

APPENDIX 4. EPBC REFERRAL REPORT

Preliminary Documentation

Cabbage Tree Road Sand Quarry - (EPBC 2016-7852)



Australian Government

Department of the Environment

Referral of proposed action

Proposed action title: Cabbage Tree Road Sand Quarry

Prepared by: Kleinfelder Australia

On Behalf of: Williamtown Sand Syndicate Pty Limited

1 Summary of proposed action

1.1 Short description

Williamstown Sand Syndicate (WSS) propose to extract approximately 3.25 Mt of sand over an approximately 8 year period (at expected market demand) or up to 15 years, allowing for a variable market demand. The proposed sand quarry is located within Lot 1 DP 224587, Lot 121 DP 556403, Lot 11 DP 629503 and Lot 1012 DP 814078 (collectively referred to as the Subject Land). Sand will be quarried at up to 530,000 tpa from a total disturbance area of 42.3 ha (Attachment 1: Subject Land).

1.2 Latitude and longitude

Co-ordinates of each corner of the study area is provide below. Due to the irregular shape of the disturbance area, co-ordinates not provided here (GIS file of the proposed disturbance areas has been provided).

Latitude	Longitude
-32.81357784100	151.79763903000
-32.80226425260	151.79999446000
-32.80448123920	151.81605881500
-32.80767511580	151.81542831100
-32.80793100250	151.81749419500
-32.81510426040	151.81607520800
-32.81478469690	151.81402471900
-32.81176546860	151.81462082100
-32.81140698190	151.81208524000
-32.81133121920	151.81144480500
-32.81106723780	151.81029300000
-32.81102296350	151.80961443500
-32.81093363020	151.80894077100
-32.81196324000	151.80870678400
-32.81169188200	151.80665281300
-32.81398755700	151.80617926600
-32.81381326490	151.80368907900
-32.81389130290	151.79948211300

1.3 Locality and property description

The Subject Land is owned by Port Stephens Council (PSC) who acquired the allotments from Rutile and Zircon Mines (Newcastle) Limited (RZM). During the thirty-year ownership by RZM, the land was used for a variety of uses including extensive heavy mineral sand mining, silica sand extraction, deposition of sand tailings, burial of monazite, equipment storage and sand filling.

The Subject Land contains predominately native vegetation, with some areas of mine rehabilitation following heavy mineral sands mining.

The Subject Land occurs on the southern boundary of the Tomago Sandbeds at Williamstown. The Subject Land is located approximately 1.5 km to the west/ south-west of Williamstown Airport and approximately 7 km to the south-east of Raymond Terrace.

1.4 Size of the development footprint or work area (hectares)

The development footprint is 42.25 ha, of which 40.38 ha contains native vegetation.

1.5 Street address of the site

282B Cabbage Tree Road Williamstown NSW 2318.

1.6 Lot description

The Subject Land consists of:

- Lot 1 DP 224587.
- Lot 121 DP 556403.
- Lot 11 DP 629503.
- Lot 1012 DP 814078.

1.7 Local Government Area and Council contact (if known)

The Subject Land occurs within the Port Stephens Council Local Government Area.

Contact: Norm Barnes

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1.8 Time frame

Subject to approval, it is proposed to commence the proposal in April 2017. The quarry would operate for approximately 8 years (at expected market demand) or up to 15 years, allowing for a variable market demand. Construction and quarrying activities (pre-extraction) would commence in year 1.

1.9 Alternatives to proposed action

<input type="checkbox"/>	No
<input checked="" type="checkbox"/>	Yes, please also complete section 2.2

1.10 Alternative time frames, locations or activities

<input type="checkbox"/>	No
<input checked="" type="checkbox"/>	Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3 and 5 (where relevant).

1.11 Commonwealth, State or Territory assessment

<input type="checkbox"/>	No
<input checked="" type="checkbox"/>	Yes, please also complete section 2.5

1.12 Component of larger action

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes, please also complete section 2.7

1.13 Related actions/proposals

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes, provide details:

1.14 Australian Government funding

<input type="checkbox"/>	No
<input type="checkbox"/>	Yes, please also complete section 2.8

1.15 Great Barrier Reef Marine Park

<input checked="" type="checkbox"/>	No
<input type="checkbox"/>	Yes, please also complete section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

2.1 Description of proposed action

The quarry will extract approximately 3.25 Mt of sand over approximately 8 years (at expected market demand) or up to 15 years allowing for a variable market demand. Sand will be quarried at up to 530,000 tpa from a total disturbance area of 42.3 ha. The variable quoted tonnages account for changing thoughts on the sand density.

The resource is effectively divided into a southern and northern resource area. Resource extraction will commence in the southern area with the establishment of an intersection on Cabbage Tree Road and a 200 metre (m) bitumen sealed access road through to the office and workshop area. Extraction and the construction of a sealed access continues north through the centre of the southern resource area to the northern area. The northern resource area is extracted south to north along the western side then the eastern side before returning to the southern area and the completion of quarrying. The final landform will remain at a minimum of 1 m above the highest predicted groundwater levels with 1 in 4 batters (1 m vertical to 4 m horizontal) around the perimeter of the resource area. Typically, the batters will be less than 1 m in height, with exception to the south-western and western boundaries of the resource where batters will reach up to 12 m high (i.e. batters up to 48 m wide).

Sand is extracted using front-end loader from the base of a batter face and loaded into a series of electric conveyors that convey the sand to the semi-mobile processing plant (i.e. it will move to seven locations during the Project). The processing plant includes an electric screen and air separator that provides a dry method for processing the sand. The sand is then stockpiled for loading into bulka bags or directly into trucks. The trucks then transport the sand from the site via a weighbridge to the consumer.

Extraction occurs through a series of 1-2 ha sectors that provide for the direct transfer of topsoil and cleared vegetation to quarried areas to promote progressive rehabilitation. The core aim and objective of the rehabilitation is to reinstate native species consistent with the existing vegetation communities (in terms of composition and structure) in the area. Methods will include a combination of natural regeneration, brush matting, direct seeding and propagated tube stock methods. It is proposed to retain the intersection and access road through to the office and workshop area along with a suitable asset protection zone for a future land use consistent with the land zoning.

Residual biodiversity impacts are proposed to be offset through the establishment of a biobanking site over the remainder of the Subject Land area, along with the retiring of offsite species credits as required under the biobanking framework.

Rehabilitated lands are also proposed to be secured under a long-term conservation agreement, once of a suitable standard. Quarrying operations will be managed under an Environmental Management Plan that provides protocols for the management and monitoring of clearing, topsoil, weeds, rehabilitation, air quality, noise, traffic and water. Annual reporting will be required to satisfy Project Approval requirements stating progress activities undertaken through the year and adherence to Project Approval Conditions. In addition, annual reporting will be required against the conditions of an Environmental Protection Licence that will likely focus on air, noise and water monitoring.

Please refer to Response to Submissions Part 1 Main Text (Major Project Website) for detailed project description.

2.2 Feasible alternatives to taking the proposed action

This Project is formed on a tender issued by PSC for a property purchased by Council as an asset. The realisation of the project and the tender will see up to \$18.5 million dollars contributed back to Council in the form of rents and royalties from the project. This royalty represents a substantial input to Council revenue for use within the LGA. In addition to the rents and royalties, Council will be provided annual funding to undertake management of the Subject Land in perpetuity, thereby reducing potential burden on the Council. Not proceeding with the project would result in a substantial loss in revenue to PSC and without revenue replacement (such as rate variations), a related reduction in the ability to maintain and supply infrastructure and services for the benefit of the residents of the LGA.

Not proceeding with the Project would also result in lost employment opportunities for up to six individuals of the local community as a result of the jobs that would be created by the quarry.

If the Project does not proceed, a regionally and state significant sand resource will remain undeveloped, resulting in the need to identify, assess and approve additional sand resources from other sites. Given the increasing scale of the sand market driven by the construction industry and the decreasing major sand suppliers in the Sydney market, demand will increase. Increased demand, coupled with a shortage of supply may lead to increased prices passed through to home owners placing further market pressure on the housing market within the Newcastle and Sydney area, this in turn can potentially result in a reduction in construction activity.

2.3 Alternative locations, time frames or activities that form part of the referred action

Resource estimates provided during the tender process with PSC estimated that the sand resources on the property above 4 m contour was 5.17 Mt. With the incorporation of a wildlife corridor separating the northern and southern and deposits, this was reduced to 4.61 Mt within an area of 69.9 ha (68.28 ha of native vegetation).

The resource boundary presented within the EIS took into consideration the initial constraints and adopted additional constraints that resulted in an estimated resources of 3.2 Mt over an area of 53.4 ha (52.01 ha of native vegetation).

Based on the responses to the public exhibition and government authority review of the EIS documentation submitted as part of the State Approval process, changes were made to the proposed development to reduce its potential impact on the environment and community.

All alternatives and changes to the project occur within the Subject Land. The changes to the proposal include:

- Reduction of the maximum extraction rate to, up to 530,000 tonnes per annum, or the equivalent of over 2,100 trucks on the road per annum when at maximum extraction.
- Change of the predominant extraction method to portable electric conveyors fed by front end loaders. Dozer push, loader, and articulated trucks may be used if required, but only when conveyors are under maintenance. This will reduce noise sources and diesel consumption.
- Change to electric processing (stackers, screens and air separator) that will be predominantly powered by mains power (Note: in the event of unforeseen outages or mains connection issues a diesel generator may be used as backup).
- Removal of a tub grinder from operations.
- Inclusion of a slip lane on the eastbound lane of Cabbage Tree Road at the intersection to the site to improve emergency avoidance of static right turning private vehicles.
- Reduction in the resource footprint of 22.5% based on a range of additional avoidance and optimisation measures.
- Extraction and rehabilitation sequencing that will limit the area exposed during operations to active quarrying blocks. Rehabilitation will commence in each extraction block once quarrying is completed in each respective block. This will result in a progressive rehabilitation plan for the life of the Project.

The key modifications to the Project are detailed below.

Extraction area

The area of extraction for the quarry has been adjusted based on a broad range of constraints and opportunities and is open to a broad range of alternatives, these include:

- PSC definition of area, depth to groundwater and the vegetation and habitat corridor area that separates the northern and southern extraction areas.
- Avoidance of high value habitat areas, including vegetation and habitat features (predominantly hollow-bearing trees), which represent habitat for a number of MNES (Threatened and Migratory Species).
- An increase in the vegetation and habitat corridor widths on the south-east and north-east of the resource areas.
- Evaluation of minimum depths of extraction to meet project costs.

Extraction method

Several alternatives to the extraction of the sand resource have been examined, these include:

Dozer push, loader and truck as proposed within the EIS.

Mobile electric conveyors fed by loader as proposed as the preferred alternative.

As the project progresses the optimum methods and equipment for extraction will be relative to efficiency and costs while maintaining noise and air quality goals at the surrounding residential dwellings.

The location of the processing plant during the Project and sequencing resource extraction has been reviewed. The EIS proposed a sequence of extraction that involved removal of effectively half of the southern resource area before moving to the northern area. The adopted sequence is aimed at establishing the office and workshop and an access road through to the northern resource area. The majority of the southern resource area will now be extracted at the end of the Project, after five years of air and noise monitoring and refinement of the project.

Site access alternatives

Alternate locations for access roads into the quarry were considered during the project design, primarily the access on the eastern side of the Subject Land. This access was discounted due to the deceleration and acceleration lanes being located directly in front of residential properties, the alignment of the road restricting visibility of merging traffic. The haulage road location is also less efficient given the majority of the resource is located on the western side of the property and the haulage road length is considerably longer than that required by the proposed access location. Access of the site from the western boundary through to Masonite Road was not adopted as it was precluded within the quarry lease with PSC and would also have a greater haulage length and would require haulage over sensitive lands associated with Hunter Water Special Area and the Tilligerry SCA.

Alternate intersection designs were considered during the Project design. Options evaluated included seagull type intersections that would provide a protected right turn for trucks leaving the quarry, along with a signalised intersection. Both of these intersections were not adopted given increased costs associated with construction for minimal operational benefit. Given potentially multiple trucks could cue at the lights and would accelerating from a standing start the associated noise from the intersection is likely to be higher than that proposed.

Rehabilitation method

Various options for rehabilitation have been considered within both the EIS and the response to submissions. The alternatives have considered the following key aspects:

The avoidance of stockpiling of topsoil, such that the seed bank may be sterilised, and material must be double handled. The adopted method avoids stockpiling where possible through the direct transfer of topsoil between extraction sectors.

Mulching of vegetation as proposed within the EIS will not occur, with a woody debris and brush matting approach using whole trees and branches that will promote a more variable organic material input to the soil providing greater habitat and seed source for rehabilitation.

With sequential topsoil and vegetation placement, progressive rehabilitation of the quarry is driven through operation practice, where new resource areas cannot be accessed without transfer of topsoil and vegetation. In contrast, topsoil and mulch stockpiling can result in lags in rehabilitation.

Please refer to Figure 1 within Response to Submissions Part 1 Main Text (Major Project Website) for a representation of the three resource areas (current, EIS and original PSC).

2.4 Context, including any relevant planning framework and state/local government requirements

Port Stephens Council (PSC) purchased four allotments (Lot 1012 DP 814078, Lot 11 DP 629503, Lot 121 DP 556403, Lot 1 DP 224587 – collectively referred to as the Subject Land) on Cabbage Tree Road from Rutile and Zircon Mines (Newcastle) Limited (RZM). The land is zoned RU2 Rural Landscape under the Port Stephens Local Environment Plan 2013 which permits development for extractive industries.

Following acquisition from RZM, PSC were made aware of the potential presence of a sand resource. PSC undertook an assessment of the potential resource characteristics and environmental constraints before seeking tenders in 2012 for interested parties to extract sand from the Subject Land. At this stage the resource was characterised as containing 4.6 million tonnes (Mt) over an area of 69.85 hectares (ha).

Castle Quarry Products was the successful tenderer and entered into a 15-year lease with PSC. Key elements of the winning tender included:

- \$5/tonne royalty based on sand leaving the quarry.
- Ground rent of \$100,000 per annum.
- Minimum extraction rate of 250,000 tonne (t) per year for Year 1 and 300,000 t each year after.
- Amounting to approximately \$16,250,000 in royalties plus \$800,000 to \$1,500,000 depending on the duration of the quarry (i.e. 8-15 years).

The lease was subsequently transferred to Williamtown Sand Syndicate Pty Ltd with the approval of PSC, including an extension to various lease milestones on account of several delays in the development of the Project. A \$250,000 security deposit was provided to PSC to demonstrate the financial capability of WSS to operate the quarry. The deposit is returnable to WSS on conclusion of the lease if completed to required standards.

2.5 Environmental impact assessments under Commonwealth, State or Territory legislation

In September 2013, a request for Director General's Requirements (DGRs) was made to NSW Department of Planning for a sand quarry that would have an extraction rate in excess of 500,000 t from a resource of 4.6 Mt. Given the extraction of greater than 500,000 tonnes per annum (tpa) the quarry was considered a State Significant Development (SSD) pursuant to the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP).

An EIS for the Project was subsequently prepared and publicly exhibited for 9 weeks from 4 December 2015 to 15 February 2016. The EIS was based on the extraction of up to 600,000 tpa from a resource of 3.32 Mt over an area of 53.4 ha. Government authorities, special interest groups and the public made submissions on the exhibited EIS. The New South Wales Department of Planning and Environment then requested the proponent, Williamtown Sand Syndicate Pty Limited (WSS), provide a response to the issues raised.

WSS completed a review of all submissions received on the EIS and provided detailed responses to the submissions, culminating in the lodgement of these responses to NSW Department of Planning and Environment in October 2016.

2.6 Public consultation (including with Indigenous stakeholders)

Throughout the preparation of the EIS and the post-exhibition and response to submissions phases, consultation has been undertaken with government agencies, utilities providers and Aboriginal heritage groups along with one on one consultation with adjoining residents and members of the community via a range of mechanisms.

Consultation activities completed have included:

- Community newsletters; prepared to coincide with the findings of completed assessments and project milestones and delivered to residents along Cabbage Tree Road and Barrie Close and made available to members of the community who have indicated a preference to receive updates.
- Community information sessions; prepared to coincide with the findings of completed assessments and project milestones.
- Public notices in print media; inviting members of the community to the information sessions.
- One-on-one meetings; as requested.
- A dedicated telephone number providing direct access to a project spokesperson.
- A contact email address providing direct access to a project spokesperson.

Issues raised during the consultation program have resulted in a number of additional or further assessments of potential environmental and social impacts (e.g., ecology, surface hydrology, groundwater, radiation, health and amenity) and changes in the project description.

Issues raised during the community consultation activities have included:

- Amenity (noise, air quality and health).
- Continuing and ongoing consultation.
- Contamination.
- Cumulative impacts.
- Economic and community benefit.
- Habitat, ecology and rehabilitation.
- Proponent details and ownership.
- Traffic.
- Flooding.
- Impacts to groundwater levels.

The issues listed above have been taken into account and considered as part of further assessments and optimisation of the project design. Other consultation outcomes may see the development of further mitigation strategies to be implemented where appropriate, as part of the specific strategies to mitigate potential impacts on the community surrounding the project site.

Consultation will continue throughout the development of the project from construction, operation to eventual decommissioning and closure.

2.7 A staged development or component of a larger action

N/A

2.8 Related actions

N/A

3 Description of environment & likely impacts

The following sections describe the impacts of the proposed action on relevant matters protected under the EPBC Act. The impact analysis conducted in the following sections has only conducted for the disturbance area currently proposed. No alternatives are discussed as the current disturbance area is the preferred option. The proposed disturbance area has been assessed as having the most reduced environmental impact, when compared to the previous options. An assessment of the impacts of the previous extraction areas against the current proposal is detailed in the table below for key ecological components and each MNES identified within the Subject Land (or presumed to be present, i.e. New Holland Mouse).

	Original Impact Area (Proposed by Port Stephens Council)	Impact Area Proposed as part of EIS (State Approval)	Current Impact Area Proposed
Total Vegetation Removal (ha)	68.28	52.01	40.38
Habitat Trees (Hollow- bearing Trees and Dead Stags)	No Data Available	211 (157 HBTs and 54 Dead Stags)	77 (56 HBTs and 21 Dead Stags)
Koala Habitat (ha)	63.21	51.83	40.38
New Holland Mouse Habitat (ha)	68.28	52.00	40.24
Grey-headed Flying-fox Habitat (ha)	68.28	52.01	40.38
<i>Eucalyptus camfieldii</i> individuals	1,422	278	227
<i>Eucalyptus</i> <i>parramattensis</i> subsp. <i>decadens</i> individuals	264	262	230
Eastern Osprey Habitat (ha)	62.93	51.56	40.38
Rufous Fantail Habitat (ha)	0.00	0.00	0.13

3.1 Matters of national environmental significance

3.1 (a) World Heritage Properties

Description

No World Heritage Properties were identified by a 10 km Protected Matters Search (October 2016).

Nature and extent of likely impact

No impacts expected.

3.1 (b) National Heritage Places

Description

No National Heritage Places were identified by a 10 km Protected Matters Search (October 2016).

Nature and extent of likely impact

No impacts expected.

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description

One declared Ramsar wetland was identified by a 10 km Protected Matters Search (October 2016)., The Subject Land occurs approximately 590 m to the north of the Ramsar wetland boundary (Hunter Estuary wetlands) (**Figure 1**).

Nature and extent of likely impact

The Subject Land occurs approximately 590 m to the north of the Ramsar wetland and will not directly impact on any areas of the wetland. The hydrology assessment concluded that the proposal will not substantially modify the surface or groundwater hydrology of the area. As such, the proposed action is unlikely to have a significant impact on the ecological character of the Hunter Estuary Wetland (Attachment 3: Assessment Against the EPBC Act Significant Impact Criteria).

3.1 (d) Listed threatened species and ecological communities

Description

Flora and fauna surveys have been conducted across the Subject Land, Ecological Assessment - Summary Report prepared by Kleinfelder (2016) (available on the Major Project Website: Response to Submissions Part 3) provides a description of the survey methods and results conducted.

All survey work conducted within the Subject Land has been used to determine the extent of ecological values within the Subject Land and any potential impacts on matters of NES. These surveys included:

- Vegetation Mapping.
- Threatened Flora Surveys.
- Fauna Surveys, including:
 - Diurnal herpetofauna searches;
 - Diurnal bird surveys;
 - Nocturnal call-playback (mammals and birds);
 - Targeted winter bird surveys;
 - Arboreal and terrestrial mammal trapping (Elliot A and Elliot B traps, and hair tubes);
 - Microchiropteran bat surveys (Anabats and harp trapping);
 - Spotlighting (mammals, nocturnal birds and herpetofauna);
 - Remote cameras;
 - Koala SAT surveys; and
 - Opportunistic surveys.
- Fauna Habitat Mapping.
- Hollow-bearing Tree Survey.

Detailed descriptions of the survey and assessment works conducted for the proposal is provided in the Ecological Assessment Summary Report (Kleinfelder 2016).

Nature and extent of likely impact

A total of 34 listed threatened species and three ecological communities were identified by a 10 km Protected Matters Search (October 2016). Note: Marine and pelagic species are not considered here due to a lack of any suitable habitat within the Subject Land, and the limited potential for indirect impacts on marine areas due to the proposal.

The results of the Protected Matter Search and an assessment of the likelihood of occurrence of each species or community is outlined below.

An assessment as to whether each of the threatened species and ecological communities modelled to occur within a 10 km radius of the Subject Land (PMST) are likely to occur was assessed based on the habitat requirements of each species against the types of habitat found on the Subject Land. A brief definition of the likelihood of occurrence criteria is provided below:

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

Where species or communities were identified as occurring or having a moderate to high potential of occurring within the Subject Land or there was the potential for indirect impacts to habitat outside the Subject Land, an assessment against the relevant Significant Impact Criteria was conducted. These assessments are provided in Attachment 3: Assessment Against the EPBC Act Significant Impact Criteria, with the conclusion of the assessments provided in the following sections.

Threatened Ecological communities

Community	Status	Likelihood of Occurrence
Central Hunter Valley eucalypt forest and woodland	CE	Nil - Not Identified
Lowland Rainforest of Subtropical Australia	CE	Nil - Not Identified
Subtropical and Temperate Coastal Saltmarsh	V	Nil - Not Identified

The vegetation communities mapped within the Subject Land are shown on Figure 1 with the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)). No threatened ecological communities listed under the EPBC Act were identified within the Subject Land (see Section 3.3 for vegetation descriptions).

Threatened Species

Birds

Scientific Name	Common Name	Status	Likelihood of Occurrence
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	Moderate
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	Moderate
<i>Calidris canutus</i>	Red Knot	E	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Calidris tenuirostris</i>	Great Knot	CE	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Charadrius leschenaultii</i>	Greater Sand Plover	V	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Charadrius mongolus</i>	Lesser Sand Plover	E	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	Nil
<i>Erythrotriorchis radiatus</i>	Red Goshawk	V	Low
<i>Grantiella picta</i>	Painted Honeyeater	V	Nil
<i>Lathamus discolor</i>	Swift Parrot	CE	Moderate
<i>Limosa lapponica baueri</i>	Bar-tailed Godwit	V	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Limosa lapponica menzbieri</i>	Northern Siberian Bar-tailed Godwit	CE	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Numenius madagascariensis</i>	Eastern Curlew	CE	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Rostratula australis</i>	Australian Painted Snipe	E	Low

Regent Honeyeater

The species was not identified within the Subject Land, but suitable foraging habitat for the species occurs. Due to the high availability of suitable foraging habitat in the locality and the highly mobile nature of the species, the removal of 40.38 ha of suitable foraging habitat due to the proposal is unlikely to significantly impact on the species.

Australasian Bittern

There is potential habitat for the species in the Coastal Wet Sand Cyperoid Heath. This habitat was assessed as marginal, with areas of preferred habitat for the species occurring to the south of the Subject Land in the Tomago Precinct of the Hunter Estuary National Park and to the west in Hexham Swamp. The species was not recorded during field surveys, but is known from the locality.

No areas of habitat for this species will be directly impacted. Additionally, as the proposal is unlikely to significantly modify the groundwater hydrology in the area, it is unlikely that there will be any indirect impacts on the species' habitat.

Swift Parrot

The species was not identified within the Subject Land, but suitable habitat for the species occurs. Due to the high availability of suitable habitat in the locality and the highly mobile nature of the species, the removal of 40.38 ha of suitable foraging habitat due to the proposal is unlikely to significantly impact on the species.

Wading Birds with Habitat in Fullerton Cove

Suitable habitat for these species occurs to the south of the Subject Land in Fullerton Cove (590 m south). As such, the proposal will not directly impact on habitat for these species.

There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these species.

Frogs

Scientific Name	Common Name	Status	Likelihood of Occurrence
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	Low
<i>Mixophyes balbus</i>	Stuttering Frog	V	Nil

Mammals

Scientific Name	Common Name	Status	Likelihood of Occurrence
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	E	Low
<i>Dasyurus maculatus maculatus</i>	Spotted-tail Quoll (SE Mainland Population)	E	Moderate
<i>Petauroides volans</i>	Greater Glider	V	Low
<i>Phascolarctos cinereus</i>	Koala (combined populations of QLD, NSW and ACT)	V	Known
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE Mainland)	V	Moderate
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	V	Moderate - High
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	Known

Spotted-tailed Quoll

The species was not identified within the Subject Land, but suitable habitat for the species occurs. Due to the high availability of suitable habitat in the locality and as no evidence of the species was identified (i.e. den or latrine sites), the removal of 40.38 ha of suitable foraging habitat due to the proposal is unlikely to significantly impact on the species.

Additionally, as feral animal control will be undertaken within the Subject Land, there is the potential for these activities to impact on a locally occurring population of the species. As such, the proposed control methodology will consider the recommendations detailed in the EPBC Act Policy Statement 3.4 – Significant Impact Guidelines for the 'Endangered Spotted-tailed Quoll *Dasyurus maculatus maculatus* (South-eastern Mainland Population) and the use of 1080' and the 'Administrative Guidelines on Significance: Supplement for the Tiger Quoll (South-eastern Mainland Population) and the use of 1080', see Environmental Management Plan (Response to Submissions Part 17 (Major Projects Website)). As such, it is unlikely that the control activities will significantly impact on the species.

