered Koala populations are listed in the NPWS database, the Hawks Nest and Tea Gardens population and the Pittwater Local Government Area population. The study area does not form part of either of two populations.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed sand mine will result in the removal of approximately 25.90ha of Secondary Koala Habitat. No areas of Preferred Koala Habitat will be directly impacted. The proposal will result in the reduction in connectively along the northern boundary of the study area which connects the area of Preferred Koala Habitat contained within Lot 10 to areas to the north (Lots 2 & 521) and to larger habitat areas further west and north-east. There will also be a reduction in connectively (width of habitat) for Koalas moving along the southern boundary of the study area north of the duel carriage Nelson Bay Road. Nelson Bay Road offers a tenuis crossing for Koalas moving to and from the Worimi Conservation Lands. Considering that no preferred habitat will be removed as a result of the proposal and no areas of habitat will be isolated, no area of habitat important to the long-term survival of the Koala likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Recovery Plan has been completed for the Koala (DECC, 2008). A number of recovery actions have been developed for each of the specific objectives, each with a performance criterion or criteria,

and in most cases these actions address the broad actions of the National Koala Conservation Strategy.
Objective 1: To conserve koalas in their existing habitat.
Objective 2: To rehabilitate and restore koala habitat and populations.
Objective 3: To develop a better understanding of the conservation biology of koalas.
Objective 4: To ensure that the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local scale.
Objective 5: To manage captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care.
Objective 6: To manage overbrowsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat.
Objective 7: To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW.

The proposal is unlikely to significantly compromise these actions developed to assist the recovery of the Koala.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of open forest containing Supplementary Habitat for the Koalas will lead to an incremental reduction of habitat in the local area. As no Preferred Koala Feed Tree Species will be required to be removed the impact on the Koala is not considered to be significant.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The Red Fox may prey on young Koalas.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The Feral Cat may prey on young Koalas.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The Feral Dog would prey on Koalas within the local area. It is recommended that Feral Dogs be controlled on site with the consultation of the NPWS and neighbouring landholders.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: Fire has the potential to cause direct mortality to Koalas and impact the availability of foraging habitat.
- **Human-caused Climate Change**: Predicted increase in the frequency and severity of droughts, periods of extremely high temperatures and increased frequency of fire have the potential to adversely impact the Koala.

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9. *Pteropus poliocephalus* Grey-headed Flying-fox

Description
The Grey-headed Flying-fox is a large species of megachiropteran bat which possess a mantle of rusty brown fur that full encircles the neck. The fur on the back is dark grey and as the common name suggests, the head is covered with light grey fur. The grey belly fur is often flecked with white and ginger. This species weighs up to a kilogram and has a forearm length of up to 180mm.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Listed as Vulnerable.

Habitat Requirements and Ecology
Grey-headed Flying-foxes are known to occupy a variety of habitats, including wet and dry sclerophyll forests, rainforest, mangroves and paperbark swamps and *Banksia* woodlands. Here they forage on a range of fruits and blossoms. Their diet is so varied that they have been recorded eating the fruit or blossom of more than 80 species of plant. The predominant food source is Eucalypt blossom and fruits from trees such as *Ficus* sp. (Figs). It is likely to act as an important pollinator for many of the trees on which they utilise blossoms. They also inhabit cultivated areas where they feed on introduced trees including commercial food crops, and can become a 'pest' animal in these areas. Ironically, this has led to this species being the most intensively researched bat in Australia.

As with most species of Flying-fox, *P. poliocephalus* roost communally where they form large communal colonies called 'camps'. Camps are mostly in rainforest patches, mangroves, paperbark forests and modified vegetation in urban areas. These camps may contain thousands of individuals, and up to 200 000 individuals have been recorded at one camp.

Typical characteristics of flying-fox roosting habitat include:
- closed canopy (rainforest, mangroves, floodplain or riparian forest dominated by *Casuarina* spp. or *Melaleuca quinquenervia*);
- continuous canopy area >1 ha (ideally >10 ha in size);
- within 50 km of the coast or at elevation <65 m;
- close proximity to waterways (<500 m), commonly rivers or creeks;
- level topography, <5° incline; canopy height >8 m; and
- positioned within nightly commuting distance (generally <20 km) of sufficient food resources to support the population of a communal roost.

They may move up to 70km from the camp each night to forage. Young are raised in maternity camps after birthing in September to October. The young are able to fly at 3 months of age and puberty is reached at 18 months, although males do not achieve effective fertility until 30 months. Vocal communication is highly sophisticated, with over 20 different situation-specific calls being recorded.

Distribution
The Grey-headed Flying-fox is distributed predominantly along the sub-tropical east coast, from Rockhampton (Qld) through NSW to SE Victoria.

Nearby Roosts
Fullerton Cove, Cromarty Lane – Bobs Farm, Blackbutt Nature Reserve.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Pteropus poliocephalus (Grey-headed Flying-fox) was observed within the study area on a number of occasions. Large numbers of Grey-headed Flying-foxes were observed feeding on flowering *Eucalyptus pilularis* (Blackbutt) throughout the study area in February 2015. The Grey-headed Flying-fox was also recorded feeding within the study area on flowering specimens of *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark) in autumn 2015. Additionally, one deceased specimen had been entangled within a barbed-wire fence surrounding the orchard.

Grey-headed Flying-foxes were noted to be largely originating from a large temporary camp located near the intersection of Cromarty and Upton approximately 2km to the east of the study area. Although suitable camp sites were considered to be present within the study area no roosting individuals were observed.

The study area was found to contain seasonal foraging habitat for this highly mobile species in the form of flowering trees particularly *Eucalyptus pilularis* (Blackbutt), *Angophora costata* (Smooth-barked Apple) and *Banksia serrata* (Old Man Banksia). Other preferred foraging species present included *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus grandis* (Flooded Gum), *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Banksia integrifolia* (Coastal Silver Banksia). Cultivated Figs within the orchard would also be a likely food source. The study area was considered to contain potential camp sites, particularly within denser areas of swamp forest dominated by the canopy species *M. quinquenervia*.

The proposal will result in the removal of 25.90ha of seasonal foraging habitat resulting in a significant reduction of foraging habitat within the local area. No areas of habitat will become isolated for this highly mobile species. A number of mitigation measures have been given to reduce the impact of the proposed sand mine on the Grey-headed Flying-fox. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to forest);
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Removal and non-use of barbed-wire.

Taking the presence of larger adjoining and nearby areas of similar habitat the within the locality including the nearby protected Worimi Conservation Lands the proposal is considered unlikely to result in the extinction of any local population of the Grey-headed Flying-fox.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for the Grey-headed Flying-fox;

- The loss of foraging habitat (approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest & 0.32ha of Flooded Gum Forest);
- The loss of suitable camp sites.

No areas of habitat are likely to become fragmented or isolated for this relatively mobile species. Considering the presence of large areas of similar habitat along Stockton Bight, no area of habitat important to the long-term survival of the Grey-headed Flying-fox is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A draft National Recovery Plan has been completed for the Grey-headed Flying-fox. The plan has a number of objectives. Objectives that are relevant to the proposal include:

- To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range;
- To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes;
- To identify roosting habitat critical to the survival of Grey-headed Flying-foxes;
- To protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes;
- To substantially reduce deliberate destruction of Grey-headed Flying-foxes in fruit crops;

The plan recommends the retention of as many foraging species as possible. Whilst inconsistent with the recovery plan the proposal is unlikely to significantly compromise this recovery plan.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of known foraging habitat.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The Red Fox would prey on this Megachiropteran bat species if feeding close to the ground or when young have inadvertently flown on to the ground.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The Feral Cat would prey on this Megachiropteran bat species if feeding close to the ground or when young have inadvertently flown on to the ground.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The Feral Dog would prey on this Megachiropteran bat species if feeding close to the ground or when young have inadvertently flown on to the ground.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to impact on foraging habitat.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to compete for food such as nectar. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Grey-headed Flying-fox by increasing the intensity and frequency of Bushfires and droughts.

Other threats include:

- electrocution on powerlines;
- entanglement in netting and on barbed wire;
- persecution in the form of shooting of animals. This oppression may be a result of Grey-headed Flying-foxes being a perceived pest in agricultural areas or as presenting a noise problem in more urbanised areas. and
- competition and hybridisation with *Pteropus alecto* (Black Flying-fox).

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10 *Scoteanax rueppellii* Greater Broad-nosed Bat

Description
The Greater Broad-nosed Bat is a large powerful bat, up to 95 mm long, with a broad head and a short square muzzle. It is dark reddish-brown to mid-brown above and slightly paler below. It is distinguished from other broad-nosed bats by its greater size.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
This species apparently feeds on large moths and beetles, and some small vertebrates, emerging just after sundown, flying slowly and directly at a height of 3-6 metres, deviating only slightly to catch larger insects. It is also predatory on vertebrates including other bats, and is a noted carnivore on other captured bats in bat traps. *S. rueppellii* is known to hunt along tree-lined creeks, the junction of woodland and cleared paddocks, and low along rainforest creeks. It may have a preference for wet gullies in tall timber country.

The species roosts mainly in tree hollows but it has also been found in the roof spaces of old buildings. Little is known of the reproductive cycle, but it is suggested that the species follows the typical Vespertilionid pattern. What is known is that females congregate in maternity colonies and single young are born in January, slightly later than the other Vespertilionid bats that share its range. Males appear to be excluded from the colony during the birthing and rearing of the young.

Distribution
The Greater Broad-nosed Bat occurs only along the eastern coastal strip of Queensland and NSW where it is restricted to the coast and adjacent areas of the Great Dividing Range. In NSW it extends as far south as the Bega Plain. They are only found at low altitudes (below 500m).

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

A small number of calls not inconsistent with those of *Scoteanax rueppellii* (Greater Broad-nosed Bat) were recorded during the bat call survey. No specimens of *S. rueppellii* were captured during the harp trapping component of the survey. The majority of the study area contains suitable hunting habitat for this microchiropteran bat species. A large amount of roosting habitat was also present with 1217 hollow-bearing trees being recorded within the study area. Many of these trees where considered to be significant as a result of their very large size and presence of suitably sized roosting hollows for this microchiropteran bat species. Approximately 877 hollow-bearing trees are proposed to be removed to make way for the sand mine footprint. The proposal will also result in a reduction in the quality of hunting habitat within the locality.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on *S. rueppellii*. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to original forest type);
- Reduction of ongoing mine impacts such as noise and artificial lighting.

- Protection of this microchiropteran bat species during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Weed Control.

Considering the presence of larger areas of adjoining and nearby habitat along the vegetated sand dunes of Stockton Bight from Fern Bay to Anna Bay which contain comparable foraging and similar densities and sizes of hollows it is considered unlikely to result in the extinction of any local population *S. rueppellii*.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for *S. rueppellii*:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees;

No areas of habitat are likely to become fragmented or isolated for this relatively mobile species. The proposal will result in a reduction of habitat for *S. rueppellii* however considering the presence of large areas of similar habitat along Stockton Bight, no area of habitat important to the long-term survival of *S. rueppellii* is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No draft or approved recovery plan has been prepared for *S. rueppellii*. The Office of Environment and Heritage refers to a number of priority actions in relation to this microchiropteran bat species to help recover the species in New South Wales. The following points are relevant to this proposal:

- Ensure largest hollow bearing trees, including dead trees and paddock trees are given highest priority for retention in PVP assessments (offsets should include remnants in high productivity) and/or other land assessment tools;
- Identify areas of private land that contain high densities of large, hollow-bearing trees as areas of high conservation value in planning instruments and land management negotiations e.g. LEP, CAPs, PVPs.

The proposed sand mine is not consistent with these actions. Rehabilitation of the disturbance area and the provision of compensatory habitat (Offsetting) will reduce the impact of the mine on the Greater-nosed Bat.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for *S. rueppellii*.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for this microchiropteran bat species. Large areas of adjoining and nearby open forest are likely to contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox may have some impact on microchiropteran bats in the local area particularly those roosting close to the ground. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. Microchiropteran Bats hunting or roosting close to the ground be subject to predation. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential roosting trees and affect the availability of food resources.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for roosting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable roosting hollows for this microchiropteran bat species. The proposal will result in the removal of a number of dead trees.

- **Human-caused Climate Change**: Has the potential to have an adverse effect on this microchiropteran bat species by increasing the intensity and frequency of Bushfires and droughts.

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11. *Falsistrellus tasmaniensis* Eastern False Pipistrelle

Description
The Eastern False Pipistrelle is relatively large with a head-body length of about 65 mm. It weighs up to 28 grams. It is dark to reddish-brown above and paler grey on its underside. It has long slender ears set well back on the head and some sparse hair on the nose.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
These bats inhabit sclerophyll forests from the Great Divide to the east coast. In Tasmania they are found in wet sclerophyll and coastal mallee. A preference has been noted for wet habitats where trees are more than 20m high. Based upon the size and shape of its wings the bat it thought to be highly mobile with a relatively large hunting range. A specimen of this species has been radio-tracked and found to move 12km from where it was hunting to where it was roosting in a very large tree.

On the mainland they eat moths, rove beetles, chafers, weevils, plant bugs, flies and ants. Their flight is swift and direct, within or just below the tree canopy. They tend to fly fast in a fixed horizontal plane with sudden darting changes in course. It has been observed roosting in holes and hollow trunks of Eucalypts, with recorded colony sizes ranging from 3 to 36 individuals. Colonies are usually almost entirely male or female groups, although evenly mixed colonies sometimes occur. They have been recorded roosting in a cave at Jenolan, NSW, and they are occasionally found in old wooden buildings.

Males produce sperm in late summer and store it in the epididymis over the winter. Females produce a large 'hibernation follicle' in autumn. Ovulation, fertilisation and pregnancy occur in late spring and early summer. Single young is born in December. Lactation continues through January and February. The Eastern Falsistrelle hibernates generally during winter, particularly in the southern extent of its range.

Distribution
The Eastern Falsistrelle occurs along the coastal ranges from southern Queensland to western Victoria, and is endemic to Australia.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Falsistrellus tasmaniensis (Eastern False Pipistrelle) was positively identified on a number of occasions within the study area during microchiropteran bat call surveys. No specimens were captured during the harp trapping component of the survey. The majority of the study area is likely to contain suitable hunting habitat for this microchiropteran bat species. A large amount of suitable roosting habitat was present with 1217 hollow-bearing trees being recorded within the study area. Many of these trees where considered to be significant as a result of their very large size and presence of suitably sized roosting hollows for this microchiropteran bat species. Approximately 877 hollow-bearing trees are proposed to be removed to make way for the sand mine footprint. The proposal will also result in a reduction in the quality of hunting habitat within the locality.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on *F. tasmaniensis*. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to original forest type);
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Protection of this microchiropteran bat species during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Weed Control.

Considering the presence of larger areas of adjoining and nearby habitat along the vegetated sand dunes of Stockton Bight from Fern Bay to Anna Bay which contain comparable foraging and similar densities and sizes of hollows it is considered unlikely to result in the extinction of any local population of *F. tasmaniensis.*

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for *F. tasmaniensis:*

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees.

No areas of habitat are likely to become fragmented or isolated for this relatively mobile species. The proposal will result in a reduction of habitat for *F. tasmaniensis* however considering the presence of large areas of similar habitat along Stockton Bight, no area of habitat important to the long-term survival of *F. tasmaniensis* is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No draft or approved recovery plan has been prepared for *F. tasmaniensis*. The Office of Environment and Heritage refers to a number of priority actions in relation to this microchiropteran bat species to help recover the species in New South Wales. The following points are relevant to this proposal:

- Ensure largest hollow bearing trees, including dead trees and paddock trees are given highest priority for retention in PVP assessments (offsets should include remnants in high productivity) and/or other land assessment tools;
- Identify areas of private land that contain high densities of large, hollow-bearing trees as areas of high conservation value in planning instruments and land management negotiations e.g. LEP, CAPs, PVPs.
- Promote the conservation of these HCV private land areas using measures such as incentive funding to landholders, off-setting and biobanking, acquisition for reserve establishment or other means

The proposed sand mine is not consistent with these actions. Rehabilitation of the disturbance area and the provision of compensatory habitat (Offsetting) will reduce the impact of the mine on *F. tasmaniensis.*

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for *F. tasmaniensis;*
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for this microchiropteran bat species. Large areas of adjoining and nearby open forest are likely to contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox may have some impact on microchiropteran bats in the local area particularly those roosting close to the ground. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. Microchiropteran Bats hunting or roosting close to the ground be subject to predation. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the

disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential roosting trees and affect the availability of food resources.

- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for roosting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable roosting hollows for this microchiropteran bat species. The proposal will result in the removal of a number of dead trees.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on this microchiropteran bat species by increasing the intensity and frequency of Bushfires and droughts.

Bibliography:

Churchill, S. (2008). *Australian Bats*. Allen & Unwin, Crows Nest, Australia.

12. *Miniopterus australis* Little Bentwing-bat

Description
Miniopterus australis (Little Bentwing-bat) has uniform chocolate fur on the back and slightly lighter fur on the belly. It has a short muzzle and domed head. The ears are short and rounded. The last phalanx on the third finger of the wing is about four times the length of the middle phalanx. This species is very similar to *Miniopterus schreibersii oceanensis* (Large Bentwing-bat) but has a smaller forearm (37 to 41mm).

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
This species inhabits tropical rainforest to warm-temperate wet and dry sclerophyll forest occurring along the coastal plains and adjacent ranges from Cape York to north-eastern N.S.W. It is a sub-canopy hunter with a preference for well-timbered areas but it is also known to hunt in clearings adjacent to forests. Prey items include crane flies, ants, moths and wasps. Flight characteristics include rapid movement with considerable manoeuvrability.

The species is a cave dweller that congregates in the summer months in maternity roost colonies and disperses during winter. In the southern part of their range they hibernate during winter but in the north they remain active throughout the year. Recorded roosts include caves, mines, stormwater drains, disused railway tunnels and houses. Mating, fertilisation and implantation occur from July to August, followed by a period of retarded embryonic development until mid-September. Pregnant females congregate in specified large nursery caves to rear their young. Births occur in December, when single young are born. It is often found to roost with the Large Bentwing-bat (*Miniopterus schreibersii*), and benefits from this larger species' ability to increase the roost temperature using metabolic heat. There is a huge nursery colony of 100,000 adult bats at Mt. Etna caves, in central Queensland.

Distribution
This species inhabits tropical rainforest to warm-temperate wet and dry sclerophyll forest occurring along the coastal plains and adjacent ranges from Cape York to north-eastern N.S.W. around the Hunter River. Its distribution within Australia becomes increasingly coastal towards the southern limit of its range in N.S.W.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

One specimen of *Miniopterus australis* (Little Bentwing-bat) was captured within the study area during the harp trapping component of the survey. This species was also positively identified on a number of occasions within the study area during the bat call surveys. A previous bat call survey (Wildthing Environmental Consultants, 2009) conducted within Lot 10 in the far east of the study area also recorded calls not inconsistent with that of *M. australis* (Small Bentwing-bat). The majority of the study area contains suitable hunting habitat for this microchiropteran bat species. However, no preferred roosting habitat in the form of caves, culverts or other similar man-made structures was found to be present. Taking into consideration the relatively large amount of suitable foraging habitat in

the local area and absence of preferred roosting habitat within the study area the proposal is unlikely to disrupt the life cycle of this microchiropteran bat species such that local extinction would occur.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered population has been identified utilising the site.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for *M. australis:*

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;

No areas of habitat are likely to become fragmented or isolated for this relatively mobile species. The proposal will result in a reduction in the quality of hunting habitat for *M. australis* however considering the presence of large areas of similar habitat along Stockton Bight, no area of habitat important to the long-term survival of *M. australis* is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No draft or approved recovery plan has been prepared for *M. australis*. The Office of Environment and Heritage refers to a number of priority actions in relation to this microchiropteran bat species to help recover the species in New South Wales. The priority actions include:

- Protect known roosting and nursery sites and surrounding forest from disturbance by restricting and/or monitoring access;
- Retain stands of native vegetation, particularly within 10km of roosts;

- Reduce use of pesticides within breeding and foraging habitat;
- Undertake non-chemical weed control to prevent obstruction of maternity cave and other roost entrances;
- Exclude fire from 100m of maternity cave, winter roost or other significant roost entrances and ensure smoke/flames do not enter these roosts;
- Control foxes, feral cats and goats around maternity caves, winter roosts and other significant roost sites;
- Ensure any fencing and gating of roosts is done in a bat friendly manner allowing adequate entrance and exit space for all species using the roost;
- Check with OEH before undertaking recreational caving activities;
- Ensure adequate foraging habitat is retained when undertaking hazard reduction activities, particularly during the breeding/reproduction season;
- Ensure appropriate hygiene protocols are implemented when undertaking research and survey work.

The majority of these actions are only relevant to site containing known roosting areas for *M. australis.* The proposal is unlikely to compromise the listed priority action statements.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction in hunting habitat for *M. australis.*
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox may have some impact around maternity caves, winter roosts and roosts within culverts, tunnels and under bridge. No suitable roosting habitat was considered to be present within the study area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The Feral Cat may have some impact around maternity caves, winter roosts and roosts within culverts, tunnels and under bridge. No suitable roosting habitat was considered to be present within the study area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: Large scale wildfire or hazard reduction can impact on foraging resources. Fire also has the potential to impact roost sites.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on this microchiropteran bat species by increasing the intensity and frequency of Bushfires and droughts.

Other threats include:

- Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic;
- Destruction of caves that provide seasonal or potential roosting sites;
- Changes to habitat, especially surrounding maternity/nursery caves and winter roosts;
- Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals;
- Introduction of exotic pathogens such as the White-nosed fungus.

Bibliography:

Churchill, S. (2008). *Australian Bats*. Allen & Unwin, Crows Nest, Australia.

Dwyer, P.D. (1995). Little Bentwing-bat (*Miniopterus australis*). In: The Mammals of Australia, pp: 492-493. Strahan, R. (Ed). Reed Books, Australia.

Parnaby, H. (1992). *An Interim Guide to Identification of Insectivorous Bats of South-eastern Australia*. Technical Reports of the Australian Museum, Sydney.

Wildthing Environmental Consultants (2009). *Statement of Effect on Threatened Flora and Fauna for a proposed depot site Lot 10 DP 1071458 Nelson Bay Road, Bobs Farm NSW.* Hay Enterprises NSW Pty. Ltd.

13. *Miniopterus schreibersii oceanensis* Large Bent-wing Bat

Description

The *Miniopterus schreibersii oceanensis* (Large Bent-wing Bat) has chocolate to reddish-brown fur on its back and slightly lighter coloured fur on its belly. It has a short snout and a high 'domed' head with short round ears. The wing membranes attach to the ankle, not to the base of the toe. The last bone of the third finger is much longer than the other finger-bones giving the "bent wing" appearance.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Large Bentwing-bat hunts in forested areas, catching moths and other flying insects above the tree tops. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals.

Distribution

The Large Bent-wing Bats occur along the east and north-west coasts of Australia.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Miniopterus schreibersii oceanensis (Large Bent-wing Bat) was positively identified within the study area during microchiropteran bat call surveys. No specimens were captured during harp trapping. The majority of the study area contains suitable hunting habitat for this microchiropteran bat species. No preferred roosting habitat in the form of caves, culverts or other similar man-made structures was found to be present. Taking into consideration the relatively large amount of suitable foraging habitat in the local area and absence of preferred roosting habitat within the study area the proposal is unlikely to disrupt the life cycle of this microchiropteran bat species such that local extinction would occur.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered population has been identified utilising the site.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for *M. schreibersii oceanensis*:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees.

No areas of habitat are likely to become fragmented or isolated for this relatively mobile species. The proposal will result in a reduction in the quality of hunting habitat for *M. australis* however considering the presence of large areas of similar habitat along Stockton Bight, no area of habitat important to the long-term survival of *M. australis* is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No draft or approved recovery plan has been prepared for *M. schreibersii oceanensis*. The Office of Environment and Heritage refers to a number of priority action statements in relation to this microchiropteran bat species to help recover the species in New South Wales. The priority actions include:

- Protect known roosting and nursery sites and surrounding forest from disturbance by restricting and/or monitoring access;
- Retain stands of native vegetation, particularly within 10km of roosts;
- Reduce use of pesticides within breeding and foraging habitat;
- Undertake non-chemical weed control to prevent obstruction of maternity caves and other roost entrances;
- Exclude fire from 100m of maternity cave, winter roost or other significant roost entrances and ensure smoke/flames do not enter these roosts;
- Control foxes, feral cats and goats around maternity caves, winter roosts and other significant roost sites;
- Ensure any fencing and gating of roosts is done in a bat friendly manner allowing adequate entrance and exit space for all species using the roost;
- Check with OEH before undertaking recreational caving activities;
- Ensure adequate foraging habitat is retained when undertaking hazard reduction activities, particularly during the breeding/reproduction season;
- Ensure appropriate hygiene protocols are implemented when undertaking research and survey work.

The majority of these actions are only relevant to sites containing known roosting areas for *M. schreibersii oceanensis*. The proposal is unlikely to compromise the listed priority action statements.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction in hunting habitat for *M. schreibersii oceanensis*.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox may have some impact around maternity caves, winter roosts and roosts within culverts, tunnels and under bridge. No suitable roosting habitat was considered to be present within the study area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The Feral Cat may have some impact around maternity caves, winter roosts and roosts within culverts, tunnels and under bridge. No suitable roosting habitat was considered to be present within the study area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: Large scale wildfire or hazard reduction can impact on foraging resources. Fire also has the potential to impact roost sites.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on this microchiropteran bat species by increasing the intensity and frequency of Bushfires and droughts.

Other threats include:

- Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic;
- Destruction of caves that provide seasonal or potential roosting sites;
- Changes to habitat, especially surrounding maternity/nursery caves and winter roosts;
- Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals;
- Introduction of exotic pathogens such as the White-nosed fungus.

Bibliography:

Churchill, S. (2008). *Australian Bats*. Allen & Unwin, Crows Nest, Australia.

Parnaby, H. (1992). *An Interim Guide to Identification of Insectivorous Bats of South-eastern Australia*. Technical Reports of the Australian Museum, Sydney.

Wildthing Environmental Consultants (2009). *Statement of Effect on Threatened Flora and Fauna for a proposed depot site Lot 10 DP 1071458 Nelson Bay Road, Bobs Farm NSW.* Hay Enterprises NSW Pty. Ltd.

Flora species considered to have potential habitat within the study area:

14. Orchids

Diuris praecox **Newcastle Doubletail**

Description

Diuris praecox is a terrestrial orchid with 6 – 10 yellow flowers with a few dark brown markings on the base of the labellum and dorsal sepal. This species has two or three linear leaves up to 400mm long.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.
ROTAP – 2VC-

Habitat Requirements and Ecology

This species grows in coastal areas in eucalypt forest, often on hilltops or slopes. Is an early-flowering species, flowering July to early August.

Distribution

This species is known from coastal areas between Ourimbah and Nelson Bay.

Corybas dowlingii **Red Helmet Orchid**

Description

Corybas dowlingii is a tuberous orchid species, with a leaf that is dark green above and slightly reddish beneath. The flower is erect and dark reddish with whitish areas within the labellum.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.

Habitat Requirements and Ecology

Forms colonies and typically grows in gullies in tall open forest on well-drained gravelly soil at elevations of 10-200m. Flowering period June – August.

Distribution

Is restricted to New South Wales where it is currently known from 4 localities including Port Stephens (2 localities), Bulahdelah and Freemans Waterhole south of Newcastle. A population is known from Port Stephens at Stoney Ridge Reserve Soldiers Point.

Cryptostylis hunteriana **Leafless Tongue Orchid**

Description

Cryptostylis hunteriana is a distinctive species recognised by its leafless habit and reddish black hairy labellum with a central, raised, hairy callus.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Endangered

Habitat Requirements and Ecology

This species is a saprophyte, which grows in small, localised colonies on flat plains close to the coast. This species has also been recorded in mountainous areas growing in moist depressions as well as in swampy habitats. Flowering time is December - February.

Distribution
The Leafless Tongue Orchid occurs from the Gibraltar Range (N.S.W) to eastern Victoria.

Pterostylis chaetophora **Tall Rustyhood**
Description
Pterostylis chaetophora is a terrestrial orchid with a slender flowering stem to 40 cm with up to 5 closely sheathing stem leaves. The flowers are 1.5 cm long, semi-erect, transparent with red-brown suffusions.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.

Habitat Requirements and Ecology
The preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey. Flowers from September to November.

Distribution
Recorded in Queensland and NSW. In NSW it is currently known from 18 scattered locations in a relatively small area between Taree and Kurri Kurri, extending to the south-east towards Tea Gardens and west into the Upper Hunter, with additional records near Denman and Wingen.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *Diuris praecox* (Newcastle Doubletail), *Corybas dowlingii* (Red Helmet Orchid), *Cryptostylis hunteriana* (Leafless Tongue Orchid) nor *Pterostylis chaetophora* (Tall Rustyhood) were recorded within the study area despite targeted and incidental surveys.

Diuris praecox (Newcastle Doubletail)
Although not recorded within the study area a number of flowering specimens of *D. praecox* were found to occur outside the study area approximately 200m to the west within the electricity easement. A total of 72 specimens of *D. praecox* were recorded during targeted surveys in 2017 to the west of the study area within the easement of Lot 255 (Appendix I). The location of *D. praecox* was found to be consistent with the local mapping completed for the Electricity Supply Upgrade from Tomago to Tomaree (ERM, 2003). The mapping contained within the ERM, 2003 report showed populations of *D. praecox* occurring within the electricity easement to the east of the study area and to the west over Nelson Bay Road.

Within the study area preferred habitat was present within open areas dominated by native grasses with no canopy or shrub layer. The area of most suitable habitat was contained within the maintained electrical easement. Suitable habitat was also considered to be present within areas of Coastal Sand Apple Blackbutt Forest with a sparse canopy and understorey cover.

The proposed sand mine will result in the removal of areas of suitable habitat for *D. praecox*, however considering the absence of this species within the study area during targeted searches the proposal is unlikely to cause extinction of the local population of *D. praecox.*

Corybas dowlingii (Red Helmet Orchid)
On the Tomaree peninsula population *C. dowlingii* is known from Soldiers Point within Stoney Ridge Reserve (Okada, 2006) and smaller areas such as a small remnant adjacent to Soldiers Point Bowling Club (Wildthing Environmental Consultants, 2012). Here the preferred habitat for *C. dowlingii* is a ground is covered with the needles of *Allocasuarina torulosa* (Forest Oak), and with *Corymbia gummifera* (Red Bloodwood), *Angophora costata* (Smooth-barked Apple) and *Eucalyptus racemosa* (Scribbly Gum) growing areas. These two areas were also characterised by soils associated with Nerong Volcanics which were absent from the study area. Whilst some suitable habitat for *C. dowlingii* within the study was considered to be present within areas of Coastal Sand Apple Blackbutt Forest area no preferred habitat was likely to be present. Considering the absence of this orchid species from within the study area the proposal is unlikely to cause extinction of the local population of *C. dowlingii*.

Cryptostylis hunteriana (Leafless Tongue Orchid)
Locally *C. hunteriana* is known to occur at Lemon Tree Passage, Salt Ash and Nelson Bay. A major population of this species was located at Bulahdelah within the Bulahdelah Bypass area where the largest population has been found (Parson Brinckenoff, 2004). Suitable habitat was considered to be present within areas of Coastal Sand Apple Blackbutt Forest however, as the local populations of *C. hunteriana* are found on Carboniferous sediments associated with low hills (deLacey, et al, 2012) and taking into consideration the absence of records within similar habitat to the study area along the dunal forests of the Stockton Bight the proposal is unlikely to cause extinction of the local population of *C. hunteriana.*

Pterostylis chaetophora (Tall Rustyhood)
A large population of *Pterostylis chaetophora* (Tall Rustyhood) is known to occur approximately 20km to the west of the study area near Grahamstown Dam within Sclerophyll Forest containing canopy species such as *Eucalyptus fibrosa* (Broad-leaved Ironbark) and *Eucalyptus tereticornis* (Forest Red Gum), with a small tree layer of *Melaleuca nodosa* (Ball Honey-Myrtle)(*pers.com* Steve Lewer, OEH 2017). Considering *P. chaetophora* was not recorded within the study area during targeted and incidental surveys and taking the differences in habitat type between the study area and known nearby habitat the likelihood of this orchid species being present within the study area would be greatly reduced, therefore the proposal is unlikely to cause extinction of the local population of *P. chaetophora.*

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for these threatened orchid species:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;

The proposal is not likely to fragment or isolate any specimens of the addressed orchid species.

The proposed sand mine may result in an incremental loss of habitat within the local area however it is unlikely that an area of habitat important to the long-term survival of these orchid species will be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for these threatened orchid species. However, the OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these flora species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for these orchid species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of habitat is one of the main threats for these orchid species. No known area of habitat for these orchid species will be removed;
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: Depending on the frequency and intensity of a fire both positive and negative outcomes can result for these orchid species. Regular low intensity burns outside the flowering period from winter to spring when the orchid is saprophytic (feeding on dead or decaying organic matter) can help by reducing weed species and opening up the surrounding habitat to reduce the orchids competition for sunlight. Infrequent high intensity burns can have a negative effect by detrimentally altering the environment for the orchid and killing orchid bulbs close to the surface. It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. The proposal is unlikely to result in a change in the frequency of fire in the local area.

- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush).** Bitou Bush was present within the study area. Bitou bush impacts on other plant species through increased competition, shade and litter level.
- ***Lantana camara* (Lantana):** Lantana was found to be present within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within the site. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be minimised.
- **Invasion of native plant communities by exotic perennial grasses:** A number of exotic perennial grasses were present within the easement within the site where specimens of D. arenaria were recorded. Grasses of particular concern were *Andropogon virginicus* (Whiskey Grass) *Anthoxanthum odoratum* (Sweet Vernal Grass), *Eragrostis curvula* (African Love Grass) and *Melinis repens* (Red Natal Grass). Another introduced grass species *Hyparrhenia hirta* (Coolatai Grass) is becoming prevalent within the local area and has the potential to significantly impact areas of known habitat.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these orchid species by increasing the intensity and frequency of Bushfires.

Other threats

- **Inappropriate activities** Inappropriate slashing regimes during flowering periods.

Bibliography:

deLacey, C., Bell, S., Chamberlain, S. (submitted 2012). *Prediction and realised habitat for a criptic plant species: the Leafless Tongue Orchid Cryptostylis hunteriana* Nicholls. *Cunninghamia*.

Harden, G. (2000*) (Revised Ed). Flora of NSW - Vol. 1*-4. New South Wales Uni Press, Sydney.

Jones, D,.J. (2006). *A Complete Guide to Native Orchids of Australia including the Island Territories.* New Holland Publishers Australia Pty Ltd.

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15. Wetland Plants

Maundia triglochinoides

Description

Maundia triglochinoides, of the family Juncaginaceae, is a perennial aquatic plant with emergent tufts of leaves arising along the length of the rhizomes. These leaves are triangular in cross-section up to 80cm long, 5-10mm wide and are confusable with the leaves of more common species such as *Phylidrum lanuginosum* (Woolly Frogsmouth) and *Triglochin procerum* (Water Ribbons). The carpels are 6-8mm long, each with a spreading beak and flowers during the warmer months. The single member of the *Maundia* genus, it is endemic to Australia.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.
This species has not been ROTAP-listed.

Habitat Requirements and Ecology

It grows in swamps or in shallow fresh water on heavy clay soils.

Distribution

Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong. Is now considered to be extinct around Sydney.

Persicaria elatior **Tall Knotweed**

Description

Persicaria elatior (Tall Knotweed), a member of the Polygonaceae family, is an erect, branched herb up to 1m tall. It has narrowly oval leaves and a loose papery tube around the stem where the leaves attach. It produces pink flowers which are held in dense long spikes, and develops into black, shiny lentil-shaped nuts (NPWS, 2002)

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.
This species is ROTAP-coded 3V

Habitat Requirements and Ecology

Persicaria elatior occurs in damp places such as swamps and margins of dams.

Distribution

It is distributed throughout Queensland and eastern NSW.

Zannichellia palustris

Description

A submerged aquatic plant. Leaves 2-7 cm long by less than 1 mm wide (OEH Profile 2017)

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.
This species is ROTAP-coded 3V

Habitat Requirements and Ecology

Grows in fresh or slightly saline stationary or slowly flowing water. Flowers during warmer months. NSW populations behave as annuals, dying back completely every summer.

Distribution
In NSW, known from the lower Hunter and in Sydney Olympic Park.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *Persicaria elatior, Maundia triglochinoides* nor *Zannichellia palustris* were recorded within the study area during fieldwork. Marginal habitat was considered to be available for both species within the areas of Freshwater Wetland and Swamp Forest that contained surface water. Locally *P. elatior* is known from the Tomago Sandbeds. *M. triglochinoides* occurs within drainage canals at Williamtown and Medowie. *Zannichellia palustris* has been recorded at Hexham Swamp. The proposed sand mine will not result in the removal of any suitable habitat for either of these aquatic flora species. As *M. triglochinoides, P. elatior* and *Z. palustris* have not been recorded within the study area the proposal is unlikely to cause extinction of these wetland flora species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed sand mine will not result in the removal of any suitable habitat for either *M. triglochinoides, P. elatior* or *Z. palustris.* Given the recommendations pertaining to the area of Freshwater Wetland and Swamp Sclerophyll Forest the proposal is not likely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long-term survival of either of these aquatic species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for either *M. triglochinoides* or *P. elatior.* However the OEH has prepared Priority Action Statements (PAS) to promote the recovery of this species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these plants recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for this species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. No suitable habitat for either of these species will be removed as a result of the proposal.
- **Invasion of native plant communities by exotic perennial grasses:** Introduced grasses such as *Paspalum urviillei* (Vasey Grass) were present within areas of suitable habitat. Exotic grasses have the potential to further invade parts of the study area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused to the study area.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera*: (Bitou Bush).** Bitou Bush was present within the study area. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation regardless of the proposal. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be reduced.

Bibliography:

Briggs, J.D. and Leigh, J.H. (1995). *Rare or Threatened Australian Plants*. CSIRO Publishing, Victoria.

Carolin, R.C. and Tindale, M.D. (1993*). Flora of the Sydney Region (4th edn.).* Reed, Sydney.

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16. Tree and Shrub Species

Callistemon linearifolius **Netted Bottlebrush**

Description

This shrub is up to 3-4 m tall, with linear (long and narrow) to linear-lanceolate (lance shaped) leaves 8-10 cm long, and 5-7 mm wide with a sharp tip, thickened margins, and distinct lateral veins. The brushes (flowers) are red and usually 9-10 cm long and approximately 50 mm in diameter. The stem upon which the filaments occur are covered in a soft downy hair at flowering. The seed capsules are approximately 7 mm in diameter.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not currently listed.
ROTAP – 2VCi

Habitat Requirements and Ecology

Grows in dry sclerophyll forest on the coast and adjacent ranges. Flowers spring – summer.

Distribution

Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW.

Eucalyptus parramattensis **subsp.** ***decadens*** **(Drooping Red Gum)**

Description

Eucalyptus parramattensis subsp. *decadens* (Drooping Red Gum) is a small smooth-barked eucalypt from the red gum family.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable
ROTAP – 2V

Habitat Requirements and Ecology

It occurs in woodland on sandy soils in wet sites. Any occurrences are likely to be restricted to areas along riparian vegetation strips or within close proximity to the water table. In the Port Stephens area, the Drooping Red Gum occurs in open wet sclerophyll woodland on heavy, often waterlogged, interbarrier depression soils. It is distinguished from *E. p. parramattensis* by the larger fruit, which are greater than 7mm in diameter. It is commonly associated with *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany). This sub-species is ROTAP listed 2V.

Distribution

Eucalyptus parramattensis ssp. *decadens* is endemic to the Hunter Region. There are two metapopulations present in the region, one on the Tomago Sandbeds and the other in the Cessnock-Kurri area.

Melaleuca biconvexa **Biconvex Paperbark**

Description

M. biconvexa is a shrub to small tree with papery bark which flowers in summer.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
It may occur in dense stands adjacent to watercourses, in association with other *Melaleuca* species or as an understorey species in wet forest. Present populations are threatened by land clearing, filling, excavation for construction of floodwater detention basins and alteration to water tables. This species is not ROTAP-listed.

Distribution
Melaleuca biconvexa occurs in disjunct populations in coastal NSW from Jervis Bay to Port Macquarie with the main concentration of records in the Gosford/Wyong Area.

Syzygium paniculatum **Magenta Lilly Pilly**
Description
The Magenta Lilly Pilly is a small to medium sized rainforest tree that grows to 8 m tall. The bark is flaky and the leaves are shiny, dark-green above and paler underneath. Leaves can be up to 10 cm long. The deep magenta fruits, which may be spherical or egg-shaped, mature in May, and contain a single seed.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.
ROTAP – 3VCi

Habitat Requirements and Ecology
On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.

Distribution
The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Despite targeted and incidental surveys neither *Callistemon linearifolius*, *Eucalyptus parramattensis* subsp. *decadens*, *Melaleuca biconvexa* or *Syzygium paniculatum* were recorded within the study area.

Callistemon linearifolius (Netted Bottlebrush)
Within the Port Stephens LGA *C. linearifolius* is known to occur at Stoney Ridge Reserve at Soldiers Point and within the Karuah area. Within these areas the soils consist of loam clay bedding on volcanic rocks (Okada, 2006). Suitable habitat was thought to be present within the areas of Coastal Sand Apple Blackbutt Forest and around the periphery of the two areas of swamp forest, however no preferred habitat was considered to be present.

Eucalyptus parramattensis subsp. *decadens* (Drooping Red Gum)
Within the Port Stephens LGA *E. parramattensis* subsp. *decadens* is known from Tomago, Williamtown and Salamander Bay. Within the study area marginal habitat was considered to be present within areas of Swamp Sclerophyll Forest.

Melaleuca biconvexa (Biconvex Paperbark)
Suitable habitat for *M. biconvexa* within the study area was considered to be present within areas of Swamp Sclerophyll Forest. No known records of *M. biconvexa* for found within proximity to the study area.

Syzygium paniculatum (Magenta Lilly Pilly)
Within the study area suitable habitat was considered to be present within the area of Flooded Gum Forest and more sheltered areas of Coastal Sand Apple Blackbutt Forest. Few local records of *S. paniculatum* are known from the local area.

The proposed sand mine will result in the removal of marginal habitat for *C. linearifolius* and *S. paniculatum*. No suitable habitat is required to be removed for either *E. parramattensis* subsp. *decadens* or M. *biconvexa*. As none of these four species were recorded within the study area or within the immediate proximity the proposal is unlikely to cause extinction of these wetland flora species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for *S. paniculatum* and *C. linearifolius*:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest (only more sheltered areas for *S. paniculatum*);

No suitable habitat for either *E. parramattensis* subsp. *decadens* or *M. biconvexa* will be removed. The proposed sand mine may result in an incremental loss of marginal habitat within the local area for *C. linearifolius* and *S. paniculatum*, however is unlikely that an area of habitat important to the long-term survival of these orchid species will be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for these four species. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help this species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for this species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area and subject site for this species have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal/modification habitat for the proposal is not considered to be significant for these flora species.
- **Invasion of native plant communities by exotic perennial grasses:** Introduced grasses such as *Andropogon virginicus* (Whisky Grass) were present within the more disturbed areas of the study area. These grasses have the potential to further invade parts of the study area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused to the study area.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera*: (Bitou Bush).** Bitou Bush was present within the study area. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation regardless of the proposal. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be reduced.

Bibliography:

Harden, G.J. (ed.) (2002) *Flora of New South Wales* Volume 2 Revised Edition. UNSW, Sydney.

NSW Scientific Committee (1999) *Callistemon linearifolius* (a shrub) - Vulnerable species determination - final. DEC (NSW), Sydney.

NSW Scientific Committee (1998). *Final Determination to list Melaleuca biconvexa* as *a Vulnerable Species*, at 'http://www.nationalparks.nsw.gov.au'.

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17. Other flora species

Cynanchum elegans **White-flowered Wax-plant**

Description

Cynanchum elegans, a member of the Asclepiadaceae family is an evergreen vine which grows to 10m in length. The stems and branches are corky. The leaves are opposite.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Endangered.
ROTAP – 3ECi

Habitat Requirements and Ecology

This climber grows mainly in dry vine thickets on richer clay-shales and fertile volcanic soils. Has also been recorded in littoral rainforests, open forest and on sand. It flowers in summer (November – March) producing clusters of white, tubular and lobed flowers.

Distribution

Cynanchum elegans is endemic to New South Wales and occurs from Gloucester to the Illawarra areas. Records are known from the Kooragang Wetlands.

Lindernia alsinoides **Noah's False Chickweed**

Description

Diffuse or erect often multi-stemmed annual herb to 30cm in height. Leaves are opposite, 5-10 mm long and 1.5-5 mm wide, oval-shaped to more or less circular at the base of the plant and almost linear near the flowers. There are 3 veins from the base of the leaf. The leaf stalk is 3 mm long. There are 1-8 blue flowers, approximately 5.5-8.5 mm long. Flowers have been recorded in November.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

Grows in swampy sites in sclerophyll forest and coastal heath. Often found around the edges of dunal Swamp Sclerophyll Forest communities that fringe freshwater wetlands and within regenerating Swamp Sclerophyll Forest that have been subject to disturbance events.

Distribution

Has been recorded from Port Stephens, Great Lakes and Greater Taree Councils. It has been recorded as far south as Williamtown.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *Cynanchum elegans* nor *Lindernia alsinoides* were recorded within the study area during fieldwork.

Cynanchum elegans (White-flowered Wax-plant)

According to the Atlas of NSW database (OEH, 2015) local records for *C. elegans* are known from

the Kooragang Wetlands. Marginal habitat within the study area for *C. elegans* was considered to be confined to more sheltered areas such as the area of Flooded Gum Forest. As this flora species was not recorded within the study area and no preferred habitat is likely to be removed the proposal is unlikely to cause extinction of this threatened flora species in the locality.

Lindernia alsinoides (Noah's False Chickweed)
Suitable habitat for *L. alsinoides* was considered to be present in and around the two areas of Swamp Forest. Due to the close proximity of the proposed sand mine there is the potential for secondary impacts such as groundwater level changes and increased weed infestation. As *L. alsinoides* was not recorded within the locality and given the recommendations pertaining to groundwater monitoring and sediment control the proposal is unlikely to cause extinction of these wetland flora species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No area of habitat for neither *C. elegans* nor *L. alsinoides* is likely to be removed or modified as a result of the proposal. As a result of the close proximity of the facility to suitable habitat for *L. alsinoides* there is the potential for secondary impacts such as groundwater changes and increased weed infestation. The proposal unlikely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long-term survival of these three flora species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for *L. alsinoides* or *C. elegans.* The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help *L. alsinoides* or *C. elegans* recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for this species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal/modification habitat for the proposal is not considered to be significant for these flora species.
- **Invasion of native plant communities by exotic perennial grasses:** Introduced grasses such as *Andropogon virginicus* (Whisky Grass) were present within the more disturbed areas of the study area. These grasses have the potential to further invade parts of the study area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused to the study area.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush).** Bitou Bush was present within the study area. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation regardless of the proposal. Given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be reduced.

Bibliography:

Briggs, J.D. and Leigh, J.H. (1995). *Rare or Threatened Australian Plants*. CSIRO Publishing, Victoria.

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Fairley, A. (2004). *Seldom Seen, Rare Plants of Greater Sydney*. New Holland Publishers (Australia) Pty Ltd.

Harden, G. (Ed) (1992). *Flora of NSW - Vol 3.* New South Wales Uni Press, Sydney.

Fauna species considered to have potential habitat within the study area:

18. Invertebrates

Petalura gigantea **Giant Dragonfly**

Description

The *Petalura gigantea* Giant Dragonfly is the second largest Dragonfly in Australia with the adult stage having a wingspan of more than 13cm and a body length of up to 14.5cm (NSW National Parks and Wildlife Service.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

Inhabits boggy seepages and swamps between and altitude of 0 – 1150m (Theischinger, & Hawking, 2006). The larvae live in permanent long chambered burrows up to 1.5m long built under swamps and emerge from terrestrial entrances above water level at night to feed. The larval stage is considered to take from 10 to 30 years and the adults emerge from October to November and fly until late January. The adults however have a very limited dispersal due to a poor flying ability.

Distribution

This dragonfly species was known to occur in SE Australia, from Moss Vale to southern Queensland. A population of the Giant Dragonfly is known from Wingecarribee Swamp south-west of Sydney. This species has been recorded at Chittaway Point on the Central Coast (Wyong Shire Council, 1999) and within the in the vicinity of Horizons Golf Course Salamander Bay in 2006 (DECC Database).

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

No large adult dragonflies consistent with *Petalura gigantea* (Giant Dragonfly) were recorded within the study area during incidental surveys. No large Nymph body shells were observed on vegetation within the areas of Swamp Forest or Freshwater Wetland. The surveys were undertaken within the time when this species would be considered to have emerged from its larval form (October to late January). The Giant Dragonfly has been recorded within Mambo Swamp on the southern shore of Port Stephens (OEH, 2012). Suitable habitat was considered to be present within the area of Freshwater Wetland and wetter areas of swamp forest. The proposal will not directly impact on any area of suitable habitat for the Giant Dragonfly. Secondary impacts such as changes in groundwater levels and increased weed infestation have the potential to impact on these species. Given the recommendations the proposal is unlikely to cause extinction of this Dragonfly species in the locality.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Considering the area of freshwater wetland and two areas of Swamp Sclerophyll Forest will not be directly impacted by the mining footprint and that the forecast drop in the groundwater level is unlikely to have any significant impact on this endangered ecological community it is unlikely that an area of important habitat to the long-term survival of the Giant Dragonfly will be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the Giant Dragonfly. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help this Dragonfly recover in NSW. Actions pertinent to the site include:

- The maintenance of the hydrological regime of Swamp Forest Habitat.
- Prevent erosion and subsequent erosion of suitable habitat.

Provided the recommendations are adhered to it is unlikely that the proposal will significantly compromise the Priority Action Plans.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. It is not considered to be significant in relation to this Dragonfly species.
- **Predation by the European Red Fox *Vulpes vulpes*:** The Red Fox was recorded within the study area and may be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **Predation by the Feral Cat *Felis catus.*** The Feral Cat was recorded within the study area at the time of the survey however would be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: Past fires were evidenced by a number of blackened tree trunks. It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area.

Other pertinent threats include the reduction in water quality within swamps the use of chemical such as herbicides or insecticides within or near swamps.

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19. Frogs

Crinia tinnula **Wallum Froglet**

Description

Crinia tinnula (Wallum Froglet) is a small frog with a highly variable colouration and pattern. The snout is pointed in profile and projects beyond the lower jaw. It can be described as having a white or light brown belly with a little mottling or flecking and a mid line of white dots along the throat.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology

The Wallum Froglet is an inhabitant of shallow acid swamps (temporary / semi-permanent) and associated connecting channels and deeper water holes (permanent) (pH < 6.0). The vegetation type in these areas consists of hard-leafed heaths, shrubs and woodland on coastal plains and dunes and associated sedgelands and swamps in low lying areas collectively known as wallum. This frog is a winter breeder with females laying approximately 120 eggs. Males are vocal between May and September making identification of the species at this time easier. Due to the morphological similarities with *C. signifera*, positive identification of *C. tinnula* is usually by call. The call of the male is described as being a bell like tinkling: "tching.....tching".

Distribution

The Wallum Froglet has a distribution range from Maryborough in Queensland south to Kurnell near Sydney. Large populations have been recorded in the Myall Lakes and Tomaree National Parks.

Litoria aurea **Green & Golden Bell Frog**

Description

The Green and Golden Bell Frog belonging to the Tree Frog Family Hylidae is a relatively large robust frog with a variable dorsal colouration of vivid pea green splotched with almost a metallic brass brown or gold. Adult size ranges from approximately 45mm to 100mm long (Department of Environment and Conservation NSW, 2005). Males are generally smaller than females.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Listed as Vulnerable.

Habitat Requirements and Ecology

This frog species inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. The Green and Golden Bell Frog is a summer breeder and voraciously cannibalistic. The males call from August through to January using a distinctive four part call: "crawk-awk, crawk, crok, crok". The common name of *L. aurea* is derived from its body colouration described as being dull olive to bright emerald green above with blotches of brown or golden-bronze.

Distribution

Litoria aurea was formerly known to inhabit the eastern seaboard of New South Wales and Victoria from Byron Bay through to the Gippsland Lake Region as well as highland sites (New England District, south-western slopes of N.S.W. and Monaro District). Recent literature indicates that the northern and southern distribution limits have not changed, however, *L. aurea* is no longer found on sites above an altitude of 300m above sea level.

Litoria brevipalmata **Green-thighed Frog**

Description

Litoria brevipalmata (Green-thighed Frog) is a ground dwelling frog approximately 40mm in length. It has chocolate brown on its back with black flecks. A dark stripe runs from the snout, through the

eye and tympanum, breaking up into blotches down the side of the body. The upper lip has a white edge which continues to the base of the arm. The sides of the body are yellowish with black flecks. The groin and the backs of the thighs are bright blue, green or blue-green with black spots. The belly is granular and white or yellow. The skin on the back is smooth to slightly granular. The finger and toe pads are medium sized, and the toes are one-third webbed.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed

Habitat Requirements and Ecology
Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. Breeding occurs following heavy rainfall in late spring and summer, with frogs aggregating around grassy semi-permanent ponds and flood-prone grassy areas. The frogs are thought to forage in leaf-litter.

Distribution
Inhabits the costal zone from south-eastern Queensland to Ourimbah on the Central Coast of NSW.

***Uperoleia mahonyi* (Mahony's Toadlet)**

Description
Mahony's Toadlet is a small (males 30 mm, female 32 mm) but robustly built frog. This species is most easily distinguished from other Uperoleia species by a black and white belly pattern that appears marbled or blotched (rather than numerous small dots or specs) and the lack of colour patch below the knee. Groin and thigh colour patches are orange. Tadpoles are indistinguishable from those of other Uperoleia species. The advertisement call is a single audible sound described as a "squelch".

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed

Habitat Requirements and Ecology
Inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range. Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps, Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species.

Distribution
Endemic to the mid-north coast of New South Wales (NSW) and to date has been found between Kangy Angy and Seal Rocks

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *C. tinnula, L. aurea, L. brevipalmata* nor *U. mahonyi* were recorded within the study area despite targeted surveys. Additional surveys for *U. mahonyi* were also undertaken by Dr Simon

Clulow in November 2017.

Suitable habitat for *C. tinnula* was contained within the area of Freshwater Wetland and to a lesser extent within the two areas of Swamp Sclerophyll Forest. *Crinia tinnula* is known to occur locally within acid swamps. The pH within the area of freshwater wetland was tested using a Horiba U 50 Water Meter (on 30-05-14) and was found to be around 6.2. This was a little high for *C. tinnula* and would likely explain the large number of calls from *Crinia signifera* (Common Eastern Froglet) at the time which prefer a more neutral pH.

Suitable habitat for *L. aurea* was contained within the area of Freshwater Wetland and to a lesser extent within the two areas of Swamp Sclerophyll Forest. Recent local records for *L. aurea* occur at Kooragang Island, Medowie (Umwelt, 2006) and Broughton Island (OEH, 2015).

Habitat for *L. brevipalmata* was available within the areas of freshwater wetland, swamp sclerophyll forest as well as the area of Flooded Gum Forest. No records for *L. brevipalmata* were found to occur within proximity to the study area (OEH, 2017).

The surveys undertaken by Dr Simon Clulow for *U. mahonyi* in November 2017 were conducted following rain within areas of Freshwater Wetland and Swamp Sclerophyll Forest in the north-east of the site which were considered to be the most likely habitat for *U. mahonyi*. A visit to the reference site at Oyster Cove (type locality for *U. mahonyi*) on 7 November 2017 found no specimens of *U. mahonyi* to be calling. A visit to the reference site at Oyster Cove on 9 November 2017 found 3-4 specimens of *U. mahonyi* to be calling intermittently. Areas of Freshwater Wetland and Swamp Sclerophyll Forest contain suitable habitat for *U. mahonyi.* Recent studies have also suggested that areas of adjacent intact vegetation to waterbodies may also be an important habitat feature for *U. mahonyi*. Areas of Coastal Sand Smooth-barked Apple Blackbutt Forest surrounding the areas of Freshwater Wetland and Swamp Sclerophyll Forest within the study area may contain suitable habitat.

Given the recommendations the proposal is unlikely to cause extinction of these frog species in the locality.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

No suitable habitat for these frog species will be removed as a result of the proposal.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No areas of suitable habitat will become fragmented or isolated as a result of the proposal.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

As *C. tinnula, L. aurea, L. brevipalmata* nor *U. mahonyi* were not recorded within the study area and taking into consideration the lack of recent local records no areas of habitat important to the long-term survival of these frog species are likely to be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

To date no Critical Habitat, as defined under Part 3 of the TSC Act has not been declared for either of these frog species.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Draft Recovery Plan has been developed for *L. aurea*. Objectives include:

- To avoid direct impacts and retain habitat;
- Minimise impacts where ever possible;
- Mitigate or ameliorate impacts; and as a last resort;
- Compensate or offset for any unavoidable impacts.

Given the lack of known key populations in the immediate locality it is considered that the proposal development will not significantly conflict with this draft recovery plan.

No Recovery or Threat Abatement Plans have been developed for *L. brevipalmata, C. tinnula* or *U. mahonyi*. However, the OEH has prepared Priority Action Statements (PAS) to promote the recovery of this frog species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these species recover in NSW.

Habitat management for *Crinia tinnula*

- Control, and where practicable, eradicate the Plague Minnow in accordance with approved Threat Abatement Plan;
- Protect swamps from fire;
- Control stormwater, drainage, groundwater extraction and associated changes in water chemistry, pH, quality and quantity that may adversely impact on habitats and/or species populations;
- Control invasion of weeds that may adversely impact on Wallum habitats.

It is considered that the proposal does not conflict with the PAS for these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to this site and species have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. Any future removal of vegetation particularly within the wetter areas of swamp forest may result in an incremental reduction in habitat for these species in the local area and may be viewed as being part of this Key Threatening Process. However, it is not considered to be significant in relation to these frog species.
- **Predation by *Gambusia holbrooki* (Plague Minnow):** This species of fish was not observed during the survey. This is most probably due to the ephemeral nature of the wetland. The proposal is not likely to increase the likelihood of this fish species.
- **Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis:** It is possible that this fungus has an impact on frogs in the local area. The proposal is unlikely to have any impact on this threatening process.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the site. Past fire within the study area was evidenced by blackened parts of tree trunks. The proposal is considered to have little impact on fire frequency.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these frog species. The proposal is unlikely to significantly contribute to Climate Change.

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20. Arboreal Reptiles

Hoplocephalus bitorquatus **Pale-headed Snake**

Description

The Pale-Headed Snake is a medium-sized largely tree-dwelling snake to 90 cm long. It is a uniform light brown or grey above with a white or cream band on the nape, bordered by a narrow blackish bar which may be solid, or broken in the middle. The top of the head is grey, and may have a series of black spots, which are most prominent along the edge of the white nape. The lips may have black vertical bars. The belly is creamy grey sometimes with darker flecks.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology

The Pale-Headed Snake is found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Favours streamside areas, particularly in drier habitats. This snake shelters during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. The main prey is tree frogs although lizards and small mammals are also taken.

Distribution

A patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah.

Hoplocephalus stephensii **Stephen's Banded Snake**

Description

Stephens' Banded Snake is a medium-sized partly tree-dwelling snake up to one metre long. It is brown or yellow-brown above, with a series of irregular, broad, dark crossbands. The head is black with a brown crown and a brown or cream patch on either side of the nape and the lips are barred with black and cream.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed

Habitat Requirements and Ecology

Stephen's Banded Snake is found in rainforest and eucalypt forests and rocky areas up to 950 m in altitude. This nocturnal snake shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day. At night it hunts frogs, lizards, birds and small mammals.

Distribution

Coast and ranges from Southern Queensland to Gosford in NSW.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *Hoplocephalus bitorquatus* (Pale-headed Snake) nor *Hoplocephalus stephensii* (Stephen's

Banded Snake) were noted within the study area. Suitable habitat for both snakes was found to be present within the open forest assemblages. According to the Atlas of NSW Wildlife (OEH, 2015) there were no records for either snake species within the locality. A large amount of shelter habitat was present with 1217 hollow-bearing trees being recorded within the study area. Many of these trees where considered to be significant as a result of their very large size and presence of suitably hollows for these reptile species.

The proposal will result in the removal of approximately 25.90ha of suitable habitat largely in the form of Coastal Sand Apple Blackbutt Forest containing suitable hunting and hollows for shelter. Approximately 877 hollow-bearing trees will require removal. The proposal will result in an incremental reduction of suitable habitat in the local area. However, considering the lack of local records the proposal is unlikely to cause extinction of these snake species in the locality.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for these two reptile species*:*

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees.

No areas of habitat are likely to become fragmented or isolated for these species. The proposal will result in a reduction of habitat, however considering the presence of large areas of similar habitat along Stockton Bight, no areas of habitat important to the long-term survival of either *H. bitorquatus* nor *H. stephensii* are likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

To date no Critical Habitat, as defined under Part 3 of the TSC Act has not been declared for these snake species.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plans have been developed for these two arboreal snakes. The Department of Environment and Climate Change has prepared Priority Action Statements (PAS) to promote the recovery of this frog species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these species recover in NSW. It is considered that the proposal does not conflict with the PAS for these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to this site and species have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. Any future removal of vegetation particularly within the wetter areas of swamp forest is likely to result in an incremental reduction in habitat for this species in the local area and may be viewed as being part of this Key Threatening Process. However, it is not considered to be significant in relation to these snake species.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. The proposal is unlikely to result in a change in the frequency of fire in the local area.
- **Loss of Hollow-bearing Trees***:* A number of hollow bearing trees will need to be removed within the area of open forest (approximately 877) resulting in an incremental reduction of this habitat resource in the local area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees will require removal as a result of the proposal.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for shelter. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on this microchiropteran bat species by increasing the intensity and frequency of Bushfires and droughts.
- **Predation by the European Red Fox *Vulpes vulpes*:** The Red Fox was recorded within the study area and may be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **Predation by the Feral Cat *Felis catus.*** The Feral Cat was recorded within the study area at the time of the survey however would be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.

