Flora and Fauna Assessment

River Road Foreshore Management – Coastal Protection Works

Shoalhaven City Council

Version 1.0 – June 2019

Document Tracking

Item	Details
Project	River Road Foreshore Management – Coastal Protection Works – Flora and Fauna Assessment
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1. Introduction

Coastal protection works are proposed for the stabilisation of the Shoalhaven River bank along River Road, Shoalhaven Heads, where periodic flooding, river opening regimes, recreational river use and existing drainage infrastructure have led to the erosion of steepening, unstable banks and loss of vegetation (including large trees) which has served to exacerbate erosion processes.

The works are proposed to stabilise the river foreshore, improve stormwater drainage infrastructure to reduce the environmental impacts caused by current infrastructure, facilitate revegetation and regeneration of the vegetated embankment, and enhance the river foreshore's resilience to processes associated with storm and river-opening events. All works proposed are in accordance with the recommendations of UNSW Water Research Laboratory (WRL 2017) who undertook an assessment of coastal management options to address erosion and destabilisation along the river.

Works will be undertaken within Lot 7004 DP 94785 and Lot 7005 DP 1075719 which are crown land public reserves for which Shoalhaven City Council is the Trust Manager, and within the Shoalhaven River waterway.

2. Project Description

Proposed works involve the following components:

- Rock revetment along a section approximately 251m long (above the high tide water-mark) (Figures 1, 3 and 4).
- Stabilisation of embankment above rock revetment with fill and jute mesh.
- Beach/sand nourishment for a length of approximately 163m long (adjacent to rock revetment) within the site, raising the existing sand level from 0m AHD to 1.3m AHD over the toe of the proposed rock revetment wall and tapering (at a slope of approx. 1:7.7 or 13%) to the existing sand surface over 10m width (increasing beach width by approx. 2m in accordance with WRL 2017 recommendations), with a volume of approximately 1059.5m^3. Sand is to be sourced from the existing dry notch at Shoalhaven River entrance. Sand nourishment may extend up to 4m within the mapped waterway (tapering to meet existing level). See Figures 1 and 4 below.
- Construction of three stormwater outlets with 4m wide rock channels (over geotextile material) extending into the River sand-flats, acting to disperse stormwater into the river with reduced impact. Channels will terminate at 6m from the proposed stormwater outlets at the toe of the embankment (see Figures 1 to 3).
- Removal of existing steps and installation of replacement steps (refer to Site Plan, Magryn 2019).
- Retention of native vegetation, particularly large Bangalay trees wherever possible.
- Revegetation along the stabilised embankment above rock revetment with endemic native plant species (consistent with Bangalay Sand Forest species) in accordance with a revegetation plan/schedule.

Figure 1. Site plan (Magryn 2019)

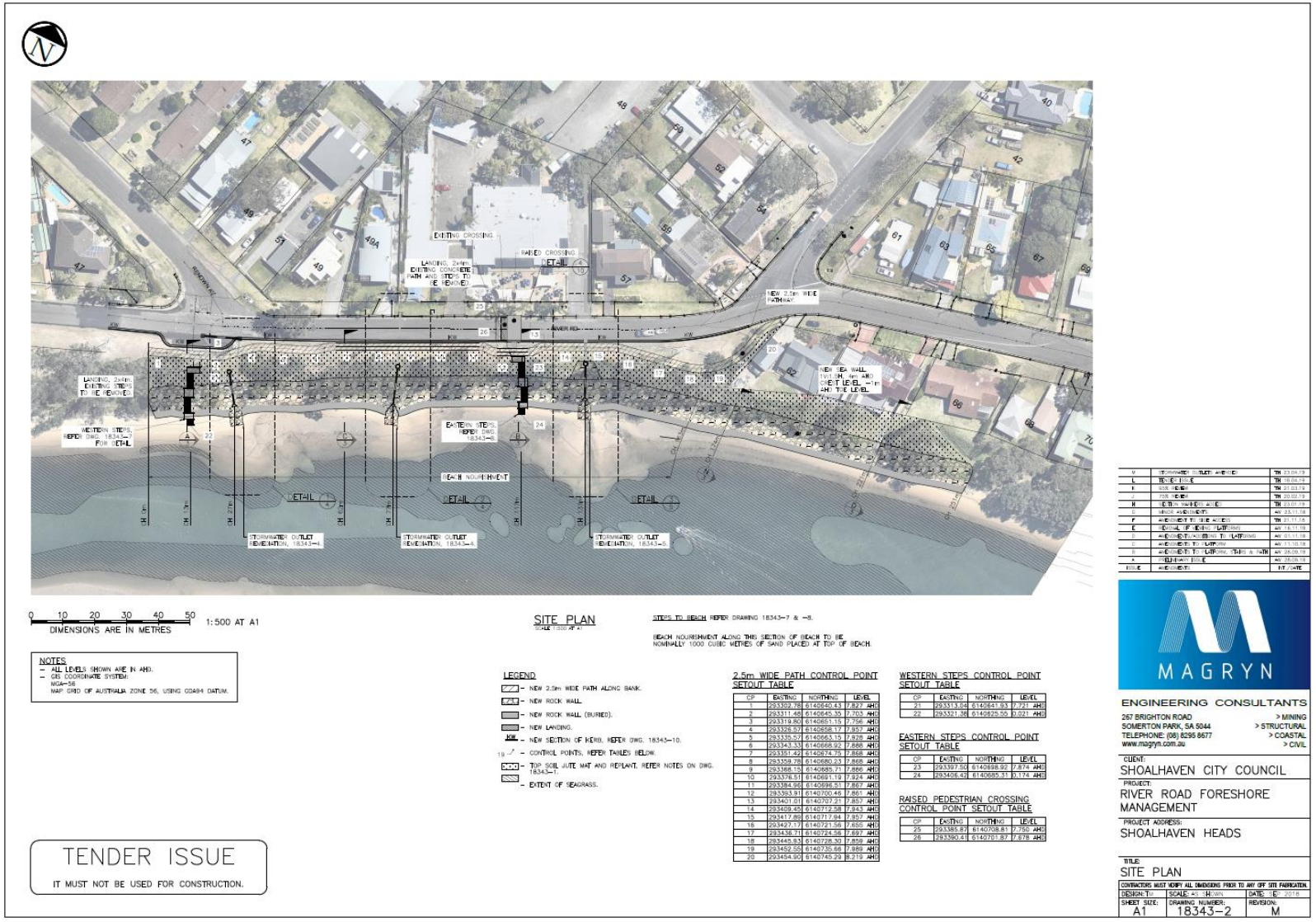


Figure 2. Drainage upgrade details (Magryn 2019)

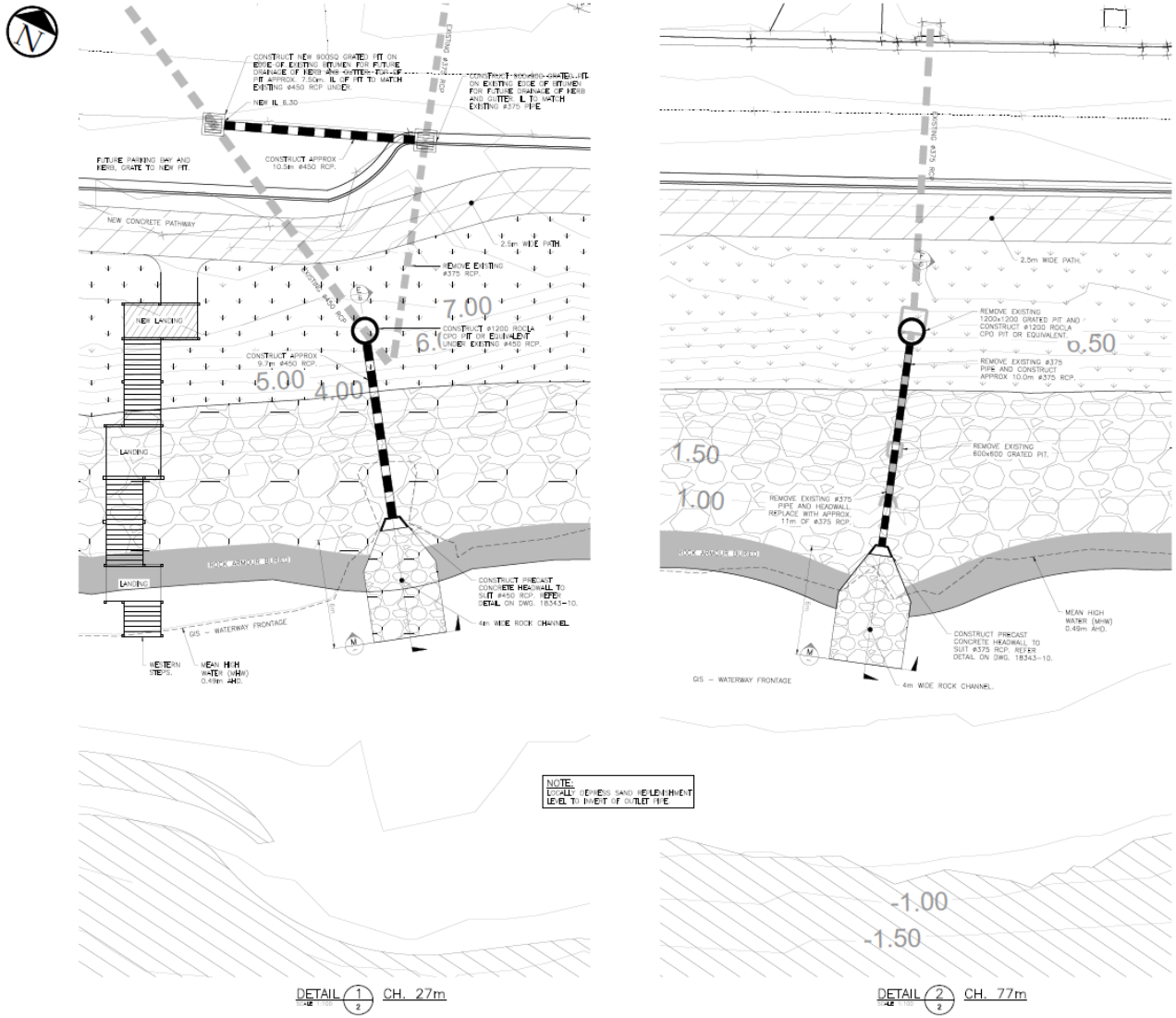


Figure 3. Stormwater outlet remediation (Magryn 2019)