Koala

Koala habitat within the Subject Land was defined as 'Preferred' and 'Supplementary' Koala habitat (as per the Port Stephens CKPoM definitions; PSC 2002) (refer to Figure 5 within Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website))). This habitat was defined as 'critical to the survival of the Koala', as defined by the *EPBC Act Referral Guidelines for the Vulnerable Koala*. Based on the assessment of available preferred and supplementary habitat within the Tomago Sandbeds KMU, the proposal will only removal a small proportion of the available preferred (1.01%) and supplementary habitat (0.78%); refer to Figure 6 within Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)).

The proposal will cause some fragmentation of habitat within the Subject Land, however, habitat corridors within the site will be maintained. The proposal also has the potential for increased impact to the species from vehicle strikes as there will be an increase in traffic. However, mitigation measures will be implemented to minimise these impacts (fencing along Cabbage Tree Road). Additionally, a vertebrate pest control program will be implemented within the impact and offset areas of the Subject Land, with feral dogs being one of the target species. As such, it is unlikely that the proposed action will significantly impact on the species.

Long-nosed Potoroo (SE Mainland)

The species was not identified within the Subject Land, but suitable habitat for the species occurs. In the locality there are few records of the species, with higher densities occurring to the north (Barrington Tops National Park) and south (Watagans National Park). As such, the population of the Long-nosed Potoroo in the locality was not assessed as an important population as it is unlikely to be a key source for breeding, dispersal or maintaining genetic diversity, and it is not near the limit of the species' range. As the local population was not assessed as important, and furthermore, the high availability of suitable habitat in the locality, the removal of 40.38 ha of habitat due to the proposal is unlikely to significantly impact on the species.

New Holland Mouse

Trapping surveys within the Subject Land were conducted prior to the 2013 fire, and the species was not identified within the Subject Land. Due to the fire that occurred across part of the Tomago Sandbeds in 2013 (extent of fire shown on Attachment 2: New Holland Mouse Habitat), suitable habitat for the species is now present and as such, a local population of the species is assumed to utilise the Subject Land. The extent of suitable habitat within the Subject Land is shown on Attachment 2: New Holland Mouse Habitat.

The local population of New Holland Mouse in the Port Stephens LGA was assessed as important as it is at the southern limit of one of the known meta-populations in NSW. Due to the high availability of suitable habitat in the locality (area burnt by fire in the locality was approximately 1,543.90 ha), the removal of 40.24 ha of habitat due to the proposal is unlikely to significantly impact on the species.

Grey-headed Flying-fox

The species was recorded foraging within the Subject Land during field surveys. No roosting camps were identified within the Subject Land, all vegetation within the disturbance area was assessed as suitable foraging habitat for the species. Due to the high availability of suitable foraging habitat in the locality, the removal of 40.38 ha of habitat due to the proposal is unlikely to significantly impact on an important population of the species.

Plants

Scientific Name	Common Name	Status	Likelihood of Occurrence
<i>Asperula asthenes</i>	Trailing Woodruff	V	Nil
<i>Commersonia prostrata</i>	Dwarf Kerrawang	E	Moderate
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	Low
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	Known
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Earp's' Gum	V	Known
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	Known
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	Low
<i>Persicaria elatior</i>	Knotweed	V	Moderate - low
<i>Phaius australis</i>	Lesser Swamp-orchid	E	Low
<i>Tetratheca juncea</i>	Black-eyed Susan	V	Low

Commersonia prostrata

The species was not identified during the field surveys, however, all areas of suitable habitat for the species were not extensively searched as they occur outside the proposed disturbance area. Due to the minimal amount of habitat removal (0.13 ha of Swamp Forest), and as indirect impacts on retained areas of habitat in the offset area are unlikely, the assessment concluded that the proposal is unlikely to result in a significant impact on a population of the species occurring on the Tomago Sandbeds.

Eucalyptus camfieldii

The species was identified within the Subject Land, including within the proposed disturbance area, refer to Figure 3 within Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)). A total of 1,868 *E. camfieldii* individuals were recorded on the Subject Land. Of these individuals, 229 occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) and 1,639 occur naturally, predominantly within the Coastal Sand Wallum Woodland-Heath. The individuals within the Subject Land that occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) are not considered to be naturally occurring. The proposal would result in the removal of 227 *E. camfieldii* individuals (the majority of which, 201, are planted/ seeded within the rehabilitation area). This impact represents a removal of 10% of the local population. The habitat to be removed is considered to be marginal habitat as it is ecotonal areas which support lower densities of the species, and also areas of rehabilitation. The proposal will not fragment or isolate any areas of habitat for the species. Impact to the adjacent vegetation to be retained in the Offset Area is unlikely due to the temporary nature of the proposal. As such, the proposal is considered unlikely to have a significant impact on an important local population of the species.

Eucalyptus parramattensis subsp. *decadens*

The species was identified within the Subject Land, including within the proposed disturbance area, refer to Figure 4 within the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)). A total of 864 *E. parramattensis* subsp. *decadens* individuals were recorded on the Subject Land. Of these individuals, 283 occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) and 581 occur naturally in the north of the Subject Land predominantly within the Tomago Sand Swamp Woodland. The individuals within the Subject Land that occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) are not considered to be naturally occurring. The proposal will remove a small proportion of the local population of *E. parramattensis* subsp. *decadens* (0.57%; 230 individuals). Additionally, these individuals are not naturally occurring and do not occur within an area of suitable habitat for the species. The proposal will not isolate or fragment any areas of potential habitat for the species, or significantly impact on the remaining suitable habitat in the Subject Land. As such, the proposal is considered unlikely to have a significant impact on an important local population of the species.

Grevillea parviflora subsp. *parviflora*

The species was identified in the north of the Subject Land outside the proposed disturbance area, refer to Figure 9 within Biodiversity Offset Strategy (Response to Submissions Part 3 (Major Projects Website)). The assessment concluded that as the species will not be directly impacted and indirect impacts on retained areas of habitat are unlikely, the action is unlikely to result in a significant impact on an important population of the species.

Persicaria elatior

The species was not identified during the field surveys, however, all areas of suitable habitat for the species were not extensively searched as they occur outside the proposed disturbance area. Due to the minimal amount of habitat removal (0.13 ha of Swamp Forest), and as indirect impacts on retained areas of habitat in the offset area are unlikely, the assessment concluded that the proposal is unlikely to result in a significant impact on a population of the species occurring on the Tomago Sandbeds.

3.1 (e) Listed migratory species

Description

Surveys within the Subject Land (as described in Section 3.1) also targeted potentially occurring migratory species.

Nature and extent of likely impact

A total of 35 listed migratory species were identified by a 10 km Protected Matters Search (October 2016). Note: Marine and pelagic species are not considered here due to a lack of any suitable habitat within the Subject Land, and the limited potential for indirect impacts on marine areas due to the proposal.

The results of the Protected Matter Search and an assessment of the likelihood of occurrence of each species is outlined below.

An assessment as to whether each of the migratory species modelled to occur within a 10 km radius of the Subject Land (PMST) are likely to occur was assessed based on the habitat requirements of each species against the types of habitat found in the Subject Land. A brief definition of the likelihood of occurrence criteria is provided below:

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

Where migratory species were identified as occurring or having a moderate to high potential of occurring within the Subject Land, or there was the potential for indirect impacts to habitat outside the Subject Land, an assessment against the relevant Significant Impact Criteria was conducted. These assessments are provided in Attachment 3: Assessment Against the EPBC Act Significant Impact Criteria and a summary of the results is provided below.

Scientific Name	Common Name	Likelihood of Occurrence
<i>Apus pacificus</i>	Fork-tailed Swift	Low - May aerially forage over Subject Land, preferred foraging habitat in Australia is inland plains
<i>Hirundapus caudacutus</i>	White-throated Needletail	Moderate – potential for the species to aerially forage over Subject Land. However, few threats to the species in Australia (non-breeding habitat).
<i>Cuculus optatus</i>	Oriental Cuckoo	Low
<i>Gallinago hardwickii</i>	Latham's Snipe	Moderate - low – marginal habitat in wetland vegetation
<i>Gallinago megala</i>	Swinhoe's Snipe	Moderate – habitat in wetland vegetation
<i>Gallinago stenura</i>	Pin-tailed Snipe	Moderate - low – marginal habitat in wetland vegetation
<i>Monarcha melanopsis</i>	Black-faced Monarch	Low
<i>Symphysistichus trivirgatus</i>	Spectacled Monarch	Low
<i>Motacilla flava</i>	Yellow Wagtail	Low
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Low
<i>Pandion cristatus</i>	Eastern Osprey	Known
<i>Rhipidura rufifrons</i>	Rufous Fantail	Known
<i>Actitis hypoleucos</i>	Common Sandpiper	Nil within the Subject Land – Assessed for indirect impacts due to suitable habitat within Fullerton Cove
<i>Arenaria interpres</i>	Ruddy Turnstone	
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	
<i>Calidris canutus</i>	Red Knot	
<i>Calidris ferruginea</i>	Curlew Sandpiper	
<i>Calidris melanotos</i>	Pectoral Sandpiper	
<i>Calidris ruficollis</i>	Red-necked Stint	
<i>Calidris tenuirostris</i>	Great Knot	
<i>Charadrius bicinctus</i>	Double-banded Plover	
<i>Charadrius leschenaultii</i>	Greater Sand Plover	
<i>Charadrius mongolus</i>	Lesser Sand Plover	
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	
<i>Limosa lapponica</i>	Bar-tailed Godwit	
<i>Numenius madagascariensis</i>	Eastern Curlew	
<i>Numenius minutus</i>	Little Curlew	
<i>Numenius phaeopus</i>	Whimbrel	
<i>Philomachus pugnax</i>	Ruff (Reeve)	
<i>Pluvialis fulva</i>	Pacific Golden Plover	
<i>Pluvialis squatarola</i>	Grey Plover	
<i>Sterna albifrons</i>	Little Tern	
<i>Tringa brevipes</i>	Grey-tailed Tattler	
<i>Tringa nebularia</i>	Common Greenshank	

<i>Tringa stagnatilis</i>	Marsh Sandpiper	
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Eastern Osprey

A juvenile individual was identified within the Subject Land during field surveys. The Subject Land occurs within 3 km of suitable foraging habitat for this species (Fullerton Cove), as such it has the potential to provide roosting and nesting habitat for the species. All vegetation within the Subject Land that has a tall canopy layer (all vegetation types except the Coastal Wet Sand Cyperoid Heath and the Tomago Sand Swamp Heath) were assessed as suitable nesting habitat for the Eastern Osprey. The proposed action was not assessed as having a significant impact on this migratory species as it would not impact on an ecologically significant proportion of the population, and indirect impacts on surrounding areas of habitat are not likely to be substantial.

Rufous Fantail

The species was identified within the Subject Land during field surveys, the Swamp Mahogany – Paperbark Swamp within the Subject Land represents potential habitat for this species. The proposed action was not assessed as having a significant impact on this migratory species as it would not impact on an ecologically significant proportion of the population, and indirect impacts on surrounding areas of habitat are not likely to be substantial.

Snipe Species

The Latham's Snipe, Swinhoe's Snipe or Pin-tailed Snipe were not identified within the Subject Land, however, suitable habitat for these species occurs within the Coastal Wet Sand Cyperoid Heath. The proposed action will not directly impact on any areas of habitat for these species, and indirect impacts through habitat modification (changes in hydrology) are not likely to be significant. As such, the proposed action is unlikely to cause significant indirect impacts on habitat for these migratory species.

Migratory Species with Habitat in Fullerton Cove

Suitable habitat for these species occurs to the south of the Subject Land in Fullerton Cove (590 m south). As such, the proposal will not directly impact on habitat for these species.

There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such, it is unlikely that there will be any significant indirect impacts on habitat for these migratory.

3.1 (f) Commonwealth marine area

Description

N/A

Nature and extent of likely impact

N/A

3.1 (g) Commonwealth land

Description

N/A

Nature and extent of likely impact

N/A

3.1 (h) The Great Barrier Reef Marine Park

Description

N/A

Nature and extent of likely impact

N/A

3.1 (i) A water resource, in relation to coal seam gas development or large coal mining development

Description

N/A

Nature and extent of likely impact

N/A

3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

3.2 (a)	Is the proposed action a nuclear action?	X	No
			Yes (provide details below)
If yes, nature & extent of likely impact on the whole environment			
3.2 (b)	Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?	X	No
			Yes (provide details below)
If yes, nature & extent of likely impact on the whole environment			
3.2 (c)	Is the proposed action to be taken in a Commonwealth marine area?	X	No
			Yes (provide details below)
If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))			
3.2 (d)	Is the proposed action to be taken on Commonwealth land?	X	No
			Yes (provide details below)
If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))			
3.2 (e)	Is the proposed action to be taken in the Great Barrier Reef Marine Park?	X	No
			Yes (provide details below)
If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))			

3.3 Description of the project area and affected area for the proposed action

3.3 (a) Flora and fauna

A total of 150 plant species, of which four were exotic, were identified during surveys undertaken in 2008, 2011 and 2013 – 2015 by RPS (2011) and Umwelt (2015). During vegetation mapping surveys (floristic quadrats) conducted by Kleinfelder in 2016, a total of 86 flora species were identified within the extraction area, and 209 were identified within the offset area (species lists for each quadrat conducted within the Subject Land is provided in the Ecological Assessment Summary Report , refer to Figure 9 within Biodiversity Offset Strategy (Response to Submissions Part 3 (Major Projects Website))).

Of the flora species identified within the Subject Land three are MNES, including; *Eucalyptus camfieldii* (Camfield's Stringybark), *Eucalyptus parramattensis* subsp. *decadens* and *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea) are listed threatened species. Two of these species, *E. camfieldii* and *E. parramattensis* subsp. *decadens* occur within the extraction area.

A total of 97 fauna species were identified within the Subject Land, including seven amphibians, 57 bird, 25 mammal and eight reptile species. Four of these species are MNES, including; Eastern Osprey and Rufous Fantail are listed migratory species, and Grey-headed Flying-fox and Koala are listed threatened species.

3.3 (b) Hydrology, including water flows

The site is located on highly permeable Pleistocene aged sand dunes, on the subject land these dunes reach up to approximately 24 m AHD. The high permeability results in little or no defined surface runoff from the site with no natural creeks on the site. The Pleistocene sands are located on the edge of Holocene aged freshwater and alluvial and estuarine swamps (about 2-3 m AHD) that drain from the site both to the east and to the south, to either the Ring Drain or Dawsons Drain before meeting Fullerton Cove. Surface drainage where present, is via a series of constructed drains, now partially blocked or ineffective (local landowner pers. comm 2016).

With the Project Area being located on the permeable sands there is a significantly reduced potential for runoff and consequential erosion to occur. The topography of the Project Area and proposed extraction means any runoff from within the Project Area is directed internally (i.e. keeping it onsite).

The dominant surface drainage pathway for most of the site is to the east where the landform drops from the edge of the resource around 5m AHD to the swamp or flats over a relatively short distance with gradient reaching up to 16%. The swamp areas have a gradient of approximately 0.1% with the elevation falling 1.5m over the 1100m to the eastern boundary of the Subject Land. From the eastern boundary of the site drainage is directed via constructed channels where the elevation drops 1m over 1900m to the northern extent of Fullerton Cove (with an average gradient of 0.05%).

For the south eastern portion of the Project Area, a portion of the resource area has the potential to drain south east across the Subject Land to a constructed drain beneath Cabbage Tree Road. In this area the landform drops at about 14% to the swamp or flats that then appears to have a very slight gradient to the south eastern corner of the site (i.e. less than 0.5m over at least 140m). From this point the area drains via series of constructed channels through to the Ring Drain, a large constructed channel around the northern extent of Fullerton Cove over a distance of 590 m with an average gradient of less than 0.4%.

The Project Area and extent of extraction has been designed such that sand extraction remains a minimum of 0.7 m above the highest predicted groundwater level, with the final landform to be established at no less than 1m above the highest predicted groundwater level, (about 2 m above the average level). Outside the project area the land is regularly inundated for extended periods after heavy rain (especially in those areas below 2.0 m AHD). The inundation is largely owed to a slight groundwater gradient that flows to the south-south-east across the Subject Land and project area.

The northern portion of the subject land is located within the Hunter Water Special Area, owing to the presence of the Tomago Sandbeds and their use for a portion of the lower Hunter's drinking water supplies.

3.3 (c) Soil and Vegetation characteristics

The following soil landscapes are mapped within the Subject Land (Matthei 1995):

- The majority of the Subject Land is mapped as Aeolian Landscapes (Tea Gardens and Shoal Bay), with an area in the south mapped as an Estuarine Landscape (Bobs Farm):
 - Tea Gardens: occurs across the majority of the Subject Land, including the northern portion of the extraction area. The geology of this landscape is Pleistocene beach ridges and sandsheets consisting of marine and Aeolian quartz sands. Aeolian reworking of the sand plan by wind action produced an irregular low sandy rises and broad deflation basins and swales within the variant of the landscape mapped within the Subject Land.
 - Shoal Bay: this soil landscape is mapped as occurring in the south-western corner of the Subject Land, and covers the majority of the southern extraction area, and the southern portion of the northern extraction area. The geology of the landscape is Pleistocene Aeolian sandsheets and low dunes composed of quartz sands.
 - Bobs Farm: this soil landscape occur in the south/ south-east of the Subject Land, covering only a small portion of the southern extraction area. The geology is Holocene estuarine mud deposits consisting of silt and clay.

The vegetation within the Subject Land is classified into four vegetation formations; Dry Sclerophyll Forests (shrubby sub-formation), Heathlands, Forested Wetlands and Freshwater Wetlands. The Dry Sclerophyll Forest types typically contain a moderately dense canopy layer with a dense midstorey or shrub layer. These vegetation types occur over the areas of higher elevation in the Subject Land, and lower lying areas in the north that are above the water table (i.e. not frequently inundated). The heathland occurs in the north of the Subject Land (outside the extraction area), this vegetation contains a dense midstorey and shrub layer, and a limited or absent canopy layer (<5% cover). The forested wetlands occur in the low lying areas of the Subject Land (outside the extraction area) where the water table is at, or close to, ground level. These vegetation communities contain a moderately dense canopy layer over graminoides and scattered shrubs. The Freshwater wetland within the Subject Site also occurs where the groundwater is at the surface level. This vegetation community is a dense heathy wetland dominated by sedges and shrubs.

3.3 (d) Outstanding natural features

There are no particular outstanding natural features unique to the Subject Land.

The Subject Land is however located partially above the Tomago Sand Beds. The Tomago Sandbeds is an underground water source that provides about 20 per cent of the lower Hunter's drinking water. The sandbeds are parallel to the coast between Newcastle and Port Stephens, starting at Tomago and extending north-east for 25 kilometres to Lemon Tree Passage (Hunter Water 2016).

<https://www.hunterwater.com.au/Water-and-Sewer/Water-Supply/Dams-and-Catchments/Tomago-Sandbeds.aspx>

3.3 (e) Remnant native vegetation

A description of the vegetation communities within the Subject Land is provided below. Full vegetation descriptions are provided in the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)), and the vegetation community mapping within the Subject Land is provided on Figure 1 of Ecological Assessment Summary Report (Major Projects Website).

Coastal Sand Apple – Blackbutt Forest

This canopy of this community is dominated by *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood). In lower lying areas of its occurrence (north-west and the central dune), the canopy is co-dominated by *Eucalyptus piperita* (Sydney Peppermint). *Eucalyptus signata* (Scribbly Gum) also occurs within the canopy of this community, with a scattered occurrence along the central dune, and also co-dominates in the east where the community intergrades with an area of Swamp Forest.

The midstorey is characterised by *Banksia serrata* (Old-man Banksia), along with occurrences of *Banksia aemula* (Wallum Banksia) where the community intergrades with the Coastal Sand Wallum Woodland-Heath. Other mid-storey species included *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle) and *Monotoca elliptica* (Tree Broom-heath).

Common shrubs include *Dillwynia retorta*, *Acacia ulicifolia* (Prickly Moses), *Acacia terminalis* (Sunshine Wattle) and *Macrozamia communis* (Burrawang).

The ground layer is typically dominated by *Pteridium esculentum* (Common Bracken), along with *Pomax umbellata*, *Imperata cylindrica* (Blady Grass) *Dianella caerulea* (Blue Flax-lily), *Hibbertia linearis*, *Lomandra glauca* (Pale Mat-rush) and *Lomandra longifolia* (Spiny-headed Mat-rush) and *Baloskion pallens*.

Climbers and twining species include *Pandorea pandorana* (Wonga Wonga Vine) and *Hardenbergia violacea* (Purple Coral Pea). This community is generally free of exotic species.

This community (remnant areas, regenerating areas and rehabilitation areas) predominantly occurs in the west of the Subject Land at higher elevations on the dunes. This community also extends into the central and eastern portions of the Subject Land, along a central dune. The majority of the extraction area occur within this vegetation community.

Coastal Sand Wallum Woodland - Heath

This canopy of this community is dominated by *Eucalyptus signata* (Scribbly Gum). *Eucalyptus piperita* (Sydney Peppermint), along with the smaller tree *Eucalyptus camfieldii* (Camfield's Stringybark) co-dominate in the west of the community's distribution. *Eucalyptus globoidea* (Shite Stringybark) dominates a patch of the community in the north-east corner. *Corymbia gummifera* (Red Bloodwood) and *Angophora costata* (Smooth-barked Apple) also occur at lower densities.

The midstorey is characterised by a dense layer of *Melaleuca nodosa* (Prickly-leaved Paperbark), *Leptospermum trinervium* (Flaky-barked Tea-tree) and *Banksia aemula* (Wallum Banksia).

Common shrubs include *Dillwynia retorta*, *Lambertia formosa* (Mountain Devils), *Isopogon anemonifolius* (Broad-leaf Drumsticks), *Leucopogon ericoides* (Pink Bear-heath), *Ricinocarpos pinifolius* (Wedding Bush), *Bossiaea heterophylla* (Variable Bossiaea), *Eriostemon australis* (Pink Wax Flower) and *Pimelea linifolia* subsp. *linifolia* (Slender Rice-flower).

The ground layer is typically dominated by *Lomandra glauca* (Pale Mat-rush), *Amperea xiphoclada* var. *xiphoclada*, *Euryomyrtus ramosissima* (Rosy Baeckea), *Haemodorum planifolium*, *Schoenus ericetorum* (Heath Bog-rush), *Astroloma pinifolium* (Pine Heath), *Hibbertia fasciculata* and *Platysace ericoides*.

This community is generally free of exotic species.

This community occurs in the north of the Subject Land, typically on lower lying areas. This community is replaced by the Coastal Sand Apple – Blackbutt Forest at higher elevations and intergrades with the Tomago Sand Swamp Heath, Tomago Sand Swamp Woodland and Swamp Mahogany – Paperbark Swamp Forest in lower/wetter areas of the Subject Land. A very small portion of this community (0.04 ha) occurs within the extraction area.

Swamp Mahogany – Paperbark Swamp Forest

The canopy is dominated by *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark).

The midstorey and shrub layers are dominated by *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle) and *Leptospermum juniperinum* (Prickly Tea-tree).

The understorey is dominated by *Blechnum indicum* (Swamp Water Fern), *Blechnum cartilagineum* (Gristle Fern), *Baumea articulata* (Jointed Twig-rush), *Baumea rubiginosa*, *Schoenus brevifolius* (Zig-zag Bog-rush), *Baloskion tetraphyllum* subsp. *meiostachyum*, *Gahnia sieberiana* (Red-fruit Saw-sedge) and *Gahnia clarkei* (Tall Saw Sedge).

This community occurs in the lower lying areas of the Subject Land. Patches of this community occur in the south-west, central portion and east of the Subject Land. A very small portion (0.13 ha) of this vegetation community occurs within the extraction area.

Coastal Wet Sand Cyperoid Heath

A scattered canopy of *Eucalyptus robusta* (Swamp Mahogany) and *Melaleuca quinquenervia* (Broad-leaved Paperbark) occurs, generally at the periphery of the community where it intergrades with the Swamp Mahogany – Paperbark Swamp Forest.

The midstorey and shrub layers are dominated by *Callistemon citrinus* (Crimson Bottlebrush) and *Leptospermum juniperinum* (Prickly Tea-tree).

The understorey is dominated by *Gahnia clarkei* (Tall Saw Sedge), *Baumea articulata* (Jointed Twig-rush), *Baumea rubiginosa*, *Blechnum indicum* (Swamp Water Fern), *Schoenus brevifolius* (Zig-zag Bog-rush), *Empodisma minus* (Spreading Rope-rush), *Gleichenia dicarpa* (Pouched Coral Fern) and *Cassytha glabella*. Scattered grasses also occur including *Hemarthria uncinata* var. *uncinata* (Mat Grass) and *Entolasia stricta* (Wiry Panic).

Two areas of this community occur in the southern-central and eastern portions of the Subject Land. The community occurs on the periphery of the Swamp Mahogany – Paperbark Swamp Forest. This community only occurs within the offset area.

Tomago Sand Swamp Heath

A scattered occurrence of *Eucalyptus piperita* (Sydney Peppermint), *Eucalyptus camfieldii* (Camfield's Stringybark) and *Corymbia gummifera* (Red Bloodwood) occur.

The dense midstorey is characterised by *Banksia aemula* (Wallum Banksia), *Melaleuca nodosa* (Prickly-leaved Paperbark) and *Leptospermum trinervium* (Flaky-barked Tea-tree), with *Persoonia lanceolata* (Broad-leaved Geebung) also occurring.

Common shrubs include *Leptospermum polygalifolium* subsp. *cismontanum*, *Leucopogon ericoides* (Pink Beard-heath), *Monotoca scoparia*, *Micromyrtus ciliata* (Heath-myrtle), *Bossiaea heterophylla* (Variable Bossiaea), *Banksia oblongifolia*, *Isopogon anemonifolius* (Broad-leaf Drumsticks) and *Ricinocarpos pinifolius* (Wedding Bush). The ground layer is typically dominated by *Euryomyrtus ramosissima* (Rosy Baeckea), *Amperea xiphoclada* var. *xiphoclada*, *Hypolaena fastigiata*, *Schoenus ericetorum* (Heath Bog-rush), *Astroloma pinifolium* (Pine Heath), *Hibbertia fasciculata*, *Platysace ericoides* and *Lomandra glauca* (Pale Mat-rush).