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21. Waterbirds

Rostratula benghalensis australis **Australian Painted Snipe**

Description

The Australian Painted Snipe is a medium-sized freshwater wader with a long bill that drops slightly at the tip. It is strongly patterned and has fairly short legs.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.

Habitat Requirements and Ecology

It is usually found in pairs, frequenting the margins of swamps and streams, chiefly those covered with low and stunted vegetation. It probes in mud along the shore to gather snails, water insects and aquatic plants. When flushed, it flies close to the ground, making for the nearest cover, and is then exceedingly difficult to flush again. The Painted Snipe appears to be nomadic, with movements mainly north in winter and south in summer. It requires shallow fresh water for breeding, though the nest is not deserted if the water dries up. Nests are usually in groups, and consist of a shallow depression in the ground, lined with grass or leaves and frequently sheltered by a low bush or tuft of grass. Nests have been recorded at a density of 24 nests/ha but other smaller colonies have had distances of 15-50 m between nests.

Distribution

The better watered areas of Eastern Australian.

Botaurus poiciloptilus **Australasian Bittern**

Description

The Australasian Bittern is a large, stocky heron-like water bird with a long thin neck and long straight bill.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Australasian Bittern lives alone or in loose groups and favours permanent fresh-waters with tall dense vegetation dominated by sedges, rushes, reeds or cutting grasses (eg. Phragmites, Scirpus, Eleocharis, Juncus, Typha, Baumea and Gahnia). Breeding is sometimes loosely colonial but in other cases pairs have been observed to maintain territories when several are present in a reedbed. The Australasian Bittern feeds on insects, small fish, eels, frogs and other aquatic life, sometimes in ricefields. It is partly nocturnal in habits, and, keeping as it does to the depths of reedy swamps, is seldom seen during the day unless flushed. The breeding season is from October to January and it is during this time that the distinct 'booming' calls can be heard.

Distribution

Within Australia, the Australasian Bittern occurs in the south-east and south-west, as well as in Tasmania and is also known as a vagrant in the north-west of Australia. This species is probably sedentary in permanent habitat with possible regular short distance movements during winter and is occasionally irruptive following heavy rains and floods, or drought elsewhere.

Ixobrychus flavicollis **Black Bittern**

Description

The Black Bittern is a dark grey to black heron with buff streaks on the throat and a characteristic yellow streak on the sides of the head and down the neck.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
It is solitary, and inhabits terrestrial, littoral and estuarine wetlands, preferring areas of permanent water, which are lined by dense vegetation (Marchant and Higgins, 1990). This species has been known to occur in flooded grasslands, forest, woodland, rainforest and mangroves (Marchant and Higgins, 1990). In the south-west region it lives in vegetation such as paperbark woodland surrounding running water or coastal swamps. Pairs may be within hearing distance along a watercourse. The Black Bittern forages at the edge of running or still water, feeding on small fish and invertebrates. The nest consists of a platform of sticks placed in a tree, usually on a branch overhanging water with the breeding season from September to January. The decline of this species in the south-west region has coincided with increases in the rate of clearing for agriculture and in the salinity of streams.

Distribution
The Black Bittern lives in south-eastern Asia, New Guinea and western, northern and eastern Australia (chiefly coastal areas). In N.S.W. they are found coastally and around inland rivers, but rarely south of Sydney (Pizzey and Knight, 1997).

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither the Australian Painted Snipe, Australasian Bittern nor the Black Bittern were recorded within the study area during fieldwork. Suitable habitat was considered to be present around the low lying areas of freshwater wetland in the east of the study area. Habitat for these three bird species would be limited by the ephemeral nature of the wetland.

The construction of the intake and outtake pipes will involve the removal/disturbance of a narrow area of intertidal habitat. The inlet outlet pipes connecting the proposed facility to the waters of Port Stephens will also be required to cross the area of Swamp Forest habitat. To reduce this impact the pipelines will be raised up on supports north of the pumphouse within the area of swamp forest and maneuvered slightly to avoid the removal of any trees. Due to the close proximity of the proposed facility to suitable habitat there is the potential for secondary impacts such as stormwater runoff and increased weed infestation. Strict controls will have to be applied to the building precinct area to prevent any future degradation to the area of swamp forest. Any disturbance as a result of the construction of the pipelines is envisaged to only be short-term. Given the recommendations the proposal is unlikely to cause extinction of these waterbird species in the locality.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Considering the area of freshwater wetland will not be directly impacted by the mining footprint and that the forecast drop in the groundwater level is unlikely to have any significant impact on this community it is unlikely that an area of important habitat to the long-term survival of these wetland bird species will be removed, modified, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the study area has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for The Australian Painted Snipe, Black Bittern or Australasian Bittern. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of remnant vegetation within the study area may be viewed as being part of this Key Threatening Process however is unlikely to be significant in relation to these waterbird species.
- **Predation by the European Red Fox *Vulpes vulpes*:** The Red Fox was recorded within the study area and may be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **Predation by the Feral Cat *Felis catus.*** The Feral Cat was recorded within the study area at the time of the survey however would be considered to have an impact on native fauna in the

local area. The proposal is unlikely to result in an increase in the number of this introduced species.

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22. Fruit Doves

Ptilinopus magnificus **Wompoo Fruit-Dove**

Description

The Wompoo Fruit-dove is a large rainforest pigeon, almost twice the size of other coloured fruit-doves. It is up to 56 cm long, with a pale grey head shading into rich green back and wings. There is a broken yellow band across each wing. The breast and belly are plum-purple and the underparts are yellow.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology

This Fruit-Dove is a frugivorous Rainforest specialist inhabiting the canopy of Sub-tropical, Warm-temperate and Littoral Rainforests. Occasionally it will stray to fruiting trees outside of Rainforest areas. Breeding occurs between July and December and is linked to the fruiting cycles of favoured feed trees including Figs, Laurels, Myrtles and native Tamarind. The females lay one egg on a flimsy platform of vine tendrils on a slender horizontal branch. This species prefers relatively undisturbed to completely intact Rainforest.

Distribution

The Wompoo Fruit-Dove is distributed from Cape York (Qld.) along the coast and ranges south to the Hunter River (N.S.W.). The southern part of the species range has decreased, having once extended to the Shoalhaven River.

Ptilinopus regina **Rose-crowned Fruit-Dove**

Description

The Rose-crowned Fruit-doves is a small, colourful rainforest pigeon to 24 cm in length. Males have a rose crown edged with yellow, and the head and breast are blue-grey, spotted white. The upper parts are grey-green, the tail-tip yellow and the abdomen are orange. Females are mostly grey-green.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology

The Rose-crowned Fruit-Dove generally lives in Rainforest, though it also frequents nearby drier forests as well as Mangroves. It usually feeds on Figs or other fruit and berry-bearing trees. The breeding season is from October to February, with a flimsy nest being constructed of twigs on a scanty platform in a low tree or bush. A seasonal movement of birds from the southern end of the range to the north occurs in winter, whilst others have been found to move seasonally in relation to the availability of fruit, with distance and direction travelled varying from one year to the next. The call is a loud, explosive, repeated 'hookcoo' which becomes faster and on declining notes as a rapid 'coocoocoocoocoo'.

Distribution

The Rose-crowned Fruit-Dove occurs in Eastern Australia, from Cape York south to the vicinity of Port Stephens. Occasionally it extends into Victoria.

Ptilinopus superbus **Superb Fruit-Dove**

Description

The Superb Fruit-dove is a small pigeon, approximately 24 cm in length. The male is brightly coloured, with golden-green upperparts, a brilliant orange-vermilion neck, and a rich purple crown. The tail is short and tipped with white. The throat and breast are grey with a lilac tinge, and a broad black band on the lower breast separates the grey breast from the creamy-white belly and green

flanks. The female is light green on the back, has a small purple spot on the crown, and no dark breast band.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology
The Superb Fruit-Dove lives mainly in Rainforest but will feed in adjacent Mangroves or Eucalypt forest, venturing into coastal habitats at various times of the year, particularly during winter. Many winter-migrating birds in N.S.W often perish by flying into windows in residential areas (A. Morris, NSW FOC, pers. comm.). It usually feeds on Figs or other fruit-bearing trees. Breeding season is from October to February. The nest is usually a platform about 10cm in diameter, composed of a few twigs; built in a small tree on a horizontal fork, usually about 3 metres from the ground, and situated in Open Forest at the edge of scrub. The species may have one of the shortest nesting periods of any Pigeon, being perhaps no more than seven days. The call is a distinctive cooing, rising in pitch and volume to a loud and clear 'whoop, whoop'. Also gives a low 'oom' in a steady sequence.

Distribution
The Superb Fruit-Dove is quite common north of Cardwell, Queensland; becoming uncommon nomads or non-breeding migrants further south to the Hunter River, with rare sightings recorded south to Tasmania.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither the Wompoo, Rose-crowned nor Superb Fruit-Doves were recorded within the study area during the survey despite targeted and incidental searches. No areas of preferred habitat were found to be present within the study area. However, the study area was considered to contain secondary transitory and foraging habitat. The fruiting *Endiandra sieberi* (Corkwood) would be the most likely foraging species within this area.

The proposal will result in the removal of approximately 25.90ha of suitable habitat largely in the form of Coastal Sand Apple Blackbutt Forest containing suitable secondary for these Fruit-Dove species. The proposal will result in an incremental reduction of secondary habitat within the local area. Considering the lack of preferred habitat the proposal is unlikely to cause extinction of these snake species in the locality.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for these Fruit-Dove Species:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest containing secondary transitionary habitat.

The proposed sand mine will result in a small incremental reduction in transitionary and secondary foraging habitat, particularly in the form of a number of specimens of *E. sieberi*. Taking into consideration the relatively the high mobility of these birds, large amount of similar surrounding habitat and lack of preferred habitat within the study area the proposal is unlikely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long term survival of these three Fruit-dove species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the assessed Fruit-dove species. However, the OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help this species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor

contributing to the loss of biological diversity. The removal of remnant vegetation within the study area may be viewed as being part of this Key Threatening Process however is unlikely to be significant in relation to these Fruit-dove species.

- **Predation by the European Red Fox *Vulpes vulpes*:** The Red Fox was recorded within the study area and may be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **Predation by the Feral Cat *Felis catus.*** The Feral Cat was recorded within the study area at the time of the survey however would be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: Past fires were evidenced by a number of blackened tree trunks. Frequent fires can lead to a reduction in foraging habitat. It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area.

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23. Cockatoos & Parrots

Calyptorhynchus lathami **Glossy-Black Cockatoo**

Description

The Glossy Black-cockatoo is a dusky brown to black cockatoo with a massive, bulbous bill and a broad, red band through the tail.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology

The Glossy Black-Cockatoo inhabits Wet and Dry Sclerophyll Forests and Woodlands. It prefers highland habitats in the northern part of its range but may be found closer to the coast when and where conditions are suitable. In the south they are widespread in lowland coastal forests, dense mountain forests, semi-arid woodland and trees bordering watercourses.

Glossy Black-Cockatoos forage primarily on the seeds of (*Allo*)*Casuarina* species, but will also take wood borers from large *Acacia* stems. *Allocasuarina torulosa, A. verticillata* and *A. littoralis* are the predominant food trees in N.S.W. On Kangaroo Island, *Casuarina stricta* is the predominant food source. They have also been observed eating *Angophora, Acacia* and *Eucalyptus* seeds. It now appears to supplement its diet with the seeds of exotic pine trees. A sign that foraging individuals have recently fed at a site is a scattering of leaves, twigs and freshly chewed cones under the (*Allo*)*Casuarina* trees. While feeding they are tame and relatively easy to approach. Flocks of Glossy Black-Cockatoos have been seen but are not common. They are usually seen in pairs or threes (being a pair and their young), or as feeding groups consisting of 10-12 birds that are likely to be loose family aggregations. Such groups seem to occupy an area permanently and have a distinctive flight pattern of slow, shallow wing-beats. Nesting takes place from March to August in the hollows of large Eucalypts, 10-20m above the ground, where a single egg is laid.

Distribution

The Glossy Black-Cockatoo inhabits Sclerophyll Forests and Woodlands of eastern Victoria to central Queensland, extending to the western slopes in New South Wales. A subspecies, *C. l. halmaturinus* exists on Kangaroo Island, South Australia.

Callocephalon fimbriatum **Gang Gang Cockatoo**

Description

The Gang Gang Cockatoo is a small dark grey cockatoo. The males have a fiery red-head and raffish crest. Females have a grey head and crest.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology

In summer they are generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter they move to lower altitudes and drier more open eucalypt forests and woodlands, and often found in urban areas. In winter they show a preference for more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. Favours old growth attributes for nesting and roosting. Breeding usually occurs between October and January in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests. Nests are most commonly recorded in eucalypt hollows in live trees close to water.

Distribution

The Gang-gang Cockatoo is distributed from southern Victoria through south and central-eastern New

South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and southwest slopes. It is rare at its extremities of its range, with isolated records known from as far west as Mudgee.

Lathamus discolor **Swift Parrot**

Description

The Swift Parrot is most closely related to Rosellas, though its habits are most closely aligned with those of the Lorikeets, which it also resembles morphologically. The main distinction of the Swift Parrot is the long red tail that is not found in Lorikeets, which generally have dumpier green tails.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Critically Endangered.

Habitat Requirements

The Swift Parrot prefers Dry Sclerophyll Forest in Tasmania and Open Forest to Woodland in the north on the mainland. It has also been recorded utilising street trees and in parks and gardens. Swift Parrots forage on the nectar of Eucalypts, often in mixed flocks with Lorikeets. The preferred winter food species are *Eucalyptus sideroxylon* (Red Ironbark), *E. albens* (White Box), *E. ovata* (Swamp Gum), *E. robusta* (Swamp Mahogany) and *E. melliodora* (Yellow Gum) and have also been observed eating the seeds and flowers of *Xanthorrhoea* sp. (Grass Trees). They also feed on insects and their larvae, fruits, berries, seeds and vegetable matter. While feeding, individuals may be approached and watched from under the feed tree. When there is an abundance of food, large congregations of hundreds of birds may gather in noisy and crowded roosts. Nesting occurs from September to January in a hollow branch of Eucalypts and they return to the mainland during March and April.

Distribution

The species is patchily distributed within the south-eastern corner of mainland Australia and Tasmania. During winter the Swift Parrot inhabits mainland Australia from Adelaide (S.A.) through Victoria, and up the east coast to south-east Queensland, as well as visiting the south and central western slopes and the Riverina in N.S.W. The Swift Parrot returns to eastern Tasmania in spring to breed.

Neophema pulchella **Turquoise Parrot**

Description

This ‘grass parrot’ is a striking green with brilliant blue edges to the wings, on which the male of the species also displays a bright red patch.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements

It lives on the edges of Eucalypt woodland adjoining clearings and on timbered ridges and creeks in farmland. It has been known to utilise gullies, rolling hills, valleys and river-flats as well as roadside verges and orchards. They are usually seen in pairs or small groups and spend most of the day on the ground. This species forages primarily on the seeds of shrubs, grasses and herbs, both native and introduced, and the spore cases of moss. They are approachable when feeding and have a characteristic flight call, which is described as a weak tinkling. Partly nomadic, flocks move locally and regionally following seasonal abundances of seed. Breeding pairs nest in small hollow branches of Eucalypts, usually 1m above the ground from August through December and from April to May. Two to five eggs are laid and young leave the nest after 30 days though remain with the parents.

Distribution

This species is endemic to Australia and the main distribution of the Turquoise Parrot is in the grassy woodlands of the western slopes and tablelands from the Darling Downs in Queensland to northern

Victoria, particularly along watercourses.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Despite targeted and incidental surveys neither the Glossy-Black Cockatoo, Gang Gang Cockatoo, Swift Parrot nor Turquoise Parrot were noted within the study area during fieldwork.

Glossy-Black Cockatoo

The study area contained marginal foraging habitat for the Glossy Black Cockatoo in the form of *Casuarina glauca* (Swamp Oak) which were present within the areas of Swamp Sclerophyll Forest. Secondary indications of foraging by the Glossy Black Cockatoo in the form of distinctly chewed cones were not noted under suitable foraging trees during fieldwork. No specimens of *C. glauca* are required to be removed for the proposed sand mine. The proposal is unlikely to result in the extinction of any local population of this species.

Callocephalon fimbriatum (Gang Gang Cockatoo)

The Gang Gang Cockatoo is usually found in upland areas such as Barrington Tops to the west of the study area. This species is known to visit lowland areas during the winter months and may utilise the study area for foraging on an intermittent basis. A large number of suitable nesting hollows were present although, this species would be more inclined to breed in upland areas. The proposal will result in a reduction in suitable foraging and transitory habitat in the local area however it is unlikely to result in the extinction of any local population of this species.

Lathamus discolor (Swift Parrot)

The Swift Parrot is generally more commonly recorded inland from the coast, however is known to come to the coast during drier inland periods or as a result of seasonal movements. Specimens of the large flowered *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus pilularis* (Blackbutt) which were present within the study area would provide seasonal preferred coastal foraging habitat for the Swift Parrot. The proposal will not result in the removal of any specimens of *E. robusta*. Whilst resulting in an incremental decline in suitable habitat, the proposal is unlikely to result in the extinction of any local population of this species.

Neophema pulchella (Turquoise Parrot)

No preferred habitat was present within the study area for the Turquoise Parrot. This Parrot species is more commonly associated with drier inland woodland areas. There are very few records of this species in the local area. It is considered that the Turquoise Parrot may utilise the study area on very rare occasions. A large number of suitable nesting hollows were present however, this species would be more inclined to breed further inland. The proposal will result in a reduction in suitable foraging and transitory habitat in the local area however it is unlikely to result in the extinction of any local population of this species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for these Cockatoo and Parrot Species:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest.

The proposed sand mine will result in a reduction in transitionary and foraging habitat. Taking into consideration the relatively the high mobility of these birds, large amount of similar surrounding habitat and lack of preferred habitat for all species with the exception of the Swift Parrot within the study area the proposal is unlikely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long term survival of these Cockatoo and Parrot species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A National Recovery Plan has been development for the Swift Parrot (Saunders & Tzaros, 2011). The plan recommends the retention of foraging species such as *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus pilularis* (Blackbutt). The proposal will involve the removal of specimens of *E. pilularis* however no E. *robusta* are required to be removed. The proposal although not complying with the recommendations it is unlikely to significantly compromise the recovery plan.

No Recovery or Threat Abatement Plan has been developed for the remaining bird species. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statements identified a number of broad strategies to help these species recover in NSW. The proposal is unlikely to significantly compromise these priority actions developed to assist the recovery of these bird species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for these bird species.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for these bird species. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. Cockatoos or Parrots foraging close to the ground may be subject to predation.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. Cockatoos or Parrots foraging close to the ground may be subject to predation.
- **Predation and hybridation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. Cockatoos or Parrots foraging close to the ground may be subject to predation.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees and affect the availability of food resources.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for nesting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable nesting hollows for these Cockatoos or Parrots. The proposal will result in the removal of a number of dead trees.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these Cockatoos or Parrots species by increasing the intensity and frequency of Bushfires and droughts.
- **Infection by *psittacine circoviral* (beak & feather) disease affecting endangered psittacine species and populations:** The proposal is unlikely to increase infection by this disease.

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24. Woodland Birds

Anthochaera phrygia **Regent Honeyeater**

Description

The Regent Honeyeater is a medium distinctive, medium-sized, black and yellow honeyeater with a sturdy, curved bill. Adults weigh 35 - 50 grams, are 20 - 24 cm long and have a wings-pan of 30 cm. Its head, neck, throat, upper breast and bill are black and the back and lower breast are pale lemon in colour with a black scalloped pattern. Its flight and tail feathers are edged with bright yellow. There is a characteristic patch of dark pink or cream-coloured facial-skin around the eye.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Critically Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Critically Endangered.

Habitat Requirements and Ecology

It occurs in temperate woodlands and open forest, including forest edges. Seasonal movements appear to be dictated by the flowering of various species of Eucalypts that are characteristic of the dry forests and woodlands of south-eastern Australia. The Regent Honeyeater prefers to forage on large-flowered Eucalypts (e.g. *Eucalyptus sideroxylon*, *E. melliodora*, *E. albens*, *E. leucoxylon*), particularly where these trees grow in more productive areas and yield plentiful and predictable nectar flows. They also forage on mistletoe and *Banksia* flowers, and arthropods. In parts of coastal N.S.W. they are also attracted to stands of *Eucalyptus robusta* (Swamp Mahogany). Nests are constructed of strips of Eucalypt bark, dried grass and other plant material. They are placed in an upright fork 4 to 25m above ground, and 2-3 eggs are laid. Nesting occurs mainly between November and January, but breeding has been recorded in all months between July and February.

Distribution

It is nomadic, although it does seem to return to nesting areas sporadically. Small flocks regularly, sometimes annually, visit the northern tablelands and the north western and central western slopes of N.S.W. in the spring and summer. Individuals also appear on the N.S.W. coast at most times of year but primarily in winter.

Daphoenositta chrysoptera **Varied Sittella**

Description

The Varied Sittella is a small songbird with a sharp, slightly upturned bill, short tail, barred undertail, and yellow eyes and feet.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology

The Varied Sittella inhabits Eucalypt forests, woodlands, mallee orchards and golf courses. This species is not found in treeless deserts, open grasslands and heavier rainforests. It prefers rough-barked species and mature smoothed-barked gums with dead branches. The Varied Sittella feeds from arthropods gleaned from crevices and decorticating bark of standing live and dead trees.

Distribution

The Varied Sittella is sedentary and inhabits most of mainland Australia apart from those areas mentioned in the habitat requirements.

Melithreptus gularis gularis **Black-chinned Honeyeater**

Description

The Black-chinned Honeyeater reaches up to 17 cm in length and has a black cap with a white crescent around the nape. A diagnostic black 'chin' occurs beneath the bill and extends down the

white throat. There is a small crescent of blue skin above the eye. The back and wings are a dull olive-green and the tail is greyish-brown. The underparts are white, with a greyish-buff tint on the breast. The bill is short, black and slightly downcurved. The call is a ringing, bubbling trill, repeated several times.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology
In N.S.W., this species is mainly found in drier sclerophyll forests and woodlands containing box-ironbark associations and River Red Gum. It is rarely recorded east of the Great Dividing Range, although it has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.

Distribution
Within its eastern range, the Black-chinned Honeyeater is found predominantly west of the Great Dividing Range in a narrow belt through from southern Queensland, through N.S.W. and south into Victoria and South Australia.

Epthianura albifrons **White-fronted Chat**
Description
The White-fronted Chat is an endemic Australian passerine bird, measuring 12 cm in length with a short slender bill, long spindly legs, a short square-tipped tail and rounded wings (Higgins *et al.* 2001). Chats from which it is easily distinguished by its black and white colouration. The plumage of the male is more striking than that of the female with the juvenile plumage being most similar to the female. The voice is a distinctive 'tang, tang' used as a contact call (Higgins *et al.* 2001).

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not Listed.

Habitat Requirements and Ecology
The White-fronted Chat is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands or lightly timbered lands. Along the coastline, White-fronted Chats are found in estuarine and marshy grounds with vegetation less than 1 m tall. The species is also observed in open grasslands and sometimes in low shrubs bordering wetland areas. Inland, the White-fronted Chat is often observed in open grassy plains, saltlakes and saltpans that are along the margins of rivers and waterways. The species is sensitive to human disturbance and is not found in built areas (Jenner 2008).

Distribution
The distribution of the White-fronted Chat extends across the southern half of Australia, from the southernmost areas of Queensland to southern Tasmania and across to Western Australia as far north as Carnarvon (Barrett *et al.* 2003).

Petroica boodang **Scarlet Robin**
Description
The Scarlet Robin is a small (13 cm) songbird with black upperparts and chin, red breast, white lower belly, a large white forehead spot, and white flashes in the wings and tail.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.

Habitat Requirements and Ecology
The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. The Scarlet Robin builds an open cup nest of plant fibres and cobwebs, sited in the fork of tree (often a dead branch in a live tree, or in a dead tree or shrub) which is usually more than 2 m above the ground.

Distribution
The Scarlet Robin is found in south-eastern Australia (extreme south-east Queensland to Tasmania, western Victoria and south-east South Australia) and south-west Western Australia. In NSW it occupies open forests and woodlands from the coast to the inland slopes (Higgins and Peter 2002). Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains.

Petroica phoenicea **Flame Robin**
Description
The Flame Robin is a small (14 cm) songbird with dark grey upperparts, orange-red underparts from chin to belly, a small white forehead spot, and white flashes in the wings and tail. The female is brown with white flashes in the wings and tail.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.

Habitat Requirements and Ecology
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). There may be two disjunct breeding populations in NSW on the Northern Tablelands and the Central–Southern Tablelands (inferred from distributional data in Barrett *et al.* 2003 and the NSW Wildlife Atlas).

Distribution
The Flame Robin is found in south-eastern Australia (Queensland border to Tasmania, western Victoria and south-east South Australia).

Pomatostomus temporalis temporalis **Grey-crowned Babbler**
Description
The Grey-crowned Babbler is the largest of four species occurring within Australia.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
The Grey-crowned Babbler ranges through open forest, woodland, scrubland, farmland and outer suburbs. Prefers woodlands with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. Members of this species are rare in settled areas and are threatened by vegetation clearance, habitat fragmentation and degradation, and competition from introduced species. Builds dome-shaped nests with a spout-like entrance, lined with grass, bark-fibre, rootlets, feathers, and wool. The Grey-crowned Babbler breeds between June and October in sedentary family units of 2-13 birds. The species produces 2-6 buff, purple-brown or dark grey eggs with dark brown scribbles. The species is insectivorous and forage in leaf litter and on the bark of trees.

Distribution
The Grey-crowned Babbler occurs in N.S.W. on the western slopes and plains, with isolated populations in coastal woodlands on the North Coast, Hunter Valley and South Coast near Nowra.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Despite targeted and incidental searches neither the Regent Honeyeater, Varied Sittella, Black-chinned Honeyeater, Grey-crowned Babbler, White-fronted Chat nor Scarlet and Flame Robins were recorded within the study area during the survey. Of these seven bird species, those most likely to utilise the study area on a regular basis would be the Varied Sittella. Open Forest occurring over the majority of the study area would provide suitable foraging and nesting habitat for the Varied Sittella.

The Regent Honeyeater, Black-chinned Honeyeater, Grey-crowned Babbler, Scarlet Robin and Flame Robin would be more commonly recorded inland from the coast particularly on the western slopes of the Great Dividing Range and would be an infrequent visitors to the local area.

Varied Sittella
As previously mentioned the Varied Sittella would be the most likely of the five listed woodland bird species to utilise the study area. This species has been recorded within Coastal Sand Apple Blackbutt Forest within the local area (EcoBiological, 2012). The proposal will result in a reduction in suitable foraging and nesting habitat within the local area however it is unlikely to result in the extinction of any local population of this species.

Regent Honeyeater
Although the Regent Honeyeater is usually recorded within inland area it is known to come to the coast during events such as drier inland weather periods. This honeyeater has been recorded nearby to the study area at Tanilba Bay on 8 June 2014 feeding on flowering specimens of *Eucalyptus robusta* (Swamp Mahogany) (Port Stephens Examiner, 2014). Preferred foraging habitat within the study area would largely be confined to the small number of specimens of large flowering *E. robusta* occurring within the two areas of swamp sclerophyll forest. Autumn/winter flowering specimens of *Eucalyptus pilularis* (Blackbutt) would also provide suitable foraging habitat. No preferred foraging habitat in the form of *E. robusta* is required to be removed for the proposed sand mine. The proposal will result in a reduction in secondary seasonal foraging habitat within the local area however it is unlikely to result in the extinction of any local population of this species.

White-fronted Chat
Suitable habitat for the White-fronted Chat was available within the areas of damp open habitat in the far north-east of the study area. As the proposed sand mine is situated outside areas of preferred habitat for the White-fronted Chat it is unlikely to result in the extinction of any local population of this species.

Black-chinned Honeyeater
Areas of open forest within the study area would provide suitable habitat for the Black-chinned Honeyeater. This species is more commonly associated with drier inland woodland areas and would be a rare visitor to the local area. The proposal will result in a reduction in foraging habitat within the local area however it is unlikely to result in the extinction of any local population of this species.

Flame Robin & Scarlet Robin

Areas of open forest within the study area would provide suitable habitat for the Flame Robin and Scarlet Robin. These species more commonly associated with upland moist eucalypt forest and would be a rare seasonal visitor to the area. The proposal will result in a reduction in foraging habitat within the local area however it is unlikely to result in the extinction of any local population of this species.

Pomatostomus temporalis temporalis Grey-crowned Babbler

Within the local area only one record of the Grey-crowned Babbler is known from 1978 occurring near Boyces Track within the know Worimi Conservation Lands (Ecotone, 2008). Further afield the nearest recent records are known to occur at Medowie (Ecotone, 2008) and North Raymond Terrace (Wildthing Environmental Consultants, 2010). Due to the lack of recent nearby records this bird species would appear to be absent or very rare within the local area. Marginal habitat was considered to be present in the far north-east of the study area where open areas with scattered trees were present. The proposed sand mine is unlikely to result in the extinction of any local population of this species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for these Woodland Bird species:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest.

The proposed sand mine will result in a reduction in transitionary and foraging habitat for the majority of these woodland species. Taking into consideration the relatively the high mobility of these birds, large amount of similar surrounding habitat the proposal is unlikely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long term survival of these Woodland Bird species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Recovery Plan has been completed for the Regent Honeyeater (DoE, 2016). The plan recommends the retention of preferred foraging trees and Mistletoe. As specimens of *E. robusta* a preferred foraging resource in the local will not be removed the proposal is unlikely to significantly compromise the Recovery Plan.

No Recovery or Threat Abatement Plan has been developed for the Varied Sittella, Black-chinned Honeyeater, White-fronted Chat, Grey-crowned Babbler nor Scarlet or Flame Robins. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for these bird species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for these woodland bird species.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees and affect the availability of food resources.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. The proposal will result in the removal of a number of dead trees and logs.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these woodland birds by increasing the intensity and frequency of Bushfires and droughts.

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25. *Burhinus grallarius* Bush Stone-curlew

Description

The Bush Stone-curlew is a large, long-legged ground dwelling bird. It has a rounded head, large yellow eyes, a black eye-stripe and a short dark bill.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Bush Stone-curlew inhabits dry open forest and woodland with an open grassy understorey that has not been overgrazed. It prefers woodland with many fallen branches where it roosts during the day. It has also been known to utilise coastal scrub, mangrove fringes, golf courses and plantations. It is active at night and is detected by its characteristic eerie call. Breeding occurs between July and January. The food of the Bush Stone-curlew is primarily insects, spiders and other invertebrates. Occasionally fruits are eaten when they become available.

Distribution

The Bush Stone-curlew is an endemic bird which was once found throughout Australia. It is widespread in north and north-east Australia, however is know very rare in southern Australia and extinct in Tasmania. Within N.S.W. this species has been recorded mainly in pastoral areas of the western slopes and plains. It is rare east of the Great Divide, however, isolated populations have been recorded from Western Sydney, Gosford, Port Macquarie and Northern Rivers around Grafton and Brunswick Heads (Marchant and Higgins, 1993).

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Bush Stone-curlew was not observed within the study area during this or previous surveys. There was no response to Bush Stone-curlew call playback conducted during nocturnal fieldwork. Suitable habitat was considered to be present within the cleared areas to the north-east, areas around the orchard and the more open areas of open forest with a less dense understorey. The proposal will result a small incremental reduction of foraging and nesting habitat for the Bush Stone-curlew. Considering the absence of this species during the site studies and taking into account the relatively large amount of suitable surrounding habitat it is considered unlikely to cause extinction of the local population of the Bush Stone-curlew.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(ii) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will result in the removal of a small amount of suitable habitat for this bird species leading to a small incremental reduction in the local area. It is unlikely that an area of habitat important to the long-term survival of these bird species is likely to be removed, modified, fragmented or isolated as a result of the proposal.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan has been developed for the Bush Stone-curlew which considers the conservation requirements of the species across its known range within New South Wales (Department of Environment and Conservation, 2006). A number of objectives were given to aid the recovery of this species. It is considered that the proposal does not significantly conflict with this recovery plan.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for the Bush Stone Curlew. However, it is not considered to be significant in relation to the Bush Stone-curlew.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. This introduced predator would have an impact on Bush Stone-curlews in the local area.

- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. This introduced predator would have an impact on Bush Stone-curlews in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to cause mortality and affect the availability of food resources.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. The proposal will result in the removal of a number of standing dead trees and dead wood lying on the ground.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these woodland birds by increasing the intensity and frequency of Bushfires and droughts.
- **Invasion of native plant communities by exotic perennial grasses:** This threatening process is already present with a small number of introduced grasses such as *Andropogon virginicus* (Whisky Grass) and *Axonopus affinis* (Narrow-leaved Carpet Grass). There is the potential for further infestation, however, given the recommendation for a vegetation management plan for this area which will include regular weed control the impact from this threatening process would be reduced.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera*: (Bitou Bush).** Bitou Bush was present within the study area. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within the study area. Given the recommendation for a vegetation management plan which will include regular weed control the impact from this threatening process would be reduced.

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26. Birds of Prey

Hieraaetus morphnoides **Little Eagle**

Description

The Little Eagle is a medium-sized (45-55 cm) bird of prey that occurs in two colour forms: either pale brown with an obscure underwing pattern, or dark brown on the upperparts and pale underneath, with a rusty head and a distinctive underwing pattern of rufous leading edge, pale 'M' marking and black-barred wingtips. Both forms have a black-streaked head with a slight crest, a pale shoulder band on the upperwings, a rather short and square-tipped barred tail, and feathered legs.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993; Aumann 2001a). For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Young fledge in early summer.

Distribution

The Little Eagle is distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment (Marchant and Higgins 1993). It occurs as a single population throughout NSW.

Lophoictinia isura **Squared-tailed Kite**

Description

The Square-tailed Kite is a reddish, medium-sized, long-winged raptor. Adults have a white face with thick black streaks on the crown and finer streaks elsewhere. The saddle, rump and central upper tail coverts are blackish with grey-brown barring. The underparts are predominantly grey-brown with black tips on the grey, square-tipped tail and wing edges. A key character in flight is the long fingered, upswept wings with a large white patch at the base of the barred 'fingers'.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Square-tailed Kite inhabits Open Forests and Woodlands, particularly those on fertile soils with abundant passerines. They may also range into nearby open habitats but not into extensive treeless regions. The Square-tailed Kite hunts mostly Passerines and foliage insects, though it also known to prey on mammals and lizards. Prey taken has also included fledging birds, insects and rabbits. Breeding occurs from July to February with an average clutch size of 3 eggs. Nests are built as a platform or bowl of sticks lined with green *Eucalyptus* leaves in forks or large horizontal branches of Eucalypts, *Angophora* or *Melaleuca* trees and may be used in successive years.

Distribution

This raptor is endemic to Australia and is widespread throughout the mainland (absent from Tasmania). The species is migratory throughout its range and is a spring-summer breeding migrant to south-eastern, southern and south-western Australia.

Erythrotriorchis radiatus **Red Goshawk**

Description

The Red Goshawk is a large, swift and powerful rufous-brown hawk, growing to a length of 45–60 cm, with a wingspan of 100–135 cm. This raptor is boldly mottled and streaked, with rufous scalloping on the back and upper wings, rufous underparts that are brightest and lack streaking on the thighs, and with massive yellowish legs and feet, and boldly barred underwings. Females are larger, more powerfully built.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Critically Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.

Habitat Requirements and Ecology

The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia (Marchant & Higgins 1993). Riverine forests are also used frequently (Debus 1991, 1993). Such habitats typically support high bird numbers and biodiversity, especially medium to large species which the goshawk requires for prey. The Red Goshawk nests in large trees, frequently the tallest and most massive in a tall stand, and nest trees are invariably within one km of permanent water.

Distribution

The Red Goshawk is an Australian endemic raptor that is distributed sparsely through northern and eastern Australia. It is recorded from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW. Scattered records occur in central Australia. The species is very rare in NSW, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens.

Pandion haliaetus **Osprey**

Description

The Osprey is a large fishing raptor with a distinct brown band passing through the eye.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Osprey can be found in open and swamp forest adjacent to the coast or estuaries and fishes in brackish or salt water, seldomly in fresh water bodies. It feeds on live fish, usually 20-40 cm in length. Plunging into the water feet first, from heights up to 50 metres above the water, it will submerge itself to at least 1m when fishing. It builds a conspicuous stick nest on a dead tree or branch, which it uses for breeding between April and November. Nesting sites are also found on man-made structures such as pylons or tall telegraph poles. The nest is added to by breeding pairs each year until they reach a massive size. In some parts of its range overseas nests are as little as 10m apart but in Australia most are separated by at least 1 km.

Distribution

The Osprey is a very cosmopolitan species, found in most continents across the Earth. A single subspecies, *P. h. cristatus*, breeds in Australia and New Guinea. Southern and inland records show that the Osprey in Australia is able to travel long distances and have been recorded as far inland as the Finke River in Central Australia. Individuals are sometimes seen inland along the larger northern rivers and the Murray River though breeding is usually confined to the coast and islands.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither the Square-tailed Kite, Little Eagle, Red Goshawk nor Osprey were recorded within or in the vicinity of the study area during fieldwork. No large nests consistent with that of a bird of prey where also noted within the study area. With the exception of the Osprey the study area contained suitable hunting habitat as part of a much larger home range for all of the remaining three birds of prey. The nearest hunting habitat for the Osprey is the waters of Tilligerry Creek and Stockton Bight. Suitable nesting habitat in the form of large trees was present for all of these birds of prey.

The proposal will result a loss of suitable hunting habitat for the Square-tailed Kite, Little Eagle and Red Goshawk and suitable nesting habitat for all of these raptors including the Osprey. This will result in a decline of habitat in the local area. Taking into consideration the relatively large amount of habitat along Stockton Bight is considered unlikely to cause extinction of the local population of these four birds of prey.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:
- *(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
- *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

The proposed Sand Mine will result in the following impacts to habitat for these bird species:
- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest.

The proposed sand mine will result in a reduction in nesting and with the exception of the Osprey hunting habitat. Taking into consideration the high mobility of these birds of prey, large amount of similar surrounding habitat the proposal is unlikely to result in the removal, modification, fragmentation or isolation of an area of habitat important to the long-term survival of these birds of prey.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan has been produced for the Red Goshawk. The specific objectives of this Recovery Plan are to:

1. improve the co-operation and co-ordination of recovery efforts between NSW and Qld;
2. review the legal status of the species at the National level;
3. standardise survey method;
4. increase awareness of the conservation status and threats affecting the Red Goshawk; and
5. identify and protect any known habitat or nest sites that occur in NSW.

The action is not likely to result in the removal of habitat that would significantly compromise the Recovery Plan.

No Recovery or Threat Abatement Plan has been developed for the remaining birds of prey species although a Priority Action Statement (PAS) has been developed for each species. The objective of the PAS is to promote the recovery of threatened species, populations and ecological communities and manage key threatening processes. It is considered that the proposal does not conflict with the PAS for the above birds of prey.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. Any future removal of vegetation is likely to result in a reduction in habitat for this species in the local area. However, it unlikely to be significant in relation to these three birds of prey.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. The proposal is unlikely to result in a change in the frequency of fire in the local area.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. This introduced predator would have an impact on native fauna within the locality.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. This introduced predator would have an impact on native fauna within the locality.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to cause mortality to young birds and affect the availability of food resources.

- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. The proposal will result in the removal of a number of standing dead trees and dead wood lying on the ground.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these woodland birds by increasing the intensity and frequency of Bushfires and droughts.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush):** Bitou Bush was present within the study area. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was found to be common within the study area and formed small thickets in some areas. The Lantana present has the potential for further infestation within the study area. Given the recommendation for a vegetation management plan which will include regular weed control the impact from this threatening process would be reduced.

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27. Owls

Ninox connivens **Barking Owl**

Description

The Barking Owl is medium-sized owl (42 cm, 650 g) smaller than the similar Powerful Owl and larger than the Southern Boobook. It has bright yellow eyes and no facial-disc. Upperparts are brown or greyish-brown, and the white breast is vertically streaked with brown. The large talons are yellow.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Barking Owl is found in forest and woodland, encountered most commonly in savanna and paperbark woodlands. It sometimes roosts in rainforests, but it requires the more open country for hunting and hollow Eucalypts for breeding. These owls are usually found in pairs which occupy permanent territories, generally greater than 100 ha. The main call of the species is a repetitive barking 'wook wook', hence the common name. It does occasionally produce a rather loud and disturbing scream that has earnt it a second common name of the 'screaming woman bird'. Mammals and birds are the main prey, though it also feeds on insects and other invertebrates. In Southern Australia it feeds particularly on rabbits. It also kills hares, rats, mice, occasional small bats and some marsupials, including possums. It kills birds up to the size of Magpies and Tawny Frogmouths.

Distribution

The Barking Owl is found throughout continental Australia except for the central arid regions. Although common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains (especially the Pilliga) and in some northeast coastal and escarpment forests.

Tyto novaehollandiae **Masked Owl**

Description

A medium-sized owl to 40 - 50 cm long, with dark eyes set in a prominent flat, heart-shaped facial disc that is encircled by a dark border. The feet are large and powerful, with fully feathered legs down to the toes.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

Within this range they inhabit a range of wooded habitats that contain both mature trees for roosting and nesting and more open areas for hunting. They are most commonly encountered within Open Forest with a sparse understorey as well as along the ecotones of these areas to more or less densely vegetated habitats. Their diet comprises mainly ground-dwelling prey, including several species of native and introduced Rodents, *Antechinus* spp. and Bandicoots. On occasions, other prey such as Possums, Gliders and other birds are taken. Masked Owls usually roost in large hollows inside large, old living trees, most often Eucalypts. Within dry forests they often choose hollow trees in gullies or drainage lines. Pairs appear to mate for life and occupy exclusive territories in order of 1000ha in size.

Distribution

Masked Owls in N.S.W. are distributed throughout the length of the Great Dividing Range and extend from the coast to the western slopes.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither the Barking nor Masked Owl were observed within the study area during the survey. No evidence of their presence was found (ie whitewash, regurgitation pellets, prey remains) nor was a response heard during the call playback census. Hunting habitat for these owl species was present over the majority of the study area particularly within areas of Open Forest. Approximately 1217 hollow-bearing trees were recorded within the study area during the hollow-bearing tree survey. Many of these trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for both the Masked and Barking Owl and a number of prey species. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows.

The Masked Owl has been recorded locality within the Tilligerry Nature Reserve (Niche, 2013) and along Stockton Bight (ERM, 2009). Few local records for the Barking Owl were found within the local area.

The proposal will remove approximately 25.90ha of potential hunting and roosting habitat. Approximately 877 hollow-bearing trees will be removed. Many of these hollow-bearing trees (up to 200) being significant as a result of their very large size and presence of large potential nesting hollows for owls such as the Masked and Barking Owls. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows. Other potential impacts include noise from the mine operation, artificial lighting.

To minimise the impact on the Masked and Barking Owl a number of recommendations have been given:

- Preclearance surveys will be required to be undertaken for the Masked and Barking Owls nesting sites during the breeding season. If a nesting tree is located then a 100m no go zone is to be put in place around this tree until either the young have fledged the nest.
- It is recommended that lighting be minimised and confined wherever possible. This will require the use of dimmer lights and directing the beams away from areas of native habitat.
- Noise is to be minimised – An acoustic barrier is to be constructed around much of the disturbance area;
- Weeds are to be controlled within areas of habitat outside the mining footprint and those areas that have undergone restoration;
- Feral animals are to be controlled as part of a vertebrate pest animal management plan;
- Minimise the direct impact on prey species during vegetation removal. Will involve the supervision of clearance activities by suitably qualified fauna ecologists.

Considering the relatively large area of habitat occurring along the dune forests of Stockton Bight which would generally contain similar densities and sizes of hollows and arboreal prey species the proposed removal of hunting, roosting and nesting habitat is unlikely to result in the extinction of any local population of the Masked and Barking Owls.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for the Masked and Barking Owls:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 9.5ha of Orchard (low quality habitat);
- The loss of approximately988 hollow-bearing trees (up to 200 potential nesting trees);
- Reduction in prey species.

No areas of habitat are likely to become fragmented or isolated for these owl species. The proposal will result in the incremental reduction in in a relatively large fragment of adjoining habitat occurring along Stockton Bight. No area of habitat important to the long-term survival of the Masked or Barking Owl is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Recovery Plan has been completed for Large Forest Owls (Powerful, Masked & Sooty Owls) (DEC, 2006) and a draft Recovery Plan has been completed for the Barking Owl (NPWS, 2003). The recovery plans recommend that developments containing bushland protect nest and roost sites, patches of habitat and prey bases. The proposal will result in the future removal of suitable hunting, roost and nesting habitat. The proposed sand mine is not consistent with these actions. Rehabilitation

of the disturbance area and the provision of compensatory habitat (Offsetting) will reduce the impact of the mine on these two threatened owl species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for these owl species.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for both the Masked and Barking Owls. Up to 200 suitable nesting hollows were considered to be present. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The Red Fox would prey on this owl species is if young have inadvertently flown on to the ground and can only return to safety by branching back up a tree.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The Feral Cat would prey on this owl species when young have inadvertently flown on to the ground and can only return to safety by branching back up a tree.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The Feral Dog would prey on this owl species when young have inadvertently flown on to the ground and can only return to safety by branching back up a tree.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees and affect the density of prey species.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for nesting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners**. The Noisy Miner was recorded within the study area during fieldwork. The proposal is unlikely to result in an increase in Noisy Miners within the study area.
- **Invasion of Native Plant Communities by *Chrysanthemoides monilifera* (Bitou Bush):** Bitou Bush was present within the study area and formed dense clumps in some areas. The removal of Bitou Bush would increase the ability of the owl species (particularly masked owl) to detect prey in the study area. It is recommended that this species be controlled within the study area.
- ***Lantana camara* (Lantana):** Lantana was present within the study area and formed dense clumps in a small number of areas. It is recommended that this species be controlled within the study area. The removal of Bitou Bush would increase the ability of these owl species (particularly masked owl) to detect prey in the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable nesting hollows for these owl species. The proposal will result in the removal of a number of dead trees.

- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Masked and Barking Owl by increasing the intensity and frequency of Bushfires and droughts.

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28. Medium Carnivorous Marsupials

Dasyurus maculatus maculatus **Tiger Quoll**

Description

The Tiger Quoll (*Dasyurus maculatus maculatus*) is the largest marsupial carnivore on the Australian mainland.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Listed as Endangered

Habitat Requirements

It is an agile climber but spends most of its time on the floor of sclerophyll forests, rainforests and coastal woodlands and heathlands. It has occasionally been seen utilising open country, grazing lands and rocky outcrops (NPWS, 1999). Nests are made in rock caves and hollow logs or trees, and basking sites are usually found nearby. A large area of relatively good quality vegetation is required for foraging. It is an opportunistic hunter of a variety of prey, including birds and their young, rats and other small terrestrial and arboreal mammals, gliders, small Macropods, reptiles and Arthropods.

Distribution

The Tiger Quoll is widespread in eastern Australia, with its distribution being spread between two subspecies. The nominate subspecies, *D. m. maculatus* occurs from southern Queensland to Tasmania whereas *D. m. gracilus* occurs in northern Queensland.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Tiger Quoll was not recorded within the study area despite targeted surveys, which involved trapping, scat analysis, spotlighting and remote camera surveys. The Atlas of NSW Wildlife database (OEH, 2015) contained a small number of local records of the Tiger Quoll within the local area. Open Forest habitat within the study area contains suitable hunting and roosting habitat for this Quoll species. A relatively large number of suitable roosts in the form of hollow logs or tree hollows were present. Tiger quolls occupy extensive home ranges which may be in excess of 580 hectares and up to 875 hectares (Watt 1993). Considering the large area of adjoining habitat along Stockton Bight it is likely that the Tiger Quoll would utilise habitat within the study area as part of a much larger home range.

The proposal will result in the removal of 25.90ha of Coastal Sand Apple Blackbutt Forest containing likely hunting and denning habitat for the Tiger Quoll. Approximately 877 hollow-bearing trees and a number of suitable hollow logs will also require removal. Other potential impacts include noise from the mine operation and artificial lighting.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on the Tiger Quoll. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to original forest type);
- Reduction of ongoing mine impacts such as noise and artificial lighting;
- Protection of the Tiger Quoll during vegetation clearance;

- Provision of compensatory habitat (Offsetting);
- Relocation of hollow logs and tree hollows into remaining habitat;
- Feral Vertebrate Pest Control;
- Weed Control.

The proposal will result in a significant reduction in Tiger Quoll habitat occurring along the dune forests of Stockton Bight. Considering the relatively large area of remaining habitat together with the given recommendations the proposed sand mine is unlikely to result in the extinction of any local population of the Tiger Quoll.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for the Tiger Quoll:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 9.5ha of Orchard (low quality habitat);
- The loss of approximately 877 hollow-bearing trees (many potential den sites);
- The loss of a number of suitable den sites in the form of hollow logs;
- Reduction in prey species.

No areas of habitat are likely to become fragmented or isolated for the Tiger Quoll. The proposal will result in the incremental reduction in of a relatively large fragment of adjoining habitat occurring along Stockton Bight. No area of habitat important to the long-term survival of the Tiger Quoll is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the Tiger Quoll. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help this species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for this species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for the Tiger Quoll.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for the Tiger Quoll. Larger areas of adjoining and nearby open forest contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox is likely to have some impact on Tiger Quolls in the local area. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The European Red Fox is likely to have some impact on Tiger Quolls in the local area. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation and hybridation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The Feral Dog is likely to have some impact on Tiger Quolls in the local area. The proposal is unlikely to result in an increase in Feral Dog numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to cause direct mortality and destroy denning habitat (tree hollows and hollow logs) and affect the availability of food resources.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for denning. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** A number of dead trees and logs would provide suitable denning habitat for the Tiger Quoll. The proposal will result in the removal of a number of dead trees and logs. It is recommended that hollow logs and some suitable gained tree hollows be relocated to areas of suitable habitat outside the sand mine footprint.

- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Tiger Quoll by increasing the intensity and frequency of Bushfires and droughts.

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29. Small carnivorous marsupials

Planigale maculata **Common Planigale**

Description

Formerly a part of the Antechinus complex, the Planigales differ mainly in that they possess a backward-facing pouch, typical of a burrowing species. The Common Planigale is the largest of the Planigales, though still small in terms of the prey that it feeds on.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Endangered under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

In NSW it is found along the coastal strip, occupying a variety of habitats ranging from rainforest, wet and dry sclerophyll forests to grasslands, marshlands and rocky areas. In these habitats it shelters under logs and rocks and any available burrows. It is a ferocious predator of small insects, often tackling prey of its own size. In NSW, the young may be born from late spring to summer and presumably the males die after reproduction, typical of small Dasyurids.

Distribution

The Common Planigale is found throughout eastern Australia.

Phascogale tapoatafa **Brush-tailed Phascogale**

Description

The Brush-tailed Phascogale is tree-dwelling marsupial carnivore with a characteristic, black, bushy 'bottlebrush' tail, with hairs up to 4 cm long. Its fur is grey above and pale cream below and it has conspicuous black eyes and large naked ears.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements

The Brush-tailed Phascogale is known from a variety of forest types from Rainforest to Woodland, but is most frequently recorded in the drier Sclerophyll Forests with little ground cover, on ridges up to 600m altitude. A nocturnal species, the Brush-tailed Phascogale is mainly arboreal but also forages on the ground, eating insects and occasionally small vertebrates. It requires small tree hollows and suitable foraging sites in the canopy, sub-canopy, and ground layer of vegetation. During the day it sleeps in a nest lined with leaves or shredded bark in a tree hollow, emerging at dusk to feed. Animals may return to the nest occasionally through the night and, when several share a nest, they tend to show a similar pattern of nocturnal activity.

Distribution

The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *Planigale maculata* (Common Planigale) nor *Phascogale tapoatafa* (Brush-tailed Phascogale) were recorded within the study area despite targeted trapping and spotlighting surveys.

Brush-tailed Phascogale
Suitable foraging and nesting habitat in the form of Coastal Sand Apple Blackbutt Forest and Flooded Gum Forest was present within the study area for the Brush-tailed Phascogale. The study area lacked preferred habitat in the form of forest, with a sparse ground cover of herbs, grasses, scleromorphic shrubs or leaf litter (Soderquist 1995). Within the lower Hunter the Brush-tailed Phascogale is often associated with rough-barked eucalypt woodlands and forests composed predominantly of ironbark which was absent from the study area.

Common Planigale
Few records of the Common Planigale are known from the local area. Open forest which covered a large portion of the study area. The majority of the study area would provide suitable foraging and nesting habitat for this small marsupial.

The proposal will result in the removal of 25.90ha of Coastal Sand Apple Blackbutt Forest containing likely hunting and denning habitat for both the Brush-tailed Phascogale and Common Planigale. Approximately 877 hollow-bearing trees will also require removal. Other potential impacts include noise from the mine operation and artificial lighting.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on the Brush-tailed Phascogale and Common Planigale. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to original forest type);
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Protection of fauna species during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Relocation of hollow logs and tree hollows into remaining habitat;
- Feral Vertebrate Pest Control;
- Weed Control.

The proposal will result in a reduction in suitable habitat for both the Brush-tailed Phascogale and Common Planigale occurring along the dune forests of Stockton Bight. Considering the lack of local records for the Common Planigale and absence of preferred habitat for the Brush-tailed Planigale together with the given recommendations the proposed sand mine is unlikely to result in the extinction of any local population of these species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for both the Brush-tailed Phascogale and Common Planigale:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 9.5ha of Orchard (low quality habitat);
- The loss of approximately877 hollow-bearing trees (many potential den sites);
- The loss of a number of ground hollow logs;

No areas of habitat are likely to become fragmented or isolated for the Brush-tailed Phascogale or Common Planigale. The proposal will result in the incremental reduction in a relatively large fragment of adjoining habitat occurring along Stockton Bight. No area of habitat important to the long-term survival of the Brush-tailed Phascogale or Common Planigale is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for either *P. maculata* or *P. tapoatafa*. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statements identified a number of broad strategies to help these species recover in NSW.

The following priority actions have been prepared for the Brush-tail Phascogale:

- Establish a long-term monitoring program of Brush-tail Phascogales across at least 30 sites.
- Undertake a targeted community education program that raises awareness of threats such as cats
- Develop and provide environmental assessment guidelines for Local Councils and other consent or determining authorities to enable adequate consideration of the potential impacts of activities or actions on phascogales.
- Monitor the effectiveness of forestry threatened species licence conditions and refine and negotiate changes if required.
- Undertake research into the impact of hazard reduction burn practices.
- Undertake fox and wild dog control at priority sites.

None of these priority actions relate to the current proposal.

The following priority actions have been prepared for the Common Planigale:

- DEC to provide information for education programs for Catchment Management Authorities, Local Councils and landholders to prioritise protection and restoration of its habitat.
- Forest management activities that include logging, grazing, burning, and feral predator control

needs to consider this species across all tenures.
- The modelling requires refinement to implement more recently derived predictor variables, including current vegetation mapping, and new records for the species.
- Research into habitat use at all spatial scales (local, landsdape, regional) should be encouraged. Investigations into dispersal cabability, use of corridors, preferred habitats, fire ecology, and impacts of feral animal control measures.
- Foxes, cats and cane toads should be controlled in known and potential planigale habitats.
- Protect and enhance ground cover and understorey structure, especially near water. Stock removal and fencing, protection and enhancement of understorey cover and feral predator control are measures that should be encouraged.
- Fire planning within reserves should be undertaken so as to promote diverse understories and ground cover structure.
- Investigations into dispersal cabability, use of corridors, preferred habitats, fire ecology and impacts of feral animal control measures would be highly valuable to land managers.

The priority action that relates to the current proposal is the control of feral predators.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for the Brush-tailed Phascogale and Common Planigale.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Larger areas of adjoining and nearby open forest contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site during fieldwork. The European Red Fox may have some impact on the Brush-tailed Phascogale in the local area. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat recorded within the site during fieldwork. The Feral Cat may have some impact on the Brush-tailed Phascogale in the local area particularly when foraging on the ground. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **Predation and hybridation of Feral Dogs *Canis lupis famililaris*** The Feral Dog may have an impact on Brush-tailed Phascogales in the local area. Brush-tailed Phascogales often foraging on or close to the ground may be subject to predation. The proposal is unlikely to result in an increase in Feral Dog numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees and affect the availability of food resources.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for nesting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** A limited amount of dead wood and dead trees were present within the study area. A number of dead trees would provide suitable nesting hollows for the Brush-tailed Phascogale and Common Planigale.

- **Human-caused Climate Change**: Has the potential to have an adverse effect on both the Brush-tailed Phascogale and Common Planigales by increasing the intensity and frequency of Bushfires and droughts.

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30. Potoroos and Bettongs

Potorous tridactylus tridactylus **Long-nosed Potoroo (SE mainland)**

Description

The Long-nosed Potoroo (SE Mainland) is a medium sized marsupial of the order Diprotodontia. The Long-nosed Potoroo (SE Mainland) can be identified by a brown to grey upper body and paler underbody. They have a long nose that tapers with a small patch of skin extending from the snout to the nose. The length of the feet is shorter than their head length. They are smaller than the Long-footed *Potorous longipes* (Potoroo).

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.

Habitat Requirements

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. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil. Mainly nocturnal, hiding by day in dense vegetation - however, during the winter months animals may forage during daylight hours. Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2-5 ha. Breeding peaks typically occur in late winter to early summer and a single young is born per litter. Adults are capable of two reproductive bouts per annum.

Distribution

The Long-nosed Potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. There are geographically isolated populations in western Victoria.

Aepyprymnus rufescens **Rufous Bettong**

Description

Rufous Bettongs are small marsupials, 70 to 80 cm long from nose to tail. They have reddish-brown fur, including on the muzzle.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.

Habitat Requirements

The Rufous Bettong occupies a variety of habitats ranging from coastal Eucalypt forests to tall Wet Sclerophyll Forests along the east coast of Australia. West of the Great Dividing Range it occupies Low Open Woodland. It tends to favour those areas where there is a sparse or grassy understorey. The Rufous Bettong constructs a nest of fibrous vegetation which is occupied during the day. It emerges just after dusk and forages on grasses and herbs as well as tubers and roots. Females are able to reach sexual maturity at 11 months and have four teats with a forward opening pouch. A single young leaves the pouch at approximately 16 weeks and follows its mother until 23 weeks.

Distribution

The original range from Coen in north Queensland to central Victoria has been reduced to a patchy distribution from Cooktown, Queensland, to north-eastern NSW as far south as Mt Royal National

Park. In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither the Long-nosed Potoroo nor the Rufous Bettong were recorded within the study area despite targeted surveys, which involved trapping, spotlighting and remote camera surveys. Suitable habitat in the form of Coastal Sand Apple Blackbutt Forest and Flooded Gum Forest was available within the study area. Locally the Long-nosed Potoroo has been previously recorded next to Williamtown Airport (RPS Harper Somers O'Sullivan, 2009) approximately 16km to the east of the study area. Few additional local records of this Potoroo species are known. No local records of the Rufous Bettong were present on the NSW Wildlife Atlas.

The proposal will result in the removal of 25.90ha of Coastal Sand Apple Blackbutt Forest containing suitable habitat for both the Long-nosed Potoroo and Rufous Bettong. Other potential impacts include noise from the mine operation and artificial lighting.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on the Long-nosed Potoroo and Rufous Bettong. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to original forest type);
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Protection of the Tiger Quoll during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Relocation of hollow logs and tree hollows into remaining habitat;
- Feral Vertebrate Pest Control;
- Weed Control.

The proposal will result in a reduction in suitable habitat occurring along the dune forests of Stockton Bight. Considering the relatively large area of remaining habitat together with the paucity of local records the proposed sand mine is unlikely to result in the extinction of any local population of either the Long-nosed Potoroo or Rufous Bettong.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological

community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following impacts to habitat for the Long-nosed Potoroo and Rufous Bettong:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of a number of hollow logs;

No areas of habitat are likely to become fragmented or isolated for the Long-nosed Potoroo and Rufous Bettong. The proposal will result in the incremental reduction in a relatively large fragment of adjoining habitat occurring along Stockton Bight. No area of habitat important to the long-term survival of either the Long-nosed Potoroo or the Rufous Bettong is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the Long-nosed Potoroo or Rufous Bettong. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help this species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction in suitable habitat for the Long-nosed Potoroo and Rufous Bettong.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox is likely to have some impact on native fauna in the local area. The proposal is

unlikely to result in an increase in fox numbers in the local area.

- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The proposal is unlikely to result in an increase in Feral Dog numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to cause direct mortality, impact on the availability of food resources and shelter.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable shelter for these species.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on both the Brush-tailed Phascogale and Common Planigales by increasing the intensity and frequency of Bushfires and droughts.

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31. Arboreal Marsupials

Cercartetus nanus **Eastern Pygmy –possum**

Description

The Eastern Pygmy –possum (*Cercartetus nanus*) is a small arboreal marsupial approximately the size of a mouse. It has soft dense fur, fawn-grey to olive brown above and light grey to white below. The rounded head has very large eyes and ears and long whiskers. The prehensile tail has a seasonally flattened base is almost naked and tapers to a fine point.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements

The species is found from rainforest through sclerophyll forest to tree heath. In New South Wales the species is found in coastal areas. Pygmy-Possums are agile climbers that feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants when in flower, insects throughout the year, and seeds and soft fruits when flowers are unavailable. Individual Pygmy-possums have numerous nests which are slept in during the day. These are usually within tree hollows or constructed spherical nests (drays) made from shredded bark and wood from eucalypts, abandoned bird nests and tea-trees.

Distribution

The species is patchily distributed within the south-eastern corner of mainland Australia and Tasmania.