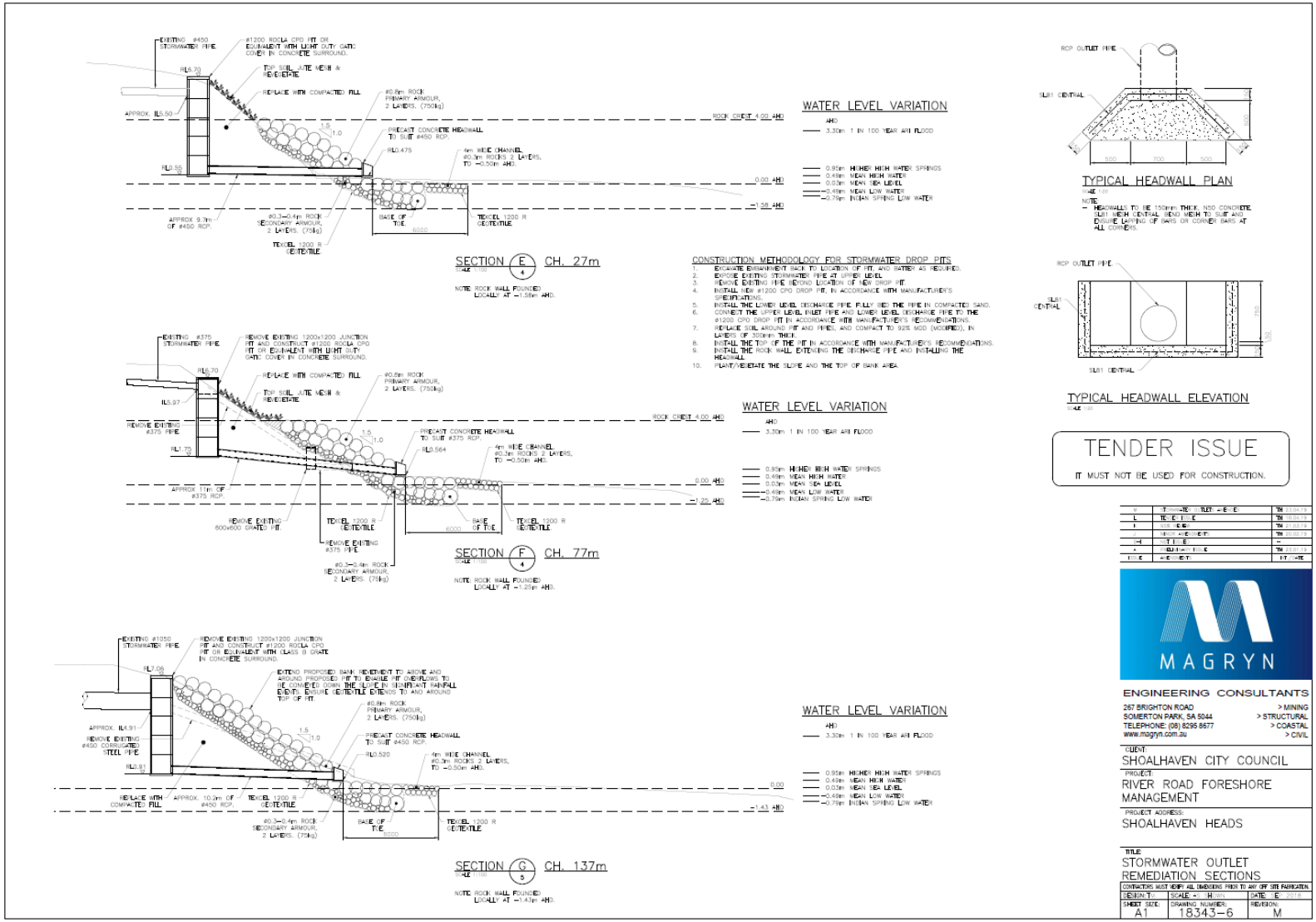
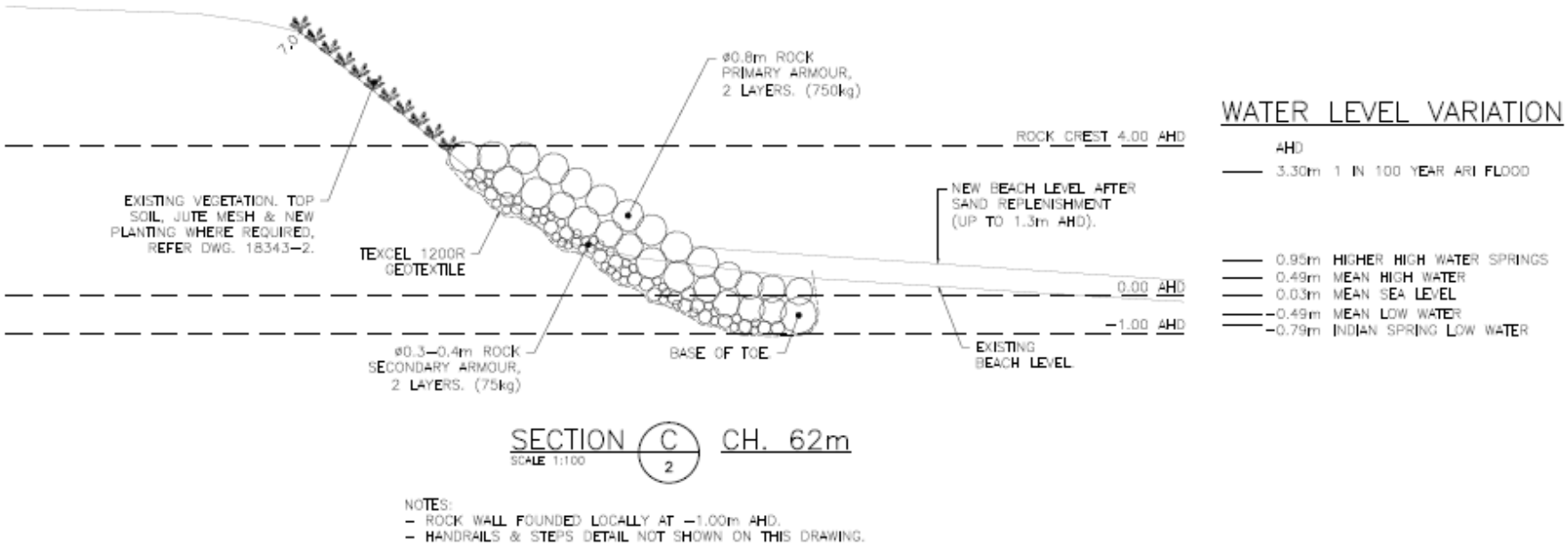


Figure 4. Typical cross-section (Magryn 2019)



3. Legislative Context

3.1 Environmental Planning & Assessment Act 1979

Part 1.7 of the EP&A Act enacts the provisions of Part 7 of the *Biodiversity Conservation Act 2016* and Part 7A of the *Fisheries Management Act 1994* in relation to the operation of the EP&A Act.

3.2 Biodiversity Conservation Act 2016

The purpose of the Biodiversity Conservation Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The Act establishes a framework for assessing and offsetting biodiversity impacts from proposed developments, including the introduction of the Biodiversity Offset Scheme with associated entry triggers.

3.2.1 Assessment against the Biodiversity Offset Scheme entry trigger criteria

The proposed development and associated impacts have been assessed against the criteria that determine entry into NSW Biodiversity Offset Scheme (BOS) pursuant to Part 7 of the NSW Biodiversity Conservation Act 2016 and Part 7 of the NSW Biodiversity Conservation Regulation 2017 (NSW BC Reg.)

1. Vegetation clearing threshold

There is no minimum lot size associated with the Crown Lots or road reserve. The area of the smallest lot (Lot 7004 DP 94785: 1.68 ha) applies pursuant to Clause 7.2(2) (NSW BC Reg.) making the area clearing threshold 0.5 ha. The total area of impact of the proposed development is approximately 0.2655 ha (note that this includes non-vegetated areas on the river foreshore). The relevant vegetation clearing threshold will therefore not be exceeded.

2. Biodiversity Values Map threshold

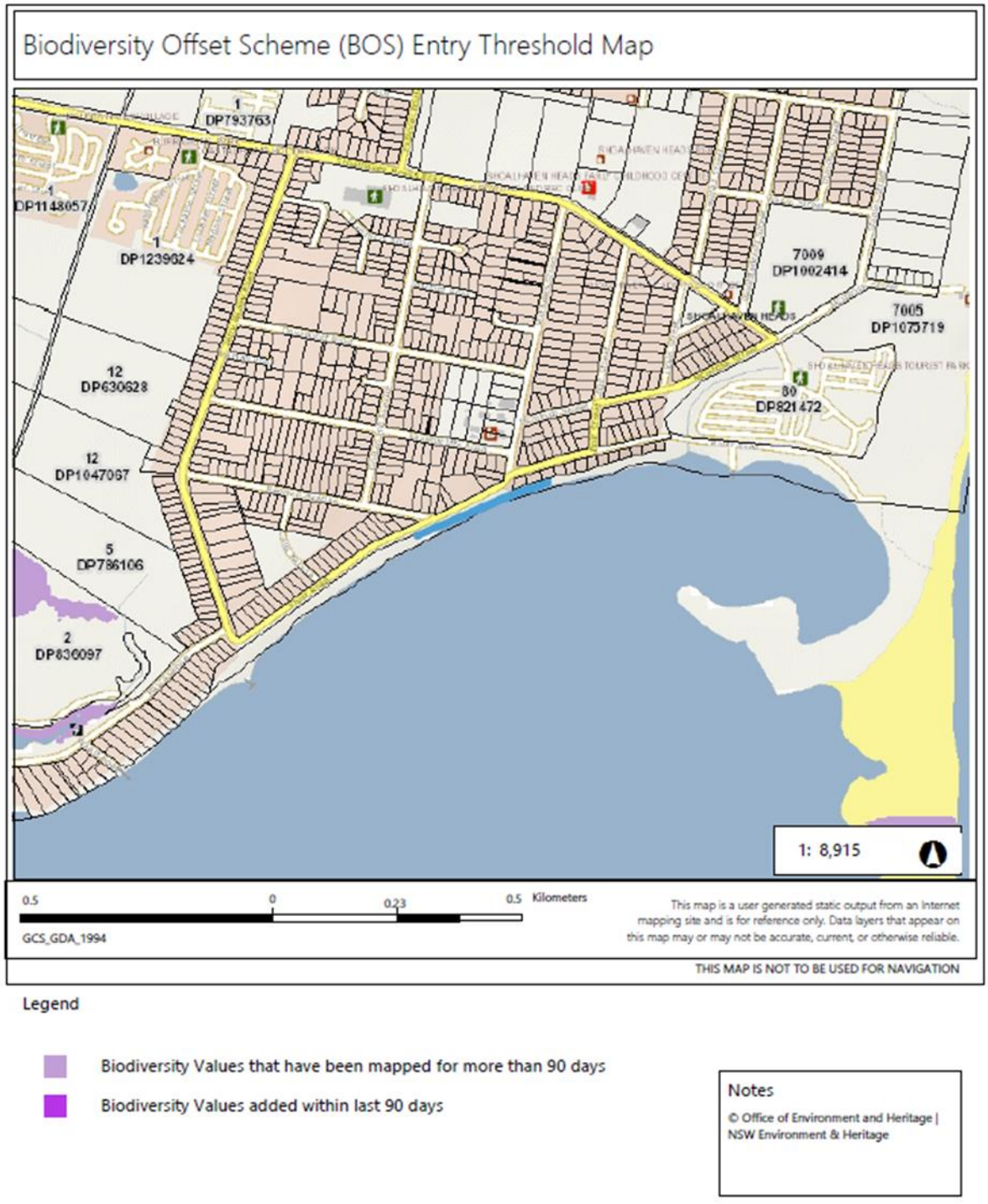
Neither clearing nor other prescribed actions (Clause 6.1 NSW BC Reg.) will impact land included on the Biodiversity Values Map (see Figure 5 below and report appended)

3. Significant impact to threatened species

The test of significance undertaken in Section 5.3 concludes that there will be no significant impact to any threatened species or endangered ecological community.