This community is generally free of exotic species.

This community occurs in the north of the Subject Land, on lower lying areas adjacent to the Coastal Sand Wallum Woodland-Heath. This community only occurs within the offset area.

Tomago Sand Swamp Woodland

The canopy of this community is dominated by *Eucalyptus parramattensis* subsp. *decadens*, with *Eucalyptus signata* (Scribbly Gum) and *Eucalyptus piperita* (Sydney Peppermint) also occurring.

The shrub layer is dominated by *Leptospermum polygalifolium* subsp. *cismontanum* (Tantoon), *Melaleuca thymifolia* (Thyme Honey-myrtle), *Banksia oblongifolia*, *Leucopogon juniperinus* (Prickly Beard-heath), *Leptospermum arachnoides*, *Mirbelia rubiifolia* (Heathy Mirbelia), *Hakea sericea* (Needlebush) and *Pultenaea retusa* (Notched Bush-pea).

The ground cover is dominated by *Schoenus brevifolius* (Zig-zag Bog-rush), *Ptilothrix deusta*, *Leptocarpus tenax*, *Lepyrodia scariosa*, *Dampiera stricta*, *Haemodorum planifolium* and *Trachymene incisa*. Scattered grasses include *Hemarthria uncinata* var. *uncinata* (Mat Grass), *Entolasia marginata* (Bordered Panic), *Entolasia stricta* (Wiry Panic) and *Eragrostis brownii* (Brown's Lovegrass).

The community is largely free from weeds. However, some *Andropogon virginicus* (Whisky Grass) is present along an access track which occurs along part of the southern boundary of the community.

A patch of this community occurs in the north of the Subject Land in an area likely to be subject to periodic inundation. This community intergrades with the Coastal Sand Wallum Woodland-Heath in higher areas and the Swamp Mahogany - Paperbark Swamp Forest in lower lying wetter areas.

Hollow-bearing Trees

A survey of hollow-bearing trees within and directly adjacent to the original extraction area was conducted prior to the re-design of the extraction area. The information on the location of hollow-bearing trees was used to inform the re-design, in order to reduce the impacts of the proposal on hollow-dependent fauna.

A total of 242 hollow-bearing trees and dead stags with hollows were identified during the survey. Of the identified habitat trees, 77 are located within the extraction area; 56 hollow-bearing trees and 21 dead stags. The habitat trees contain a total of 42 small hollows, 28 medium hollows and 29 large hollows. It should be noted that the number and size of hollows was determined from a ground assessment. A summary of the total number of potential hollows identified during the survey is outlined in the table below, and are mapped on Figure 8 of Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)).

Type	Hollow Size		
	Small (<8 cm)	Medium (8 – 20 cm)	Large (>20 cm)
Impact Area			
Hollow-bearing Tree	28	21	22
Dead Stag	14	7	7
Total	42	28	29
Offset Area			
Hollow-bearing Tree	47	85	43
Dead Stag	11	22	18
Total	58	107	61

As can be seen by the data in table above, the revised extraction area has been positioned to reduce impacts on habitat trees. The number of hollow-bearing trees likely to occur within the offset area is expected to be much greater as it was not extensively surveyed.

3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

N/A

3.3 (g) Current state of the environment

The majority of the Subject Land contains remnant native vegetated. Previous sand extraction and associated disturbances have occurred within the Subject Land, as a result there are areas of naturally regenerating native vegetation and native rehabilitation. Previous disturbances include; heavy mineral sand mining, silica extraction, settling ponds, sand tailings areas, potential monazite trenches, Ilmenite stockpile, scarp yard, infrastructure areas and illegal dumping. Approximately 65% of the 42.25 ha extraction area has been cleared or mined for heavy mineral sand mining since 1954. More recently, a bushfire occurred across the site in November 2013.

The extraction area (42.25 ha) is located in the western and central parts of the Subject Land, within the areas of higher elevation. The extraction area is predominately vegetated with dry sclerophyll forest (40.38 ha), approximately half of which is either rehabilitation or regenerating forest (21.85 ha). A small portion of the development site consists of un-vegetated areas,

two previous sand extraction areas and access tracks (1.88 ha). The northern section of the impact area was previously subject to heavy mineral sand mining (now consisting of rehabilitation).

It is proposed that the land not subject to the action be secured as a biobank site. The proposed biobank is 131.14 ha and occupies the majority of the remaining areas of the Subject Land. There is a small area of exotic vegetation (1.26 ha) in the south east corner of the Subject Land and a small strip of land along the south-western boundary (1.46 ha), both of which have been excluded from the proposed biobank. The vegetation within the biobank site consists of dry sclerophyll forests, forested wetlands and freshwater wetlands.

Weed infestations within the Subject Land are restricted to areas of previous disturbance. The Regenerating areas of the Coastal Sand Apple – Blackbutt Forest only contain a scattered canopy layer and have a higher dominance of weeds in the understorey than the remnant forest, with *Eragrostis curvula* (African Lovegrass) and *Lantana camara* (Lantana) occurring. Weeds also occur along access tracks throughout the site, particularly *Eragrostis curvula* (African Lovegrass).

The Coastal Sand Apple – Blackbutt Forest (Rehabilitation) has previously been subject to mining, and contains a greater diversity of canopy trees, with species such as *Eucalyptus signata* (Scribbly Gum), *Eucalyptus parramattensis* subsp. *decadens* and *Eucalyptus camfieldii* (Camfield's Stringybark) co-dominating. The latter two of these species, do not typically occur or dominate the vegetation community.

Six introduced fauna species were identified during field surveys; Red Fox, Wild Dogs, House Mouse, Black Rat, European Rabbit and Domestic Horse. Evidence of impacts from European Rabbits, diggings, visually evident within the extraction and offset areas.

3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

There are no places on the site with recognised State or Commonwealth historic heritage value.

Appendix 10 of the EIS document (available on the NSW Planning Major Projects Website at https://majorprojects.affinitylive.com/public/28f2e23cbac9fbf43ea0b7f84f1ba531/12.%20Appendix%2010_Historic%20Heritage_Cultural%20Heritage%20Values.pdf) provided an assessment of the heritage values of the Subject Land, the report concluded there was no likely heritage constraint to development within the subject area.

During the project development consultation with surrounding land owners identified the presence of the footings for a former World War Two radar installation remaining on the Subject Land within the proposed extraction area. All surface infrastructure of the radar installation has been removed, and it is considered unlikely to constitute a significant unique or informative historic heritage item

3.3 (i) Indigenous heritage values

An Aboriginal Cultural Heritage Assessment Report (ACHAR) was undertaken by McCardle Cultural Heritage Pty Ltd (MCH) for the proposed project and was presented within the EIS in a report dated November 2015. This report was subsequently amended following comment from the New South Wales Office of Environment and Heritage and is available on the NSW Planning Major Projects Website at:

<https://majorprojects.affinitylive.com/public/762a9c224eb55477d105334772b3b9c3/Revised%20Aboriginal%20Cultural%20Heritage%20Assessment%20Dec%202016.pdf>.

Key aspects of the ACHAR included the following:

- Consultation with the Aboriginal Community was undertaken consistent with the NSW guideline for Aboriginal Cultural Heritage Consultation Requirements for Proponents (April 2010). This included the following four stages:
 - Stage 1, compiling the Registered Aboriginal Parties (RAPs) – November 2014:
 - Letters to organisations in order to identify Aboriginal people and/or groups who hold cultural knowledge.
 - Notice in the Newcastle Herald
 - Letters to Aboriginal groups and people identified by the various organisations.
 - Stage 2, presenting information to the RAPs on the proposed project and seeking their preferred methods for the sharing of cultural information pertaining to the Subject Land – December 2014.
 - Stage 3, gathering information on the cultural significance of the Subject Land. The stakeholders did not disclose any information pertaining to sites or places of cultural significance associated with the historic or contemporary periods within the project area or surrounding area. However, it must be noted that traditional/cultural knowledge and/or information regarding sites and/or places of cultural significance may exist that were not divulged to MCH by those consulted.
 - Stage 3 – Site Survey – January 2015. All RAPs were invited to participate in a survey of the subject land.
 - Stage 4 – Copies of the draft ACHAR were provided to all RAPs for review and comment – February 2015.
 - Post EIS Consultation – In December 2016 a copy of the revised ACHAR was provided to the RAPs.
- The subject land is located on the outer edge of the Pleistocene aged inner barrier sand dunes, near the edge of the resource rich interbarrier depression.

- Given the distance from reliable water and associated resources it is likely the extraction area may have been used for short term camping, travel and or hunting and gathering, rather than long term camping, this view was supported by the registered Aboriginal Stakeholders.
- One previously identified site (38-4-1381), originally containing 66 artefacts (42 flake pieces, 16 flakes, four cores, one grinding stone and one ochre nodule), was relocated within the extraction area. The site showed motorbike tracks across it. The site was assessed as having poor integrity, low research potential and low scientific significance. No additional sites were identified.
- Due to the impacts of past and present land uses, no Potential Archaeological Deposits (PADs) were identified.
- Archaeological affects from the proposed quarry include the loss of the previously recorded site and modification of the landform from the removal of the majority of the existing sand dune.

3.3 (j) Other important or unique values of the environment

The Subject Land adjoins Tilligerry State Conservation Area (SCA), which occurs to the north-west of the Subject Land. Consultation with the National Parks and Wildlife Service section of the Office of Environment and Heritage was undertaken and it was determined that a 50 m buffer from the SCA should be adopted. This buffer distance was based on existing policy position and to avoid potential edge effects on vegetation communities and habitat.

The Subject Land, at its closest point is approximately 590 m north of the RAMSAR listed Hunter Wetlands National Park (Fullerton Cove). The proposed activity is not considered likely to affect this RAMSAR site on the following basis:

- The quarry is located on sands with a high vertical permeability and lower horizontal permeability that results in negligible water runoff and a high groundwater table.
- The quarry extraction limit is set to 0.7 m above the highest predicted water table, with reinstatement to a minimum of 1 m above that level (about 2 m above average).
- Controls required by the Hunter Water Corporation on account of the project being located partially over the Tomago Sand Beds provides a high level of protection to the underlying groundwater that flows on a low gradient toward Fullerton Cove.
- A very low topographical gradient between the Subject Land and Fullerton Cove ensures any surface runoff is highly unlikely to retain suspended sediment and reach Fullerton Cove.
- The predicted air quality and noise emissions and the proposed air quality and noise controls to protect the health and amenity of nearby residents ensures that Fullerton Cove will not be adversely affected by the project.

3.3 (k) Tenure of the action area (e.g. freehold, leasehold)

The Subject Land is freehold, under ownership by Port Stephens Shire Council. Williamtown Sand Syndicate will be operating the Quarry under a lease arrangement with council. Port Stephens Shire Council have also given their approval for the use of remaining area of the Subject Land as a offset area. Port Stephens Shire Council will establish a biobank site, and sell the credits to WSS for retirement.

3.3 (l) Existing uses of area of proposed action

The existing use of the area of the proposed action is limited, the Council tender process for the potential use of land for sand extraction commenced in 2012 and as such has not authorised the land for any purpose. It is noted that nearby residents use the land on occasion for recreation uses. Prior to the commencement of the tender process for a potential quarry the land was leased to a neighbouring landowner for livestock agistment.

3.3 (m) Any proposed uses of area of proposed action

The only proposed use is the activity that is the subject of this Referral

4 Environmental outcomes

The following table details the environmental outcomes that will be achieved for all MNES that were identified as occurring within the Subject Land (or assumed present in the case of New Holland Mouse), or that have the potential to be indirectly impacted on due to the proposed action.

Proposed Outcomes	How Outcome will be Achieved	Measuring and Monitoring Success of Outcome	Confidence in Achieving the Proposed Outcome
Wetlands of International Importance			
No impact on Hunter Estuary National Park (Ramsar Wetland) through modification of the groundwater due to the proposed action	<p>No groundwater extraction.</p> <p>Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained.</p> <p>Area has a very low hydraulic gradient with limited or no connected drainage from the Subject Land to Fullerton Cove.</p> <p>Protocols for the use of hydrocarbons on the project enforced by the Hunter Water Corporation due to location of Tomago Sand Beds.</p>	<p>Groundwater monitoring will be conducted throughout the life of the project. The groundwater model will be updated every two years.</p> <p>Erosion and sediment controls retain all runoff from the project within the subject land.</p>	Confidence of achieving the outcome is high. Constant monitoring and update of the groundwater model and the floor level of the extraction area will ensure the extraction level is adapted thought the life of the project.
Listed Threatened Species and Communities			
<p>Removal of 40.37 ha of vegetation that represents:</p> <ul style="list-style-type: none"> 40.37 ha of Koala habitat 40.24 ha of New Holland Mouse Habitat 40.37 ha of Grey-headed Flying-fox habitat 	The proposed extraction area will be cleared progressively. Prior to clearing the extraction area will delineated.	The extraction area boundary will be surveyed and delineated prior to clearing to ensure no accidental incursions.	Confidence of the clearing to be restricted to 40.37 ha is high as an accurate survey of the project boundary will be conducted prior to the commencement of clearing.
Retention of movement corridors within and through Subject Land	The proposed disturbance area has been reduced so that no areas of vegetation within the Subject Land area isolated, and movement and dispersal corridors are retained.	The extraction area boundary will be surveyed and delineated prior to clearing.	Confidence of achieving the outcome is high as the modified footprint is the only footprint be considered for approval. Additionally, the retained area of the Subject Land that facilitate the movement corridors will be protected in perpetuity under a biobanking agreement.

Proposed Outcomes	How Outcome will be Achieved	Measuring and Monitoring Success of Outcome	Confidence in Achieving the Proposed Outcome
Rehabilitation of native vegetation within the extraction area.	Rehabilitation will be conducted through combination of topsoil re-distribution and planting and seeding of locally endemic species, see the Environmental Management Plan (Response to Submissions Part 17 (Major Projects Website)).	Rehabilitation will be monitored for a period of eight years post completion. This will ensure suitable species mix is achieved.	Confidence of achieving the outcome is high. Previous rehabilitation following sand mining has been shown to be successful (e.g. Sibelco). The rehabilitation plan for the site has been prepared, and forms part of the site's Environmental Management Plan. Adherence to this plan will be required under State Legislation approval.
Protection and enhancement of threatened species and their habitat within offset areas.	<p>A total of 130.14 ha of native vegetation will be protected and enhanced on-site through the establishment of a biobank site. The biobank will include:</p> <ul style="list-style-type: none"> • 104.78 ha of Koala habitat • 74.90 ha of New Holland Mouse Habitat • 130.14 ha of Grey-headed Flying-fox foraging habitat • 1,641 <i>Eucalyptus camfieldii</i> individuals • 634 <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> individuals • 102 <i>Grevillea parviflora</i> subsp. <i>parviflora</i> individuals <p>A further 75 - 100 ha will be secured off-site (to satisfy the additional 580 - 690 ecosystem credits and 306 Koala credits required to satisfy State Approval requirements). This site will also be protected through the establishment of a biobank site.</p> <p>Habitat will be enhanced through management actions implemented as part of the biobank agreements.</p>	Monitoring and reporting as part of the biobanking agreement will be conducted to ensure targets are achieved.	Confidence level of achieving the outcome is high as land will be secured under a biobanking agreement.
Reduced impacts on native fauna species through implementation of a vertebrate pest control program	The program will be implemented, as detailed in the Environmental Management Plan (Response to Submissions Part 17 (Major Projects Website)). This will involve monitoring and implementation of shooting, trapping and/ or baiting programs, as required.	Monitoring will be conducted as part of the control program.	
Koala			
No net loss of Koala habitat due to the proposed action	Progressive rehabilitation of the disturbance area with preferred and supplementary Koala habitat.	Rehabilitation will be monitored for a period of eight years post completion. This will ensure suitable species mix is achieved.	Confidence of achieving the outcome is high. Previous rehabilitation following sand mining has been shown to be successful (e.g. Sibelco). The rehabilitation plan for the site has been prepared, and forms part of the site's Environmental Management Plan. Adherence to this plan will be required under State Legislation approval.
	Gain in Koala habitat due to planting of a preferred feed tree species, <i>Eucalyptus robusta</i> , within disturbed areas of offset.	Area of supplementary planting within the offset (on-site biobank) will be monitored as part of the biobanking agreement to ensure targets are achieved.	Confidence of achieving the outcome is high as the action will be a requirement of the biobanking agreement for the site. As such, funding for the work will be secured and external audits on the action will be conducted.

Proposed Outcomes	How Outcome will be Achieved	Measuring and Monitoring Success of Outcome	Confidence in Achieving the Proposed Outcome
Limit potential vehicle strikes along Cabbage Tree Road and within the Subject Land.	A Koala exclusion fence will be installed along the properties frontage with Cabbage Tree Road. The fence will continue along internal access roads with a speed limit is 40 km/hr.	The fence will be monitored using remote cameras and inspected to identify maintenance requirements.	High confidence as the fencing will be installed in accordance with the <i>Koala Sensitive Design Guideline</i> (DEHP 2012).
Camfield's Stringybark and Earp's Gum			
Removal of 230 individuals of <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> individuals	The surveys across the extraction area (and its immediate surrounds) were conducted by a series of parallel transects which covered the entire extraction area. The surveys were conducted by individuals who were confident in identification of the two species, and the location of each individual was recorded using a hand-held GPS (accurate to 2 – 5 m).	The extraction area boundary will be surveyed and delineated prior to clearing to ensure no accidental incursions.	The confidence of achieving the removal of only 230 <i>E. parramattensis</i> subsp. <i>decadens</i> and 227 <i>E. camfieldii</i> individuals is moderate to high. It is believed that the surveys conducted across the extraction area were sufficient and conducted by individuals with sufficient knowledge. There is some inherent inaccuracy in the method of collecting the location of each individual (i.e. GPS error of 2 – 5 m).
No net loss of <i>Eucalyptus camfieldii</i> due to the proposed action.	<i>Eucalyptus camfieldii</i> will be used within seed mix for the rehabilitation of the disturbance area and monitoring will indicate the rate at which the species is establishing.	Monitoring will be used to estimate the density of the species across the rehabilitation and ensure all individuals removed are replaced post activity.	Confidence of achieving the outcome is high. The species has been included in the rehabilitation plan for the site. This plan forms part of the sites Environmental Management Plan and adherence to this plan will be required under State Legislation approval. Additionally, the individuals within the proposed extraction area occur within an area of rehabilitated vegetation. As such there is confidence in the successful rehabilitation of the species as part of the proposed action.
Migratory Species			
Eastern Osprey and Rufous Fantail			
Removal of 40.37 ha of vegetation that represents: <ul style="list-style-type: none"> 40.37 ha of Eastern Osprey habitat 0.13 ha of Rufous Fantail Habitat 	The proposed extraction area will be cleared progressively. Prior to clearing the extraction area will delineated.	The extraction area boundary will be surveyed and delineated prior to clearing to ensure no accidental incursions.	Confidence of the clearing to be restricted to 40.37 ha is high as an accurate survey of the project boundary will be conducted prior to the commencement of clearing.
Protection and enhancement of migratory species habitat within offset areas.	A total of 130.14 ha of native vegetation will be protected and enhanced on-site through the establishment of a biobank site. The biobank will include: <ul style="list-style-type: none"> 101.02 ha of Eastern Osprey habitat 40.13 ha of Rufous Fantail Habitat Habitat will be enhanced through management actions implemented as part of the biobank agreements.	Monitoring and reporting as part of the biobanking agreement will be conducted to ensure targets are achieved.	Confidence level of achieving the outcome is high as land will be secured under a biobanking agreement.

Proposed Outcomes	How Outcome will be Achieved	Measuring and Monitoring Success of Outcome	Confidence in Achieving the Proposed Outcome
Migratory Species with Habitat in Fullerton Cove			
No impact on migratory species habitat through modification of the groundwater due to the proposed action	<p>No groundwater extraction.</p> <p>Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained.</p> <p>Area has a very low hydraulic gradient with limited or no connected drainage from the Subject Land to Fullerton Cove.</p> <p>Protocols for the use of hydrocarbons on the project enforced by the Hunter Water Corporation due to location of Tomago Sand Beds.</p>	<p>Groundwater monitoring will be conducted throughout the life of the project. The groundwater model will be updated every two years.</p> <p>Erosion and sediment controls retain all runoff from the project within the subject land.</p>	Confidence of achieving the outcome is high. Constant monitoring and update of the groundwater model and the floor level of the extraction area will ensure the extraction level is adapted thought the life of the project.

5 Measures to avoid or reduce impacts

5.1 Mitigation Measures

Identification of the potential impacts, a risk assessment for each impact and the management and control measures which have been implemented to minimise the impacts on MNES, are outlined in the table. Details on the management and control measures are outlined in the relevant sections of the Environmental Management Plan (EMP) (Response to Submission Part 17 (Major Projects Website)) (referenced in Table 5). The risk of the impacts were evaluated using the methodology (matrix) detailed in Section 4 of the Department of the Environment Environmental Management Plan Guidelines (2014). The impacts of the proposed action have been fully described and assessed as part of the Referral documentation for the proposed action.

The following mitigation measures form part of the Environmental Management Plan for the proposed action, which is required under the State Legislation approval. As such, the proponent is fully committed to undertaking these mitigation measures and they will form part of the proposed action through adherence to the plan throughout the life of the action. Monitoring and reporting is also required under the EMP, these details are set-out within that document.

Threats to MNES	Potential Impacts	Management and Control Measures	Risk Assessment (after controls are implemented)
Wetlands of International Importance			
Impact area occurs approximately 590 m upstream of the Hunter Estuary Wetlands.	No direct impacts, potential for downstream impacts if any modification of groundwater hydrology due to proposed action.	<ul style="list-style-type: none"> Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained (See Section Error! Reference source not found. of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Minor).
Listed Threatened Species and Ecological Communities			
Threatened Birds: <ul style="list-style-type: none"> Regent Honeyeater Swift Parrot 	Clearing of suitable foraging habitat	<ul style="list-style-type: none"> Retention of corridors. Rehabilitation of extraction area (see Section Error! Reference source not found.) 	Moderate (Likelihood: Highly Likely/ Consequence: Minor).

Threats to MNES	Potential Impacts	Management and Control Measures	Risk Assessment (after controls are implemented)
<ul style="list-style-type: none"> Australasian Bittern Wading Birds with habitat in Fullerton Cove 	Increase risk of Psittacine Beak and Feather Disease (PBFD) through release of rehabilitated parrot species.	<ul style="list-style-type: none"> Clearing procedures, including pre-clearing surveys and habitat tree felling procedures will be followed to limit impacts on local fauna species (see Section Error! Reference source not found. of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Moderate).
	Introduction of Myrtle Rust of <i>Phytophthora cinnamomi</i> which could impact on habitat	<ul style="list-style-type: none"> All machinery will be free of soil and organic matter prior to entering the extraction area (see Section Error! Reference source not found. of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Moderate).
	Indirect impacts on habitat through modification of groundwater hydrology	<ul style="list-style-type: none"> Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained (See Section 5.8 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Minor).
	No direct impacts, potential for downstream impacts if any modification of groundwater hydrology due to proposed action.		
Threatened Mammals: <ul style="list-style-type: none"> Spotted-tail Quoll Koala Long-nosed Potoroo New Holland Mouse Grey-headed Flying-fox 	Clearing of suitable habitat will impact on any potentially occurring threatened mammal species during clearing and from habitat loss.	<ul style="list-style-type: none"> Koala protocol, if any individuals are identified during clearing (see Section 5.18 of the EMP). Retention of corridors. Rehabilitation of extraction area (see Section Error! Reference source not found.). Clearing procedures, including pre-clearing surveys and habitat tree felling procedures will be followed to limit impacts on local fauna species (see Section 5.18 of the EMP). 	Moderate (Likelihood: Highly Likely/ Consequence: Minor).
	Removal of habitat trees (relevant to Spotted-tail Quoll).	<ul style="list-style-type: none"> Habitat tree felling procedures and installation of nesting boxes (see Section 5.18 of the EMP). 	Moderate (Likelihood: Highly Likely/ Consequence: Minor).
	Indirect impacts on habitat through modification of the groundwater hydrology	<ul style="list-style-type: none"> Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained (See Section 5.8 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Minor).
	Ingestion of 1080 poison, which will be used as part of vertebrate pest control program.	<ul style="list-style-type: none"> Any use of 1080 poison as part of the proposed action will be used in accordance with Commonwealth guidelines (see Section 5.6 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Moderate).
	Impacts from Chlamydia, induced from stress (relevant to Koala).	<ul style="list-style-type: none"> Clearing procedures, including pre-clearing surveys and habitat tree felling procedures will be followed to limit impacts on local fauna species (see Section 5.18 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Moderate).
	Modification of habitat from impacts from Myrtle Rust and <i>Phytophthora cinnamomi</i>	<ul style="list-style-type: none"> All machinery will be free of soil and organic matter prior to entering the extraction area (see Section 5.5 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Moderate).