Petaurus australis **Yellow-bellied Glider**

Description

The Yellow-bellied Glider (*Petaurus australis*) is the largest of the Australian Petaurids and is the most vocal.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements

It occurs patchily in tall, mature Wet Eucalypt Forest, at a density 0.05-0.14 individuals per hectare in preferred habitat. Plant and insect exudates (sap, nectar, honeydew and manna) make up the bulk of its diet. Eucalypt sap is consumed throughout the year. Eucalypt blossom provides valuable food when available, while insects, spiders and pollen provide most of the protein in the diet. During the day, the Yellow-bellied Glider rests in a den in a hollow branch, usually in a living, smooth-barked Eucalypt. It emerges at night to forage, sometimes travelling more than 2km from the den. The home range is of the order of 35 hectares. Young are born mostly from August to September in the southern part of the range and from May to September in the northern parts (although some births have been recorded throughout the year). Pouch life is 90-100 days, after which the young is suckled in the den for 40-60 days.

Distribution

It ranges throughout eastern Australia from Portland, Victoria to central-coastal Queensland. A separate population of the subspecies (*P. a. reginae*) occurs on the western Rainforest slopes in northern Queensland.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or

ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *Petaurus australis* (Yellow-bellied Glider) nor *Cercartetus nanus* (Eastern Pygmy –possum) were recorded within the study area despite targeted trapping and spotlighting surveys. Open forest habitat covering the majority of the study area was thought to provide suitable foraging and nesting habitat for both these arboreal species.

Locally the Eastern Pigmy Possum has been recorded at within the dunal forests of Stockton Bight just north of Fern Bay (Umwelt, 2004). No records of the Yellow-bellied Glider were found along the Stockton Bight Forests.

The proposal will result in a small incremental reduction of suitable habitat for both these marsupials, however, considering the large area of adjoining habitat within the local area the proposal is not likely to result in the extinction of any local population of either species.

To reduce the impact of the proposal in relation to these three arboreal marsupials it is recommended that the removal of hollow-bearing trees be supervised by a suitably qualified and vaccinated ecologist. It is also recommended that suitable compensatory nestboxes be installed within the remaining area of open forest and adjacent areas prior to clearing to replaced lost nesting hollows. Artificial lighting used to operate at night or used for security may influence these nocturnal marsupials. Artificial lighting used to operate at night or used for security may influence nocturnal fauna. It is recommended that lighting be minimised and confined wherever possible.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following potential impacts to habitat for both the Eastern Pigmy Possum and Yellow-bellied Glider:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees (many potential nest sites);

No areas of habitat are likely to become fragmented or isolated for the Eastern Pigmy Possum or Yellow-bellied Glider. The proposal will result in the incremental reduction in a relatively large fragment of adjoining habitat occurring along Stockton Bight. No areas of habitat important to the long-term survival of either the Eastern Pigmy Possum or Yellow-bellied Glider are likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan has been released for the Yellow-bellied Glider. The plan recommends the retention of suitable habitat and nest trees. Due to the absence of records of Yellow-bellied Gliders along the dunal forests of Stock Bight the proposal would not be considered to significantly compromise this recovery plan.

No Recovery or Threat Abatement Plan has been developed for the Eastern Pigmy Possum. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of these two species and the abatement of key threatening processes in NSW. The Priority Action Statements identified a number of broad strategies to help these species recover in NSW. These actions include:

- Ensure the largest hollow-bearing trees (including dead trees) are given highest priority for retention.
- Conduct field surveys using "Elliot" traps in trees and on the ground and pitfall traps to further delineate distribution and key populations. Avoid periods of cold weather. Areas identified for development should receive high priority (Medium priority);
- Control and monitor abundance of feral predators, especially cats, where there are known populations of EPP in areas of high quality habitat and encourage night-time curfews for cats on urban fringes adjacent to these habitats (Medium Priority);
- Provide map of known occurrences to Rural Fire Service and seek fire frequency of >10 years on Bush Fire Risk Management Plan(s), risk register and/or operation map(s)(High Priority);
- Reserve fire management strategies to include operational guidelines to protect this species from fire, with fire frequency of >10 years;
- Encourage research on appropriate fire and land management regimes for retention and recruitment of Eastern Pigmy Possum habitat (Medium Priority);
- Encourage research on the ecology, movements, habitat use and genetics of populations(Medium Priority);
- Encourage and support land managers to undertake management actions that benefit the species. (Control feral predators and rabbits, Avoid frequent burning of habitat; Protect habitat in proposed development areas and retain linkages across the broader landscape, Avoid overgrazing by stock and fire wood collection in areas of heathy understorey vegetation, Regenerate and replant local feed sources.

The proposal is unlikely to significantly compromise these priority actions developed to assist the recovery of the Eastern Pigmy Possum.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for these marsupial species.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for Eastern Pigmy Possum and Yellow-bellied Glider. Large areas of adjoining and nearby open forest contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European Red Fox is likely to have some impact on Squirrel Gliders in the local area. Eastern Pigmy Possum or Yellow-bellied Gliders foraging close to the ground may be subject to predation. The proposal is unlikely to result in an increase in fox numbers in the local area.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. Eastern Pigmy Possums and Yellow-bellied Gliders foraging close to the ground may be subject to predation. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **Predation and hybridation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. Eastern Pigmy Possums or Yellow-bellied Gliders foraging close to the ground may be subject to predation. The proposal is unlikely to result in an increase in Feral Dog numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential nesting trees and affect the availability of food resources.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for nesting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable nesting hollows for the Eastern Pigmy Possum or Yellow-bellied Glider. The proposal will result in the removal of a number of dead trees.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Squirrel Glider by increasing the intensity and frequency of Bushfires and droughts.

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32. Megachiropteran Bats

Syconycteris australis **Common Blossom-bat**

Description

Syconycteris australis (Common Blossom-bat) is a miniature species of flying-fox with fawn to reddish brown fur. It has large eyes, a long thin muzzle with raised nostrils and a very long tongue.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

In the southern part of its range (i.e. NSW) the combination of heathlands and coastal rainforest is essential. They have a foraging area of about 13ha of heathland and use the same area each night. The foraging area is rarely more than 4km from the roosting habitat. Banksias are the staple food source, however southern populations of *Syconycteris australis* also feed on the blossoms of paperbarks, bottlebrushes, bloodwoods and cultivated bananas. They actively forage for most of the night and continue to forage during rain and on strongly moonlit nights.

Roosting occurs amongst large leaves or amongst dense vines, with a number of different roost sites utilised. Roosts vary from canopy to sub-canopy and from forest edge to centre depending on the current weather conditions. These bats enter daily torpor if they have not eaten the previous night and the temperature falls below 26 degrees celsius. When in torpor their metabolic rate drops to 15% of their normal resting metabolic rate. In NSW, one young is usually born in October or November and another between February and April. Lactation lasts for up to 3 months. In northern Queensland breeding seems to occur continuously.

Distribution

Its distribution extends from the tropics, down eastern coast of Australia to south of the Port Macquarie area in NSW. It has recently been recorded at North Hawks Nest (Wildthing Environmental Consultants, 2012).

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Common Blossom Bat was not recorded within the study area during fieldwork. Open forest habitats within the study area were considered to provide suitable foraging and roosting habitat of varying quality. *Banksia serrata* (Old Man Banksia) a preferred foraging species was present over a large portion of the study area along with secondary foraging species such as *Melaleuca quinquenervia* (Broad-leaved Paperbark). The study area is situated south of the known distribution of this megachiropteran bat species with the nearest records located at North Hawks Nest (Wildthing Environmental Consultants, 2012). The proposal will involve the removal of foraging habitat such as *B. serrata* resulting in an incremental reduction of habitat in the local area. Specimens of *M. quinquenervia* will not be removed. Taking into consideration the location of the study area occurring outside the known distribution of the Common Blossom Bat and the large areas of suitable adjoining habitat within the local area the proposal is not likely to result in the extinction of any local population of this mobile species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following potential impacts to habitat for the Common Blossom Bat:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest (containing the foraging species *Banksia serrata*);

No areas of habitat are likely to become fragmented or isolated for this mobile species. The proposal will result in the incremental reduction in a relatively large fragment of adjoining habitat occurring along Stockton Bight. As the study area is located outside the known current distribution of the Common Blossom Bat no area of habitat important to the long-term survival is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the Common Blossom Bat. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of this species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help this species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of suitable foraging habitat.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The Red Fox would prey on this Megachiropteran bat species if feeding close to the ground or when young have inadvertently flown on to the ground.
- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. The Feral Cat would prey on this Megachiropteran bat species if feeding close to the ground or when young have inadvertently flown on to the ground.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The Feral Dog would prey on this Megachiropteran bat species if feeding close to the ground or when young have inadvertently flown on to the ground.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential cause direct mortality or impact on the availability of foraging habitat.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to compete for food such as nectar. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on the Common Blossom Bat by increasing the intensity and frequency of Bushfires and droughts.

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33. Microchiropteran Bats

Kerivoula papuensis **Golden-tipped Bat**

Description

The Golden-tipped Bat has dark brown, curly fur with bright golden tips. The distinctively coloured fur extends along the wings, legs and tail. It has a short, pointed, over-hanging muzzle and pointy, funnel-shaped ears. Adults weigh about 6 grams and have a wingspan of about 25 cm.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

The Golden-tipped Bat is found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. It is also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. This species roosts mainly in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests, also in tree hollows, dense foliage and epiphytes; located in rainforest gullies on small first and second-order streams. It is a specialist feeder on small web-building spiders.

Distribution

The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW. Also occurs in New Guinea.

Saccolaimus flaviventris **Yellow-bellied Sheathtail Bat**

Description

The Yellow-bellied Sheathtail-bat is a large, insectivorous bat up to 87 mm long. It has long, narrow wings, a glossy, jet-black back, and a white to yellow belly extending to the shoulders and just behind the ear. It has a flattened head and a sharply-pointed muzzle. The tail is covered with an extremely elastic sheath that allows variation in the tail-membrane area. Males have a prominent throat pouch; females have a patch of bare skin in the same place.

Conservation Status

Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

It has been reported from a wide variety of habitats. Hunting height appears to vary depending upon the height of the dominant vegetation in Eucalypt forests it feeds above the canopy, but in Mallee or open country it comes lower to the ground. Prey species include Beetles, Long-horned Grasshoppers, Shield Bugs and Flying Ants.

Usually solitary, but occasionally occurring in colonies of less than ten individuals, the Yellow-bellied Sheathtail-bat roosts in tree hollows, animal burrows, dry clay cracks, under rock slabs and in abandoned Sugar Glider nests. It has also been found resting on the walls of buildings in broad daylight, and one such individual, caught at Queanbeyan (NSW), appeared to be so exhausted that it made no effort to escape. Similar reports suggest that it is migratory in southern Australia and that individuals found resting in the open are in the course of a winter migration from the cooler to warmer areas. They have been reported from southern Australia only between January and June.

Males have a prominent throat-pouch which is devoid of glandular tissue but a sub-cutaneous gland lies behind it. The throat-pouch is represented by a rudimentary fold of skin in the female. There is no seasonal difference in testicular size in males and there is no relationship between reproductive condition in males and the size of the throat pouch. Pregnancy is always restricted to the right uterine horn. Single young are born between December and mid-March. Sub-adults have only been collected in January and February.

Distribution
This species is widespread across Australia and its apparent rarity is probably due to its flying so high and fast that it is seldom collected.

Myotis macropus **Southern Myotis**
Description
Myotis macropus (Large-footed Myotis) is similar to most other bats with a grey-brown fur colour. The main distinguishing feature of this species is its unusually large feet.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
Myotis macropus seldom occurs far from suitable water bodies which range from rainforest streams to large reservoirs and even brackish water. It hunts by raking the surface of the water for aquatic insects and small fish. Some aerial hunting also occurs for prey items include moths, beetles, crickets, cockroaches, flies and many water insects. It roosts in small colonies of between 15 and several hundred individuals with recorded roosts including caves, mines and disused railway tunnels as well as dense rainforest foliage in the tropical parts of its range. Some occurrences of roosting in tree hollows are also noted.

Distribution
The Large-footed Myotis has been recorded along much of the coastal strip of Australia occurring from the east of South Australia, around the Victorian, New South Wales, Queensland and Northern Territory coasts and into Western Australia as far as the Kimberleys (the northern population is likely to be a different subspecies - currently undergoing taxonomic revision). In N.S.W., the Large-footed Myotis is found in various habitats of the coast and adjacent ranges. Recently, it has also been found along the Murray River valley well into South Australia.

Mormopterus norfolkensis **Eastern Freetail-bat**
Description
Mormopterus norfolkensis (Eastern Freetail-bat) has dark brown to reddish brown fur on the back and is slightly paler below. Like other freetail-bats it has a long (3 - 4 cm) bare tail protruding from the tail membrane. Like other freetail-bats they have hairless faces with wrinkled lips and triangular ears.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology

Mormopterus norfolkensis occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.

Distribution

The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW.

Chalinolobus dwyeri **Long-eared Pied Bat**
Description
Chalinolobus dwyeri (Long-eared Pied Bat) is a small to medium-sized bat with long, prominent ears and glossy black fur. The lower body has broad white fringes running under the wings and tail-

membrane, meeting in a V-shape in the pubic area.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Vulnerable.

Habitat Requirements and Ecology

This species has been found occupying dry sclerophyll forest and woodland, both to the east and west of the Great Divide. Recordings of this species have also been made in subalpine woodland and at the ecotone of rainforest and wet Eucalypt forest. The Large-eared Pied Bat roosts in caves, abandoned mud-nests of Fairy Martins and mine tunnels. Colonies recorded have ranged in size from 3 to 37 individuals, and are usually located in the twilight area not far from the cave entrance.

Distribution

Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

Vespadelus troughtoni **Eastern Cave Bat**
Description
Vespadelus troughtoni (Eastern Cave Bat) is a small bat with light brown fur on its back and ginger tips mainly around the head. Fur on the belly is dark at the base with light fawn tips.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as Vulnerable under schedule 2.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
It is a cave-dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. In all situations, the roost sites are frequently in reasonably well-lit areas. Single-sex colonies varying in size from 6 to 50 individuals are more commonly recorded; however a large colony of 500 individuals of equal sex ratio has been recorded in a mine. Little is known of its diet and hunting behaviour. Similarly, information on reproductive activities is limited to the noted capture of lactating females in December in the Atherton Tablelands.

Distribution
Although it is widely distributed, relatively few records of this species exist, particularly in the southern part of its range where it appears to be localised. The main population stretches from Cape York south to the mid-north coast of NSW.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Neither *Mormopterus norfolkensis* (Eastern Freetail-bat), *Kerivoula papuensis* (Golden-tipped Bat), *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat), *Chalinolobus dwyeri*, *Myotis macropus* nor

Vespadelus troughtoni (Eastern Cave Bat) were identified within the study area during fieldwork despite the undertaking of harp trapping and echolocation call recording. The study area provided hunting habitat for all of these threatened microchiropteran bat species. Preferred hunting habitat in the form of suitable areas of surface water for *M. macropus* would be present on ephemeral areas of water within the area of Freshwater Wetland. Preferred roosting habitat in the form of tree hollows was present over the majority of the study area for *K. papuensis, S. flaviventris* and to a lesser extent *M. macropus.* Roosting habitat in the form of caves and similar man-made structures was not present within the study area for *C. dwyeri* and *V. troughtoni*.

A number of local records of *M. norfolkensis, S. flaviventris* and *M. macropus* are known to occur within similar habitat along the dunal forests of Stockton Bight (RPS, 2015) & (ERM, 2005). Few local records of *V. troughtoni, C. dwyeri* and *K. papuensis* were found to be present.

The proposal will result in the removal of approximately 25.90ha of Coastal Sand Apple Blackbutt Forest containing suitable hunting habitat for all six microchiropteran bat species. Approximately 877 hollow-bearing trees will also require removal. Other potential impacts include noise from the mine operation and artificial lighting.

A number of mitigation measures have been given in the report to reduce the impact of the proposed sand mine on these threatened microchiropteran bat species. These include:

- Protection of remaining habitat/vegetation;
- Rehabilitation of habitat within extraction area (11.74ha back to original forest type);
- Reduction of ongoing mine impacts such as noise and artificial lighting.
- Protection of fauna species during vegetation clearance;
- Provision of compensatory habitat (Offsetting);
- Relocation of hollow logs and tree hollows into remaining habitat;
- Feral Vertebrate Pest Control;
- Weed Control.

The proposal will result in a reduction in suitable habitat for all six microchiropteran bat species. Taking into consideration the large areas of similar adjoining habitat within the local area the proposal is not likely to result in the extinction of any local population of these microchiropteran bat species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following potential impacts to habitat for these microchiropteran bat species:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;
- The loss of approximately 877 hollow-bearing trees (potential roost sites for *M. norfolkensis, S. flaviventris* and *K. papuensis*);

No areas of habitat are likely to become fragmented or isolated for these mobile species. The proposal will result in the incremental reduction in a relatively large fragment of adjoining habitat occurring along Stockton Bight. No area of habitat important to the long-term survival of these microchiropteran bat species is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for these microchiropteran bat species. The OEH has prepared Priority Action Statements (PAS) to promote the recovery of this species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the study area have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. The removal of an area of open forest for the proposal will lead to an incremental reduction of habitat for these microchiropteran bat species.
- **Loss of Hollow-bearing Trees**: The proposal will result in the loss of approximately 877 hollow-bearing trees. Many of the trees where considered to be significant as a result of their very large size and presence of suitably sized nesting hollows for hollow-dependent microchiropteran bat species. Large areas of adjoining and nearby open forest are likely to contain similar densities and sizes of hollows.
- **Predation by the European Red Fox *Vulpes vulpes***: The European Red Fox was recorded within the site by Remote Camera and scat analysis on a number of occasions. The European

Red Fox may have some impact on microchiropteran bats in the local area particularly those roosting close to the ground. The proposal is unlikely to result in an increase in fox numbers in the local area.

- **Predation by the Feral Cat *Felis catus***: The Feral Cat was recorded within the study area during the remote camera survey and by identification of tracks. Microchiropteran Bats hunting or roosting close to the ground may be subject to predation. The proposal is unlikely to result in an increase in Feral Cat numbers in the local area.
- **High frequency fire resulting in the disruption of life cycle processors in plants and animals and loss of vegetation structure and composition**: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. Fire has the potential to destroy potential roosting trees and affect the availability of food resources.
- **Competition from feral honeybees *Apis mellifera*:** The Feral Honeybee has the potential to occupy hollows used for roosting. The proposal is unlikely to result in an increase in Feral Honeybees within the study area.
- **Removal of dead wood and dead trees:** Dead wood and dead trees were present within the study area. A number of dead trees would provide suitable roosting hollows for the hollow-dependent microchiropteran bat species. The proposal will result in the removal of a number of dead trees.
- **Human-caused Climate Change**: Has the potential to have an adverse effect on these microchiropteran bat species by increasing the intensity and frequency of Bushfires and droughts.

Other threats include:

- Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic;
- Destruction of caves that provide seasonal or potential roosting sites;
- Changes to habitat, especially surrounding maternity/nursery caves and winter roosts;
- Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals;
- Introduction of exotic pathogens such as the White-nosed fungus.

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34. Endangered Populations

***Dromaius novaehollandiae* (Emu) – population in the NSW North Coast Bioregion and Port Stephens LGA.**

Description
Dromaius novaehollandiae (Emu) is a is a large flightless bird that stands up to 1.9 m tall, with long legs and neck and shaggy grey-brown to dark-brown or grey-black plumage.

Conservation Status
Threatened Species Conservation Act 1995 – Listed as an Endangered Population.
Environmental Protection and Biodiversity Conservation Act 1999 – Not listed.

Habitat Requirements and Ecology
It occupies a range of predominantly open habitats, including plains, grasslands, woodlands and scrubs, and may occur occasionally in forest.

Distribution
The Emu is distributed broadly but patchily through NSW and elsewhere in Australia. An isolated population of Emus occurs in the NSW North Coast Bioregion and Port Stephens LGA. The population is disjunct from other populations in the Sydney Basin and New England Tableland Bioregion. The population of Emus in the NSW North Coast Bioregion and Port Stephens LGA represents the north-eastern limit of the species in NSW.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of sections 78, 79 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

The Emu was not recorded within the study area during fieldwork. Few recent local records for this bird species were present on the NSW Wildlife Atlas (OEH, 2015). Although the Emu prefers more open areas such as grassland and woodlands, open forest covering a large portion of the study area would provide some habitat for this flightless bird. The proposal will involve the removal of an area of suitable habitat resulting in an incremental reduction of habitat in the local area. Taking into consideration the paucity of recent local records and the relatively large amount of suitable surrounding habitat along Stockton Bight it is considered unlikely to cause extinction of the local population of the Emu.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed Sand Mine will result in the following potential impacts to habitat for these microchiropteran bat species:

- The loss of approximately 25.90ha of Coastal Sand Smooth-barked Apple Blackbutt Forest;

No areas of habitat are likely to become fragmented or isolated for this relatively mobile species. The proposal will result in the incremental reduction in a relatively large fragment of adjoining habitat occurring along Stockton Bight. No area of habitat important to the long-term survival of the Emu is likely to be removed, fragmented or isolated.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

None of the site has been designated 'critical habitat' under Part 3 of the TSC Act.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No Recovery or Threat Abatement Plan has been developed for the Emu population in the NSW North Coast Bioregion and Port Stephens LGA. The Department of Environment and Climate Change has prepared Priority Action Statements (PAS) to promote the recovery of this species and the abatement of key threatening processes in NSW. The Priority Action Statement identified a number of broad strategies to help these species recover in NSW. It is considered that the proposal does not significantly conflict with the PAS for this species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act that are relevant to the site have been listed in bold below followed by an assessment of the applicability of the threatening process in regards to the proposal and the species considered.

- **Clearing of Native Vegetation**: The clearing of vegetation is listed as a major factor contributing to the loss of biological diversity. Any future removal of vegetation will result in an incremental reduction in habitat for the Emu in the local area and may be viewed as being part of this Key Threatening Process. However, it is unlikely to be considered significant in relation to these species.
- **High frequency fire resulting in the disruption of life cycle processors in plants and**

animals and loss of vegetation structure and composition: It is difficult to ascertain the disruption and structural changes, if any, past fires have caused the study area. The proposal is unlikely to result in a change in the frequency of fire in the local area.

- **Predation by the European Red Fox *Vulpes vulpes*:** The Red Fox recorded within the study area at the time of the survey and would be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **Predation by the Feral Cat *Felis catus.*** The Feral Cat was recorded within the study area at the time of the survey and would be considered to have an impact on native fauna in the local area. The proposal is unlikely to result in an increase in the number of this introduced species.
- **Predation and hybridisation of Feral Dogs *Canis lupis famililaris*** The Feral Dog was recorded within the study area as a result of the remote camera surveys. The Feral Dog would prey on young Emu chicks. The proposal is unlikely to result in an increase in the number of this introduced species.

Bibliography:

NSW Scientific Committee (2002) *Emu Population in the NSW North Coast Bioregion and Port Stephens Local Government Area - Endangered Population Listing*. NSW Scientific Committee Final Determination. NSW Department of Environment, Climate Change and Water: Sydney.

APPENDIX F

HOLLOW-BEARING TREE SURVEY

Hollow-bearing Tree Data Key for Table F1.

- **DBH** – Diameter at Breast Height. Tree trunk diameter measured at breast height (1.4 metres above ground level). Fabric diameter tape used which assumes a circular cross section.
- **Tree Height** – Estimated with the use of an inclinometer and rangefinder (metres).
- **Coordinates - GDA - 1994**
- **Habitat/Hollows** –

  Class 1 – very large sized hollow openings (i.e. >20cm) suitable for species such as Owls

  Class 2 – large sized hollow openings (i.e. 15-20cm) suitable for species such as Possums and Owls

  Class 3 – medium sized hollow-openings (i.e. 5-15cm) suitable for species such as Gliders and Possums

  Class 4 – small sized hollow openings (i.e. <5cm) suitable for species such as microchiropteran bats.

- **Spout:** Hollow opening towards sky offering little protection from the weather.
- **Arboreal Termite Nest -** Termite nest within tree constructed by *Nasutitermes walkeri* - suitable for nesting bird species, particularly *Dacelo novaeguineae* (Laughing Kookaburra) and *Todiramphus sanctus* (Sacred Kingfisher). Also utilised by microchiropteran bat, reptile and arboreal mammal species.

- **Location of hollow-bearing trees:** Figures F1, F2 & F3.

Table F1: Details of hollow-bearing tree survey.

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1.	*Eucalyptus pilularis* Blackbutt	406355	6372951	0.9	27	1 x Class 3 1 x Class 4 1 x Arboreal termite nest	
2.	*E. pilularis*	406351	6372961	0.6	20	1 x Class 4	Leaning NE
3.	*Angophera costata* Smoothbarked Apple	406375	6372969	0.5	18	1 x Class 2 1 x Class 3 1 x Class 4	
4.	Dead treetrunk	406378	6372966	0.35	5	1 x Class 1 1 x Class 2 Spout	
5.	*E. pilularis*	406381	6372964	1.2	32	2 x Class 1 3 x Class 2 4 x Class 4	Large scar from base of tree
6.	Stag	406392	6372974	0.5	20	3 x Class 2 3 x Class 1 1 x arboreal termite nest	
7.	Stag	406390	6372980	0.45	18	1 x Class 2 Spout	
8.	*A. costata*	406399	6372983	0.65	20	1 x Class 4	
9.	*A. costata*	406400	6372983	0.6	27	1 x Class 3	
10.	*A. costata*	406399	6372992	0.7	20	1 x Class 3?	
11.	*E. pilularis*	406389	6373003	0.9	30	3 x Class 2 3 x Class 3 2 x Class 4	
12.	*E. pilularis*	406401	6373020	0.7	30	1 x Class 3 1 x Class 4	
13.	*E. pilularis*	406408	6373017	0.5	25	1 x Class 2 1 x Class 3 1 x Class 4	Smaller dead fork
14.	*E. pilularis*	406422	6373017	0.6	25	2 x Class 2 1 x Class 3 1 x Class 4	
15.	*A. costata*	406423	6373024	0.6	25	1 x Class 4?	
16.	*A. costata*	406426	6373024	0.7	25	2 x Class 4	
17.	*E. pilularis*	406418	6373051	0.6	25	1 x Class 4 Arboreal termite nest	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
18.	*E. pilularis*	406420	6373052	0.45	18	1 x Class 2 hollow at base 1 x Class 4	
19.	*E. pilularis*	406409	6373056	0.8	25	2 x Class 1 1 x Class 4	
20.	*E. pilularis*	406400	6373061	0.9	25	1 x Class 1	
21.	*A. costata*	406401	6373067	0.5	16	1 x Class 2 Spout	
22.	*E. pilularis*	406431	6373124	0.6	20	2 x Class 3	
23.	*E. pilularis*	406427	6373123	0.45	20	1 x Class 3 1 x Class 4	
24.	*E. pilularis*	406418	6373115	0.45	17	1 x Class 2	
25.	*E. pilularis*	406427	6373109	0.8	25	1 x Class 2	
26.	*E. pilularis*	406435	6373106	0.5	22	2 x Class 1	
27.	*E. pilularis*	406438	6373095	0.5	25	2 x Class 2 2 x Class 3 2 x Class 4 1 x Class 2 small forked arm from base	
28.	*A. costata*	406440	6373093	0.4	17	1 x Class 4	
29.	*A. costata*	406443	6373083	0.45	20	1 x Class 4	
30.	*A. costata*	406447	6373080	0.8	25	2 x Class 3 2 x Class 4 Arboreral termite nest	
31.	*E. pilularis*	406422	6373086	1	30	2 x Class 3 2 x Class 4 Arboreral termite nest	
32.	*A. costata*	406424	6373079	0.4	17	1 x Class 4?	
33.	*A. costata*	406424	6373064	0.4	17	1 x Class 4?	
34.	*E. pilularis*	406430	6373058	0.6	25	2 x Class 3 2 x Class 3	
35.	*Dead trunk*	406430	6373054	0.4	5	1 x Class 3	
36.	*E. pilularis*	406441	6373049	0.4	15	1 x Class 4 1 x Knot	
37.	*A. costata*	406447	6373029	0.8	17	1 x Class 3 2 x Class 4 1 x Arboreal termite nest	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
38.	*E. pilularis*	406453	6373010	0.7	25	1 x Class 2 2 x Class 3 2 x Class 4	
39.	*A. costata*	406432	6372996	0.7	30	2 x Class 2 2 x Class 3	
40.	*E. pilularis*	406431	6372987	0.7	25	1 x Class 3 1 x Class 4 1 x Arboreal termite nest with holes	Sacred Kingfisher nest?
41.	*E. pilularis*	406421	6372984	0.8	30	2 x Class 1 (1 at base) 1 x Class 3 1 x Class 4	
42.	*E. pilularis*	406415	6372964	0.9	25	1 x Class 2? 2 x Class 3?	
43.	*E. pilularis*	406452	6372964	0.7	18	1 x Class 4	
44.	*E. pilularis*	406461	6372971	0.8	22	1 x Class 4	
45.	*E. pilularis*	406459	6372979	0.6	20	1 x Class 4	
46.	*E. pilularis*	406461	6372983	0.6	20	1 x Class 2 1 x Class 3	
47.	*A. costata*	406454	6372992	0.7	18	1 x Class 2 1 x Class 4	
48.	*E. pilularis*	406448	6372993	0.55	22	1 x Class 2 2 x Class 3	
49.	*E. pilularis*	406478	6373008	0.5	20	2 x Class 2	
50.	*E. pilularis*	406487	6373019	0.8	20	2 x Class 2 2 x Class 3 1 x Class 4 Arboreal termite nest	
51.	*E. pilularis*	406487	6373023	0.45	15	1 x Class 3 1 x Class 4	
52.	*E. pilularis*	406486	6373033	0.5	16	1 x Class 2 1 x Class 1	
53.	*E. pilularis*	406477	6373029	0.8	20	1 x Class 3 1 x Class 4	
54.	*E. pilularis*	406464	6373027	0.3	10	1 x Class 2 1 x Class 3	
55.	*E. pilularis*	406451	6373028	0.5	20	1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
56.	*E. pilularis*	406464	6373054	0.6	20	1 x Class 3	
57.	*E. pilularis*	406478	6373065	0.6	18	1 x Class 3 1 x Class 2	
58.	*E. pilularis*	406476	6373067	0.7	19	1 x Class 3 (dead branch)	
59.	*E. pilularis*	406480	6373069	0.5	20	1 x Class 4	
60.	*E. pilularis*	406475	6373074	0.6	20	1 x Class 4 Arboreal termite nest	
61.	*A. costata*	406472	6373080	0.6	20	1 x Class3	
62.	*A. costata*	406447	6373060	0.6	20	3 x Class 3 2 x Class 4 Arboreal termite nest	
63.	*E. pilularis*	406439	6373056	0.75	22	2 x Class 3 1 x Class 4	
64.	*E. pilularis*	406435	6373087	0.5	18	1 x Class 2 1 x Class 3	
65.	*E. pilularis*	406457	6373095	0.7	25	1 x Class 3	
66.	*A. costata*	406454	6373092	0.5	18	1 x Class 3	
67.	*A. costata*	406457	6373088	0.45	17	1 x Class 2 2 x Class 3	
68.	*E. pilularis*	406493	6373121	0.55	18	1 x Class 4	
69.	*E. pilularis*	406471	6373112	0.7	22	1 x Class 4 2 x Class 2	
70.	*E. pilularis*	406461	6373109	0.5	18	Class 4	
71.	*A. costata*	406457	6373117	0.55	18	1 x Class 4	Photo No. 5648 Small scratches, bracket fungus
72.	*E. pilularis*	406466	6373125	0.7	20	1 x Class 3 1 x Class 4	
73.	*E. pilularis*	406459	6373127	0.6	22	2 x Class 4	
74.	*A. costata*	406463	6373128	0.45	15	1 x Class 3 1 x Class 4	
75.	*E. pilularis*	406467	6373147	1	25	1 x Class 1 3 x Class 2 2 x Class 3 3 x C lass 4	
76.	*E. pilularis*	406439	6373142	0.7	17	1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
77.	*E. pilularis*	406423	6373149	1	17	3 x Class 1 3 x Class 2 2 x Class 4	Photo no. 5649 Large shallow hole at base
78.	*A. costata*	406418	6373144	0.6	17	2 x Class 2 2 x Class 3	
79.	*E. pilularis*	406411	6373124	0.9	22	1 x Class 2 1 x Class 4	
80.	*A. costata*	406444	6373118	0.65	22	1 x Class 3 1 x Class 4	
81.	*E. pilularis*	406404	6373107	0.8	15	1 x Class 1	Spout in trunk joining large hollow at base
82.	*E. pilularis*	406398	6373103	0.4	17	1 x Class 1	Hollow in dead branch
83.	*E. pilularis*	406394	6373108	0.5	18	1 x Class 3	
84.	*A. costata*	406388	6373113	0.7	22	1 x Class 3 1 x Class 4	
85.	*E. pilularis*	406367	6373127	0.5	20	1 x Class 1 2 x Class 2 1 x Class 3	
86.	*E. pilularis*	406356	6373110	0.95	30	2 x Class 2 1 x Class 3	
87.	*E. pilularis*	406339	6373109	0.8	25	1 x Class 1 2 x Class 3 2 x Class 4	
88.	*E. pilularis*	406334	6373095	0.7	25	2 x Class 2 1 x Class 4	
89.	*A. costata*	406337	6373091	0.65	22	1 x Class 2 1 x Class 3	
90.	*A. costata*	406339	6373086	0.45	20	1 x Class 4	
91.	*A. costata*	406338	6373086	0.3	10	1 x Class 3	
92.	*E. pilularis*	406341	6373083	0.6	20	2 x Class 2 2 x Class 3 with *Apis mellifera* (European Honey Bee) nest. 2 x Class 4	Photo No. 5653 Sandy burrow at base.
93.	*A. costata*	406350	6373082	0.4	12	1 x Class 2 2 x Class 4	
94.	*E. pilularis*	406351	6373082	1	22	2 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						3 x Class 3 2 x Class 4	
95.	*E. pilularis*	406364	6373068	0.75	20	1 x Class 1 (dead spout) 3 x Class 2 1 x Class 3	Goanna scratches?
96.	*E. pilularis*	406366	6373065	1	25	2 x Class 2	
97.	*A. costata*	406365	6373049	0.4	18	1 x Class 2	
98.	*A. costata*	406363	6373038	0.6	20	1 x Class 4 Stick birds nest (bird of prey or Aus. Raven?)	Photo no. 5654
99.	*E. pilularis*	406372	6373047	0.5	20	2 x Class 3 1 x Class 4	
100.	*A. costata*	406374	6373047	0.3	13	1 x Class 3	
101.	*E. pilularis*	406376	6373044	0.6	20	2 x Class 3 2 x Class 4	
102.	*E. pilularis*	406384	6373050	0.8	25	1 x Class 2 2 x Class 3 1 x Class 4	
103.	*E. pilularis*	406380	6373089	0.6	25	1 x Class 2 1 x Class 3 1 x Class 4	
104.	*E. pilularis*	406378	6373091	0.6	25	1 x Class 2 2 x Class 3	
105.	*A. costata*	406381	6373094	0.45	18	1 x Class 4 1 x Class 3	
106.	Dead tree	406380	6373103	0.4	15	3 x Class 4	
107.	*E. pilularis*	406397	6373086	0.7	25	1 x Class 2 3 x Class 3 Arboreal termite nest	
108.	*E. pilularis*	406380	6373029	0.6	22	1 x Class 2 1 x Class 3	
109.	*E. pilularis*	406361	6372983	0.9	25	2 x Class 3 2 x Class 4	
110.	*E. pilularis*	406354	6372977	0.8	22	1 x Class 1 1 x Class 2 2 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						Arboreal termite nest	
111	*E. pilularis*	406379	6372923	1	30	3 x Class 2 1 x Class 3	Trimmed for easement
112	*E. pilularis*	406373	6372914	0.4	15	1 x Class 2	Hollow in dead branch
113	*A. costata*	406378	6372909	0.45	16	1 x Class 4	
114	*E. pilularis*	406394	6372892	1.1	18	1 x Class 1 2 x Class 2 Arboreal termite nest	Photo no. 5656 1 Class 2 full of dirt
115	*E. pilularis*	406400	6372913	0.8	17	2 x Class 1	
116	*E. pilularis*	406405	6372901	0.4	15	1 x Class 3	
117	*E. pilularis*	406418	6372912	0.9	20	1 x Class 2 2 x Class 3 Arboreal termite nest Large shallow hole at base	
118	*Dead trunk*	406420	6372904	0.35	4	1 x Class 1 through trunk	
119	*E. pilularis*	406427	6372917	0.6	20	2 x Class 3	
120	*E. pilularis*	406432	6372914	0.65	20	2 x Class 2 1 x Class 3 1 x Class 1	
121	*E. pilularis*	406436	6372917	0.8	22	1 x Class 2 1 x Class 4	Photo no. 5658 Dead scar through tree
122	*E. pilularis*	406455	6372915	0.9	25	4 x Class 2 3 x Class 3 1 x Class 4 Arboreal termite nest	
123	*E. pilularis*	406460	6372903	0.7	22	2 x Class 3 2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
124	*E. pilularis*	406440	6372898	0.5	20	2 x Class 3 1 x Class 4	1 Class 3 in trunk
125	*E. pilularis*	406440	6372889	0.5	12	2 x Class 2	
126	*E. pilularis*	406440	6372886	0.65	20	1 x Class 3 1 x Class 4 Arboreal termite nest	
127	*E. pilularis*	406455	6372874	0.75	22	1 x Class 1 in trunk 4m up 2 x Class 4 1 x Class 3	Photo no. 5659
128	*E. pilularis*	406459	6372877	0.4	18	2 x Class 2	
129	*E. pilularis*	406459	6372862	0.8	22	1 x Class 1 2 x Class 2 1 x Class 4	
130	*A. costata*	406464	6372873	0.4	10	1 x Class 4	Scratches
131	*E. pilularis*	406465	6372879	0.5	17	1 x Class 1 Spout full of dirt 1 x Class 2 1 x Class 3 1 x Class 4 Arboreal termite nest	
132	*E. pilularis*	406473	6372883	0.4	12	1 x Class 3 1 x Class 4	
133	*E. pilularis*	406470	6372897	0.6	20	1 x Class 3	
134	*E. pilularis*	406473	6372901	0.6	20	1 x Class 3	
135	*E. pilularis*	406470	6372907	0.7	20	3 x Class 2 1 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
136	*E. pilularis*	406471	6372920	0.6	20	2 x Class 2 1 x Class 4 Arboreal termite nest	
137	*E. pilularis*	406469	6372936	1	22	1 x Class 3 1 x Class 4	
138	*E. pilularis*	406485	6372933	0.6	18	2 x Class 1	Photo no. 5661 1 in trunk, 1 at base
139	*A. costata*	406492	6372920	0.4	12	1 x Class 3 7m up	
140	*E. pilularis*	406494	6372920	0.5	18	1 x Class 4	
141	*E. pilularis*	406498	6372919	0.5	18	2 x Class 3	
142	*E. pilularis*	406493	6372909	0.8	18	1 x Class 4	
143	*E. pilularis*	406493	6372907	0.5	18	1 x Class 2 1 x Class 3 1 x Class 4	
144	*E. pilularis*	406482	6372913	0.45	20	1 x Class 3	
145	*E. pilularis*	406483	6372916	0.6	20	2 x Class 3	1 in trunk
146	*E. pilularis*	406482	6372918	0.6	20	1 x Class 4	Scar at base
147	*A. costata*	406408	6372876	0.7	10	1 x Class 1 through trunk 1 x Class 2	Fine scratches
148	*E. pilularis*	406413	6372872	0.6	15	1 x Class 1 spout	3 forks of tree
149	*A. costata*	406416	6372867	0.45	16	1 x Class 4?	
150	*E. pilularis*	406426	6372842	0.5	18	1 x Class 4	
151	*A. costata*	406438	6372820	0.7	18	1 x Class 3 2 x Class 4	
152	*E. pilularis*	406467	6372850	1.2, 0.9	25	1 x Class 1 2 x Class 2 3 x Class 3	2 forks of tree

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
153	*E. pilularis*	406464	6372836	0.65	25	3 x Class 3 3 x Class 4	
154	*E. pilularis*	406471	6372836	1	25	2 x Class 3 3 x Class 4	
155	*E. pilularis*	406486	6372859	0.7	25	1 x Class 4	
156	*A. costata*	406490	6372859	0.4	17	1 x Class 4	
157	*A. costata*	406499	6372857	0.75	16	1 x Class 1 spout full of dirt	
158	*A. costata*	406495	6372863	0.8	18	1 x Class 1 1 x Class 3	
159	*E. pilularis*	406478	6372872	0.5	20	1 x Class 3	
160	*E. pilularis*	406479	6372874	0.5	22	1 x Class 1 full of dirt 1 x Class 2	
161	Dead tree	406478	6372875	0.3	7	2 x Class 1 1 at base, 1 spout	Hollow running through trunk
162	*E. pilularis*	406476	6372870	0.65	20	2 x Class 3 1 x Class 4	
163	*E. pilularis*	406478	6372863	0.5	18	1 x Class 1	
164	*A. costata*	406483	6372866	0.4	18	1 x Class 4?	
165	*E. pilularis*	406476	6372867	0.45	18	1 x Class 3	
166	*E. pilularis*	406471	6372869	0.5	20	1 x Class 3	
167	*E. pilularis*	406488	6372881	0.55	20	1 x Class 3 1 x Class 4	
168	*E. pilularis*	406510	6372876	0.65	20	1 x Class 2 1 x Class 3 1 x Class 4	
169	*E. pilularis*	406510	6372888	0.9	18	1 x Class 1 open spout	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
170	*E. pilularis*	406517	6372850	0.7	16	1 x Class 3 1 x Class 4	
171	*A. costata*	406539	6372857	0.7	20	3 x Class 1 3 x Class 4	
172	*A. costata*	406531	6372860	0.7	18	1 x Class 3 1 x Class 4	
173	*A. costata*	406522	6372858	0.4	17	1 x Class 4	
174	*E. pilularis*	406523	6372873	0.45	17	2 x Class 4 Arboreal termite nest	
175	*E. pilularis*	406522	6372876	0.55	20	1 x Class 3	
176	*E. pilularis*	406524	6372881	0.5	18	1 x Class 2 dead end branch	
177	Dead Tree	406531	6372885	0.5	6	1 x Class 1	Hollow running through middle of trunk to top
178	*E. pilularis*	406536	6372872	0.65	20	1 x Class 1 1 x Class 2	
179	*A. costata*	406443	6372817	0.5	18	3 x Class 3	
180	*A. costata*	406460	6372822	0.4	18	2 x Class 4	
181	*E. pilularis*	406475	6372829	1.2	20	1 x Class 1 1 x Class 3	Two forks of tree
182	*E. pilularis*	406490	6372837	0.7	20	1 x Class 2 1 x Class 3 2 x Class 4	
183	*A. costata*	406496	6372837	0.65	16	1 x Class 1 Possible nest 1 x Class 3	Photo No. 4169
184	*A. costata*	406509	6372848	0.5	18	1 x Class 2 1 x Class 3 1 x Class 4?	
185	*E. pilularis*	406512	6372847	0.55	20	3 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
186	*E. pilularis*	406535	6372860	0.9	16	1 x Class 1 at base 1 x Class 1 at spout 1 x Class 3	Five forks of tree
187	*E. pilularis*	406549	6372870	0.8	20	1 x Class 4	
188	*E. pilularis*	406543	6372879	1	18	1 x Class 1 at base 2 x Class 2 1 x Class 3	
189	*E. pilularis*	406541	6372887	0.9	20	1 x Class 1 at base 2 x Class 2 1 x Class 3	
190	*E. pilularis*	406534	6372890	0.6	20	1 x Class2?	
191	*A. costata*	406528	6372887	0.45	18	1 x Class 2 2 x Class 3 1 x Class 4	
192	*A. costata*	406525	6372887	0.5	18	1 x Class 4 2 x Class 4?	
193	*A. costata*	406551	6372888	0.45	16	1 x Class 3	
194	*E. pilularis*	406554	6372888	0.55	16	3 x Class 2 1 x Class 3	
195	*A. costata*	406564	6372886	0.5	18	1 x Class 3? 1 x Class 4?	
196	*E. pilularis*	406563	6372877	0.7	18	1 x Class 4 in trunk - worn around edge.	Two forks of tree
197	*M. quinquenervia*	406564	6372866	0.65	20	1 x Class 2 in trunk 1 x Class 4?	
198	*E. pilularis*	406569	6372896	0.65	20	1 x Class 1 1 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
199	*E. pilularis*	406565	6372900	0.5	18	1 x Class 3	
200	Dead tree	406562	6372900	0.45	16	1 x Class 1 1 x Class 2 2 x Class 3 1 x Class 4 crack through trunk.	Hollow through entire trunk
201	*E. pilularis*	406562	6372900	0.6	18	1 x Class 2?	
202	*E. pilularis*	406547	6372901	0.5	16	2 x Class 2 2 x Class 3	Tree growing on a lean
203	*A. costata*	406547	6372902	0.4	16	1 x Class 3 1 x Class 4?	
204	*A. costata*	406567	6372907	0.15	8	1 x Class 4	
205	*E. pilularis*	406574	6372904	0.6	18	2 x Class 3 2 x Class 4	
206	*E. pilularis*	406579	6372902	0.6	18	1 x Class 2 Arboreal termite nest with hole	
207	*A. costata*	406583	6372903	0.45	16	1 x Class 3 1 x Class 4	
208	*E. pilularis*	406597	6372903	1.1	22	2 x Class 1	
209	*A. costata*	406611	6372918	0.5	18	2 x Class 3 2 x Class 4	
210	*E. pilularis*	406612	6372918	0.9	20	1 x Class 1 1 x Class 2 2 x Class 3	
211	*M. quinquenervia*	406626	6372926	0.7	20	1 x Class 2 1 x Class 3 in trunk 2 x Class 4	
212	*M. quinquenervia*	406632	6372932	0.6	18	1 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
213	*M. quinquenervia*	406639	6372933	0.5	18	1 x Class 3	
214	*E. pilularis*	406643	6372939	0.55	16	2 x Class 2	
215	*E. pilularis*	406641	6372945	0.55	18	1 x Class 2	
216	*E. pilularis*	406644	6372951	0.5	14	2 x Class 1 1 x Class 3	
217	*E. pilularis*	406648	6372963	1.3	20	2 x Class 1 1 x Class 2 1 x Class 3 1 x Class 4 Arboreal termite nest with hole.	Three forks in tree. Tree has been cut back
218	*A. costata*	406637	6372942	0.45	18	2 x Class 4?	
219	*E. pilularis*	406634	6372941	0.8	20	2 x Class 4	
220	*E. pilularis*	406620	6372939	1	22	1 x Class 2 1 x Class 3 Arboreal termite nest with hole	
221	*E. pilularis*	406604	6372936	1.1	22	1 x Class 1 4 x Class 2 3 x Class 3	Two forks in tree
222	*E. pilularis*	406597	6372947	0.9	20	2 x Class 3	
223	*A. costata*	406579	6372938	0.6	20	1 x Class 3	
224	*E. pilularis*	406581	6372931	0.6	20	2 x Class 3 Arboreal termite nest	
225	*A. costata*	406590	6372926	0.6	16	3 x Class 3 1 x Class 4	Scratches on tree
226	*A. costata*	406603	6372925	0.45	18	2 x Class 3 1 x Class 4	
227	*E. pilularis*	406585	6372913	0.45	18	3 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
228	*E. pilularis*	406572	6372920	0.5	20	1 x Class 1? 1 x Class 3 1 x Class 4	
229	*E. pilularis*	406560	6372918	0.55	20	2 x Class 2 5 x Class 3 2 x Class 4	
230	*A. costata*	406558	6372915	0.5	20	1 x Class 3? 2 x Class 4?	
231	Dead tree	406557	6372918	0.5	6	1 x Class 1 through trunk	
232	*A. costata*	406553	6372919	0.45	16	1 x Class 4	
233	*E. pilularis*	406548	6372923	0.6	20	2 x Class 3 1 x Class 4	
234	*A. costata*	406544	6372921	0.5	18	2 x Class 3 1 x Class 4 Arboreal termite nest	
235	*A. costata*	406543	6372920	0.4	12	1 x Class 2 1 x Class 4	
236	*A. costata*	406540	6372921	0.4	8	2 x Class 3	
237	Dead tree	406537	6372934	0.45	10	3 x Class 2 2 x Class 3	Hollow through trunk
238	Dead tree	406533	6372929	0.4	8	1 x Class 1 spout 2 x Class 2	
239	*A. costata*	406528	6372923	0.45	14	2 x Class 3 1 x Class 4?	
240	*A. costata*	406524	6372908	0.45	14	2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
241	*E. pilularis*	406518	6372910	0.85	18	2 x Class 1 at base 5 x Class 2 2 x Class 4	
242	*A. costata*	406516	6372907	0.55	18	3 x Class 4	
243	*A. costata*	406511	6372911	0.45	18	4 x Class 3 2 x Class 4 Arboreal termite nest	
244	*A. costata*	406509	6372911	0.45	16	1 x Class 3 1 x Class 4?	
245	*E. pilularis*	406505	6372907	0.5	16	Arboreal termite nest	
246	*E. pilularis*	406500	6372901	0.6	20	1 x Class 2 2 x Class 3	
247	*E. pilularis*	406501	6372891	0.65	20	2 x Class 1 3 x Class 2 2 x Class 3 1 x Class 4	
248	*A. costata*	406501	6372935	0.45	18	2 x Class 4	
249	*A. costata*	406511	6372935	0.5	16	1 x Class 3 1 x Class 4	
250	*A. costata*	406522	6372926	0.7	18	1 x Class 1 at spout 4 x Class 3 2 x Class 4	
251	*E. pilularis*	406522	6372934	0.9	20	1 x Class 2 1 x Class 3?	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
252	*E. pilularis*	406350	6372992	0.7	18	3 x Class 2 3 x Class 3 2 x Class 4 Large arboreal termite nest with holes	
253	*A. costata*	406336	6373022	0.5	16	2 x Class 2 3 x Class 3	
254	*E. pilularis*	406332	6373020	0.45	14	1 x Class 1 at base full of dirt 1 x Class 2 1 x Class 4	Tree leaning south
255	*A. costata*	406342	6373030	0.7	8	1 x Class 1 spout 1 x Class 2 at side	Live trunk Large goanna scratches
256	*A. costata*	406338	6373042	0.5	14	1 x Class 3 1 x Class 4?	
257	*A. costata*	406306	6373059	0.5	16	1 x Class 4	
258	*A. costata*	406300	6373064	0.4	14	1 x Class 4 in dead part of trunk	
259	*A. costata*	406299	6373058	0.5	16	1 x Class 4	
260	*A. costata*	406290	6373075	0.6	16	1 x Class 1 Spout 2 x Class 3	
261	*A. costata*	406273	6373099	0.3	20	1 x Class 3	
262	*E. pilularis*	406256	6373115	0.7	22	3 x Class 3 1 x Class 4	
263	*E. pilularis*	406267	6373117	0.4	16	1 x Class 2	
264	*E. pilularis*	406246	6373122	0.75	22	1 x Class 3 2 x Class 4	
265	*E. pilularis*	406235	6373124	0.65	22	3 x Class 1	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
266	*E. pilularis*	406216	6373148	1.1	25	3 x Class 3 2 x Class 2 2 x Class 4	
267	*E. pilularis*	406243	6373144	0.95	25	2 x Class 1	
268	*E. pilularis*	406235	6373148	1.2	23	3 x Class 1 (1 very large) 2 x Class 4 1 x Class 2	
269	*A. costata*	406253	6373151	0.4	17	1 x Class 4	
270	*E. pilularis*	406262	6373149	0.55	16	2 x Class 4	Leaning tree
271	*E. pilularis*	406270	6373143	0.55	16	1 x Class 3 1 x Class 4	Leaning tree
272	*E. pilularis*	406268	6373137	0.5	18	1 x Class 3 broken off trunk	
273	*E. pilularis*	406275	6373130	0.5	18	1 x Class 4	
274	*E. pilularis*	406281	6373127	0.9	20	Large knot 2 x Class 1 2 x Class 2 2 x Class 3 1 x Class 4	Leaning NE
275	*A. costata*	406295	6373126	0.5	15	2 x Class 4	Lace Monitor scratches
276	*E. pilularis*	406291	6373150	0.55	18	1 x Class 2 1 x Class 3 1 x Class 4	
277	*E. pilularis*	406291	6373161	0.5	20	1 x Class 2	
278	*E. pilularis*	406294	6373168	0.7	18	2 x Class 1 2 x Class 2 1 x Class 4	Dead side branch

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
279	*E. pilularis*	406281	6373167	0.5	18	Hollow in trunk 1 x Class 2 (narrow)	
280	*E. pilularis*	406270	6373160	0.6	18	1 x Class 1 (opening at base hollow through trunk) 3 x Class 2 1 x Class 3	
281	*E. pilularis*	406255	6373187	0.85	14	2 x Class 2 Dead spouts	
282	*Dead tree*	406264	6373200	0.35	8	1 x Class 2 spout	
283	*Dead tree*	406270	6373196	0.4	10	3 x Class 2 1 at base, hollow through middle	
284	*E. pilularis*	406278	6373188	0.5	18	1 x Class 4	
285	*Dead tree*	406286	6373183	0.4	10	2 x Class 2 2 x Class 3 2 x Class 4	
286	*A. costata*	406301	6373184	0.4	14	2 x Class 4	
287	*E. pilularis*	406310	6373192	0.85	18	1 x Class 1 2 x Class 2 1 x Class 3 1 x Class 4	
288	*Dead tree*	406308	6373177	0.45	10	1 x Class 2 2 x Class 3 1 x Class 4	
289	*A. costata*	406313	6373160	0.35	11	2 x Class 2 (1 at base)	*Lomandra longifolia* growing up in tree.