The proposed development and associated impacts do not trigger entry into the Biodiversity Offset Scheme and do not require a Biodiversity Development Assessment Report to be undertaken.

Figure 5. Biodiversity Values Map clip



4. Site Context and Environmental Constraints

4.1 Site location

The site is located on the north-western foreshore of the Shoalhaven River adjacent to River Road, roughly between Renown Avenue and Matthews Street in Shoalhaven Heads, NSW (Figure 6 and 7). The site lies within the Shoalhaven River estuary approximately 1km from the ephemeral Shoalhaven River entrance.

Figure 6. Site location

4.2 Site description

The foreshore area comprises a narrow sandy beach and a vegetated sand embankment (maximum height about six metres) which typically slopes down to the southeast at between 35 and 45 degrees to the gently sloping sandy beach. The narrow sandy beach exists through the length of the site between the river and the embankment, typically 2m to 3m wide, becoming slightly wider at the eastern end of the site and containing a narrow, patchy band of shore wrack (e.g. Photos 1 and 2). The sandy beach slopes gently to shallow sand-flats, which are partially exposed at low tide. In some locations there are pebble deposits over the sand-flats. No vegetation occurs on the sand-flats. The sand-flats give way to a deeper channel, occurring 10-15m south of the beach (i.e. away from embankment) and up to 25m south where existing storm-water pipes have caused plumes/lobes of sand extending further into the river. The edges of the channel support Eelgrass (*Zostera capricorni*). Note that there will be no impact to the Eelgrass or any other live marine vegetation.

Figure 7. Site with works areas

Site showing approx. location of proposed rock channels, revetment and sand nourishment works

Existing stormwater drainage delivers stormwater to the river at three locations. At each of these locations, the function of the stormwater infrastructure interacting with river processes has resulted in erosion of the embankment, in addition to scouring of the beach and creation of plumes/lobes. The proposed stormwater infrastructure works will be undertaken in the existing stormwater locations to replace and enhance the existing infrastructure.

The vegetation present on the sand embankment is moderately to highly disturbed and comprised of an endemic canopy (including *Eucalyptus botryoides*, *Angophora floribunda* and *Banksia serrata*) with a predominantly exotic understorey (including Kikuyu, Asparagus Fern and Mother of Millions). The existing native vegetation conforms to PCT659 Bangalay – Old Man Banksia open forest on coastal sands, Sydney Basin and South East Corner, albeit in a moderately to highly disturbed and modified condition.

The steep, sandy nature of the slope, combined with the coastal processes has resulted in the systematic erosion and destabilisation of the bank and its vegetation, leading to the falling of numerous large trees in recent years, which in turn has exacerbated the erosion and destabilisation process.

The River Road road-verge is generally a flat grassed area, bordered by River Road (with treated pine bollard fence delineating pedestrian area) and the vegetated top edge of the embankment (Photo 11).

Photo 1. Site looking east from west end

Photo 2. Site looking west from east end

Photo 3. Scouring of beach from existing stormwater processes

Photo 4. Existing stormwater drainage to beach

Photo 5. Existing beach (low tide) and steep embankment

Photo 6. Steps to be replaced

Photo 7. Embankment showing erosion, failed trees and weedy, patchy vegetation

Photo 8. Embankment showing sand slip, dead trees and weedy, patchy vegetation

Photo 9. Embankment showing disturbed weedy vegetation and sand slip

Photo 10. Unstable embankment with predominantly exotic vegetation

Photo 11. Trees lining upper bank and road verge

Photo 12. Large Bangalay trees to be retained on upper bank

Photo 13. Mid-embankment showing vegetation to be cleared on lower bank

4.3 Vegetation and habitat assessment

Site inspections were undertaken on and 4 March 2019 and 6 May 2019 to assess and map the existing vegetation and habitat features on the site.

The vegetation present on the sand embankment is moderately to highly disturbed and comprised of an endemic canopy (including *Eucalyptus botryoides*, *Angophora floribunda* and *Banksia serrata*) with a predominantly exotic understorey (including Kikuyu, Asparagus Fern and Mother of Millions). The existing vegetation on the embankment conforms most closely to PCT659 (Biometric SR512) Bangalay – Old Man Banksia open forest on coastal sands, Sydney Basin and South East Corner. This vegetation type is associated with *Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions* Endangered Ecological Community, and the vegetation occurring on site can be regarded as corresponding to this EEC, albeit in a highly disturbed and modified condition. A full species list is provided below in Table 1.

No suitable threatened species habitat occurs on the embankment within the site. Two small, shallow hollows (<10cm diameter and approx. 15cm deep) were observed, both in low Bangalay trees. The hollows were both at a height where visible inspection was possible. No animals were observed within the hollows and they are considered too shallow to be utilised by any threatened species.

The existing rock walls contain crevices but are considered too exposed and accessible by predators to be utilised by threatened microbat species such as Southern Myotis.

Habitat is present on and immediately adjacent to the site for threatened shorebirds and wading birds. A narrow sandy beach exists through the length of the site between the river and the embankment. This sandy beach is typically 2m to 3m wide for the length of the access route and through the site, becoming slightly wider at the eastern end of the site. The sandy beach slopes

gently to shallow sand-flats, which are partially exposed at low tide. The sand-flats give way to a deeper channel, occurring 10-15m south of the beach (up to 25m south where existing storm-water pipes have caused plumes of sand extending further into the river). The edges of the channel support Eelgrass (*Zostera capricorni*).

No targeted threatened fauna surveys were undertaken as part of this assessment.

Table 1. Flora Species List – River Road Foreshore Management Project site – Shoalhaven Heads

Native flora	
Botanical name	**Common name**
Eucalyptus botryoides	Bangalay
Banksia integrifolia	Coastal Banksia
Angophora floribunda	Rough-barked Apple
Casuarina glauca	Swamp She-oak
Acmena smithii	Lilly Pilly
Glochidion ferdinandi	Cheese Tree
Pittosporum undulatum	Sweet Pittosporum
Elaeocarpus reticulatus	Blueberry Ash
Acacia longifolia subsp. *longifolia*	Sydney Golden Wattle
Acacia longifolia subsp. *sophorae*	Coastal Wattle
Breynia oblongifolia	Coffee Bush
Melaleuca linarifolia (planted)	Snow in Summer
Melaleuca quinquinervia (planted)	Broad-leaved Paperbark
Callistemon citrinus (cultivar) (planted)	Crimson Bottlebrush
Westringia fruticosa (planted)	Coast Westringia
Melaleuca hypericifolia (planted)	
Correa alba (planted)	White Correa
Leptospermum polygalifolium (planted)	Tea-tree
Grevillea longifolia/maclayeana (planted)	
Myoporum acuminatum (planted)	Boobialla
Macrozamia communis	Burrawang
Pittosporum revolutum	Rough-fruit Pittosporum
Crinum pedunculatum	Swamp Lily
Pteridium esculentum	Bracken fern
Adiantum aethiopicum	Maidenhair Fern
Doodia aspera	Rasp Fern
Rubus parvifolius	Native Raspberry
Olearia viscidula	
Dodonea triquetra	Hop Bush
Lomandra longifolia	Spiny mat rush
Cynodon dactylon	Couch
Imperata cylindrica	Blady Grass
Themeda triandra	Kangaroo Grass
Dichelcane micrantha	Plume Grass
Phragmites australis	Native Reed
Ficinia nodosa	Knobby Club-rush
Dianella caerulea	Blue Flax-lily
Solanum americanum	Glossy Nightshade
Tetragonia tetraganoides	New Zealand Spinach
Atriplex sp.	
Carpobrotus glaucescens	Pigface

Exotic flora	
Botanical name	**Common name**
Cenchrus clandestinus	Kikuyu
Asparagus aethiopicus	Asparagus fern
Ipomoea indica	Morning Glory
Leonotis leonurus	Lions Tail
Bryophyllum delagoense	Mother of Millions
Lantana camara	Lantana
Tradescantia fluminensis	Trad
Senecio angulatus	Climbing Groundsel
Delairea odorata	Cape Ivy
Nephrolepis cordata	Fishbone Fern
Dimorphotheca ecklonis	South African Daisy
Stenotaphrum secundatum	Buffalo Grass
Crassula multicava	Shade Crassula
Crassula sarmentosa	
Acetosa sagittata	Turkey Rhubarb
Hyrocotyle bonariensis	Beach Pennywort
Ehrharta erecta	Panic Grass
Cakile maritima	Sea Rocket
Senecio petasitis	Velvet Groundsel
Erythrina x sykesii	Coral Tree
Conyza bonariensis	Fleabane
Hypochaeris sp.	Cats Ear
Rhaphiolepis indica	Indian Hawthorn
Monstera deliciosa	Monstera
Bidens pilosa	Bidens
Tropaeolum majus	Nasturtium
Hypoestes aristata	Ribbon Plant

4.4 Other environmental constraints

Other environmental constraints relevant to the site that require consideration beyond the scope of this flora and fauna assessment include:

- Acid Sulfate Soils – mapped as occurring in the vicinity of the site
- Aboriginal heritage – potential for artefacts within the site
- Flooding – site is mapped as being flood-prone
- Coastal Management SEPP controls

These have been addressed in the Statement of Environmental Effects submitted as part of the development application.

5. Assessment of Likely Environmental Impacts

5.1 Direct and indirect impacts associated with the development

Areas that will be impacted directly and indirectly as a result of the proposal include:

- The lower half of the embankment between the foreshore and River Road – subject to clearing and excavation works prior to installation of rock revetment;
- The beach foreshore and sand-flats within the site – subject to machinery access and sand nourishment works;
- The beach foreshore for approx. 300m along river foreshore from carpark and toilet block at southern end of Jerry Bailey Road – subject to machinery access;
- The road reserve including the verge of River Road – subject to machinery access, vegetation pruning and landscaping works;
- Sand-flats adjacent to the site – potentially subject to movement of deposited sand (expected to be minor and limited to eastward lateral movement).
- Upper half and top of the embankment which would be subject to revegetation activities.

Figure 8. Approximate area of direct impacts within site

Approximate area of impact from proposed works

Clearing and trimming of native vegetation associated with the proposed rock revetment works along the lower bank and landscaping works along the River Road road-verge would likely impact approximately 692.7m2 of native vegetation including the removal of two large (>25cm DBH) and six small (<25cm DBH) *Banksia integrifolia*, four large and eight small *Eucalyptus botryoides*, one large and two small *Angophora floribunda*, three small *Glochidion ferdinandi*, one small *Acmena smithii*, and several native shrub and groundcover species including *Lomandra longifolia, Acacia longifolia*

subsp. *sophorae, Carpobrotus glaucescens, Tetragonia tetraganoides, Cynodon dactylon, Myoporum acuminatum, Pittosporum undulatum* and *Breynia oblongifolia*. Most of the vegetation that would be impacted is comprised of exotic species, particularly Kikuyu grass, Asparagus fern, Morning Glory, Lions Tail, Mother of Millions, Lantana and Trad, in addition to planted, non-endemic species including *Correa alba* and *Grevillea* sp.