Threats to MNES	Potential Impacts	Management and Control Measures	Risk Assessment (after controls are implemented)
	Increased vehicle activity along Cabbage Tree Road	<ul style="list-style-type: none"> The proposed action will implement a recognised mitigation measure with a high effectiveness, through the installation of Koala proof fencing along Cabbage Tree Road and along internal roads with speed limits above 40 km/ hour (Section 5.3 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Moderate).
Threatened Flora: <ul style="list-style-type: none"> <i>Commersonia prostrata</i> <i>Eucalyptus camfieldii</i> <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> <i>Grevillea parviflora</i> subsp. <i>parviflora</i> <i>Persicaria elatior</i> 	Clearing of individuals (<i>E. camfieldii</i> and <i>E. parramattensis</i> subsp. <i>decadens</i>) and suitable habitat	<ul style="list-style-type: none"> Retention of corridors. Clear delineation of clearing boundary (see Section 5.18 of the EMP). Rehabilitation of extraction area (with <i>Eucalyptus camfieldii</i> (see Section 5.18 of the EMP). 	Moderate (Likelihood: Highly Likely/ Consequence: Minor).
	Indirect impacts on habitat and retained individuals through modification of the groundwater hydrology	<ul style="list-style-type: none"> Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained (See Section 5.8 of the EMP Error! Reference source not found.). 	Low (Likelihood: Unlikely/ Consequence: Minor).
	Impacts on retained individuals from Myrtle Rust and <i>Phytophthora cinnamomi</i>	<ul style="list-style-type: none"> All machinery will be free of soil and organic matter prior to entering the extraction area (see Section 5.5 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Moderate).
Listed Migratory Species			
<ul style="list-style-type: none"> Eastern Osprey Rufous Fantail 	Clearing of suitable habitat	<ul style="list-style-type: none"> Retention of corridors. Rehabilitation of extraction area (see Section 5.18 of the EMP). 	Moderate (Likelihood: Highly Likely/ Consequence: Minor).
	Indirect impacts on habitat through modification of groundwater hydrology	<ul style="list-style-type: none"> Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained (See Section 5.8 of the EMP). 	Low (Likelihood: Unlikely/ Consequence: Minor).
Snipe Species			
Migratory species with Habitat in Fullerton Cove	No direct impacts, potential for downstream impacts if any modification of groundwater hydrology due to proposed action.		

The residual impacts on the proposal include the clearing of 40.37 ha of native vegetation which includes:

- 40.37 ha of Koala habitat
- 40.24 ha of New Holland Mouse Habitat
- 40.37 ha of Grey-headed Flying-fox habitat
- 227 individuals of *Eucalyptus camfieldii*
- 230 individuals of *Eucalyptus parramattensis* subsp. *decadens*

These residual impacts have been offset as part of the offset package proposed to satisfy the State Legislation requirements. The details of the offset package have been detailed below. Additionally, the offsets have been assessed against the EPBC Act offset assessment guide.

5.2 Offset Strategy

A biodiversity offset strategy for the Cabbage Tree Road Sand Quarry (Response to Submissions Part 3 (Major Projects Website)). To determine the offset requirements of the proposal for the State Approval Process, the assessment was conducted in accordance with the Biobanking Assessment Methodology (BBAM) 2014 (OEH 2014) and the *NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and Stage Significant Infrastructure (SSI) Projects* (OEH 2011).

The total area of the Subject Land is 176.12 ha. The development site (42.25 ha) is located in the western and central parts of the Subject Land, within the areas of higher elevation. This impact area is inclusive of all extraction and operational areas that would be impacted by the proposal. The majority of the development site is within Lot 1 in DP224587, with a small area extending through the central portions of Lot 121 in DP 556403 and Lot 11 in DP 629503. It is proposed that the majority of the land not subject to development be secured as a biobank site. The proposed biobank is 131.12 ha and occupies the majority of the remaining areas of the Subject Land (130.14 ha of native vegetation and 0.99 ha cleared tracks). There is a small area of exotic vegetation (1.26 ha) in the south east corner of the Subject Land and a small strip of land along the south-western boundary (1.46 ha), both of which have been excluded from the proposed biobank, see Figure 2 in the Offset Strategy (Response to Submissions Part 3 (Major Projects Website)).

An assessment of the development site and biobank site was undertaken in accordance with the BBAM 2014. The assessment determined that the impact at the development site requires a total of 2,207 ecosystem credits for impact on HU860 and 17,479 *Eucalyptus camfieldii*, 3,220 *Eucalyptus parramattensis* subsp. *decadens*, 525 Eastern Osprey, 1,050 Koala and 9 Wallum Froglet species credits. The assessment determined that the biobank site would generate a total of 1,189 ecosystem credits, and 11,651 *Eucalyptus camfieldii*, 4,501 *Eucalyptus parramattensis* subsp. *decadens*, 724 *Grevillea parviflora* subsp. *parviflora*, 717 Eastern Osprey, 744 Koala and 606 Wallum Froglet species credits.

The following table summarises the credits generated at the impact site and the credits that will be retired at the biobank to fulfil, or partially fulfil these credit requirements.

Credit Type	Credits Requirements (Impact Site)	Credits at the Biobank: To be Retired (% of credit requirement meet)	
HU860 Ecosystem Credits	2,207	HU860	273
		HU851	311
		HU917	80
		HU965	22
		HU938	388
		HU948	115
		Total	1,189 (54% of credits required)
<i>Eucalyptus camfieldii</i>	17,479	<i>Eucalyptus camfieldii</i>	11,651
		<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	1,281
		<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	724
		Total	13,656 (78% of credits required)
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	3,220	3,220 (100% of credits required)	
Eastern Osprey	525	717 (137% of credits required)	
Koala	1,050	744 (71% of credits required)	
Wallum Froglet	9	606 (6,733% of credits required))	

It is proposed to retire all ecosystem credits created at the biobank site (total 1,189 ecosystem credits), as per variation criterion (f) for mitigated net loss (tier 3) under the Interim Policy, to partially fulfil the ecosystem credit requirements at the development site, this would fulfil 54% of the ecosystem credit requirements. This variation criterion allows for conversion of ecosystem credits to a regional conservation priority as identified in a regional conservation plan or similar. The proposed biobank is of high conservation value due to its location, as it occurs adjacent to Tilligerry SCA, proposed Hunter Water biobank sites and mapped fauna habitat and corridors; quality of vegetation, as it supports moderate to good vegetation that is predominantly old-growth; and the presence of threatened species and ecological communities within the site.

Williamtown Sand Syndicate are committed to retiring between 80% - 85% of the required ecosystem credits for the development, utilising the ecosystem credits generated at the on-site biobank and additional credits available at a potential off-site biobank located to the east of Williamtown Airport. The retirement of this proportion of ecosystem credits is considered adequate for the proposed development, given that the impact area predominantly contains rehabilitated or regenerating vegetation (54% of the impact area), and the majority of the vegetation within the on-site and potential off-site biobank sites is

old-growth forest. Additionally, both the on-site and potential offsite biobanks contain a threatened ecological community (Swamp Sclerophyll Forest) and multiple threatened species (based on historical records).

The biobank site fulfils the species credit requirements for impacts on *Eucalyptus parramattensis* subsp. *decadens*, Eastern Osprey and Wallum Froglet. The biobank site does not generate enough species credits for *Eucalyptus camfieldii*, with a shortfall of 5,828 species credits, and the Koala, with a shortfall of 306 species credits.

The biobank fulfils 67% of the species credits required for *Eucalyptus camfieldii* at the development site. As such it is proposed to apply Variation Criteria (B) – Convert one type of species credit to another type of species credit with the same or more endangered conservation status, under Tier 3: Negotiation a “Mitigated Net Loss Outcome” of the OEH Interim Policy (OEH 2011). There are residual species credits generated at the Biobank site for *E. parramattensis* subsp. *decadens* (1,281) and *G. parviflora* subsp. *parviflora* (724). As such the total number of species credits available at the biobank to offset impacts on *E. camfieldii* at the development site is 13,656 (78% of the required 17,479 credits). The fulfilment of 78% of the required *E. camfieldii* species credits is considered adequate. As the majority of the *E. camfieldii* within the development site is part of a planted (rehabilitated) population, it is highly unlikely that the species would have been present in this area prior to rehabilitation. Additionally, the species will be replanted within the rehabilitation area, as it will represent potential habitat for the species due to the lower elevation of the final landform. Furthermore, there are additional species credits generated at the biobank for both the Eastern Osprey and Wallum Froglet. While these fauna species credits may not directly transfer to offset impacts against *E. camfieldii*, WSS propose to retire these credits as part of the offset package for the development.

Williamstown Sand Syndicate are committed to retiring the remaining 306 Koala species credits at an off-site offset within the Tomago Sandbeds KMU. Williamstown Sand Syndicate are currently investigating potential freehold land to the east of Williamstown Airport to establish a biobank. Based on a desktop assessment, the land contains preferred and supplementary Koala habitat and could potential fulfil the remaining Koala credit requirements, within the Tomago Sandbeds KMU.

Specific management actions proposed for the biobank site to address each of the standard and relevant additional management actions listed under BBAM 2014 have also been outlined in this report to enable retirement of ecosystem and species credits. Key management actions include weed control, vertebrate pest control, installation and maintenance of fencing and signage, preparation and implementation of a fire management plan, and erosion and sediment control.

5.2.1 EPBC Act Offset Assessment Guide

An assessment of the suitability of the offset package proposed to fulfil the State Legislation requirements has been assessed in the following sections against the EPBC Act offset assessment guide. This has been conducted for species that were identified (or assumed present, in the case of the New Holland Mouse) within the Subject Land and have the potential to be impacted on by the proposed action.

Koala

Impact Calculator

The proposed action will impact on a total of 40.37 ha of Koala habitat. The site has been assessed as containing habitat with a value of 7, based on the Koala habitat assessment tool detailed in the *EPBC Act Referral Guidelines for the Vulnerable Koala Combined populations of Queensland, New South Wales and the Australian Capital Territory*.

The output from the calculator determined that the total quantum of impact (adjusted hectares) is 28.26 ha.

Offset Calculator

Start Area and Quality of Habitat

The proposed offset area is 130.14 ha, of which 104.78 ha represents suitable Koala habitat, including; Swamp Mahogany – Paperbark Swamp Forest (remnant and regenerating), Tomago Sand Swamp Woodland, Coastal Sand Apple – Blackbutt Forest (Remnant, Regenerating and Rehabilitation) and Coastal Sand Wallum Woodland-Heath.

An assessment of the Koala habitat with the proposed on-site offset against the Koala habitat assessment tool within the *EPBC Act Referral Guidelines for the Vulnerable Koala Combined populations of Queensland, New South Wales and the Australian Capital Territory* is provided in the table below.

Attribute	Score	Discussion
Koala Occurrence	+1	<ul style="list-style-type: none"> EPBC PMST report identified the species or species habitat known to occur in area. The species was identified within the southern portion of the Subject Land (outside the extraction area) during surveys in 2011. No evidence of the species was identified within the extraction area (or the Subject Land) during surveys in 2015, however this is likely due to impacts from the 2013 bushfire. Post-2013 bushfire, there are seven records of the species within 5 km of the Subject Land (within the KMU).
Vegetation Composition	+2	<ul style="list-style-type: none"> The vegetation associations in the extraction area have been mapped as either preferred or supplementary habitat (as defined by the CKPoM; PSC 2002). The rehabilitation area was defined as preferred habitat due to the occurrence of

Attribute	Score	Discussion
		<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> and <i>Eucalyptus signata</i> , while the remnant forest is classified as supplementary habitat.
Habitat Connectivity	+2	<ul style="list-style-type: none"> The extraction area is connected to a large expanse of vegetation (>500 ha) to the north of the Subject Land.
Key Existing Threats	+1	<ul style="list-style-type: none"> Vehicle strikes and dog attacks have been identified as a key threat to the Port Stephens population. The exact level of vehicle strikes and dog attacks in the area is not known. However, evidence of dogs (tracks) was observed within the Subject Land along the access track that runs through the extraction area.
Recovery Value	+1	<ul style="list-style-type: none"> Uncertain whether the habitat is important for achieving the interim recovery objectives, as it is not known if the habitat is: Of sufficient size to be genetically robust/operate as a viable sub-population, or Free of disease or have low incidence of disease, or Breeding.
Total Score	7	

The offset site was assessed as containing habitat with a value of 7. As the areas of Swamp Mahogany – Paperbark Swamp Forest (Regenerating) and Coastal Sand Apple – Blackbutt Forest (Regenerating) currently only contain scattered canopy trees (total of 17.28 ha of the offset area – 16%), the habitat quality of the offset area was revised to 6 for the offset assessment guide.

The future quality of the habitat without the offset was assessed as declining slightly to a score of 5. Any future development that may occur within or surrounding the land has the potential to degraded that habitat on site. The future quality of the habitat with the offset, is likely to increase due to management actions to a score of 8. This will be achieved through planting of preferred feed trees, weed control, pest control and maintaining connectivity.

Time Over Which Loss is Averted

As the proposed offset will be secured under a biobanking agreement (in-perpetuity measure), the maximum timeframe of 20 years was used.

Time Until Ecological Benefit

The majority of the offset area contains remnant vegetation with few management issues, as such the time until ecological benefit is only the time taken to establish and implement the biobanking agreement. As all offsets will be secured prior to the commencement of the activity, for the majority of the site the ecological benefit will be immediate. For the 17.28 ha of regenerating vegetation (16% of the offset site), rehabilitation works (tree planting) and natural regeneration of the canopy are required to achieve ecological benefits. These works could take up to 20 years for benefits to be realised. As such, within the offset assessment guide, a timeframe of 10 years has been input.

Risk of Loss

The land proposed for the offset is currently zoned RU2 – Rural Landscape, and as such has the potential to be subdivided into a maximum of four allotments and subject to separate ownership and management. Due to ecological constraints within the offset area (low lying land, threatened species and ecological communities) it is unlikely that the whole offset area would be lost. However, the site constraints would not limit the installation of rural fencing and infrastructure, and access tracks. Additionally, the environmental compliance record of the individual owners cannot be assured. As such the risk of loss without the offset was assessed as 50%.

The risk of loss with the offset is very low due to the mechanism that will be implemented to secure the land (biobank agreement). However, the risk of loss cannot be 100% guaranteed, due to potential for boundary encroachment, policy/legislation changes, as such the risk of loss with the offset is assessed as 5%.

Confidence in Result

A confidence level of 95% was given to both the change in habitat quality and averted loss components.

All management actions required to be implemented as part of the offset will be incorporated into biobanking agreement. The targets of the biobanking agreement will be monitored and reported to the State Government (OEH), and audits by the State Government are conducted as part of the biobank agreement.

The confidence in the averted loss is also due to the implementation of a biobank agreement over the site, which is the State Governments preferred offsetting mechanism. The potential for loss of the land once the biobank agreement is enacted is low due to the legislative protection the mechanism provides.

Net Present Value

The net present value output from the offset assessment guide was 49.07 ha, which offsets 173.63% of the impacts. As such the minimum 90% direct offsets requirement is met for the species.

New Holland Mouse

Impact Calculator

The proposed action will impact on a total of 40.24 ha of New Holland Mouse habitat. The habitat quality within the impact area was assessed as 10. The vegetation within the impact area was assessed as high quality due to the time since fire; three years (fire in October 2013). Abundance of the species has been shown to peak in vegetation three to five years post fire event. As such the total quantum of impact (adjusted hectares) is 40.24 ha.

Offset Calculator

Start Area and Quality of Habitat

The proposed offset area is 130.14 ha, of which 74.90 ha represents suitable New Holland Mouse habitat, including; Coastal Sand Apple – Blackbutt Forest (Remnant, Regenerating and Rehabilitation), Coastal Sand Wallum Woodland-Heath, Tomago Sand Swamp Woodland and Tomago Sand Swamp Heath.

The offset site was assessed as containing habitat with a value of 10, due to the time since fire (as outlined above).

The future quality of the habitat without the offset was assessed as declining to a score of 5, while the future quality of the habitat with the offset was assessed as 8. These scores were primarily given due to the potential for fire events within the offset area and their frequency. Without the offset site, it cannot be certain that wild fires will create suitable habitat into the future. While with the offset, implementation of prescribed burns will form part of the management actions required as part of the biobank. Planning and management of fires within the site, in conjunction with adjacent land holders, and in consideration of threatened species requirements will ensure that at times into the future suitable habitat for the New Holland Mouse will be present. A score of 8 was given as highly optimal habitat (vegetation 3 to 5 years post fire) cannot be maintained within the offset area at all times. As such habitat quality for the species will vary over time in conjunction with the fire regime.

Time Over Which Loss is Averted

As the proposed offset will be secured under a biobanking agreement (in-perpetuity measure), the maximum timeframe of 20 years was used.

Time Until Ecological Benefit

The majority of the offset area contains remnant vegetation with few management issues, as such the time until ecological benefit is only the time taken to establish and implement the biobanking agreement. As all offsets will be secured prior to the commencement of the activity, for the New Holland Mouse habitat within the site the ecological benefit will be immediate. As such, within the offset assessment guide, a timeframe of 1 year has been input.

Risk of Loss

The land proposed for the offset is currently zoned RU2 – Rural Landscape, and as such has the potential to be subdivided into a maximum of four allotments and subject to separate ownership and management. Due to ecological constraints within the offset area (low lying land, threatened species and ecological communities) it is unlikely that the whole offset area would be lost. However, the site constraints would not limit the installation of rural fencing and infrastructure, and access tracks. Additionally, the environmental compliance record of the individual owners cannot be assured. As such the risk of loss without the offset was assessed as 50%.

The risk of loss with the offset is very low due to the mechanism that will be implemented to secure the land (biobank agreement). However, the risk of loss cannot be 100% guaranteed, due to potential for boundary encroachment, policy/legislation changes, as such the risk of loss with the offset is assessed as 5%.

Confidence in Result

A confidence level of 95% was given to both the change in habitat quality and averted loss components.

All management actions required to be implemented as part of the offset will be incorporated into biobanking agreement. The targets of the biobanking agreement will be monitored and reported to the State Government (OEH), and audits by the State Government are conducted as part of the biobank agreement.

The confidence in the averted loss is also due to the implementation of a biobank agreement over the site, which is the State Government's preferred offsetting mechanism. The potential for loss of the land once the biobank agreement is enacted is low due to the legislative protection the mechanism provides.

Net Present Value

The net present value output from the offset assessment guide was 35.26 ha, which offsets 87.63% of the impacts. The offset area is slightly below the minimum of 90% direct offsets requirement for the species. While the direct offsets proposed for this species do not meet the minimum 90% requirement, it should be noted that the disturbance area will be progressively rehabilitated with native vegetation. This rehabilitation will in future represent optimal habitat for the species (peak activity in rehabilitation shown to be eight to nine years post topsoil replacement).

Grey-headed Flying-fox

Impact Calculator

The proposed action will impact on a total of 40.37 ha of Grey-headed Flying-fox habitat. The habitat quality within the impact area was assessed as 8. While there is a large area of available foraging habitat, the impact area lacks winter flowering

Eucalypts species (e.g. *Eucalyptus robusta*) and fruit resources. The output from the calculator determined that the total quantum of impact (adjusted hectares) is 32.30 ha.

Offset Calculator

Start Area and Quality of Habitat

The proposed offset area is 130.14 ha, all of which represents suitable foraging habitat for the species. The offset site was assessed as containing habitat with a value of 9. The offset area contains a range of Eucalypt species, including the winter flowering *E. robusta*, but lacks any fruit resources.

The future quality of the habitat both with and without the offset was assessed as 9. While the area of habitat may change without offsetting (due to potential development), it is unlikely that the quality of habitat for the species would change. While the proposed management actions would increase the quality of the vegetation in general, they are unlikely the impact on the quality of the habitat for the Grey-headed Flying-fox as resources are unlikely to be affected by the proposed management (slight increase in tree number due to planting, but not assessed as large enough to increase score).

Time Over Which Loss is Averted

As the proposed offset will be secured under a biobanking agreement (in-perpetuity measure), the maximum timeframe of 20 years was used.

Time Until Ecological Benefit

The majority of the offset area contains remnant vegetation with few management issues, as such the time until ecological benefit is only the time taken to establish and implement the biobanking agreement. As all offsets will be secured prior to the commencement of the activity, for the New Holland Mouse habitat within the site the ecological benefit will be immediate. As such, within the offset assessment guide, a timeframe of 1 year has been input.

Risk of Loss

The land proposed for the offset is currently zoned RU2 – Rural Landscape, and as such has the potential to be subdivided into a maximum of four allotments and subject to separate ownership and management. Due to ecological constraints within the offset area (low lying land, threatened species and ecological communities) it is unlikely that the whole offset area would be lost. However, the site constraints would not limit the installation of rural fencing and infrastructure, and access tracks. Additionally, the environmental compliance record of the individual owners cannot be assured. As such the risk of loss without the offset was assessed as 50%.

The risk of loss with the offset is very low due to the mechanism that will be implemented to secure the land (biobank agreement). However, the risk of loss cannot be 100% guaranteed, due to potential for boundary encroachment, policy/legislation changes, as such the risk of loss with the offset is assessed as 5%.

Confidence in Result

A confidence level of 95% was given to both the change in habitat quality and averted loss components.

All management actions required to be implemented as part of the offset will be incorporated into biobanking agreement. The targets of the biobanking agreement will be monitored and reported to the State Government (OEH), and audits by the State Government are conducted as part of the biobank agreement.

The confidence in the averted loss is also due to the implementation of a biobank agreement over the site, which is the State Government's preferred offsetting mechanism. The potential for loss of the land once the biobank agreement is enacted is low due to the legislative protection the mechanism provides.

Net Present Value

The net present value output from the offset assessment guide was 48.11 ha, which offsets 148.97% of the impacts. As such the minimum 90% direct offsets requirement is met for the species.

Eucalyptus camfieldii* and *Eucalyptus parramattensis* subsp. *decadens

Impact Calculator

The proposed action will impact on a total of 227 *Eucalyptus camfieldii* individuals and 230 *Eucalyptus parramattensis* subsp. *decadens* individuals.

Offset Calculator

Start Value

The proposed offset area includes a total of 1,641 *Eucalyptus camfieldii* individuals and 634 *Eucalyptus parramattensis* subsp. *decadens* individuals.

Time Until Ecological Benefit (Time Horizon)

The majority of the offset area contains remnant vegetation with few management issues, as such the time until ecological benefit is only the time taken to establish and implement the biobanking agreement. As all offsets will be secured prior to the commencement of the activity within the offset assessment guide, a timeframe of 1 year has been input for both species.

Future Value Without Offset

The land proposed for the offset is currently zoned RU2 – Rural Landscape, and as such has the potential to be subdivided into a maximum of four allotments and subject to separate ownership and management. Due to ecological constraints within the

offset area (low lying land, threatened species and ecological communities) it is unlikely that the whole offset area would be lost. However, the site constraints would not limit the installation of rural fencing and infrastructure, and access tracks. Additionally, the environmental compliance record of the individual owners cannot be assured. As such the risk of loss without the offset which was assessed as a potential 50% population reduction. A future value without offset of 820 individuals for *Eucalyptus camfieldii* and 317 individuals for *Eucalyptus parramattensis* subsp. *decadens* was input into the calculator.

Future Value with Offset

The future value with offset has been input as 1,641 for *Eucalyptus camfieldii* and 634 for *Eucalyptus parramattensis* subsp. *decadens*. No increase in the population has been assumed (over the 20-year period), due to the slow growing nature of these species (tree species).

Confidence in Result

A confidence level of 95% was given to level of certainty about the success of the proposed offset. All management actions required to be implemented as part of the offset will be incorporated into biobanking agreement. The targets of the biobanking agreement will be monitored and reported to the State Government (OEH), and audits by the State Government are conducted as part of the biobank agreement

Net Present Value

The net present value output from the offset assessment guide for *E. camfieldii* was 778.39, which offsets 342.90% of the impacts on the species. The net present value output from the offset assessment guide for *E. parramattensis* subsp. *decadens* is 300.55 individuals, which offsets 130.67% of the impacts on the species. As such the minimum 90% direct offsets requirement is met for both these species.

6 Conclusion on the likelihood of significant impacts

6.1 Do you THINK your proposed action is a controlled action?

X	No, complete section 5.2
	Yes, complete section 5.3

6.2 Proposed action IS NOT a controlled action.

The proposed action is not considered to be a controlled action as it will not have a significant impact on any MNES, as:

- Koala:
 - The proposed action will impact on 40.38 ha of habitat for the species. This represents a small proportion of the available preferred (1.01%) and supplementary (0.78%) habitat within the Tomago Sandbeds KMU.
 - Mitigation measures will be implemented as part of the project's Environmental Management Plan to reduce impacts on the species within the Subject Land (pre-clearing surveys, tracking of any identified Koala's, Koala proof fencing along Cabbage Tree Road and internally along access roads and vertebrate pest control program).
- New Holland Mouse:
 - The proposed action will impact on 40.24 ha of suitable habitat for the species. This represents a small proportion of the suitable habitat in the locality, approximately 2.6% of the area recently burnt by fire in 2013.
- Grey-headed Flying-fox:
 - No camp sites were identified in the Subject Land.
 - The proposed action will impact on 40.38 ha of suitable habitat for the species. This is unlikely to be a significant impact on the species due to the large amount of foraging habitat in the locality (Tilligerry SCA). Additionally, there will only be a minor impact (0.13 ha) to areas containing the winter flowering species *Eucalyptus robusta*, with a large area (40.13 ha) retained within the offset area.
- *Eucalyptus camfieldii*:
 - The proposed action will impact on approximately 10% of the individuals within the locality.
 - There will be no net loss of the species within the Subject Land as the species will be utilised within the rehabilitation of the proposed extraction area.
- *Eucalyptus parramattensis* subsp. *decadens*:
 - The proposed action will remove approximately 230 individuals from the extraction area, which represents a small proportion, 0.57%, of the local population.
- Eastern Osprey:
 - The proposed action will not impact on an ecologically significant proportion of the population or substantially impact on the species habitat.
- Rufous Fantail:
 - The proposed action will not impact on an ecologically significant proportion of the population or substantially impact on the species habitat.

Additionally, the proposed offset strategy was assessed as exceeding the EPBC Act offset assessment guide requirement of minimum 90% direct offset for all species (listed above), except the New Holland Mouse which under the proposed offset strategy

6.3 Proposed action IS a controlled action

Matters likely to be significantly impacted

	World Heritage values (sections 12 and 15A)
	National Heritage places (sections 15B and 15C)
	Wetlands of international importance (sections 16 and 17B)
	Listed threatened species and communities (sections 18 and 18A)
	Listed migratory species (sections 20 and 20A)
	Protection of the environment from nuclear actions (sections 21 and 22A)
	Commonwealth marine environment (sections 23 and 24A)
	Great Barrier Reef Marine Park (sections 24B and 24C)
	A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)

Protection of the environment from Commonwealth actions (section 28)

Commonwealth Heritage places overseas (sections 27B and 27C)

7 Environmental record of the person proposing to take the action

	Yes	No
7.1 Does the party taking the action have a satisfactory record of responsible environmental management? Provide details The company has been established for this project, as such has no prior record.	X	
7.2 Provide details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: (a) the person proposing to take the action, or (b) if a permit has been applied for in relation to the action - the person making the application. If yes, provide details		X
7.3 If the person taking the action is a corporation, please provide details of the corporation's environmental policy and planning framework and if and how the framework applies to the action. The Company taking the action is a newly formed company. An Environmental Management Plan has been prepared for the proposed action, which includes an environmental policy.	X	
7.4 Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act? Provide name of proposal and EPBC reference number (if known)		X

8 Information sources and attachments

(For the information provided above)

8.1 References

DEHP (2012). Koala-sensitive Design Guideline: A Guide to Koala-sensitive design for planning and development activities. Prepared by the Koala Conservation Unit, Department of Environment and Heritage Protection QLD (DEHP).