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
290	*E. pilularis*	406323	6373173	0.45	12	1 x Class 2 2 x Class 4	
291	*E. pilularis*	406339	6373161	0.5	18	1 x Class 4	
292	*E. pilularis*	406346	6373167	0.5	17	1 x Class 2 1 x Class 3	
293	*E. pilularis*	406338	6373174	0.55	18	1 x Class 4	
294	*Dead tree*	406321	6373152	0.5	12	1 x Class 1 at spout	
295	*E. pilularis*	640325	6373145	0.5	16	1 x Class 4	
296	*E. pilularis*	406329	6373145	0.5	16	1 x Class 4	
297	*A. costata*	406330	6373139	0.35	14	2 x Class 4	
298	*E. pilularis*	406332	6373137	0.5	18	1 x Class 3 1 x Class 4	
299	*E. pilularis*	406336	6373136	0.5	20	1 x Class 3	
300	*E. pilularis*	406340	6373125	0.5	15	1 x Class 1 spout.	
301	*E. pilularis*	406340	6373135	0.55	22	1 x Class 2 2 x Class 3 (1 at base, 1 narrow hollow near base)	
302	*E. pilularis*	406345	6373140	0.55	18	1 x Class 3 1 x Class 4	
303	*A. costata*	406344	6373155	0.55	17	1 x Class 4	
304	*E. pilularis*	406345	6373175	0.8	22	2 x Class 4	
305	*Dead trunk*	406368	6373165	1	18	3 x Class 1 (1 full of dirt with *Lomandra longifolia*) 1 x Class 2	
306	*E. pilularis*	406382	6373167	0.65	20	1 x Class 2 2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
307	*E. pilularis*	406392	6373166	0.75	20	1 x Class 4	
308	*E. pilularis*	406373	6373190	0.7	20	1 x Class 2 1 x Class 4	
309	*E. pilularis*	406372	6373188	0.5	15	1 x Class 3	
310	*E. pilularis*	406352	6373192	0.65	18	1 x Class 4	
311	*E. pilularis*	406342	6373191	1.1	30	2 x Class 1 3 x Class 2 3 x Class 3 1 x Class 4	
312	*E. pilularis*	406329	6373199	0.6	20	1 x Class 4 2 x Class 3	
313	*E. pilularis*	406322	6373198	0.5	17	3 x Class 3	
314	*E. pilularis*	406320	6373194	0.5	18	1 x Class 2 1 x Class 4?	
315	*E. pilularis*	406393	6373209	0.5	18	1 x Class 2 1 x Class 3 (dead side branch) 1 x Class 4	
316	*E. pilularis*	406292	6373220	0.7	22	2 x Class 3	
317	*E. pilularis*	406277	6373214	0.5	20	1 x Class 3 1 x Class 2	
318	*E. pilularis*	406305	6373219	0.5	17	1 x Class 3	
319	*E. pilularis*	406310	6373222	0.6	17	1 x Class 2 1 x Class 3 1 x Class 4	
320	*E. pilularis*	406310	6373237	0.55	18	1 x Class 1 (full of dirt) 1 x Class 2 2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
321	*E. pilularis*	406495	6373175	0.55	20	4 x Class 4	
322	*E. pilularis*	406486	6373174	0.5	18	1 x Class 3 2 x Class 4	
323	*A. costata*	406481	6373169	0.3	16	1 x Class 4	Fine scratches
324	*E. pilularis*	406475	6373172	0.65	22	1 x Class 3 2 x Class 4	
325	*E. pilularis*	406472	6373168	0.5	16	1 x Class 3 1 x Class 4	
326	*A. costata*	406452	6373158	0.45	18	1 x Class 3 3 x Class 4	Scratches
327	*E. pilularis*	406466	6373188	0.5	20	1 x Class 1 4 x Class 3 1 x Class 4	
328	*E. pilularis*	406460	6373192	0.55	16	1 x Class 2 3 x Class 4	leaning tree
329	*E. pilularis*	40676	6373191	0.55	16	1 x Class 2 1 x Class 3 2 x Class 4	leaning tree
330	*A. costata*	406499	6373196	0.5	20	1 x Class 2	
331	*E. pilularis*	406512	6373193	0.6	22	1 x Class 4	
332	*E. pilularis*	406536	6373222	0.5	22	2 x Class 1 1 x Class 3	Bird whitewash under canopy.
333	*E. pilularis*	406534	6373231	0.5	22	2 x Class 3 2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
334	*Dead tree*	406521	6373244	0.75	20	Hollow through trunk 2 x Class 1 3 x Class 3 5 x Class 4	
335	*A. costata*	406505	6373247	0.85	18	4 x Class 1 2 x Class 2 1 x Class 3 2 x Class 4	Large scratches
336	*E. pilularis*	406514	6373231	0.5	20	2 x Class 3	
337	*E. pilularis*	406507	6373226	0.5	20	1 x Class 3	
338	*E. pilularis*	406502	6373214	0.55	20	3 x Class 4 1 x Class 3	Small arboreal termite nest.
339	*A. costata*	406485	6373215	0.45	17	1 x Class 3	
340	*E. pilularis*	406472	6373226	0.75	20	1 x Class 2 2 x Class 3 1 x Class 4 from scar at base	Leaning tree
341	*E. pilularis*	406462	6373208	0.7	18	2 x Class 1 2 x Class 2 2 x Class 4	
342	*A. costata*	406444	6373208	0.5	20	1 x Class 4?	
343	*E. pilularis*	406434	6373211	0.5	18	1 x Class 4	
344	*E. pilularis*	406432	6373201	0.55	18	1 x Class 4?	
345	*E. pilularis*	406433	6373177	0.6	18	2 x Class 3	
346	*A. costata*	406434	6373171	0.35	16	1 x Class 4	
347	*A. costata*	406402	6373191	0.6	18	1 x Class 4	Scratches
348	*E. pilularis*	406373	6373211	0.6	18	1 x Class 4	
349	*E. pilularis*	406349	6373226	0.7	20	1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
350	*E. pilularis*	406332	6373221	0.65	20	1 x Class 1 2 x Class 2 1 x Class 3 1 x Class 4	
351	*E. pilularis*	406327	6373206	0.55	22	1 x Class 4	
352	*E. pilularis*	406329	6373242	0.6	20	2 x Class 2 2 x Class 3	
353	*E. pilularis*	406329	6373232	0.5	18	1 x Class 3	
354	*A. costata*	406315	6373239	0.35	15	1 x Class 3	
355	*E. pilularis*	406214	6373159	0.5	14	1 x Class 2	Leaning
356	*A. costata*	406203	6373158	0.5	16	1 x Class 4?	
357	*E. pilularis*	406195	6373168	0.9	18	1 x Class 1 1 x Class 2 3 x Class 3 2 x Class 4	
358	*E. pilularis*	406194	6373207	0.7	20	2 x Class 3 2 x Class 4	
359	*E. pilularis*	406199	6373211	0.6	18	1 x Class 2	
360	*E. pilularis*	406200	6373224	0.6	20	2 x Class 3 2 x Class 4	
361	*A. costata*	406200	6373232	0.55	16	1 x Class 1 1 x Class 2	
362	*E. pilularis*	406206	6373233	0.6	18	1 x Class 3 1 x Class 4	
363	*E. pilularis*	406207	6373238	0.45	15	2 x Class3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
364	*E. pilularis*	406211	6373244	0.8	18	2 x Class 1 1 x Class 2 2 x Class 3	
365	*E. pilularis*	406223	6373259	0.85	18	2 x Class 3 Long narrow hollow at base, hollow through trunk.	
366	*A. costata*	406209	6373189	0.5	16	1 x Class 1 1 x Class 4	
367	*E. pilularis*	406210	6373192	0.45	12	1 x Class 1 spout	
368	*E. pilularis*	406218	6373201	0.5	16	1 x Class 4	
369	*E. pilularis*	406222	6373203	0.75	18	2 x Class 2 2 x Class 3 2 x Class 4	
370	*E. pilularis*	406228	6373197	0.5	18	1 x Class 2	
371	*E. pilularis*	406233	6373201	0.55	20	2 x Class 2 1 x Class 3 1 x Class 4	
372	*Dead trunk*	406241	6373205	0.55	9	Hollow through trunk 1 x Class 1 1 x Class 2 opening	
373	*A. costata*	406242	6373214	0.5	20	2 x Class 4	
374	*E. pilularis*	406248	6373239	0.85	20	4 x Class 1 2 x Class 2	Scratches
375	*E. pilularis*	406260	6373231	0.7	18	2 x Class 2 1 x Class 4	
376	*E. pilularis*	406271	6373234	0.6	18	2 x Class 2	
377	*E. pilularis*	406275	6373236	0.3	12	1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
378	*E. pilularis*	406274	6373241	0.8	18	1 x Class 1 spout maybe full of dirt	
379	*E. pilularis*	406257	6373256	0.6	14	Hollow through middle 1 x Class 1 1 x class 2 1 x Class 3 1 x Class 4	Leaning
380	*E. pilularis*	406246	6373258	0.65	18	1 x Class 1 1 x Class 2 1 x Class 4	
381	*E. pilularis*	406240	6373271	0.55	18	1 x Class 2 1 x Class 4	
382	*Dead trunk*	406248	6373270	0.5	10	1 x Class 1 Spout 1 x Class 2 side branch	
383	*E. pilularis*	406249	6373263	0.65	22	3 x Class 2 1 x Class 3 1 x Class 4	
384	*E. pilularis*	406257	6373285	0.55	20	2 x Class 4	
385	*E. pilularis*	406240	6373301	1.2	25	2 x Class 1 1 x Class 3 at base 1 x Class 2	Photo No. 6441 Potential Owl tree
386	*E. pilularis*	406261	6373299	0.5	18	1 x Class 3	
387	*E. pilularis*	406280	6373307	0.65	22	1 x Class 1 dead side branch 2 x Class 2 1 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
388	*A. costata*	406290	6373304	0.25	8	1 x Class 3 1 x Class 4	
389	*E. pilularis*	406290	6373301	0.5	22	2 x Class 2 1 x Class 3	
390	*E. pilularis*	406290	6373290	0.6	22	1 x Class 3 2 x Class 4	
391	*E. pilularis*	406282	6373280	0.7	25	2 x Class 2 2 x Class 3 2 x Class 4	
392	*A. costata*	406294	6373281	0.45	20	1 x Class 4	
393	*Dead trunk*	406294	6373274	0.4	8	Hollow through trunk 1 x Class 1 spout 1 x Class 2 at base 1 x Class 4	
394	*A. costata*	406302	6373277	0.4	14	1 x Class 4	
395	*A. costata*	406303	6373275	0.45	15	1 x Class 4	
396	*E. pilularis*	406297	6373265	0.55	16	1 x Class 4	
397	*E. pilularis*	406288	6373257	0.8	22	1 x Class 3 2 x Class 4	
398	*E. pilularis*	406307	6373252	0.85	22	Large opening at base 2 x Class 2 2 x Class 3	
399	*A. costata*	406306	6373258	0.3	12	1 x Class 3	
400	*E. pilularis*	406303	6373249	1.1	22	3 x Class 2 1 x Class 3 2 x Class 4	
401	*E. pilularis*	406293	6373241	0.4	15	1 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
402	*E. pilularis*	406296	6373232	0.5	20	1 x Class 3 1 x Class 4	
403	*E. pilularis*	406342	6373249	0.7	22	1 x Class 1 spout with dirt 3 x Class 2 1 x Class 3 1 x Class 4	
404	*E. pilularis*	406326	6373264	1.1	22	3 x Class 3 4 x Class 4	
405	*E. pilularis*	406327	6373295	0.55	20	1 x Class 4	
406	*Dead trunk*	406349	6373301	0.45	6	1 x Class 1 spout	
407	*E. pilularis*	406335	6373297	0.5	18	2 x Class 3 1 x Class 4	
408	*E. pilularis*	406332	6373310	0.9	22	1 x Class 3 3 x Class 4	
409	*E. pilularis*	406313	6373311	0.55	20	3 x Class 4	
410	*E. pilularis*	406344	6373318	0.8	20	1 x Class 1 2 x Class 2 1 x Class 4	
411	*E. pilularis*	406356	6373323	0.55	20	2 x Class 3	
412	*E. pilularis*	406363	6373326	0.6	20	Possible 1 x Class 1 at spout 1 x Class 2 used at base 1 x Class 3	
413	*E. pilularis*	406408	6373141	0.7	20	1 x Class 4	
414	*E. pilularis*	406563	6373243	0.9	30	1 x Class 1 1 x class 2 3 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
415	*E. pilularis*	406559	6373263	0.9	28	2 x Class 1 1 x class 2 3 x Class 3 2 x Class 4 Arboreal termite nest Potential owl tree	Arboreal termite nest Potential owl tree
416	*E. pilularis*	406601	6373249	1	30	5 x Class 1 3 x class 2 3 x Class 3 5 x Class 4	Potential owl tree
417	*E. pilularis*	406633	6373296	0.75	25	3 x class 2 4 x Class 3 2 x Class 4	
418	*E. pilularis*	406632	6373300	0.55	25	1 x class 2	
419	*A. costata*	406634	6373296	0.45	16	1 x class 4	
420	*E. pilularis*	406635	6373314	0.8	28	2 x Class 1 3 x class 2 3 x Class 3 3 x Class 4	
421	*E. pilularis*	406648	6373345	0.8	28	1 x class 4	
422	*E. pilularis*	406662	6373371	0.55	25	1 x class 2 1 x Class 3 1 x Class 4	
423	*A. costata*	406571	6373303	0.6	18	1 x class 1 large spout 1 x Class 1 in trunk	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
424	*E. pilularis*	406541	6373280	0.8	28	1 x Class 3 1 x Class 4	
425	*E. pilularis*	406540	6373276	0.6	25	1 x Class 3	
426	*E. pilularis*	406544	6373270	0.7	25	1 x Class 3 1 x Class 4	
427	*E. pilularis*	406517	6373269	0.5	18	1 x Class 3 1 x Class 4	
428	*E. pilularis*	406514	6373275	0.65	20	1 x Class 2 1 x Class 4	
429	*E. pilularis*	406504	6373264	0.7	25	1 x Class 4	
430	*E. pilularis*	406503	6373271	0.45	14	1 x Class 3 1 x Class 4	
431	*E. pilularis*	406491	4373281	1	28	1 x Class 1 large opening 7 m up trunk 3 x class 2 3 x Class 3 2 x Class 4	
432	*E. pilularis*	406518	6373289	0.6	20	1 x Class 3 1 x Class 4	
433	*E. pilularis*	406504	6373296	0.75	20	1 x Class 2 1 x Class 3 1 x Class 4	
434	*A. costata*	406487	6373298	0.5	15	1 x Class 1 large giant spout	Evidence of Yellow Tailed Cockatoos feeding

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
435	*E. pilularis*	406464	6373296	0.7	20	1 x Class 1 2 x Class 3 1 x Class 4	
436	*E. pilularis*	406459	6373296	0.5	20	1 x Class 4	
437	*E. pilularis*	406454	6373293	0.75	20	1 x Class 1 1 x Class 2 1 x Class 3 2 x Class 4	
438	*E. pilularis*	406481	6373246	0.8	22	2 x Class 3 1 x Class 4	
439	*E. pilularis*	406476	6373242	0.45	18	2 x Class 4	
440	*E. pilularis*	406464	6373243	0.6	22	1 x Class 2 1 x Class 3	
441	*E. pilularis*	406457	6373219	0.55	20	1 x Class 4	
442	*E. pilularis*	406434	6373227	0.7	22	1 x Class 2 2 x Class 3 2 x Class 4	Arboreal termite nest
443	*E. pilularis*	406462	6373222	0.55	20	1 x class 2 2 x Class 4	Arboreal termite nest
444	*E. pilularis*	406425	6373220	0.5	18	1 x Class 3	
445	*E. pilularis*	406412	6373211	0.85	26	1 x Class 3 1 x Class 4	
446	*E. pilularis*	406387	6373206	0.5	18	1 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
447	*E. pilularis*	406393	6373216	0.9	14	1 x Class 1	Top of tree broken off recently Potential owl tree.
448	*E. pilularis*	406397	6373229	0.65	20	Arboreal termite nest 1 x Class 1 2 x Class 3 1 x Class 4	
449	*E. pilularis*	406407	6373238	0.95	25 leaning	2 x class 2 2 x Class 3 1 x Class 4	
450	*E. pilularis*	406423	6373253	0.9	22	1 x Class 3 1 x Class 4	
451	*E. pilularis*	406436	6373286	0.65	20	1 x Class 3 1 x Class 4	
452	*E. pilularis*	406464	6373261	0.65	20	1 x Class 3	Arboreal termite nest
453	*E. pilularis*	406413	6373279	0.65	20	1 x Class 2 3 x Class 3 3 x Class 4	
454	*E. pilularis*	406404	6373281	0.75	25	1 x Class 1 opening at base 1 x Class 1 2 x Class 2 1 x Class 3	
455	*E. pilularis*	406401	6373281	0.5	18	1 x Class 2	
456	*E. pilularis*	406387	6373291	0.5	20	1 x Class 3 1 x Class 4	Arboreal termite nest

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
457	*E. pilularis*	406383	6373293	0.65	20	1 x Class 3 2 x Class 4	
458	*E. pilularis*	406377	6373304	2 x 0.7 forks	20	2 x Class 2 1 x Class 3 1 x Class 4	
459	*E. pilularis*	406395	6373305	0.6	18	1 x Class 4	
460	*E. pilularis*	406406	6373300	0.55	18	1 x Class 3	
461	*E. pilularis*	406410	6373292	0.8	25	1 x Class 1 1 x Class 3	
462	*E. pilularis*	406340	6373272	0.4	14	1 x Class 2	
463	*E. pilularis*	406343	6373279	0.55	18	1 x Class 3 1 x Class 4	
464	*E. pilularis*	406350	6373290	0.85	22	1 x Class 1 1 x Class 2 2 x Class 4	
465	*E. pilularis*	406362	6373296	0.6	15	1 x Class 3 1 x Class 4	
466	*E. pilularis*	406372	6373329	0.6	18	1 x Class 2	
467	*E. pilularis*	406391	6373347	0.75	20	2 x Class 4	
468	*E. pilularis*	406388	6373333	0.45	20	1 x Class 3	
469	*Dead tree*	406401	6373351	0.45	8	1 x Class 1 spout 1 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
470	*E. pilularis*	406417	6373356	0.65	22	1 x Class 1 shallow hollow at base 1 x Class 1 1 x Class 3 1 x Class 4	Arboreal termite nest
471	*E. pilularis*	406417	6373360	0.45	14 leaning	1 x Class 3	
472	*A. costata*	406406	6373340	0.45	20	1 x Class 4	
473	*A. costata*	406406	6373336	0.3	17	1 x Class 3	
474	*E. pilularis*	406407	6373341	0.45	16	1 x Class 2 1 x Class 3 in trunk	
475	*E. pilularis*	406410	6373328	0.8	20	2 x Class 3 1 x Class 4	*Lomandra longifolia* growing on tree.
476	*E. pilularis*	406423	6373333	0.7	22	1 x Class 2 2 x Class 4	
477	*E. pilularis*	406437	6373339	0.8	20	3 x Class 1 1 x Class 2 3 x Class 3 2 x Class 4	
478	*E. pilularis*	406441	6373338	0.7	20	2 x Class 2 1 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
479	*E. pilularis*	406446	6373333	0.7	22	1 x Class 1 2 x Class 2 1 x Class 3 1 x Class 4	
480	*E. pilularis*	406439	6373333	0.5	20 leaning	1 x Class 2 1 x Class 3	
481	*E. pilularis*	406452	6373316	0.5	18	1 x Class 2 1 x Class 3	
482	*E. pilularis*	406447	6373315	0.65	22	2 x Class 4	
483	*E. pilularis*	406427	6373318	0.9	22	3 x Class 1 1 x class 1 at base 4 x Class 2	Potential Owl tree
484	*E. pilularis*	406429	6373307	1	22 leaning	2 x Class 1 4 x Class 2 3 x Class 3 2 x Class 4	
485	*A. costata*	406449	6373302	0.6	18	1 x Class 1 spout shallow	
486	*E. pilularis*	406465	6373315	1.1	30	3 x Class 2 2 x Class 3 2 x Class 4	
487	*E. pilularis*	406474	6373313	0.65	22	2 x Class 2 1 x Class 3 2 x Class 4	
488	*E. pilularis*	406500	6373309	0.55	20	1 x Class 2 1 x Class 4	
489	*E. pilularis*	406507	6373315	0.55	20	1 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
490	*E. pilularis*	406487	6373346	0.7	30	1 x Class 2 1 x Class 3 2 x Class 4	
491	*E. pilularis*	406479	6373334	0.5	20	1 x Class 4	
492	*E. pilularis*	406478	6373328	0.75	20	1 x Class 2 1 x Class 4	
493	*A. costata*	406473	6373327	0.5	12	1 x Class 1 spout	
494	*E. pilularis*	406462	6373342	0.55	20	1 x Class 4	
495	*E. pilularis*	406453	6373360	0.8	20	1 x Class 1 1 x Class 2 1 x Class 3 3 x Class 4	
496	*E. pilularis*	406449	6373391	0.55	22	1 x Class 1 2 x Class 2 1 x Class 4	
497	*A. costata*	406440	6373389	0.45	16	1 x Class 3 1 x Class 4	
498	*A. costata*	406438	6373385	0.5	25	1 x Class 4	Scratches on truck consistent with a small arboreal mammal such as a Squirrel Glider.
499	*E. pilularis*	406428	6373398	0.45	16	1 x Class 2 1 x Class 3 2 x Class 4	
500	*E. pilularis*	406404	6373396	0.75	20	2 x Class 2 1 x Class 3 3 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
501	*E. pilularis*	406501	6373337	0.8	25	2 x Class 1 3 x Class 2 2 x Class 3 1 x Class 4	Lace Monitor observed in tree.
502	*E. pilularis*	406516	6373334	0.9	25	2 x Class 2 3 x Class 3 2 x Class 4	
503	*E. pilularis*	406523	6373320	0.95	30	1 x Class 3 2 x Class 4	
504	*E. pilularis*	406534	6373322	0.55	22	1 x Class 2 1 x Class 3	
505	*E. pilularis*	406544	6373325	0.7	25	1 x Class 1 2 x Class 2 3 x Class 3	
506	*A. costata*	406560	6373332	0.55	16	2 x Class 2 2 x Class 4 Scratches on tree	
507	*A. costata*	406554	6373336	0.5	18	1 x Class 3 1 x Class 4	
508	*E. pilularis*	406559	6373345	0.65	18	1 x Class 1 ? spout 1 x Class 4	Arboreal termite nest
509	*E. pilularis*	406563	6373346	0.55	18	2 x Class 2	
510	*Dead Tree*	406567	6373350	0.6	12	3 x Class 1 3 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
511	*E. pilularis*	406547	6373347	0.75	22	2 x Class 2 4 x Class 3 2 x Class 4	
512	*E. pilularis*	406542	6373300	0.6	22	1 x Class 1 at base 1 x Class 4	
513	*E. pilularis*	406587	6373317	0.65	22	1 x Class 2 1 x Class 3 1 x Class 4	
514	*A. costata*	406178	6373210	0.5	14	1 x Class 1 full of dirt 1 x Class 1 Spout 1 x Class 2	
515	*E. pilularis*	406156	6373213	0.75	20	2 x Class 1 1 x Class 2 Arboreal termite nest	
516	*A. costata*	406158	6373220	0.45	16	1 x Class 2 2 x Class 3	
517	*E. pilularis*	406168	6373232	0.8	25	2 x Class 1 (1 scar high in tree) 1 x Class 2 2 x Class 3 (1 scar through tree)	Arboreal termite nest
518	*E. pilularis*	406173	6373243	0.65	25	1 x Class 1 1 x Class 2 1 x Class 3 at base 1 x Class 4	
519	*E. pilularis*	406155	6373243	0.65	25	1 x Class 3 2 x Class 4	Arboreal termite nest

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
520	*A. costata*	406155	6373244	0.2	15	1 x Class 3 (1.8m up trunk)	
521	*A. costata*	406162	6373255	0.4	8	1 x Class 1 Spout	Scratches
522	*A. costata*	406160	6373255	0.55	8	1 x Class 1 open scar 1 x Class 3	
523	*A. costata*	406169	6373256	0.7	18	1 x Class 1 spout with dirt	
524	*E. pilularis*	406170	6373252	0.65	20	1 x Class 1 2 x Class 3	
525	*E. pilularis*	406125	6373265	0.9	25	1 x Class 3 2 x Class 4	
526	*A. costata*	406132	6373266	0.45	14	1 x Class 1 spout	
527	*E. pilularis*	406144	6373280	0.5	18	1 x Class 2 2 x Class 4	
528	*Dead tree*	406140	6373282	0.3	8	1 x Class 2 1 x Class 3 hollow throughout	
529	*E. pilularis*	406142	6373281	0.65	20	1 x Class 2 2 x Class 4	
530	*E. pilularis*	406143	6373288	0.9	30	1 x Class 2 scar throughout with hollow cracks 2 x Class 2 4 x Class 3 2 x Class 4 Lomandra growing in hollows	
531	*E. pilularis*	406142	6373287	0.75	25	2 x Class 3	
532	*A. costata*	406139	6373286	0.3	10	1 x Class 3	
533	*A. costata*	406125	6373281	0.4	20	1 x Class 3	
534	*A. costata*	406114	6373285	0.75	18	3 x Class 1	*Lomandra longifolia* growing out of one hollow.

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
535	*A. costata*	406098	6373293	0.5	20	2 x Class 2	Scratches
536	*A. costata*	406097	6373294	0.45	18	1 x Class 2	
537	*E. pilularis*	406124	6373298	0.75	22	2 x Class 1 2 x Class 2 2 x Class 3	
538	*E. pilularis*	406125	6373298	0.6	22	3 x Class 1 2 x Class 4	
539	*E. pilularis*	406127	6373303	0.55	22	1 x Class 3 1 x Class 4	
540	*E. pilularis*	406131	6373308	0.6	25	1 x Class 2 1 x Class 4	
541	*E. pilularis*	406152	6373310	0.6	22	2 x Class 2 2 x Class 3 1 x Class 4	
542	*E. pilularis*	406167	6373303	0.65	22	1 x Class 1 4 x Class 2 4 x Class 3 3 x Class 4	Large number of fauna scratches on trunk.
543	*E. pilularis*	406172	6373300	0.7	25	1 x Class 1 1 x Class 4	
544	*E. pilularis*	406172	6373305	0.65	25	1 x Class 1 2 x Class 2 2 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
545	*E. pilularis*	406176	6373290	1.1	30	1 x Class 1 1 x Class 2 5 x Class 3 2 x Class 4	
546	*E. pilularis*	406145	6373309	0.55	18	1 x Class 1 1 x Class 4?	
547	*E. pilularis*	406138	6373316	1.1	30	1 x Class 1 4 x Class 2 6 x Class 3 2 x Class 4	
548	*E. pilularis*	406102	6373316	0.75	25	2 x Class 3 2 x Class 4	
549	*E. pilularis*	406093	6373340	0.65	25	2 x Class 3 1 x Class 4	
550	*E. pilularis*	406083	6373379	0.75	30	1 x Class 3?	
551	*E. pilularis*	406088	6373385	0.85	20	1 x Class 1 scar from base 3 x Class 3	
552	*A. costata*	406096	6373365	0.6	25	1 x Class 3 2 x Class 4	
553	*B. serrata*	406138	6373368	0.5	18	2 x Class 2	
554	*A. costata*	406138	6373369	0.5	20	3 x Class 3 2 x Class 4	Fauna scratches
555	*E. pilularis*	406129	6373381	0.6	22	1 x Class 3	Fauna scratches

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
556	*E. pilularis*	406128	6373386	0.65	22	1 x Class 1 2 x Class 2 3 x Class 3 3 x Class 4	*Lomandra longifolia* growing in tree.
557	*A. costata*	406119	6373393	0.5	20	3 x Class 2	Fauna scratches
558	*E. pilularis*	406100	6373391	1.2	30	1 x Class 1 at base 3 x Class 1 1 x Class 2 2 x Class 3 3 x Class 4	
559	*Dead tree*	406097	6373396	0.65	12	4 x Class 1 3 x Class 2 2 x Class 3	
560	*E. pilularis*	406092	6373427	0.65	22	2 x Class 4	Fauna scratches
561	*E. pilularis*	406097	6373427	0.6	22	1 x Class 2 3 x Class 3 2 x Class 4	
562	*A. costata*	406112	6373436	0.4	18	2 x Class 3 Scratches	
563	*E. pilularis*	406108	6373425	0.55	20	2 x Class 4	
564	*E. pilularis*	406113	6373424	0.9	25	2 x Class 4	
565	*Dead Tree*	406130	6373431	0.5	10	2 x Class 1 Hollow throughout	
566	*E. pilularis*	406139	6373429	1.2	30	4 x Class 3 3 x Class 4	
567	*A. costata*	406135	6373422	0.5	16	2 x Class 3	Fauna scratches

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
568	*A. costata*	406135	6373417	0.45	18	1 x Class 3 1 x Class 4 at base	Fauna scratches
569	*E. pilularis*	406165	6373400	0.8	25	2 x Class 2 2 x Class 3	
570	*E. pilularis*	406184	6373401	1	30	2 x Class 1 4 x Class 2 3 x Class 3 2 x Class 4	*Lomandra longifolia* growing in tree.
571	*E. pilularis*	406184	6373415	0.7	26	2 x Class 3	
572	*E. pilularis*	406183	6373416	0.5	22	1 x Class 2 1 x Class 3?	
573	*A. costata*	406188	6373433	0.5	25	3 x Class 4	
574	*A. costata*	406172	6373442	0.6	18	2 x Class 2 1 x Class 3?	Fauna scratches
575	*A. costata*	406186	6373437	0.5	20	3 x Class 3 3 x Class 4	
576	*E. pilularis*	406208	6373439	0.55	20	4 x Class 2 1 x Class 3	
577	*E. pilularis*	406207	6373433	0.6	22	2 x Class 3 1 x Class 4	
578	*E. pilularis*	406236	6373427	0.75	22	1 x Class 2 1 x Class 3 1 x Class 4 scar opening 1m up 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
579	*E. pilularis*	406231	6373418	0.6	20	2 x Class 1 3 x Class 2 1 x Class 3	
580	*Dead Tree*	406224	6373410	0.5	8	3 x Class 1 spout hollow throughout	
581	*E. pilularis*	406229	6373413	0.7	22	2 x Class 1 1 x Class 2 1 x Class 4	
582	*E. pilularis*	406239	6373419	0.5	20	1 x Class 1 1 x Class 4	
583	*E. pilularis*	406249	6373431	0.8	25	2 x Class 1 3 x Class 2 1 x Class 3	
584	*E. pilularis*	406235	6373284	0.75	25	1 x Class 1 2 x Class 2 2 x Class 3	Arboreal Termite nest
585	*E. pilularis*	406215	6373284	0.7	25	3 x Class 1 (1 at base) 2 x Class 2 1 x Class 3	
586	*E. pilularis*	406215	6373285	0.8	25	4 x Class 1 (1 at base) 2 x Class 2 3 x Class 3 1 x Class 4	
587	*E. pilularis*	406207	6373294	0.85	25	1 x Class 3	
588	*Dead tree*	406189	6373297	0.6	5	1 x Class 1 spout with *Lomandra longifolia*	Tree hollow through middle.

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
589	*E. pilularis*	406193	6373291	0.65	22	1 x Class 1 1 x Class 2 3 x Class 3 2 x Class 4	
590	*E. pilularis*	406183	6373269	0.55	22	1 x Class 2 1 x Class 3 1 x Class 4	
591	*A. costata*	406188	6373267	0.3	16	1 x Class 3	
592	*E. pilularis*	406190	6373264	0.55	20	1 x Class 3 1 x Class 4	Arboreal termite nest.
593	*E. pilularis*	406199	6373265	0.55	20	1 x Class 3 1 x Class 4	
594	*E. pilularis*	406201	6373276	0.55	20	1 x Class 1 1 x Class 3 1 x Class 4	
595	*E. pilularis*	406228	6373318	0.7	22	3 x Class 1 2 x Class 2 1 x Class 3 1 x Class 4	
596	*E. pilularis*	406232	6373319	0.65	20	1 x Class 2 2 x Class 3 1 x Class 4	
597	*E. pilularis*	406221	6373318	0.55	22	2 x Class 1 2 x Class 2 4 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
598	*E. pilularis*	406217	6373320	0.7	22	1 x Class 2	
599	*E. pilularis*	406195	6373322	0.65	22	1 x Class 2?	
600	*E. pilularis*	406195	6373323	0.6	22	3 x Class 3	Arboreal termite nest
601	*B. serrata*	406231	6373310	0.5	7	1 x Class 3 1 x Class 3 at base	
602	*Dead tree*	406196	6373326	0.25	6	1 x Class 3 spout	
603	*A. costata*	406189	6373328	0.45	10	2 x Class 4	
604	*E. pilularis*	406186	6373329	0.6	18	2 x Class 4	
605	*Dead tree*	406183	6373327	0.3	8	2 x Class 4	
606	*B. serrata*	406182	6373320	0.45	12	1 x Class 3 spout	
607	*E. pilularis*	406162	6373338	0.7	20	1 x Class 3 1 x Class 4	
608	*E. pilularis*	406159	6373338	0.6	18	1 x Class 2	
609	*E. pilularis*	406162	6373347	0.5	18	1 x Class 1 in trunk	
610	*E. pilularis*	406128	6373343	0.65	18	2 x Class 4	
611	*B. serrata*	406108	6373353	0.4	6	1 x Class 4 scar	
612	*E. pilularis*	406101	6373353	0.5	18	2 x Class 3 2 x Class 4	
613	*E. pilularis*	406094	6373345	0.5	18	2 x Class 4	
614	*Dead Tree*	406092	6373341	0.2	8	1 x Class 4 spout	
615	*E. pilularis*	406089	6373338	0.55	19	2 x Class 4	
616	*Dead Tree*	406103	6373316	0.45	14	1 x Class 3 2 x Class 4	
617	*A. costata*	406118	6373314	0.4	16	1 x Class 3 shallow	
618	*A. costata*	406117	6373332	0.6	17	2 x Class 4	
619	*E. pilularis*	406108	637338	0.55	18	2 x Class 4	
620	*E. pilularis*	406099	6373343	0.5	18	2 x Class 4	
621	*E. pilularis*	406143	6373390	0.5	18	2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
622	*E. pilularis*	406157	6373381	0.5	18	1 x Class 4	
623	*E. pilularis*	406170	6373365	0.65	18	2 x Class 3 1 x Class 4	
624	*E. pilularis*	406172	6373350	0.55	18	2 x Class 3 1 x Class 4	
625	*Dead Tree*	406172	6373350	0.2	3	1 x Class 4 spout	
626	*E. pilularis*	406173	6373353	0.65	19	1 x Class 3 1 x Class 4	
627	*E. pilularis*	406174	6373354	0.7	20	1 x Class 2 4 x Class 3 2 x Class 4	
628	*E. pilularis*	406192	6373355	0.75	20	1 x Class 1 1 x Class 2 1 x Class 3 1 x Class 4	
629	*A. costata*	406201	6373365	0.2	5	2 x Class 4	
630	*E. pilularis*	406201	6373365	0.7	20	3 x Class 2 1 x Class 4	
631	*E. pilularis*	406214	6373361	0.55	18	1 x Class 1 1 x Class 1 scar in trunk	Arboreal Termite Nest
632	*E. pilularis*	406225	6373372	0.65	18	1 x Class 2 1 x Class 4	
633	*E. pilularis*	406229	6373377	0.65	18	2 x Class 4	
634	*E. pilularis*	406235	6373389	0.55	18	1 x Class 3 1 x Class 4	
635	*E. pilularis*	406258	6373433	0.8	20	1 x Class 3 1 x Class 4	
636	*A. costata*	406259	6373432	0.4	4	1 x Class 2 spout	
637	*E. pilularis*	406258	6373433	0.65	18	1 x Class 2 1 x Class 3 1 x Class 4	
638	*A. costata*	406257	6373421	0.5	16	1 x Class 1 Scar	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
639	*A. costata*	406262	6373421	0.75	17	4 x Class 1 1 x Class 2 1 x Class 3	
640	*E. pilularis*	406267	6373416	0.8	18	2 x Class 1 4 x Class 2 1 x Class 4	
641	*E. pilularis*	406276	6373393	0.7	18	1 x Class 1 2 x Class 2 1 x Class 4	
642	*B. serrata*	406278	6373380	0.5	15	1 x Class 3 in trunk	
643	*E. pilularis*	406273	6373379	0.8	19	1 x Class 3	
644	*A. costata*	406269	6373375	0.5	18	1 x Class 3	
645	*E. pilularis*	406255	6373367	0.6	17	1 x Class 1 1 x Class 3	
646	*A. costata*	406253	6373365	0.6	17	2 x Class 2 1 x Class 3 1 x Class 4	
647	*E. pilularis*	406255	6373368	0.7	18	2 x Class 3	
648	*E. pilularis*	406255	6373373	0.7	18	1 x Class 1 1 x Class 2 1 x Class 3	
649	*A. costata*	406224	6373352	0.45	18	1 x Class 4	
650	*E. pilularis*	406227	6373340	0.4	16	1 x Class 3 1 x Class 4	
651	*E. pilularis*	406231	6373341	0.6	18	2 x Class 3	
652	*A. costata*	406239	6373357	0.5	16	2 x Class 4	
653	*E. pilularis*	406243	6373353	0.5	17	1 x Class 2 1 x Class 3	
654	*E. pilularis*	406247	6373343	0.6	18	1 x Class 2 2 x Class 3	
655	*E. pilularis*	406250	6373340	0.65	18	3 x Class 3 1 x Class 4	
656	*E. pilularis*	406295	6373345	0.75	18	1 x Class 1	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						1 x Class 2 1 x Class 3 1 x Class 4 Lomandra	
657	*E. pilularis*	406279	6373342	0.6	16	1 x Class 1 1 x Class 2 with *Lomandra longifolia* 2 x Class 3	
658	*E. pilularis*	406279	6373348	0.8	8	1 x Class Spout	
659	*A. costata*	406266	6373354	0.4	5	1 x Class 2 Spout	
660	*E. pilularis*	406284	6373372	0.55	16	1 x Class 2 1 x Class 3	
661	*E. pilularis*	406293	6373429	0.7	18	3 x Class 3 2 x Class 4	
662	*E. pilularis*	406312	6373414	1.1	20	3 x Class 1 2 x Class 2 1 x Class 4	
663	*A. costata*	406320	6373404	0.5	18	1 x Class 3 2 x Class 4	
664	*E. pilularis*	406324	6373399	0.8	18	3 x Class 3 1 x Class 4	
665	*E. pilularis*	406331	6373386	0.85	20	1 x Class 2 1 x Class 3	
666	*B. serrata*	406324	6373386	0.4	16	1 x Class 4 scar	
667	*E. pilularis*	406306	6373385	0.7	18	1 x Class 2 1 x Class 3	
668	*E. pilularis*	406312	6373371	0.7	20	1 x Class 1 2 x Class 2 1 x Class 4	
669	*E. pilularis*	406298	6373359	0.65	20	1 x Class 1 2 x Class 2	
670	*E. pilularis*	406306	6373339	0.55	18	2 x Class 2 2 x Class 3	
671	*E. pilularis*	406328	6373354	0.9	20	1 x Class 1 at base 1 x Class 1 2 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						1 x Class 3	
672	*E. pilularis*	406333	6373363	0.5	17	1 x Class 1 Spout	
673	*E. pilularis*	406335	6373363	0.65	17	1 x Class 1 Spout 1 x Class 2	
674	*E. pilularis*	406349	6373386	1	20	5 x Class 1 4 x Class 2 2 x Class 3	
675	*A. costata*	406354	6373389	0.5	18	1 x Class 3 1 x Class 4	
676	*A. costata*	406384	6373403	0.65	17	1 x Class 1 Spout 1 x Class 1 Scar 1 x Class 2 at base 1 x Class 4	
677	*A. costata*	406402	6373403	0.6	18	1 x Class 2 2 x Class 3	
678	*E. pilularis*	406381	6373395	0.7	18	1 x Class 2 2 x Class 3 1 x Class 4	
679	*E. pilularis*	406382	6373394	0.5	18	2 x Class 2 1 x Class 4	
680	*A. costata*	406383	6373388	0.35	12	1 x Class 4 Spout 1 x Class 4 Scar	
681	*E. pilularis*	406381	6373384	0.7	18	2 x Class 2 3 x Class 4	
682	*E. pilularis*	406378	6373376	0.55	18	2 x Class 4	
683	*Dead tree*	406374	6373364	0.65	6	1 x Class 1 Spout 2 x Class 1 Hollow throughout	
684	*E. pilularis*	406353	6373361	0.6	18	2 x Class 3	
685	*E. pilularis*	406349	6373362	0.6	18	2 x Class 1 1 x Class 2 1 x Class 3	
686	*E. pilularis*	406357	6373338	0.65	18	1 x Class 2 in trunk 2 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
687	*E. pilularis*	406363	6373336	0.6	18	1 x Class 2 3 x Class 3 1 x Class 4	
688	*A. costata*	406508	6373001	0.45	10	1 x Class 3	
689	*E. pilularis*	406504	6373001	0.7	20	1 x Class 3	
690	*E. pilularis*	406504	6373031	0.5	16	1 x Class 4	
691	*E. pilularis*	406516	6373071	0.8	25	2 x Class 3	
692	*E. pilularis*	406518	6373081	0.7	18	1 x Class 4	
693	*E. pilularis*	406520	6373088	0.8	22	1 x Class 1 with dirt 1 x Class 3	
694	*E. pilularis*	406509	6373085	0.65	18	2 x Class 2 2 x Class 4 Scratches on tree	
695	*E. pilularis*	406514	6373155	0.6	17	1 x Class 4	
696	*A. costata*	406523	6373159	0.6	10	1 x Class 1 spout Goanna scratches	
697	*A. costata*	406524	6373166	0.7	10	1 x Class 3	
698	*E. pilularis*	406538	6373176	0.9	20	Scar 1t base 4 x Class 1 2 x Class 2 3 x Class 3 2 x Class 4	
699	*E. pilularis*	406542	6373198	1.1	30	7 x Class 1 8 x Class 2 5 x Class 3 7 x Class 4	
700	*E. pilularis*	406553	6373211	0.8	25	1 x Class 3 1 x Class 4	
701	*E. pilularis*	406563	6373218	0.8	22	2 x Class 4	
702	*A. costata*	406594	6373248	0.5	12	1 x Class 2	
703	*E. pilularis*	406594	6373229	0.6	18	1 x Class 3 1 x Class 4	
704	*E. pilularis*	406594	6373222	0.7	20	2 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						1 x Class 4	
705	*E. pilularis*	406579	6373202	0.6	20	2 x Class 4	
706	*E. pilularis*	406575	6373196	0.65	20	1 x Class 2 1 x Class 3 1 x Class 4	
707	*E. pilularis*	406566	6373191	0.5	18	1 x Class 4	
708	*E. pilularis*	406570	6373182	0.45	15	1 x Class 4	
709	*E. pilularis*	406566	6373182	0.6	20	1 x Class 4	
710	*E. pilularis*	406557	6373177	0.7	20	2 x Class 3 2 x Class 4	
711	*E. pilularis*	406556	6373171	0.6	18	1 x Class 3 1 x Class 4	
712	*E. pilularis*	406638	6372998	1	20	2 x Class 1 3 x Class 2 4 x Class 3 5 x Class 4	
713	*E. pilularis*	406655	6373014	0.6	15	1 x Class 4	
714	*E. pilularis*	406657	6373013	0.6	18	1 x Class 2 1 x Class 3 2 x Class 4	
715	*E. pilularis*	406671	6373036	0.7	18	1 x Class 1 3 x Class 2	
716	*E. pilularis*	406676	6373037	0.8	18	1 x Class 2 1 x Class 3	
717	*E. pilularis*	406684	6373037	0.9	25	2 x Class 2 1 x Class 3 2 x Class 4	
718	*M. quinquenervia*	406699	6373049	0.4	9	1 x Class 4	
719	*E. pilularis*	406712	6373061	0.7	18	2 x Class 4	
720	*E. pilularis*	406716	6373067	0.7	17	1 x Class 3	Arboreal Termite Nest
721	*E. pilularis*	406731	6373082	0.6	16	1 x Class 3	Covered in Grape Vine.