Vegetation, particularly larger trees on the upper portion of the bank will be retained and protected to every extent possible. A consultant arborist will be present on site to advise on the practical retention of trees. Removal of trees along the upper embankment may be required where deemed necessary for safety by the consultant arborist.

Revegetation of disturbed areas including backfilled areas along the top of the rock revetment will be undertaken utilising species consistent with Bangalay Sand EEC.

Modification of the beach and sand-flats will occur as a result of sand nourishment. The existing sand level is approximately 0m AHD with the proposed level with nourishment to be 1.3m AHD, covering the toe of the rock revetment and tapering to the existing beach surface over a 10m width, for a length of 163m within the site. Sand nourishment will therefore be applied at a volume of 1059.5m3 and a slope of approx. 1:7.7 or 13%.

Movement of deposited sand from nourishment works is expected to be minor and limited to eastward lateral movement with river flow (Figure 9). Movement of sand will be monitored as per DPI Fisheries recommendations.

Figure 9. Anticipated direction of sand movement

Machinery used for works associated with the rock revetment (including clearing) and sand nourishment, will access the site via the beach foreshore for approx. 300m along river foreshore from carpark and toilet block at southern end of Jerry Bailey Road.

Minor trimming of trees (including *Banksia integrifolia* and *Glochidion ferdinandi*) may be undertaken along the River Road road-verge for machinery access and installation/upgrade of drainage infrastructure and subsequent filling and stabilisation of the embankment. Some impact to tree root zones is possible, but will be minimised under the guidance of the consultant arborist.

5.3 Threatened species impact assessment – NSW legislation

Section 1.7 of the EP&A Act 1979 applies the provisions of Part 7 of the NSW Biodiversity Conservation Act 2016 and Part 7A of the NSW Fisheries Management Act 1994 that relate to the operation of the Act in connection with the terrestrial and aquatic environment. Each are addressed below

5.3.1 *Biodiversity Conservation Act 2016*

An assessment of the potential for NSW threatened flora and fauna species occurring on-site or otherwise being impacted by the proposal was undertaken (see Appendix B: NSW Threatened Species Likelihood of Occurrence Table).

The following species and endangered ecological communities are known to occur on-site or are considered to have some potential to occur on-site or be otherwise impacted by the proposal, and therefore required further assessment under Part 7 of the NSW Biodiversity Conservation Act 2016:

- Beach Stone-curlew *Esacus magnirostris*
- Black-tailed Godwit *Limosa limosa*
- Broad-billed Sandpiper *Limicola falcinellus*
- Curlew Sandpiper *Calidris ferruginea*
- Greater Sand-plover *Charadrius leschenaultii*
- Great Knot *Calidris tenuirostris*
- Hooded Plover *Thinornis rubricollis*
- Lesser Sand-plover *Charadrius mongolus*
- Little Tern *Sternula albifrons*
- Orange-bellied Parrot *Neophema chrysogaster*
- Pied Oystercatcher *Haematopus longirostris*
- Sanderling *Calidris alba*
- Sooty Oystercatcher *Haematopus fuliginosus*
- Terek Sandpiper *Xenus cinereus*
- *Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions* Endangered Ecological Community

Section 7.3 of the Act provides a five-part 'test of significance' to determine whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats. Each Part is addressed below:

Part 1: In the case of a threatened species, where the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is to be placed at risk of extinction.

Note: all threatened species habitat and biology information from NSW OEH Threatened Biodiversity Data Collection and NSW OEH Threatened Biodiversity Profile Search website. Individual profile references included in Section 8 Referneces.

Shore-birds with potential breeding habitat on-site

Beach Stone-curlew: Found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. They forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Beach Stone-curlews breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves.

Beach Stone-curlews are usually seen alone or in pairs, but sometimes occur in small groups. Birds forage by stalking slowly like a heron or with quicker dashes after prey.

The diet consists of crabs and other marine invertebrates.

They are mainly active at dawn, dusk and at night, but birds are often seen when they shift or move about sedately during the day. Less strictly nocturnal than the related Bush Stone-curlew (Burhinus grallarius).

In NSW, clutches have been recorded from early October to late March, but elsewhere in temperate Australia, breeding has been recorded from September. Their nests are just a shallow scrape in sand or gravel, above the tidal zone at the backs of beaches, or on sandbanks and islands or among open mangroves.

Only one egg is laid, but birds will re-lay after the failure of a breeding attempt. Both parents defend the nest and care for the young. The young are precocial but appear not to be independent until they are 7-12 months old.

SAII: Breeding - Clearing in mapped areas could constitute a SAII.

Hooded Plover: Endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay, NSW, south through Victoria and Tasmania to the western side of the Eyre Peninsula (South Australia). Presently the Hooded Plover occurs in NSW north to Sussex Inlet. Occasionally, individual birds are sighted slightly further north to the Shoalhaven River and Comerong Beach and one bird was sighted at Lake Illawarra in March 2001.

In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beachcast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.

Hooded Plovers forage in sand at all levels of the zone of wave-wash during low and mid-tide or among seaweed at high-tide, and occasionally in dune blowouts after rain. At night they favour the

upper zones of beaches for roosting. When on rocks they forage in crevices in the wave-wash or spray zone, avoiding elevated rocky areas and boulder fields. In coastal lagoons they forage in damp or dry substrates and in shallow water, depending on the season and water levels.

Hooded Plovers are seen singly, in pairs, family groups or small flocks, with 16 birds at Cudmirrah Beach being the largest group recorded in NSW in recent years. During winter, very few birds are seen in pairs.

The Hooded Plover diet consists mainly of marine worms, molluscs, crustaceans, insects, water plants and seeds.

In eastern Australia, Hooded Plovers usually breed from August to March on sandy ocean beaches strewn with beachcast seaweed, in a narrow strip between the high-water mark and the base of the fore-dunes. They often nest within 6 m of the fore-dune, mostly within 5 m of the high-water mark, but occasionally among or behind dunes. The nest is a scrape in the sand near debris, making it vulnerable to predators and beach disturbance. Both parents incubate 2-3 eggs for a period of 28 days and share the care of the young. Hooded Plovers display high nest site fidelity and nest solitarily. On mainland Australia, nests may be 2-5 km apart.

SAII: Breeding - Clearing in mapped areas could constitute a SAII.

Little Tern: Migrates from eastern Asia and found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to northern Queensland, and is seen until May, with only occasional birds seen in winter months.

Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records).

Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.

The nest is a scrape in the sand, which may be lined with shell grit, seaweed or small pebbles.

Both parents incubate up to three well-camouflaged eggs for up to 22 days, aggressively defending the nest against intruders until the young fledge at 17 - 19 days.

Often seen feeding in flocks, foraging for small fish, crustaceans, insects, worms and molluscs by plunging in the shallow water of channels and estuaries, and in the surf on beaches, or skipping over the water surface with a swallow-like flight.

SAII: N/A

Pied Oystercatcher: Favours intertidal flats of inlets and bays, open beaches and sandbanks.

Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish.

Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones. Two to three eggs are laid between August and January. The female is the primary incubator and the young leave the nest within several days.

SAII: N/A

Sooty Oystercatcher: Found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels. Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or small mounds of pebbles, shells or seaweed when nesting among rocks.

SAII: N/A

NSW Office of Environment & Heritage "Important Area Maps" are available for Bar-tailed Godwit, Black-tailed Godwit, Curlew Sandpiper and Eastern Curlew, which indicate the entire tidal-influenced Shoalhaven/Crookhaven estuary as being an important area. OEH's Important Area Maps are not yet available for Beach Stone Curlew, Hooded Plover, Curlew Sandpiper and Great Knot, for which there are Serious and Irreversible Impacts (SAII) associated with breeding (note that for Great Knot the important area maps are associated with feeding prior to migration). Due to the lack of useful information available, advice was sought regarding the potential for impacts to threatened shorebirds from the NPWS Shorebird Recovery Coordinator, particularly whether any important breeding or foraging areas occur in the vicinity of the site.

The advice provided was that:

"There is no nesting of Hooded Plover, Little Tern or Pied Oystercatcher in this area, however it is an important feeding area for migratory shorebirds including Bar Tailed Godwit."

"…timing the works between now and August, may avoid direct impacts as most migratory shorebirds are now back in the northern hemisphere, and will not return until September/October."

The Shorebird Recovery Coordinator expressed uncertainty regarding the implications of potential changes to the sand-grain size over the sand-flats as a result of sand-nourishment. Such implications will be monitored and considered further as more information becomes available.

Test of significance

The potential for any impact to Beach Stone-curlew, Hooded Plover, Little Tern, Pied Oystercatcher and Sooty Oystercatcher is considered unlikely due to the following factors:

- Suitable foraging, roosting and nesting habitat for these species occurring within the site and impact areas is limited and typically within a very narrow strip along the foreshore comprising the narrow sandy beach and immediate sand-flats.
- No – or only sub-optimal breeding habitat exists for Beach Stone-curlew (which favours areas above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees, and also among open mangroves), Hooded Plover (which favours broad flat beaches backed by sparsely vegetated sand-dunes for shelter and nesting), Little Tern (favours low dunes or sandy beaches near estuary

mouths or adjacent to coastal lakes and islands – locally known to nest on broad sand-flats adjacent to the estuary mouth), Pied Oystercatcher (locally known to nest on broad sand-flats adjacent to the estuary mouth), and Sooty Oystercatcher (breeds almost exclusively on offshore islands and occasionally on isolated promontories).

- The existing sand strip between the water at high-tide and the steep embankment is very narrow (predominantly no more than 2m) (Photo 14 below). This area contains no sand banks or dunes. The location is also a popular walking and dog-walking area. There are no records of these species nesting within or adjacent to the site. Nesting of Little Terns and Pied Oystercatchers is known to occur on the more expansive sand flats associated with the spit of the Shoalhaven River entrance. These species are therefore unlikely to utilise the site for breeding.
- Roosting habitat is sub-optimal. The existing sand strip between the water at high-tide and the steep embankment is very narrow (typically no more than 2-3m) (Photo 14 below). This area contains no sand banks or dunes. The location is also a popular walking and dog-walking area. These species are therefore unlikely to utilise the site for roosting.
- No – or sub-optimal – foraging habitat exists for Hooded Plover (favours wave wash) and the Sooty Oystercatcher (favours exposed rock and coral at low tide).
- Depth of tidal sand-flat would be altered slightly with sand-nourishment. This would be for a length of 163m only (an insignificant length in the context of the Shoalhaven River estuary) and would stabilise in time. In the immediate Shoalhaven estuary from the entrance to Berry's Bay and around to the north-western corner of Comerong Island there is over 4.5km of sandy foreshore and extensive tidal flats (Figure 10 below) (this varies with tide and entrance opening). The area of potential foraging habitat that would be altered is insignificant and the degree of modification minor and impermanent. Following sand-nourishment, the waterline and shallows will remain within the site, only relocated by approximately 2-3m. The proposed works will therefore not impact the availability or quality of foraging habitat for these species.
- These species are highly mobile and transient and unlikely to visit or remain on site during machinery operation.
- Works are temporary in nature.
- If required as condition of consent, works could be undertaken during November to December – the typical nesting period for local threatened nesting shorebirds.
- If required as condition of consent, Council would liaise with the NPWS Shorebird Recovery Coordinator through the nesting period to remain aware of the timing and activity of threatened nesting shorebirds.
- If required as condition of consent, A Council Environmental Officer or other suitably qualified person would undertake pre-clearance surveys prior to works commencing each day and prior to machinery access and egress from site. If any of these species are detected in the vicinity of the works or machinery access/egress, works and/or machinery movement will stop immediately and not resume until the bird has vacated the site of its own accord. In the event that a nest or nesting birds are detected, works will cease and mitigation measures will be adapted in consultation with the NPWS Shorebird Recovery Coordinator, to minimise risk of disturbance to the birds and ensure their protection.