Matthei, L.E. (1995) *Soil Landscapes of the Newcastle 1:100 000 Sheet Map*, Department of Land and Water Conservation, Sydney.

OEHP (2014). *BioBanking Assessment Methodology 2014*. Office of Environment and Heritage NSW (OEHP), Sydney.

Office of Environment and Heritage NSW (OEHP) (2011b) *NSW OEHP interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects*. Chief Executive Officer. 25 June 2011.

A number of additional reference are included in Attachment 3: Significant Impact Criteria and the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)).

8.2 Reliability and date of information

The information used to inform this referral was collected and collated by suitably qualified consultants. Data has been collected and updated since the original surveys in 2008, with the majority of works being conducted between 2011 and 2015 for the original EIS, with updates occurring in 2016 (Response to Submissions). All reports are subject to internal peer review. The mapping data uses the most up to date LPI and Nearmap imagery.

8.3 Attachments

		✓ attached	Title of attachment(s)
You must attach	figures, maps or aerial photographs showing the locality of the proposed action (section 1)	✓	Attachment_1_SubjectLand
	GIS file delineating the boundary of the referral area (section 1)		
	figures, maps or aerial photographs showing the location of the proposed action in respect to any matters of national environmental significance or important features of the environments (section 3)	✓	Attachment_2_NewHollandMouseHabitat Major Projects Website: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6125 (Ecological Assessment Summary Report Response to Submissions Part 3)
If relevant, attach	copies of any state or local government approvals and consent conditions (section 2.5)		
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)	✓	Major Projects Website: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6125
	copies of any flora and fauna investigations and surveys (section 3)	✓	Major Projects Website: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6125 (Ecological Assessment Summary Report Response to Submissions Part 3)
	technical reports relevant to the assessment of impacts on protected matters that support the arguments	✓	Major Projects Website: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6125 Response to Submissions – Various

and conclusions in the referral (section 3) conclusions in the referral (section 3 and 4)		<p>Appendices</p> <p>Attachment_3_SignificantImpactCriteria</p>
report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)	✓	<p>Major Projects Website:</p> <p>http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6125</p> <p>(Response to Submissions Part 2 and Revised Aboriginal Cultural Heritage Assessment Dec 16)</p>

9 Contacts, signatures and declarations

Proposed action title:

9.1 Person proposing to take action

Name and Title: Murray Towndrow as secretary for the Williamtown Sand Syndicate Pty Limited

Organisation: Williamtown Sand Syndicate Pty Limited

Trust deed: WSS Unit Trust deed attached

ACN / ABN: A.C.N. 606 820 875

Postal address: PO Box 898 NEWCASTLE NSW 2300

Telephone: 0429 875 355

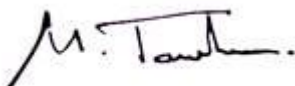
Email: murray@arbus.com.au

Declaration: I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.

I understand that giving false or misleading information is a serious offence.

I declare that I am not taking the action on behalf of or for the benefit of any other person or entity.

Signature:



Date: 22/12/2016

9.3 Person preparing the referral information (if different from section 9.1)

Name: Samara Schulz

Title: Senior Ecologist

Organisation: Kleinfelder Australia Pty LTD

ACN / ABN: 23 146 082 500

Postal address: 95 Mitchell Road Cardiff NSW 2285

Telephone: 02 4949 5200

Email: sschulz@kleinfelder.com

Declaration: I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.

I understand that giving false or misleading information is a serious offence.

Signature:



Date: 22/12/2016

REFERRAL CHECKLIST

NOTE: This checklist is to help ensure that all the relevant referral information has been provided. It is not a part of the referral form and does not need to be sent to the Department.

HAVE YOU:

- ☒ Completed all required sections of the referral form?
- ☒ Included accurate coordinates (to allow the location of the proposed action to be mapped)?
- ☒ Provided a map showing the location and approximate boundaries of the project area for the proposed action?
- ☒ Provided a map/plan showing the location of the action in relation to any matters of NES?
- ☒ Provided a digital file (preferably ArcGIS shapefile, refer to guidelines at [Attachment A](#)) delineating the boundaries of the referral area?
- ☒ Provided complete contact details and signed the form?
- ☒ Provided copies of any documents referenced in the referral form?
- ☒ Ensured that all attachments are less than three megabytes (3mb)?
- ☒ Sent the referral to the Department (electronic Copy)

Geographic Information System (GIS) data supply guidelines

If the area is less than 5 hectares, provide the location as a point layer. If the area greater than 5 hectares, please provide as a polygon layer. If the proposed action is linear (eg. a road or pipeline) please provide a polyline layer.

GIS data needs to be provided to the Department in the following manner:

- Point, Line or Polygon data types: ESRI file geodatabase feature class (preferred) or as an ESRI shapefile (.shp) zipped and attached with appropriate title
- Raster data types: Raw satellite imagery should be supplied in the vendor specific format.
- Projection as GDA94 coordinate system.

Processed products should be provided as follows:

- For data, uncompressed or lossless compressed formats is required - GeoTIFF or Imagine IMG is the first preference, then JPEG2000 lossless and other simple binary+header formats (ERS, ENVI or BIL).
- For natural/false/pseudo colour RGB imagery:
 - If the imagery is already mosaiced and is ready for display then lossy compression is suitable (JPEG2000 lossy/ECW/MrSID). Prefer 10% compression, up to 20% is acceptable.
 - If the imagery requires any sort of processing prior to display (i.e. mosaicing/colour balancing/etc) then an uncompressed or lossless compressed format is required.

Metadata or 'information about data' will be produced for all spatial data and will be compliant with ANZLIC Metadata Profile. (http://www.anzlic.org.au/policies_guidelines#guidelines).

The Department's preferred method is using ANZMet Lite, however the Department's Service Provider may use any compliant system to generate metadata.

Privacy and Confidentiality Notice

The Department is required under section 74(3) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to publish the information (including personal information of the author and/or third parties) provided in this referral on the internet. The information published may include your personal information.

Information including your personal information included in this referral will be used for the purposes of administering the EPBC Act. The information may be provided to various Commonwealth, State and Territory agencies for the purposes of administering the Act or other Commonwealth, State or Territory legislation. For example, if the proposed action (or a component of it) is to be taken in the GBRMP, the Minister is required to provide a copy of your referral to GBRMPA (see section 73A, EPBC Act). For information about how the GBRMPA may use your information, see http://www.gbrmpa.gov.au/privacy/privacy_notice_for_permits.

The Department will collect, use, store and disclose the personal information contained in this referral in a manner consistent with its obligations under the *Privacy Act 1988* and the Department's privacy policy.

The Department's privacy policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint.

A copy of the Department's privacy policy is available at: <http://environment.gov.au/privacy-policy>.

The Department is not obliged to publish information that the Minister is satisfied is commercial-in-confidence. If you believe that this referral contains information that is commercial-in-confidence, you must clearly identify such information and the reason for its confidentiality at the time of making the referral. The Minister cannot be satisfied that particular information included in a referral is commercial-in-confidence unless you demonstrate to the Minister (by providing reasons in writing) that:

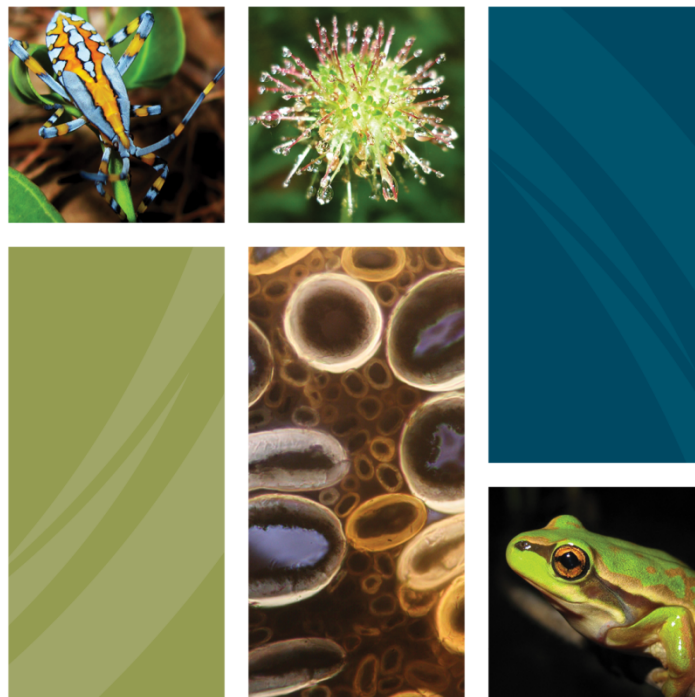
- release of the information would cause competitive detriment to the person; and
- the information is not in the public domain; and
- the information is not required to be disclosed under another law of the Commonwealth, a State or a Territory; and
- the information is not readily discoverable.

The Department is subject to certain legislative and administrative accountability and transparency requirements of the Australian Government including disclosures to the Parliament and its Committees. While the Department will treat all referral information provided in this referral sensitively, any information contained in or relating to a referral, including information identified by a person as commercial-in-confidence, may be disclosed by the Department:

- to its employees and advisers in order to evaluate or assess a referral;
- to the Parliamentary Secretary;
- within the Department or other agencies where this serves the legitimate interest of the Australian Government;
- in response to a request by a House or Committee of the Parliament of the Commonwealth of Australia;
- where information is authorised or permitted by law to be disclosed; and
- where the information is in the public domain other than by the Department's disclosure of that information.



Cabbage Tree Road Sand Quarry



Williamtown Sand Syndicate

Assessments against the EPBC Act
Significant Impact Criteria

Cabbage Tree Road, Williamtown NSW

22 December 2016

Cabbage Tree Road Sand Quarry

Assessments against the EPBC Act Significant Impact Criteria Cabbage Tree Road, Williamtown NSW

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Project No: 20170448
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Prepared for:

WILLIAMTOWN SAND SYNDICATE

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Document Control:

Version	Description	Date	Author	Technical Reviewer	Peer Reviewer
1.0	Final	22 December 2016	S. Schulz	K. Peters	K. Peters

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1. WETLANDS OF INTERNATIONAL IMPORTANCE

1.1 HUNTER ESTUARY WETLANDS

An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:

- areas of the wetland being destroyed or substantially modified

The Subject Land occurs approximately 590 m to the north of the Ramsar wetland. As such, the proposal will not directly impact on the Ramsar wetland and no areas of the wetland will be destroyed or substantially modified.

- *a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland*

The Subject Land occurs upstream of Fullerton Cove, which forms part of the Hunter estuary wetlands. The final landform of the extraction area will be 1 m above the maximum predicted groundwater level. Extraction will occur to 70 cm above the maximum predicted groundwater level, and then 30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry to ensure that the level above the maximum predicted groundwater level is maintained. Additionally, no extraction of groundwater is proposed as part of the action. As such, the proposal is unlikely to substantially modify the hydrological regime upstream of the Hunter estuary and it is unlikely that there will be any indirect impacts on the Ramsar Wetland.

- *the habitat or lifecycle of native species including invertebrate fauna and fish species, dependent upon the wetland being seriously affected*

The Subject Land occurs approximately 590 m to the north of the Hunter estuary wetlands and will not directly impact on habitat within the wetland. As outlined above, it is unlikely that there will be indirect impacts on the hydrology of the wetland. As such, it is unlikely that the proposal will impact on native species dependent upon the wetland.

- *a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or*

As outlined above, the proposed action is unlikely to modify the surface or groundwater hydrology of the area, and no water extraction is proposed as part of the action. As such, it is unlikely that the action will impact on the salinity levels in the downstream Ramsar Wetland.

As the proposed activity occurs within the Hunter Water Catchment and upstream of a Ramsar wetland, a number of mitigation measures have been implemented to limit the potential for impacts on water quality. These include, but are not limited to: the use of electric conveyors, stackers, screens and air separators in the extraction and processing rather than generators to limit diesel consumption; a concrete bunded area for refuelling of machinery onsite and tank refuelling within the workshop (i.e. under cover) to avoid surface water runoff; and, bunding under the electric screen and air separator plant to capture hydraulic leaks, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

Due to the limited sources of potential contaminants, the relatively small volume of contaminants being used during the project, and the additional mitigation measures to be implemented, it is unlikely that the proposal will impact on the water quality of the Hunter estuary wetlands.

- *an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.*

As the proposal will not occur within or directly adjacent to the wetland it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to the wetland.

2. LISTED THREATENED SPECIES AND ECOLOGICAL COMMUNITIES

2.1 BIRDS

Regent Honeyeater and Swift Parrot

The Regent Honeyeater was once widespread throughout southeast Australia. Now it is mainly found in limited areas of northeast Victoria and central-east NSW. It has been observed breeding in several areas in north-eastern Victoria (Chiltern district, Killawarra State Forest, Benalla district), and along the western slopes of the Great Dividing Range in NSW (Bundarra-Barraba district, Capertee Valley). Regent Honeyeaters are nomadic feeders and can be found elsewhere throughout its previous range where there is suitable blossom occurring (Franklin *et al.* 1989). This species is mostly recorded in box-ironbark eucalypt associations. They prefer the wettest, most fertile sites within these associations, such as along creek flats, broad river valleys and foothills. In NSW, riparian forests of *Casuarina cunninghamiana* (River Oak), those with *Amyema cambagei* (Needle-leaf Mistletoe), are also important for feeding and breeding. At times of food shortage the birds also use other woodland types and wet lowland coastal forest dominated by *E. robusta* (Swamp Mahogany) or *Corymbia maculata* (Spotted Gum) (Franklin *et al.* 1989; Ley and Williams 1992; Webster and Menkhurst 1992; Geering and French 1998; Oliver *et al.* 1999). Nectar is the principal food, but sugary exudates from insects are also used (Oliver 1998, 2000).

The Swift Parrot is small migratory parrot (25 cm) that breeds in Tasmania and migrates to south-eastern Australia for the winter months. In Tasmania, the species is dependent on Blue Gums for both flower nectar and for nesting hollows, of which there has been large scale clearing of these trees in Tasmania over many years (Brereton 1997). On the mainland, the Swift Parrot feed trees include winter flowering species such as *E. robusta* (Swamp Mahogany), *C. maculata* (Spotted Gum), *C. gummifera* (Red Bloodwood), *E. sideroxylon* (Mugga Ironbark), and *E. albens* (White Box). Commonly used lerp infested trees include *E. macrocarpa* (Grey Box), *E. moluccana* (Grey Box) and *E. pilularis* (Blackbutt) (Brown 1989). Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum (Barrett *et al.* 2003).

There is one record of the Regent Honeyeater and six records of the Swift Parrot occurring within a 10 km radius of the Subject Land.

Both of these species were assessed as having suitable habitat within the Subject Land, but were not identified during field surveys. As these species are nomadic and utilise resources within their range during different seasons and years, there is potential that these species forage within the Subject Land on occasion. The Swift Parrot breeds only in Tasmania and the Subject Land does not represent known breeding habitat for the Regent Honeyeater. In NSW the key breeding areas for the Regent Honeyeater are located in the Capertee Valley and the Bundarra-Barraba region. However, a breeding event was recorded in the Hunter Region (at the Hunter Economic Zone, Kurri Kurri) in 2007/ 2008.

The core area of occurrence within the Hunter Region for both of these species is around the Cessnock area, where they forage in Box-Ironbark Woodlands and Spotted Gum – Ironbark Forest associations.

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*

The proposed action is unlikely to lead to the long-term decline in the size of a population of these species, as; the vegetation within the extraction area does not provide breeding habitat for the species; the Subject Land is not within the core area of these species occurrence within the region; and, there is a high availability of suitable foraging habitat in the area adjoining the extraction area, both within the Subject Land, and to the north within the Tilligerry State Conservation Area (SCA). As such the removal of 40.38 ha of foraging habitat for these species is unlikely to significantly impact on a population.

- *reduce the area of occupancy of the species*

While the proposal will remove approximately 40.38 ha of suitable foraging habitat for these species. Given the large distribution of these species in the Hunter and the large area of available habitat to be retained within the offset are, it is unlikely that the proposed action will reduce their area of occupancy. Additionally, the proposed disturbance area will be progressively rehabilitated, as such there is the potential for these species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east, with suitable foraging habitat for these species occurring along

this corridor. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As both of these species are highly mobile, and only foraging habitat is present within the Subject Land, the proposed action will not fragment any populations of these species.

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

The National Recovery Plan for the Regent Honeyeater identifies that any breeding or foraging areas where the species is likely to occur is habitat critical to the survival of the species (Commonwealth of Australia 2016). The recovery plan maps the presence category of the Subject Land as 'Species likely to occur', as such the habitat within the Subject Land is critical to the survival of the species. The vegetation within the Subject Land likely provides opportunistic foraging habitat and supplementary foraging areas in times of low nectar resources in core foraging areas. Due to the large area of similar habitat types in the surrounding area (offset area and Tilligerry SCA), it is unlikely that the removal of 40.38 ha of foraging habitat within the extraction will adversely affect habitat critical to the survival of the Regent Honeyeater.

The National Recovery Plan for the Swift Parrot (Saunders and Tzaros 2011) outlines that 'habitat critical to the survival of the Swift Parrot includes; those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team'. As such, in Hunter region the 'important bird area' around Cessnock (Birdlife International 2016) is likely to be the only known area critical to the survival of the species due to the frequency in which this area is visited. As the Subject Land only provides opportunistic foraging habitat for the Swift Parrot, it is unlikely to be critical to the survival of the species. As such the proposed action will not impact on habitat critical to the survival of the Swift Parrot.

- *disrupt the breeding cycle of a population*

The Swift Parrot does not breed in on the mainland of Australia, as such the proposed action is unlikely to disrupt its breeding cycle.

Core breeding habitat for the Regent Honeyeater occurs in the Capertee Valley and the Bundarra-Barraba region. However, a breeding event was recorded in the Hunter Region (at the Hunter Economic Zone, Kurri Kurri) in 2007/ 2008. Breeding has not been recorded at any other locations within the region. As such, the Subject Land does not contain known breeding habitat for the species, and it is unlikely that the proposed action will disrupt the breeding cycle of the Regent Honeyeater.

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

As outlined above, the Subject Land likely provides opportunistic foraging habitat and supplementary foraging areas for both of these species. There is a large amount of suitable foraging habitat for these species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such, the removal of 40.38 ha of foraging habitat within the extraction area is unlikely to lead to the decline of these species.

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

Competition for nectar resources from Feral Honeybees and other nectivorous birds (native and exotic), is identified as a potential threat to the Regent Honeyeater (Commonwealth of Australia 20106) and the Swift Parrot (Saunders and Tzaros 2011). Also, aggressive behaviour by over abundant Noisy Miners, a key threatening process, could also impact on the occurrence and abundance of these species in areas of habitat. It is not expected that the proposed action would increase the potential for either of these harmful species becoming established in habitat for these species.

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

Psittacine Beak and Feather Disease (Pbfd) is a common and potentially deadly disease of parrots caused by a circovirus. A large number of Lorikeets that are rescued and rehabilitated often carry the disease when released into the wild. As the habitat of these species overlap, there is the potential that the virus can be transferred to Swift Parrots (Saunders and Tzaros 2011). There is the possibility that the proposed action could impact on parrot species during clearing activities. If any captured parrots are rehabilitated and released into the wild, there is the potential for them to spread Pbfd. However, it is not expected that a significant number of parrots would be impacted on during clearing. The Environmental Management Plan (within Response to Submissions Part 7 (Major Projects Website)), details clearing procedures, including pre-clearing surveys and habitat tree felling procedures, to minimise impacts on locally occurring fauna species.

As both species are dependent upon Eucalypt dominated habitats for foraging in the region, impacts to their habitat from Myrtle Rust and *Phytophthora cinnamomi* are possible.

Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread,

all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere with the recovery of the species.*

The proposed action is not consistent with one objective of the Recovery Plan for the Regent Honeyeater; 'improve the extent and quality of Regent Honeyeater habitat' (Commonwealth of Australia 2016).

The proposed action does not contravene any of the objectives of the Swift Parrot Recovery Plan (Saunders and Tzaros 2011).

The temporary loss of 40.38 ha of opportunistic foraging habitat for these two species is unlikely to impact on their recovery.

Australasian Bittern

The Australasian Bittern occurs in reeds and marshes in terrestrial freshwater wetlands and, occasionally estuarine habitats, generally where there is permanent water. The Australasian Bittern is a cryptic bird, roosting during the day on the ground amongst dense reeds (Marchant & Higgins 1990). Foraging occurs mainly at night with typical prey consisting of small mammals, birds, amphibians, eels, crustaceans and insects. The breeding season is from October through to February with nests being built in stands of *Phragmites*, *Typha*, and rushes (*Juncus*, *Baumea* spp.). The nest is usually comprised of a well-constructed flat platform of rushes or reeds. The species may occur singly, in pairs, or in groups of up to 12 individuals (Marchant & Higgins 1990). The Australasian Bittern is generally sedentary but sometimes moves in response to flooding and drought (Smith *et al.* 1995).

The Tomago area (which includes the Hunter Wetlands National Park and Hunter Estuary Wetlands Ramsar site) are considered to represent vital habitat for the local Australasian Bittern population. In October 2011, the Hunter Bird Observers Club (HBOC) conducted an evening survey of lower Hunter wetlands and recorded six calling birds (five in Hexham Swamp and one in the Tomago wetlands) (HBOC 2012). In 2009, 2 – 4 birds were regularly recorded at the Tomago Wetlands between April and September and single birds were observed at Hexham Swamp and Deep Pond on Kooragang Island (HBOC 2009). Within the Hunter Region, the core breeding range is likely to be contained within the broader Hunter Estuary (i.e. Hexham Swamp, Kooragang Island, Tomago, Williamtown (Finegan *et al.* 2001)). The majority of preferred habitat for this species occurs in areas with some level of protection e.g. National Parks, Council reserves and in SEPP 14 wetlands (Roderick & Stuart 2010). Some areas remain unprotected and may be at threat from inappropriate hydrological practices and

indirect impacts of nearby development. It is also noted that it is unclear what the impact will be on this species' local habitat of the returning of brackish/saline waters to some of these areas via the opening of the floodgates in Hexham Swamp and the Tomago wetlands (Roderick & Stuart 2010).

The species was not identified during field surveys, but suitable habitat for the species occurs within the Coastal Wet Sand Cyperoid Heath and the species is known from the locality. The habitat within the Subject Land was assessed as marginal. As outlined above, preferred habitat for the species occurs in the locality, to the south in the Tomago Precinct of the Hunter Estuary National Park and west of the Subject Land at Hexham Swamp.

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 areas of habitat for this species will be directly impacted, as such it is unlikely that the proposed action will lead to a long-term decrease in the size of a population.

- *reduce the area of occupancy of the species*

As the proposed action will not directly impact on any suitable habitat for the species it will not reduce the area of occupancy of the species.

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

The proposed action will not directly impact on any habitat for the species, and will not create any barriers to movement between the habitat on site and other areas of habitat in the locality. As such the proposed action will not fragment a population.

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

The proposed action will not directly impact on any areas of habitat for the species. The Subject Land does not occur directly upstream of the Tomago Precinct of the Hunter Wetlands National Park, and it is unlikely that impacts on the Subject Land would alter the hydrology of this area. Furthermore the proposed action is unlikely to modify the surface or groundwater hydrology of the area.

As such it is unlikely that there will be an adverse effect on critical habitat.

- *disrupt the breeding cycle of a population*

The proposed action will not directly impact on any areas of suitable habitat for the species, i.e. Coastal Wet Sand Cyperoid Heath. Additionally, the extraction will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on the species habitat through impacts to groundwater hydrology.

Therefore, the proposed action is unlikely to disrupt the breeding cycle of a population.

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

As the proposed action will not directly impact on the species habitat, and as indirect impacts from groundwater hydrology are not likely to be significant, it is unlikely that the proposal will impact on habitat such that the species is likely to decline.

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

As the proposed action will not directly impact on any areas of habitat for the species, and as indirect impacts are unlikely, it is not expected that the action will result in an invasive species becoming established in the species habitat.

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

As the proposed action will not directly impact on any areas of habitat for the species, and as indirect impacts are unlikely, it is not expected that the action will introduce disease that may cause the species to decline.

- *interfere with the recovery of the species.*

As the proposed action will not directly impact on any areas of habitat for the species, and as indirect impacts are unlikely, it is not expected that the action will interfere with the recovery of the species.

Wading Birds with Habitat in Fullerton Cove

Critically Endangered and Endangered Species

- Red Knot
- Curlew Sandpiper
- Great Knot
- Lesser Sand Plover
- Northern Siberian Bar-tailed Godwit

- Eastern Curlew

All of these species utilise habitat in Australia for foraging only, with breeding territories primarily in Asia. Foraging habitat for these species occurs within Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts through modification of surface and groundwater hydrology as the extraction area occurs upstream of the Hunter Estuary National Park.

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*

Suitable habitat for these species occur approximately 590 m to the south of the Subject Land within the Ramsar Wetland at Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these species, and subsequently it is unlikely that the proposed action will lead to the long-term decrease in a population of any of these species.

- *reduce the area of occupancy of the species*

As the proposed action will not directly impact on any suitable habitat for these species, and indirect impacts are unlikely (see above), the proposed action will not reduce the area of occupancy of any of these species.

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

The proposed action will not directly impact on any habitat for these species, and will not create any barriers to movement between areas of habitat in the locality. As such the proposed action will not fragment a population.

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

The proposed action will not directly impact on any areas of habitat for these species, and indirect impacts are unlikely. Therefore, it is unlikely that there will be an adverse effect on critical habitat for these species.

- *disrupt the breeding cycle of a population*

Not applicable. None of these species breed in Australia.