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
722	*E. pilularis*	406748	6373114	0.65	20	1 x Class 3 2 x Class 4	
723	*E. pilularis*	406588	6373346	0.8	20	Large opening at base 2 x Class 3 2 x Class 4	
724	*E. pilularis*	406581	6373354	0.7	20	2 x Class 2 1 x Class 3 1 x Class 4	
725	*E. pilularis*	406581	6373359	0.6	18	1 x Class 3	
726	*E. pilularis*	406575	6373356	0.6	17	2 x Class 4	
727	*E. pilularis*	406568	6373360	0.65	16	1 x Class 2 1 x Class 4	
728	*Dead tree*	406550	6373355	0.45	16	3 x Class 2 3 x Class 3 1 x Class 4	
729	*E. pilularis*	406535	6373358	0.7	15	1 x Class 1 spout 1 x Class 1 dead side branch	
730	*E. pilularis*	406527	6373360	0.6	18	1 x Class 4	
731	*A. costata*	406541	6373360	0.3	8	1 x Class 2 spout	
732	*Dead tree*	406552	6373363	0.85	8	1 x Class 1 spout	photo 7820
733	*E. pilularis*	406544	6373368	0.7	15	1 x Class 1 Large opening at base	
734	*A. costata*	406540	6373377	0.5	18	1 x Class 2 1 x Class 4	
735	*E. pilularis*	406549	6373391	0.7	16	2 x Class 3 1 x Class 4	Leaning east
736	*A. costata*	406547	6373397	0.55	17	1 x Class 1	
737	*A. costata*	406542	6373392	0.45	16	1 x Class 4	
738	*A. costata*	406549	6373403	0.45	18	2 x Class 4	
739	*E. pilularis*	406527	6373386	0.65	20	2 x Class 1 1 x Class 3 1 x Class 4	
740	*A. costata*	406522	6373381	0.5	17	1 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
741	*E. pilularis*	406521	6373376	0.6	18	1 x Class 3 1 x Class 4	
742	*E. pilularis*	406520	6373373	0.45	17	1 x Class 1 1 x Class 4	
743	*A. costata*	406520	6373347	0.75	13	1 x Class 1 spout	
744	*A. costata*	406516	6373340	0.5	16	2 x Class 3	
745	*E. pilularis*	406510	6373348	0.75	17	2 x Class 4	
746	*A. costata*	406507	6373359	0.5	17	1 x Class 2 1 x Class 4	
747	*A. costata*	406506	6373370	0.65	13	1 x Class 1 1 x Class 2	
748	*E. pilularis*	406495	6373366	0.6	18	1 x Class 1 1 x Class 2 1 x Class 4	
749	*E. pilularis*	406484	6373371	0.85	20	3 x Class 3 2 x Class 4	
750	*E. pilularis*	406471	6373377	0.45	10	1 x Class 2	Leaning south
751	*E. pilularis*	406486	6373381	0.5	16	1 x Class 2	
752	*E. pilularis*	406493	6373381	0.5	17	1 x Class 3	
753	*E. pilularis*	406453	6373394	0.9	25	2 x Class 2 1 x Class 3 2 x Class 4	
754	*E. pilularis*	406476	6373401	2 x 0.7	18	1 x Class 2 hollow near base 1 x Class 3 1 x Class 4	
755	*A. costata*	406482	6373402	0.5	14	1 x Class 3	
756	*E. pilularis*	406485	6373400	0.5	17	1 x Class 2 1 x Class 4	
757	*E. pilularis*	406492	6373401	0.55	15	1 x Class 2	
758	*E. pilularis*	406506	6373408	0.8	20	1 x Class 2 2 x Class 4	
759	*E. pilularis*	406524	6373423	1	25	Arboreal termite nest	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
760	*Dead tree*	406562	6373438	0.45	8	1 x Class 1 Spout	
761	*A. costata*	406588	6373465	0.8	18	1 x Class 1 1 x Class 2 1 x Class 3	
762	*E. pilularis*	406582	6373483	0.8	20	1 x Class 1 2 x Class 2 2 x Class 3 2 x Class 4	
763	*A. costata*	406585	6373483	0.85	17	1 x Class 1 2 x Class 2	
764	*E. pilularis*	406612	6373473	0.7	18	1 x Class 2 1 x Class 3	
765	*E. pilularis*	406630	6373466	2 x 0.5	20	1 x Class 1 3 x Class 3	
766	*A. costata*	406629	6373466	0.35	14	1 x Class 1 Spout?	
767	*E. pilularis*	406640	6373457	0.8	20	3 x Class 1 3 x Class 2 2 x Class 3 3 x Class 4	
768	*A. costata*	406641	6373469	0.4	22	1 x Class 2	
769	*E. pilularis*	406624	6373450	0.7	22	1 x Class 1 1 x Class 2 1 x Class 3	
770	*E. pilularis*	406377	6373403	0.8	20	1 x Class 2 x Class 4	
771	*E. pilularis*	406593	6373420	0.55	17	1 x Class 4	
772	*E. pilularis*	406602	6373414	0.7	16	1 x Class 3 1 x Class 4	
773	*E. pilularis*	406589	6373382	0.8	22	2 x Class 2 2 x Class 3 2 x Class 4	
774	*E. pilularis*	406593	6373372	0.6	18	1 x Class 2 3 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
775	*E. pilularis*	406600	6373379	0.7	15	2 x Class 4	Tree leaning
776	*A. costata*	406621	6373385	0.65	18	1 x Class 4	Lace Monitor scratches
777	*A. costata*	406630	6373381	0.5	14	1 x Class 4 dead side branch	
778	*A. costata*	406635	6373393	0.4	14	1 x Class 4 dead side branch	
779	*E. pilularis*	406642	6373404	0.8	20	1 x Class 1 spout probably full of dirt	
780	*E. pilularis*	406615	6373408	0.6	18	1 x Class 3	
781	*E. pilularis*	406644	6373423	0.55	20	1 x Class 1 1 x Class 4	
782	*Dead tree*	406665	6373414	0.9	8	2 x Class 1 spouts	
783	*E. pilularis*	406658	6373432	0.7	16	1 x Class 1 3 x Class 2 2 x Class 4 Hollow at base	
784	*E. pilularis*	406694	6373429	0.9	17	2 x Class 1 1 x Class 3 1 x Class 4 Leaning tree	
785	*A. costata*	406690	6373445	0.45	12	2 x Class 2	
786	*Dead tree*	406693	6373452	0.5	6	1 x Class 2 spout	
787	*E. pilularis*	406694	6373452	0.6	16	1 x Class 1 1 x Class 2 1 x Class 3	
788	*E. pilularis*	406692	6373456	0.45	16	1 x Class 4	
789	*E. pilularis*	406698	6373464	0.65	20	1 x Class 2	
790	*E. pilularis*	406705	6373467	0.5	16	1 x Class 2	
791	*E. pilularis*	406704	6373463	0.8	20	2 x Class 2 3 x Class 4	
792	*E. pilularis*	406722	6373453	0.8	20	1 x Class 1 3 x Class 2 3 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
793	*E. pilularis*	406715	6373450	0.8	17	2 x Class 1 1 x Class 2 1 x Class 4	
794	*E. pilularis*	406696	6373475	0.7	18	1 x Class 1 3 x Class 2 1 x Class 4	
795	*E. pilularis*	406677	6373466	0.6	18	1 x Class 2 1 x Class 3 1 x Class 4	
796	*E. pilularis*	406663	6373461	0.8	18	1 x Class 2 1 x Class 3 1 x Class 4	
797	*E. pilularis*	406660	6373452	0.8	22	1 x Class 3 2 x Class 4	
798	*E. pilularis*	406652	6373462	0.75	17	1 x Class 2 3 x Class 3	
799	*E. pilularis*	406641	6373477	1	25	3 x Class 1 3 x Class 2 3 x Class 3 2 x Class 4	
800	*E. pilularis*	406630	6373492	0.9	20	1 x Class 3	Old burrows at base of tree.
801	*A. costata*	406672	6373483	0.3	7	1 x Class 3	
802	*E. pilularis*	406672	6373484	0.5	14	1 x Class 4	
803	*E. pilularis*	406683	6373513	1	25	3 x Class 1 3 x Class 2 4 x Class 3 3 x Class 4	
804	*A. costata*	406684	6373527	0.5	17	2 x Class 4	
805	*E. pilularis*	406681	6373535	0.7	25	2 x Class 3 2 x Class 4	
806	*E. pilularis*	406670	6373540	1	30	2 x Class 3 2 x Class 4	
807	*E. pilularis*	406657	6373544	0.55	25	1 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
808	*E. pilularis*	406651	6373551	0.6	18	1 x Class 1 at base 1 x Class 3	
809	*A. costata*	406650	6373546	0.3	12	1 x Class 4	
810	*E. pilularis*	406652	6373541	0.6	20	1 x Class 3 1 x Class 4	
811	*E. pilularis*	406654	6373533	0.5	11	1 x Class 2 spout 1 x Class 3 in trunk	
812	*E. pilularis*	406659	6373525	0.6	18	1 x Class 2 2 x Class 4	
813	*E. pilularis*	406654	6373519	0.5	18	1 x Class 4	
814	*E. pilularis*	406651	6373518	0.6	20	1 x Class 2 1 x Class 4	
815	*E. pilularis*	406658	6373515	0.8	25	1 x Class 3	
816	*E. pilularis*	406654	6373512	0.8	30	1 x Class 3 1 x Class 4	
817	*E. pilularis*	406650	6373528	0.6	18	1 x Class 2 2 x Class 4	Arboreal termite nest
818	*A. costata*	406641	6373523	0.5	18	1 x Class 4	
819	*E. pilularis*	406634	6373537	0.75	25	1 x Class 4	Arboreal termite nest
820	*E. pilularis*	406623	6373538	0.65	18	1 x Class 4	
821	*E. pilularis*	406613	6373528	0.6	17	3 x Class 3 1 x Class 2 2 x Class 4	
822	*E. pilularis*	406622	6373519	0.75	25	1 x Class 2 2 x Class 3 1 x Class 4	
823	*E. pilularis*	406609	6373513	0.7	25	1 x Class 3 2 x Class 4	
824	*E. pilularis*	406603	6373510	0.9	25	2 x Class 2 2 x Class 3 2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
825	*E. pilularis*	406576	6373488	0.8	20	1 x Class 3 2 x Class 4	
826	*E. pilularis*	406586	6373520	0.9	25	1 x Class 2 3 x Class 3 2 x Class 4	
827	*E. pilularis*	406596	6373530	0.8	20	1 x Class 2 2 x Class 3 1 x Class 4	
828	*E. pilularis*	406594	6373533	0.9	25	1 x Class 1 1 x Class 3 2 x Class 4	
829	*E. pilularis*	406614	6373548	0.7	25	1 x Class 3	
830	*E. pilularis*	406610	6373553	0.75	20	2 x Class 4	
831	*A. costata*	406624	6373567	0.45	18	1 x Class 2	
832	*A. costata*	406632	6373569	0.6	20	1 x Class 4	
833	*A. costata*	406641	6373566	0.5	20	1 x Class 4	
834	*E. pilularis*	406696	6373568	0.8	18	3 x Class 3 3 x Class 4	
835	*E. pilularis*	406678	6373559	0.55	16	2 x Class 4	
836	*E. pilularis*	406689	6937491	0.55	17	1 x Class 3	
837	*E. pilularis*	406860	6373477	0.75	18	4 x Class 2 2 x Class 3 1 x Class 4	
838	*E. pilularis*	406870	6373508	0.6	20	1 x Class 2 2 x Class 3 1 x Class 4	
839	*E. pilularis*	406869	6373513	0.65	18	1 x Class 1 dead spout 1 x Class 2	Arboreal Termite nest
840	*E. pilularis*	406864	6373501	0.6	15	1 x Class 1 hollow at base 1 x Class 2	
841	*E. pilularis*	406855	6373502	0.8	25	1 x Class 2 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
842	*E. pilularis*	406847	6373509	0.7	20	2 x Class 2 2 x Class 3 Arboreal termite nest	
843	*E. pilularis*	406854	6373496	0.8	13	1 x Class 1 spout	
844	*E. pilularis*	406835	6373465	0.75	25	2 x Class 2 3 x Class 3 1 x Class 4	
845	*E. pilularis*	406826	6373473	0.5	17	1 x Class 1 full of dirt	
846	*E. pilularis*	406824	6373478	0.6	17	1 x Class 3 2 x Class 4	
847	*E. pilularis*	406820	6373490	1.1	30	4 x Class 2 3 x Class 3 2 x Class 4	
848	*E. pilularis*	406827	6373463	0.7	2	4 x Class 2 2 x Class 3 2 x Class 4	
849	*E. pilularis*	406807	6373471	0.7	20	1 x Class 3	Large Arboreal Termite nest
850	*E. pilularis*	406799	6373482	0.4	15	1 x Class 4	
851	*E. pilularis*	406799	6373494	0.6	17	1 x Class 4	
852	*E. pilularis*	406801	6373472	0.6	18	2 x Class 2 1 x Class 3	
853	*A. costata*	406790	6373467	0.55	12	1 x Class 3 termites in tree	
854	*E. pilularis*	406777	6373470	0.55	18	1 x Class 4	
855	*E. pilularis*	406791	6373452	0.6	20	1 x Class 1 3 x Class 4 2 x Class 4	
856	*E. pilularis*	406756	6373443	0.65	16	1 x Class 1 spout 1 x Class 3	
857	*E. pilularis*	406761	6373433	0.6	16	1 x Class 2	
858	*E. pilularis*	406738	6373450	0.5	15	1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
859	*E. pilularis*	406758	6373482	0.75	22	1 x Class 3 1 x Class 4	
860	*E. pilularis*	406746	6373483	0.5	17	1 x Class 3	
861	*E. pilularis*	406754	6373497	0.7	20	2 x Class 3 1 x Class 4	
862	*E. pilularis*	406752	6373505	0.55	18	1 x Class 2 1 x Class 3 Termite nest	
863	*E. pilularis*	406750	6373516	0.5	18	2 x Class 2 1 x Class 3	
864	*E. pilularis*	406738	6373518	0.9	25	2 x Class 3 1 x Class 2	
865	*Dead tree*	406746	6373503	0.5	16	2 x Class 2 1 x Class 3	
866	*Dead tree*	406740	6373507	0.5	14	1 x Class 1 spout	
867	*Dead tree*	406736	6373501	0.6	18	1 x Class 2 1 x Class 3	
868	*Dead tree*	460730	6373489	0.8	25	1 x Class 3 1 x Class 4	
869	*Dead tree*	406722	6373479	0.55	15	1 x Class 3 1 x Class 4	
870	*Dead tree*	406723	6373478	0.5	18	1 x Class 3 2 x Class 4	
871	*Dead tree*	406723	6373471	0.5	16	2 x Class 4	
872	*Dead tree*	406696	6373493	0.8	18	1 x Class 4	Leaning tree
873	*E. pilularis*	406709	6373491	0.45	17	1 x Class 2	
874	*A. costata*	406710	6373494	0.5	18	1 x Class 4	
875	*E. pilularis*	406713	6373508	0.5	17	1 x Class 3	
876	*E. pilularis*	406722	6373516	1	30	2 x Class 2 2 x Class 3	
877	*E. pilularis*	406777	6373506	0.45	16	1 Class 4	
878	*E. pilularis*	406777	6373496	0.7	22	1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
879	*E. pilularis*	406784	6373510	0.75	16	3 x Class 2 2 x Class 3 Leaning tree	
880	*E. pilularis*	406800	6373506	0.75	20	2 x Class 3	
881	*E. pilularis*	406807	6373508	0.85	20	1 x Class 1 maybe full of dirt 2 x Class 2 2 x Class 4	Arboreal termite nest
882	*E. pilularis*	406819	6373510	0.75	25	1 x Class 2 1 x Class 3 1 x Class 4	
883	*E. pilularis*	406829	6373535	0.6	17	1 x Class 3 1 x Class 4	
884	*E. pilularis*	406833	6373536	0.5	20	1 x Class 2 1 x Class 4	
885	*E. pilularis*	406834	6373538	0.5	16	1 x Class 4	Arboreal termite nest
886	*E. pilularis*	406853	6373540	0.55	16	1 x Class 2 1 x Class 3 1 x Class 4	
887	*E. pilularis*	406856	6373535	0.65	17	1 x Class 3 1 x Class 4	Arboreal termite nest
888	*E. pilularis*	406861	6373532	0.5	17	1 x Class 4	
889	*A. costata*	406527	6373527	0.6	16	1 x Class 3	
890	*A. costata*	406571	6373526	0.35	15	1 x Class 3	
891	*A. costata*	406566	6373522	0.5	16	1 x Class 3	
892	*A. costata*	406558	6373515	0.5	18	1 x Class 4	
893	*E. pilularis*	406552	6373506	0.9	22	2 x Class 2 2 x Class 3 2 x Class 4	
894	*E. pilularis*	406553	6373505	0.65	20	1 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
895	*A. costata*	406554	6373492	0.85	27	1 x Class 4	
896	*E. pilularis*	406538	6373446	0.8	30	1 x Class 1 at base 1 x Class 1 1 x Class 2 1 x Class 3 2 x Class 4	
897	*E. pilularis*	406527	6373440	0.7	20	1 x Class 1 1 x Class 2	
898	*A. costata*	406516	6373434	0.5	17	1 x Class 3 1 x Class 4	
899	*A. costata*	406529	6373441	0.95	15	1 x Class 2 1 x Class 4	
900	*E. pilularis*	406511	6373435	0.85	20	2 x Class 2 2 x Class 3 2 x Class 4	
901	*E. pilularis*	406507	6373436	0.5	15	2 x Class 3	
902	*A. costata*	406509	6373446	0.55	17	1 x Class 1 spout full of dirt? 1 x Class 4	
903	*E. pilularis*	406477	6373415	0.6	16	1 x Class 3 1 x Class 4	
904	*A. costata*	406516	6373395	0.5	15	1 x Class 3 2 x Class 4	
905	*A. costata*	406536	6373407	0.4	11	1 x Class 3	
906	*E. pilularis*	407075	6373445	0.8	20	1 x Class 4	
907	*Dead tree*	407064	6373460	0.5	16	1 x Class 2 3 x Class 3 3 x Class 4	
908	*E. pilularis*	407019	6373464	0.65	16	2 x Class 1 2 x Class 2 2 x Class 3	
909	*E. pilularis*	407025	6373457	0.85	20	2 x Class 3 1 x Class 4	
910	*Dead tree*	407028	6373457	0.5	7	1 x Class 1 spout full of dirt?	
911	*E. pilularis*	407023	6373429	0.75	16	2 x Class 1	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
912	*E. pilularis*	406991	6373406	0.7	20	2 x Class 3 1 x Class 4	
913	*Dead tree*	406984	6373399	0.25	7	1 x Class 1 spout	
914	*E. pilularis*	406981	6373392	0.75	20	1 x Class 2 2 x Class 3 2 x Class 4	
915	*E. pilularis*	406972	6373397	0.6	18	2 x Class 3 2 x Class 4	
916	*E. pilularis*	406965	6373387	0.8	17	4 x Class 1	*Apis mellifera* (European Honey Bee) nest in hollow. Tree trunk hollow through middle.
917	*E. pilularis*	406957	6373374	0.65	20	2 x Class 4	
918	*E. pilularis*	406956	6373374	0.6	10	1 x Class 3	
919	*A. costata*	406936	6373341	0.9	17	1 x Class 1 spout	Arboreal Termite Nest
920	*A. costata*	406931	6373350	0.8	19	1 x Class 2 spout full of dirt	
921	*A. costata*	406856	6373273	0.55	16	1 x Class 4	
922	*E. pilularis*	406844	6373260	0.8	20	1 x Class 1 1 x Class 4	
923	*E. pilularis*	406833	6373251	0.55	18	1 x Class 4	
924	*E. pilularis*	406992	6373433	0.9	17	3 x Class 1 1 x Class 2 1 x Class 3	
925	*E. pilularis*	406998	6373436	0.8	17	1 x Class 1 1 x Class 2	
926	*E. pilularis*	407194	6373488	0.5	18	2 x Class 4	
927	*E. pilularis*	407179	6373485	0.8	18	1 x Class 2 1 x Class 3 2 x Class 4	
928	*E. pilularis*	407161	6373480	0.7	20	1 x Class 2 2 x Class 3	
929	*E. pilularis*	407158	6373487	0.75	20	2 x Class 3 2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
930	*E. pilularis*	407145	6373490	0.7	20	2 x Class 2 2 x Class 3 1 x Class 4	Arboreal Termite Nest
931	*E. pilularis*	407140	6373489	0.7	16	1 x Class 1 2 x Class 4	
932	*E. pilularis*	407142	6373480	0.8	25	3 x Class 3 2 x Class 4	
933	*E. pilularis*	407146	6373479	0.65	20	1 x Class 2 1 x Class 3	
934	*E. pilularis*	407108	6373492	0.7	20	1 x Class 2 2 x Class 3 2 x Class 4	
935	*A. costata*	407117	6373498	0.5	15	2 x Class 4	
936	*E. pilularis*	407097	6373489	0.5	18	1 x Class 1 full of dirt? 1 x Class 4	
937	*E. pilularis*	407090	6373494	0.7	20	1 x Class 3 1 x Class 4	
938	*E. pilularis*	407080	6373482	0.75	20	1 x Class 1 1 x Class 2 1 x Class 4	
939	*E. pilularis*	407079	6373479	0.85	25	1 x Class 1 2 x Class 2 3 x Class 3 2 x Class 4	
940	*E. pilularis*	407073	6373473	0.5	16	1 x Class 3 2 x Class 4	
941	*A. costata*	407058	6373499	0.5	18	1 x Class 3 1 x Class 4	
942	*E. pilularis*	407065	6373487	0.55	17	2 x Class 2 1 x Class 3	
943	*E. pilularis*	407070	6373465	0.65	20	1 x Class 2 1 x Class 4	
944	*E. pilularis*	407096	6373464	0.5	17	2 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
945	*E. pilularis*	407097	6373468	0.7	20	1 x Class 1 1 x Class 3 1 x Class 4	
946	*E. pilularis*	407097	6373468	0.7	20	4 x Class 3 2 x Class 4	Open scar near base Arboreal termite nest
947	*E. pilularis*	406871	6373535	0.95	20	1 x Class 1 scar at base running up through trunk	Tree damaged in storm.
948	*E. pilularis*	406837	6373541	0.65	10	1 x Class 2 3 x Class 3 2 x Class 4	
949	*E. pilularis*	406829	6373546	0.65	20	1 x Class 3 shallow	
950	*A. costata*	406826	6373544	0.45	15	2 x Class 4	
951	*E. pilularis*	406824	6373543	0.5	17	2 x Class 2 3 x Class 3 2 x Class 4	
952	*E. pilularis*	406803	6373543	0.7	20	2 x Class 4	
953	*E. pilularis*	406720	6373563	0.7	20	1 x Class 2 full of dirt	
954	*E. pilularis*	406697	6373547	0.65	20	1 x Class 2 2 x Class 3	
955	*A. costata*	406695	6373536	0.6	20	1 x Class 2	
956	*A. costata*	406698	6373530	0.45	17	2 x Class 3 2 x Class 4	
957	*E. pilularis*	406699	6373529	0.6	18	2 x Class 3 1 x Class 4	
958	*E. pilularis*	406724	6373527	0.5	18	1 x Class 1 spout full of dirt Hollow throughout	
959	*Dead tree*	406724	6373541	0.5	8	1 x Class 1 spout 3 x Class 2 1 x Class 4	
960	*E. pilularis*	406747	6373555	0.65	20	1 x Class 2 1 x Class 4	
961	*A. costata*	406721	6373544	0.45	18	2 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
962	*E. pilularis*	406733	6373555	0.5	12	2 x Class 4 Deep scratches	
963	*A. costata*	406747	6373558	0.45	20	2 x Class 1 2 x Class 2 2 x Class 3	
964	*E. pilularis*	406756	6373556	0.8	20	3 x Class 1 2 x Class 2 1 x Class 3	
965	*E. pilularis*	406775	6373556	0.85	20	1 x Class 1 1 x Class 4	
966	*E. pilularis*	406778	6373545	0.65	20	1 x Class 1 scar/spout 1 x Class 2 with *Lomandra longifolia*.	
967	*E. pilularis*	406778	6373538	0.65	20	1 x Class 2	
968	*E. pilularis*	406756	6373545	0.5	18	4 x Class 2 4 x Class 3 2 x Class 4	
969	*E. pilularis*	406752	6373547	0.9	20	1 x Class 3	
970	*E. pilularis*	406743	6373543	0.7	20	2 x Class 3	
971	*E. pilularis*	406742	6373541	0.5	20	1 x Class 3	
972	*E. pilularis*	406755	6373538	0.5	20	1 x Class 2 scar 2 x Class 4	
973	*E. pilularis*	406757	6373529	0.5	20	2 x Class 4	
974	*E. pilularis*	406761	6373519	0.65	20	1 x Class 1 scar from base 2 x Class 2 1 x Class 3	
975	*E. pilularis*	406793	6373531	1	20	1 x Class 2 1 x Class 3	
976	*E. pilularis*	406800	6373535	0.7	20	3 x Class 4	
977	*E. pilularis*	406893	6373534	0.55	18	1 x Class 1	
978	*E. pilularis*	406893	6373521	0.5	18	2 x Class 2 2 x Class 3	
979	*E. pilularis*	406877	6373485	1.1	20	1 x Class 3 scar in trunk	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
980	*B. serrata*	406895	6373471	0.4	12	2 x Class 3 1 x Class 4	
981	*E. pilularis*	406904	6373475	0.5	16	1 x Class 3 1 x Class 3 at base	
982	*E. pilularis*	406914	6373479	0.55	18	1 x Class 3 spout	
983	*A. costata*	406911	6373489	0.3	10	1 x Class 1 1 x Class 3	
984	*E. pilularis*	406909	6373498	0.65	17	3 x Class 3 1 x Class 3 scar in trunk 1 x Class 4	
985	*E. pilularis*	406907	6373498	0.6	16	1 x Class 1	
986	*E. pilularis*	406909	6373502	1	20	1 x Class 4 spout	
987	*A. costata*	406901	6373496	0.3	15	1 x Class 1 spout with dirt 1 x Class 3 with Lomandra 3 x Class 3 1 x Class 4	
988	*E. pilularis*	406915	6373504	0.65 + 0.4	20	1 x Class 1 scar with *Lomandra longifolia*. 2 x Class 2 2 x Class 3	
989	*E. pilularis*	406919	6373510	0.7	20	1 x Class 1 1 x Class 2	
990	*A. costata*	406920	6373511	0.5	18	1 x Class 1 1 x Class 3 1 x Class 3 scar in trunk	
991	*E. pilularis*	406920	6373512	1	20	1 x Class 1 1 x Class 2	
992	*E. pilularis*	406937	6373523	0.7	20	1 x Class 1 1 x Class 3	
993	*E. pilularis*	406946	6373522	0.7	20	2 x Class 1 spouts 1 x Class 1 1 x Class 3	
994	*E. pilularis*	406949	6373519	0.8	16	1 x Class 3 scar in trunk	
995	*A. costata*	406951	6373514	0.3	6	1 x Class 1 scar in trunk	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
996	*E. pilularis*	406953	6373502	0.6	20	1 x Class 2 spout	
997	*E. pilularis*	406943	6373490	0.55	16	2 x Class 3	
998	*A. costata*	406939	6373489	0.55	20	1 x Class 1 1 x Class 2 1 x Class 3	
999	*E. pilularis*	406938	6373488	0.65	20	1 x Class 1	
1000	*E. pilularis*	406924	6373487	0.65	20	1 x Class 3 1 x Class 3 2 x Class 4	*Apis mellifera* (European Honey Bee) nest in hollow.
1001	*E. pilularis*	406925	6373482	0.8	20	3 x Class 2 5 x Class 3 2 x Class 4	
1002	*E. pilularis*	406925	6373477	1.1	20	1 x Class 1	
1003	*E. pilularis*	406935	6373470	0.4 + 0.5	17	1 x Class 2	
1004	*E. pilularis*	406936	6373471	0.45	16	2 x Class 3	
1005	*E. pilularis*	406943	6373471	0.5	16	1 x Class 1 spout 1 x Class 2 spout	Hollow through trunk.
1006	*Dead tree*	406943	6373473	0.45	10	1 x Class 1 spout 1 x Class 3	
1007	*Dead tree*	406943	6373473	0.5	8	1 x Class 3 2 x Class 4	
1008	*E. pilularis*	406947	6373478	0.6	18	1 x Class 1 Spout	
1009	*A. costata*	406951	6373483	0.45	10	2 x Class 3 1 x Class 4	
1010	*E. pilularis*	406967	6373514	0.6	20	2 x Class 3 1 x Class 3 scar near base	
1011	*E. pilularis*	406970	6373513	0.7	20	1 x Class 3 scar at base	
1012	*E. pilularis*	406973	6373508	0.5	17	2 x Class 4	
1013	*E. pilularis*	406974	6373502	0.55	20	3 x Class 2 1 x Class 3	
1014	*E. pilularis*	406974	6373489	0.6	19	1 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						2 x Class 4	
1015	*E. pilularis*	406964	6373470	0.55	19	1 x Class 2 spout/scar in trunk	
1016	*A. costata*	406970	6373471	0.65	15	1 x Class 2 1 x Class 3	
1017	*E. pilularis*	406983	6373479	0.6	20	1 x Class 1 with *Lomandra longifolia*. 2 x Class 1 2 x Class 2 4 x Class 3 1 x Class 4	
1018	*E. pilularis*	406991	6373484	0.65 + 0.65	20	2 x Class 4	
1019	*E. pilularis*	407000	6373489	0.5	18	1 x Class 1 1 x Class 2	
1020	*E. pilularis*	407003	6373493	0.6	20	1 x Class 4	
1021	*E. pilularis*	407014	6373484	0.5	18	2 x Class 4	
1022	*E. pilularis*	407008	6373499	0.5	20	1 x Class 3	
1023	*E. pilularis*	407003	6373507	0.5	20	1 x Class 1 scar at base 2 x Class 2 1 x Class 3 1 x Class 4	
1024	*E. pilularis*	406988	6373512	0.9	20	1 x Class 2 2 x Class 3 1 x Class 4	
1025	*E. pilularis*	406988	6373506	0.8	20	1 x Class 2 1 x Class 3	
1026	*E. pilularis*	406999	6373513	0.7	20	1 x Class 1 1 x Class 4	
1027	*E. pilularis*	407026	6373500	0.7	20	2 x Class 4	
1028	*E. pilularis*	407008	6373513	0.6	20	1 x Class 3 scar in trunk	
1029	*E. pilularis*	407024	6373508	0.5	15	4 x Class 4	Arboreal termite nest
1030	*E. pilularis*	407047	6373481	0.6	20	5 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1031	*E. pilularis*	407033	6373480	0.7	20	3 x Class 4	
1032	*E. pilularis*	407025	6373492	0.4	18	1 x Class 3 1 x Class 4	
1033	*E. pilularis*	407020	6373481	0.8	20	1 x Class 2 long narrow scar in trunk 1 x Class 2	
1034	*E. pilularis*	406842	6373236	0.5	16	2 x Class 4	
1035	*A. costata*	406842	6373233	0.6	18	1 x Class 4 scar at base	
1036	*B. serrata*	406842	6373232	0.3	6	1 x Class 2 spout 1 x Class 3	
1037	*A. costata*	406841	6373227	0.5	6	1 x Class 3	
1038	*A. costata*	406832	6373222	0.3	14	1 x Class 3 2 x Class 4	
1039	*A. costata*	406818	6373223	0.6	18	1 x Class 1 spout 1 x Class 2 spout 1 x Class 3 spout	
1040	*Dead tree*	406810	6373220	0.5	8	1 x Class 2 1 x Class 3	
1041	*Dead tree*	406810	6373212	0.5	10	1 x Class 4 Scratches	
1042	*A. costata*	406800	6373215	0.5	18	1 x Class 3 2 x Class 4	
1043	*E. pilularis*	406796	6373212	0.55	18	2 x Class 4	
1044	*E. pilularis*	406795	6373203	0.7	20	2 x Class 4	
1045	*A. costata*	406799	6373199	0.35	15	1 x Class 2	Hollow through tree.
1046	*Dead tree*	406781	6373196	0.4	3	1 x Class 3 spout 2 x Class 4	
1047	*Dead tree*	406770	6373184	0.6	12	5 x Class 3 2 x Class 4	
1048	*A. costata*	406781	6373170	0.7	20	2 x Class 4	
1049	*A. costata*	406765	6373167	0.8	20	1 x Class 3 1 x Class 4	
1050	*A. costata*	406767	6373157	0.5	18	1 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1051	*E. pilularis*	406741	6373081	0.55	18	2 x Class 2 2 x Class 3 1 x Class 4	
1052	*A. costata*	406735	6373070	0.55	18	1 x Class 2	
1053	*E. pilularis*	406679	6373010	0.65	20	3 x Class 4	
1054	*A. costata*	406671	6373007	0.5	18	1 x Class 1 3 x Class 4	
1055	*E. pilularis*	406664	6373003	1	18	4 x Class 1 2 x Class 2 1 x Class 3 1 x Class 4 scar in trunk	
1056	*E. pilularis*	406818	6373194	1.1	20	3 x Class 1 2 x Class 2 1 x Class 3	
1057	*E. pilularis*	407007	6373407	1	20	2 x Class 3 1 x Class 4	
1058	*E. pilularis*	407031	6373419	0.7	20	1 x Class 3 1 x Class 4	
1059	*E. pilularis*	407051	6373515	0.55	20	1 x Class 3 3 x Class 4	
1060	*E. pilularis*	407056	6373527	1	20	1 x Class 2 4 x Class 3 2 x Class 4	
1061	*E. pilularis*	407057	6373529	1	20	1 x Class 2 1 x Class 3	
1062	*E. pilularis*	407091	6373520	0.7	20	1 x Class 4	
1063	*E. pilularis*	407098	6373520	0.55	20	1 x Class 2 1 x Class 3	
1064	*Dead tree*	407098	6373526	0.45	16	2 x Class 3	
1065	*E. pilularis*	407091	6373540	0.6	20	1 x Class 3 2 x Class 4	
1066	*E. pilularis*	407103	6373543	0.45 + 0.5	20	1 x Class 3 1 x Class 4	
1067	*E. pilularis*	407109	6373539	0.5	18	1 x Class 3 spout	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1068	*E. pilularis*	407112	6373529	0.4 + 0.4	16	1 x Class 4	
1069	*E. pilularis*	407118	6373516	0.55	20	3 x Class 2 1 x Class 3	
1070	*E. pilularis*	407144	6373499	0.65	20	1 x Class 4	
1071	*E. pilularis*	407164	6373512	0.6	20	1 x Class 4	
1072	*E. pilularis*	407172	6373524	0.7	20	2 x Class 4	
1073	*E. pilularis*	407190	6373532	0.8	20	1 x Class 3 1 x Class 4	
1074	*E. pilularis*	407203	6373533	0.55	20	1 x Class 3	
1075	*E. pilularis*	407205	6373542	0.45 + 0.45	20	1 x Class 4	
1076	*E. pilularis*	407193	6373571	0.5	19	1 x Class 3	
1077	*E. pilularis*	407179	6373578	0.5	20	1 x Class 4	
1078	*E. pilularis*	407175	6373577	0.6	20	1 x Class 3 2 x Class 4	
1079	*E. pilularis*	407163	6373554	0.7	20	3 x Class 4	
1080	*E. pilularis*	407133	6373564	0.6	20	1 x Class 3 2 x Class 4	
1081	*E. pilularis*	407128	6373551	0.8	22	1 x Class 4	
1082	*E. pilularis*	407131	6373544	0.5	18	2 x Class 4	
1083	*A. costata*	407121	6373527	0.6	18	1 x Class 3 1 x Class 4	
1084	*E. pilularis*	407110	6373565	0.7	20	1 x Class 2 1 x Class 3 1 x Class 4	
1085	*E. pilularis*	407110	6373575	0.65	20	1 x Class 1 1 x Class 2 4 x Class 3 3 x Class 4	Arboreal termite nest
1086	*E. pilularis*	407091	6373569	0.65	20	1 x Class 2 2 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1087	*E. pilularis*	407105	6373598	0.8	20	3 x Class 1 1 x Class 1 with *Lomandra longifolia*. 6 x Class 2 3 x Class 3 1 x Class 4	
1088	*Dead tree*	407094	6373602	0.85	18	2 x Class 4	
1089	*E. pilularis*	407089	6373611	0.5	20	1 x Class 3 1 x Class 4 scar in trunk	
1090	*B. serrata*	407087	6373611	0.45	15	1 x Class 3	
1091	*B. serrata*	407079	6373605	0.45	16	1 x Class 1 spout 1 x Class 2 spout	
1092	*E. pilularis*	407079	6373596	0.5	12	2 x Class 2 2 x Class 3 1 x Class 4	
1093	*E. pilularis*	407073	6373595	0.75	20	2 x Class 4	
1094	*E. pilularis*	407064	6373589	0.5	18	2 x Class 2 3 x Class 3 2 x Class 4	
1095	*E. pilularis*	407062	6373572	1	22	1 x Class 1 2 x Class 2 2 x Class 3	
1096	*E. pilularis*	407056	6373564	0.75	20	1 x Class 3 3 x Class 4	
1097	*E. pilularis*	407069	6373547	0.65	22	3 x Class 4	
1098	*E. pilularis*	407051	6373597	0.5	20	1 x Class 3 3 x Class 4	
1099	*E. pilularis*	407066	6373618	1	20	1 x Class 4	
1100	*E. pilularis*	407071	6373626	0.5	18	1 x Class 1 scar at base 1 x Class 2 4 x Class 3 2 x Class 4	
1101	*E. pilularis*	407093	6373642	0.85	20	3 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1102	*E. pilularis*	407102	6373644	0.7	20	1 x Class 3 2 x Class 4	
1103	*E. pilularis*	407104	6373644	0.55	20	1 x Class 4	
1104	*E. pilularis*	407107	6373642	0.5	18	1 x Class 3	
1105	*E. pilularis*	407106	6373642	0.45	17	2 x Class 4	
1106	*E. pilularis*	407111	6373637	0.3 + 0.32	10	1 x Class 3 spout	
1107	*B. serrata*	407110	6373636	0.3	10	1 x Class 4 shallow	
1108	*E. pilularis*	407122	6373626	0.4	18	1 x Class 3 2 x Class 4	
1109	*E. pilularis*	407122	6373625	0.8	20	1 x Class 4	
1110	*E. pilularis*	407122	6373621	0.3	10	1 x Class 4	
1111	*E. pilularis*	407126	6373622	0.5	18	1 x Class 3 1 x Class 4	
1112	*E. pilularis*	407138	6373627	0.5	18	2 x Class 3 2 x Class 4	
1113	*E. pilularis*	407156	6373628	1.2	22	1 x Class 3 3 x Class 4	
1114	*E. pilularis*	407173	6373596	0.5	20	2 x Class 4	
1115	*E. pilularis*	407161	6373598	0.55	20	1 x Class 4	
1116	*E. pilularis*	407156	6373589	0.4	18	1 x Class 2 5 x Class 3 2 x Class 4	
1117	*E. pilularis*	407143	6373595	0.6	20	1 x Class 4	
1118	*E. pilularis*	407109	6373605	0.6	20	2 x Class 4	
1119	*E. pilularis*	407121	6373600	0.55	20	2 x Class 4	
1120	*E. pilularis*	407125	6373597	0.55	20	3 x Class 4	
1121	*E. pilularis*	407132	6373593	0.5	20	2 x Class 4	
1122	*E. pilularis*	407174	6373593	0.5	19	2 x Class 4	
1123	*E. pilularis*	407175	6373597	0.5	20	3 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1124	*E. pilularis*	407176	6373597	0.45	18	1 x Class 2 opening at base 3 x Class 4	
1125	*E. pilularis*	407184	6373596	0.5	18	2 x Class 4	
1126	*E. pilularis*	407187	6373584	0.5	20	4 x Class 4	
1127	*E. pilularis*	407193	6373582	0.55	20	1 x Class 1 spout	Arboreal termite nest
1128	*E. pilularis*	407200	6373587	0.7	18	1 x Class 1 1 x Class 2 scar at base 1 x Class 4	
1129	*E. pilularis*	407215	6373606	0.65	18	1 x Class 1 scar in trunk 3 x Class 2 5 x Class 3 2 x Class 4	
1130	*E. pilularis*	407216	6373614	1	18	1 x Class 1 spout	
1131	*E. pilularis*	407211	6373612	0.5	17	4 x Class 3 4 x Class 4	
1132	*E. pilularis*	407208	6373609	0.8	19	3 x Class 4 shallow	
1133	*B. serrata*	407195	6373622	0.35	10	2 x Class 4	
1134	*E. pilularis*	407194	6373625	0.65	19	3 x Class 2 2 x Class 3 2 x Class 4	
1135	*E. pilularis*	407203	6373625	0.6	18	1 x Class 2 2 x Class 3 1 x Class 4	Damaged and leaning on 1134
1136	*Dead tree*	407207	6373627	0.8	10	1 x Class 3? 1 x Class 4	
1137	*E. pilularis*	407212	6373630	0.5	18	1 x Class 1 1 x Class 2 3 x Class 3 1 x Class 4	
1138	*E. pilularis*	407209	6373638	0.8	20	1 x Class 1 3 x Class 2 2 x Class 3 2 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1139	*E. pilularis*	407190	6373644	0.75	20	1 x Class 2 shallow 3 x Class 3 2 x Class 4	
1140	*E. pilularis*	407176	6373635	0.8	20	1 x Class 4	
1141	*E. pilularis*	407172	6373633	0.45	17	1 x Class 2 1 x Class 3 1 x Class 4	
1142	*E. pilularis*	407165	6373638	0.65	18	1 x Class 2 2 x Class 3 1 x Class 4	
1143	*E. pilularis*	407159	6373636	0.65	19	2 x Class 2 6 x Class 3 3 x Class 4	
1144	*E. pilularis*	407147	6373642	0.7	19	6 x Class 3 2 x Class 4	
1145	*E. pilularis*	407132	6373653	0.8	19	1 x Class 1 scar at base 6 x Class 3 2 x Class 4	
1146	*E. pilularis*	407123	6373666	0.85	19	1 x Class 1 with 2 openings at base 1 x Class 1 1 x Class 3 1 x Class 4	
1147	*E. pilularis*	407122	6373669	0.75	18	3 x Class 2 3 x Class 3 1 x Class 4	
1148	*E. pilularis*	407118	6373668	0.85	19	2 x Class 2 3 x Class 3 2 x Class 4	
1149	*E. pilularis*	407113	6373669	0.9	19	1 x Class 3 3 x Class 4	
1150	*E. pilularis*	407105	6373666	0.6	17	2 x Class 3 2 x Class 4	
1151	*E. pilularis*	407099	6373664	0.55	19	1 x Class 4 at base 2 x Class 4	
1152	*Dead tree*	407121	6373693	0.35	12	2 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						1 x Class 4	
1153	*E. pilularis*	407136	6373689	0.85	19	2 x Class 4	
1154	*E. pilularis*	407145	6373688	0.5 + 0.4	19	3 x Class 4	
1155	*E. pilularis*	407142	6373685	0.35	14	1 x Class 4	
1156	*E. pilularis*	407151	6373698	0.7	18	1 x Class 4	
1157	*E. pilularis*	407160	6373722	0.4 + 0.6	19	1 x Class 4	
1158	*E. pilularis*	407184	6373732	0.65	19	2 x Class 2 8 x Class 3 2 x Class 4	
1159	*Dead tree*	407197	6373732	0.75	16	1 x Class 4	
1160	*E. pilularis*	407156	6373726	0.45	18	2 x Class 4	
1161	*E. pilularis*	407151	6373728	1	18	1 x Class 4	
1162	*E. pilularis*	407157	6373737	0.45 + 0.4	18	2 x Class 4	
1163	*E. pilularis*	407164	6373743	0.4 + 0.3	17	1 x Class 4	
1164	*E. pilularis*	407166	6373744	0.25 + 0.4	17	2 x Class 4	
1165	*E. pilularis*	407178	6373746	0.4 + 0.4	18	1 x Class 2 2 x Class 3	
1166	*E. pilularis*	407187	6373749	0.7	18	2 x Class 4	
1167	*E. pilularis*	407192	6373746	0.5 + 0.3	18	3 x Class 3 2 x Class 4	
1168	*E. pilularis*	407194	6373750	0.8	20	1 x Class 4 Whitewash	
1169	*A. costata*	407195	6373754	0.5	16	1 x Class 3 1 x Class 4	
1170	*E. pilularis*	407165	6373767	1	20	1 x Class 3	
1171	*E. pilularis*	407181	6373781	0.55	19	1 x Class 3	
1172	*"Eucalyptus*					1 x Class 3 spout	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
	robusta						
1173	*Swamp Mahogany"*	407250	6373806	0.35	14	1 x Class 4	
1174	*E. robusta*	407253	6373801	0.65	18	2 x Class 3	
1175	*E. robusta*	407260	6373789	0.6	17	2 x Class 4	
1176	*E. robusta*	407267	6373785	0.5	19	3 x Class 1 2 x Class 2 2 x Class 3 1 x Class 4	*Apis mellifera* (European Honey Bee) nest in large hollow..
1177	*E. robusta*	407320	6373860	0.45	16	1 x Class 1 scar in base 3 x Class 3 1 x Class 4	Arboreal termite nest
1178	*E. pilularis*	407295	6373815	0.9	19	3 x Class 1 2 x Class 3 2 x Class 4	Arboreal termite nest
1179	*E. pilularis*	407310	6373817	0.85	19	1 x Class 2 shallow 1 x Class 3 2 x Class 4	
1180	*E. pilularis*	407316	6373817	1.3	19	3 x Class 2 3 x Class 3 2 x Class 4	Arboreal termite nest
1181	*E. pilularis*	407339	6373822	0.7	17	2 x Class 3	Arboreal termite nest
1182	*E. pilularis*	407348	6373819	0.9	19	1 x Class 1? 2 x Class 3 2 x Class 4	Arboreal termite nest
1183	*E. pilularis*	407361	6373827	0.55 + 0.5	16	1 x Class 4	Arboreal termite nest
1184	*E. pilularis*	407370	6373833	0.75	18	1 x Class 1 spout	
1185	*E. pilularis*	407384	6373820	0.6	16	4 x Class 1 2 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						1 x Class 3	
1186	*Dead tree*	407396	6373820	0.7	10	1 x Class 4	Arboreal termite nest
1187	*E. pilularis*	407345	6373798	0.9	18	2 x Class 1 2 x Class 2 1 x Class 3 2 x Class 4	Arboreal termite nest
1188	*E. pilularis*	407346	6373783	0.8	18	2 x Class 3 1 x Class 4	Arboreal termite nest
1189	*E. pilularis*	407323	6373755	1.1	19	2 x Class 3 2 x Class 4	
1190	*E. pilularis*	407327	6373780	0.6	18	2 x Class 4	
1191	*E. pilularis*	407327	6373786	0.5	17	1 x Class 1 1 x Class 2 2 x Class 3	
1192	*E. pilularis*	407326	6373798	0.5	18	3 x Class 2 5 x Class 3 4 x Class 4	
1193	*A. costata*	407329	6373800	0.7	19	1 x Class 1 2 x Class 2 2 x Class 4	*Apis mellifera* (European Honey Bee) nest in large hollow.
1194	*E. pilularis*	407334	6373805	0.6 + 0.6	18	2 x Class 3 2 x Class 4	
1195	*E. pilularis*	407353	6373696	0.7	19	1 x Class 1 4 x Class 2 10 x Class 3 5 x Class 4	
1196	*E. pilularis*	407369	6373714	0.65	18	1 x Class 1 shallow 1 x Class 2 4 x Class 4 Scratches	
1197	*Dead tree*	407278	6373722	0.7	17	2 x Class 1 2 x Class 2	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1198	*A. costata*	407280	6373727	0.5	18	1 x Class 1 3 x Class 2 3 x Class 3 1 x Class 4	
1199	*E. pilularis*	407286	6373736	1	22	2 x Class 3 2 x Class 4	
1200	*E. pilularis*	407260	6373721	1	20	4 x Class 3 1 x Class 4	
1201	*E. pilularis*	407266	6373692	0.65	18	2 x Class 1 3 x Class 2 2 x Class 3 2 x Class 4	Arboreal termite nest
1202	*A. costata*	407264	6373693	0.5	17	1 x Class 3 1 x Class 4	
1203	*Dead tree*	407251	6373694	0.7	16	1 x Class 3	
1204	*E. pilularis*	407252	6373709	0.65	18	1 x Class 3 1 x Class 4	
1205	*E. pilularis*	407257	6373711	0.5	18	1 x Class 4	
1206	*E. pilularis*	407260	6373731	0.6	17	2 x Class 2 3 x Class 3 4 x Class 4	
1207	*E. pilularis*	407256	6373730	0.5	17	1 x Class 2 3 x Class 3 2 x Class 4	
1208	*E. pilularis*	407253	6373730	0.85	20	4 x Class 3 2 x Class 4	
1209	*E. pilularis*	407252	6373731	0.75	19	2 x Class 1 3 x Class 2 2 x Class 3 2 x Class 4	
1210	*E. pilularis*	407226	6373745	0.9	20	2 x Class 3 2 x Class 4	Arboreal termite nest
1211	*E. pilularis*	407210	6373752	0.8	20	1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1212	*E. pilularis*	407226	6373771	0.75	20	9 x Class 1 1 x Class 1 at base 3 x Class 2 1 x Class 2 at base 1 x Class 3	Hollow trunk.
1213	*E. pilularis*	407231	6373772	0.7	20	1 x Class 1 2 x Class 2 3 x Class 3 3 x Class 4	
1214	*Dead tree*	407234	6373772	1.2	18	3 x Class 4	
1215	*E. pilularis*	407240	6373774	0.85	20	2 x Class 4	
1216	*E. pilularis*	407224	6373792	0.75	19	1 x Class 1 2 x Class 2 1 x Class 3 1 x Class 4	
1217	*E. pilularis*	407221	6373789	0.65	18	2 x Class 1 2 x Class 2 4 x Class 3	
1170	*E. pilularis*	407254	6373772	0.8	20	1 x Class 2 2 x Class 3	
1171	*E. pilularis*	407261	6373762	0.9	19	1 x Class 2	
1172	*E. pilularis*	407097	6373468	0.7	20	2 x Class 3 2 x Class 4	
1173	*E. pilularis*	406871	6373535	0.95	20	2 x Class 3 1 x Class 4	
1174	*E. pilularis*	406837	6373541	0.65	10	1 x Class 1 spout full of dirt Hollow throughout	
1175	*E. pilularis*	406829	6373546	0.65	20	1 x Class 1 spout 3 x Class 2 1 x Class 4	
1176	*A. costata*	406826	6373544	0.45	15	1 x Class 2 1 x Class 4	
1177	*E. pilularis*	406824	6373543	0.5	17	2 x Class 3 1 x Class 4	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1178	*E. pilularis*	406803	6373543	0.7	20	2 x Class 4 Deep scratches	
1179	*E. pilularis*	406720	6373563	0.7	20	2 x Class 1 2 x Class 2 2 x Class 3	
1180	*E. pilularis*	406697	6373547	0.65	20	3 x Class 1 2 x Class 2 1 x Class 3	
1181	*A. costata*	406695	6373536	0.6	20	1 x Class 1 1 x Class 4	
1182	*A. costata*	406698	6373530	0.45	17	1 x Class 1 scar/spout 1 x Class 2 with *Lomandra longifolia*	
1183	*E. pilularis*	406699	6373529	0.6	18	1 x Class 2	
1184	*E. pilularis*	406724	6373527	0.5	18	4 x Class 2 4 x Class 3 2 x Class 4	
1185	*Dead tree*	406724	6373541	0.5	8	1 x Class 3	
1186	*E. pilularis*	406747	6373555	0.65	20	2 x Class 3	
1187	*A. costata*	406721	6373544	0.45	18	1 x Class 3	
1188	*E. pilularis*	406733	6373555	0.5	12	1 x Class 2 scar 2 x Class 4	
1189	*A. costata*	406747	6373558	0.45	20	2 x Class 4	
1190	*E. pilularis*	406756	6373556	0.8	20	1 x Class 1 scar from base 2 x Class 2 1 x Class 3	
1191	*E. pilularis*	406775	6373556	0.85	20	1 x Class 2 1 x Class 3	
1192	*E. pilularis*	406778	6373545	0.65	20	3 x Class 4	
1193	*E. pilularis*	406778	6373538	0.65	20	1 x Class 1	
1194	*E. pilularis*	406756	6373545	0.5	18	2 x Class 2 2 x Class 3	
1195	*E. pilularis*	406752	6373547	0.9	20	1 x Class 3 scar in trunk	
1196	*E. pilularis*	406743	6373543	0.7	20	2 x Class 3	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
						1 x Class 4	
1197	*E. pilularis*	406742	6373541	0.5	20	1 x Class 3 1 x Class 3 at base	
1198	*E. pilularis*	406755	6373538	0.5	20	1 x Class 3 spout	
1199	*E. pilularis*	406757	6373529	0.5	20	1 x Class 1 1 x Class 3	
1200	*E. pilularis*	406761	6373519	0.65	20	3 x Class 3 1 x Class 3 scar in trunk 1 x Class 4	
1201	*E. pilularis*	406793	6373531	1	20	1 x Class 1	
1202	*E. pilularis*	406800	6373535	0.7	20	1 x Class 4 spout	
1203	*E. pilularis*	406893	6373534	0.55	18	1 x Class 1 spout with dirt 1 x Class 3 with *Lomandra longifolia* 3 x Class 3 1 x Class 4	
1204	*E. pilularis*	406893	6373521	0.5	18	1 x Class 1 scar with *Lomandra longifolia* 2 x Class 2 2 x Class 3	
1205	*E. pilularis*	406877	6373485	1.1	20	1 x Class 1 1 x Class 2	
1206	*B. serrata*	406895	6373471	0.4	12	1 x Class 1 1 x Class 3 1 x Class 3 scar in trunk	
1207	*E. pilularis*	406904	6373475	0.5	16	1 x Class 1 1 x Class 2	
1208	*E. pilularis*	406914	6373479	0.55	18	1 x Class 1 1 x Class 3	
1209	*A. costata*	406911	6373489	0.3	10	2 x Class 1 spouts 1 x Class 1 1 x Class 3	
1210	*E. pilularis*	406909	6373498	0.65	17	1 x Class 3 scar in trunk	
1211	*E. pilularis*	406907	6373498	0.6	16	1 x Class 1 scar in trunk	

Tree No.	Species	COORDINATES GDA – 94 E	COORDINATES GDA – 94 N	DBH (M)	Height (M)	Habitat/Hollows	Comments
1212	*E. pilularis*	406909	6373502	1	20	1 x Class 2 spout	
1213	*A. costata*	406901	6373496	0.3	15	2 x Class 3	
1214	*E. pilularis*	406915	6373504	0.65 + 0.4	20	1 x Class 1 1 x Class 2 1 x Class 3	
1215	*E. pilularis*	406919	6373510	0.7	20	1 x Class 1	
1216	*A. costata*	406920	6373511	0.5	18	1 x Class 3 2 x Class 4	*Apis mellifera* (European Honey Bee) nest.
1217	*E. pilularis*	406920	6373512	1	20	3 x Class 2 5 x Class 3 2 x Class 4	

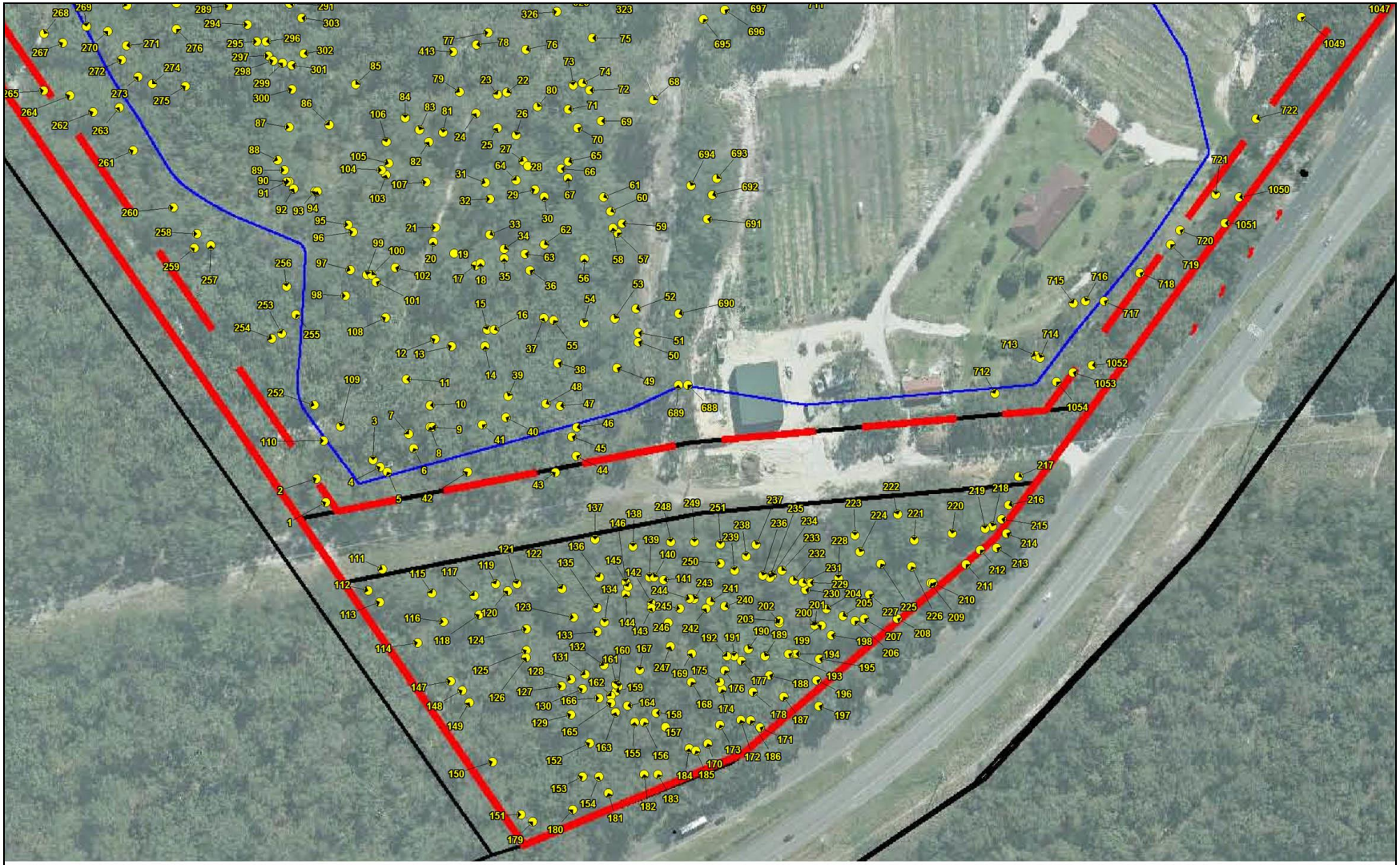


Figure F1: Location of Habitat Trees

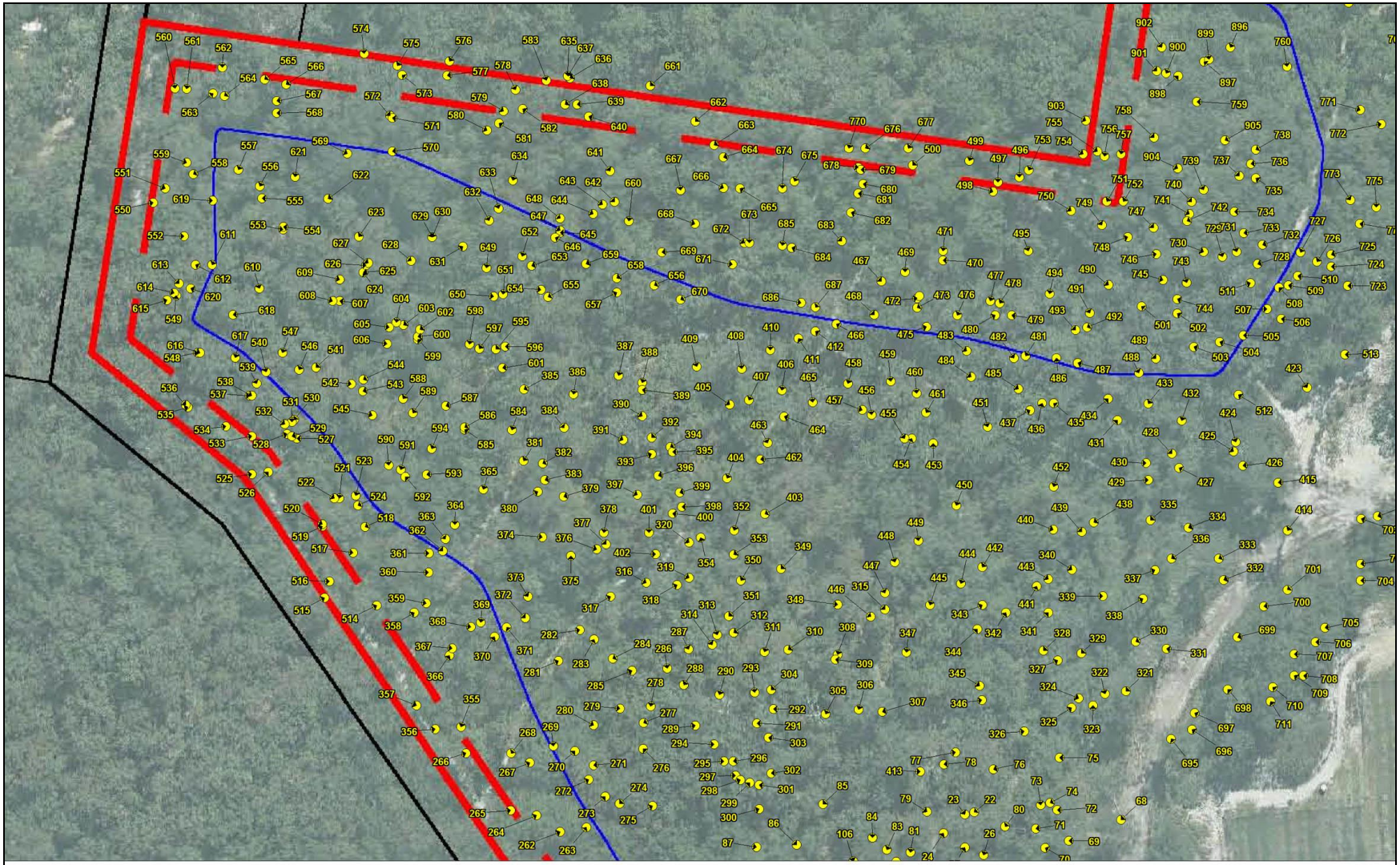


Figure F2: Location of Habitat Trees

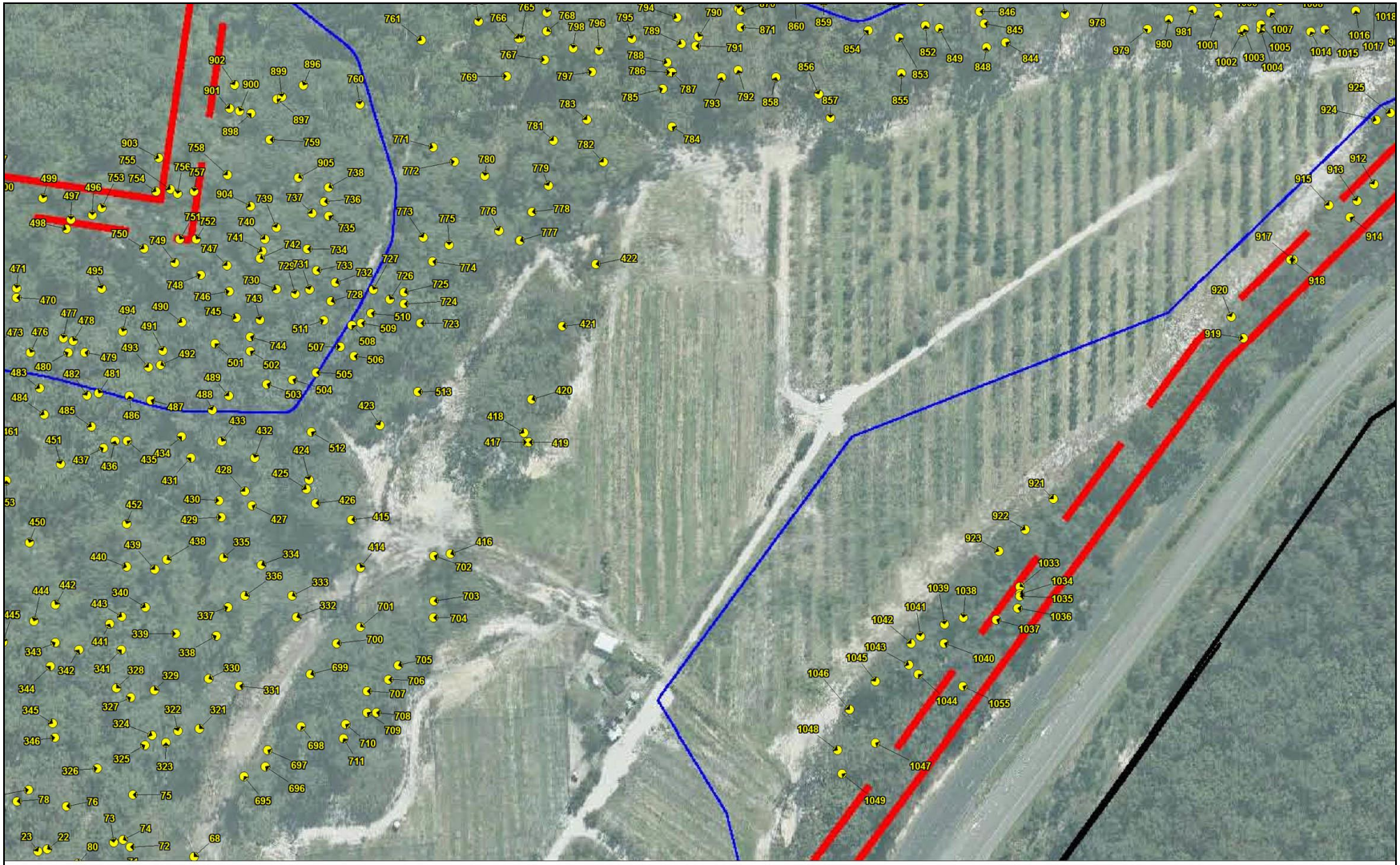


Figure F3: Location of Habitat Trees

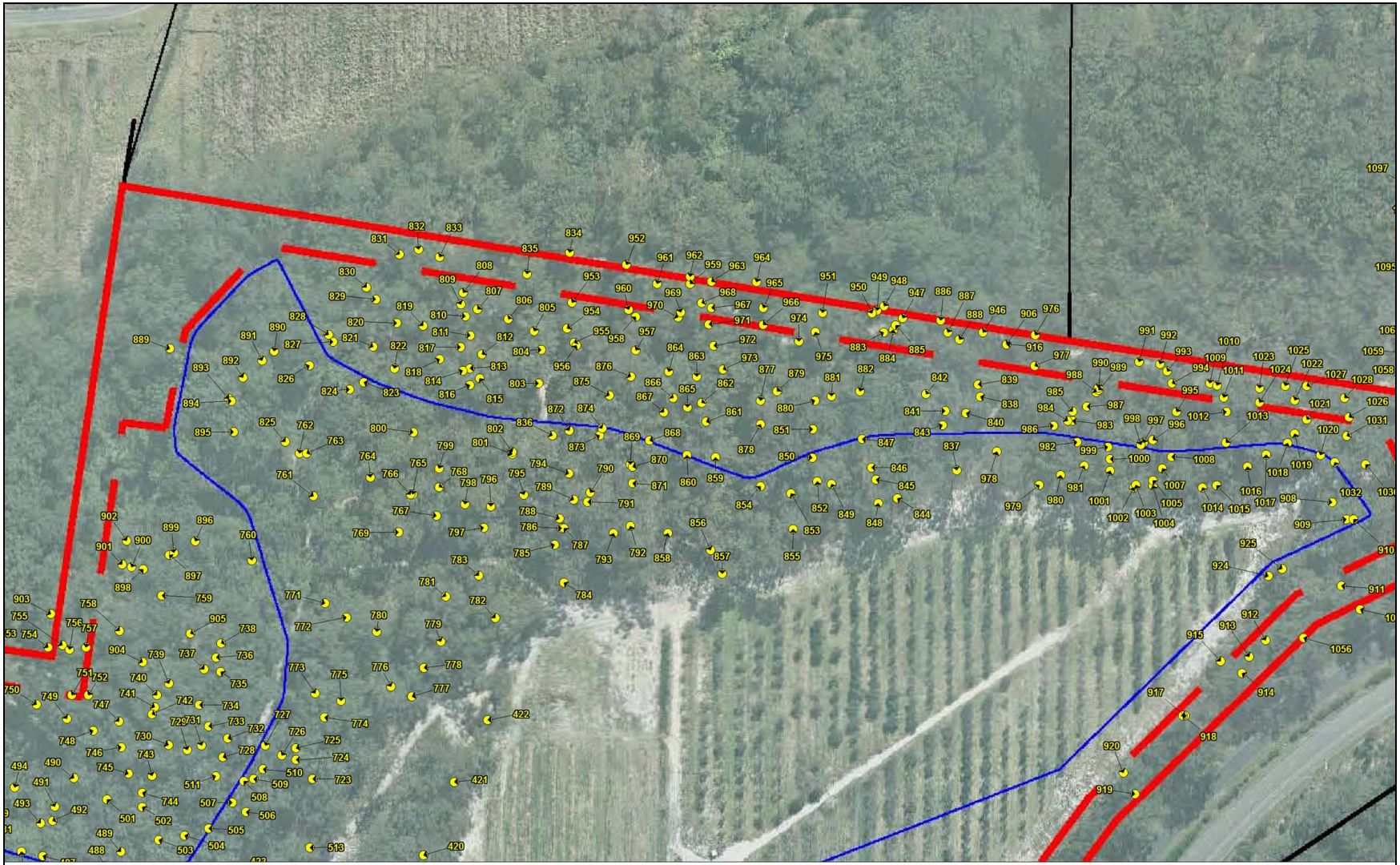


Figure F4: Location of Habitat Trees

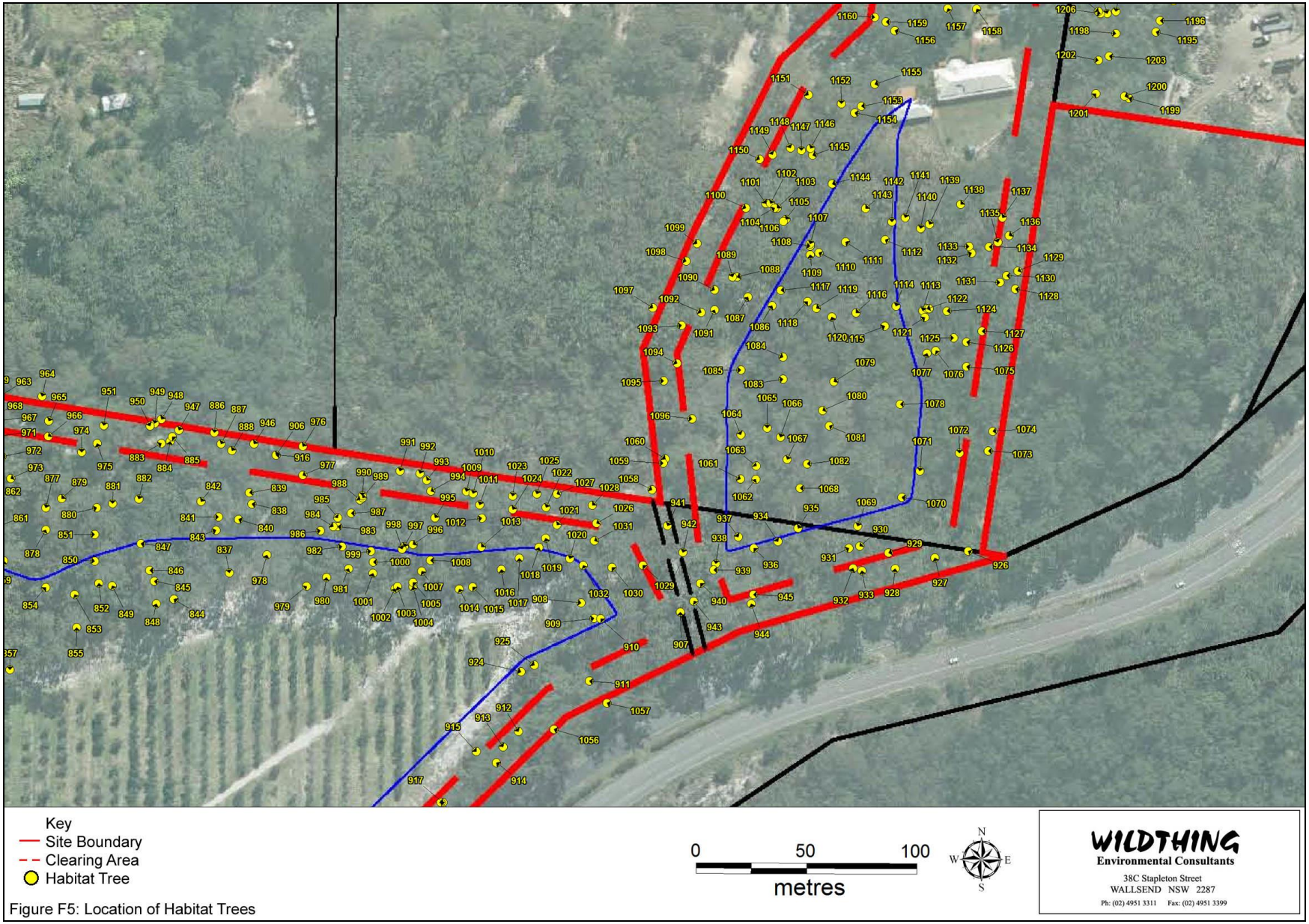


Figure F5: Location of Habitat Trees

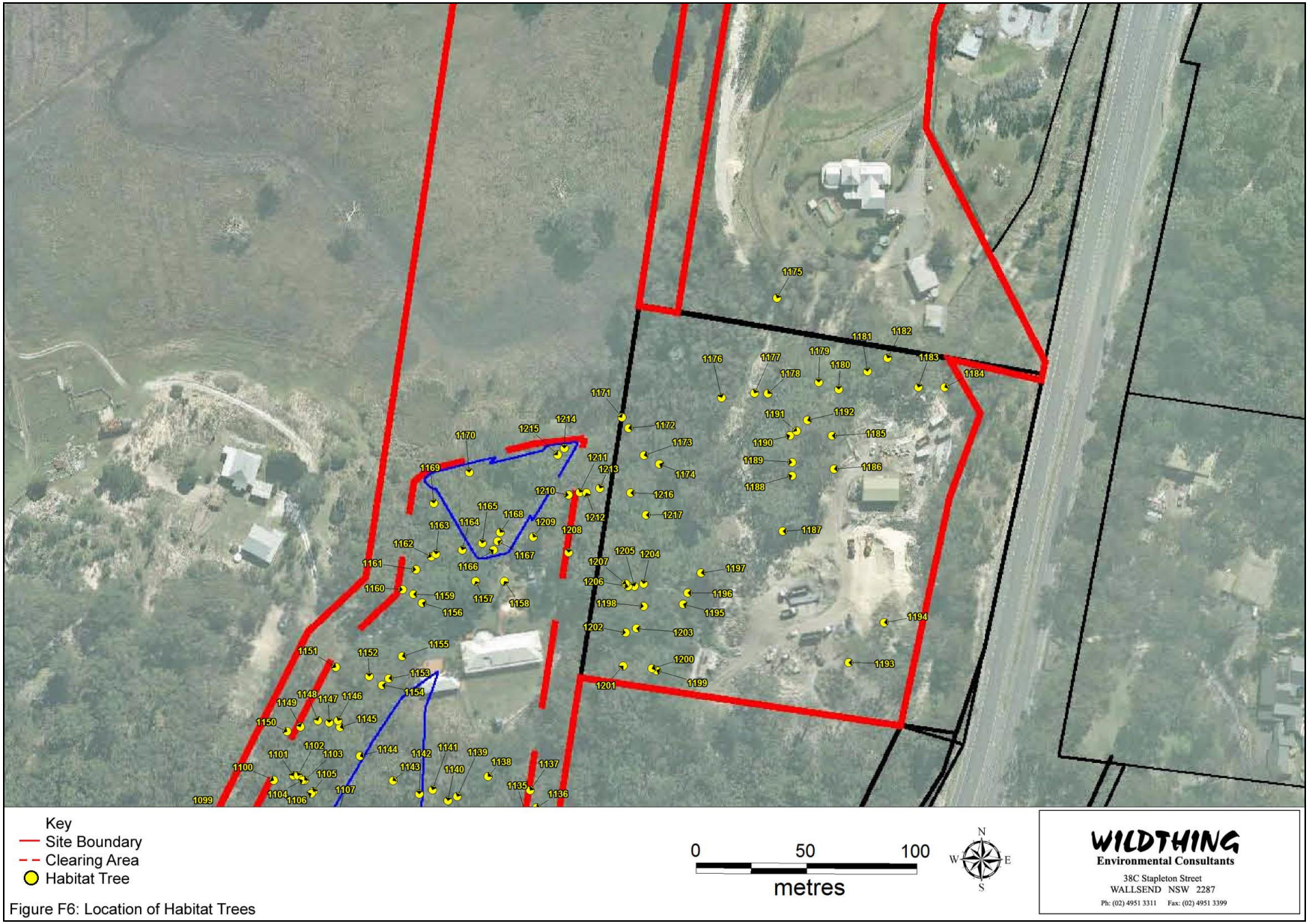


Figure F6: Location of Habitat Trees

APPENDIX G

DETAILS OF SURVEY EFFORT

Table G1: Survey effort, dates, times and weather conditions

DATE	TIME (24HR)	SURVEY EFFORT (EXPRESSED IN PERSON HOURS)	ACTIVITY	WEATHER
Monday 04/02/13	1230 - 1300 1300 - 1600	0.5 3.0 two persons	General Site inspection Targeted searches for *Cryptostylis hunteriana* (Leafless Tongue-orchid), *Callistemon linearifolius* (Netted Bottlebrush), *Syzygium paniculatum* (Magenta Lilly Pilly), *Eucalyptus parramattensis* subsp. *decadens* (Drooping Redgum). Incidental observations.	3/8 cloud, SSE breeze, 24°C, 61% humidity.
Wednesday 06/02/13	1300 - 1500	2.0 two persons	Targeted searches for *Cryptostylis hunteriana* (Leafless Tongue-orchid). Incidental observations.	3/8 cloud, SSE breeze, 24°C, 47% humidity.
Monday 15/04/13	1000 - 1700	10.0 person hours	Trap deployment Incidental observations	5/8 cloud, Calm, 26°C, 49% humidity.
Tuesday 16/04/13	0600 – 0800 0815 - 0845	5.0 person hours Two persons 0.5 2 persons	Checking traps. Incidental observations Reptile Survey	6/8 cloud, Calm, 19°C, 90% humidity.
Wednesday 17/04/13	0600 - 0800	2.0 person hours	Checking traps. Incidental observations	1/8 cloud, Calm, 19°C, 82% humidity.
Thursday 18/04/13	0600 – 0800 0800 - 0830	2.0 person hours 0.5	Checking traps. Incidental observations Avifauna Survey	1/8 cloud, Calm, 17°C, 82% humidity.
Friday 19/04/13	0600 - 1000	4.0 person hours	Checking Traps, Trap retrieval & Incidental observations.	3/8 cloud, Calm, 17°C, 51% humidity.
Tuesday 21/05/13	1530 – 1600 1600 – 1645 1715 – 1845 1845 – 1915	4.0 person hours	Deployment of two Harp Traps Avifauna Survey Spotlighting/Mobile Bat call survey. Owl, Bush Stone-curlew & Mammal Call Playback	4/8 cloud, calm, 19°C, 82% humidity, Slight westerly breeze, 6/8 Moon behind thin layer of cloud.

DATE	TIME (24HR)	SURVEY EFFORT (EXPRESSED IN PERSON HOURS)	ACTIVITY	WEATHER
	1915 - 1935		Checking of Harp Traps Stationary Bat Call Survey (Anabat left out all night).	
Wednesday 22/05/13	0630 - 0715	0.5	Checking and retrieval of Harp Traps Retrieval of Anabat/Avifauna Survey	5/8 cloud, calm, 12°C 70% humidity.
Thursday 30/05/13	1700	8.0	Stationary Bat Call Survey (Anabat left out all night).	0/8 cloud, calm, 20°C 70% humidity.
Friday 31/05/13	0700 - 0730	0.5	Retrieval of Anabat/Avifauna Survey. Incidental observations.	Minimum of 15°C overnight. 0/8 cloud, calm.
Tuesday 11/06/13	1200 - 1530	3.5	Vegetation Survey (Transects & Plots) Incidental observations.	2/8 cloud, calm, 19°C 64% humidity.
Friday 14/06/13	1130 - 1430	3.0 Two persons	Vegetation Survey (Transects & Plots) Incidental observations.	1/8 cloud, calm, 18°C 53% humidity.
Friday 28/06/13	1000 - 1400	4.0 Two persons	Searches for *Corybas dowlingii*. Vegetation Survey (Transects & Plots) Incidental observations.	8/8 cloud, calm, 14.5°C 94% humidity
Wednesday 03/07/13	1045 - 1530	4.75 Two persons	Vegetation Survey (Transects & Plots) Incidental observations	1/8 cloud, calm, 11°C 96% humidity
Friday 05/07/13	1400 - 1430	0.5 Two persons	Deployment of motion sensitive camera Incidental observations.	1/8 cloud, calm, 16°C 79% humidity
Monday 08/07/13	0730 - 8000	0.5	Retrieval of motion sensitive camera Incidental observations.	1/8 cloud, SW wind direction, 9.5°C 86% humidity
Friday 12/07/13	1445-1530	0.75 Two persons	Vegetation Survey (Plot) Deployment of motion sensitive camera	2/8 cloud, SW wind direction, 15°C 80% humidity
Monday 15/07/13	0730-0800	0.5	Retrieval of motion sensitive camera. Incidental observations.	4/8 cloud, SW wind direction, 14°C 91% humidity
Tuesday 16/07/13	1230-1300	0.5 Two Persons	Deployment of motion sensitive camera. Incidental observations.	4/8 cloud, SW wind direction, 18°C 67% humidity
Friday 19/07/13	1045-1200	1.25 Two Persons	Retrieval of motion sensitive camera Vegetation Survey (Plot).	4/8 cloud, SW wind direction, 20°C 74% humidity
Tuesday 13/08/13	1300 - 1530	3.5 Two Persons	Targeted searches for *Diuris praecox* (Newcastle Doubletail), *Diuris arenaria* (Tomaree Doubletail), *Rhizanthella slateri* (Eastern Underground Orchid).	3/8 cloud, slight SW wind direction, 20°C 44% humidity

DATE	TIME (24HR)	SURVEY EFFORT (EXPRESSED IN PERSON HOURS)	ACTIVITY	WEATHER
			Deployment of motion sensitive camera. Incidental observations.	
Wednesday 21/08/13	1000 - 1330	3.5 Two Persons	Targeted searches for *Diuris praecox* (Newcastle Doubletail), *Diuris arenaria* (Tomaree Doubletail) *Rhizanthella slateri* (Eastern Underground Orchid) & *Tetratheca juncea* (Black-eyed Susan). Retrieval of motion sensitive camera. Incidental observations.	0/8 cloud, slight SW wind direction, 18°C 42% humidity
Tuesday 03/09/13	1800 - 1830	0.5	Stationary Bat Call Survey (Anabat left out all night). Incidental observations.	Conditions at 6.50pm 0/8 cloud, Wind Easterly direction 18km/h, 19°C, 67% humidity. Top day temperature 23°C.
Wednesday 04/09/13	0730 - 0830	1.0	Retrieval of Anabat/Avifauna Survey. Incidental observations.	0/8 cloud, NW wind 19km/h 8°C, 44% relative humidity, 1023hPa.
Friday 13/09/13	1100 – 1500	4.0 Two persons	Targeted searches for *Diuris praecox* (Newcastle Doubletail), *Diuris arenaria* (Tomaree Doubletail), *Tetratheca juncea* (Black-eyed Susan) & *Rhizanthella slateri* (Eastern Underground Orchid). Retrieval of motion sensitive camera. Incidental observations.	0/8 cloud, NW wind 22km/h 8°C, 44% relative humidity, 1006hPa.
Wednesday 25/09/13	1030 - 1500	4.5 Two persons	Targeted searches for *Diuris praecox* (Newcastle Doubletail), *Diuris arenaria* (Tomaree Doubletail) *Tetratheca juncea* (Black-eyed Susan) & *Rhizanthella slateri* (Eastern Underground Orchid). Retrieval of motion sensitive camera. Incidental observations.	0/8 cloud, Calm, 17°C, 89% relative humidity, NW wind 19km/h
Wednesday 13/11/13	1400 – 1700 1800 - 1830 1900 – 2200	8.0 Two persons	Targeted searches for *Cryptostylis hunteriana.* Deployment of two Harp Traps Spotlighting/Mobile Bat call survey. Owl, Bush Stone-curlew & Mammal Call Playback Checking and retrieval of Harp Traps Stationary Bat Call Survey (Anabat left out all night).	0/8 cloud, Easterly wind, 24°C, 68% relative humidity 0/8 cloud, Easterly wind, 22°C, 68% relative humidity, 6/8 Moon

DATE	TIME (24HR)	SURVEY EFFORT (EXPRESSED IN PERSON HOURS)	ACTIVITY	WEATHER
Tuesday 29-04-14	1500 – 1600	1.0 Two persons	Reptile Survey	1/8 high cloud, Calm, 25°C, 89% relative humidity, NW wind 19km/h
	1600 – 1700	1.0 Two persons	Deployment of two Harp Traps Avifauna Survey.	
		3.0 Two persons	Spotlighting/Mobile Bat call survey.	3/8 cloud, Easterly wind, 22°C, 68% relative humidity, No moon observed.
	1740 - 2000		Owl, Bush Stone-curlew & Mammal Call Playback	
Wednesday 30-04-14	0415 - 0445	0.5	Checking and retrieval of Harp Traps. Incidental observations.	4/8 high cloud, 17°C, 90% relative humidity, Calm. Rained shortly after trap collection.
Monday 26-05-14	0900 - 1400	5.0 Two persons	Trap deployment Incidental observations	0/8 cloud, 17°C, 85% relative humidity, Calm.
Tuesday 27-05-14	0600 – 0800	2.0	Checking traps. Incidental observations	6/8 high cloud, 20°C, 81% relative humidity, Calm.
	0800 - 0830	0.5 (one person)	Avifauna Survey	
Wednesday 28-05-14	0600 - 0800	2.0 Two Persons	Checking traps. Incidental observations	7/8 cloud, 19°C, 67% relative humidity, Calm.
Thursday 29-05-14	0600 - 0800	2.0 Two persons	Checking traps. Incidental observations	1/8 cloud, 16°C, 71% relative humidity, Calm.
Friday 30-05-14	0600 - 0930	3.5 Two persons	Checking Traps, Trap retrieval & Incidental observations.	8/8 cloud, Showers overnight, 17°C, 90% relative humidity, Calm.
Tuesday 03-06-14	0900 - 1300	4.0 Two persons	Surveys around Wetland & Swamp Forest. Diurnal amphibian and Koala surveys. Test water in wetland	0/8 cloud. 17°C, 65% relative humidity, Calm.
Thursday 12-06-14	1715 - 1915	2.0 Two persons	Spotlighting. Owl, Bush Stone-curlew & Mammal Call Playback	0/8 cloud, 16°C, 60% relative humidity, Calm. 8/8 Moon.
Thursday 27-11-14	1830 – 1915	0.5	Deployment of two Harp Traps Retrieval of motion sensitive camera	6/8 cloud, 21°C, 71% relative humidity, SE Breeze.
	1915 – 1945	0.5	Avifauna Survey	

DATE	TIME (24HR)	SURVEY EFFORT (EXPRESSED IN PERSON HOURS)	ACTIVITY	WEATHER
	2000 - 2130	1.5 Two persons	Spotlighting Owl, Bush Stone-curlew & Mammal Call Playback	5/8 cloud, 18°C, 60% relative humidity, Slight SE breeze. 2/8 Moon.
Friday 28-11-14	0445 – 0515	0.5 0.5 (one person)	Checking and retrieval of Harp Traps Avifauna Survey	3/8 cloud, 18°C, 70% relative humidity, Calm.
Thursday 22-01-15	1900 – 1930 2030 - 1000	0.50 1.5	Deployment of two Harp Traps Spotlighting/Mobile Bat call survey. Owl, Bush Stone-curlew & Mammal Call Playback	3/8 cloud, 22°C, 90% relative humidity, Calm. 6/8 cloud, 21°C, 80% relative humidity, Slight E breeze.
Friday 23-01-15	0500 - 0530	0.5 0.5	Checking and retrieval of Harp Traps Avifauna Survey	4/8 cloud, 20°C, 80% relative humidity, Calm.
Friday 30-01-15	1030 - 1430	4.0 (3 persons)	Habitat tree survey Incidental observations.	6/8 cloud, 24°C, 80% relative humidity, Calm.
Tuesday 10-02-15	1100 - 1230	1.5 (2 persons)	Habitat tree survey Incidental observations.	4/8 cloud, 28°C, 80% relative humidity, Calm.
Thursday 19-02-15	0930 - 1400	4.5 (2 persons)	Habitat tree survey Checked Wildlife Camera	6/8 cloud, High 25°C, 85% relative humidity, Calm.
Friday 06-03-15	0930 - 1300	3.5 (2 persons)	Habitat tree survey Checked Wildlife Camera Incidental observations.	0/8 cloud, 28°C, 70% relative humidity, NW breeze.
11-03-15	0930 - 1400	4.5 (2 persons)	Habitat tree survey and incidental observations.	6/8 cloud, 26°C, 80% relative humidity, W breeze.
27-03-15	0930 – 1300	3.5 (2 persons)	Habitat tree survey and incidental observations.	0/8 cloud, 20°C, 80% relative humidity, WNW breeze.
17-04-15	1200 - 1430	2.5 (1 person)	Survey of specimens of Swamp Mahogany within Swamp Forest for signs of Koalas	8/8 cloud, 20°C, 30% relative humidity, Calm.