Photo 14. Narrow beach strip between sand-flats and steep embankment

Figure 10. Sandy foreshore and sand-flats within the Shoalhaven River estuary

Shore-birds – foraging and roosting only

Black-tailed Godwit: is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works. Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. Roosts and loafs on low banks of mud, sand and shell bars. Frequently recorded in mixed flocks with Bar-tailed Godwits.
SAII: N/A

Broad-billed Sandpiper**:** The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.
The species is an active forager, typically feeding by rapidly and repeatedly jabbing its bill into soft wet mud. Feeding also occurs while wading, often in water so deep that they have to submerge their heads and necks in order to probe the underlying mud. Their diet includes insects, crustaceans, molluscs, worms and seeds.
Individuals are strongly migratory and only mildly gregarious when not breeding. Large flocks are seldom recorded and birds are often either encountered alone or feeding with other waders such as Red-necked Stints or Curlew Sandpipers.
SAII: N/A

Curlew Sandpiper: Distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration. The Curlew Sandpiper breeds in Siberia and migrates to Australia (as well as Africa and Asia) for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores.
Curlew Sandpipers are omnivorous, feeding on worms, molluscs, crustaceans, insects and some seeds. Birds breed at 2 years of age and the oldest recorded bird is 19 years old. Most birds caught in Australia are between 3 and 5 years old.
SAII: Breeding - While this species breeds in Siberia, it relies on successful feeding to migrate for this purpose. Important feeding areas are mapped.

Greater Sand-plover: Breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.
Diet includes insects, crustaceans, polychaete worms and molluscs. Prey is detected visually by running a short distance, stopping to look, then running to collect the prey.
SAII: N/A

Great Knot: In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms.
Migrates to Australia from late August to early September, although juveniles may not arrive until October-November. Most birds return north in March and April, however some individuals may stay over winter in Australia. Forages for food by methodically thrusting its bill deep into the mud to search for invertebrates, such as bivalve molluscs, gastropods, polychaete worms and crustaceans.
SAII: Breeding - While this species breeds outside NSW, it relies on successful feeding to migrate for this purpose. Important feeding areas are mapped.

Lesser Sand-plover: Breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms.
Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge. Diet includes insects, crustaceans, molluscs and marine worms. Prey is usually detected visually with the birds making short, quick runs, with abrupt stops to lunge at the ground or look for prey.
SAII: N/A

Sanderling: A regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common, arriving from September and leaving by May (some may overwinter in Australia). Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.
Generally occurs in small flocks and may associate freely with other waders.
Individuals run behind receding waves, darting after insects, larvae and other small invertebrates in the sand, then dart back up the beach as each wave breaks.
Also feeds on plants, seeds, worms, crustaceans, spiders, jellyfish and fish, foraging around rotting heaps of kelp, at the edges of shallow pools on sandspits and on nearby mudflats.
Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.
Breeding occurs in the Northern Hemisphere.
SAII: N/A

Terek Sandpiper: A rare migrant to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. The latter has been identified as nationally and internationally important for the species. In Australia, the species has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools. Generally roosts communally amongst mangroves or dead trees, often with related wader species. Breaks up into smaller flocks or even solitary birds when feeding in open intertidal mudflats. The diet includes worms, crabs and other crustaceans, small shellfish and the adults and larvae of various flies, beetles and water-bugs. Feeding is undertaken by moving rapidly and erratically over soft, wet mud, pecking or probing at the surface.
SAII: N/A

Test of significance

The potential for any impact to Black-tailed Godwit, Broad-billed Sandpiper, Curlew Sandpiper, Greater Sand-plover, Great Knot, Lesser Sand-plover, Sanderling and Terek Sandpiper is considered unlikely due to the following factors:

- Suitable foraging and roosting habitat for these species occurring within the site and impact areas is limited and typically within a very narrow strip along the foreshore comprising the narrow sandy beach and immediate sand-flats.

- No – or sub-optimal – foraging habitat exists for Broadbilled Sandpiper (favours mudflats), Sanderling (favours beaches with waves), Terek Sandpiper (favours mudbanks and sandbanks near mangroves)

- Roosting habitat is sub-optimal. The existing sand strip between the water at high-tide and the steep embankment is very narrow (typically no more than 2-3m) (Photo 14). This area contains no sand banks or dunes. The location is also a popular walking and dog-walking area.

- Depth of tidal sand-flat would be altered slightly with sand-nourishment. This would be for a length of 163m only (an insignificant length in the context of the Shoalhaven River estuary) and would stabilise in time. In the immediate Shoalhaven estuary from the entrance to Berry's Bay and around to the north-western corner of Comerong Island there is over 4.5km of sandy foreshore and extensive tidal flats (Figure 10) (this varies with tide and entrance opening). The area of potential foraging habitat that would be altered is insignificant and the degree of modification minor and impermanent. Following sand-nourishment, the waterline and shallows will remain within the site, only relocated by approximately up to 5m.

- These species are highly mobile and transient and unlikely to visit or remain on site during machinery operation.

- Works are temporary in nature.

- If required as a condition of consent, a Council Environmental Officer or other suitably qualified person would undertake pre-clearance surveys prior to works commencing each

day and prior to machinery access and egress from site. If any of these species are detected in the vicinity of the works or machinery access/egress, works and/or machinery movement will stop immediately and not resume until the bird has vacated the site of its own accord.

As a result of the above assessment, a species impact statement for this Part for Beach Stone-curlew, Hooded Plover, Little Tern, Pied Oystercatcher, Sooty Oystercatcher, Black-tailed Godwit, Broad-billed Sandpiper, Curlew Sandpiper, Greater Sand-plover, Great Knot, Lesser Sand-plover, Sanderling and Terek Sandpiper is not required.

Part 2 In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

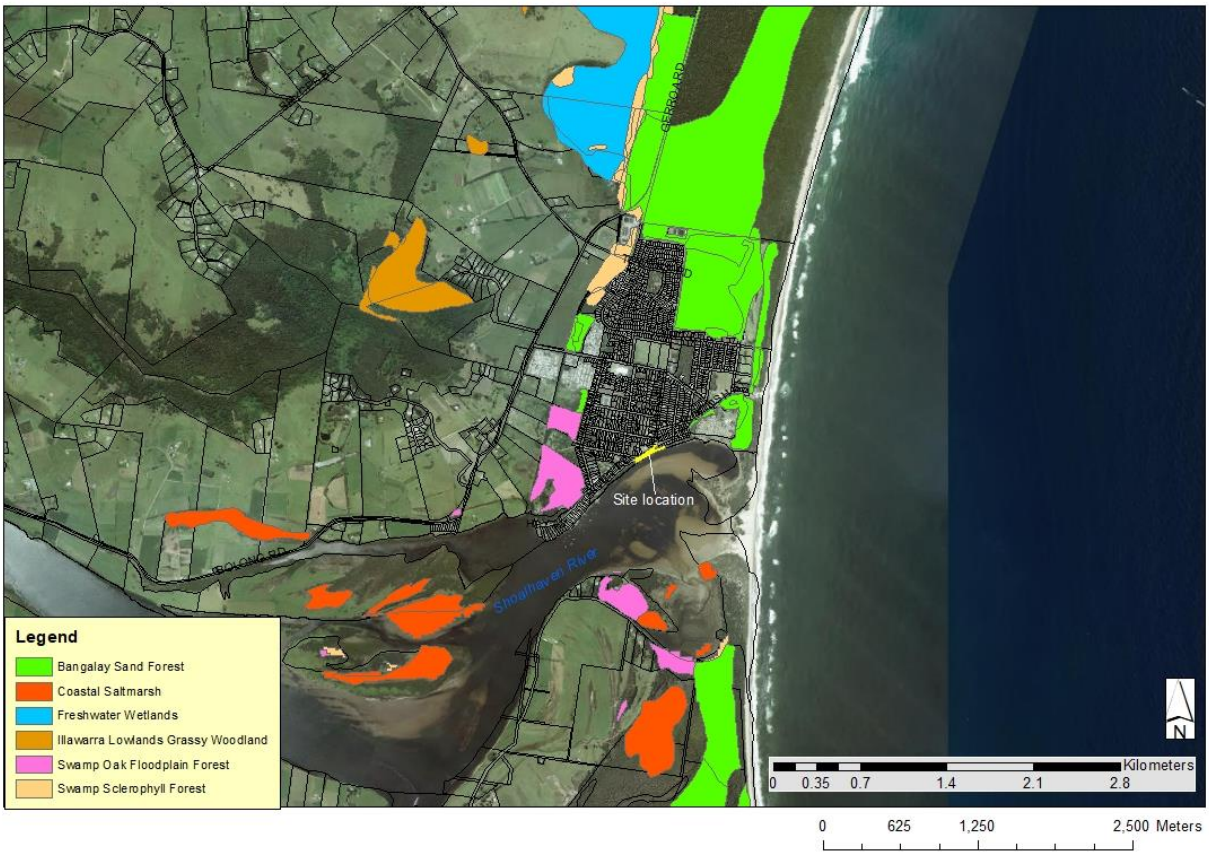
(a) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(b) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The proposed works would involve impact to and removal of vegetation that is considered to comprise the following endangered ecological communities:

- *Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions* (hereafter referred to as Bangalay Sand Forest)

Figure 11. Endangered Ecological Communities in the broader locality of the site



Endangered Ecological Communities in the Locality

Bangalay Sand Forest

Bangalay Sand Forest is the name given to the ecological community associated with coastal sand plains of marine or Aeolian origin. It occurs on deep, freely draining to damp sandy soils on flat to moderate slopes within a few kilometres of the sea and at altitudes below 100 metres. The community is characterised by an assemblage of species specified in the Scientific Committee's determination (NSW Scientific Committee 2011), typically with a relatively dense or open tree canopy dominated by Bangalay (*Eucalyptus botryoides*) and Coast Banksia (*Banksia integrifolia*), an understorey of mesophyllous or sclerophyllous small trees and shrubs, and a variable groundcover dominated by sedges, grasses or ferns.

Within the site, the area of Bangalay Sand Forest (in varying condition) is approximately 2466.3m^2, of which approximately 610.4m^2 will be cleared or trimmed as a result of the proposal (Figures 12 and 14).

In the locality there is over 300 ha of Bangalay Sand Forest comprised of disconnected patches including areas at Seven Mile Beach (approx. 243.3 ha), adjacent to Coomonderry Swamp (34.4 ha), Seven Mile Beach Golf Course (29.4 ha), hind dunes adjacent to Seven Mile Beach Golf Course (8.5 ha), East of Caravan Park (6.9 ha), and small patches North-West of the site (0.79 ha and 2 ha). The Bangalay Sand Forest occurring on site is not mapped. The nearest mapped Bangalay Sand Forest EEC occurs 578m to the East and 615m to the North-West (Figures 11 and 13).