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

As the proposed action will not directly impact on these species' habitat, and as indirect impacts from groundwater hydrology are not likely to be significant, it is unlikely that the proposal will impact on habitat such that these species are 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*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park), it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.

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

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will introduce a disease that is harmful to these species.

- *interfere with the recovery of the species.*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will interfere with the recovery of these species.

Vulnerable Species

- Greater Sand Plover
- Bar-tailed Godwit

These two species utilise habitat in Australia for foraging only, with breeding territories in Asia or Northern Europe. Habitat for these species occurs within Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts through modification of surface and groundwater hydrology as the extraction area occurs upstream of the Hunter Estuary National Park.

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*

Suitable habitat for these species occurs approximately 590 m to the south of the Subject Land within the Ramsar Wetland at Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these species, and subsequently it is unlikely that the proposed action will lead to a long-term decrease in an important population of either of these species.

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

As the proposed action will not directly impact on any suitable habitat for these species, and indirect impacts are unlikely (see above), the proposed action will not reduce the area of occupancy of either of these species.

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

The proposed action will not directly impact on any habitat for these species, and will not create any barriers to movement between areas of habitat in the locality. As such the proposed action will not fragment an important population.

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

The proposed action will not directly impact on any areas of habitat for these species, and indirect impacts are unlikely, as such it is unlikely that there will be an adverse effect on critical habitat for these species.

- *disrupt the breeding cycle of an important population*

Not applicable. Neither species breeds in Australia.

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

As the proposed action will not directly impact on these species' habitat, and as indirect impacts from groundwater hydrology are not likely to be significant, it is unlikely that the proposal will impact on habitat such that these species are likely to decline.

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

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.

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

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will introduce a disease that is harmful to these species.

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

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Estuary National Park) it is unlikely that it will interfere with the recovery of these species

2.2 MAMMALS

Spotted-tailed Quoll

Historically the Spotted-tailed Quoll occupied a large range throughout eastern Australia. Following European settlement however, the species has undergone a dramatic decline as a result of habitat clearance, disease, and competition with the introduced fox and feral cat. Currently, the Spotted-tailed Quoll occupies a disjunct distribution along the coast and ranges of eastern Australia, from southern Queensland to Victoria, and into Tasmania. Small populations of a north Queensland sub-species also occur in the vicinity of Bundaberg. These animals are secretive and difficult to detect in their large home range. A community survey throughout NSW including the Port Stephens area, added almost 12% of additional records for this species.

The Spotted-tailed Quoll has been reported from a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, woodland, coastal heathland, as well as along riparian forests in the inland. Spotted-tailed Quolls are generally solitary, nocturnal, and semi-arboreal species, occupying home-ranges of between 750 and 3,500 ha. Den and nest sites for the Spotted-tailed Quoll have been recorded in caves, rock crevices, tree hollows, and hollow logs (Edgar & Belcher 1995; Lunney & Matthews 2001). The Spotted-tailed Quoll is mostly nocturnal, although will hunt during the day, and consumes a variety of prey including

gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects; also eats carrion and takes domestic fowl.

The species was not recorded during the field surveys, however, suitable habitat for the species occurs within all vegetation types within the Subject Land.

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*

The species was not detected during field surveys and there is only one recent record of the species within 10 km (approximately 7 km north-west of the Subject Land, from January 2016; NSW BioNet). However, due to the cryptic nature of the species and the high availability of habitat along the Tomago Sandbeds, there is the potential for a local population to utilise the Subject Land.

A mitigation measure of the proposed action is the implementation of a vertebrate pest control program. If deemed appropriate, the control methods may involve the use of 1080 baiting. The proposed feral animal control program would be conducted in accordance with the 'EPBC Act Policy Statement 3.4 – Significant Impact Guidelines for the Endangered Spotted-tailed Quoll *Dasyurus maculatus maculatus* (Southeastern Mainland Population) and the use of 1080' and the 'Administrative Guidelines on Significance: Supplement for the Tiger Quoll (Southeastern Mainland Population) and the use of 1080', see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

The significant impact guidelines for the species outline that the following activities might have a significant impact on the Spotted-tailed Quoll: baiting in, or near, known isolated or fragmented populations; baiting in areas at the extremities of the species' known range; and, baiting in areas not previously baited that may contain susceptible Spotted-tailed Quoll populations. None of these activities will be conducted, as; due to the high availability of suitable habitat to the north of the Subject Land (within the Tilligerry SCA) it is unlikely that any potentially occurring local population is isolated or fragmented; the species occurs along the east coast from Gladstone through NSW to Western Victoria, as such the Subject Land is not at the extremity of the species range; and, baiting is undertaken within the Tilligerry SCA to the north of the Subject Land.

As such, provided the program is undertaken in accordance with the Significant Impact Guidelines and the supplementary information for the species, it is unlikely that the action will significantly impact on the species.

- *reduce the area of occupancy of the species*

The proposed action will temporarily remove 40.38 ha of habitat for the species. There is a large amount of habitat for the species that will be retained within the offset area and to the north of the Subject Land (Tilligerry SCA). Additionally, the proposed disturbance area will be progressively rehabilitated, as such there is the potential for the species to utilise the area as foraging habitat once the rehabilitation reaches a suitable age; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

As outlined above, any baiting undertaken as part of a vertebrate pest control program within the Subject Land will be conducted in accordance with the Significant Impact Guidelines and the supplementary information for the species reducing the potential impact on the species. As such, it is unlikely that the proposed action will reduce the area of occupancy of the species.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment a potentially occurring local population.

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

The National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus* (DELWP 2016) identifies habitat critical to the survival of the species as 'large patches of forest with adequate

denning resources and relatively high densities of medium-sized mammalian prey'. As such, the Subject Land is likely to form part of an area of critical habitat. The proposed action will not adversely affect this habitat due to the relatively small area of removal, considering the high availability of suitable within, and to the north of, the Subject Land.

- *disrupt the breeding cycle of a population*

Maternal dens sites for the species include rock crevices, caves, boulder tumbles, hollow logs, hollow tree roots and burrows (DELWP 2016). No dens sites were identified during field surveys, however, the proposed activity will remove approximately 56 hollow-bearing trees and 21 dead stags progressively over the life of the project. During the hollow-bearing tree survey conducted within and adjacent to the previously proposed extraction area, a further 109 hollow-bearing trees and dead stags were identified. The hollow-bearing tree survey was used during the re-design of the proposed extraction area, in order to reduce the impacts of the proposal on hollow-dependent fauna.

Due to the availability of suitable habitat to be retained within the Subject Land and the surrounding Tilligerry SCA, it is unlikely that the proposed action will disrupt the breeding cycle of a locally occurring population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such, the removal of 40.38 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

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

Competition and predation from introduced predators, such as Cats, Foxes and Wild Dogs is a potential threat to the species. The proposed action is unlikely to lead to an increase in the threat of these invasive species on the Spotted-tailed Quoll. Additionally, a vertebrate pest control program will be implemented as part of the proposed action, which will decrease potential predation pressures of these invasive species on the Subject Land and surrounds; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

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

No diseases are listed as contributing the decline of the species. Additionally, it is unlikely that the proposed action would introduce or exacerbate Myrtle Rust and *Phytophthora cinnamomi* (which could impact on the species' habitat).

- *interfere with the recovery of the species.*

While the proposed action is not consistent with one objective of the Recovery Plan for the Spotted-tailed Quoll; 'Reduce the rate of habitat loss and fragmentation on private land' (DELWP 2016), the temporary loss of 40.38 ha habitat for this species is unlikely to impact on its recovery.

Koala

The Koala occurs from north-eastern Queensland, south along the coast and ranges to south-western South Australia, including areas west of the Great Dividing Range (DECC 2008).

The species inhabits eucalypt woodlands and forests and feeds on the foliage of Eucalypt and non-Eucalypt species. Across their range, the species has been recorded as foraging or sitting in 69 different Eucalypt species and almost 30 non-Eucalypt species, however, most studies of Koala foraging habits noted that the species predominantly feeds on one or a few Eucalypt species at any site (Moore and Foley 2000). Within the Port Stephens area, *Eucalyptus robusta*, *E. parramattensis* and *E. tereticornis* were identified as preferred feed trees by Lunney *et al.* (1998). Additionally, vegetation associations containing *Eucalyptus signata* were also identified as important in this study.

The species is generally solitary (OEH 2015b), but they have a complex social hierarchy, living in breeding aggregations comprising of the territory of a dominant male overlapping a small number of mature females, also juveniles of various ages occur (DECC 2008; OEH 2015b). Across their range, adult Koalas generally exhibit long-term fidelity to their individual home range. Within the Port Stephens area studies have established home ranges of 0.2 ha to 500 ha, with an average of 80 – 90 ha (DECC 2008).

There is evidence that the population within the Port Stephens area is in decline. The mortality rate in 1995 was estimated to be 5 – 10% of the population. Since 1995 this rate has declined linearly to less than half that level. As trends in road mortality rates of animals can provide a good surrogate for animal abundance, this may indicate a substantial decline in the population at Port Stephens (TSSC 2012). Modelling of the impacts of fire and dogs on the Port Stephens population conducted by Lunney *et al.* (2007) also identified that these two pressures are

impacting on the local population. The research estimated the population to be between 350 and 800 individuals, and modelled that under basic assumptions (impacts from dogs and fire), the population was unlikely to survive 50 years (Lunney *et al.* 2007).

The Subject Land falls within a key Koala population (Tomago Sandbeds Koala Management Unit (KMU); CKPOM 2002) in the Port Stephens LGA. There is a high number of records of the species within 1 km of the site. There are a total of nine Atlas records within the Subject Land; one from 2011 (accuracy of 10 m), one from 2008 (accuracy of 1,000 m) and the remaining seven in 1992 or prior (all accuracy of 1,000 m). Additionally, there are 37 records within 1 km of the Subject Land, of which five are within the last 10 years. This suggests that the area is potentially of high importance to the Koala in the area, particularly due to the occurrence of areas of preferred habitat.

The species was identified in the south of the Subject Land during surveys conducted by RPS (2011). However, surveys conducted by Umwelt (2015) in September 2015 did not return any activity during SAT surveys, which was attributed to the fire which occurred two years prior to the field surveys (October 2013). While the SAT surveys conducted by Umwelt in 2015 did not identify any Koala activity, the Subject Land would have contained habitat suitable for utilisation by the species. Matthews *et al.* (2007) identified that burnt trees could be utilised by Koalas from as little as three months after fire, as the epicormic growth provides sufficient nutrients. Un-burnt areas are important during wildfire events to maintain the population and service as a source of colonising individuals into areas of burnt bush (Matthews *et al.* 2007). It is likely that Koala re-colonisation of the habitat burnt in 2013 fire, including the Subject Land, is still occurring. This is supported by the lack of activity detected by Umwelt in 2015 (two years post fire), and the lack of Atlas records within burnt areas in close proximity to the Subject Land. Post 2013 fire event, there are seven records of the species within 5 km of the Subject Land (within the KMU). These occur along Medowie Road approximately 3 to 4 km to the east/north-east (4 records from 2014) and approximately 4 km north along Richardson Road (two records from 2014 and one record from 2015). The four records along Medowie Road all occur within areas that were not burnt during the fire and the three records along Richardson Road occur within 1 km of the mapped fire extent.

Due to the recent fire disturbance (October 2013), the precautionary principle was applied and the preferred habitat within the Subject Land is assumed to have the potential to support a medium (normal) usage category. As outlined by Phillips and Callaghan (2011), "low activity levels recorded in what might otherwise be med-high carrying capacity *P. cinereus* habitat may be a result of contemporary population dynamics, landscape configuration and/or historical disturbances including logging, mining, fire, agricultural activities and/or urban development".

The local population of Koalas which potentially occupy the Subject Land do not occur at the extent of the range of the species. However, the local population has been assessed as 'important' as the population of the species in the Port Stephens LGA is likely to be important for maintaining genetic diversity and/or breeding and dispersal.

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 decline of the Koala population in the Port Stephens LGA has historically been attributed to habitat loss, however, impacts from fires, dogs (Lunney *et al.* 2007) and motor vehicles (Phillips *et al.* 1996) have been identified as significant threats to the species. The habitat loss due to the proposal (19.19 ha of preferred habitat and 21.19 ha of supplementary habitat) has been assessed as minor in the context of the sandbeds (approximately 1.01% of the preferred habitat within the KMU; see d (i) below). The proposal also has the potential for increased impact to the species from vehicle strikes as there will be an increase in traffic. However, traffic assessments concluded that the proposal will only cause a minor increase in traffic volume. At absolute maximum extraction rates, the proposal will increase traffic along Cabbage Tree Road by less than 3% in a 24 hour period. However, it is expected under average operational conditions that traffic increases along Cabbage Tree Road will be less than 1%. Additionally, the proposal will not increase dog numbers in the locality.

During clearing there is the potential for displacement of an individual if the extraction area forms part of its home-range. The removal of an area of an individual's home range may force it to move, potentially impeding on the home range of another individual. This could result in conflicts in the local area due to the high fidelity the species exhibit to their home range. Based on the assessment of an average home range in the Port Stephens area of 80 – 90 ha (DECC 2008), the proposal has the potential to impact on the home range of approximately one to two adult Koalas. While there is the potential to displace one to two individuals, this impact is unlikely to be significant due to the large area of available habitat within the Tomago Sandbeds KMU. Lunney *et al.* (2007) modelled the carrying capacity of the Port Stephens area to be a maximum of 2,500 individuals. However, the population within the same area was estimated to be only 350 – 800 individuals (Lunney *et al.* 2007). Based on this assessment, habitat availability is not the limiting factor for the Koala population in Port Stephens area and it is likely that there is a large amount of available habitat within the locality that is either unoccupied, or could potentially support a higher density of Koalas.

Based on this information, it is unlikely that the proposal would lead to the long-term decline of an important population.

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

While the proposal will remove approximately 40.38 ha of suitable habitat for the species, it will not reduce the area of occupancy as a large area of suitable habitat will be retained in the offset area (approximately 104.78 ha). Given the large distribution of the species, this removal is not assessed as reducing the area of occupancy of an important population. Additionally, the proposed disturbance area will be progressively rehabilitated (with suitable habitat for the species; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website))), as such there is the potential for the species to re-occupy this area once the rehabilitation reaches a suitable age.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east, with Koala habitat occurring along this corridor. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat for the Koala extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of Koala habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment an important population.

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

The *EPBC Act Referral Guidelines for the Vulnerable Koala Combined populations of Queensland, New South Wales and the Australian Capital Territory*, Commonwealth of Australia 2014, outline a Koala habitat assessment tool to determine if a site contains critical Koala habitat. The habitat within the extraction area has been assessed against the criteria,

and is detailed in **Table 2** (the site occurs within a coastal area, as such these criterion have been used).

Table 1: Assessment of habitat critical to the survival of the Koala

Attribute	Score	Discussion
Koala Occurrence	+1	<ul style="list-style-type: none"> • EPBC PMST report identified the species or species habitat known to occur in area. • The species was identified within the southern portion of the Subject Land (outside the extraction area) during surveys in 2011. • No evidence of the species was identified within the extraction area (or the Subject Land) during surveys in 2015, however this is likely due to impacts from the 2013 bushfire. • Post-2013 bushfire, there are seven records of the species within 5 km of the Subject Land (within the KMU).
Vegetation Composition	+2	The vegetation associations in the extraction area have been mapped as either preferred or supplementary habitat (as defined by the CKPoM; PSC 2002). The rehabilitation area was defined as preferred habitat due to the occurrence of <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> and <i>Eucalyptus signata</i> , while the remnant forest is classified as supplementary habitat.
Habitat Connectivity	+2	The extraction area is connected to a large expanse of vegetation (>500 ha) to the north of the Subject Land.
Key Existing Threats	+1	Vehicle strikes and dog attacks have been identified as a key threat to the Port Stephens population. The exact level of vehicle strike and dog attacks in the area is not known. However, evidence of dogs (tracks) was observed within the Subject Land along the access track that runs through the extraction area.
Recovery Value	+1	<p>Uncertain whether the habitat is important for achieving the interim recovery objectives, as it is not known if the habitat is:</p> <ul style="list-style-type: none"> • Of sufficient size to be genetically robust/operate as a viable sub-population, or • Free of disease or have low incidence of disease, or • Breeding.
Total Score	7	As such the impact area is classified as habitat critical to the survival of the species.

The above assessment is relevant to all areas of the extraction area, as such the extraction area contains a total of 40.38 ha of habitat critical to the survival of the species. Within the offset area, the Swamp Mahogany – Paperbark Swamp Forest, Coastal Sand Wallum Woodland-Heath and Tomago Sand Swamp Woodland are also classified as habitat critical to the survival of the Koala. While the Coastal Wet Cyperoid Heath and the Tomago Sand Swamp Heath, do not represent Koala habitat (full habitat assessment detailed in the Ecological

Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)). As such, a total of 104.78 ha of habitat critical to the survival of the Koala will be retained within the Offset Area.

The impacts of the proposed action were assessed against the factors detailed in Figure 2 (Assessing adverse effects on habitat critical to the survival of the Koala) of the *EPBC Act Referral Guidelines* (detailed in the following sections). The assessment concluded that while the extraction area was assessed as critical habitat, the impacts of the proposal are unlikely to adversely affect habitat critical to the survival of the species due to the large area of habitat, with similar characteristics, occurring in the locality.

Amount of Habitat Removal

An analysis of the preferred and supplementary Koala habitat within the Tomago Sandbeds KMU was undertaken to inform the impact assessment. The analysis involved examining available vegetation mapping for the Tomago Sandbeds KMU and assigning each vegetation community type as preferred, supplementary or other Koala habitat based on comparison of the floristic descriptions of the vegetation mapping studies with the descriptions of preferred and supplementary habitat by Lunney *et al.* (1998) and PSC (2002). The desktop analysis was primarily based on the *Vegetation of the Tomago and Anna Bay Sandbeds* (Bell and Driscoll 2006), which covers most of the Tomago Sandbeds KMU and is the most accurate and recent vegetation mapping available. For areas not covered by the Bell and Driscoll (2006) mapping within the Tomago Sandbeds KMU, the *Lower Hunter and Central Coast Regional Environment Management Strategy* (LHCCREMS; NPWS, 2000) vegetation mapping was used. Additionally, the vegetation mapping within the Subject Land was added to the totals.

The assessment identified an estimated 1,900 ha of preferred and 2,716 ha of supplementary habitat within the Tomago Sandbeds KMU (**Table 2**). A map of the habitat within the KMU is presented on Figure 6 of the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Project Website)).

Table 2: Estimated preferred and supplementary Koala habitat and potential Koala habitat within the Tomago Sandbeds KMU.

Koala habitat category	Equivalent vegetation map units (MU)		Total area (ha) of Koala habitat (including Subject Land)
	Bell and Driscoll (2006)	LHCCREMS (2000)	
Preferred	5, 7, 9, 17-19, 21, 24 & 43	36 & 37	1,900 ha
Supplementary	1-3, 11, 22 and 41	33	2,716 ha
Marginal, other and excluded	20, 23, 25-29, 31-38 & 42	9, 12, 15, 17, 30, 34, 36a, 40, 44, 46 and 47	N/A
Total			4,616 ha

The proposed action will temporarily remove 19.19 ha of preferred habitat and 21.19 ha of supplementary habitat from the KMU. This equates to 1.01% of the mapped preferred Koala habitat and 0.78% of the mapped supplementary habitat within the KMU. Due to the relatively small removal of habitat from the Tomago Sandbeds KMU, this impact on habitat is not considered to be adverse.

Method of Clearing

The proposed extraction area will be progressively cleared, and rehabilitated with native vegetation that will constitute Koala habitat.

Soft-felling clearing procedures will also be implemented to ensure that no individuals are negatively impacted during clearing. This will involve both nocturnal and diurnal surveys prior to clearing, and any Koalas identified within the clearing area will be captured, given a veterinary check and tracked (remote tracker) for a three month period.

See the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)) for details on mitigation measures.

Density or Abundance of Koalas

As outlined in the introduction, no Koala activity was detected within the Subject Land during surveys in 2015. These surveys occurred two years post fire, and suggest that the area is still being recolonised. While the abundance of the species in the area is not known, the habitat has the potential to support a medium (normal) usage category. However, as outlined above (response to long term decrease in important population criteria) habitat availability is unlikely to be the limiting factor of the Koala population in the Port Stephens area, and it is likely that a large amount of available habitat to the north of the Subject Land is either un-occupied, or could support a higher density of individuals.

Level of Fragmentation

As outlined above (response to habitat fragmentation criteria), no areas of habitat for the species will be completely isolated. There will be some fragmentation of habitat in the south-west of the Subject Land, however, all areas of habitat will be connected to habitat within and to the north of the Subject Land.

- *disrupt the breeding cycle of an important population*

Disruptions to social interactions or creating barriers to movement and dispersal has the potential to impact on the breeding cycle of the species. The proposed action will not create any barriers to movement or dispersal as all areas of retained vegetation within and adjacent to the site will be connected.

As outlined above (response to long term decrease in important population criteria), there is the potential to displace individuals during clearing, forcing individuals closer together. However, it was also outlined that habitat availability is unlikely to be the limiting factor of the Koala population in the Port Stephens area. As such, it is likely that any displaced Koalas would be able to move into available habitat within or to the north of the Subject Land, and it is unlikely that they would be significantly impacted on, such that their breeding cycle would be disrupted.

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

As outlined above (response to adversely affect habitat critical to the survival of the species criteria), the proposed action will temporarily remove 19.19 ha of preferred habitat and 21.19 ha of supplementary habitat from the KMU. This equates to 1.01% of the mapped preferred Koala habitat and 0.78% of the mapped supplementary habitat within the KMU. Due to the relatively small removal of habitat from the Tomago Sandbeds KMU, this impact on habitat is unlikely to lead to the decline of the species.

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

Dogs are a significant threat to the species. The proposed action will not lead to an increase in dogs in the locality. Additionally, the proposed action will implement a vertebrate pest control program within the Subject Land, with wild dogs as one of the target species, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

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

Impacts from Chlamydia can be expressed in individuals when they undergo stress, such as habitat loss, interactions with predators, nutritional stress or overcrowding (DECC 2008). The proposed action will result in habitat loss. However, as outlined above (response to long term decrease in important population criteria) habitat availability is unlikely to be the limiting factor of the Koala population in the Port Stephens area, and there is likely a large amount of

available habitat to the north of the Subject Land that is either un-occupied, or could support a higher density of individuals. Additionally, in order to access this habitat, Koalas would not be forced to cross any roads, which has the potential to cause further stress. As such, the potential for the proposed action to spread the Chlamydia disease such that it is likely to significantly reduce the reproductive output of the species is unlikely.

Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death. *Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country. Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate either of these diseases that may impact on Koala habitat. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

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

The proposed action was assessed against the impacts detailed in Section 8 of the *EPBC Act Referral Guidelines* to determine if it is likely that the action will substantially interfere with the recovery of the species (detailed in the following sections). The assessment concluded that it is unlikely that the action will substantially interfere with the recovery of the Koala.

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.

The proposed action is unlikely to lead to the increase in dog attacks in the locality as it does not involve the construction of residential dwellings and associated pet ownership. Additionally, the proposed action will implement a vertebrate pest control program within the Subject Land, with wild dogs as one of the target species, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

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.

The proposal has the potential for increased impact to the species from vehicle strikes as there will be an increase in traffic. However, traffic assessments concluded that the proposal will only cause a minor increase in traffic volume. At absolute maximum extraction rates, the proposal will increase traffic along Cabbage Tree Road by less than 3% in a 24 hour period. However, it is expected under average operational conditions that traffic increases along Cabbage Tree Road will be less than 1%.

The proposed action will implement a recognised mitigation measure with a high effectiveness, through the installation of Koala proof fencing along Cabbage Tree Road and along internal roads with speed limits above 40 km/hour. It is recognised that this control is only applicable to the Subject Land.

Facilitating the introduction or spread of disease or pathogens (e.g. *Chlamydia* or *Phytophthora cinnamomi*) that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity of the habitat.

As outlined above (response to introduce disease criteria), it is unlikely that the proposed action will introduce or spread a disease or pathogen that is harmful to the species or its habitat. As such, the potential for the proposed action to reduce the reproductive output of the species is unlikely.

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.

As outlined above (response to habitat fragmentation criteria), no areas of habitat for the species will be completely isolated. There will be some fragmentation of habitat in the south-west of the Subject Land, however, all areas of habitat will be connected to habitat within and to the north of the Subject Land. As such, it is unlikely that the proposed action will lead to the long-term reduction in genetic fitness or access to habitat critical to the survival of the Koala.

Change the 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.

The final landform of the extraction area will be 1 m above the maximum predicted groundwater level. Extraction will occur to 70 cm above the maximum predicted groundwater level, and then

30 cm of topsoil will be re-distributed. The final landform will be monitored throughout the life of the quarry, to ensure that the level above the maximum predicted groundwater level is maintained. Additionally, no extraction of groundwater is proposed as part of the action. As such, the proposal is unlikely to substantially modify the hydrological regime in the area.

Long-nosed Potoroo (SE Mainland)

Preferred habitat for this species is coastal heath and wet or dry sclerophyll forest with a specific requirement of a dense ground cover and light soil. The home ranges of males and females differ with the range of the male (about 4 ha) generally overlapping the ranges of two or three females (just under 2 ha). The animals are mostly but not entirely nocturnal and use a 'pad' made of a small depression in the ground under thick grass cover as a nest. The diet of Long-nosed Potoroos is made up of insects and arthropods that are foraged for among leaf litter or dug for in the ground in a similar fashion to that of the bandicoots. An important part of the diet is the fruiting bodies of hypogaeal fungi that are dug from the ground and it is thought that the animals play an important role in distributing the spores of these fungi throughout the forest. In turn these fungi form beneficial relationships with the roots of a number of eucalypts (Claridge *et al.* 1993; Johnston 1995; Long 2001).

The species was not identified within the Subject Land, but suitable habitat for the species occurs within all vegetation types within the Subject Land. There is only one record of the species in the locality (10 km), occurring approximately 2.5 km to the east of the extraction area. Higher densities occurring to the north (Barrington Tops National Park) and south (Watagans National Park). As such the population of the Long-nosed Potoroo in the locality was not assessed as an important population as it is unlikely to be a key source for breeding, dispersal or maintaining genetic diversity, and it is not near the limit of the species range.