DATE	TIME (24HR)	SURVEY EFFORT (EXPRESSED IN PERSON HOURS)	ACTIVITY	WEATHER
			Searches for *Persicaria elatior, Lindernia alsinoides* & *Melaleueca biconvexa.* Amphibian survey within area of Freshwater Wetland. Searches for *Persicaria elatior, Persicaria elatior, Lindernia alsinoides, Zannichellia palustris & Melaleueca biconvexa.*	
28-04-15	1630 - 1830	2.0 1 person	Amphibian survey within area of Freshwater Wetland Avifauna Survey	0/8 cloud
04-05-15	0930 - 1300	(2 persons)	Habitat tree survey and incidental observations.	0/8 cloud, 15°C, 46% relative humidity, NW breeze.
19-05-15	1300 - 1400	(2 persons)	Habitat tree survey and incidental observations.	
Tuesday 02-06-15	0930 - 1200	(2 persons)	Habitat tree survey and incidental observations.	6/8 cloud, 16°C, Calm, 54% relative humidity. SW breeze.
Wednesday 03-06-15	0930 -1400	(2 persons)	Habitat tree survey and incidental observations.	6/8 cloud, 16°C, Calm, 54% relative humidity.
Thursday 04-06-15	0800 - 1300	(2 persons)	Habitat tree survey and incidental observations.	1/8 cloud, 16°C, Calm, 36% relative humidity.
Wednesday 29-07-15	1630 – 1700 0530 - 2200	4.5 (2 person)	Avifauna survey Spotlighting/Owl, Bush Stone-curlew & Mammal Call Playback	0/8 cloud, 15°C, 55% relative humidity, Calm, 7/8 moon
Tuesday 20-10-15	0900 - 1030	1.5 (1 person)	Koala Tree survey NW of study area	1/8 cloud, 30°C, Calm, 85% relative humidity.
Monday 05-09-16	0900 - 1100	3.0 (3 persons)	Targeted searches for *Diuris praecox* (Newcastle Doubletail), *Diuris arenaria* (Tomaree Doubletail) and *Rhizanthella slateri* (Eastern Underground Orchid) & *Tetratheca juncea* (Black-eyed Susan).	0/8 cloud, 13°C, Calm, 66% relative humidity.
Wednesday 07-09-16	1200 - 1500	2.0 (3 persons)	Targeted searches for *Diuris praecox* (Newcastle Doubletail) and *Diuris arenaria* (Tomaree Doubletail).	0/8 cloud, 21°C, Calm, 57% relative humidity.

DATE	TIME (24HR)	SURVEY EFFORT (EXPRESSED IN PERSON HOURS)	ACTIVITY	WEATHER
Friday 23-09-16	0900 - 1200	2.0 (one person)	Targeted searches for *Diuris praecox* (Newcastle Doubletail) and *Diuris arenaria* (Tomaree Doubletail).	5/8 cloud, 18°C, Wind SW 26km/h, 54% relative humidity.
Tuesday 10-10-17	1200 - 1500	3 (two persons)	Targeted searches for *Pterostylis chaetophora* (Tall Rustyhood)	8/8 cloud, 20°C, Wind ENE 15km/h, 87% relative humidity.
Thursday 12-10-17	0730 - 1530	8.0 2 persons	Targeted searches for *Pterostylis chaetophora* (Tall Rustyhood).	8/8 cloud, 19°C, Wind SW 7km/h, 97% relative humidity.
Friday 13-10-17	0730 - 1200	4.5 2 persons	Targeted searches for *Pterostylis chaetophora* (Tall Rustyhood).	0/8 cloud, 19°C, Wind W 4km/h, 84% relative humidity.
Thursday 02/11/17	1300 - 1430	1.5 (1 person)	General site inspection of site with Dr Simon Clulow to determine survey areas for *Uperoleia mahonyi* (Mahony's Toadlet).	3/8 cloud, 22°C, Wind E 20km/h, 66% relative humidity.
Tuesday 07-11-17	2000 - 2300	3.0	Surveys for *Uperoleia mahonyi* (Mahony's Toadlet) by Dr Simon Clulow.	8/8 cloud, 17.3°C, wind 2.3km/h, 89.3% relative humidity. Raining lightly on and off
Thursday 09-11-17	2000 - 0000	4.0	Surveys for *Uperoleia mahonyi* (Mahony's Toadlet) by Dr Simon Clulow.	0/8 cloud, 14.2°C, wind 0 km/h, 88.0% relative humidity.

APPENDIX H

EPBC ACT PROTECTED MATTERS SEARCH

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

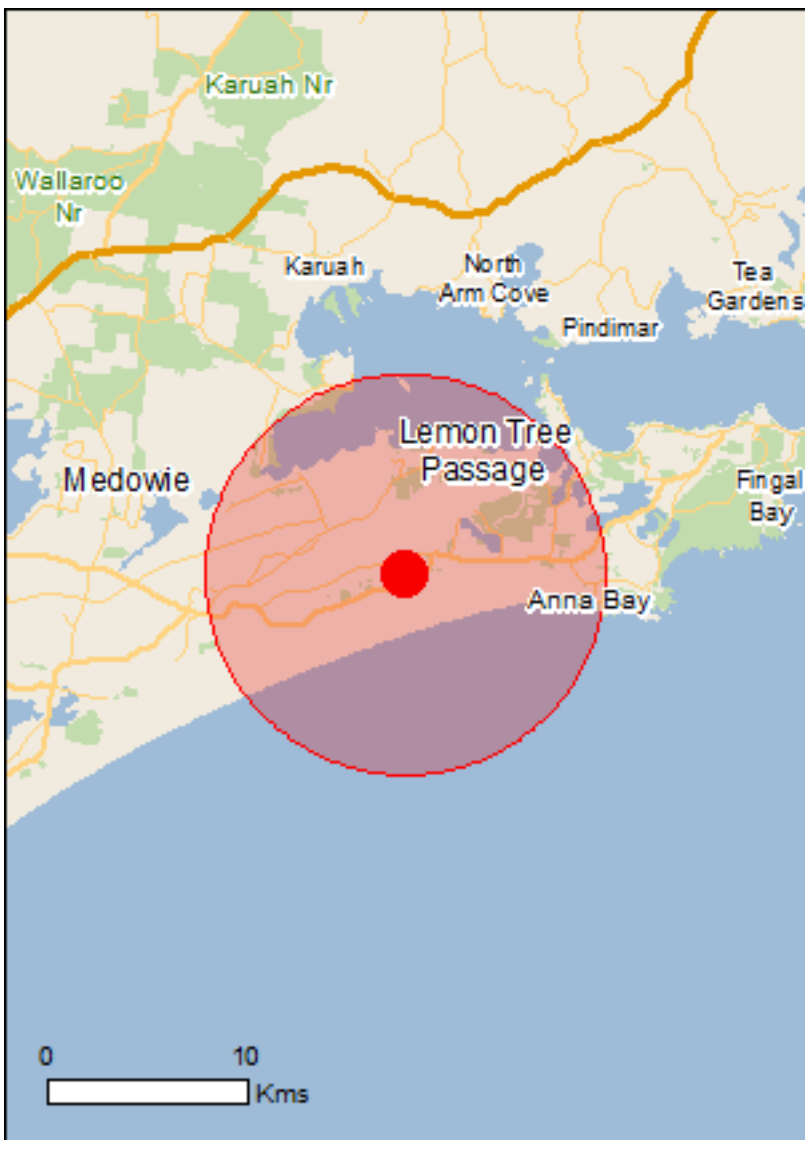
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 16/11/17 14:44:35

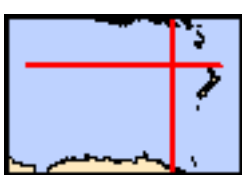
Summary
Details
Matters of NES
Other Matters Protected by the EPBC Act
Extra Information
Caveat
Acknowledgements



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Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	67
Listed Migratory Species:	66

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	None
Listed Marine Species:	97
Whales and Other Cetaceans:	15
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	10
Regional Forest Agreements:	1
Invasive Species:	43
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Hunter estuary wetlands	Within 10km of Ramsar
Myall lakes	Within 10km of Ramsar

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
Temperate East

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion	Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area

Name	Status	Type of Presence
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat known to occur within area
Diuris praecox Newcastle Doubletail [55086]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus parramattensis subsp. decadens Earp's Gum, Earp's Dirty Gum [56148]	Vulnerable	Species or species habitat known to occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat known to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area
Tetratheca juncea Black-eyed Susan [21407]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (east coast population)		
Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor		
Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Housing Authority

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area

Name	Threatened	Type of Presence
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche cauta		
Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita		
Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini		
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov.		
Pacific Albatross [66511]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus		
Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura tentaculata		
Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus		
Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris		
Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna		
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus		
Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus abdominalis		
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus whitei		
White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Histiogamphelus briggsii		
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa		
Javelin Pipefish [66251]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Reptiles		

Name	Threatened	Type of Presence
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis		
Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus		
Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Gir-um-bit	NSW
Gir-um-bit	NSW
Snapper Island	NSW
Tilligerry	NSW
Tilligerry	NSW
Tilligerry	NSW
Tomaree	NSW
Worimi	NSW
Worimi	NSW
Worimi	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and		Species or species

Name	Status	Type of Presence
Sterile Pussy Willow [68497]		habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Port Stephens Estuary	NSW
Salt Ash Air Weapons Range	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.77455 152.00126

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX I

BIOBANKING CREDIT

REPORTS

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 14/03/2018 Time: 9:02:43AM Calculator version: v4.0

Major Project details

Proposal ID:	0159/2016/2410MP
Proposal name:	Bobs Farm Sand Mine
Proposal address:	Nelson Bay Road Bobs Farm NSW 2316
Proponent name:	Ammos Resources Management Pty Ltd
Proponent address:	
Proponent phone:	
Assessor name:	Daryl Harman
Assessor address:	38C Stapleton Street WALLSEND NSW 2287
Assessor phone:	02 4951 3311
Assessor accreditation:	0159

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	1.15	8.17
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	0.32	1.31
Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	35.41	1,681.00
Total	36.88	1,690

Credit profiles

1. Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, (HU860)

Number of ecosystem credits created	1,681
IBRA sub-region	Karuah Manning

Offset options - Plant Community types	Offset options - IBRA sub-regions
Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast, (HU860) Smooth-barked Apple - White Stringybark - Red Mahogany - Melaleuca sieberi shrubby open forest on lowlands of the lower North Coast, (HU832) Scribbly gum - Wallum Banksia - Prickly-leaved Paperbark heathy coastal woodland on coastal lowlands, (HU851) Smooth-barked Apple - Blackbutt heathy open forest of the Tomaree Peninsula, (HU862)	Karuah Manning and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (HU533)

Number of ecosystem credits created	1
IBRA sub-region	Karuah Manning

Offset options - Plant Community types	Offset options - IBRA sub-regions
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (HU533) Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion, (HU673) Cladium procerum coastal freshwater wetland, (HU949) Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter, (HU950) Typha rushland, (HU951) Tall Spike Rush freshwater wetland, (HU954) Lepironia articulata sedgeland, (HU955) Jointed Twig-rush sedgeland, (HU956)	Karuah Manning and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU938)

Number of ecosystem credits created	8
IBRA sub-region	Karuah Manning

Offset options - Plant Community types	Offset options - IBRA sub-regions
Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU938) Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (HU633) Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowlands, (HU863) Prickly-leaved Paperbark forest on coastal lowlands of the Central Coast and Lower North Coast, (HU930) Broad-leaved Paperbark - Swamp Mahogany - Swamp Oak - Saw Sedge swamp forest of the Central Coast and Lower North Coast, (HU931) Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast, (HU932) Paperbarks - Woollybutt swamp forest on coastal lowlands of the Central Coast, (HU933) Swamp Mahogany - Paperbarks - Harsh Ground Fern swamp forest of the Central Coast, (HU936) Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast, (HU937) Swamp Mahogany - Broad-leaved Paperbark - Swamp Water Fern - Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU939) Flax-leaved Paperbark - Tall Sedge shrubland of the Sydney Basin, (HU940) Swamp paperbark - Baumea juncea swamp shrubland on coastal lowlands of the Central Coast and Lower North Coast, (HU944) Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley, (HU945)	Karuah Manning and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

BioBanking Credit Calculator

Ecosystem credits

Proposal ID :	0159/2016/2410MP
Proposal name :	Bobs Farm Sand Mine
Assessor name :	Daryl Harman
Assessor accreditation number :	0159
Tool version :	v4.0
Report created :	14/03/2018 09:00

Assessment circle name	Landscape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
1	16.40	HU860_Moderate/Good_High	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Moderate/Good_High	No	Clearing	25.90	75.00	0.00	75.00	0	1,563	Masked Owl	61.11	3.00	1,563
1	16.40	HU860_Moderate/Good_High	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Moderate/Good_High	No	MZ1	3.44	75.00	50.00	25.00	0	79	Masked Owl	0.00	3.00	79
1	16.40	HU860_Moderate/Good_High	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Moderate/Good_High	No	MZ2	5.17	75.00	71.88	3.12	0	33	Masked Owl	0.00	3.00	33
1	16.40	HU860_Moderate/Good_Derived grassland	Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Moderate/Good_Derived grassland	Yes	MZ3	0.90	22.92	19.79	3.13	0	6	Masked Owl	0.00	3.00	6
1	16.40	HU938_Moderate/Good	Broad-leaved Paperbark - Swamp Oak - Saw Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast	Moderate/Good	Yes	MZ4	1.15	60.67	56.67	4.00	8	8	Barking Owl	0.00	3.00	8
1	16.40	HU533_Moderate/Good_Poor	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate/Good_Poor	Yes	MZ5	0.32	55.81	55.81	0.00	1	1	Black-tailed Godwit	0.00	2.60	1

BioBanking Credit Calculator

Species credits

Proposal ID :

Proposal name :

Assessor name :

Assessor accreditation number :

Tool version : v4.0

Report created : 14/03/2018 09:00

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
			No					

APPENDIX J

EXPERIENCE AND QUALIFICATIONS

Since its inception in 1993, **Wildthing Environmental Consultants** have undertaken a diverse range of studies over a wide geographic range from southern Sydney through to south-eastern Queensland and the western plains of New South Wales. All of these studies have satisfied the relevant Local Council, State Government and Commonwealth Government legislation and assessment guidelines in accordance with the project specifications.

Curriculum Vitae

Name: Daryl Harman

Position: Senior Ecologist

Qualifications:
Bachelor of Applied Science, (Environmental Science). Charles Sturt University Wagga Wagga. 1994-1997.
Certificate II in Bushland Regeneration, North Wagga TAFE, 1998.
Accredited BioBanking Assessor under the NSW Threatened Species Conservation Act 1995 No. 159.
BAM Assessor Accreditation No: BAAS17074 Valid 13/11/2020

Fields of Competence:
- Flora and Fauna Impact Assessments
- Field Surveys involving Flora, Fauna and Habitat identification
- Ecological Constraints Assessments
- Environmental Management Plans
- Habitat Tree Identification and Clearance Supervision
- Nest Box Management Plans, Installation and Monitoring
- Geographic Information System Mapping
- Aquatic Fauna Surveys
- Plant identification.
- Fauna identification including invertebrates

Licences and other
- Scientific Investigation Licence, NSW National Parks and Wildlife Service.
- NSW Drivers Licence, Class C.
- Current with Lyssa Virus injections.
- Current Whitecard to work on construction sites.
- Work Safely at Heights RIIWHS204D card.

PROFESSIONAL EMPLOYMENT AND EXPERIENCE
Wildthing Environmental Consultants, Newcastle (2002–Present) -Ecologist

Details of work carried out:
- BioBanking Assessments
- Assessments on Flora and Fauna including invertebrates
- Species Impact Statements
- Seven Part Test Assessments for Flora and Fauna.
- Environmental Management Plans.
- Environmental Mine Monitoring.
- Bushfire Protection and Attack Assessments.
- Habitat Tree Felling Supervision
- Nest Box installation, monitoring & maintenance.
- Aquatic Fauna Surveys

Total Earth Care Pty. Ltd Warriewood NSW (2001 – 2002) - Bush Regenerator. Working around various sites in the Greater Sydney area.
Johnstone Centre, Charles Sturt University, Wagga Wagga, NSW - August & October 2001 Casual Technician (Flora and fauna surveys)
Charles Sturt University, Wagga Wagga NSW, Science and Technology (April 1999 – March 2001) Casual Technical Officer.
NSW Department of Agriculture, Wagga Wagga - Casual Regulatory Officer/Casual Farm Assistant (1998).

Greening Australia, Wagga Wagga, NSW (November/December 1998) Casual Technical Officer (Roadside Flora Surveys).

Charles Sturt University, Wagga Wagga NSW, Science and Technology (November/ December 1997) - Casual Technical Officer

Australian Army (1992 – 1997) - Infantry Soldier, Ready Reserve Scheme.

Certificates/Short Courses

- Work Safely at Heights RIIWHS204D Statement of Attainment (1 February 2018) Newcastle Rescue & Consultancy Pty Ltd, Beresfield, NSW.
- BAM Accredited Assessor Training 5-day Course, Newcastle 18-22 September 2017.
- Threatened Invertebrate Workshop (Snails. Dragonflies, Beetle, Moths & Butterflies. Dr Chris Reid & Dr Frank Koehler - Australian Museum, Sydney. Ecological Consultants Association of NSW. 22 June 2017.
- Statement of Attainment Prepare and Apply Chemicals AHCCHM303A, Transport, handle and store chemicals AHCCHM304A. Blackbutt Rangers Cottage, 11 February 2016.
- Shorebird Identification and Assessment Workshop. Ecological Consultants Association of NSW. Course Leader - Phil Straw. 20 April 2015.
- BioBanking & Biodiversity Certification Assessor Accreditation Training Course 4 - 8 August 2014.
- Snail Workshop - Australian Botanic Garden, Mount Annan. Presented by Dr Stephanie Clark, Director of Invertebrate Identification Australia. 24 January 2013.
- Statement of Attainment - Apply First Aid (HLTFA311A - Allens Training 28 September 2012.
- Eucalypts of the Sydney Region. Eucalypt identification workshop with Van Klaphake. CECAL Hall, Earlwood. (10 & 11 July 2010).
- HLTFA301B Apply First Aid (17 September 2009).
- Safe Working at Heights Statement of Attainment (August 2008) Combined Safety Services, Adamstown NSW. BCPRF2001A.
- Sedges and Rushes of Sydney and the Blue Mountains –Van Klaphake. Marrickville, Sydney. (21 & 22 May 2005).
- Workshop on the Translocation of Threatened Plants. June 2004 - Royal Botanic Gardens Sydney.
- Community Greening Volunteer. – Newcastle City Council. 30 August 2003 - Induction Training Module.
- 25 March 2002 – Occupational Health and Safety, Induction Training for Construction Work. General course under the Occupational Health and Safety Regulation 2001. Work Cover NSW. Course completed to work on worksites.
- Identification of Coleoptera from the Australo-Pacific Region - CSIRO Canberra. (10 - 16 December 2001).
- 13th Taxonomic Workshop: Hirudinea, Lepidoptera, Mollusca, Nematoda, Odonata and Plecoptera. Lake Hume Resort. 12 – 13 February 2001.
- Certificate II in Bushland Weed Control, North Wagga TAFE, 1998.
- Chainsaw Operations - North Wagga TAFE - 1998.
- Wildlife Management – A subject through Charles Sturt University, Thurgoona Campus, Albury NSW. Summer Break 1997.
- Shearing Shed Hand - College Statement Wagga Wagga TAFE 1989.

Memberships

- Australian Association of Bush Regenerators. - Accredited Member
- Ecological Consultants Association of NSW - Full Practicing Member

Name: Mungo Worth

Position: Ecologist

Qualifications: BioBanking & Biodiversity Certification Assessor Accreditation Training Course 4 - 8 August 2014.

Fields of Competence:
• Flora and Fauna Impact Assessments
• Field Surveys involving Flora, Fauna and Habitat identification
• Ecological Constraints Assessments
• Environmental Management Plans
• Bushfire Protection and Attack Assessments
• Habitat Tree Identification and Clearance Supervision
• Nest Box Management Plans, Installation and Monitoring
• Plant identification
• Fauna identification

Licences and other:
• Scientific Investigation Licence, NSW National Parks and Wildlife Service
• NSW Drivers Licence, Class C
• Current with Lyssa virus injections
• Current Whitecard to work on construction sites

Professional Employment and Experience:
Wildthing Environmental Consultants:
• Salt Ash, NSW (1995 – 2001, 2003 – 2004)
• Burleigh Heads, QLD (2002 – 2003)
• Wallsend, NSW (2005 – Present)

(1995 – Present) – Bat call analyst

(1995 – 1997) – Technical Assistant / Junior Ecologist

(1997 – 2004) - Ecologist

(1999 – 2001) – Training Officer

(2002 – 2003) – Queensland Projects Manager

(2004) –IT officer

(2005 – Present) – Manager / Ecologist

Details of work carried out:
• Assessments on Threatened Flora and Fauna
• Species Impact Statements – Fieldwork, Report Writing
• Seven Part Test Assessments for Flora and Fauna
• Environmental Management Plans
• Environmental monitoring
• Bushfire Protection and Attack Assessments
• Habitat tree clearance supervision and fauna rescue
• Nest Box installation, monitoring & maintenance
• Plant identification
• Fauna identification

Certificates/Short Courses:
• HLTFA301B Apply First Aid (17 September 2009).
• Safe Working at Heights Statement of Attainment (August 2008) Combined Safety Services, Adamstown NSW. BCPRF2001A.
• 25 March 2002 – Occupational Health and Safety, Induction Training for Construction Work. General course under the Occupational Health and Safety Regulation 2001. Work Cover NSW. Course completed to work on worksites.

Memberships:
• Australasian Bat Society.

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DATE OF BIRTH:	03/02/1985

Employment History Summary

Employer: **Wildthing Environmental Consultants**
2014-Present Ecologist
Preparing Ecological Impact Assessments
Preparing Species Impact Assessments
Preparing Ecological Assessments for electricity infrastructure projects

Employer: **University of Technology, Sydney**
2010-2014 PhD scholarship student in Marine Biology.
See Education Highlights for further information

Employer: **Umwelt Environmental Consultants**
2010 Contractor – *Polychaete taxonomist*

Employer: **University of Newcastle**
2009-2010 Laboratory demonstrator – *Teaching 2nd Year course 'Ecology'*

Employer: **University of Newcastle**
2009 Laboratory demonstrator – *Teaching 3rd Year course 'Environmental Biology'*

Employer: **University of Newcastle - Ecotoxicology and Ecology Laboratory**
2008-2009 Research Officer and Benthic Ecologist - *specialising in polychaete and other benthic fauna identification and ecology*

Employer: **Australian Museum – Marine Invertebrates Department**
2008 Technical Officer – *Assisted in the review of the polychaete family Ampharetidae for scientific publication*

Employer: **Hunter- Central Rivers Catchment Management Authority (HCRCMA)**
2005 – 2006 Assistant WaterWatch Coordinator – *Teaching water quality testing protocol and freshwater ecology*

Employer: **University of Newcastle - Microbiology Laboratory**
2005 Laboratory technician – *Bluescope Steel Water Tank Project*

Education Highlights

2014	Publication: Dixon-Bridges, K.; Gladstone, W. & Hutchings, P. (2014). One new species of *Micronephthys* Friedrich, 1939 and one new species of *Nephtys* Cuvier, 1817 (Polychaeta: Phyllodocida: Nephtyidae) from eastern Australia with notes on *Aglaophamus australiensis* (Fauchald, 1965) and a key to all Australian species. *Zootaxa*, **3872**(5): 513-540.
2014	Publication: Dixon-Bridges, K., Hutchings, P. & Gladstone, W. (2014) Effectiveness of habitat classes as surrogates for biodiversity in marine reserve planning. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **24**(4): 463-477.
2010-2014	PhD in Marine Biology at the University of Technology, Sydney in association with the Marine Parks Authority, Fisheries and the Australian Museum. My thesis examined the effectiveness of the current conservation zoning system of the Port Stephens-Great Lakes Marine Park (PSGLMP) and devised a more efficient and cost effective protocol for future use, examined polychaete biodiversity associated with a rare soft-coral habitat within the PSGLMP in order to employ a no-anchor zone for conservational purposes, discovered and described three new species of polychaete, and examined conservation value on a temporal scale within the estuarine environment
2010	Presented at the International Polychaete Conference, Lecce, Italy
2009	Various public seminars at the Australian Museum detailing my PhD project
2007	Honours work featured in the FRDC (Fisheries Research and Development) Magazine and AMSA (Australian Marine Science) Bulletin
2007	Won Fisheries Research Development Corporation Best Poster Presentation Prize at the Australian Marine Science Association Conference
2006-2007	1st Class Honours in Biology assessing polychaete assemblage condition below pearl farms on the Kimberley coast in Western Australia in association with Paspaley Pearls, Cygnet Bay Pearls, Fisheries Research Development Corporation and Pearl Producers Association

Referees

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Mike Lawrie

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Master of Environment
Specialisation in Environmental Science
Commenced 2014

University of Newcastle
Bachelor of Environmental Science and Management
Major in Physical Systems
2009 – 2011

Professional Development
December 2014 - 2017 Ecologist - Wildthing Environmental Consultants

- Environmental consulting and flora/fauna surveys.
- Preparation of reports including Flora and Fauna Assessment on a variety of projects electricity, infrastructure and residential projects.
- Preparation of Koala Plan of Management reports.
- Using a number of animal traps including Elliott traps, harp traps, pitfalls, hair tubes, Anabats, camera traps and glider tubes.
- Performing hollow-bearing tree assessments.
- Vegetation and habitat mapping.
- Supervision of tree clearings.

April 2013 – January 2015 Ecologist - SLR Consulting

- Environmental consulting and flora/fauna surveys.
- Using a number of animal traps including Elliott traps, harp traps, pitfalls, hair tubes, Anabats, camera traps and glider tubes.
- Vegetation and habitat mapping
- Preparing reports including Flora and Fauna Assessment and Koala Plan of Management reports.

September 2014 – December 2014 Environmental Scientist - Hazchem Pty Ltd

- Investigation of contaminated sites including Phase 1 and Phase 2 assessments
- Field work investigating contaminated sites including soil and water sampling.
- Data analysis and preparation of reports for contaminated sites.

October 2013 – October 2014 Environmental Scientist - Tom Farrell Institute for the Environment

- Assisting with research, compiling environmental information and reporting on a variety of projects.
- Use of GIS programs for analysis of data.
- Involved in water quality monitoring projects for Port Stephens Council, Newcastle City Council and Caring for Our Country.
- Taking measurements for surface water and groundwater flow and testing water quality.

October 2010 – June 2014 Surveyor's Assistant - Richard Hutchison Surveying

- Assisting the surveyor set up technical equipment and taking measurements using a theodolite and manual measuring devices.
- Assessing land features, marking boundaries using pegs, stakes and strings and clearing vegetation and obstructing features.

Additional Qualifications

- NSW Construction Induction card
- Apply First Aid certificate
- NSW Driver's Licence

Referees

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Curriculum Vitae: Ben Ellis

Position: Ecologist

Qualifications: Bachelor of Environmental Science and Management (Living Systems). Newcastle University Callaghan. 2009-2011.

Fields of Competence:
• Flora and Fauna Impact Assessments
• Field Surveys involving Flora, Fauna and Habitat identification
• Ecological Constraints Assessments
• Habitat Tree Identification and Clearance Supervision
• Nest Box Installation and Monitoring
• Plant identification
• Fauna identification

Licences and other:
• Scientific Investigation Licence, NSW National Parks and Wildlife Service
• NSW Drivers Licence, Class C
• Current Whitecard to work on construction sites

Wildthing Environmental Consultants, Newcastle (2012 – 2014) - Ecologist
Details of work carried out:
• Assessments on Flora and Fauna
• Species Impact Statements - Fieldwork - Report Writing
• Seven Part Test Assessments for Flora and Fauna.
• Habitat Tree Felling Supervision
• Nest Box installation, monitoring & maintenance.
• Plant identification.
• Fauna identification.

Australian Reptile Park, Somersby NSW (2006) – Reptile/Marsupial Keeper.
Animal care, dietary planning, behaviour observation and wild animal reintroduction.

Certificates/Short Courses:
• HLTFA311B Apply First Aid (28 September 2012).
• Safe Working at Heights Statement of Attainment (January 2013) Combined Safety Services, Adamstown NSW. RIIOHS204A.
• 12 April 2012 – Work Health and Safety, General Construction Induction under the Work Health and Safety Regulation 2011. Work Cover NSW. Course completed to work on worksites.

Memberships:
• Native Animal Trust Fund.

Annex O – Traffic Impact Assessment



Bobs Farm Sand Quarry

Ammos Resource Management Pty Ltd

Traffic Impact Assessment

July 2016

SECA solution

Bobs Farm Sand Extraction development

Traffic Impact Assessment

Author: Sean Morgan

Client: Ammos Resource Management Pty Ltd

Issue: Ver03/30062014

Reference: P0243

1 July 2016

Quality Review and Document History

Version	Date	Description	Prepared By	Approved By
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1 Introduction

1.1 Background

Seca Solution was commissioned by Tattersall Lander Pty Ltd on behalf of Ammos Resource Management Pty Ltd to prepare a Traffic Impact Assessment for the proposed sand extraction quarry located off Nelson Bay Road, Bobs Farm. This report will form part of the supporting documentation being prepared to support a Development Application (DA) to Port Stephens Council.

As this is a mining project, the development proposal will be reviewed by the Department of Planning and Infrastructure and DGRs have been issued for the project.

The project is located adjacent to Nelson Bay Road which forms part of the regional road network. Whilst Council are the road authority the project will also be reviewed by the Roads and Maritime Services (RMS) and they will need to provide concurrence for the project to have access off Nelson Bay Road.

Initial discussion has been held with Council and the access proposals discussed to allow for entry off Nelson Bay Road and exit movements onto Marsh Road.

This traffic impact assessment has been prepared in accordance with Austroads Guidelines and the "RTA Guide to Traffic Generating Developments" published by the Roads and Maritime Services (RMS).

1.2 Scope of Report

The scope of this report is to review the traffic and access impacts associated with the proposed development and to assess the access arrangements for the development. The report provides advice on road network capacity, access issues and safety review.

1.3 Issues and Objectives of the study

The issues relative to the proposal are:

- Determine the future traffic generation for the development;
- Assess impact on the local road network due to the additional flows;
- Review the access arrangements for the development;
- Assess any other transport impacts associated with the development including a safety review.

The objective of the report is to document the impacts of the proposed development and provide advice on any infrastructure work required on the external road network as part of the development.

1.4 Planning Context

In preparing this document, the following guides and publications were used:

- RTA Guide to Traffic Generating Developments, Version 2.2 Dated October 2002;
- RMS TDT 2013/04 "Update Traffic surveys August 2013"
- Department of Planning EIS Guidelines, Roads and Related Facilities

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1.5 Authority Requirements

The following issues were included in the DGRs issued for the development (including comments raised by the RMS) and are addressed in the following sections of this traffic impact assessment.

Table 1-1 DGRs Response

Comment	Report Inclusion
Accurate predictions of project-related traffic and a detailed assessment of the potential impacts of project-related traffic on the capacity, safety and efficiency of the road network	4.1, 4.1.2, 4.3.1, 4.3.2
A detailed description of the measures that would be implemented to upgrade and / or maintain the capacity, efficiency and safety of effected roads and intersections over the life of project	4.3.2
Identify all relevant vehicular traffic routes and intersections for access to / from the subject site	4.2, 4.2.1
Current traffic counts for all of the above traffic routes and intersections	2.3.1-7
The distribution on the road network of the trips generated by the proposed development. It is requested that the predicted traffic flows are shown diagrammatically to a level of detail sufficient for easy interpretation	4.2.1
Consideration of the traffic impacts on existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generated by the proposed development during the construction and operational stages. The study should also give consideration to the cumulative traffic impacts of other proposed and approved developments in the area	4.3
Traffic analysis of any major / relevant intersection, using SIDRA or similar traffic model	4.3.2
Any other impacts on the regional and state road network including consideration of pedestrians, cyclists and public transport facilities and provision of service vehicles	3.2.3, 3.5, 4.1.5

2 Existing Situation

2.1 Site Description and Proposed Activity

2.1.1 Site Location and Access

The site is located within the general locality of Bobs Farm with road frontage to both Nelson Bay Road and Marsh Road (Figure 2-1 below). Access for heavy vehicles will be provided off Nelson Bay Road with exiting heavy vehicle movements via Marsh Road. Access for light vehicles will be allowed via both of these access points.

The site is currently vacant.

The location of the site is shown below in Figure 2-1.



Source: Google maps

■ *Figure 2-1 - Site Location*

Existing land use adjacent to the site is a mixture of rural residential and a local primary school.

2.2 Existing Traffic Conditions

2.2.1 Road Hierarchy

The major road through the locality is **Nelson Bay Road** which provides an important road link between the Nelson Bay area to the east of the site and Newcastle / Newcastle airport and the Pacific Highway to the west of the site. In the locality of the subject site, it provides two lanes of travel in both directions with a sealed shoulder. There are verges to both sides and there is a central median to restrict right turn movements to intersections with a number of U turn bays provided along its length to cater for local traffic demands.

The speed limit varies along its length and in the vicinity of the subject site is 80 km/h.

Access to the site is also available via Marsh Road, a local road providing access to a number of local rural suburbs and rural residential holdings. It provides a single lane of travel in both directions and operates under the posted speed limit of 60 km/h. There is a school zone located close to the intersection with Nelson Bay Road with the normal restriction of 40 km/h during the morning and afternoon school activity periods.

2.2.2 Roadworks

There are currently no road works occurring within the immediate vicinity of the of the subject site. Further to the east of the site, the Roads and Maritime Services (RMS) are currently upgrading Nelson Bay Road, from the current

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single lane of travel to provide two lanes of travel in both directions. There will be a central median to restrict right turn movements with a number of U turn facilities provided at side roads to allow for the right turn demand movements.

2.2.3 Traffic Management Works

No further traffic management works are proposed along Nelson Bay Road in this locality.

2.2.4 Pedestrian and Cycling Facilities

There are minimal pedestrian and cycling facilities in the general locality of the site, reflective of the very low demands in this area. Pedestrians and cyclists are able to utilise the sealed shoulder provided in both directions along Nelson Bay Road. During the site work a number of cyclists were observed on Nelson Bay Road but no pedestrians. This is reflective of the relatively remote location of the area from the major centres.

2.3 Traffic Flows

2.3.1 Peak Hour Flows

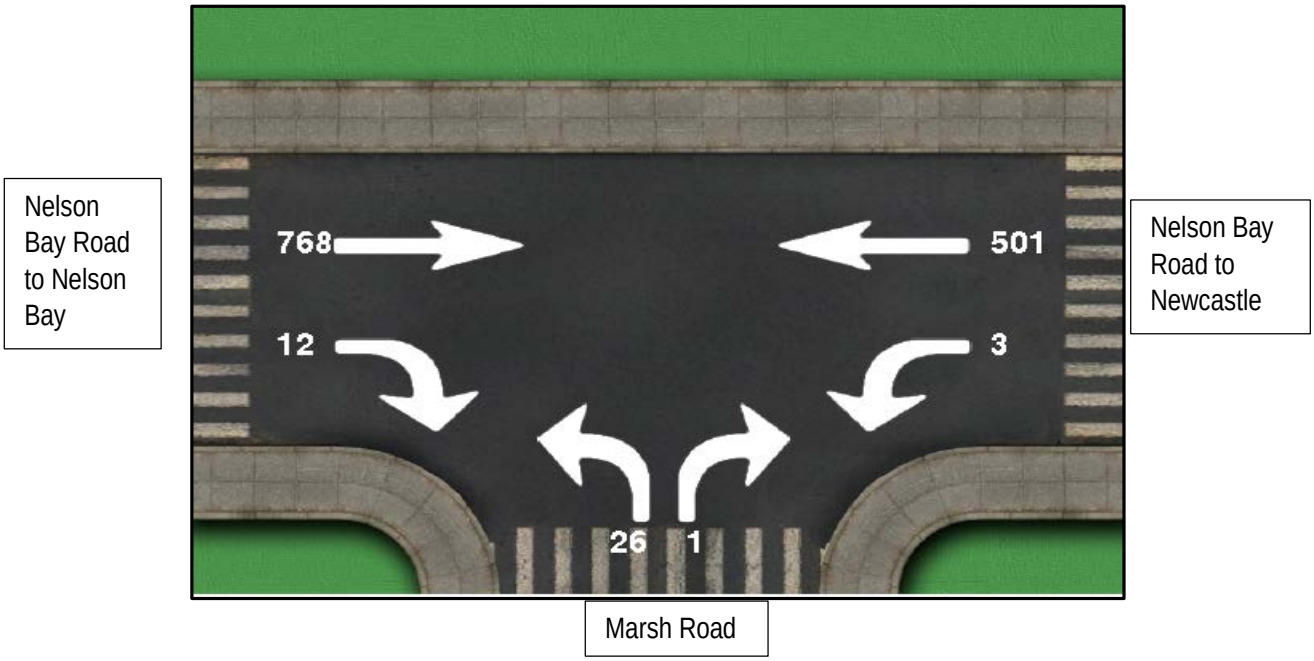
As part of the study work, Seca Solution completed traffic surveys at the 3-way give way controlled intersection of Marsh Road and Nelson Bay Road. These surveys were completed during both the morning and afternoon peak periods on Thursday 21st August 2014 during term time. The two-way traffic flows adjacent to the site on Nelson Bay Road (south of Marsh Road) were:

- 1,273, split 769 westbound towards Newcastle (60%) in the morning peak between 7.45 and 8.45 AM and
- 1,321, split 826 eastbound towards Nelson Bay (62%) in the afternoon peak between 3.30 and 4.30 PM

During the same periods, the two-way traffic movements on Marsh Road were much lower, at 42 in the AM peak and 110 in the PM period.

The surveyed morning and afternoon traffic flows are shown below:

Figure 2-2 - AM peak surveyed numbers



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Figure 2-3 – PM peak surveyed numbers



2.3.2 Daily Traffic Flows

As part of the project, Seca Solution commissioned automatic tube counts to obtain current traffic volumes along both Nelson Bay Road and Marsh Road. A summary of the tube count data is provided below:

- The Marsh Road Annual Average Daily Traffic flow (AADT) was 713 vehicles per day. This was split between 412 eastbound and 301 westbound. This value is considerably lower than the value identified above (based on peak hour flows) and indicates that peak hour flows are influenced by the activities associated with student drop off and pick at the nearby school.
- The eastbound AADT on Nelson Bay Road was recorded at 7,612 vehicles per day.
- The westbound AADT on Nelson Bay Road was recorded at 7,699 vehicles per day.
- The combined two-way AADT for this section of Nelson Bay Road was 15,311 vehicles per day.

These tube counts were competed between 12th and 18th September 2014 outside of school holidays.

2.3.3 Daily Traffic Flow Distribution

The daily traffic volumes are reasonably balanced in both directions, with the above data indicating a bias in traffic movements eastbound in the morning and westbound in the afternoon. This would be reflective of the commuter demands, with commuters travelling from the Nelson Bay area towards greater Newcastle, Maitland and the Lower Hunter Valley and the reverse occurring in the afternoon period.

2.3.4 Vehicle Speeds

No speed surveys were completed as part of the study work. It is considered that drivers on Nelson Bay Road could travel at speeds over the posted speed limit, due to the speed limit being 100 km/h to the west of this location and there being no noticeable change in the road environment. For eastbound traffic, the road upgrades that have occurred in this area encourage drivers to speed up and as such could travel over the posted speed limit of 80 km/h. The posted speed limit increases to 100 km/h to the west of the site and it is considered that drivers speed up in anticipation of this change in speed.

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The automatic tube counts provide the following data:

- 85th percentile speed on Nelson Bay Road eastbound was 91 km/h
- 85th percentile speed on Nelson Bay Road westbound was 90 km/h.

Vehicle speeds are low on Marsh Road, reflective of the road width and alignment as well as the presence of the school zone in this area. The tube count was located close to the intersection with Nelson Bay Road but west of the U-turn facility and indicates the following speeds:

- 85th percentile on Marsh Road eastbound was 65 km/h
- 85th percentile on Marsh Road westbound was 59 km/h.

2.3.5 Existing Site Flows

The site currently generates minimal traffic flows.

2.3.6 Heavy Vehicle Flows

Heavy vehicle movements in the vicinity of the subject site are relatively low, reflective of the limited through traffic movements along Nelson Bay Road. As a road that serves the Nelson Bay peninsular, there are no through traffic movements, with the only heavy vehicle movements being those associated with deliveries to the various urban centres. Heavy vehicle movements are restricted to delivery vehicles to the major shopping centres as well as some light industrial users.

During the traffic surveys, the vast majority of the traffic were light vehicles with the heavy vehicle content representing some 5% of the overall traffic movements.

2.3.7 Current Road Network Operation

Observations on site during the peak periods showed that the road network currently operates very well with minimal delays and congestion. The traffic movements along Nelson Bay Road flows well with no delays or congestion, and the two lanes of travel allow faster moving traffic to pass slow vehicles as appropriate. For traffic movements in and out of Marsh Road, the delays were minimal and drivers were able to determine suitable gaps for the right turn movements with very minimal delays.

Further to the west, it can be seen that the single lane of travel causes some delays, due to the volume of traffic. However, the road upgrade will allow for 2 lanes of travel and eliminate these delays.

Traffic flows along Nelson Bay Road are also influenced by seasonal demands, with summer demands increasing due to the tourists facilities in the Nelson Bay area. Similarly, the weekend traffic demands can be relatively high, reflective of weekend and day trips to the Nelson Bay area.

2.4 Traffic Safety and Accident History

Accident data provided by the RMS for the locality shows that there have been a low number of recorded accidents in the vicinity of the intersection of Nelson Bay Road and Marsh Road, reflective of the low side road traffic flows and the good alignment of this intersection, providing good visibility in both directions for drivers entering and exiting the side road. The accidents that have occurred have been located away from the intersection and do not relate to the layout of the intersection nor its controls.

2.5 Parking Supply and Demand

2.5.1 On-street Parking Provision

Parking is permitted along both sides of the roads in the locality, on the verges as required with normal restricts in the immediate vicinity of the intersection and driveways.

2.5.2 Off-Street Parking Provision

There is parking provided within the various lots in the immediate vicinity of the subject site.

2.5.3 Parking Demand and Utilisation

During the site work, there were no vehicles parked on Nelson Bay Road. It is considered that any vehicles parking on this road would be associated with emergency or breakdowns only, as there is no demand to park on the road side in this location.

Vehicles associated with drop off and pick up at the local school on Marsh Road park adjacent to the school but outside of the school hours there is very little demand for parking in this location, with the local houses all allowing for off-street parking.

2.5.4 Set down or pick up areas

There is an indented bus drop off / pick up zone outside the entrance to the local school on Marsh Road.

2.6 Public Transport

2.6.1 Rail Station Locations

The subject site is not served by trains. The nearest train station is in Hexham, approximately 25kms from the subject site.

2.6.2 Bus Stops and Associated Facilities

There is a bus drop off zone located outside the local school on Marsh Road together with a bus stop on the opposite side of the road. There is a single shelter on Marsh Road to service these bus stops. There are bus stops located on both sides of Nelson Bay Road to both sides of the intersection with Marsh Road, to service patron demands for buses that operate along Nelson Bay Road. The stops on Nelson Bay Road provide a sign only with no seats or shelter.

2.7 Other Proposed Developments

There are no other major developments occurring in the immediate vicinity of the subject site.

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3 Proposed Development

3.1 The Development

The development proposal allows for a sand mining operation, with access off Nelson Bay Road and Marsh Road. The initial stage of the proposal allows for establishing the site, clearing the site of vegetation and providing the two access points. The following stages are nominated:

a. Operational Stage 1 – Clearing and stockpiling of topsoil and production of initial sand material that is likely to be processed into landscaping soil base and sports field top-dress material.

b. Operational Stage 2- Processing of blonde sand material for all products range.

c. Operational Stage 3 – Setting up of dredging operations and winning of sand material for the processing of all products range.

Within the operational stages the main activities will be the bulk handling of sand material, utilising front end loaders and trucks and the general truck and dogs for transport of the material to the required markets.

The peak use on the site would allow for 200 trucks to enter and exit the site per day.

3.1.1 Phasing and Timing

The development will be established in the first phase then proceed to operations. No staging of the project has been allowed for in this assessment.

3.1.2 Access and Circulation Requirements

A vehicle access point is proposed to allow for direct access off Nelson Bay Road. This access will be used by both light and heavy vehicles and allow for entry movements only, with no exit movements. This access will be designed and constructed in accordance with Council and RMS design requirements. All vehicles will exit the site via the access road upgrade to Marsh Road. For heavy vehicles requiring access from the east of the site, access would be via the entry point off Nelson Bay Road. Trucks will travel along Nelson Bay Road and then complete a U-turn to then turn left into the site. There is an existing U-turn facility provided to the west of the site access, with a deceleration lane for the traffic turning off the westbound traffic lane. At this location, the opposing traffic streams are separated by some 45 metres, which allows for a safe U-turn to occur for trucks.

The access driveway on Marsh Road is located to the east of the local school and all trucks will exit and turn right out of this driveway to turn towards Nelson Bay Road. There is an existing access at this location which will be upgraded to allow for the increased use and this access will be designed and constructed in accordance with Council design requirements.

Circulation within the site will be determined by the operational requirements of the development. All vehicles will be able to enter the site and manoeuvre as required within the site and exit in a forward direction.

3.2 Access

The new access of Nelson Bay Road and the upgraded driveway will be designed and constructed in accordance with Council and / or RMS requirements and allows for left in traffic movements only off Nelson Bay Road due to the central median. The upgraded access on Marsh Road will allow for all traffic movements, however trucks will only exit through this access and undertake a right turn. No heavy vehicles will enter the site through the Marsh Road access.

3.2.1 Driveway Location

The driveway access on Nelson Bay Road is located on the inside of a low angle left hand bend. In this location Nelson Bay Road provides two lanes of travel in both directions and the trucks will turn off the through lane and enter a left turn deceleration (to be constructed) before entering the site. This entry point is located 30 metres west of an existing U-turn lane on Nelson Bay Road and will only allow for left turn in traffic movements.

The driveway on Marsh Road will be an upgrade of the existing access point in this location. Marsh Road in this location offers a reasonably straight alignment to provide safe entry and exit movements. Due to the low speed limit (60 km/h) and the low traffic speeds, this access will be a simple driveway access with no left turn deceleration lane provided. All trucks exiting the site will turn right out of this driveway. All vehicles entering the site at this location will be light vehicles only associated with staffing requirements.



Photo 1 – View west along Marsh Road showing road alignment. Access to site is on left hand side of the photograph

3.2.2 Service Vehicle Access.

All service vehicle access will be via Marsh Road, with servicing levels expected to be low. There will be a requirement for a fuel truck to access the site as well as occasional maintenance vehicles for the quarry vehicles which will be located permanently on site. For the material handling trucks, servicing requirements will be completed off site.

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3.2.3 Access to Public Transport

The site has limited access to public transport, with limited bus services provided along Nelson Bay Road and Marsh Road. While future workers could use these bus services, it is considered that the proposed development will generate no demand for public transport use.

3.3 Circulation

3.3.1 Pattern of circulation

All vehicles will be able to enter and exit the site in a forward direction from the local road network. All trucks will enter the site off Nelson Bay Road via the left turn slip. These trucks will then proceed through the site in a forward direction and then exit the site onto Marsh Road. All trucks will turn right when exiting the site onto Marsh Road. Light vehicles will access the site via Marsh Road, move within the site and then exit the site onto Marsh Road in a forward direction.

3.3.2 Road width

The access points on Nelson Bay Road and Marsh Road will be designed and constructed in accordance with Council and RMS requirements and will allow for the movement of trucks. The internal roads will take into account the swept path requirement of a truck and trailer combination. There will not be any formal roads within the site, due to the nature of the development.

3.3.3 Internal Bus Movements

No internal bus movement required for this development.

3.3.4 Service Area Layout

No dedicated service area is provide. Trucks will be serviced off site and there will be no requirement for a dedicated service bay on the site.

3.4 Parking

The parking for the development will be provided for the staff located on site with access via the driveway off Marsh Road. This will be in an informal area close to the offices on the site.

There will be no requirement for the trucks to park on the site overnight. Equipment associated with the quarry operations will stand on site.

3.5 Pedestrian and Bicycle Facilities

The site is relatively remote and as such it is considered that there will be no demand for pedestrian or cyclists' access. The access off Marsh Road will allow for pedestrian and cyclist access should it be required. There will be no demand or provision for internal movement of pedestrians or cyclists within the site.

4 Transportation Analysis

4.1 Traffic Generation

Traffic associated with the development will vary based upon the market demands. Advice from the study team indicates that a peak daily demand could be 200 trucks entering and exiting the site. This is an absolute peak and at other times, there would be much lower flows and during particularly quiet periods, there would be no demand for trucks to enter and exit the site.

As a worst case scenario, this assessment has worked on the assumption that the peak daily demand could be 200 trucks entering and exiting the site per day. The site is proposed to operate between 6.00 AM and 6.00 PM Monday to Saturday.

Based on a typical working day of 10 hours for the delivery of material off site, the development will generate some 20 inbound and 20 outbound trucks per hour on average when the site is working at maximum capacity.

4.1.1 Daily and Seasonal Factors

The nature of the development will lead to significant variation is daily traffic flows, dependent upon market demands. During quiet periods, it is expected that there would be no demand for trucks to enter or exit the site. Flows could be much lower on a Saturday and the site will not operate on Sundays or public holidays.

4.1.2 Sight Distances

The site access point on Nelson Bay Road is located within an 80 km/h speed zone. This access is an entry only and as such there is no requirement for drivers to observe vehicle movements on Nelson Bay Road to exit the site at this location. For drivers entering the site, the alignment of Nelson Bay Road ensures that the required forward visibility distance is available along the road, to allow a driver to observe the left turn slip road into the site. For the 80 km/h, the stopping sight distance requirements is 100 metres and this distance is available based upon the on-site assessment. This distance will allow a driver approaching the site access to observe the start of the left turn deceleration lane and allow for safe manoeuvring into this lane for the trucks. This will also allow drivers following the trucks to adjust their vehicle speeds or move into the right hand lane on Nelson Bay Road and ensure that the trucks can safely enter the left turn slip lane.

For the existing U-turn facility on Nelson Bay Road, for the westbound trucks turning off Nelson Bay Road, there is a deceleration lane for the U-turn bay, allowing the truck to enter this U-turn facility in a safe manner. There is good visibility available on this approach, which is greater than 100 metres. Trucks will then have to turn right out of this U-turn facility to then head east along Nelson Bay Road to then access the left turn slip into the site. At this point, the sight visibility distance exceeds 300 metres, safely exceeding the sight line distance of 160 metres for the sight distance requirements at this location.

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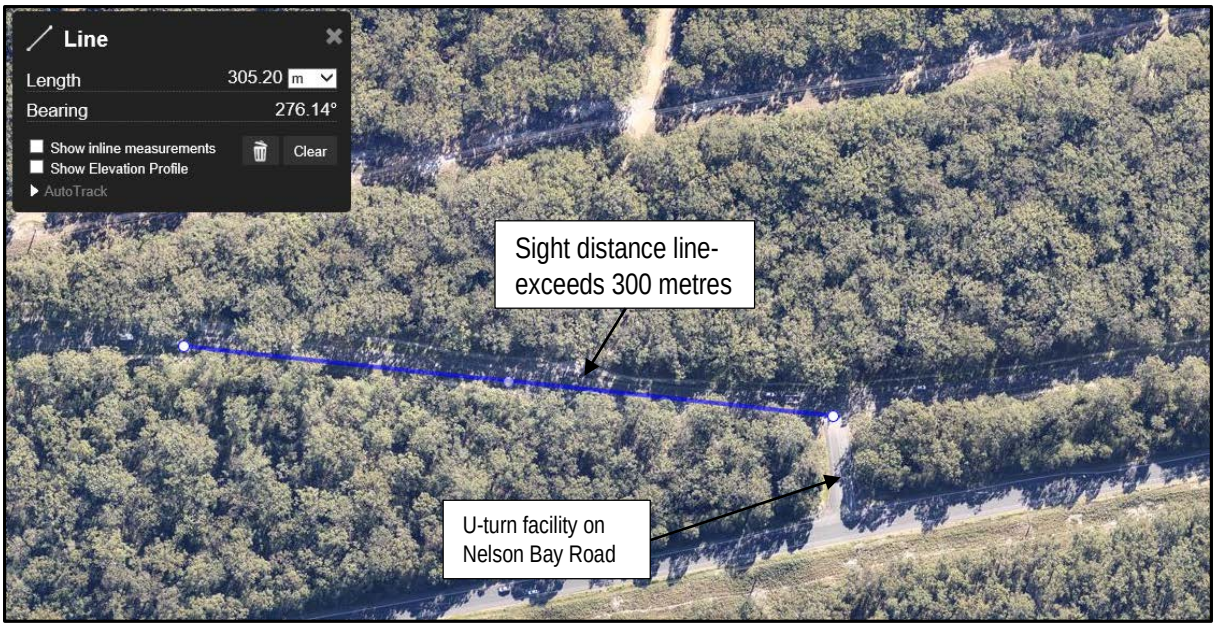


Photo 2 Aerial of U-turn facility on Nelson Bay Road west of Marsh Road

The access point on Marsh Road is located within a 60 km/h speed zone, and the required sight distance for a driveway in this speed zone is 83 metres. Under Austroad requirements for an intersection in this speed zone, the safe intersection sight distance is 105 metres. For drivers exiting the site, the sight distance available to the left is 140 metres or more, as shown below.



Photo 3 Aerial photo showing available sight distance left of the site access on Marsh Road

Visibility to the right is less than this distance, due to the road alignment to the east of the site (as shown in Photo 3 below). However, vehicle speeds at this point are below 60 km/h, as drivers have turned off Nelson Bay Road into Marsh Road. The distance available is 78 metres, which is some 5 metres less than the required distance of 83 metres for the posted speed zone of 60 km/h. However, it is noted that the minimum sight distance requirement for a driveway in this speed zone is 65 metres, which is less than the distance available. Further, it is noted that for a 50 km/h zone the sight distance requirement for a driveway is 69 metres desirable (45 metres minimum) and it is considered reasonable that vehicle speeds at this point could be 50 km/h, as this distance is only 70 metres away from Nelson Bay Road.



Photo 4 Aerial photo showing sight line to the right of the site access



Photo 5 – View to left for driver exiting the site on Marsh Road

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Photo 6 – View to right for driver exiting site on Marsh Road

Overall, it is considered that the sight distances available for vehicles entering and exiting the site via Marsh Road are acceptable, given the road alignment and the vehicle speeds.

4.1.3 Queuing at entrance to site

There are no vehicle queues expected at site entry / exit points. Given the low overall traffic demands associated with the future development and the left in traffic arrangement on Nelson Bay Road all vehicles will be able to enter the site without delay. Any queues associated with exit movements from the site are expected to be minimal and will be contained within the site.

Light vehicle movements associated with staff are expected to be low with no delays as these vehicles turn left off Marsh Road to enter the site.

4.1.4 Comparison with existing site access

The site is currently used as a home business and has an access onto Marsh Road. The current use on site involves the occasional use of truck and dog combinations and these trucks operate in a safe manner with no reported issues or concerns.

4.1.5 Pedestrian Movements

The development is not expected to be a generator of pedestrian movements either to the site or within the site.

4.2 Traffic Distribution and Assignments

Given the location of Bobs Farm on the Nelson Bay peninsula, through traffic is limited. The markets for the quarry products are expected to be primarily to the north via Raymond Terrace or south through the greater Hunter area.

95% of all traffic is expected to have an origin/destination west of the site with all traffic using Nelson Bay Road.

4.2.1 Origin / destinations assignment

90% of traffic is expected to have an origin/destination west of the site along Nelson Bay Road. The location of the access and the raised central median on Nelson Bay Road restricts heavy vehicle access to the site to be from the west only, including any traffic initially from the east. This will be reinforced by WHS Guidelines for the site operations.

All heavy vehicles exiting the site will access Marsh Road and connect with Nelson Bay Road with the vast majority expected to want to head west from Marsh Road onto Nelson Bay Road.

The destination for deliveries will depend on market forces. Haulage routes are expected to be dispersed along existing local roads with:

- north bound deliveries travelling along Richardson Road to the Pacific Highway and Raymond Terrace
- west bound deliveries travelling along Cabbage Tree Road to Tomago and west along the New England Highway
- southbound deliveries travelling to Tomago to then travel south along the M1 Motorway
- Newcastle based deliveries travelling along Nelson Bay Road to Kooragang and connecting with the local road network as appropriate

Both Nelson Bay Road and Cabbage Tree Road are restricted access vehicle routes suitable for B-doubles and similar heavy haulage.

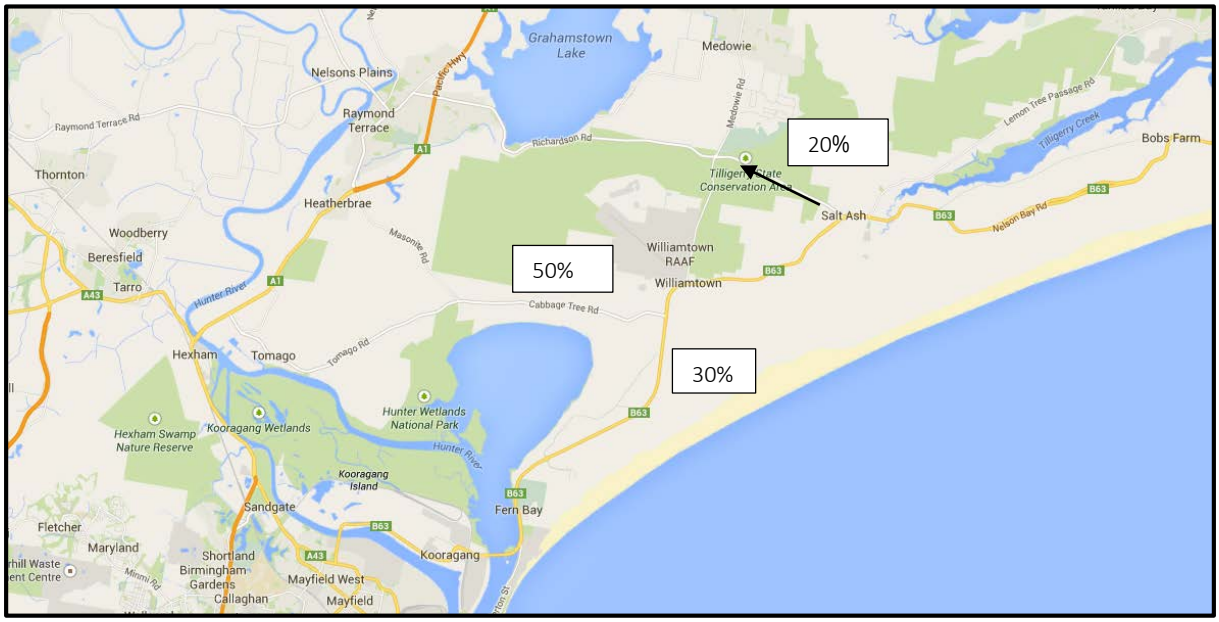


Figure 4-1 Traffic movements associated with outbound material movements

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4.3 Impact of Generated Traffic

4.3.1 Impact on daily Traffic Flows

It can be seen that the development will have a low impact upon the overall daily traffic movements in the general locality of the subject site. At peak operations, there will be 200 truck movements in and out of the site with 90% of these movements heading west along Nelson Bay Road. This will potentially increase flows in Nelson Bay Road to the west of the site by 360 vehicles. The current AADT for this length of Nelson Bay Road is 15,311 and this could increase to 15,671 vehicles per day, an increase of 2.3% over the existing flows.