The Bangalay Sand Forest vegetation represented on site is moderately to highly degraded and modified, with poor connectivity, high levels of weed infestation in the understorey and is a narrow, patchy strip with poor or non-existent vegetated buffers (Photos 15 and 16 below). This vegetation community continues to the east for approximately 280m in similarly disturbed and patchy condition, and to the west for approximately 300m in somewhat better condition.

The steep, sandy nature of the slope, combined with the coastal processes outlined in Section 1.2 has resulted in the systematic erosion and destabilisation of the bank and its vegetation, leading to the falling of numerous large trees in recent years, which in turn has exacerbated the erosion and destabilisation process (Photos 7-10).

Without the proposed works the degradation of the Bangalay Sand Forest vegetation within site will continue.

The proposed works would not only serve to stabilise the embankment and protect the existing Bangalay Sand Forest on the upper embankment, but would also involve and facilitate effective revegetation and regeneration of the vegetation community, as part of the project and into the future through the efforts of the River Road Bush Regeneration Group.

The potential impact to Bangalay Sand Forest EEC as a result of the proposal is not considered significant for the following reasons:

- An area of approximately 610.4m^2 would be impacted, representing only 24.75% of the existing Bangalay Sand Forest vegetation on site (2466.3m^2) and only 0.02% of the existing Bangalay Sand Forest mapped in the locality (>300 ha);
- The existing Bangalay Sand Forest vegetation on site is patchy, poorly connected and contains high levels of weed infestation;
- The lower embankment will be cleared only, while the upper embankment which contains the larger proportion of Bangalay Sand Forest will be retained and protected to every extent possible. Connectivity as it is, will therefore not be further compromised;
- Existing processes of erosion if left unchecked will further degrade the Bangalay Sand Forest vegetation on site;
- The proposal will involve stabilisation of the site, revegetation and weed control, each of which will serve to enhance the vegetation community and facilitate conservation of the EEC within the site.

In consideration of the above assessment, the proposed works are unlikely to have an adverse effect on – or substantially and adversely modify the composition of – Bangalay Sand Forest EEC, such that a local occurrence of the EEC is placed at risk of extinction. As a result, a species impact statement for this Part for this community is not required.

Figure 12. Approximate extent of Bangalay Sand Forest within the site

Figure 13. Mapped Bangalay Sand Forest EEC in the surrounding locality

Figure 14. Bangalay Sand Forest EEC likely to be impacted as a result of the proposed works

Bangalay Sand Forest EEC to be impacted as a result of proposed works

Photo 15. Patchy Bangalay Sand Forest on site with weedy understorey on site

Photo 16. Disturbed, weedy understorey and Bangalay Sand Forest predominantly confined to upper embankment

Part 3 In relation to the habitat of a threatened species or ecological community:

(a) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(b) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(c) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Bangalay Sand Forest EEC

- The lower embankment will be cleared only, while the upper embankment which contains the larger proportion of Bangalay Sand Forest will be retained and protected to every extent possible. Connectivity as it is, will therefore not be further compromised;
- Existing processes of erosion if left unchecked will further degrade the Bangalay Sand Forest vegetation on site;
- The proposal will involve stabilisation of the site, revegetation and weed control, each of which will serve to enhance the vegetation community and facilitate conservation of the EEC within the site;
- The existing Bangalay Sand Forest vegetation on site is patchy, poorly connected and contains high levels of weed infestation;
- An area of approximately 610.4m^2 would be impacted, representing only 24.75% of the existing Bangalay Sand Forest vegetation on site (2466.3m^2) and only 0.02% of the existing Bangalay Sand Forest mapped in the locality (>300 ha);
- The vegetation is not mapped as Bangalay Sand Forest EEC, is in low condition and becoming more degraded with existing processes, and is patchy with no connectivity to other occurrences of the EEC. This occurrence of Bangalay Sand Forest EEC is not important for the long-term survival of the EEC.

In consideration of the above assessment, the proposed path is unlikely to lead the vegetation community within the reserve to the risk of extinction. As a result, a species impact statement for this Part for this community is not required.

Refer also to responses in Part 1 and Part 2 above. A species impact statement is not required for this part.

Part 4 Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).

No "*areas of outstanding biodiversity values"* have been declared in the City of Shoalhaven.

Part 5 Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The only key threatening process listed under the NSW *Biodiversity Conservation Act 2016* considered relevant to the proposed activity is *Clearing of Native Vegetation.* The impact of the proposed activity, however, is not considered to be significant as it is unlikely to lead to:

- the destruction of habitat resulting in the loss of local populations of individual species

- fragmentation
- expansion of dryland salinity
- riparian zone degradation
- increased greenhouse emissions
- increased habitat of invasive species
- significant loss of leaf litter
- loss or disruption of ecological function
- changes to soil biota outside the development footprint

Furthermore, the works will facilitate the conservation and enhancement of vegetation in this location. The proposed revegetation activities, would result in an increase to net native vegetation in the area.

As a consequence, the proposed activity is considered not likely to result in the operation of, or significantly increase the impact of this particular key threatening process and a species impact statement is not required for this part.

5.3.2 *Fisheries Management Act 1994*

The proposed works involve upgrades to storm-water infrastructure, including the installation of three 4m wide rock channels that will protrude into the (variable) waterway frontage to dissipate storm-water entering the river. The rock channels will reduce the effect of storm-water creating sand lobes or plumes. The rock walls will sit at approximately 0m AHD and extend 6m from the storm-water outlet headwalls into the river foreshore and sand-flats in an area with very gentle slope, removed from the deeper river channel by 10m or more.

The proposal also involves sand nourishment for a length of 163m within the site, raising the existing sand level from 0m AHD to 1.3m AHD over the toe of the rock wall and tapering (at a slope of approx. 1:7.7 or 13%) to existing beach surface over 10m width, with a volume of approximately 1059.5m^3. Sand nourishment works may encroach up to approximately 4m into the mapped waterway frontage (at Mean High Water MHW of 0.49m AHD).

Within the waterway area on site, only shallow sand-flat areas containing no marine vegetation will be impacted. The deeper channel and Eelgrass are located at 5 to 10m beyond the areas to be impacted.

No marine vegetation or threatened marine fauna will be impacted by the proposal.

Part 1 In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is to be placed at risk of extinction.

There are no threatened species likely to inhabit the Shoalhaven Heads estuary.

Several saltwater species listed in the schedules of the Act are known to have occurred on the south coast of NSW:

- Grey Nurse Shark *Carcharias taurus* and Blind Slug *Smeagol hilaris* are listed as Critically Endangered.
- Southern Bluefin Tuna *Thunnus maccoyii* and Scalloped Hammerhead Shark *Sphyrna lewini* are listed as Endangered.
- Great White Shark *Carcharodon carcharia* and Black Rockcod *Epinephalus daemelii* are listed as Vulnerable.
- Green Sawfish *Pristis zijsron* is listed as Presumed Extinct.

Populations of these species have primarily been reduced by over-harvesting and habitat degradation.

Grey Nurse Shark: Grey Nurse Sharks are found predominantly in inshore coastal waters. They have been recorded at various depths, but mainly found in waters between 15 and 40 metres deep. Grey Nurse Sharks gather at a number of key sites along the coast of NSW and southern Queensland. These sites have gravel or sand filled gutters, rocky reefs or caves, and are called aggregation sites. Lake Conjola and the proposed opening area is not a known aggregation site and doesn't provide suitable habitat for aggregation. As such, the species is unlikely to occur there and the proposed activity would have no effect on the life cycle of the species. The areas within the Shoalhaven River estuary adjacent to the proposed works are too shallow to provide suitable habitat for the Grey Nurse Shark.

Blind Slug: This is a pulmonate (with lung) slug. It has only been collected from a small isolated location at Merry Beach, south of Ulladulla. The species lives in gravel and cobble filled rocky crevices and beaches at Merry Beach. The proposed works would therefore have no effect on the lifecycle of this species.

Southern Bluefin Tuna: The Southern Bluefin Tuna are pelagic fish occurring in the oceanic waters normally on the seaward side of the continental shelf. The proposed works would therefore have on effect on the lifecycle of this species.

Scalloped Hammerhead Shark: The Scalloped Hammerhead Shark is a coastal pelagic species with a circum-global distribution in warm temperate and tropical coastal areas. They are known to form large migratory schools and in Australia tend to move as far south as Sydney during the warmer months. The proposed works therefore would have no effect on the lifecycle of this species.

Great White Sharks: Great White Sharks are normally found in inshore waters around rocky reefs and islands and often near seal colonies. They have been recorded at varying depths down to 1,200 metres. The areas within the Shoalhaven River estuary adjacent to the proposed works are too shallow to provide suitable habitat for the Great White Shark.

Black Rockcod: Black Rockcod live in relatively shallow rocky reefs where they are usually found in caves, ledges, gutters and beneath bommies (DoPI 2015). Small juveniles are often found in coastal rocky pools, and larger juveniles around rocky shores in estuaries (DoPI 2015). The site of the proposed works does not currently provide any habitat for all these life stages.

Green Sawfish: Green Sawfish (presumed extinct in NSW) are bottom dwelling rays commonly found in near-coastal environments including estuaries, river mouths, embankments and along sandy and muddy beaches. It has been recorded in Jervis Bay, but the last confirmed sighting of the species in NSW was in 1972 from the Clarence River at Yamba. Although the site of the proposed activity does provide suitable habitat, in the unlikely event that a Green Sawfish was present at the time of works

including sand nourishment, it would be expected to be able to swim away in response to the disturbance with little consequent disruption to its life cycle. The proposed works are therefore not considered likely to place a viable local population of Green Sawfish at risk of extinction.

Part 2 In the case of an endangered population, whether the proposed development or activity is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

The endangered populations listed under the Act are:

- *Ambassis agassizii* Steindachner Agassiz's glassfish, olive perchlet, western New South Wales population
- *Craterocephalus amniculus* Darling River Hardyhead, Hunter River population
- *Gadopsis marmoratus* river blackfish, Snowy River population
- *Tandanus tandanus* freshwater catfish, eel tailed catfish, Murray-Darling Basin population
- *Posidonia australis* seagrass, Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie populations

These areas would be unaffected by the proposed works within the Shoalhaven River estuary.

Part 3 In the case of an endangered ecological community or critically endangered ecological community whether the proposed development or activity:

I. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

II. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The endangered ecological communities listed under the Act are:

- Aquatic ecological community in the natural drainage system of the lower Murray River catchment
- Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River
- Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River
- Aquatic ecological community in the catchment of the Snowy River in NSW

These areas would be unaffected by the proposed works within the Shoalhaven River estuary.

Part 4 In relation to the habitat of a threatened species or ecological community:

I. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

II. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

III. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

N/A - The area affected by the activity does not provide habitat for threatened species, populations or ecological communities (refer responses to Part 1 through Part 3 above)

Part 5 Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly),

N/A - The only critical habitat currently on the register is "Critical Habitat of Grey Nurse Shark" with listed and mapped areas of:

- Bass Point (Shellharbour)
- Big and Little Seal Rocks
- Fish Rock and Green Island (South West Rocks)
- Julian Rocks (Byron Bay)
- Little Broughton Island (Port Stephens)
- Magic Point (Maroubra)
- Montague Island (Narooma)
- The Pinnacle (Forster)
- Tollgate Islands (Batemans Bay)

These areas would be unaffected by the proposed works within the Shoalhaven River estuary.