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*

A potentially occurring local population of the species was not assessed as an important population. As such the proposed action will not lead to the long-term decrease in the size of an important population of the species.

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

A potentially occurring local population of the species was not assessed as an important population. As such the proposed action will not reduce the area of occupancy of an important population of the species.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

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

There is no recovery plan for this species, as such habitat critical to its survival has not been identified. As the proposed action will not directly impact on an area of habitat for an important population, it is unlikely that it will adversely affect habitat critical to the species survival.

- *disrupt the breeding cycle of an important population*

A potentially occurring local population of the species was not assessed as an important population. As such the proposed action will not disrupt the breeding cycle of an important population of the 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 proposed action will temporarily remove 40.38 ha of available habitat for the species. Due to the high availability of suitable habitat to be retained within the Subject Land, and also to the north within the Tilligerray SCA, it is unlikely that the removal of the habitat from the extraction area will lead to the species decline.

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

Predation of the species by foxes, wild dogs and cats is a known threat. The proposed action is unlikely to lead to an increase in the threat of these invasive species on the Long-nosed Potoroo. Additionally, a vertebrate pest control program will be implemented as part of the proposed action, which will decrease any potential predation pressures of these invasive species in the Subject Land and surrounds; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

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

No diseases are listed as contributing the decline of the species. Additionally, it is unlikely that the proposed action would introduce or exacerbate Myrtle Rust and *Phytophthora cinnamomi* (which could impact on the species habitat).

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

The temporary removal of 40.38 ha of habitat for the species is unlikely to interfere with its recovery.

New Holland Mouse

The New Holland Mouse is a small burrowing native rodent distinguished from the introduced House Mouse by its larger ears and eyes, bi-colour tail, the absence of a notch on its upper incisors (Strahan 2010, Menkhorst & Knight 2011) and the lack of any 'mousy odour' (Menkhorst & Knight 2011).

The New Holland Mouse has a fragmented distribution across the east coast of Australia with disjunct populations in New South Wales, Victoria, and Tasmania and is estimated to occur in only six to eight metapopulations based on relevant state wildlife atlas data (TSSC 2010). At a landscape level, these metapopulations appear to be based on specific habitat requirements (Fox & Fox 1978; Wilson & Laidlaw 2003) and a particular preference for soft substrates, generally sand (Strahan 2010) which is thought to be preferred for digging burrows (Wilson & Laidlaw 2003).

Habitat requirements for the New Holland Mouse includes open heathland, open woodland with a heathy understorey, and vegetated sand dunes. Areas with high floristic diversity, particularly in leguminous perennials (Kemper & Wilson 2008) coincide with this species distribution and diet requirements (largely granivorous).

Research (Braithwaite & Gullan 1978; Fox & Fox 1978; Fox & McKay 1981; Posamentier & Recher 1974; Wilson & Laidlaw 2003) has identified the New Holland Mouse as a species that readily occurs in areas subjected to disturbance, particularly fire and sand mining. In regards to fire, species abundance has been found to peak during early to mid-stages of vegetation succession three to five years following a fire event. In regards to sand mining, the New Holland Mouse first appears between four and five years post topsoil replacement, and peaks after eight to nine years (Fox & Fox 1978; Fox & McKay 1981; Fox 1982; Fox & Fox 1984; Wilson 1991).

The New Holland Mouse lives for up to two years and can reach sexual maturity after 13 weeks. Breeding takes place late winter to early summer, followed by a gestation period of 32 – 39 days (Kemper & Wilson 2008). Timing of breeding events is related to abundance and quality of food resources which coincides with rainfall patterns and fire succession (Fox *et al.* 1993).

Key threats to the New Holland Mouse include habitat loss and modification, poorly managed fire regimes (too frequent), predation and competition mainly from introduced species such as the Red Fox, Cat and Dog, and climate change.

The New Holland Mouse has not been recorded in the Subject Land. However, the NSW Wildlife Atlas contains 40 records occurring within 10 km of the Subject Land in similar habitat types. Of these, 16 records are within 5 km of the Subject Land.

Within the Subject Land, the Coastal Sand Apple – Blackbutt Forest, Coastal Sand Wallum Woodland-Heath, and Tomago Sand Swamp Heath represent potential nesting and foraging habitat, and the Tomago Sand Swamp Woodland represents potential foraging habitat. A total of 116.60 ha of suitable habitat occurs within the Subject Land, of which 40.24 ha occurs within the extraction area.

All of the vegetation communities identified as suitable habitat for the species are typically structured with a medium density canopy, shrubby heath layer on a sandy substrate. Floristic surveys (Kleinfelder 2016) identified high floristic diversity across the site including 31 species of leguminous perennials which are favoured by the New Holland Mouse (Kemper & Wilson 2008) and a high occurrence of Common Bracken, also favoured by the species.

Recent disturbance history is evident across this area, with a fire event occurring in October 2013 and sand mining occurring in the 1970s. An assessment of previously sand mined areas identified that although the optimum time for New Holland Mouse succession into rehabilitated

areas is long past (eight to nine years post rehabilitation), the current structural complexity of the area and the recent fire event make the area suitable habitat.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This includes populations that are key source populations for breeding and/or dispersal, populations that are necessary for maintaining genetic diversity and/or populations that are on the edge of species' ranges.

Eleven metapopulations of the New Holland Mouse have been recorded since European settlement however, analysis of state wildlife data indicate there may be only six to eight populations (TSSC 2010) remaining. An estimate of total numbers is less than 10,000 individuals (Menkhorst *et al.* 2008) and is likely to be declining. As such, any remaining population of the New Holland Mouse must be considered as important.

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 New Holland Mouse has not been recorded in the Subject Land, however; 113 ha of suitable habitat occurs within the site, suitable habitat occurs extensively in adjacent areas, 40 confirmed records occur within 10 km of the site, and a fire event in 2013 occurred within the site, making the likelihood of this species occurrence high. Based on this evidence, any individuals within the site would be part of the Port Stephens New Holland Mouse metapopulation.

The proposed project will result in the removal of 40.24 ha of suitable habitat within the Subject Land. This amount of habitat removal will no doubt have an impact on any individuals using the Subject Land. However, the fire that impacted the site in 2013 also covered a much larger area to the north of the Subject Land (Attachment_2). An assessment of the amount of suitable habitat for the New Holland Mouse within the area covered by the 2013 fire was undertaken to inform the assessment. Vegetation communities mapped by the *Vegetation of the Tomago and Anna Bay Sandbeds* (Bell and Driscoll 2006) within the fire affected area was assessed for habitat suitability. The following vegetation communities that were assessed as suitable habitat occurred within the fire affected area; Clay Wallum Scrub (3ai), Earp's Gum – Peppermint Scrubby Forest (3aii, 4ciii), Earp's Gum Sedge Woodland (4d), Forest Oak – Stringybark – Apple Forest (1e), Peppermint – Apple – Bloodwood Forest (1aii), Scribbly Gum – Apple – Bloodwood Forest (1b) and Tomago Blackbutt – Apple – Bloodwood Forest (1ai, 1aii). It should be noted that areas of rehabilitation have not been included in this assessment

(as rehabilitated vegetation types cannot be confidently assumed as representing suitable habitat), as such it is likely that there is a much larger area of suitable habitat in the fire affected area.

A total of 1,543.90 ha of suitable habitat was assessed as occurring on the sandbeds within the fire affected area, combined with the 76.36 ha of suitable habitat retained within the Subject Land, there is a total of 1,620.26 ha available. As such, the proposed action will remove approximately 2.48% of the suitable habitat from the area. Additionally, the proposed extraction will occur progressively, with a maximum of 9.16 ha being cleared in the first two years. Assuming that the first two years of extraction occur in 2017 and 2018, the proposal will only be removing habitat within the optimal range for New Holland Mouse succession (three to five years post fire) for the first two years of extraction. Additionally, further habitat will be created through the progressive rehabilitation of the extraction area.

Due to the high availability of suitable habitat with the same disturbance history as that within the extraction area, it is unlikely that the proposed action will lead to the long-term decline of an important population of the species.

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

Due to the availability of suitable habitat adjacent to the extraction area, the proposed action will not reduce the area of occupancy of an important population.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of vegetation in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, movement corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

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

There is no recovery plan for the species, as such no critical habitat has been defined. However, it is reasonable to assume that due to the specific habitat requirements of the species, that areas of suitable habitat that have undergone the appropriate disturbance regime could be classified as critical to the survival of the species. As such, the habitat within the Subject Land could be classified as critical to the survival of the species.

The proposed action will impact on approximately 2.48% of identified suitable habitat for the species within the 2013 fire affected area. Due to the relatively small impact on this habitat, it is unlikely to adversely affect habitat critical to the survival of the species. Additionally, the proposed extraction will occur progressively, with a maximum of 9.16 ha being cleared in the first two years. Assuming that the first two years of extraction occur in 2017 and 2018, the proposal will only be habitat within the optimal range for New Holland Mouse succession (three to five years post fire) for the first two years of extraction. Additionally, further habitat will be created due to the proposal through the progressive rehabilitation of the extraction area.

- *disrupt the breeding cycle of an important population*

Breeding takes place late winter to early summer, followed by a gestation period of 32 – 39 days (Kemper & Wilson 2008). Timing of breeding events is related to abundance and quality of food resources which coincides with rainfall patterns and fire succession (Fox et al. 1993).

At present, suitable habitat within the Subject Land is three years post fire event, thus placing the habitat within the optimal range for New Holland Mouse succession (three to five years post fire). As such, successful breeding within any potentially occurring portion of the local population has the potential to be disturbed by the proposal.

Due to the stage nature and relatively small area of habitat removal, in the context of the available habitat in the area, it is unlikely that any potential disruption to the species breeding will be significant.

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

A total of 1,543.90 ha of suitable habitat was assessed as occurring on the sandbeds within the fire affected area, combined with the 76.36 ha of suitable habitat retained within the Subject Land, there is a total of 1,620.26 ha. As such, the proposed action will remove approximately 2.48% of the suitable habitat from the area. Additionally, the proposed extraction will occur progressively, with a maximum of 9.16 ha being cleared in the first two years. Assuming that

the first two years of extraction occur in 2017 and 2018, the proposal will only be removing habitat within the optimal range for New Holland Mouse succession (three to five years post fire) for the first two years of extraction. Additionally, further habitat will be created due to the proposal through the progressive rehabilitation of the extraction area.

As such it is unlikely that the habitat impacts of the proposal will lead to the long term decline of the species.

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

Predation of the species by foxes, wild dogs and cats is a known threat. The proposed action is unlikely to lead to an increase in the threat of these invasive species on the New Holland Mouse. Additionally, a vertebrate pest control program will be implemented as part of the proposed action, which will decrease any potential predation pressures of these invasive species in the Subject Land and surrounds; see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

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

No diseases are listed as contributing the decline of the species. Additionally, it is unlikely that the proposed action would introduce or exacerbate Myrtle Rust and *Phytophthora cinnamomi* (which could impact on the species habitat).

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

The temporary removal of 40.38 ha of habitat for the species is unlikely to interfere with its recovery. Additionally, the progressive rehabilitation of the extraction area will create areas of suitable habitat for the species in the future.

Grey-headed Flying-fox

The Grey-headed Flying-fox occurs along the eastern seaboard of Australia roosting in communal colony sites, which are used permanently, annually, or occasionally depending on food availability (Tidemann, 1995). Colonies can vary considerably in size from hundreds to many thousands of individuals, and fluctuate according to food resources (Parry-Jones & Augee 1991; Tidemann, 1995). Fruits from numerous rainforest trees and other myrtaceous species form a large component of their diet, and consequently mass nomadic movements occur throughout their range in response to fruit availability. Large colonies are very vocal even during the day, and can significantly damage roost trees by their sheer weight of numbers.

“The Grey-headed flying fox must be acknowledged as being highly significant to the health and maintenance of many ecosystems in eastern Australia. The species performs the ecosystem services of pollination and seed dispersal for a wide range of native trees, including commercially important hardwood and rainforest species. It thus contributes directly to reproduction, regeneration and the evolutionary processes of forest ecosystems. Flying-foxes are unique in the large distances they disperse pollen and seeds. The population of Grey-headed flying fox must be of sufficient size for this to continue. If numbers were reduced to small or localised groups, then rainforest seed dispersal and hardwood pollination processes would be severely curtailed” (Eby, 2000).

The species was recorded foraging within the Subject Land during field surveys. No roosting camps were identified within the Subject Land. All areas of native vegetation within the extraction area and offset area are potential foraging habitat for the species.

It is unknown if the individuals utilising the Subject Land form part of an important population; while the Subject Land is not at the extent of the species range, the population may be an important source population for breeding or dispersal, or important for maintaining genetic diversity. As such the precautionary principle has been applied and the Subject Land was assessed as forming part of the range of an important population of the species.

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 proposed action would temporarily remove 40.38 ha of foraging habitat for the species. Due to the high availability of foraging habitat to be retained within the offset area and also protected within the Tilligerry SCA, it is unlikely that the removal of the habitat from the extraction area would lead to the long term decline of the population.

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

Due to the availability of suitable habitat in the area surrounding the extraction area (both within and adjacent to the Subject Land), the proposed action will not reduce the area of occupancy of the species.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of

native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land, however, no barriers to movement will be created. Due to the highly mobile nature of these species the proposal will not cause the fragmentation of a population of the species.

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

Based on the criteria detailed in the Draft National Recovery Plan for the Grey-headed Flying-fox, the habitat within the extraction area has the potential to be critical to the survival of the species as it may support a continuously occupied camp (DECCW 2009). The proposed action will not adversely affect this habitat due to the relatively small area of removal, considering the high availability of suitable habitat within, and to the north of, the Subject Land.

- *disrupt the breeding cycle of an important population*

As no camps were identified within the Subject Land, the proposed action is unlikely to disrupt the breeding cycle of an important population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such the removal of 40.38 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

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

No introduced invasive species are identified as threatening the species. Competition with the Black Flying-fox is identified as a threat to the species (DECCW 2009). The proposed action is unlikely to increase the abundance or activity of the Black Flying-fox in the locality.

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

Australian bat lyssavirus can cause disease and mortality in Grey-headed Flying-foxes when Flying-foxes undergo significant ecological stress (DECCW 2009). The proposed action is unlikely to cause significant ecological stresses for the species, as such it is unlikely to lead to the species decline due to the relatively small area of temporary habitat removal.

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

The proposed action may contravene the objectives of the recovery plan if the habitat to be impacted is 'critical habitat'. However, the temporary loss of 40.38 ha habitat for this species is unlikely to impact on its recovery.

2.3 PLANTS

Commersonia prostrata

Commersonia prostrata is a prostrate shrub forming dense mats to 1 m across and only 5 cm high. Stems and branches are sparsely covered with stellate hairs. Leaves are ovate to lanceolate. Flowering is mainly between October and November. Initially white, the petals turn pink with age. Fruits can be found during spring to summer (Harden 2000).

Habitat occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) Woodland at Rose Lagoon; Blue-leaved Stringybark (*E. agglomerata*) Open Forest at Tallong; and in Brittle Gum (*E. mannifera*) Low Open Woodland at Penrose; Scribbly Gum (*Eucalyptus haemastoma*)/ Swamp Mahogany (*E. robusta*) Ecotonal Forest at Tomago (OEH 2015a).

Dwarf Kerrawang occurs on the Southern Tablelands (one plant at Penrose State Forest, one plant at Rows Lagoon and one plant at Tallong) and on the North Coast (less than 100 plants at the Tomago Sandbeds north of Newcastle). It is also found in Victoria (OEH 2015a). A total of 10 records for this species occur in the Hunter-Central Rivers CMA region (NSW Wildlife Atlas). These records are confined to the Tomago Sandbeds to the north of the Subject Land, between Masonite Road and Oyster Cove Road. Nine of these records occur within 10 km of the Subject Land. The closest record is located approximately 900 m north-west.

Habitat for the species within the Subject Land occurs primarily within the Tomago Sand Swamp Woodland, with habitat also present along the peripheries of the Swamp Mahogany – Paperbark Swamp Forest, particularly the areas in the north-east of the Subject Land where the Swamp Forest intergrades with the Coastal Sand Wallum Woodland-Heath and the Coastal Sand Apple – Blackbutt Forest. No areas of Tomago Sand Swamp Woodland will be impacted on due to the proposal and 0.13 ha of Swamp Mahogany – Paperbark Swamp Forest will be removed.

The species was not identified during the field surveys, however, all areas of suitable habitat for the species were not extensively searched as they occur outside the proposed disturbance area.

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*

The proposed action will impact on 0.13 ha of potential habitat for this species, the main area of suitable habitat for the species (Tomago Sand Swamp Woodland and peripheries of Swamp Forest in north-east) will not be impacted. Additionally, the proposed action will not substantially modify the ground or surface water hydrology, and it is unlikely that there will be modification any areas of habitat for this species due to the proposed action. As such it is unlikely that the proposed action will lead to the long-term decline in a population.

- *reduce the area of occupancy of the species*

The proposed action will remove 0.13 ha of habitat for the species. There is a large amount of habitat for the species that will be retained within the offset area and to the north of the Subject Land (Tilligerry SCA). As such, it is unlikely that the proposed action will reduce the area of occupancy of the species.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/ south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment a potentially occurring local population.

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

The National Recovery Plan for the Dwarf Kurrumbidgee *Rulingia prostrata* (Carter and Walsh 2010) did not identify habitat critical to the survival of the species (to be conducted as part of a recovery action).

It is unlikely that the area of habitat to be impacted by the action (0.13 ha of Swamp Forest) is critical to the survival of the species. Higher quality habitat for the species occurs in the north of the Subject Land; Tomago Sand Swamp Woodland and the peripheries of the Swamp Mahogany – Paperbark Swamp Forest in the north-east. This area will not be impacted on due to the proposed action, at its closest point, the extraction area is 180 m from this area of habitat, and will not be impacted on

- *disrupt the breeding cycle of a population*

The proposed action will only impact on 0.13 ha of potential habitat and will not fragment or isolate any areas of habitat for the species. Additionally, the highest quality habitat for the species within the Subject Land occurs outside the extraction area and it is unlikely that there will be any indirect impacts on this habitat. As such, it is unlikely that the proposed action will disrupt the breeding cycle of a population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such the removal of 0.13 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

- *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 recovery plan for the species identifies impacts from introduced and native environmental weeds as a threat to the species in Victoria, and populations in NSW appear to be less at risk (Carter and Walsh 2010). However, there is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implemented as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.

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

The species is susceptible to impacts from *Phytophthora cinnamomi*. *Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Evidence of this disease was not identified within the Subject Land, however, it is known to occur in the region. It is not expected that the proposal will introduce or exacerbate the spread of this disease. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere with the recovery of the species.*

The proposed action does not contravene any of the objectives of the recovery plan for the species (Carter and Walsh 2010). Additionally, as the proposed action will only impact on 0.13 ha of habitat for the species it is unlikely that it will interfere with the recovery of the species.

Eucalyptus camfieldii

Eucalyptus camfieldii is a tree or mallee to 10 m high with orbiculate, cordate, glossy green and hispid juvenile leaves. Adult leaves are broad-lanceolate, 7 – 10 cm long, 2 – 3 cm wide, green and glossy. Buds are sessile, broadly ovoid and angular. The species occurs in coastal shrub heath on sandy soils on sandstone, often of restricted drainage (Hill 2002).

The identification of the species on the Tomago Sandbeds (and other locations on the Central Coast) in the 1990's was an extension of the species range, which had previously been restricted to the Hawkesbury Sandstone geology of the Sydney Basin (Hill 2003; Bell and Driscoll 2006). The extent of the population on the Tomago Sandbeds is not well known, with only four Atlas records (two of which are within the Subject Land). Additionally, Bell and Driscoll (2006) noted that the individual occurred at five locations on the Tomago Sandbeds.

A total of 1,868 *E. camfieldii* individuals were recorded on the Subject Land. Of these individuals, 229 occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) and 1,639 occur naturally, predominantly within the Coastal Sand Wallum Woodland-Heath. The

individuals within the Subject Land that occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) are not considered to be naturally occurring. It is highly unlikely that the species would have been present in this area prior to heavy mineral sand mining in the 1970's. The majority of the naturally occurring population within the Subject Land was identified at lower elevations, typically below 6 m elevation, within the Coastal Sand Wallum Woodland-Heath and Tomago Sand Swamp Heath. Only a few individuals were identified within the Coastal Sand Apple Blackbutt Forest; these individuals occur at elevations below 9 m in areas which are co-dominated by *Eucalyptus piperita* (Sydney Peppermint) and with *Melaleuca nodosa* (Prickly-leaved Paperbark) in the understorey. As such, it is likely that all individuals have been planted or seeded into this area during rehabilitation works.

A survey of the extent of the local population was undertaken. The total local population of *E. camfieldii* identified during these surveys was 2,263 individuals; 1,868 within the Subject Land, 334 within Mine Rehabilitation areas to the west and north, and 61 within an area of Peppermint – Apple – Bloodwood Forest (mapped by Bell and Driscoll (2006)), to the north of the Subject Land. However, it is likely that the local population is larger than that identified during the field surveys, as not all areas of rehabilitation or Peppermint – Apple – Bloodwood Forest within the locality were surveyed, see Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Project Website)).

All patches of *E. camfieldii* identified during the field surveys occur within 3 km of the individuals within the Subject Land and are within vegetation that is contiguous with the Subject Land. All of these individuals were assessed as being part of the local population as it is likely that they are cross-pollinating with individuals within the Subject Land, as highly mobile species, such as birds, bats and insects, are pollinators for *Eucalypts* (House 1997). As such, there is the potential for genetic material to be spread a long distance (Pots and Wiltshire 1997).

The proposal would result in the removal of 227 *E. camfieldii* individuals within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) on the Subject Land. This represents a total of 12% of the population within the Subject Land. In relation to the total estimated local population, the impacts equate to a total removal of 10% of the local population.

The proposal will remove individuals that are not naturally occurring as they have been seeded/planted following rehabilitation. The majority of the area in which they occur was not assessed as potential habitat for the species. Suitable habitat for the species within the disturbance area occurs in low lying areas which adjoin the Coastal Sand Wallum Woodland-Heath. The species was identified in these ecotonal areas where *E. piperita* and *M. nodosa* occur.

There is the potential for indirect impacts on 197 individuals occurring within 50 m of the extraction area. These individuals occur adjacent to the disturbance area and as such, there is the potential for indirect impacts through habitat modification. However, these impacts are unlikely to significantly impact on the reproductive potential or health of the retained individuals, as the disturbance will not be permanent, with progressive rehabilitation occurring within the disturbance area.

The proposal was assessed as not significantly modifying the hydrology of the area (surface or groundwater). As such, indirect impacts to the retained population due to changes in hydrology are unlikely to occur.

The proposal will remove approximately 10% of the local population (227 individuals), the majority of which (201 individuals) have been seeded/planted into the rehabilitation area and are not naturally occurring. The potential for indirect impacts (edge effects from the extraction area) on the adjacent population within the Subject Land will be temporary as the site will be progressively cleared and rehabilitated.

The location of *E. camfieldii* individuals within the Subject Land and the individuals identified as occurring within the local population is shown on Figure 2 of the Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)). The population of *E. camfieldii* within the Subject Land was assessed as important as it occurs near the limit of the species range.

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 proposal will require the removal of 227 individuals (10% of the local population). Due to the relatively small impact (10%) this is not assessed as a significant decrease in the population. Additionally, the species will be used within the rehabilitation of the disturbance area, which will re-instate the removed individuals. This mitigation measure has been proven to be successful for the species, which is evident through its presence within rehabilitation of the proposed disturbance area (see Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)) for vegetation descriptions).

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

While the proposal will remove some individuals from the local population, it will not reduce the area of occupancy as the majority of the local population, including a number of individuals within and directly adjacent to the Subject Land, will be retained.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. Habitat for the species occurs to the north of the Subject Land (Peppermint – Apple – Bloodwood Forest).

The local population that was identified as seven clusters of individuals that occur within approximately 3 km of each other. The proposal will remove a total of 19.01 ha of occupied vegetation (including 227 individuals) from the largest cluster within the local population. However, this removal will not cause the fragmentation into two or more populations. All individuals within the local population will still be connected via areas of remnant native vegetation post extraction, and the distance between clusters will not be increased (i.e. no additional distance for pollination vectors). Additionally, the disturbance area will not represent a hostile barrier as it will be progressively cleared and rehabilitated, including the use of *E. camfieldii* within the rehabilitation.

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

The habitat in which the individuals within the disturbance area occur is unlikely to be critical to the survival of the species as it was only assessed as marginal habitat. As outlined above the naturally occurring population within the Subject Land was typically in lower lying areas, within the Coast Sand Wallum Woodland-Heath (within the offset area). Within the disturbance area the low lying ecotonal areas which adjoin the Coastal Sand Wallum Woodland-Heath where *E. piperita* and *M. nodosa* occur, represent suitable habitat for the species. As the species can occur within these ecotonal areas, the exact area of suitable habitat is hard to define. As such, all areas in the north of the extraction area that occur below 9 m (highest elevation at which the species was identified on-site) and which adjoin the Coastal Sand Wallum Woodland-Heath were assessed as suitable habitat. Based on this definition, a total of 11.17 ha of suitable habitat for the species will be impacted (0.04 ha of Coastal Sand Wallum Woodland-Heath, 6.42 ha remnant Coastal Sand Apple – Blackbutt Forest and 4.7 ha of rehabilitation). Due to the small area of removal it is unlikely that the habitat to be removed is critical to the survival of the species.

A total of 12.37 ha of suitable habitat for the species has the potential to be modified within the Subject Land, as it occurs within 50 m of the extraction area. However, due to the temporary nature of the disturbance (progressive clearing and rehabilitation) it is unlikely that the disturbance will adversely affect this area of habitat.