As a major state road, under the Network Planning guidelines provided by the RTA (now RMS) the road would be classified as a Class 5R, typically providing 2 or more lanes with frequent overtaking opportunities. This guide indicates that the average daily traffic flows would be 12,000 vehicles per day. The next classification of road, 6R, with annual traffic flows greater than 12,000 vehicles per day would typically provide 4 or more traffic lanes.

Overall it is concluded that the additional traffic movements associated with the proposed development will have an acceptable impact upon daily traffic flows along Nelson Bay Road.

4.3.2 Peak Hour Impacts on Intersections

The peak hour traffic volumes associated with the development have been determined based upon first principals. The development, at peak operations, will generate 200 inbound and 200 outbound truck movements per day, and based on the truck movements occurring over a 10 hour day the average hourly traffic movement would be 20 inbound and 20 outbound movements per hour, which could include peak hour periods.

The key intersection that could be impacted upon by the proposed development would be the give way controlled intersection of Nelson Bay Road and Marsh Road. The operation of this intersection has been assessed with the computer program Sidra based upon the existing traffic data collected for the project. This traffic data was collected 21st April 2014 outside of school holidays.

The automatic traffic data collected for the project shows the daily traffic flow variance along Nelson Bay Road and demonstrates the distinctive peak in traffic movements. It is noted, and confirmed with the Sidra modelling, that some delays could occur for trucks when exiting Marsh Road during the peak periods. Outside of these peak periods the delays are much lower and the intersection operates well.

The results for the intersection analysis for the morning peak period (7.45 to 8.45) and afternoon peak period (15.30 to 16.30) are shown below.

Table 4-1 – Sidra results, 2014 existing situation Marsh Road and Nelson Bay Road

Approach	Level of Service	Delay (seconds)	Queue (metres)
Nelson Bay Road (Nelson Bay)	A / A	0.2 / 1.0	0.5 / 2.4
Marsh Road – left turn out	A / A	9.3 / 10.6	0.7 / 2.3
Marsh Road – right turn out	E / F	58.3 / 70.6	0.3 / 1.4
Nelson Bay Road (Newcastle)	A / A	0.0 / 0.0	0.0 / 0.0
Overall	A / A	0.3 / 0.9	0.6 / 2.4

Note- results for the AM / PM peak periods

The above analysis shows that the intersection operates well with minimal delays, although it is noted that that the right turn out operates at a level of service of E in both the AM and F in the PM peak periods with delays of 58.3 and 70.6 seconds respectively. Observations on site show however that typically the delay for traffic turning right out of Marsh Road are low, as drivers have good visibility and can use the central turn lane to undertake the right turn out of the side road in two stages.



Photo 7 – View to right for drivers exiting Marsh Road onto Nelson Bay Road

It can be seen that with the additional traffic associated with the quarry trucks added to the right turn movement out of Marsh Road, the delays will increase for drivers and could lead to frustration and safety concerns. It is further noted that the trucks exiting the site and using this intersection will be laden and as such, will not be able to accelerate at a significant rate.

To ensure road safety is maintained and not impact upon other traffic movements out of Marsh Road, all trucks exiting the proposed development will turn left out of Marsh Road, proceed along Nelson Bay Road to the roundabout at Nelson Bay Road / Port Stephens Drive and complete a U-turn at this location. This will be enforced through WH&S for the site as well as driver instructions for any contractors visiting the site. As part of the site induction all drivers will be advised of the restriction for the left turn only from Marsh Road onto Nelson Bay Road.

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The traffic modelling above, together with on-site observations, confirm that the left turn out of Marsh Road operates well with minimal delays. The alignment of Nelson Bay Road in this location allows for good visibility to the right. Nelson Bay Road to the left (westbound) in this location is reasonably flat allowing laden trucks to accelerate to the posted speed limit appropriately with minimal delays to the through traffic movements on Nelson Bay Road.

The intersection of Marsh Road and Nelson Bay Road has been assessed allowing for all additional truck movements associated with the quarry turning left into and left out of Marsh Road. The results of the Sidra analysis are presented below.

Table 4-2 - Sidra results, 2014 existing situation Marsh Road and Nelson Bay Road plus development traffic

Approach	Level of Service	Delay (seconds)	Queue (metres)
Nelson Bay Road (Nelson Bay)	A / A	0.2 / 1.0	0.1 / 2.5
Marsh Road – left turn out	A / A	12.3 / 10.7	2.6 / 3.0
Marsh Road – right turn out	E / F	60.2 / 77.0	0.3 / 1.6
Nelson Bay Road (Newcastle)	A / A	0.3 / 0.2	0.0 / 0.0
Overall	A / A	0.7 / 1.3	2.6 / 3.0

Note- results for the AM / PM peak periods

The Sidra results above demonstrate that the additional truck movements will have a negligible impact upon the operation of this intersection, with the left turn in and left turn out of Marsh Road operating at similar levels to the existing operation.



Photo 8 – View along Marsh Road showing two lane approach to Nelson Bay Road with separate left turn lane

The intersection of Marsh Road and Nelson Bay Road was then assessed for the future design year of 2026, allowing for 12 years background growth. The results of this analysis are presented below. A typical annual growth value of 2% has been applied on Nelson Bay Road.

Table 4-3 - Sidra results, 2026 flows allowing for 2% annual growth along Nelson Bay Road plus development traffic

Approach	Level of Service	Delay (seconds)	Queue (metres)
Nelson Bay Road (Nelson Bay)	A / A	0.2 / 1.1	0.6 / 3.5
Marsh Road – left turn out	A / A	13.0 / 11.7	2.8 / 3.5
Marsh Road – right turn out	F / F	124.9 / 192.5	0.7 / 3.7
Nelson Bay Road (Newcastle)	A / A	0.3 / 0.2	0.0 / 0.0
Overall	A / A	0.7 / 1.5	2.8 / 3.7

Note- results for the AM / PM peak periods

The above results demonstrate that allowing for background growth on Nelson Bay Road, the intersection will continue to operate well with the additional left in and left out traffic movements associated with the development proposal.

Seca Solution has previously collected traffic data at the intersection of Nelson Bay Road and Port Stephens Drive during the critical afternoon peak period on 2nd April 2014 (outside of school holidays) and the results of the survey are shown in Figure 4-2 below.

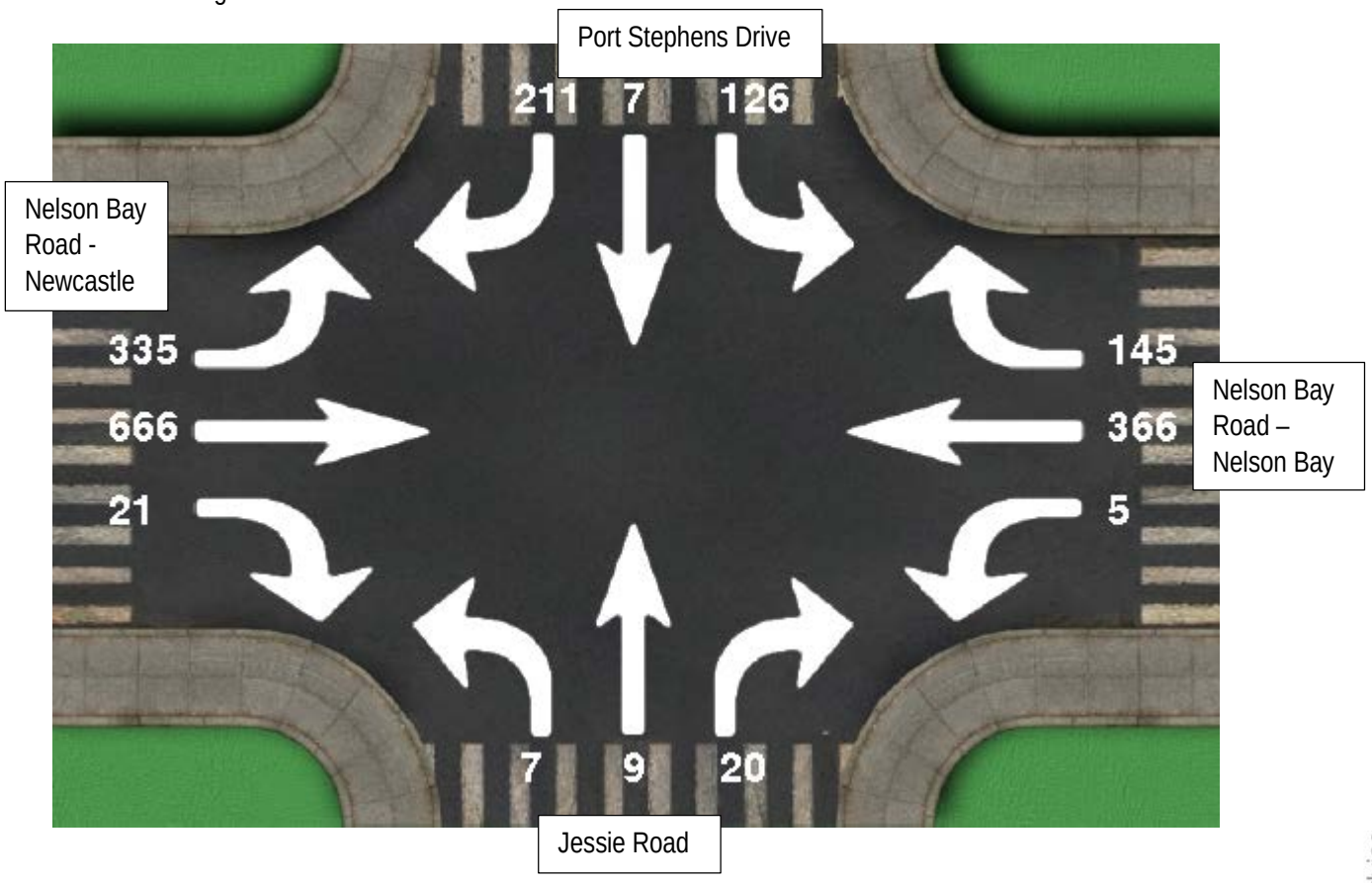


Figure 4-2 – Traffic survey results, roundabout at Nelson Bay Road and Port Stephens Drive (PM peak)

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The operation of this roundabout has been assessed with Sidra and the results of the analysis are presented below in Table 4-4.

Table 4-4 - Sidra modelling, roundabout of Nelson Bay Road and Port Stephens Road

Approach	Level of service	Delay (seconds)	Queue (metres)
Jessie Road	A / A	9.2 / 9.9	1.4 / 1.9
Nelson Bay Road east	A / A	8.5 / 8.8	12.4 / 16.8
Port Stephens Road	A / A	11.6 / 12.1	7.4 / 10.5
Nelson Bay Road west	A / A	6.7 / 7.1	17.6 / 24.6

Note – results for 2014 PM existing flows / 2024 PM flows allowing for 20% growth on all movements.

The above analysis shows that the roundabout is operating well with minimal delays and congestion for all road users. This roundabout will be impacted upon by the trucks from the quarry that have turned left out of Marsh Road and then use this roundabout to complete a U-turn.

The current traffic flows through this roundabout are in the order of 1900 vehicles per hour in the PM peak, with a similar value in the AM peak. The additional traffic movements associated with the development could increase these values by some 20 vehicles per hour, representing an increase of 1% over the existing flows. It is considered that this will have a negligible impact upon the operation of the roundabout, based upon site observations and the Sidra analysis above for the peak period. Outside of the peaks, the traffic movements are much lower (20% or more) and the roundabout will operate with less delays, allowing for the movement of the trucks to occur.

The observations on site indicate that in the morning peak this roundabout operates well with similar or lower delays that during the morning peak period. Therefore there will be minimal impact created the additional truck movements associated with the proposal.

For the access route through to Newcastle / Raymond Terrace and Maitland, all of the major intersections are controlled by traffic signals or roundabouts and operate well with minimal delays and congestion. It is considered that the additional 40 trucks movements per hour maximum would have an acceptable impact upon these intersections.

4.3.3 Background traffic and other developments

In accordance with normal RMS requirements, the impact of the additional traffic has been reviewed allowing for 10 years background growth along Nelson Bay Road. A review of the historic traffic data along Nelson Bay Road shows that the rate of background growth is very low, at less than 1.5% per annum. Allowing for 15% background growth over a 10 year timeframe it is considered that the roundabout and the road network in the locality of the subject site will continue to operate to a high level.

As part of the planning for the upgrade of Nelson Bay Road, the RMS have assessed the background growth along the road which would allow for development such as the development site and has designed the road and the connections accordingly. Therefore it is concluded that the background growth together with the traffic associated with the development will have an acceptable impact.

The Sidra results above show that the roundabout at the intersection of Nelson Bay Road and Port Stephens Drive will continue to operate with minimal delays and congestion. With all traffic movements increase by 20% the roundabout continues to operate with low overall delays and minimal queues.

4.3.4 Impact of Construction Traffic

There will be minimal construction activity on site associated with the proposed development, as the site set up and establishment allows for clearing of vegetation only. The major impact during the establishment of the site will be during the construction of the left turn slip into the site off Nelson Bay Road. This will require work on the site as well as work adjacent to the existing road carriageway.

As part of the construction work for the left turn slip into the site, a Traffic Management Plan will need to be developed and implemented. This will be submitted to the RMS and Council for approval prior to any works commencing on site. A Works Authorisation Deed (WAD) will also be signed with the RMS to ensure the site access is designed and constructed in accordance with the road authority requirements.

4.4 Impact on Road Safety

The additional traffic flows associated with the development of the subject site will have a relatively low impact upon traffic safety. The site entry point for the trucks is located on nelson bay Road and a left turn deceleration lane will be provided in accordance with Austroads and RMS design requirements to ensure trucks can safely enter the site. All vehicles will exit the site on Marsh Road, via the existing vehicle access point. This access is located on a relatively straight section of road offering good visibility for drivers entering and exiting the site at this location. All light vehicles will enter and exit the site via this access point. The connection to the main road network is via the stop sign controlled intersection of Marsh Road and Nelson Bay Road and this intersection provides sheltered turn lanes and good visibility. The trucks associated with the development will turn left out of this intersection, with good visibility permitting these vehicles to safely enter the traffic stream on Nelson Bay Road. These trucks will then complete a U-turn at the roundabout of Nelson Bay Road and Port Stephens Drive, which ensures road safety is maintained for all users.

Overall it is considered that the proposed development will have a negligible impact upon road safety in the general locality of the subject site.

4.5 Parking Analysis

The parking for the proposed development can all be accommodated on site. There will be an area set aside beside the office which will accommodate the staff located on site. The site will only require 1 or 2 people to operate the facility. Note that the trucks will not be parked on site and as such do not need to be provided for nor parking for the truck drivers private vehicles.

4.6 Public Transport

4.6.1 Options for improving services

It can be seen that the site is not well serviced by public transport and the nature of the development does not support public transport use. No improvements to public transport are considered necessary for the project.

5 Improvement Analysis

5.1 Improvements to Accommodate Existing Traffic

The existing road network in the immediate vicinity of the subject site is well developed and there are no road network upgrades currently occurring within the immediate vicinity of the subject site. The RMS are currently upgrading Nelson Bay Road to the east of the site to provide two lanes of travel between the subject site and Port Stephens Drive. This will benefit the trucks movements associated with the development. No further road upgrades are required to accommodate the existing traffic movements.

5.2 Improvements to Accommodate Background Traffic

The upgrade of Nelson Bay Road by the RMS is being completed to improve road safety and ensure there is adequate capacity for future increases in traffic movements. It is considered that no further road upgrades are required other than those currently being completed by the RMS on Nelson Bay Road.

5.3 Additional Improvements to Accommodate Development Traffic

Based upon the Sidra analysis, it is considered that no road upgrade works are required to accommodate the traffic movement's associated with the subject development site. Trucks will turn left out of Marsh Road and travel along Nelson Bay Road to then complete a U-turn at the roundabout controlled intersection at Port Stephens Drive. This will ensure that there are no delays for traffic at the intersection of Marsh Road and Nelson Bay Road and ensures that there will be no impact upon road safety at this location.

5.4 Alternative Improvements

No alternative improvements are put forward for the project.

6 Summary and Recommendations

6.1 Summary

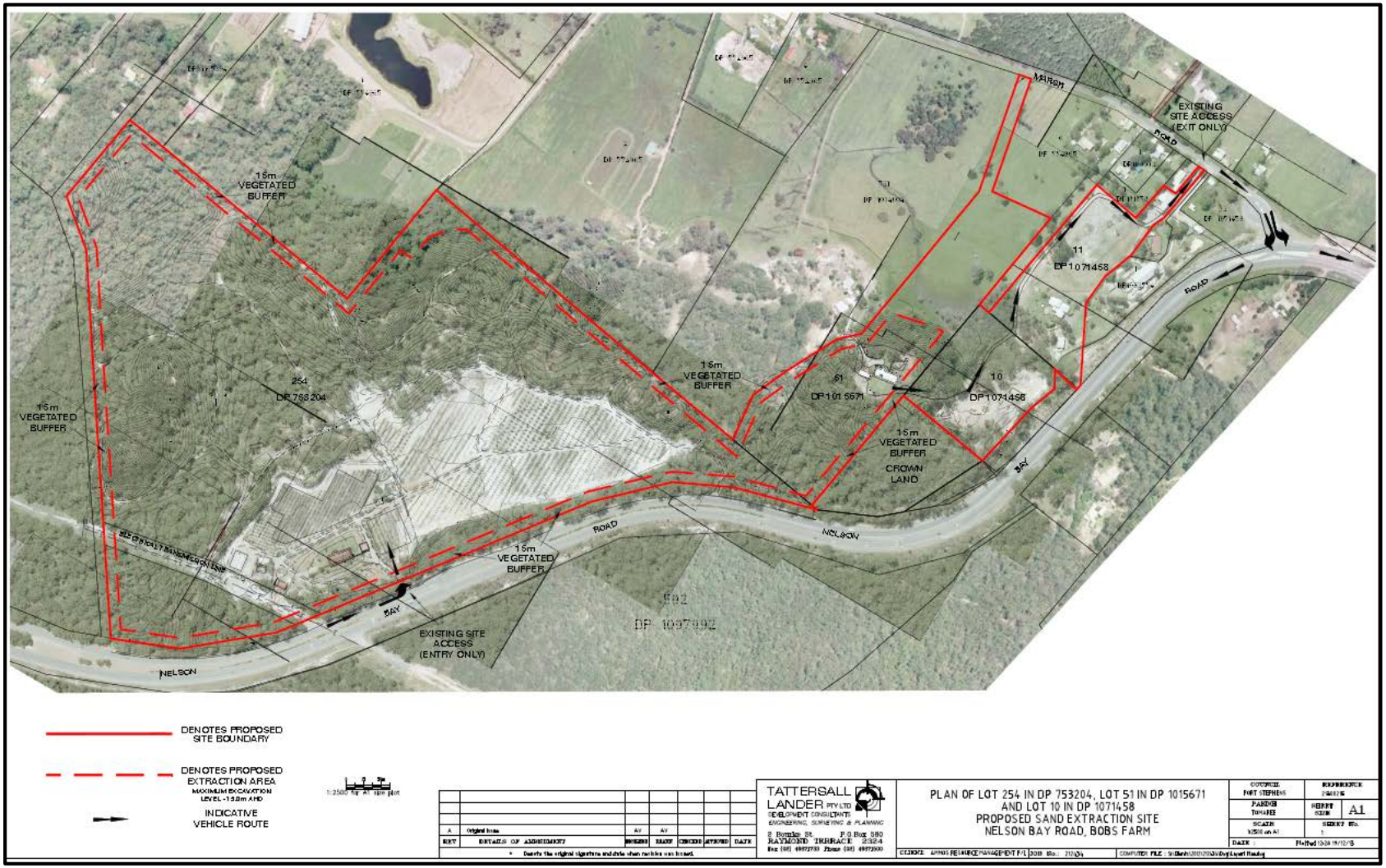
The following conclusions are drawn from the investigations into the proposed sand quarry at Bobs Farm off Nelson Bay Road:

1. The proposal allows for a sand quarry with all heavy vehicle entry via a new access point off Nelson Bay Road. Light vehicle access will be via the upgraded access off Marsh Road and all vehicle exit movements will be via this access on Marsh Road.
2. The site is located within the locality of Bobs Farm with frontage to both Nelson Bay Road and Marsh Road. The major access route for outbound material will be to the west of the site along Nelson Bay Road to centres such as Newcastle, Raymond Terrace and the Lower Hunter Valley.
3. All trucks will enter the site directly off Nelson Bay Road via an upgraded access. This will require a left turn deceleration lane to be built on Nelson Bay Road and this will be designed and constructed in accordance with RMS and Council requirements. All trucks will then drive through the site and exit via the existing access point on Marsh Road. All trucks will turn right out of the exit on Marsh Road and then proceed to the intersection of Nelson Bay Road with Marsh Road.
4. Due to potential delays for the trucks turning right out of Marsh Road and associated safety concerns, all trucks will turn left out of Marsh Road and proceed in an eastbound direction along Nelson Bay Road. The trucks will then complete a U-turn at the roundabout controlled intersection of Nelson Bay Road and Port Stephens Drive to return in a westbound direction. The trucks will then continue along Nelson Bay Road and then use Richardson Road to head towards Raymond Terrace and the Pacific Highway, or Cabbage Tree Road to head towards the New England Highway and Maitland or continue along Nelson Bay Road towards Newcastle. Both Nelson Bay Road and Cabbage Tree Road are RAV approved routes suitable for heavy haulage.
5. All light vehicles will enter and exit the site via the access point on Marsh Road. This will reduce the conflict between light and heavy vehicle and allows direct access to the site office.
6. The site access points have been reviewed on site and allow for safe vehicle movements, with adequate sight lines available based upon vehicle speeds and the posted speed limits.
7. All parking can be accommodated on site. The trucks will not be parked on site over-night and there is minimal on-site staffing levels requiring minimal on-site parking.

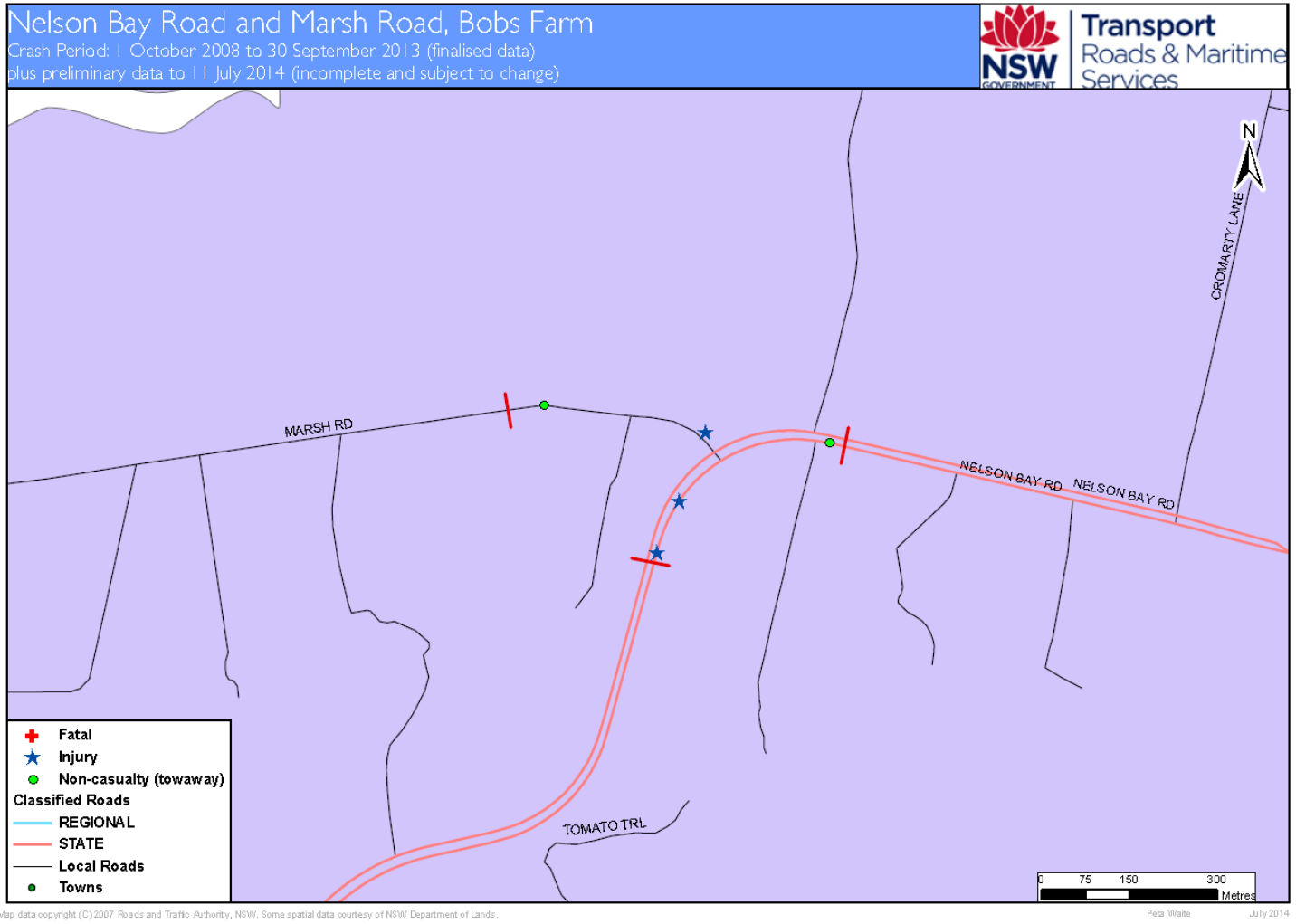
The overall conclusion from the investigations is that traffic and access arrangements for the development proposal are satisfactory and that there is no traffic or access impediments to the development. The trucks access routes have been reviewed based upon impacts for other road users and road safety and the proposed access routes can operate in a safe and efficient manner with minimal delays for other road users. The access point on Nelson Bay Road will be designed and constructed in accordance with RMS and Council requirements to ensure the trucks can safely enter the site. The access on Marsh Road is an existing access point and allows for a safe entry and exit movements.

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Appendix A Site Plan



Appendix B Accident Data



Summary Crash Report

Transport for NSW — Centre for Road Safety

# Crash Type		
Car Crash	5	100.0%
Light Truck Crash	0	0.0%
Rigid Truck Crash	0	0.0%
Articulated Truck Crash	0	0.0%
'Heavy Truck Crash	(0)	(0.0%)
Bus Crash	0	0.0%
"Heavy Vehicle Crash	(0)	(0.0%)
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	1	20.0%
Pedal Cycle Crash	0	0.0%
Pedestrian Crash	0	0.0%

' Rigid or Artic. Truck " Heavy Truck or Heavy Bus
These categories are NOT mutually exclusive

Location Type		
*Intersection	0	0.0%
Non intersection	5	100.0%

* Up to 10 metres from an intersection
~ 07:30-09:30 or 14:30-17:00 on school days

Collision Type		
Single Vehicle	4	80.0%
Multi Vehicle	1	20.0%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	0	0.0%
Other Classified Road	3	60.0%
Unclassified Road	2	40.0%

Contributing Factors		
Speeding	3	60.0%
Fatigue	1	20.0%

Weather		
Fine	5	100.0%
Rain	0	0.0%
Overcast	0	0.0%
Fog or mist	0	0.0%
Other	0	0.0%

Road Surface Condition		
Wet	1	20.0%
Dry	4	80.0%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	1	20.0%
Daylight	2	40.0%
Dusk	0	0.0%
Darkness	2	40.0%

Crash Movement		
Intersection, adjacent approaches	0	0.0%
Head-on (not overtaking)	0	0.0%
Opposing vehicles; turning	0	0.0%
U-turn	0	0.0%
Rear-end	1	20.0%
Lane change	0	0.0%
Parallel lanes; turning	0	0.0%
Vehicle leaving driveway	0	0.0%
Overtaking; same direction	0	0.0%
Hit parked vehicle	0	0.0%
Hit railway train	0	0.0%
Hit pedestrian	0	0.0%
Permanent obstruction on road	0	0.0%
Hit animal	0	0.0%
Off road, on straight	0	0.0%
Off road on straight, hit object	1	20.0%
Out of control on straight	0	0.0%
Off road, on curve	0	0.0%
Off road on curve, hit object	3	60.0%
Out of control on curve	0	0.0%
Other crash type	0	0.0%

Speed Limit				
~ 40km/h or less	0	0.0%		
40 km/h or less	0	0.0%	80 km/h zone	4	80.0%
50 km/h zone	0	0.0%	90 km/h zone	0	0.0%
60 km/h zone	1	20.0%	100 km/h zone	0	0.0%
70 km/h zone	0	0.0%	110 km/h zone	0	0.0%

CRASHES	5	
Fatal crash	0	0.0%
Injury crash	3	60.0%
Non-casualty crash	2	40.0%

CASUALTIES	3	
Killed	0	0.0%
Injured	3	100.0%
^ Unrestrained	0	0.0%

^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Time Group		% of Day	
00:01 - 02:59	1	20.0%	12.5%
03:00 - 04:59	0	0.0%	8.3%
05:00 - 05:59	0	0.0%	4.2%
06:00 - 06:59	1	20.0%	4.2%
07:00 - 07:59	0	0.0%	4.2%
08:00 - 08:59	0	0.0%	4.2%
09:00 - 09:59	0	0.0%	4.2%
10:00 - 10:59	0	0.0%	4.2%
11:00 - 11:59	0	0.0%	4.2%
12:00 - 12:59	0	0.0%	4.2%
13:00 - 13:59	1	20.0%	4.2%
14:00 - 14:59	0	0.0%	4.2%
15:00 - 15:59	1	20.0%	4.2%
16:00 - 16:59	0	0.0%	4.2%
17:00 - 17:59	0	0.0%	4.2%
18:00 - 18:59	0	0.0%	4.2%
19:00 - 19:59	0	0.0%	4.2%
20:00 - 21:59	0	0.0%	8.3%
22:00 - 24:00	1	20.0%	8.3%

Street Lighting Off/Nil	% of Dark
1 of 2 in Dark	50.0%

Crashes		Casualties
1	2014	1
1	2010	0
3	2009	2

~ School Travel Time		
Involvement	0	0.0%

McLean Periods			% Week
A	1	20.0%	17.9%
B	0	0.0%	7.1%
C	1	20.0%	17.9%
D	0	0.0%	3.5%
E	0	0.0%	3.6%
F	0	0.0%	10.7%
G	0	0.0%	7.1%
H	1	20.0%	7.1%
I	1	20.0%	12.5%
J	1	20.0%	10.7%

Day of the Week						# Holiday Periods					
Monday	0	0.0%	Thursday	0	0.0%	Sunday	2	40.0%	New Year	0	0.0%	Queen's BD	0	0.0%	Easter SH	0	0.0%
Tuesday	0	0.0%	Friday	0	0.0%	WEEKDAY	2	40.0%	Aust. Day	0	0.0%	Labour Day	0	0.0%	June/July SH	0	0.0%
Wednesday	2	40.0%	Saturday	1	20.0%	WEEKEND	3	60.0%	Easter	0	0.0%	Christmas	0	0.0%	Sept./Oct. SH	0	0.0%
									Anzac Day	0	0.0%	January SH	1	20.0%	December SH	0	0.0%

Crashid dataset 01/10/08-30/09/13 plus preliminary data to 11/07/14 Nelson Bay Road and Marsh Road, Bobs Farm
Note: Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.

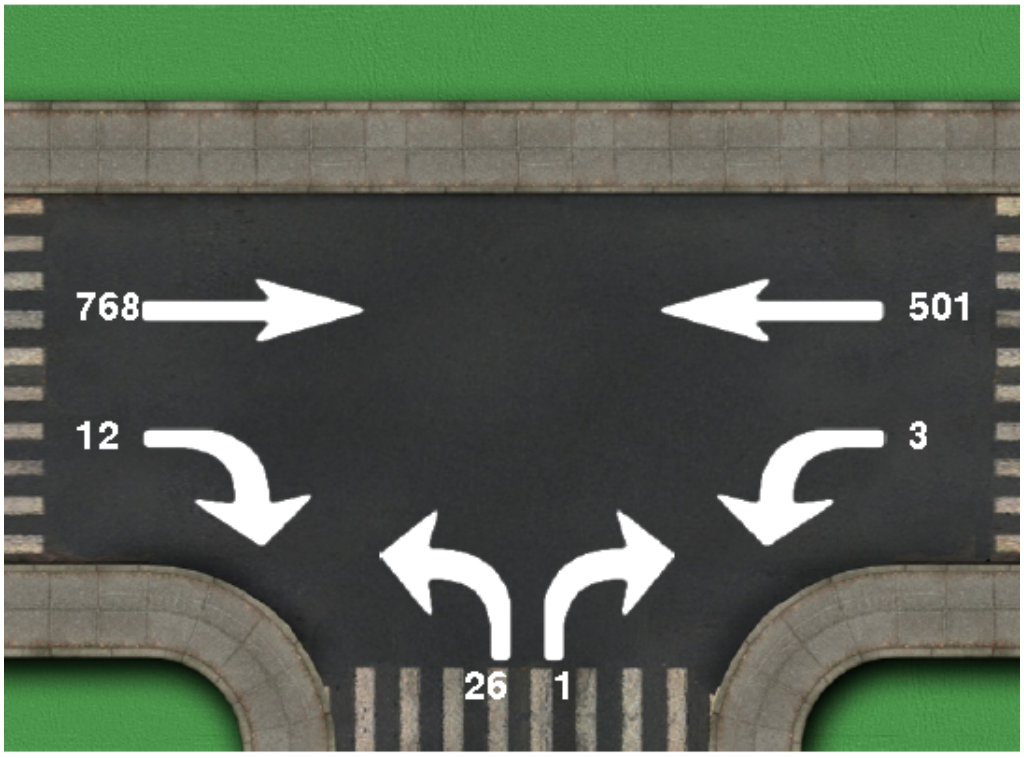
Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Rep ID: REG01 **Office:** Hunter **User ID:** waitep Page 1 of 1 Generated: 11/07/2014 08:20

Appendix C Traffic Surveys Nelson Bay Road / Marsh Road

Intersection Peak Hour

Location: Marsh Road at Nelson Bay Road,
GPS Coordinates: N = -32.766439, W= 152.013208
Date: 2014-08-21
Day of week: Thursday
Weather:
Analyst: sm



Intersection Peak Hour

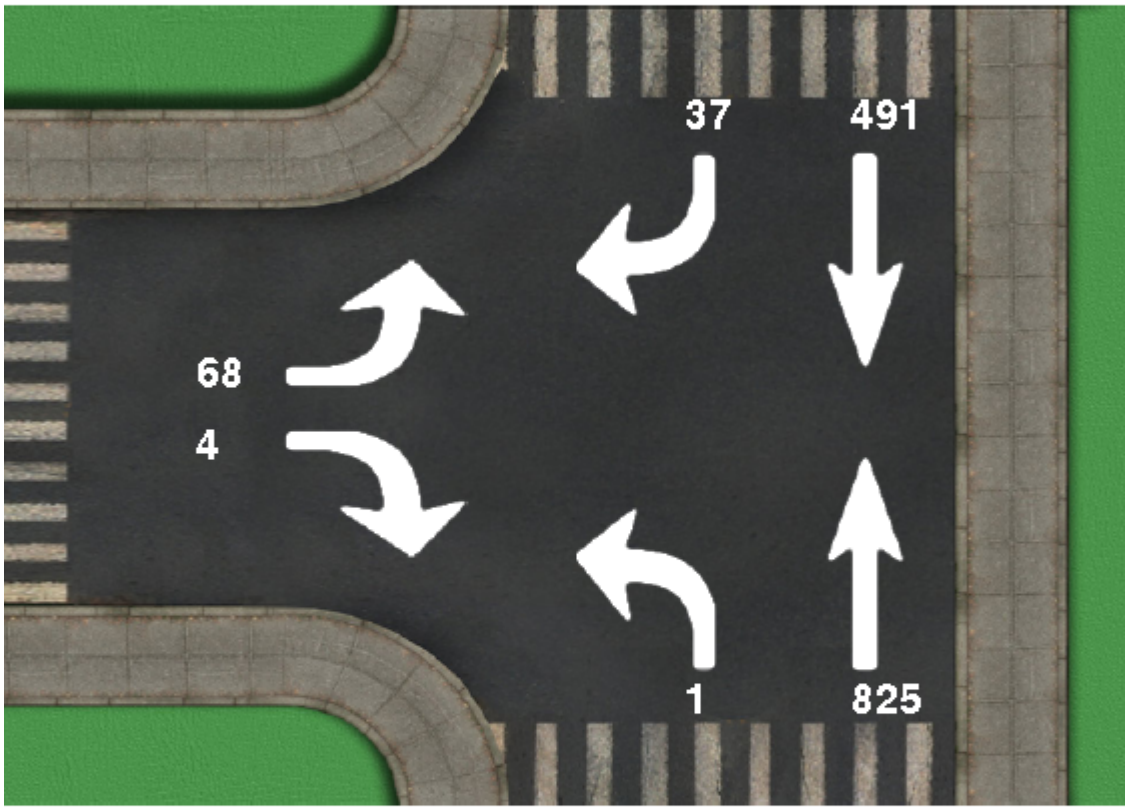
07:45 - 08:45

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	0	0	0	3	501	0	26	0	1	0	768	12	1311
Factor	0.00	0.00	0.00	0.38	0.90	0.00	0.72	0.00	0.25	0.00	0.87	0.43	0.90
Approach factor	0.00			0.90			0.68			0.88			

Quality Traffic Advice

Intersection Peak Hour

Location: Nelson Bay Rd at Marsh Rd, Bobs Farm
GPS Coordinates:
Date: 2014-08-21
Day of week: Thursday
Weather:
Analyst: BM



Intersection Peak Hour

15:30 - 16:30

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	0	491	37	0	0	0	1	825	0	68	0	4	1426
Factor	0.00	0.85	0.71	0.00	0.00	0.00	0.25	0.82	0.00	0.59	0.00	0.33	0.94
Approach factor	0.84			0.00			0.82			0.56			

Appendix D Sidra Results

Criteria for interpreting results of SIDRA

1-Level of Service (LoS)

LoS	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Good	Good
B	Good, with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but requires accident study
D	Operating near capacity	Near capacity and requires accident study
E	At capacity, excessive delay: roundabout requires other control method	At capacity, requires other control mode
F	Unsatisfactory, requires other control mode or additional capacity	Unsatisfactory, requires other control mode

2-Average Vehicle Delay (AVD)

The AVD is a measure of operational performance of an intersection relating to its LoS. The average delay should be taken as a guide only for an average intersection. Longer delays may be tolerated at some intersections where delays are expected by motorists (e.g. those in inner city areas or major arterial roads).

LoS	Average Delay / Vehicle (secs)	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and	Acceptable delays and spare
C	28 to 42	Satisfactory	Satisfactory but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays: roundabout requires other control mode	At capacity; requires other control mode
F	Exceeding 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode

3-Degree of Saturation (D/S)

The D/S of an intersection is usually taken as the highest ratio of traffic volumes on an approach to an intersection compared with the theoretical capacity, and is a measure of the utilisation of available green time. For intersections controlled by traffic signals, both queues and delays increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its D/S is kept below 0.75. When D/S exceeds 0.9, queues are expected.

Quality Traffic Advice

INTERSECTION SUMMARY

Site: 2014 AM Nelson Bay Road and Marsh Road

2014 AM base flows
Stop / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Travel Speed (Average)	59.6	km/h	59.6	km/h
Travel Distance (Total)	1328.4	veh-km/h	1594.1	pers-km/h
Travel Time (Total)	22.3	veh-h/h	26.7	pers-h/h
Demand Flows (Total)	1311	veh/h	1573	pers/h
Percent Heavy Vehicles (Demand)	4.8	%		
Degree of Saturation	0.203			
Practical Spare Capacity	382.0	%		
Effective Intersection Capacity	6448	veh/h		
Control Delay (Total)	0.13	veh-h/h	0.15	pers-h/h
Control Delay (Average)	0.3	sec	0.3	sec
Control Delay (Worst Lane)	58.3	sec		
Control Delay (Worst Movement)	58.3	sec	58.3	sec
Geometric Delay (Average)	0.2	sec		
Stop-Line Delay (Average)	0.1	sec		
Idling Time (Average)	0.1	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.1	veh		
95% Back of Queue - Distance (Worst Lane)	0.7	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	34	veh/h	40	pers/h
Effective Stop Rate	0.03	per veh	0.03	per pers
Proportion Queued	0.01		0.01	
Performance Index	22.5		22.5	
Cost (Total)	454.00	$/h	454.00	$/h
Fuel Consumption (Total)	91.1	L/h		
Carbon Dioxide (Total)	217.4	kg/h		
Hydrocarbons (Total)	0.016	kg/h		
Carbon Monoxide (Total)	0.257	kg/h		
NOx (Total)	0.340	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 2014 AM Nelson Bay Road and Marsh Road

2014 AM base flows
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Nelson Bay Road (Nelson Bay)											
5	T1	768	5.0	0.203	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	12	0.0	0.022	9.2	LOS A	0.1	0.5	0.49	0.69	50.9
Approach		780	4.9	0.203	0.2	NA	0.1	0.5	0.01	0.01	59.8
North: Marsh Road											
7	L2	26	0.0	0.029	9.3	LOS A	0.1	0.7	0.35	0.87	51.3
9	R2	1	0.0	0.016	58.3	LOS E	0.0	0.3	0.92	1.00	30.8
Approach		27	0.0	0.029	11.1	LOS A	0.1	0.7	0.37	0.87	50.1
West: Nelson Bay Road (Newcastle)											
10	L2	3	0.0	0.002	5.5	LOS A	0.0	0.0	0.00	0.58	53.6
11	T1	501	5.0	0.133	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		504	5.0	0.133	0.0	NA	0.0	0.0	0.00	0.00	59.9
All Vehicles		1311	4.8	0.203	0.3	NA	0.1	0.7	0.01	0.03	59.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Quality Traffic Advice

INTERSECTION SUMMARY

Site: 2014 PM Nelson Bay Road and Marsh Road

2014 PM base flows
Stop / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Travel Speed (Average)	58.8	km/h	58.8	km/h
Travel Distance (Total)	1445.1	veh-km/h	1734.1	pers-km/h
Travel Time (Total)	24.6	veh-h/h	29.5	pers-h/h
Demand Flows (Total)	1426	veh/h	1711	pers/h
Percent Heavy Vehicles (Demand)	4.6	%		
Degree of Saturation	0.218			
Practical Spare Capacity	348.7	%		
Effective Intersection Capacity	6529	veh/h		
Control Delay (Total)	0.43	veh-h/h	0.52	pers-h/h
Control Delay (Average)	1.1	sec	1.1	sec
Control Delay (Worst Lane)	70.6	sec		
Control Delay (Worst Movement)	70.6	sec	70.6	sec
Geometric Delay (Average)	0.6	sec		
Stop-Line Delay (Average)	0.5	sec		
Idling Time (Average)	0.4	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.3	veh		
95% Back of Queue - Distance (Worst Lane)	2.4	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	100	veh/h	120	pers/h
Effective Stop Rate	0.07	per veh	0.07	per pers
Proportion Queued	0.04		0.04	
Performance Index	25.3		25.3	
Cost (Total)	509.26	$/h	509.26	$/h
Fuel Consumption (Total)	100.3	L/h		
Carbon Dioxide (Total)	239.0	kg/h		
Hydrocarbons (Total)	0.017	kg/h		
Carbon Monoxide (Total)	0.282	kg/h		
NOx (Total)	0.357	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 2014 PM Nelson Bay Road and Marsh Road

2014 PM base flows
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Nelson Bay Road (Nelson Bay)											
5	T1	491	5.0	0.130	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	37	0.0	0.109	14.2	LOS A	0.3	2.4	0.70	0.87	47.5
Approach		528	4.6	0.130	1.0	NA	0.3	2.4	0.05	0.06	58.9
North: Marsh Road											
7	L2	68	0.0	0.093	10.6	LOS A	0.3	2.3	0.47	0.93	50.6
9	R2	4	0.0	0.076	70.6	LOS F	0.2	1.4	0.94	1.00	27.9
Approach		72	0.0	0.093	14.0	LOS A	0.3	2.3	0.50	0.93	48.4
West: Nelson Bay Road (Newcastle)											
10	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.00	0.58	53.6
11	T1	825	5.0	0.218	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		826	5.0	0.218	0.0	NA	0.0	0.0	0.00	0.00	59.9
All Vehicles		1426	4.6	0.218	1.1	NA	0.3	2.4	0.04	0.07	58.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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INTERSECTION SUMMARY

Site: 2014 Mid day Nelson Bay Road and MarshRoad

2014 mid day mid week base flows
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Travel Speed (Average)	59.5	km/h	59.5	km/h
Travel Distance (Total)	989.0	veh-km/h	1186.8	pers-km/h
Travel Time (Total)	16.6	veh-h/h	19.9	pers-h/h
Demand Flows (Total)	976	veh/h	1171	pers/h
Percent Heavy Vehicles (Demand)	4.8	%		
Degree of Saturation	0.124			
Practical Spare Capacity	691.0	%		
Effective Intersection Capacity	7877	veh/h		
Control Delay (Total)	0.11	veh-h/h	0.13	pers-h/h
Control Delay (Average)	0.4	sec	0.4	sec
Control Delay (Worst Lane)	29.2	sec		
Control Delay (Worst Movement)	29.2	sec	29.2	sec
Geometric Delay (Average)	0.3	sec		
Stop-Line Delay (Average)	0.1	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.1	veh		
95% Back of Queue - Distance (Worst Lane)	0.7	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	33	veh/h	40	pers/h
Effective Stop Rate	0.03	per veh	0.03	per pers
Proportion Queued	0.02		0.02	
Performance Index	16.8		16.8	
Cost (Total)	339.61	$/h	339.61	$/h
Fuel Consumption (Total)	68.0	L/h		
Carbon Dioxide (Total)	162.2	kg/h		
Hydrocarbons (Total)	0.012	kg/h		
Carbon Monoxide (Total)	0.192	kg/h		
NOx (Total)	0.251	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 2014 Mid day Nelson Bay Road and Marsh Road

2014 mid day mid week base flows
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Nelson Bay Road (Nelson Bay)											
5	T1	466	5.0	0.123	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	12	0.0	0.021	8.9	LOS A	0.1	0.5	0.47	0.67	51.1
Approach		478	4.9	0.123	0.2	NA	0.1	0.5	0.01	0.02	59.7
North: Marsh Road											
7	L2	26	0.0	0.028	9.2	LOS A	0.1	0.7	0.33	0.87	51.4
9	R2	1	0.0	0.007	29.2	LOS C	0.0	0.1	0.82	0.94	40.6
Approach		27	0.0	0.028	9.9	LOS A	0.1	0.7	0.35	0.87	50.9
West: Nelson Bay Road (Newcastle)											
10	L2	3	0.0	0.002	5.5	LOS A	0.0	0.0	0.00	0.58	53.6
11	T1	468	5.0	0.124	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		471	5.0	0.124	0.0	NA	0.0	0.0	0.00	0.00	59.9
All Vehicles		976	4.8	0.124	0.4	NA	0.1	0.7	0.02	0.03	59.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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INTERSECTION SUMMARY

Site: 1 [2014 AM Nelson Bay Road and Marsh Road+dev]

2014 AM base flows
plus development flows
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	**Vehicles**	**Persons**
Travel Speed (Average)	59.1 km/h	59.1 km/h
Travel Distance (Total)	1372.1 veh-km/h	1646.5 pers-km/h
Travel Time (Total)	23.2 veh-h/h	27.8 pers-h/h
Demand Flows (Total)	1354 veh/h	1625 pers/h
Percent Heavy Vehicles (Demand)	8.0 %	
Degree of Saturation	0.203	
Practical Spare Capacity	382.0 %	
Effective Intersection Capacity	6659 veh/h	
Control Delay (Total)	0.26 veh-h/h	0.32 pers-h/h
Control Delay (Average)	0.7 sec	0.7 sec
Control Delay (Worst Lane)	60.2 sec	
Control Delay (Worst Movement)	60.2 sec	60.2 sec
Geometric Delay (Average)	0.5 sec	
Stop-Line Delay (Average)	0.2 sec	
Idling Time (Average)	0.1 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	0.3 veh	
95% Back of Queue - Distance (Worst Lane)	2.6 m	
Queue Storage Ratio (Worst Lane)	0.00	
Total Effective Stops	68 veh/h	82 pers/h
Effective Stop Rate	0.05 per veh	0.05 per pers
Proportion Queued	0.02	0.02
Performance Index	23.8	23.8
Cost (Total)	513.09 $/h	513.09 $/h
Fuel Consumption (Total)	113.5 L/h	
Carbon Dioxide (Total)	275.0 kg/h	
Hydrocarbons (Total)	0.019 kg/h	
Carbon Monoxide (Total)	0.297 kg/h	
NOx (Total)	0.769 kg/h	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 1 [2014 AM Nelson Bay Road and Marsh Road+dev]

2014 AM base flows
plus development flows
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Nelson Bay Road (Nelson Bay)											
5	T1	768	5.0	0.203	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	12	0.0	0.023	9.5	LOS A	0.1	0.5	0.50	0.70	50.7
Approach		780	4.9	0.203	0.2	NA	0.1	0.5	0.01	0.01	59.8
North: Marsh Road											
7	L2	49	50.0	0.072	12.3	LOS A	0.3	2.6	0.40	0.94	48.9
9	R2	1	0.0	0.016	60.2	LOS E	0.0	0.3	0.92	1.00	30.3
Approach		50	49.0	0.072	13.3	LOS A	0.3	2.6	0.41	0.94	48.3
West: Nelson Bay Road (Newcastle)											
10	L2	23	90.0	0.020	6.6	LOS A	0.0	0.0	0.00	0.56	50.0
11	T1	501	5.0	0.133	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		524	8.7	0.133	0.3	NA	0.0	0.0	0.00	0.02	59.5
All Vehicles		1354	8.0	0.203	0.7	NA	0.3	2.6	0.02	0.05	59.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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INTERSECTION SUMMARY

Site: 1 [2014 PM Nelson Bay Road and Marsh Road+dev]

2014 PM base flows
plus development traffic
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	**Vehicles**	**Persons**
Travel Speed (Average)	58.6 km/h	58.6 km/h
Travel Distance (Total)	1506.0 veh-km/h	1807.2 pers-km/h
Travel Time (Total)	25.7 veh-h/h	30.9 pers-h/h
Demand Flows (Total)	1486 veh/h	1783 pers/h
Percent Heavy Vehicles (Demand)	6.5 %	
Degree of Saturation	0.218	
Practical Spare Capacity	348.7 %	
Effective Intersection Capacity	6804 veh/h	
Control Delay (Total)	0.54 veh-h/h	0.65 pers-h/h
Control Delay (Average)	1.3 sec	1.3 sec
Control Delay (Worst Lane)	77.0 sec	
Control Delay (Worst Movement)	77.0 sec	77.0 sec
Geometric Delay (Average)	0.7 sec	
Stop-Line Delay (Average)	0.6 sec	
Idling Time (Average)	0.4 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	0.4 veh	
95% Back of Queue - Distance (Worst Lane)	3.0 m	
Queue Storage Ratio (Worst Lane)	0.00	
Total Effective Stops	131 veh/h	157 pers/h
Effective Stop Rate	0.09 per veh	0.09 per pers
Proportion Queued	0.05	0.05
Performance Index	26.8	26.8
Cost (Total)	555.41 $/h	555.41 $/h
Fuel Consumption (Total)	115.5 L/h	
Carbon Dioxide (Total)	278.1 kg/h	
Hydrocarbons (Total)	0.020 kg/h	
Carbon Monoxide (Total)	0.312 kg/h	
NOx (Total)	0.597 kg/h	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 1 [2014 PM Nelson Bay Road and Marsh Road+dev]

2014 PM base flows
plus development traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Nelson Bay Road (Nelson Bay)											
5	T1	511	7.0	0.137	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R2	37	0.0	0.114	14.7	LOS B	0.4	2.5	0.71	0.88	47.2
Approach		548	6.5	0.137	1.0	NA	0.4	2.5	0.05	0.06	58.9
North: Marsh Road											
7	L2	88	0.0	0.120	10.7	LOS A	0.4	3.0	0.48	0.94	50.5
9	R2	4	0.0	0.084	77.0	LOS F	0.2	1.6	0.94	1.00	26.6
Approach		92	0.0	0.120	13.6	LOS A	0.4	3.0	0.50	0.94	48.6
West: Nelson Bay Road (Newcastle)											
10	L2	21	95.0	0.019	6.6	LOS A	0.0	0.0	0.00	0.56	49.8
11	T1	825	5.0	0.218	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		846	7.2	0.218	0.2	NA	0.0	0.0	0.00	0.01	59.7
All Vehicles		1486	6.5	0.218	1.3	NA	0.4	3.0	0.05	0.09	58.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: C:\Sidra folders\Bobs Farm.sip7

Quality Traffic Advice

INTERSECTION SUMMARY

Site: 1 [2026 AM Nelson Bay Road and Marsh Road+dev]

20264 AM base flows
plus development flows
allows 2% growth per annum
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	**Vehicles**	**Persons**
Travel Speed (Average)	59.2 km/h	59.2 km/h
Travel Distance (Total)	1680.1 veh-km/h	2016.1 pers-km/h
Travel Time (Total)	28.4 veh-h/h	34.0 pers-h/h
Demand Flows (Total)	1658 veh/h	1990 pers/h
Percent Heavy Vehicles (Demand)	7.5 %	
Degree of Saturation	0.252	
Practical Spare Capacity	288.8 %	
Effective Intersection Capacity	6578 veh/h	
Control Delay (Total)	0.30 veh-h/h	0.36 pers-h/h
Control Delay (Average)	0.7 sec	0.7 sec
Control Delay (Worst Lane)	124.9 sec	
Control Delay (Worst Movement)	124.9 sec	124.9 sec
Geometric Delay (Average)	0.4 sec	
Stop-Line Delay (Average)	0.2 sec	
Idling Time (Average)	0.1 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	0.3 veh	
95% Back of Queue - Distance (Worst Lane)	2.8 m	
Queue Storage Ratio (Worst Lane)	0.00	
Total Effective Stops	70 veh/h	84 pers/h
Effective Stop Rate	0.04 per veh	0.04 per pers
Proportion Queued	0.02	0.02
Performance Index	29.0	29.0
Cost (Total)	617.63 $/h	617.63 $/h
Fuel Consumption (Total)	134.5 L/h	
Carbon Dioxide (Total)	325.2 kg/h	
Hydrocarbons (Total)	0.023 kg/h	
Carbon Monoxide (Total)	0.357 kg/h	
NOx (Total)	0.850 kg/h	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 1 [2026 AM Nelson Bay Road and Marsh Road+dev]

20264 AM base flows
plus development flows
allows 2% growth per annum
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Nelson Bay Road (Nelson Bay)											
5	T1	952	5.0	0.252	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	12	0.0	0.027	10.9	LOS A	0.1	0.6	0.57	0.76	49.7
Approach		964	4.9	0.252	0.2	NA	0.1	0.6	0.01	0.01	59.8
North: Marsh Road											
7	L2	49	50.0	0.080	13.0	LOS A	0.3	2.8	0.45	0.95	48.5
9	R2	1	0.0	0.037	124.9	LOS F	0.1	0.7	0.97	1.00	19.7
Approach		50	49.0	0.080	15.3	LOS B	0.3	2.8	0.46	0.96	47.1
West: Nelson Bay Road (Newcastle)											
10	L2	23	90.0	0.020	6.6	LOS A	0.0	0.0	0.00	0.56	50.0
11	T1	621	5.0	0.164	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		644	8.0	0.164	0.3	NA	0.0	0.0	0.00	0.02	59.5
All Vehicles		1658	7.5	0.252	0.7	NA	0.3	2.8	0.02	0.04	59.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: C:\Sidra folders\Bobs Farm.sip7

Quality Traffic Advice

INTERSECTION SUMMARY

Site: 1 [2026 PM Nelson Bay Road and Marsh Road+dev]

2026 PM base flows
plus development traffic
plus 2% growth per annum
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values		
Performance Measure	**Vehicles**	**Persons**
Travel Speed (Average)	58.4 km/h	58.4 km/h
Travel Distance (Total)	1831.2 veh-km/h	2197.5 pers-km/h
Travel Time (Total)	31.4 veh-h/h	37.6 pers-h/h
Demand Flows (Total)	1807 veh/h	2168 pers/h
Percent Heavy Vehicles (Demand)	6.4 %	
Degree of Saturation	0.271	
Practical Spare Capacity	261.8 %	
Effective Intersection Capacity	6672 veh/h	
Control Delay (Total)	0.76 veh-h/h	0.91 pers-h/h
Control Delay (Average)	1.5 sec	1.5 sec
Control Delay (Worst Lane)	192.5 sec	
Control Delay (Worst Movement)	192.5 sec	192.5 sec
Geometric Delay (Average)	0.6 sec	
Stop-Line Delay (Average)	0.9 sec	
Idling Time (Average)	0.8 sec	
Intersection Level of Service (LOS)	NA	
95% Back of Queue - Vehicles (Worst Lane)	0.5 veh	
95% Back of Queue - Distance (Worst Lane)	3.7 m	
Queue Storage Ratio (Worst Lane)	0.00	
Total Effective Stops	136 veh/h	163 pers/h
Effective Stop Rate	0.08 per veh	0.08 per pers
Proportion Queued	0.04	0.04
Performance Index	32.6	32.6
Cost (Total)	671.69 $/h	671.69 $/h
Fuel Consumption (Total)	138.5 L/h	
Carbon Dioxide (Total)	333.1 kg/h	
Hydrocarbons (Total)	0.024 kg/h	
Carbon Monoxide (Total)	0.376 kg/h	
NOx (Total)	0.694 kg/h	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Annex P – Certificates of Title

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 521/1034604

SEARCH DATE	TIME	EDITION NO	DATE
26/11/2014	4:48 PM	1	15/10/2001

LAND

LOT 521 IN DEPOSITED PLAN 1034604
AT BOBS FARM
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF TOMAREE COUNTY OF GLOUCESTER
TITLE DIAGRAM DP1034604

FIRST SCHEDULE

DARRELL JOHN UPTON
BEVERLY UPTON
AS TENANTS IN COMMON IN EQUAL SHARES (T 7991771)

SECOND SCHEDULE (2 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE CROWN GRANT(S)
2 W736141 RIGHT OF WAY APPURTENANT TO THE PART SHOWN SO BENEFITED IN TITLE DIAGRAM AFFECTING THE LAND SHOWN SO BURDENED IN DP48166

NOTATIONS

NOTE: THE CERTIFICATE OF TITLE FOR THIS FOLIO OF THE REGISTER DOES NOT INCLUDE SECURITY FEATURES INCLUDED ON COMPUTERISED CERTIFICATES OF TITLE ISSUED FROM 4TH JANUARY, 2004. IT IS RECOMMENDED THAT STRINGENT PROCESSES ARE ADOPTED IN VERIFYING THE IDENTITY OF THE PERSON(S) CLAIMING A RIGHT TO DEAL WITH THE LAND COMPRISED IN THIS FOLIO.
UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

* Any entries preceded by an asterisk do not appear on the current edition of the Certificate of Title. Warning: the information appearing under notations has not been formally recorded in the Register. InfoTrack an approved NSW Information Broker hereby certifies that the information contained in this document has been provided electronically by the Registrar General in accordance with Section 96B(2) of the Real Property Act 1900.

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 254/753204

SEARCH DATE	TIME	EDITION NO	DATE
25/1/2016	10:15 AM	6	13/6/2007

LAND

LOT 254 IN DEPOSITED PLAN 753204
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF TOMAREE COUNTY OF GLOUCESTER
(FORMERLY KNOWN AS PORTION 254)
TITLE DIAGRAM CROWN PLAN 6053.1497

FIRST SCHEDULE

PATRA HOLDINGS PTY LIMITED (T 6414338)

SECOND SCHEDULE (5 NOTIFICATIONS)

1 THE RESERVATION AND EXCEPTION TO THE CROWN OF ALL GOLD, SILVER, COAL, PETROLEUM & URANIUM
* 2 X118809 EASEMENT FOR TRANSMISSION LINE PURSUANT TO SECTION 136L CROWN LANDS CONSOLIDATION ACT, 1913, NOTIFIED IN GOV. GAZ. NO 54 DATED 28.3.1987, PAGE 1488
3 W736141 RIGHT OF WAY AFFECTING THE PART SHOWN SO BURDENED IN DP48166
4 6414338 COVENANT
5 AD184386 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

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LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 51/1015671

SEARCH DATE	TIME	EDITION NO	DATE
25/1/2016	10:15 AM	4	21/10/2014

LAND

LOT 51 IN DEPOSITED PLAN 1015671
AT BOBS FARM
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF TOMAREE COUNTY OF GLOUCESTER
TITLE DIAGRAM DP1015671

FIRST SCHEDULE

PATRA HOLDINGS PTY LTD
RACHEAL AMBER CHRISTIE
AS JOINT TENANTS (T AI969728)

SECOND SCHEDULE (3 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE CROWN GRANT(S)
2 W736141 RIGHT OF WAY APPURTENANT TO THE LAND ABOVE DESCRIBED AFFECTING THE LAND SHOWN SO BURDENED IN DP48166
3 AI969729 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

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LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 11/1071458

SEARCH DATE	TIME	EDITION NO	DATE
25/1/2016	10:15 AM	2	8/7/2013

LAND

LOT 11 IN DEPOSITED PLAN 1071458
AT BOB'S FARM
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF TOMAREE COUNTY OF GLOUCESTER
TITLE DIAGRAM DP1071458

FIRST SCHEDULE

ALLAN IAN CECIL HAY
EVELYN CAROL ELIZABETH HAY
AS JOINT TENANTS

SECOND SCHEDULE (6 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE CROWN GRANT(S)
2 DP253798 RESTRICTION(S) ON THE USE OF LAND -SEE Q189103
3 DP832882 RESTRICTION(S) ON THE USE OF LAND
4 AB498091 MORTGAGE TO ST. GEORGE BANK LIMITED
5 AC57332 RESTRICTION(S) ON THE USE OF LAND
6 DP1186716 EASEMENT FOR ACCESS 20 METRE(S) WIDE AND VARIABLE AFFECTING THE PART(S) SHOWN SO BURDENED IN DP1186716

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

* Any entries preceded by an asterisk do not appear on the current edition of the Certificate of Title. Warning: the information appearing under notations has not been formally recorded in the Register. InfoTrack an approved NSW Information Broker hereby certifies that the information contained in this document has been provided electronically by the Registrar General in accordance with Section 96B(2) of the Real Property Act 1900.