Part 6 Whether the proposed development or activity is consistent with a Priorities Action Statement

Of the species listed in Part 1 above, Priority Action Statements (PAS) have been prepared for Grey Nurse Sharks, Blind Slug, Scalloped Hammerhead, Southern Bluefin Tuna, Black Rockcod, and Great White Shark. As demonstrated in Part 1 above, the proposed activity would have no effect on these species. Similarly the proposed activity are unlikely to be inconsistent with respective PASs.

Part 7 Whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

Key Threatening Process	**Assessment**
Degradation of native riparian vegetation along NSW water courses	Positive – initial works will involve clearing of 610.4m2 native vegetation for the purpose of installing rock revetment. The rock revetment will then serve to stabilise the embankment and facilitate revegetation, regeneration and conservation of the riparian vegetation.

Key Threatening Process	Assessment
Hook and line fishing in areas important for the survival on threatened fish species	Not applicable – proposal does not comprise or facilitate hook and line fishing.
Human-caused climate change	Not applicable – the proposal does not contribute to human-cause climate change.
Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams	Negligible – the proposal involves upgrades to storm-water infrastructure, including the installation of three 4m wide rock channels that will protrude into the (variable) waterway frontage to dissipate storm-water entering the river. The rock channels will reduce the effect of storm-water creating sand lobes or plumes. The rock walls will sit at approximately 0m AHD and extend 6m from the storm-water outlet headwalls into the river foreshore and sand-flats in an area with very gentle slope, removed from the deeper river channel by 10m or more. Additionally the location of works is the NW edge of the predominantly closed Shoalhaven River estuary. The proposal will therefore have only a negligible effect on the flow regime of Shoalhaven River. Nor will the infrastructure impede the passage of fish.
Introduction of fish to waters within a river catchment outside their range	Not applicable – the proposal does not involve releasing fish.
Introduction of non-indigenous fish and marine vegetation to the coastal waters of NSW	Not applicable – the proposal does not involve the introduction of non-indigenous fish.
Removal of large woody debris from NSW rivers and streams	Not applicable – the proposal does not involve the removal of woody debris.
The current shark meshing program in NSW waters	Not applicable – the proposal does not involve shark meshing.

5.4 Protected Matters impact assessment – Commonwealth legislation

5.4.1 *Environment Protection & Biodiversity Conservation Act 1999*

An EPBC Protected Matters Report was generated on 10 May 2019. An EPBC Protected Matters Report provides general guidance on matters of national significance and other matters protected by the EPBC Act in the area selected. Of those threatened species and endangered ecological

communities reported as likely occurring or having habitat within the area of the report, the following were considered to have potential habitat on the site and requiring further assessment:

- Curlew Sandpiper (CE, M)
- Eastern Curlew (CE)
- Great Knot (CE, M)
- Lesser Sand Plover (E, M)
- Red Knot (E, M)
- Australian Fairy Tern (V)(Br)
- Greater Sand Plover (V, M)
- Bar-tailed Godwit (M)
- Broad-billed Sandpiper (M)
- Common Greenshank (M)
- Double-banded Plover (M)
- Grey-tailed Tattler (M)
- Little Tern (M) (Br)
- Pacific Golden Plover (M)
- Pectoral Sandpiper (M)
- Red-necked Stint (M)
- Ruddy Turnstone (M)
- Sanderling (M)
- Whimbrel (M)
- Wood Sandpiper (M)

(CE – Critically endangered; E – Endangered; V – Vulnerable; M – Migratory; Br – Breeding habitat in Australia)

Other species including marine species and migratory birds may occur occasionally within the vicinity of the proposed activity but would not be affected by the proposal.

The EPBC Significant Impact Criteria are as follows:

Critically endangered and endangered species - Significant impact criteria Species to consider: **Curlew Sandpiper, Eastern Curlew, Great Knot, Lesser Sand Plover, Red Knot**	
Criteria	***Assessment***
lead to a long-term decrease in the size of a population	The proposed activity will not directly impact the Curlew Sandpiper, Eastern Curlew, Great Knot, Lesser Sand Plover or Red Knot, will not affect or disrupt breeding and will not impact on breeding or foraging habitat
reduce the area of occupancy of the species	No
fragment an existing population into two or more populations	No
adversely affect habitat critical to the survival of a species	No important habitat will be impacted
disrupt the breeding cycle of a population	Works can be undertaken outside breeding period and not affect breeding habitat

modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No important habitat will be impacted
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	No invasive species will be introduced
introduce disease that may cause the species to decline	No disease will be introduced
interfere with the recovery of the species	No

Vulnerable species - Significant impact criteria Species to consider: **Australian Fairy Tern** **Greater Sand Plover**	
Criteria	***Assessment***
lead to a long-term decrease in the size of an important population of a species	The proposed activity will not directly impact the Australian Fairy Tern or Greater Sand Plover, will not affect or disrupt breeding and will not impact on breeding or foraging habitat
reduce the area of occupancy of an important population	No
fragment an existing important population into two or more populations	No
adversely affect habitat critical to the survival of a species	No important habitat will be impacted
disrupt the breeding cycle of an important population	Works will be undertaken outside breeding period for nesting shorebirds and will not affect breeding habitat.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No important habitat will be impacted.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	No invasive species will be introduced
introduce disease that may cause the species to decline	No disease will be introduced
interfere substantially with the recovery of the species	No

Additional consideration was given to the four principal threats determined by DEWHA (2009) to be most relevant to judgements on significance of impact to migratory shorebirds. These include:

- habitat loss
- habitat degradation
- disturbance, and
- direct mortality.

Degradation of shorebird habitat has a similar effect on populations as direct habitat loss. Many migratory shorebirds have specialised feeding techniques, making them susceptible to slight changes

to prey sources and their foraging environments. Habitat degradation is associated with activities such as invasion of intertidal mudflats by exotic species. For example, invasion of exotic rice grass (*Spartina anglica*) is thought to have led to the loss of both roosting and foraging habitats for migratory shorebirds in America (Stralberg et al, 2004). Similar impacts from this species have been observed in parts of Australia (Minton and Whitelaw, 2000).

Other examples of activities that may cause degradation to shorebird habitats include water pollution and changes to the water regime; loss of marine or estuarine vegetation which helps stabilise mudflats and provides organic matter to support the invertebrates on which migratory shorebirds feed; expansion of mangroves; artificial changes to hydrological regimes that affect the productivity of the feeding environment; and exposure of acid sulphate soils.

Habitat degradation may also be caused by impacts which are indirect, or not directly associated with a particular activity. For example, nutrient runoff from a construction or development site may compromise the quality of water at a wetland downstream of the development.

The proposal does not involve or contribute to habitat loss or habitat degradation.

Potential disturbance will be involved, however the works are temporary in nature and would occur outside the nesting periods for locally occurring threatened shorebirds (generally Nov-Feb).

Depth of tidal sand-flat would be altered slightly with sand-nourishment. This would be for a length of 163m only (an insignificant length in the context of the Shoalhaven River estuary) and would stabilise in time. In the immediate Shoalhaven estuary from the entrance to Berry's Bay and around to the north-western corner of Comerong Island there is over 4.5km of sandy foreshore and extensive tidal flats (this varies with tide and entrance opening). The area of potential foraging habitat that would be altered is insignificant and the degree of modification minor and impermanent. Following sand-nourishment, the waterline and shallows will remain within the site, only relocated by approximately 2-3m. The proposed works will therefore not impact the availability or quality of foraging habitat for these species.

These species are highly mobile and transient and unlikely to visit or remain on site during machinery operation.

Direct mortality to threatened and migratory shorebirds will be avoided through the timing of works in addition to mitigation measures involving monitoring and stop-work protocols.

A Council Environmental Officer or other suitably qualified person would undertake pre-clearance surveys prior to works commencing each day and prior to machinery access and egress from site. If any of these species are detected in the vicinity of the works or machinery access/egress, works and/or machinery movement will stop immediately and not resume until the bird has vacated the site of its own accord. In the event that a nest or nesting birds are detected, works will cease and mitigation measures will be adapted in consultation with the NPWS Shorebird Recovery Coordinator, to minimise risk of disturbance to the birds and ensure their protection.

Conclusion of EPBC Significant Impact Assessment

The proposal is therefore unlikely to have an adverse effect on a vulnerable, endangered, critically endangered or migratory species or its habitat, nor on the extent or integrity of an endangered ecological community such that its local occurrence is likely to be placed at risk of extinction. Further assessment and referral to the Commonwealth is therefore not required.

6. Mitigation Measures to Minimise Impacts

The following mitigation measures will be implemented to reduce the risk of impact to the environment:

1. A Traffic Management Plan shall be developed for the works – including for:
   a) Vehicular movement along River Road and the southern ends of Renown Avenue and Mathews Street when machinery access along road verge is required;
   b) Pedestrian traffic along River Road in proximity to the works; and
   c) Pedestrian traffic along the Shoalhaven River shoreline in proximity to the proposed works.

2. Notification at approximately two weeks prior to commencement of works shall be given to residents and property owners including:
   a) All residents and property owners on River Road;
   b) All other residents and property owners within 250m of the works site.

3. Works shall be confined to the hours of 7 am – 6 pm on weekdays to avoid disruption to residents.

4. Site delineation will be undertaken prior to works commencing including the following:
   a) Stakes with high visibility flagging will be installed every 10m along sand-flat to delineate buffer line of 5m to the Eelgrass (Zostera sp.).
   b) Exclusion fencing will be used at either end of the site on the foreshore to prevent entry by pedestrians etc.
   c) High visibility barrier webbing or similar will be used to delineate the extent of clearing on the embankment.

5. Works shall be undertaken in accordance with the relevant requirements of the 'Blue Book' (Landcom 2004) particularly section 5.3, i.e., retention of vegetation, minimising disturbance, erosion control and rapid establishment. Sediment and erosion controls shall be maintained in good working order for the duration of the action and subsequently until the site has been stabilised and the risk of erosion and sediment from the site is minimal.

6. The contractor shall keep an emergency spill kit on-site at all times with procedures to contain and collect any leakage or spillage of fuels, oils and greases from plant and equipment.

7. To avoid the risk of pollution from machinery, refuelling shall generally be done off site, however if refuelling on site is required, due care shall be taken to avoid spilling fuel and a tray shall be used to catch any accidentally spilt fuel.

8. No major equipment maintenance works shall be undertaken on-site.

9. A suitably qualified arborist will be present during vegetation clearing works and any excavation works within 5m of the stems of trees greater than 150mm DBH to advise on the practical retention of trees along the upper bank. Wherever possible, all trees (and other

native vegetation) on the upper bank (above rock revetment area) are to be retained. Where trees cannot be practically or safely retained, the suitably qualified arborist will advise on removal to minimise disturbance to the bank and other vegetation.

10. Trees to be removed must be felled into the works area carefully so as not to damage trees to be retained in or beyond the works footprint.