There is no national recovery plan for the species and no areas of critical habitat have been defined. The Office of Environment and Heritage has developed a targeted strategy for this species under the Saving Our Species program. This species has been assigned to the 'site-managed species' management stream as this species is considered to require 'site-based management in order to secure it from extinction in NSW for 100 years'. Four management sites have been established at Mangrove Creek Dam, Kur-ring-gai Chase National Park, North Head Sydney Harbour, and Royal National Park. The proposal does not impact on any of these management areas (all located over 50 km south of the Subject Land).

- *disrupt the breeding cycle of an important population*

The proposal will progressively remove 227 individuals from within the disturbance area, which will reduce the number of individuals within the local population (i.e. decrease the genetic pool). However, as the majority of the local population will be retained (90%), and will remain connected, it is unlikely that the removal of these individuals will impact on the breeding cycle of the population.

The proposal will also potentially cause edge effects to the surrounding occupied habitat (approximately 12.37 ha), as such there is the potential to disrupt pollinators. However, this is unlikely to be a significant disruption as operations will move progressively through the extraction area and any potential disturbances to pollinators (birds and bats) through increased noise and human activity will be limited.

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

As outlined above the proposal will impact on approximately 11.17 ha of suitable habitat, potentially modify (through indirect impacts) a further 12.37 ha of occupied habitat, and no habitat will be isolated. Due to the limited impacts of the proposal and the availability of habitat in the area (both within the Subject Land and in adjacent areas), it is unlikely that any impacts to habitat will cause the species to decline.

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

There is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implanted as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.

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

Potential harmful diseases which *E. camfieldii* is susceptible to include Myrtle Rust and *Phytophthora cinnamomi*.

Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death.

Phytophthora cinnamomi is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Evidence of these two diseases was not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

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

Habitat loss and disturbance, and possible in-breeding in small populations have the potential to threaten the species. The proposal will directly impact on 11.17 ha of marginal habitat, and there is the potential to indirectly impact on 12.37 ha of habitat, and the proposal will temporarily remove approximately 10% of the local population. As outlined in the above sections, due to the small area of impact, within predominately marginal habitat, and as the

species will be used in the rehabilitation, impacts of the proposal on the local population were not assessed as significant and it is unlikely to interfere with the recovery of the species.

Eucalyptus parramattensis* subsp. *decadens

Eucalyptus parramattensis subsp. *decadens* is a small smooth-barked tree to 15 m tall (although generally around 7 m) with white or grey bark that does not shed cleanly. Leaves are 7-20 cm long and 4-3.5 cm wide; discolours and flowering occurs from November to January (Hill 2002). The species generally occurs in dry sclerophyll woodland with dry heath understorey on deep, low-nutrient sands, in areas subject to periodic inundation or which have relatively high water tables.

Bell (2006) identifies the *E. parramattensis* subsp. *decadens* individuals in the Subject Land as part of one of nine sub-populations of this species on the Tomago Sandbeds; the RAAF Williamstown West sub-population. The assessment conducted by Bell (2006), which is based on Atlas records, identifies the RAAF Williamstown West and the RAAF Williamstown East sub-populations as forming the majority of the meta-population on the Tomago Sandbeds.

A total of 864 *E. parramattensis* subsp. *decadens* individuals were recorded on the Subject Land. Of these individuals, 283 occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) and 581 occur naturally in the north of the Subject Land predominantly within the Tomago Sand Swamp Woodland. The individuals within the Subject Land that occur within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) are not considered to be naturally occurring. It is highly unlikely that the species would have been present in this area prior to heavy mineral sand mining in the 1970's as it does not represent potential habitat for the species, due to the elevation of this area. The naturally occurring population of the species on site occurs in lower lying areas subject to periodic inundation. As such, it is likely that all individuals have been planted or seeded into this area during rehabilitation works.

The local population of the species has conservatively been classified as the RAAF Williamstown West sub-population (as defined by Bell 2006). This is considered to be appropriate for the assessment as: the Subject Land is contiguous with the whole sub-population through vegetated areas; successive records within the sub-population are separated by less than 1 km (Bell 2006); and, the species is likely to be pollinated by foraging birds, bats and insects, as with most eucalypts, hence material has the potential to be spread kilometres (OEH 2011). The size of the local population was estimated as part of this assessment to be 40,214 individuals (see Ecological Assessment Summary Report (Response to Submissions Part 3 (Major Projects Website)) for methodology).

The proposal would result in the removal of 230 *E. parramattensis* subsp. *decadens* individuals within the Coastal Sand Apple – Blackbutt Forest (Rehabilitation) on the Subject Land. This removal represents a total of 27% of the population within the Subject Land. In relation to the total estimated local population, the impact equates to a total removal of 0.57% of the local population.

The proposal will remove individuals that are not naturally occurring as they have been seeded/ planted following rehabilitation. The area in which they occur was not assessed as potential habitat for the species, due to its elevation.

There is the potential for indirect impacts on 54 individuals occurring within the rehabilitation area that occur within 50 m of the extraction area. These individuals occur within close proximity to the disturbance area and as such, there is the potential for habitat modification.

The proposal was assessed as not significantly modifying the hydrology of the area (surface or groundwater). As such, indirect impacts to the retained population due to changes in hydrology are unlikely to occur.

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 RAAF Williamstown West sub-population (of which the individuals within the Subject Land form part of) is part of the Tomago Sandbeds Meta-population. As this is only one of two meta-populations of the species, the individuals within the Subject Land have been classified as forming part of an important population as the local population is key for breeding and dispersal, and maintaining genetic diversity.

The proposal will remove approximately 230 planted/ seeded individuals, which was assessed as representing an impact on 0.57% of the local population. There is limited potential for indirect impacts on naturally occurring individuals within the Subject Land, as at its closest point the disturbance area occurs approximately 180 m from the naturally occurring population within the Subject Land. Additionally, the proposal will not significantly modify the hydrology of the area, indirect impacts from changes to hydrology area unlikely.

As the proposal will only impact on a small proportion of the local population and it is unlikely to cause indirect impacts, it is unlikely that it will lead to the long-term decline in the population.

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

While the proposal will remove some individuals from the local population, it will not reduce the area of occupancy as the majority of the local population, including a number of individuals within and directly adjacent to the Subject Land, will be retained.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. Habitat for the species occurs to the north of the Subject Land, throughout the sub-population area (Clay Wallum Scrub and Earp's Gum Sedge Woodland displayed on Figure 4 of the shows the distribution of habitat for the species in the sub-population area; total of 393.13 ha).

The proposal will remove a total of 19.01 ha of occupied vegetation from the south of the local population, including 230 individuals. However, this removal will not cause the fragmentation into two or more populations. All individuals within the local population will still be connected via areas of remnant native vegetation post extraction, and the distance between individuals will not be increased (i.e. no additional distance for pollination vectors). Additionally, the disturbance area will not represent a hostile barrier as it will be progressively cleared and rehabilitated.

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

A Draft National Recovery Plan (OEH 2011) has been prepared for this species. The plan outlines that the species occupies more than 2,500 hectares, and that it all contributes to the long-term conservation of the species. Other criteria used to assess the potential of a significant impact on the species are considered more useful (OEH 2011).

As outlined above the habitat to be impacted was not assessed as suitable for the species (due to its elevation and that it is not subject to periodic inundation). As such it is unlikely to be critical to the species survival.

- *disrupt the breeding cycle of an important population*

The removal of approximately 0.57% of the local population will not significantly reduce the genetic diversity of the local population. The proposed activity will not cause any parts of the local population to become isolated, and in-turn the breeding potential of any areas of the population will not be limited. Additionally, it is unlikely that there will be any indirect impacts on the naturally occurring individuals in the north of the Subject Land (approximately 180 m

from the disturbance area). As such it is unlikely that the proposed action will disrupt the breeding cycle of an important population of the species.

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

As outlined above the proposal will not impact on any areas of suitable habitat for the species. Additionally, indirect impacts on habitat are unlikely as the disturbance area is located approximately 180 m from areas of suitable habitat and substantial modification of the surface and groundwater hydrology are unlikely to occur due to the action. As such it is unlikely that any impacts to habitat will cause the species to decline.

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

As areas of suitable habitat for the species occur approximately 180 m from the proposed disturbance area, it is unlikely that the action will result in an invasive species becoming established in habitat for *E. parramattensis* subsp. *decadens*. Furthermore, to limit the potential spread of weeds from the disturbance area into the offset area, a weed control program will be implanted as part of the action. This will involve regular inspections of the disturbance area interface being conducted and follow-up weed control for the life of the project (until rehabilitation is signed off), see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)).

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

Potential harmful diseases which *E. parramattensis* subsp. *decadens* is susceptible to include Myrtle Rust and *Phytophthora cinnamomi*.

Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death.

Phytophthora cinnamomi is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

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

A Draft National Recovery Plan (OEH 2011) has been prepared for this species. Four specific recovery objectives are identified in this plan; Distribute information that assists in conserving and managing Earp's Dirty Gum; Ensure appropriate use of Earp's Dirty Gum in rehabilitation projects; Raise awareness of Earp's Dirty Gum and facilitate community involvement in the recovery plan; and, Ensure appropriate protection of the Fern Bay form. The proposed action will not interfere with these objectives.

Additionally, this recovery plan also identifies habitat loss and fragmentation, and habitat degradation due to frequent fire and human disturbance as the main threats to the survival of the species. The proposal will not result in any habitat loss or fragmentation, or will it result in frequent fires. Additionally, the proposal will further secure the Subject Land through installation of boundary fencing in the south and secure access points along Cabbage Tree Road, which will limit unauthorised human access to the site.

Grevillea parviflora subsp. parviflora

Grevillea parviflora subsp. parviflora is a dense spreading low shrub growing to 1 m in height, occurring from Prospect and the lower Georges River, to Camden, Appin and Cordeaux Dam area. Disjunct northern populations also occur near Putty, Cessnock and Cooranbong (Makinson 2002). The species reportedly occurs in heath and shrubby woodland, in sandy or lightly clay soils usually over thin shales (Olde & Marriot 1995; Makinson 2002). The species is lignotuberous and is capable of resprouting following fire and other disturbances. Regionally, *G. parviflora subsp. parviflora* is known to occur within Karuah Nature Reserve (Port Stephens Shire: Bell 2002) and Lower Hunter National Park (Cessnock Shire; Bell 2001), although no information is available on population sizes.

A total of 102 individuals were identified in the northern part of the Subject Land, primarily within the Tomago Sand Swamp Woodland and Coastal Sand Wallum Woodland – Heath. Species occurs in the north of the Subject Land, it was noted during surveys off-site for other species that the population extends the north of the Subject Land (within the Tilligerry SCA). As the full extent of the population is not known, the precautionary principal was applied and it is assumed that the individuals within the Subject Land form part of an important population.

As records of the species along the Sandbeds are scattered, the local population may be an important source or linking population to maintain genetic diversity along the Sandbeds.

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 proposed action will not directly impact on the occurrence of the population within the Subject Land. Additionally, it is unlikely that the proposed action will impact on the habitat of the species retained within the Subject Land (modification of surface and groundwater hydrology unlikely) As such, it is unlikely that the proposed action will lead to the long-term decrease of an important population of the species.

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

The proposed action will not reduce the area of occupancy of an important population as the species will not be directly impacted on, and losses from indirect impacts are unlikely.

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

The population identified within the Subject Land occurs along the northern boundary and extends off-site to the north. Additionally, a record of the species occurs approximately 300 m to the west of the extraction area. As the proposed extraction area will not directly remove any individuals it will not fragment the known population within the Subject Land. Additionally, the population within the Subject Land will still be connected via areas of remnant native vegetation to the recorded individual to the west of the Subject Land.

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

There is no recovery plan for the species, as such no critical habitat has been identified. It could be assumed that areas of high quality habitat (those with limited disturbance and a known population) would be critical to the survival of the species.

The proposed action will remove 40.38 ha of potential habitat for the species, however, 19.01 ha of this is rehabilitation and is unlikely to be high quality habitat. The proposed action was not assessed as substantially modifying the hydrology of area, as such indirect impacts on areas of retained habitat are unlikely. As such, the proposed action is unlikely to adversely affect habitat critical to the survival of the species.

- *disrupt the breeding cycle of an important population*

As the known population within the Subject Land occurs approximately 350 m from the disturbance area (at its closest point), It is unlikely that there will be any indirect impacts on the individuals within the offset area, or any significant impacts on the species pollinators (insects). As such it is unlikely that the proposed action will disrupt the breeding cycle of an important population of the species.

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

As outlined above the proposal will impact on approximately 40.38 ha of potential habitat for the species (19.01 ha was not assessed as high quality), it is unlikely that the proposal will indirectly impact on habitat for the species and no habitat will be isolated. Due to the limited impacts of the proposal and the availability of habitat in the area (both within the Subject Land and in adjacent areas), it is unlikely that any impacts to habitat will cause the species to decline.

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

There is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implanted as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.

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

Grevillea parviflora subsp. *parviflora* is susceptible to *Phytophthora cinnamomi*, and Myrtle Rust can impact on the species habitat.

Phytophthora cinnamomi is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora cinnamomi* occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Myrtle Rust is a disease caused by the exotic fungus *Puccinia psidii*. It infects species of the Myrtaceae family and causes leaf deformation, defoliation, reduce fertility, dieback, stunted growth, and plant death.

Evidence of these two diseases were not identified within the Subject Land, however, they are known to occur in the region. It is not expected that the proposal will introduce or exacerbate any of these diseases that may cause the species to decline. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

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

Habitat loss and disturbance, and weed invasion (from over abundant native species). The proposal will not directly impact on any individuals, additionally the proposed action will not significantly reduce the availability of quality habitat for the species. As such, it is unlikely that the proposed action will interfere with the recovery of the species.

Persicaria elatior

Persicaria elatior is an erect herb to 90 cm tall, with stalked, glandular hairs (i.e. they are knobbed when seen under a lens) on most plant parts. Its leaves are up to 11 cm long and 30 mm wide. A sheath encircles the stem at the base of each leaf, which is characteristic of its plant family. Its tiny flowers are in long, narrow spikes to 5 cm long. The pink flower-segments are less than 4 mm long (Harden 2002).

Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests), and also occurs in Queensland. This species normally grows in damp places beside streams and lakes and occasionally in swamp forests or associated with disturbance (OEH 2014).

Habitat for the species within the Subject land occurs within the Swamp Mahogany – Paperbark Swamp Forest and Coastal Wet Cyperoid Heath, where areas of permanent water occur. The proposed action will remove on 0.13 ha of Swamp Mahogany – Paperbark Swamp Forest, which represents potential habitat for the species.

The species was not identified during the field surveys, however, all areas of suitable habitat for the species were not extensively searched as they occur outside the proposed disturbance area. Three records of the species in the locality (10 km), two approximately 4.5 km north-west

near Raymond Terrace (from 2010) and a third approximately 450 m to the north of the Subject Land (from 1970).

Due to the scattered nature of records for the species along the east coast, it has been assumed that any potentially occurring local population is an important population.

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 proposed action will impact on 0.13 ha of potential habitat for this species. Additionally, the proposed action will not substantially modify the ground or surface water hydrology, and it is unlikely that there will be modification of any areas of habitat for this species due to the proposed action. As such it is unlikely that the proposed action will lead to the long-term decline in a population.

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

The proposed action will remove 0.13 ha of habitat for the species. There is a large amount of habitat for the species that will be retained within the offset area and to the north of the Subject Land (Tilligerry SCA). As such, it is unlikely that the proposed action will reduce the area of occupancy of the species.

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

The Subject Land occurs on the edge of a large patch of vegetation that extends along the sandbeds to the west and east. The proposal will temporarily remove a total of 40.38 ha of native vegetation from the edge of this corridor. As such, the proposal will not fragment any areas of habitat extending off the site.

Within the Subject Land the proposal will cause some minor fragmentation of two areas of habitat in the west/ south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such, the proposal will not fragment a potentially occurring local population.

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

There is no recovery plan for the species, as no areas of critical habitat have been identified.

It is unlikely that the area of habitat to be impacted by the action (0.13 ha of Swamp Forest) is critical to the survival of the species. Large areas of potential habitat for the species occur within the Subject Land and along the Sandbeds to the north.

- *disrupt the breeding cycle of an important population*

The proposed action will only impact on 0.13 ha of potential habitat and will not fragment or isolate any areas of habitat for the species. Additionally, the highest quality habitat for the species within the Subject Land occurs outside the extraction area and it is unlikely that there will be any indirect impacts on this habitat. As such, it is unlikely that the proposed action will disrupt the breeding cycle of a population.

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

There is a large amount of suitable habitat for the species to be retained within the Subject Land and in areas to the north within the Tilligerry SCA. As such the removal of 0.13 ha of habitat within the extraction area is unlikely to lead to the decline of the species.

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

There is the potential for the proposal to introduce weed species into the retained habitat within the offset area. A weed control program will be implanted as part of the quarry, with regular inspections of the disturbance area interface being conducted, see the Environmental Management Plan (Response to Submissions Part 7 (Major Projects Website)). As there will be regular inspections and follow-up weed control for the life of the project (until rehabilitation is signed off) it is unlikely that a harmful species will become established within the species habitat.

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

The species is susceptible to impacts from *Phytophthora cinnamomi*. *Phytophthora cinnamomi* is a pathogen which infects the plant roots and causes disease and plant death. Infection of susceptible ecological communities can result in modification of the community, reduction in functionality and habitat loss or degradation for dependant flora and fauna species. The pathogen is spread in water, soil or plant material that contains the pathogen. *Phytophthora*

cinnamomi occurs in all Australian states and territories (except NT), and is well established in many of the higher rainfall areas of the country.

Evidence of these this disease was not identified within the Subject Land, however, it is known to occur in the region. It is not expected that the proposal will introduce or exacerbate the spread of this diseases. To limit the potential of spread, all machinery conducting clearing within the extraction area will be clean and free of any soil or vegetative material when it enters the site.

- *interfere with the recovery of the species.*

As the proposed action will only impact on 0.13 ha of habitat for the species it is unlikely that it will interfere with the recovery of the species.

3. LISTED MIGRATORY SPECIES

Eastern Osprey

The Osprey, also known as the Fish-Hawk or White-headed Osprey, is a long-lived, sedentary and cosmopolitan species (Marchant & Higgins 1993). Its core habitat includes bays, estuaries, mangrove swamps, beaches, dunes, cliffs, inshore waters of mainland and islands, and coral and rocky reefs (Roberts & Ingram 1976; Gosper 1981, 1983; Ekert & Brady 2004). In Australia, the Osprey mainly occurs in the coastal zone, covering approximately 75% of the mainland coastline. There are thought to be three disjunct populations: the northern and eastern population occurring from Broome, WA to the south coast of NSW; the southern population from Kangaroo Island to the Great Australian Bight and; the western population from Esperance to Cape Keraudren (Marchant & Higgins 1993).

In NSW, the Osprey occurs from the Queensland/NSW border to the south coast, with a number of inland records. The breeding season for the Osprey occurs from June to October. The Osprey is monogamous and very faithful to the nest-site and nesting territory, and returns to the same nest in successive years (Olsen 1995; Ekert & Brady 2004). The Osprey constructs a large nest, predominantly composed of dead sticks, branches, driftwood, seaweed, bark and woodchips. The nests are constructed on a variety of sites but most commonly in a fork or broken trunk in the upper part of a dead tree or dead crown of a live tree (Clancy 1993; Rose 2000). The diet of the Osprey mainly consists of fish, although small terrestrial vertebrates, seabirds and crustaceans have also been recorded (Marchant & Higgins 1993).

A juvenile individual was identified within the Subject Land during field surveys. A large stick nest was also identified within the Subject Land, however, no species were observed to be utilising the nest at the time of field surveys. The Subject Land occurs within 3 km of suitable foraging habitat for this species (Fullerton Cove), as such it has the potential to provide roosting and nesting habitat for the species. All vegetation within the Subject Land that has a tall canopy layer (all vegetation types except the Coastal Wet Sand Cyperoid Heath and the Tomago Sand Swamp Heath) were assessed as suitable nesting and roosting habitat for the Eastern Osprey. A total of 40.38 ha of habitat will be impacted due to the proposed action, and 103.47 ha will be retained within the Subject Land (of which 101.02 ha will be protected within the offset area).

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*

There are 13 records of the species in the locality (10 km). The majority of the records in the locality (12 of the 13) occur on or within close proximity to Kooragang Island (one record within the Subject Land from field surveys). In the locality, Kooragang Island and other areas of the Hunter Wetlands National Park are likely to represent important habitat for the species as these areas provide both foraging habitat (open water), and roosting and nesting habitat. While the proposed action will impact on 40.38 ha of suitable habitat for the species (with 103.47 ha retained within the Subject Land), it is unlikely to represent important habitat for the species.

There is the potential for indirect impacts on habitat for this species through modification of the groundwater hydrology. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for this 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*

Due to the lifecycle of the species, they are not threatened by invasive predators as they nest high in the tree canopy or high on artificial structures, and they hunt over water bodies rarely landing on the ground (occasionally to eat prey). As such, it is unlikely that the proposed action will result in the establishment of an invasive species that is harmful to the species.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

One juvenile individual was identified within the Subject Land. Additionally, a potential nest was observed, however, no species were identified as occupying the nest during field surveys. There is the potential that the juvenile individual identified within the Subject Land was dispersing and may not have been resident within the Subject Land. However, if there is a resident pair within the Subject Land, the proposed action has the potential to disrupt the lifecycle of these individuals. Any potentially occurring individuals within the Subject Land form part of the 'northern and eastern population' of the species which extends from Broome in WA through to the south coast of NSW. As such, they would form part of a large population, the

exact numbers not known, however, surveys in 1997 – 1999 identified at least 40 pairs from Grassy Head to Old Bar (DoE 2016). As such, any potential impacts within the Subject Land would not affect an ecologically significant proportion of the population.

Rufous Fantail

The Rufous Fantail (*Rhipidura rufifrons*) is a medium to small sized bird that is on average 16 cm long, with a wing span of 21 cm. In Australia the species is scattered in northern Australia, and widespread on the east of the Great Dividing Range along the east coast of NSW and into VIC. In NSW species mostly occurs in dense, moist habitats, mainly in wet sclerophyll forests, often in gullies and usually in areas with a dense understorey of acacias, shrubs, and herbs, and often ferns (Higgins *et al.* 2006).

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*

The Swamp Mahogany – Paperbark Swamp within the Subject Land represents potential habitat for this species. The proposed action will directly impact on 0.13 ha of habitat for this species. The proposed action will not substantially modify the ground or surface water hydrology, and it is unlikely that there will be modification to any areas of habitat for this species due to the proposed action.

Within the Subject Land, the proposal will cause some minor fragmentation of two areas of habitat in the west/south-west of the Subject Land. The proposed extraction area has been revised to ensure no areas of habitat will be isolated. As such, corridors within the Subject Land will be maintained. All areas of vegetation retained within the Subject Land will be linked to other areas of vegetation both within and adjacent to the site. Along the western boundary, areas of habitat will be linked through a retained strip of vegetation that is either 20 m or 50 m wide (depending on the point along the boundary). A corridor of vegetation between the northern and southern extraction areas will also be retained.

As such it is unlikely that the proposed action will lead to a long-term decline in a population.

- *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*

No invasive species are listed as threatening the Rufous Fantail. However, there is the potential of predation on the species by Foxes. A vertebrate pest control program will be implemented as part of the proposed action.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

Due to the relatively small area of direct impacts on suitable habitat for the species (0.13 ha), it is unlikely that the proposed action will disrupt the lifecycle of an ecologically significant proportion of the population.

Snipe Species

- Latham's Snipe
- Swinhoe's Snipe
- Pin-tailed Snipe

These species were not identified during field surveys, but suitable habitat for these species occurs within the Coastal Wet Sand Cyperoid Heath.

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*

The proposed action will not directly impact on any areas of habitat for these migratory species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these 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*

As the proposal will not occur within any areas of habitat for these species it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

None of these species breed in Australia, as such it is unlikely that the proposed action will disrupt their breeding cycle.

These migratory species forage and roost in their Australian range, and migrate between these foraging grounds and breeding territories in the northern hemisphere. It is unlikely that the proposed action will disrupt the lifecycle of these species as the proposed action will not directly impact on their habitat and indirect impacts on habitat are unlikely. Additionally, no parts of the proposed action have the potential to seriously disrupt the lifecycles of an ecologically significant proportion of these species.

Migratory Species with Habitat in Fullerton Cove

- Common Sandpiper
- Ruddy Turnstone
- Sharp-tailed Sandpiper
- Red Knot
- Curlew Sandpiper
- Pectoral Sandpiper
- Red-necked Stint
- Great Knot
- Double-banded Plover
- Greater Sand Plover
- Lesser Sand Plover
- Broad-billed Sandpiper
- Bar-tailed Godwit
- Eastern Curlew
- Little Curlew
- Whimbrel
- Ruff (Reeve)
- Pacific Golder Plover
- Grey Plover
- Little Tern
- Grey-tailed Tattler
- Common Greenshank
- Marsh Sandpiper

All of these species utilise habitat in Australia for foraging only, with breed territories primarily in Asia, or Northern Europe. Habitat for these species occurs within Fullerton Cove. The proposed action will not directly impact on any areas of habitat for these species. There is the potential for indirect impacts through modification of surface and groundwater hydrology as the extraction area occurs upstream of the Hunter Estuary National Park.

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*

The proposed action will not directly impact on any areas of habitat for these migratory species. There is the potential for indirect impacts on these species' habitat through modification of the groundwater hydrology, upstream of the Ramsar Wetland. The proposed extraction level will be restricted to a depth of 0.7 m above the maximum predicted groundwater level, with the final landform at 1 m above the maximum predicted groundwater level. As such it is unlikely that there will be any significant indirect impacts on habitat for these 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*

As the proposal will not occur within or directly adjacent to the habitat for these species (Hunter Wetlands National Park) it is unlikely that it will cause the establishment or spread of an invasive species that is harmful to these species.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species.*

None of these species breed in Australia, as such it is unlikely that the proposed action will disrupt their breeding cycle.

These migratory species utilise Fullerton Cove for foraging and roosting, and migrate between these foraging grounds and breeding territories in the northern hemisphere. It is unlikely that the proposed action will disrupt the lifecycle of these species as the proposed action will not directly impact on their habitat and indirect impacts on habitat are unlikely. Additionally, no parts of the proposed action have the potential to seriously disrupt the lifecycles of an ecologically significant proportion of these species.

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