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 10/1071458

SEARCH DATE	TIME	EDITION NO	DATE
25/1/2016	10:15 AM	3	30/4/2009

LAND

LOT 10 IN DEPOSITED PLAN 1071458
AT BOBS FARM
LOCAL GOVERNMENT AREA PORT STEPHENS
PARISH OF TOMAREE COUNTY OF GLOUCESTER
TITLE DIAGRAM DP1071458

FIRST SCHEDULE

ALLAN IAN HAY
EVELYN CAROL HAY
AS JOINT TENANTS (T AE643313)

SECOND SCHEDULE (3 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE CROWN GRANT(S)
2 AE576044 RESTRICTION(S) ON THE USE OF LAND
* AF113183 VARIATION OF RESTRICTION AE576044
* 3 DP1186716 EASEMENT FOR ACCESS 20 METRE(S) WIDE AND VARIABLE APPURTENANT TO THE LAND ABOVE DESCRIBED

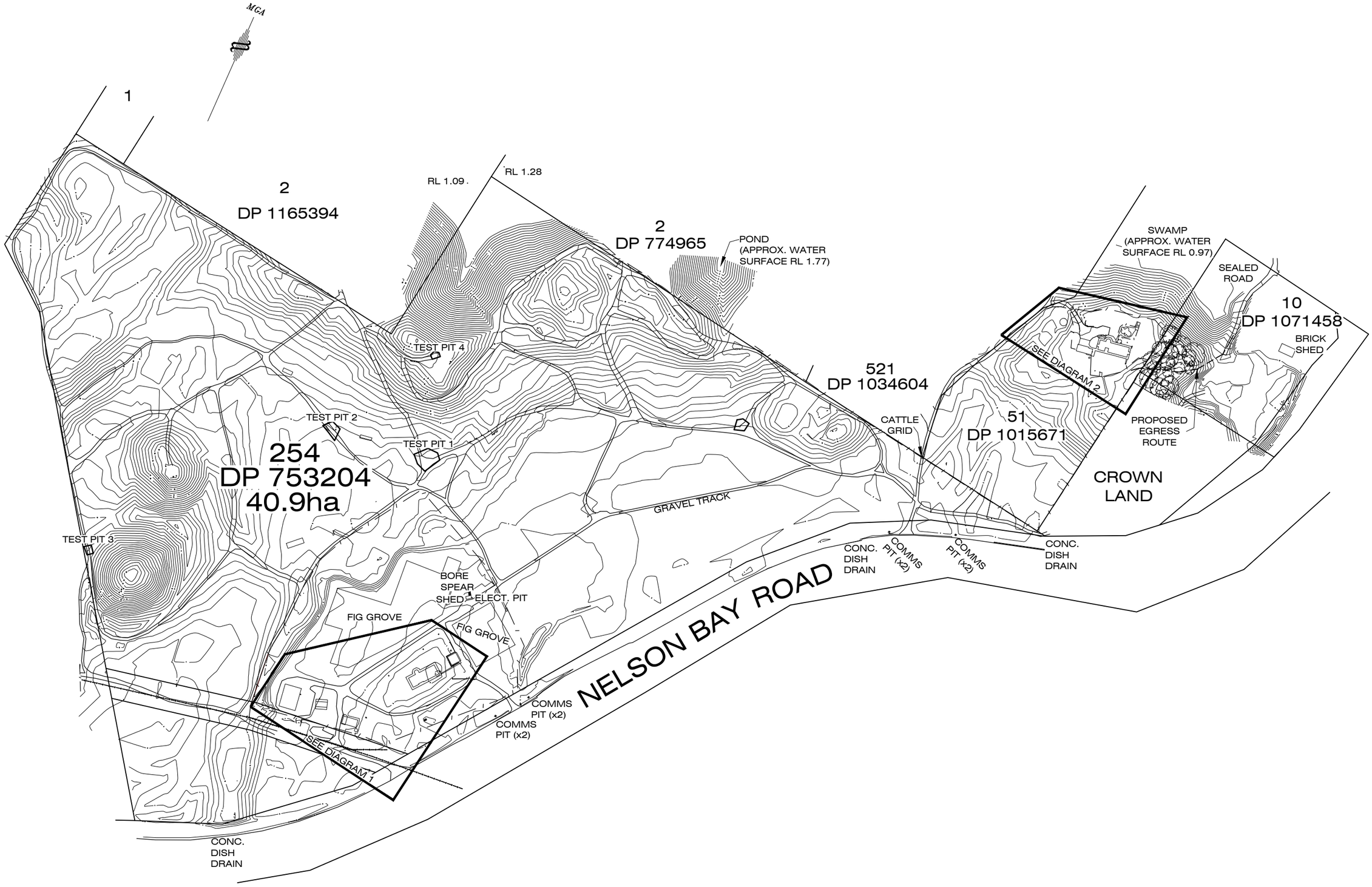
NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

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Annex Q– Site Detail Plan – Existing Site



NOTE: THE BOUNDARIES SHOWN IN THIS PLAN ARE APPROXIMATE ONLY. FROM MARKS FOUND DURING THE TOPOGRAPHIC SURVEY IT WOULD APPEAR THAT RECENT SURVEYS SURROUNDING THE SUBJECT LOT MAY IMPACT ON THE DIMENSIONS NOW AVAILABLE. IN ORDER TO CONFIRM BOUNDARY DIMENSIONS, A PLAN OF REDEFINITION WILL BE REQUIRED.

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
A	Original Issue					

* Denote the original signature and date when revision was issued.

TATTERSALL LANDER PTY LTD
DEVELOPMENT CONSULTANTS
ENGINEERING, SURVEYING & PLANNING
2 Bourke St. P.O.Box 580
RAYMOND TERRACE 2324
Fax (02) 49871733 Phone (02) 49871500

DETAIL SURVEY
LOT 254 IN DP 753204, LOT 51 IN DP 1015671 AND LOT 10 IN DP 1071458
51 NELSON BAY ROAD, BOBS FARM

COUNCIL: PORT STEPHENS	REFERENCE: ####
PARISH	SHEET SIZE: A1
SCALE: 1:2000 on A1	SHEET No.: ####
DATE : Plotted 13:25 27/06/13	
CLIENT: PATRA HOLDINGS PTY LTD	JOB No.: 212434
COMPUTER FILE : S:\Clients\2012\212434\Dwg\TOPO.dwg	

2
DP 774965

521
DP 1034604

51
DP 1015671

MGA

1

2

DP 1165394

254
40.9ha

NELSON BAY ROAD

GRAVEL TRACK

TEST PIT 4

TEST PIT 1

TEST PIT 2

TEST PIT 3

BORE
SPEAR

ELECT.
PIT

SHED

FIG GROVE

CONC.
DISH
DRAIN

COMMS
PIT (x2)

SEE INSERT

NOTE: THE BOUNDARIES SHOWN IN THIS PLAN ARE APPROXIMATE ONLY. FROM MARKS FOUND DURING THE TOPOGRAPHIC SURVEY IT WOULD APPEAR THAT RECENT SURVEYS SURROUNDING THE SUBJECT LOT MAY IMPACT ON THE DIMENSIONS NOW AVAILABLE. IN ORDER TO CONFIRM BOUNDARY DIMENSIONS, A PLAN OF REDEFINITION WILL BE REQUIRED.

ELECT.
DIST.
BOARD

BRICK
RESIDENCE

SHED/
RESIDENCE

INSERT
SCALE 1:500

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
A	Original Issue					

* Denote the original signature and date when revision was issued.

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ENGINEERING, SURVEYING & PLANNING
2 Bourke St. P.O.Box 580
RAYMOND TERRACE 2324
Fax (02) 49871733 Phone (02) 49871500

DETAIL SURVEY
LOT 254, 51 NELSON BAY ROAD
BOBS FARM

COUNCIL: PORT STEPHENS		REFERENCE: ####	
PARISH		SHEET SIZE	A1
SCALE: 1:2000 on A1		SHEET No.: ####	
DATE :	Plotted 09:36 30/05/13		
CLIENT: PATRA HOLDINGS PTY LTD	JOB No.: ####	COMPUTER FILE : S:\Clients\2012\212434\Dwg\TOPO.dwg	

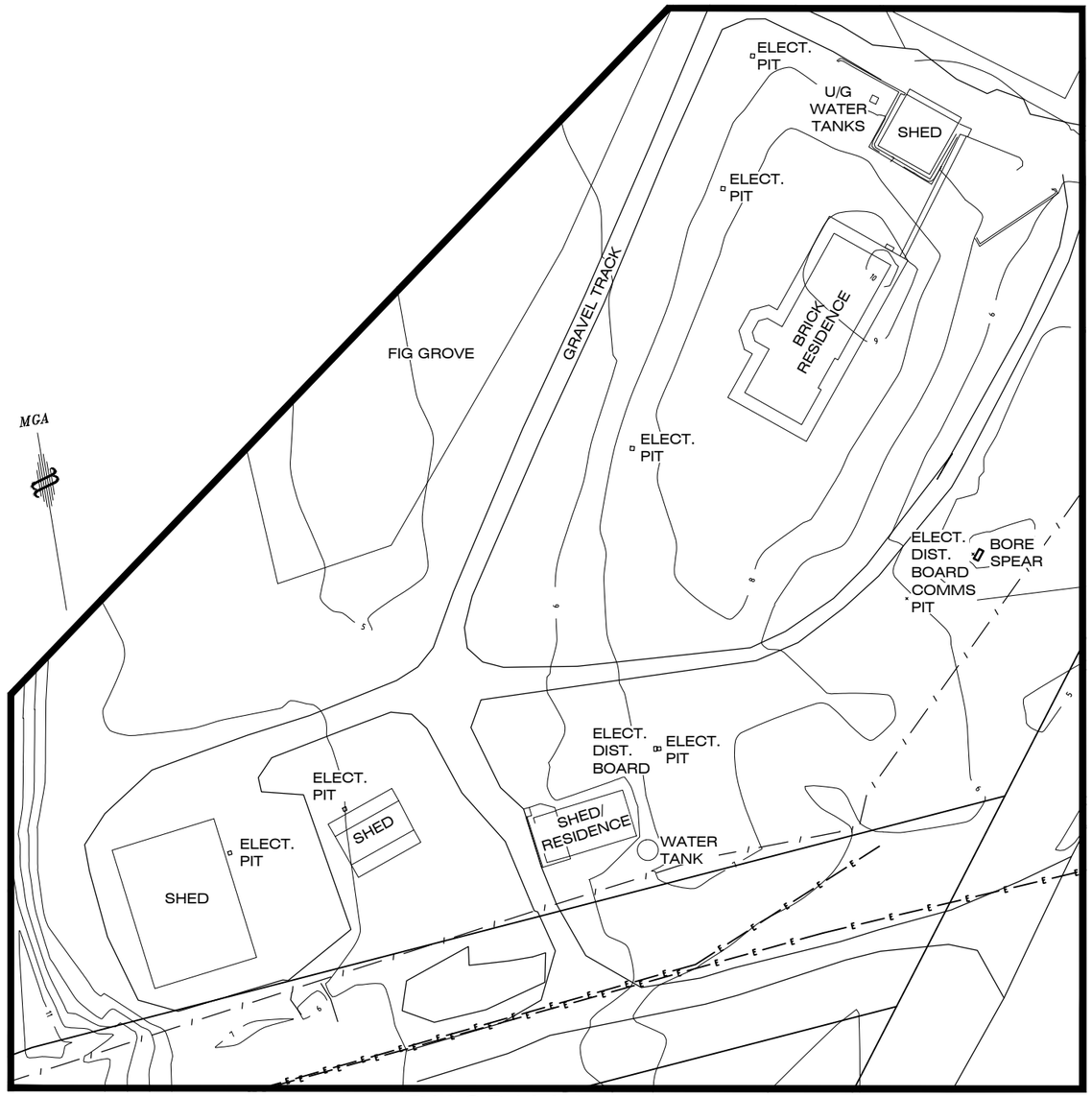


DIAGRAM 1
SCALE 1:500

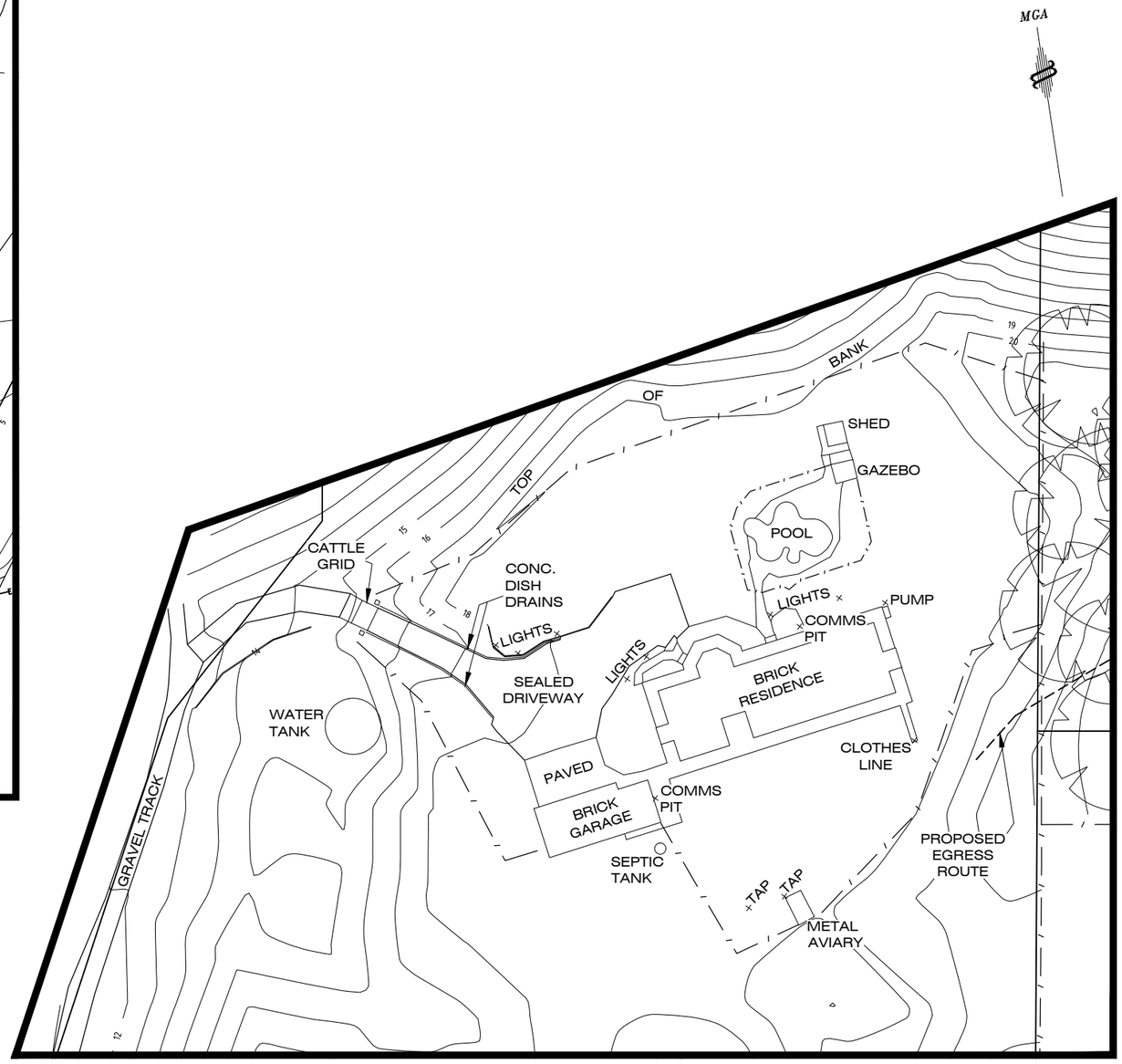


DIAGRAM 2
SCALE 1:400

NOTE: THE BOUNDARIES SHOWN IN THIS PLAN ARE APPROXIMATE ONLY. FROM MARKS FOUND DURING THE TOPOGRAPHIC SURVEY IT WOULD APPEAR THAT RECENT SURVEYS SURROUNDING THE SUBJECT LOT MAY IMPACT ON THE DIMENSIONS NOW AVAILABLE. IN ORDER TO CONFIRM BOUNDARY DIMENSIONS, A PLAN OF REDEFINITION WILL BE REQUIRED.

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
A	Original Issue					
*	Denote the original signature and date when revision was issued.					

TATTERSALL LANDER Pty Ltd
DEVELOPMENT CONSULTANTS

SCALE : SEE DIAGRAMS	SHEET No. :####	FILE : ####	SHEET SIZE A1
	JOB No. : ####	DATE : Plotted 13:26 27/06/13	
COMPUTER FILE : S:\Clients\2012\212434\Dwg\TOPO.dwg			

Annex R – Stage 2 Sand Deposit Investigation



BOBS FARM SAND DEPOSIT
STAGE 2 INVESTIGATION

Report Title	Bobs Farm Sand Deposit Stage 2 Investigation	Report Number	2013-11-02- D
Client	Ammos Resource Management Pty Ltd	Prepared by	MP, MvK
Date	02/12/2013	Checked by	MvK

Quarry Mining Systems Pty Ltd
ABN 62 149 242 382
PO Box 7030, Redhead, NSW, 2290, Australia
Newcastle T +61 (2) 4910 0929 **F** +61 (2) 4944 8840 **E** info@quarryminingsystems.com.au

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1. There has been no material change to the structure of the business since the date of QMS's investigations;
2. The material provided to QMS and any information or responses provided to QMS by, officers, employees or advisors of the business is accurate and complete;
3. There were no documents other than those disclosed which the QMS was instructed to review and examine;
4. All material information and documents have been provided by you to QMS.

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QMS reserves the right to make any changes or improvements to this Report at any time.

EXECUTIVE SUMMARY

Ammos Resource Management Pty Ltd (Ammos) engaged Quarry Mining Systems (QMS) to investigate the quality and quantity of sand available at their Nelson Bay Rd site at Bobs Farm, to determine what potential markets the identified sand may suit and what further work may be done to develop these markets. This report presents the results of the second of potentially five (5) stages of investigations and development, as defined in the scope later in this report.

The sand samples tested within this report were retrieved from drilling operations within the Bobs farm site. The results from these samples confirm similar sand lenses exist as described in the QMS stage 1 report with further investigations undertaken up to 16 metres below the water table defining a new sand type as described below.

Five (5) major classifications of sand exist across the Bobs Farm site as detailed in Table 1 below.

1. The topsoil / root zone sand material is recommended to be put aside for rehabilitation as noted previously in the QMS stage 1 report.
2. The mottled sand (Upper Grey Sand) is likely to be a suitable base for a number of soil type applications including sports field, some cricket and golf course applications. With further processing, if economic, this may also be suitable for a number of other markets.
3. The blonde sand layers are likely to be suitable for a number of applications including glass, some frac applications (further testing required), some construction applications, mortars, grouts, soil/sporting fields base sand, landscape/horticulture, some cricket field and golf course applications, Export decorative sands (beach, aesthetics etc.), and bio-retention.
   Components of the high silica sands (99% Silica or greater) with further testing may have applications as Industrial Fillers, silica flour, some ceramic applications, fused silica, silicon carbide and potentially Ferro-silicon production and possibly other specialist applications like electronics or watches. Further testing is required to prove up these markets.
4. The Black, Dark Mud / Sand may be suitable as the base for soil applications but is expected to be put aside from main production as a by-product which is to be

dealt with during potential sand production. This will be developed in the next stage mining plan for the site.

5. The lower grey sand unit, beneath the site water table, contained a black fleck, which was confirmed to be heavy minerals at a low percentage ranging from 0.18 to 2% in total. This quantity was believed by the QMS report authors to be too low to make mining of this sand for heavy minerals economic, See Appendix 10 of this report for independent work to confirm this. This grey sand however may be suitable for a number of other applications after some processing to remove the dark fleck depending on the costs of processing and market demand for the individual sand types at that time. As this sand sits below the existing site water table the cost to win this material and process also needs to be considered in mine planning.

Table 1 – Sand Volume Estimates, Potential Value and Markets by Resource Type

Bobs Farm Site Stage 2-Sand Volume Estimates Potential Value & markets					
Resource Type	**Volume (m3)**	**Approx. Tonnes**	**$ / Tonne**	**Potential $ Value**	**Potential Application**
Top soil / Root zone	151,477	242,364	$10-$19	$2,400,000 - $4,600,000	Rehabilitation, seed stock
Sand-Mottled / Upper Grey Sand	331,808	530,892	$10-$19	$5,300,000 - $10,000,000	Landscape soil base, sports field top-dress sand base
Sand–Blonde	2,289,773	3,663,636	$10-$30* Frac or glass may attract higher prices	$36,600,000 - $109,900,000	Potential Construction, Landscape soil base, sports field top-dress sand base, Some Frac etc.; with further processing potentially others as noted below.
Black Dark Mud /Sand	343,110	548,976	$0 - $10	$0 - $5,480,000	Soil Applications
Lower Grey Sand	3,487,237	5,579,579	$10-$30* Frac or glass may attract higher prices	$55,790,000 - $167,300,000	Potential Construction, Landscape soil base, sports field top-dress sand base; with further processing potentially others as noted below
Totals	6,603,405	10,565,448	-	~$100,000,000 - ~$297,280,000	All prices are indicative only and subject to market demand

Note: Water Table (Hole Depth) -B1-3.5m, B2-10.2m, B3-13.2m, B4-7.3m, B5-15.4m
All volume and tonnage estimates are provided by VGT as presented in Appendix 8 of this report

Overall the Bobs Farm site would appear to have at least three units of sand in mineable quantity present across the site. Two (2) units above the existing water table 'Mottled/Upper Grey' and 'Blonde' and one (1) below, the 'Lower grey' flecked sand. Other sand lenses exist which may be exploited for soil, landscape or other markets as they are uncovered. A detailed mining plan needs to be developed to address the most profitable means of extracting sand from this site overtime, to maximise value and optimise the winning and processing operations.

Note: The market prices quoted here are indicative only, subject to market demand and may vary significantly from that quoted.

It is recommended that the next QMS stage 3, mining plan, be developed to optimise extraction from the site and assist in development of the best plant processing operations to produce market ready products.

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1. INTRODUCTION

1.1 Stage 1 Review

The Bobs Farm site deposit is situated on the northern end of the Stockton Bight Dunal system, approximately 200km north of Sydney, in Port Stephens, NSW, Australia. An initial QMS Stage 1 research program was undertaken in June 2013 within this deposit and from this work a potential sand resource was identified. This Stage 1 work undertaken involved the establishment of test pits at various locations across the site to gain an understanding of the quality and consistency of the sand with depth. It was clear from this stage 1 testing that a series of sand lenses existed and a range of potential markets also existed for these sands. This prompted the need for further staged investigation to better understand the sand properties with depth across the site and to clarify the likely mineable volume that may apply to each market.

1.2 Outcomes of Stage 1

1. A preliminary estimate of minimum volume of sand to various datum levels.
2. A preliminary estimate of the quality of the resources in the deposit.
3. An outline of some potential markets for the quarried product.
4. A preliminary estimate of any hazardous materials within the deposit.
5. Knowledge of current water table at the test pits.

1.3 Background To Stage 2

The investigation in stage 2 was targeted at drilling the sand to the water table and then a further 16 metres below it to fully understand whether the sand quality changed significantly with depth across the site and whether the retrieval and subsequent processing of the sand ready for sale would be commercially viable and sustainable.

2. SCOPE OF INVESTIGATION

From the original Quarry Mining Systems proposal –
The scope of this investigation was to establish the projected viability of mining the sand deposit on this property. The work was to be completed in stages depending on the instructions of the owners and the results of the previous stage. Each stage was to provide greater levels of certainty about the quantity and quality of the sand deposit.

Stage 1 investigation provided-

a. 5 test pits dug by long reach excavator to establish resource sand quantity and quality at various points on the site. Dependant on site conditions during sampling.
b. Analysis of samples from the pits.
c. Preliminary indications of sand volumes and quality available at the site.

Stage 2 provided further testing to firm up the resource and an estimate of value at depth across the site.

Stage 3 of the work is to outline the design of an appropriate mining plan to process the sand resource identified in stages 1 and 2.

Stage 4 is to implement the stage 3 design work.

Stage 5 is to be the operation and ongoing management of the plant, product testing and quality of sand supplied to the various markets.

3. OUTCOMES OF STAGE 2

1. Approximately five test holes were drilled to 16 metres below the existing site water table, where possible, and samples were extracted with depth for further testing.
2. Samples were tested to confirm the quality of the sand with depth in the five (5) site locations and from this estimates of various sand quantities were made.
3. Five (5) permanent water test bores were established within the site to allow ongoing water testing and monitoring. This is expected to assist in establishment of future development applications for the site as the project progresses.
4. Drilling identified potentially mineable lenses of sand and confirmed the test pit work undertaken within the QMS stage1 investigation.
5. The more detailed testing of the relevant sand lenses has confirmed the likely property with depth across the site and a more reliable estimate of saleable sand volume for the identified markets.

Table 2 Sand Volume Estimates across the site

Bobs Farm Site Stage 2 - Sand Volume Estimates					
Resource Type	**Borehole- Hole Depth (m) / (Layer Depth m)**				
	1	**2**	**3**	**4**	**5**
Top soil / Root zone	0 – 3.8	0 – 3.5	0 - 1	0 – 0.2	0 - 1
Sand- Mottled / Upper Grey Sand	-	3.5 – 5 (1.5)	1 – 4 (3)	0.2 – 3 (2.8)	1 – 5.5 (4.5)
Sand– Blonde	-	5 – 10.5 (5.5)	4 – 14.5 (10.5)	3 – 5.6 (2.6)	5.5 – 17.5 (12)
Black Dark Mud /Sand	3.8 – 4.5	10.5 - 12	14.5 - 16	5.6 – 6.5	17.5 -20
Water Table- Hole Depth	3.5	10.2	13.2	7.3	15.4
Coloured Grey bands	-	-	-	6.5 – 11.5	20 – 22.6
Lower Grey Sand	4.5 – 19 (14.5)	12 – 26.5 (14.5)	16 – 26.5 (10.5)	11.5 – 24 (12.5)	22.6 – 26.5 (3.9)

Note: Top Soil (is at or below existing surface), Dark Sand (at Orchard RL), Variable sand quality Mixed in BH2 (near Dump site), Mottled (across site, see Stage 1Test Pits), Blonde (above water table), Black Mud or sediment (normally just beneath water table), Grey sand with black fleck (deeper beneath water table)

4. GEOLOGY OF AREA

Planning of the stage 2 drilling program involved a thorough investigation of the site and Greg Thomson of VGT was engaged by QMS as an independent professional geologist to assist in optimising the drill locations to provide the most information possible for the least disturbance to the site.

Five (5) drill holes were undertaken, in areas identified across the site based upon the historical geological maps, using knowledge of geological formation and with reference to previous test pits taken on the same site in the QMS stage 1 investigation.

In establishing the drill holes it became clear that a number of different sand lenses existed with depth and similar formation characteristics were identifiable across the site from previous test pits, now in dedicated drill hole locations. The location of the water table was established across the site and the drill holes were extended up to 16 metres below the site water table with samples retrieved from these locations where possible. Upon completion of the sample extraction permanent water monitoring wells were established in a number of locations across the site.

The Stage 2 drilling investigation involved the use of different augers to capture sand samples which were logged with depth and tested to confirm physical, chemical and geological properties of the in situ sand lenses.

The test results for each hole were recorded with depth to confirm the likely properties of the sand in that region. Changes in geology with depth were inferred from the available information and were used here to confirm likely potential market applications for each sand type. See also Appendices 1 to 9 of this report.

Bobs Farm Site - Test Pits and Bore Hole Locations

	FEATURE	EASTING (MGA)	NORTHING (MGA)	GROUND RL (m)	TOP OF PIPE RL (MARKED WITH TEXTA)	RL OF TOP OF COVER BOX (MARKED WITH)
MONITORING WELLS	PH1	406685.6	6373153.8	5.824	6.386	6.469
	PH2	406592.8	6373286.7	11.719	12.284	12.369
	PH3	406297.2	6373318.9	15.478	15.995	16.108
	PH4	406260.7	6373082.8	9.452	10.008	10.117
	PH5	406803.7	6373515.8	18.249	18.819	18.899
TEST PITS	TP1	406568.0	6373292.5	12.65	-	-
	TP2	406462.5	6373280.0	12.30	-	-
	TP3	406276.0	6373056.0	11.90	-	-
	TP4	406532.0	6373398.0	31.05	-	-
	TP6	406863.0	6373463.0	7.00	-	-

Table 3 Bore hole Locations

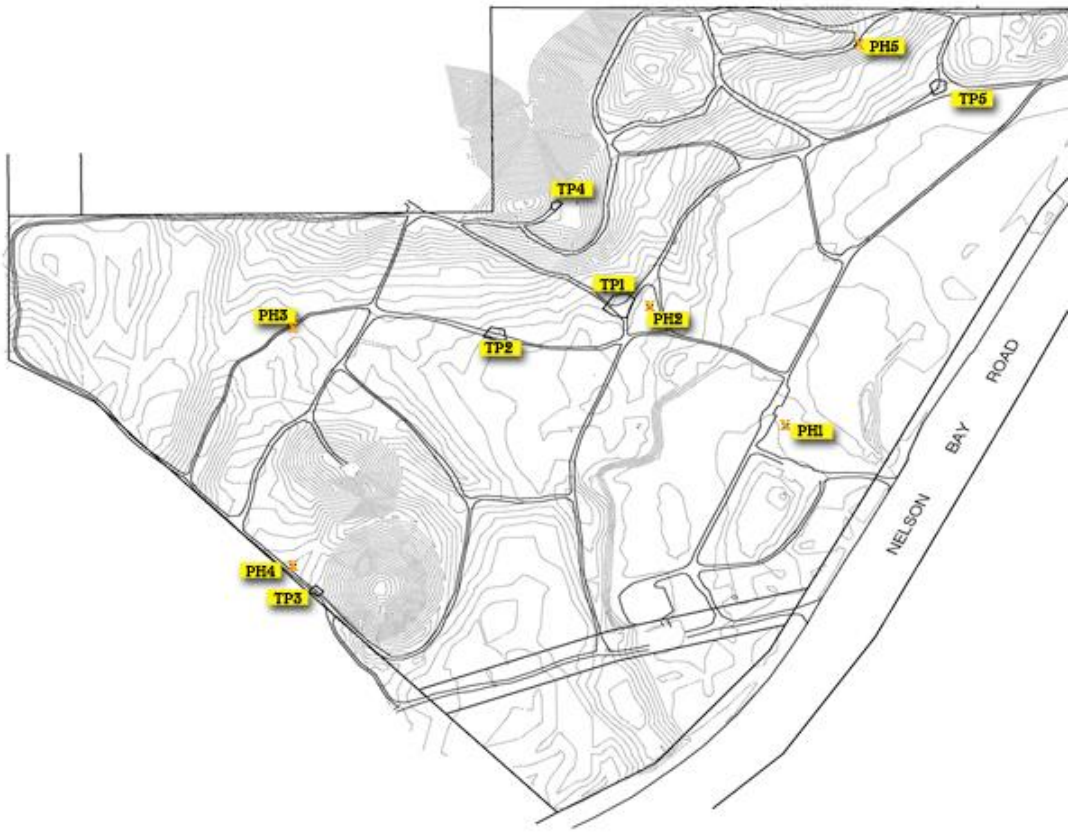


Figure 1: Bobs Farm Test pit and Bore Hole Locations

5. FIELD INVESTIGATION

5.1 METHODOLOGY

Each borehole was drilled using the solid flight auger technique until the water table was reached, then drilling was changed to hollow flight auger until the bottom of the hole was reached. The main reason for the change to the hollow flight auger was to prevent the hole from caving during sampling, allowing a clean and representative sample to be obtained with depth for testing.

Above the water table the samples were taken directly from between the auger flights, only after a thin outer sand layer was scraped off to avoid hole smearing as the auger is removed from the hole. By using this method the retrieved samples, were expected to have reduced contamination from the sampling process. The range of the sample depth (e.g. 1 to 2 metres), was logged and the colour, texture and or moisture content of that layer recorded. When sand layers were visibly consistent in colour, texture and moisture of the samples were obtained and logged in increments of approximately 1.0 to 1.5 metres in order to gain as many sample bags for testing as possible and accurately represent the lenses of sand with depth.

Below the water table the sand samples were taken using a sand bailer. The method consisted of manually lowering the sand bailer within the shaft of the hollow flight auger then plunging it up and down to capture as much sand sample as possible; the driller would then empty the water out of the sand bailer being careful not to lose any of the captured sand. This method was determined to be the most effective means of obtaining representative samples in the saturated conditions; however it was difficult to capture all fines within the water. This was seen to mirror any potential extraction process in future mining stages so was deemed to be a suitable sampling method.

The sample bags were sealed, labelled and clearly identified with a fully traceable numbering system which confirmed the site sample location and drill hole depth. These samples were collected and transported back by QMS to a suitable enclosed environment, at the end of each day, where they were stored until being sent away for the required testing to be conducted. Prior to being sent for testing the bulk

samples were systematically reduced into their respective test sample sizes by the cone and quartering method in accordance with AS 1141.3.1 – 2012 clause 6.4.3.
The above site sampling and logging process was designed by Greg Thomson (GT- Professional geologist), Michael van Koeverden (MvK- QMS Director, quarry products specialist and charted professional civil engineer), Mark Philpott (MP- QMS Director), and Shane Thomas (ST- Student Engineer); with QMS retrieving all samples for later testing. Sample reduction and preparation was undertaken at the QMS facility Redhead, under the supervision and direction of MvK and MP of QMS.

5.2 SUMMARY OF FIELD INVESTIGATION

Stage two investigations consisted of five boreholes drilled over a total of eight days on site. The drilling, was performed by Total Drilling and commenced on the 6 August 2013, with borehole one being the first hole drilled and concluding with borehole four on the 15 August 2013. The drilling process started using a truck rig; however on the 8 August 2013 the truck rig became bogged when moving from borehole BH2 to borehole BH5 and a tracked drill rig was used thereafter to traverse the soft sandy environment. The track rig arrived on site on the 9 August 2013 and moved easily across the site completing the remaining holes.

Three holes BH1, BH2 and BH4, were drilled to a depth of 16 metres below the water table, with BH3 and BH5 only reaching a depth of 15 and 13 metres below the water table respectively. Regular samples ranging between three to seven kilograms each were taken over the five bore holes above the water table, however below the water table obtaining larger sample sizes proved difficult, as the sand would not stay within the standard drilling equipment.

In order to overcome the problem of retrieving samples of adequate size, below the water table, a custom bailing tool was made by Total Drilling. The custom tool still proved difficult at times to obtain the required sample size and as such smaller samples were taken at a greater frequency to make up the required quantity, with bulk samples taken at larger intervals. In this way the sample size was maximised with depth within each hole.

5.3 Typical Site Borehole drilling and logging process.



Figure 2–5: Drill down with solid flight auger to a specified depth, then the auger flights cleaned, then sand samples retrieved from between the flights for bagging.



Figure 6-8 - The samples were weighed, and a sand tray made for each borehole to demonstrate how the sand layering changed with depth.



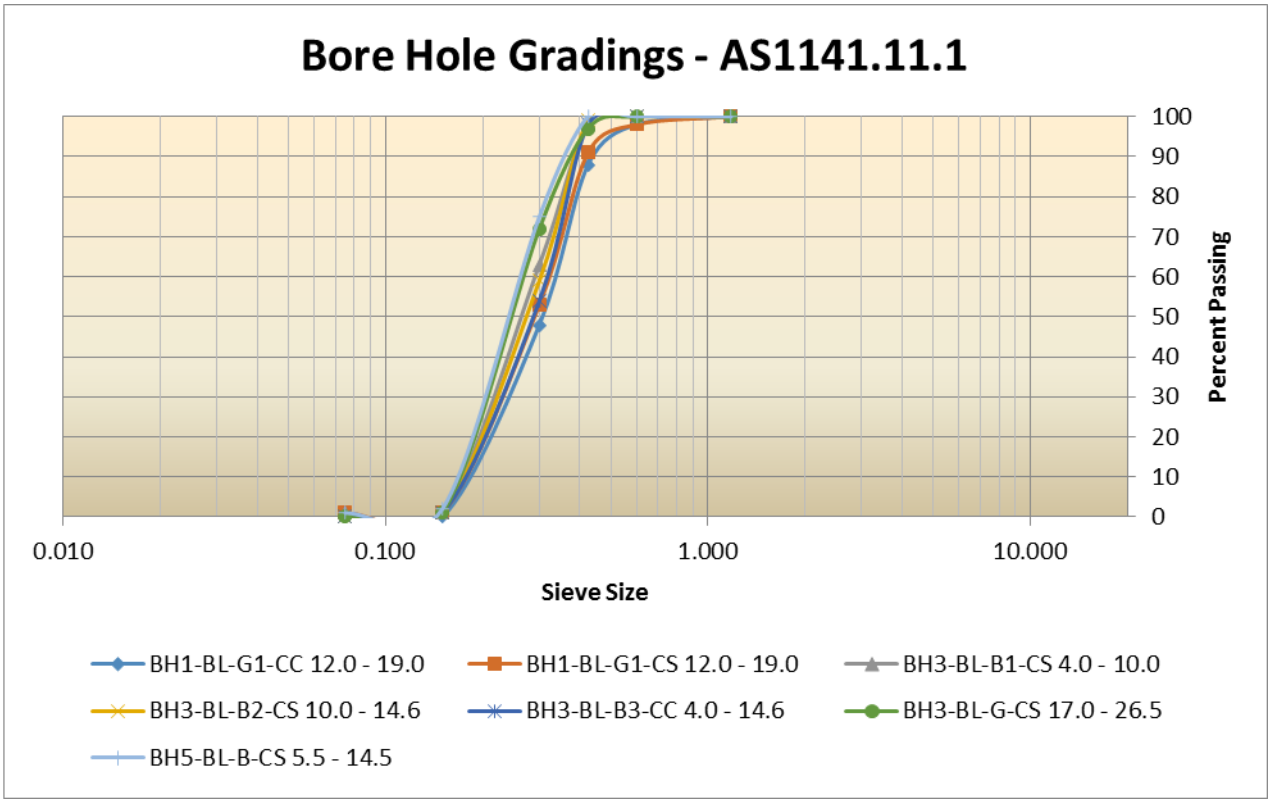


Figure 9-11 Below the water table a sand bailer was used to retrieve the samples.

Solid flight auger drilling was used as the first choice, where possible, as it provided a clean sample quickly. When the sand layers were saturated a hollow flight auger was required to hold the hole open as the sampling was done down the auger shaft. Below the water table a bailer was the only way to obtain significant and representative sand samples by dipping it down the hollow shaft of the auger, with the samples taken and transported by QMS for further testing and analysis.

6. BORE HOLE LABORATORY TESTING AND RESULTS DISCUSSION

6.1 Grading Summary- Construction Grading

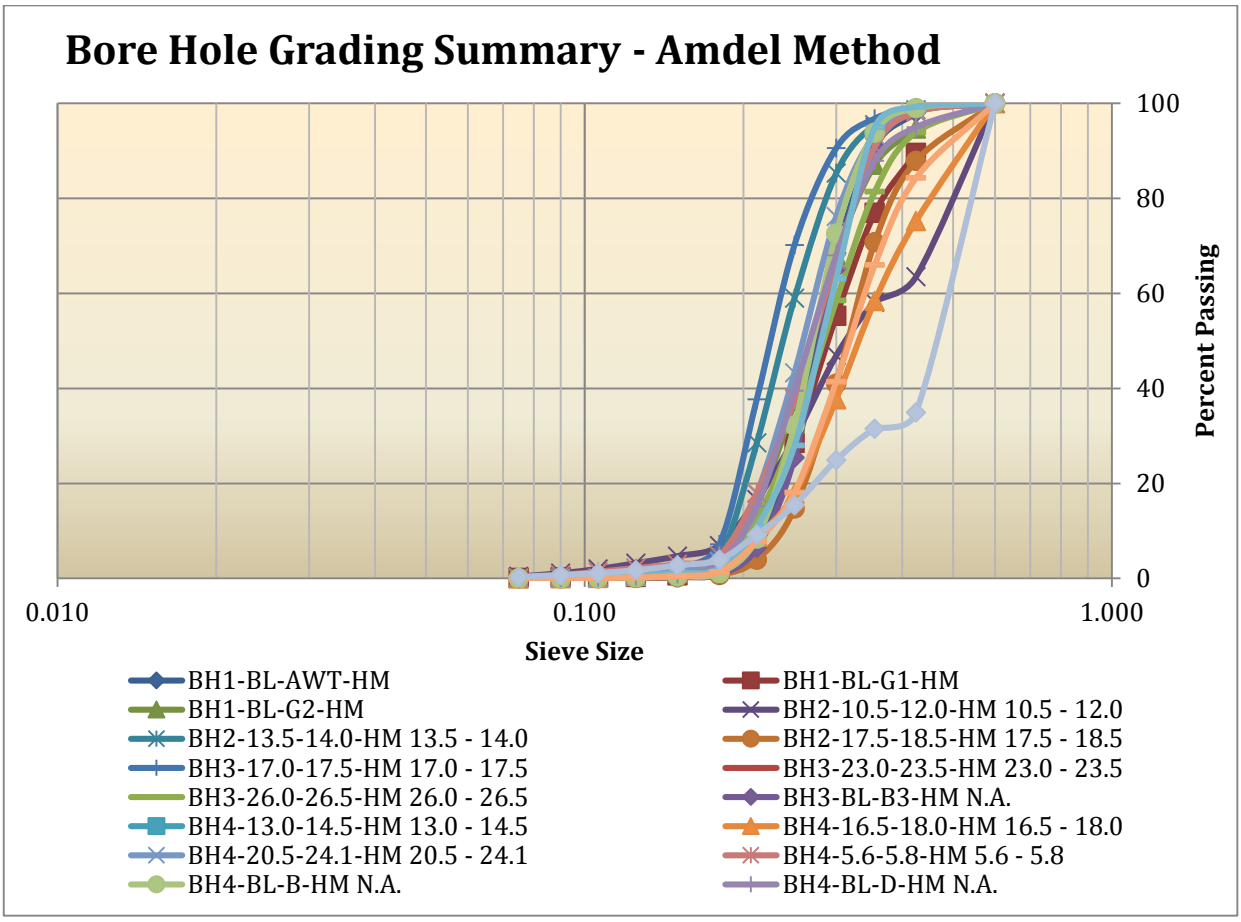


Sample ID	BH1-BL-G1-CC	BH1-BL-G1-CS	BH3-BL-B1-CS	BH3-BL-B2-CS	BH3-BL-B3-CC	BH3-BL-G-CS	BH5-BL-B-CS
Depth	12.0 - 19.0	12.0 - 19.0	4.0 - 10.0	10.0 - 14.6	4.0 - 14.6	17.0 - 26.5	5.5 - 14.5
AS1141.11.1 - % Passing							
1.18	100	100	100	100	100	100	100
0.600	98	98	100	100	100	100	100
0.425	88	91	98	99	98	97	100
0.300	48	53	63	59	54	72	75
0.150	0	1	1	1	1	1	2
0.075	0	1	1	0	0	0	1

Figure 12 Construction Grading

Construction material gradings were undertaken on sand lenses that appeared visually suitable. Any significant discolouration, sign of contamination or dark lenses were excluded from this testing as they would be unlikely to be mined for construction applications. The cost of removing these deleterious materials from the saleable sand would potentially make production of construction sand uneconomic. This could be re-visited during the next stages as the site mining plan is developed.

6.2 Grading Summary- Detailed Grading



Sample ID	BH1-BL-AWT-HM	BH1-BL-G1-HM	BH1-BL-G2-HM	BH2-10.5-12.0-	BH2-13.5-14.0-HM	BH2-17.5-18.5-	BH2-26.0-26.5-	BH2-BL-B-HM	BH3-17.0-17.5-	BH3-23.0-23.5-	BH3-26.0-26.5-	BH3-BL-B3-HM	BH4-13.0-14.5-	BH4-16.5-18.0-	BH4-20.5-24.1-	BH4-5.6-5.8-	BH4-BL-B-HM	BH4-BL-D-HM	BH5-BL-B-HM	BH5-BL-G-HM	BH5-BL-M-HM
Depth	0.6 - 3.5	12.0 - 19.0	4.2 - 12.0	10.5 - 12.0	13.5 - 14.0	17.5 - 18.5	26.0-26.5	N.A.	17.0 - 17.5	23.0 - 23.5	26.0 - 26.5	N.A.	13.0 - 14.5	16.5 - 18.0	20.5 - 24.1	5.6 - 5.8	N.A.	N.A.	N.A.	N.A.	N.A.
Sieve Size	%Passing																				
0.600	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
0.425	98.1	89.6	94.7	63.5	98.7	87.9	96.5	99.1	99	83.7	93.9	98.2	84.2	75.2	98.6	98.2	99	95	99.3	84.3	34.9
0.355	91	77	87.1	58.1	95.5	70.8	92.2	94.9	96.8	66.9	81.4	90.6	67.1	58.4	93.4	90.8	93.8	87.9	95	66	31.5
0.300	68.5	55.3	68	46.9	85.3	41	83.6	77.6	90.6	42.3	58.5	65.2	40.4	37.7	76.2	67.1	72.6	68	63.1	41.4	24.9
0.250	30.3	28.5	37.3	29.5	59	14.7	70.5	43.5	70.2	20.3	31	25.4	17.8	17.8	43.3	37.8	32.2	39.5	28	18.1	15.4
0.212	6.9	10.5	15.4	16.6	28.5	3.9	50.2	15	37.7	8.7	12.5	6.4	7.8	8.8	17.9	18	8.4	15.1	10.9	7.8	9.2
0.180	1.4	2.2	3.9	6.9	4.4	0.7	21.1	3.1	7.2	2.3	3.3	0.8	1.3	2.7	3.6	4.8	1.1	3.2	2.1	1.4	3.9
0.150	0.3	0.6	1.5	4.7	1.1	0.2	7.9	1.1	2.3	0.7	0.9	0.3	0.4	1.3	1.5	3	0.4	0.9	1.1	0.5	2.7
0.125	0.2	0.3	0.8	3.2	0.3	0.1	1.4	0.6	0.8	0.2	0.2	0.2	0.1	0.5	0.5	2.2	0.2	0.4	0.6	0.2	1.7
0.106	0.1	0.2	0.5	2	0.1	0	0.4	0.3	0.2	0.1	0.1	0.1	0	0.1	0.1	1.4	0.1	0.2	0.3	0.1	1.1
0.090	0.1	0.2	0.3	1.1	0	0	0.1	0.1	0.1	0	0	0.1	0	0	0	0.7	0	0.1	0.1	0	0.7
0.075	0	0.1	0.1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3

Figure 13 Detailed Grading Analysis

More detailed gradings were taken to provide a full description of the sand size properties across the site. By including additional sieve sizes a broader range of potential market applications can be confirmed.

6.3 Sand Particle Shape and Sphericity

Table 4: Results from the particle shape analysis

Sample #	Average Roundness	Average Sphericity	Comments
BH3-BL-B3-PL	0.60	0.74	Subrounded, with Moderately high sphericity
BH3-BL-G-PL	0.60	0.75	Subrounded, with Moderately high sphericity
BH5-BL-G-PL	0.65	0.74	Rounded, with Moderately high sphericity
BH5-BL-B-PL	0.61	0.72	Rounded, with Moderately high sphericity

Table 5: Results from the particle shape analysis

Sample #	Average Roundness	Average Sphericity	Comments
BH3-BL-B3-PL	0.60	0.74	Subrounded, with Moderately high sphericity
BH5-BL-B-PL	0.61	0.72	Rounded, with Moderately high sphericity
BH3-BL-G-PL	0.60	0.75	Subrounded, with Moderately high sphericity
BH5-BL-G-PL	0.65	0.74	Rounded, with Moderately high sphericity

Blend
Clay
Blonde
Mottle
Grey

The sand lenses tested for sphericity and shape were those that were likely to be used in applications like frac sand where shape and packing efficiency are important. This included the blonde and grey sands that were clean to very clean in colour and unlikely to introduce contaminants during their use.

Sphericity= 0.72 – 0.75 and Roundness= 0.6 – 0.65 both exceed the American Petroleum Industry Specification (API) of $\geq$0.6

Grading is close to the 40/70 US mesh size.

Crushing Strength is expected to be high with the high silica content in the sands (further testing may be required here)

Borehole 3:

- Blonde (Above Water Table) 94% silica,
- Grey (Below Water Table) 88% silica

Borehole 5:

- Blonde (Above Water Table) 99% silica,
- Grey (Below Water Table) 90% silica
-

Acid Solubility is expected to be minimal due to the high silica nature within the sand.

Further testing is required to confirm the suitability of the required properties.

Table 6 Frac Sand Report Analysis- Size.

Sample ID	BH3-17.0-17.5-HM		BH3-23.0-23.5-HM		BH3-26.0-26.5-HM		BH3-BL-B3-HM		BH5-BL-B-HM		BH5-BL-G-HM		BH5-BL-M-HM	
Depth	17.0 - 17.5		23.0 - 23.5		26.0 - 26.5		N.A.		N.A.		N.A.		N.A.	
Sieve Size	%Pass	% Ret	%Pass	% Ret	%Pass	% Ret	%Pass	% Ret	%Pass	% Ret	%Pass	% Ret	%Pass	% Ret
0.600	100	0	100	0	100	0	100	0	100	0	100	0	100	0
0.425	99	1	83.7	16.3	93.9	6.1	98.2	1.8	99.3	0.7	84.3	15.7	34.9	65.1
0.355	96.8	3.2	66.9	33.1	81.4	18.6	90.6	9.4	95	5	66	34	31.5	68.5
0.300	90.6	9.4	42.3	57.7	58.5	41.5	65.2	34.8	63.1	36.9	41.4	58.6	24.9	75.1
0.250	70.2	29.8	20.3	79.7	31	69	25.4	74.6	28	72	18.1	81.9	15.4	84.6
0.212	37.7	62.3	8.7	91.3	12.5	87.5	6.4	93.6	10.9	89.1	7.8	92.2	9.2	90.8
0.180	7.2	92.8	2.3	97.7	3.3	96.7	0.8	99.2	2.1	97.9	1.4	98.6	3.9	96.1
0.150	2.3	97.7	0.7	99.3	0.9	99.1	0.3	99.7	1.1	98.9	0.5	99.5	2.7	97.3
0.125	0.8	99.2	0.2	99.8	0.2	99.8	0.2	99.8	0.6	99.4	0.2	99.8	1.7	98.3
0.106	0.2	99.8	0.1	99.9	0.1	99.9	0.1	99.9	0.3	99.7	0.1	99.9	1.1	98.9
0.090	0.1	99.9	0	100	0	100	0.1	99.9	0.1	99.9	0	100	0.7	99.3
0.075	0	100	0	100	0	100	0	100	0	100	0	100	0.3	99.7
Max		0.300		0.425		0.425		0.355				0.425*		0.425*
Min		0.180		0.212		0.180		0.212				0.212		0.212

Max Size	mm	3.36	2.38	1.68	1.19	0.841	0.595	0.4
Min Size	mm	1.680	0.841	0.841	0.595	0.400	0.297	0.210
US Mesh	mesh	6/12	8/16	12/20	16/30	20/40	30/50	40/70
Crush Test	US	NT	NT	NT	NT	NT	NT	NT

Note: NT = Not Tested

Parts of Borehole 3 and 5 appear to satisfy some of the frac sand criteria and as such additional testing may be worthwhile to prove up a potential market Demand for Frac sand has risen dramatically as the use of hydraulic fracturing becomes more frequently used to exploit natural gas trapped in shale deposits. For example, in the US, Frac sands now represent the second largest market in the US after glass making (Elliot, 2012). Frac sand has also been used in the removal of coal seam gas where it enables more effective release of gas and water from underground gas reservoirs.

6.4 Petrographic Examination of Sand with depth across the site

Table 7 Material composition results from the petrographic report- grouped by borehole

Sample #	Material Composition																
	Quartz (%)	Mod strained quartz or comp grains of quartz (%)	Quartzite (%)	Chert (%)	Vein quartz (%)	Other Minerals (%)	Feldspar (%)	Argillaceous clasts (%)	Acid volcanics (%)	Intermediate Volcanics (%)	Ferruginous fragments (%)	Meta arenite (%)	Pelite (%)	Carbonaceous matter (%)	Shell fragments (%)	Check (%)	Free Silica Content (%)
BH1-BL-G1-PL	80	11	2	4	<1	1	1	1	<1	0	0	0	0	0	0	100	91
BH1-BL-G2-PL	54	4	0	<1	0	0	<1	0	0	0	0	0	0	42	0	100	58
BH2-BL-B-PL	77	12	1	0	<1	1	4	1	4	0	0	0	0	0	0	100	91
BH2-BL-10.5-12.0-PL	44	3	0	0	0	0	<1	0	0	0	0	0	0	53	0	100	47
BH2-BL-G-PL	85	12	<1	0	<1	<1	1	0	2	0	0	0	0	0	0	100	97
BH3-BL-B3-PL	69	16	2	2	1	<1	3	0	3	2	0	1	1	0	0	100	94
BH3-BL-G-PL	62	17	5	1	<1	1	2	0	4	2	0	4	2	0	0	100	88
BH4-BL-B-PL	89	10	<1	0	<1	<1	<1	0	1	<1	<1	0	0	0	0	100	99
BH4-BL-G-PL	75	11	2	5	<1	1	3	2	<1	1	0	0	0	0	0	100	93
BH5-BL-B-PL	96	3	<1	0	<1	<1	<1	0	1	<1	<1	0	0	0	0	100	99
BH5-BL-G-PL	65	15	4	2	0	<1	2	0	4	2	0	3	2	0	1	100	90

Blend
Clay
Blonde
Mottle
Grey

Note:
Borehole 1- Blends confirm variable silica content 58 – 91%, carbonaceous matter in a layer at 42%
Borehole 2- Clay layer- carbonaceous Matter in a layer 53%, Grey sand- silica ~ 97%
Borehole 3- Blonde sand- 94% silica, Grey sand - silica 88%
Borehole 4- Blonde sand- 99% silica, Grey sand- silica 93%
Borehole 5- Blonde sand- 99% silica, Grey sand- silica 90%

Sands suitable for glass - Free silica content in the range of 95- 99.8% with other required properties.

Table 8 Material composition results from the petrographic report- grouped by Classification

Sample #	Material Composition																
	Quartz (%)	Mod strained quartz or comp grains of quartz (%)	Quartzite (%)	Chert (%)	Vein quartz (%)	Other Minerals (%)	Feldspar (%)	Argillaceous clasts (%)	Acid volcanics (%)	Intermediate Volcanics (%)	Ferruginous fragments (%)	Meta arenite (%)	Pelite (%)	Carbonaceous matter (%)	Shell fragments (%)	Check (%)	Free Silica Content (%)
BH1-BL-G1-PL	80	11	2	4	<1	1	1	1	<1	0	0	0	0	0	0	100	91
BH1-BL-G2-PL	54	4	0	<1	0	0	<1	0	0	0	0	0	0	42	0	100	58
BH2-BL-10.5-12.0-PL	44	3	0	0	0	0	<1	0	0	0	0	0	0	53	0	100	47
BH2-BL-B-PL	77	12	1	0	<1	1	4	1	4	0	0	0	0	0	0	100	91
BH3-BL-B3-PL	69	16	2	2	1	<1	3	0	3	2	0	1	1	0	0	100	94
BH4-BL-B-PL	89	10	<1	0	<1	<1	<1	0	1	<1	<1	0	0	0	0	100	99
BH5-BL-B-PL	96	3	<1	0	<1	<1	<1	0	1	<1	<1	0	0	0	0	100	99
BH2-BL-G-PL	85	12	<1	0	<1	<1	1	0	2	0	0	0	0	0	0	100	97
BH3-BL-G-PL	62	17	5	1	<1	1	2	0	4	2	0	4	2	0	0	100	88
BH4-BL-G-PL	75	11	2	5	<1	1	3	2	<1	1	0	0	0	0	0	100	93
BH5-BL-G-PL	65	15	4	2	0	<1	2	0	4	2	0	3	2	0	1	100	90

Blend
Clay
Blonde
Mottle
Grey

Note:

Free silica:

- Blonde sand had Free Silica – 91 – 99% (Across Boreholes 2, 3, 4, 5)
- Grey Sand had Free Silica- 88 – 97% (Across Boreholes 2 , 3, 4 and 5)
- Blend Sand – 58 – 91% (Note Borehole 1- Blend highlights the variability in silica content in this hole location)
- Clay in Borehole 2 was in a heavy 53% carbonaceous layer.

6.5 Soil Analysis- Extracts from reports

Table 9 Soil Analysis and Amendment

Bore Hole 1 Above Water Table - BH1-BL-AWT-SO 0.7
Key Observations. This soil has very slight acidity and has desirably low salinity levels. The cation exchange has high sodicity making it highly prone to dispersion. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from phosphorus all nutrients need boosting. This soil is not recommended for phosphorus sensitive species, in particular natives. With the addition of a low P multipurpose fertiliser and compost, this soil will be suitable for plant growth.
Amendment Strategy Plant growth will benefit from the application of a **Low P Multipurpose NPK fertiliser at 50g/m2.**Incorporate **10g/m2 application of gypsum** to help balance the cations and reduce dispersion An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.
Bore Hole 1 Below Water Table - BH1-BL-G1-SO 0.5
Key Observations. Sample 'BH1-BL-G1-SO 0.5' was analysed for its chemical properties. This soil has extreme acidity and moderate salinity levels. The cation exchange has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate all nutrients need boosting. This soil will take time to ameliorate to become suitable for plant growth. We recommend further analysis after treatments have been applied.
Amendment Strategy Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. This is due to the acidity, which reduces the availability of many nutrients. A leguminous mulch (at 20% by volume) could be beneficial here If the leguminous mulch is not used, then incorporate composted organic matter i.e. **Green Waste Compost at 10L/m2** to improve soil structure and organic content, and thus further support plant growth. This will also help to buffer against potential toxicities and reduce dispersion. To further control dispersive tendencies, apply **gypsum at 100 g/m2** and incorporate thoroughly. Aluminium levels should be monitored to ensure that toxicity does not occur. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 200 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Untreated, this soil is not fit for purpose. We recommend retesting the aluminium and pH a fortnight following the lime application.

Bore Hole 2 - BH2-10.5-12.0-SO 0.7

Key Observations.

Sample 'BH2-10.5-12.0-SO 0.7' was analysed for its chemical properties. This soil has strong acidity and very high salinity levels. The cation exchange is highly magnesic making the soil hardsetting and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is moderate indicating good nutrient uptake and retention. Aside from sulphate, iron and magnesium all nutrients need boosting. Due to the high sulphate levels, soil is saline therefore select saline tolerant native species for growth.

Amendment Strategy

Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 60g/m2.** To further control dispersive tendencies, apply **gypsum at 300 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 300 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**

Bore Hole 2 - BH2-BL-B-SO 0.9

Key Observations.

Sample 'BH2-BL-B-SO 0.9' was analysed for its chemical properties. This soil has medium acidity and desirably low salinity levels. The cation exchange is highly sodic making the soil dispersive and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating good nutrient uptake and retention. All nutrients require boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

Amendment Strategy - Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. This is due to the acidity, which reduces the availability of many nutrients. A leguminous mulch (at 20% by volume) could be beneficial here If the leguminous mulch is not used, then incorporate composted organic matter i.e. **Green Waste Compost at 10L/m2** to improve soil structure and organic content, and thus further support plant growth.

This will also help to buffer against potential toxicities and reduce dispersion. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. Aluminium levels should be monitored to ensure that toxicity does not occur. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 50 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Untreated, this soil is not fit for purpose. We recommend retesting the aluminium and pH a fortnight following the lime application.

Bore Hole 2 - BH2-BL-G-SO 0.6

Key Observations.

Sample 'BH2-BL-G-SO 0.6' was analysed for its chemical properties. This soil has very strong acidity and desirably low salinity levels. The cation exchange is highly sodic causing dispersion and has high levels of, hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate and zinc all

nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

Amendment Strategy
Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 45g/m2.** To help boost magnesium levels, apply **dolomite at 140 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 150 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Apply **trace elements at 15g/m2**. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

Bore Hole 3 - BH3-BL-B3-SO 1.25

Key Observations.
Sample 'BH3-BL-B3-SO 1.25' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hardsetting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

Amendment Strategy
Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are overall, deficient. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

Bore Hole 3 - BH3-BL-G-SO 0.603

Key Observations.
Sample 'BH3-BL-G-SO 0.603' was analysed for its chemical properties. This soil has extreme acidity and low salinity levels. The cation exchange is highly sodic causing dispersion and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate and zinc all nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

Amendment Strategy
Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 45g/m2.** To help boost magnesium levels, apply **dolomite at 140 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 150 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Apply **trace elements at 15g/m2**. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

Bore Hole 4 - BH4-BL-B-SO 0.71
Key Observations. Sample 'BH4-BL-B-SO 0.71' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hardsetting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting. We recommend further testing after treatments have been applied.
Amendment Strategy Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are, overall, deficient. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.
Bore Hole 4 - BH4-BL-G-SO 0.51
Key Observations. Sample 'BH4-BL-G-SO 0.51' was analysed for its chemical properties. This soil has very strong acidity and desirably low salinity levels. The cation exchange is highly sodic, sightly magnesic making the soil dispersive and hardsetting and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from zinc all nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.
Amendment Strategy Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 100 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients.
Bore Hole 5 - BH5-BL-B-SO 1.302
Key Observations. Sample 'BH5-BL-B-SO 1.302' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hard setting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting.
Amendment Strategy Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are, overall, deficient. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.