11. Pruning or trimming of any trees to be retained must be undertaken in accordance with AS 4373-1996 "Pruning of Amenity Trees".

12. A Heritage Sites Officer shall be engaged through the Jerrinja LALC to monitor excavation works. If any Aboriginal heritage artefacts are uncovered, works shall immediately stop and the Office of Environment and Heritage notified.

13. In the event that bones, which could be human are uncovered, works shall stop, the site secured, and the NSW Police shall be immediately notified. Jerrinja LALC and the state authority shall be notified as soon as NSW Police deem it appropriate.

14. Inspection of the shore-line in proximity to the works shall be undertaken by a suitably experienced ecologist or Council Environmental Officer, each morning prior to works commencing if during the nesting periods of the threatened nesting shore-birds Little Tern, Pied Oystercatcher and Hooded Plover (approx. November – December). Council's Environmental Officers will liaise with the OEH Shorebird Recovery Coordinator to determine nesting periods. In the event that nesting of these species is detected in close proximity to the work-site, works must cease immediately. Advice will then be sought from the OEH Shorebird Recovery Coordinator on protection of the birds.

15. Works will be undertaken in accordance with an Acid Sulfate Soil management plan (dependent on test results from current investigations).

16. All contractors on site will be made aware of the potential for asbestos containing debris to be present on site. In the event that any Asbestos products are discovered / uncovered during works, removal shall be undertaken in accordance with the Asbestos Management Plan.

17. All fill material used on site is to be free of organic material, tree stumps, roots, rubbish, large stones, building material and excessive clay or silt. Introduced fill material must be tested and classified by the geotechnical engineer as either VNM or ENM before placement (as per construction notes).

18. Sand / beach nourishment will be confined to the areas indicated on the site plan and will cover the toe of the rock revetment to a depth of approximately 1.3m AHD, tapering to existing beach surface over a 10m width (as per the site plan), achieving a slope of 1:7.7 (13%) and a volume of approximately 1059.5m3.

19. Any disturbed / filled areas on the bank above the rock revetment are to be stabilised with jute mesh or similar immediately following works.

20. A Revegetation Plan will be developed by – or in consultation with – Council's Natural Resources and Floodplain Unit to guide the revegetation and subsequent maintenance of the vegetated bank above the rock revetment area. The Revegetation Plan will include the following:
    a) Plant species and minimum diversity, with preference given to species consistent with the locally occurring Bangalay Sand Forest EEC;
    b) Planting plan with planting locations and densities, which considers suitability of species in position on site and any required view lines (e.g. road and viewing area sight-lines, and proximity to access steps, storm-water pipes and rock revetment);
    c) Planting methodology including use of water crystals and plant guards if appropriate;
    d) Maintenance regime including replacement planting, watering until establishment and weed control.

21. Revegetation of the site is to commence in accordance with the Revegetation Plan following completion of works.

22. Monitoring of the movement of sand is to be undertaken as per the recommendations of DPI Fisheries "*to inform any future proposals for renourishment at River Road along with providing information about the longevity of any sand nourishment works".*

23. Prior to commencement of works, a minimum of four photo-points are to be established along the river foreshore for the purpose of monitoring the following:
    a) Survival and growth rates of revegetation plantings and retained vegetation;
    b) Stability of the embankment and any developing or persistent erosion;
    c) Movement of sand from sand nourishment (as per DPI Fisheries recommendations);
    d) Use of the sand-flat areas adjacent to the site by foraging shorebirds following sand-nourishment.
24. Photo-monitoring is to be undertaken commencing prior to works, continuing immediately upon completion of works and every subsequent 3 months for 2 years monitoring the features and issues outlined in mitigation measure 23.

7. Conclusion

This report assesses the potential impacts native flora and fauna of proposed coastal protection works at River Road Shoalhaven Heads.

Assessment under the *Biodiversity Conservation Act 2004*, *Fisheries Management Act 1994* and *Environmental Protection and Biodiversity Conservation Act 2000* concluded that the proposed works were unlikely to have a significant adverse effect on any NSW or Commonwealth listed threatened species or endangered ecological communities. Neither a species impact statement nor referral to the Commonwealth are required. The vegetation and habitat throughout the site, including Bangalay Sand Forest EEC will be protected and enhanced in the long-term as a result of the works.

Mitigation measures are outlined in Section 6 to be implemented throughout the project and the maintenance and monitoring period, to minimise direct and indirect impacts to native flora and fauna and their habitats, in addition to informing future management options for the Shoalhaven River foreshore in the vicinity of Shoalhaven Heads.

8. References

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APPENDIX A.

River Road Foreshore, Shoalhaven Heads - Likelihood of occurrence table

The table of likelihood of occurrence evaluates the likelihood of threatened species to occur on the subject site. This list is derived from previously recorded species within a 5 km radius (taken from Office of Environment and Heritage (OEH) Wildlife Atlas) around the subject site. Ecology information has been obtained from the Threatened Species Profiles on the NSW OEH website (www.threatenedspecies.environment.nsw.gov.au).

Likelihood of occurrence in study area

1. Unlikely – Species, population or ecological community is not likely to occur. Lack of previous recent (<25 years) records and suitable potential habitat limited or not available in the study area.
2. Likely – Species, population or ecological community could occur and study area is likely to provide suitable habitat. Previous records in the locality and/or suitable potential habitat in the study area.
3. Present – Species, population or ecological community was recorded during the field investigations.

Possibility of impact

1. Unlikely – The proposal would be unlikely to impact this species or its habitats. No EP&A Act 7-Part Test or EPBC Act significance assessment is necessary for this species.
2. Likely – The proposal could impact this species, population or ecological community or its habitats. An EP&A Act 7-Part Test and/or EPBC Act significance assessment is required for this species, population or ecological community.

Endangered Ecological Community name	***Status***	***Likelihood of presence within areas impacted by the activity***
Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	Endangered - *NSW* BC *Act*	Occurs within the subject site
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Endangered - *NSW* BC *Act* Vulnerable - Commonwealth *EPBC Act*	Occurs within 1km of the site (nearest records approx. 0.97km from the site) but site surveys confirmed that this EEC does not occur in close proximity such that it is at risk of being impacted by the proposal.
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered - *NSW* BC *Act*	Does not occur on-site and is not mapped as occurring in close proximity (not within 2km) to the site.
Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	Endangered - *NSW* BC *Act* Critically Endangered - Commonwealth *EPBC Act*	Does not occur on-site and is not mapped as occurring in close proximity (not within 1.5km) to the site.
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered - *NSW* BC *Act* Endangered - Commonwealth *EPBC Act*	Occurs within 1km of the site (nearest records approx. 0.44km from the site) but site surveys confirmed that this EEC does not occur in close proximity such that it is at risk of being impacted by the proposal.

Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered - *NSW* BC *Act*	Does not occur on-site and is not mapped as occurring in close proximity to the site (closest record approx. 1.24km from the site).

Species name	***Status***	***Habitat requirements (www.environment.nsw.gov.au)***	***Likelihood of presence within areas impacted by the activity***
FLORA			
Sand Spurge *Chamaesyce psammogeton*	Endangered *NSW* BC *Act*	Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (*Spinifex sericeus*) and Prickly Couch (*Zoysia macrantha*). Sand Spurge seeds float, so some dispersal between beaches may occur.	No – no habitat present
Solanum celatum	NSW BC Act Endangered	Grows in rainforest clearings or in wet sclerophyll forests. Flowers August to October and produces fruit between December and January. Normally recorded in disturbed margins and clearings.	No – no habitat present
AMPHIBIANS			
Green and Golden Bell Frog *Litoria aurea*	Vulnerable *EPBC Act* Endangered *NSW* BC *Act*	Heath, woodland and open dry sclerophyll forest on a variety of soil types except clay based. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Breeding frogs will call from open spaces, under vegetation or rocks or from within burrows in the creek bank. Egg masses are laid in burrows or under vegetation in small pools. After rains, tadpoles	No – no habitat present

		are washed into larger pools where they complete their development in ponds or ponded areas of the creekline. Tadpole development ranges from Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water.	
REPTILES			
Loggerhead Turtle *Caretta caretta*	Endangered *EPBC Act* Endangered *NSW* BC *Act*	Loggerhead Turtles are ocean-dwellers, foraging in deeper water for fish, jellyfish and bottom-dwelling animals. The female comes ashore to lay her eggs in a hole dug on the beach in tropical regions during the warmer months.	No – no habitat present
MICROBATS			
N/A			
BIRDS			
Australasian Bittern *Botaurus poiciloptilus*	*NSW* BC *Act* Endangered *EPBC Act* Endangered	Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats. It favours wetlands with tall, dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. The species favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over muddy or peaty substrate.	No – No suitable habitat present

		Knowledge of the breeding ecology of the Australasian Bittern is relatively poor. Available data indicate that the Australasian Bittern breeds in relatively deep, densely vegetated freshwater swamps and pools, building its nests in deep cover over shallow water. In rushland, it may avoid breeding in the densest areas; alternatively, this may simply reflect the accessibility of the few nests that have been found. If population density is high, it may resort to open wetlands for nesting, e.g. in stunted Acacia, but this may be exceptional behaviour. It is clear that a complexity of habitat is required in order for foraging and breeding to occur in one location. The species requires shallow water, less than 30 cm deep with medium to low density reeds, grasses or shrubs for foraging and needs deeper water, with medium to high density reeds, rushes or sedges for nesting.	
Beach Stone-curlew *Esacus magnirostris*	Critically endangered NSW BC Act	They are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. They forage in the intertidal zone of beaches and estuaries, on island, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Beach stone curlews breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves.	Suitable habitat present. Potentially occurring.
Black Bittern *Ixobrychus flavicollis*	Vulnerable *NSW* BC *Act*	Terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation that may comprise grassland, woodland forest rainforest and mangroves. Roosts in trees or on ground amongst dense reeds, nests in branches overhanging water	No – no habitat present
Black-tailed Godwit *Limosa limosa*	Vulnerable *NSW* BC *Act*	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large	Suitable habitat present. Potentially occurring.

		intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works. Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. Roosts and loafs on low banks of mud, sand and shell bars.	
Blue-billed Duck *Oxyura australis*	Vulnerable *NSW* BC *Act*	Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Blue-billed Ducks will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies. Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed.	No – no habitat present
Broad-billed Sandpiper *Limicola falcinellus*	Vulnerable *NSW* BC *Act*	Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers	Suitable habitat present. Potentially occurring.

		roost on banks on sheltered sand, shell or shingle beaches. The species is an active forager, typically feeding by rapidly and repeatedly jabbing its bill into soft wet mud. Feeding also occurs while wading, often in water so deep that they have to submerge their heads and necks in order to probe the underlying mud. Their diet includes insects, crustaceans, molluscs, worms and seeds.	
Curlew Sandpiper *Calidris ferruginea*	Vulnerable *NSW* BC *Act* Migratory *EPBC Act*	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Forages on mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15–30 mm, but up to 60 mm, deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Occasionally they forage on wet mats of algae or waterweed, or on banks of beachcast seagrass or seaweed. They rarely forage on exposed reefs. In Roebuck Bay, northern Western Australia, they are also said to feed on part of the mudflats that have been exposed for a longer period, foraging in small groups. Roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other	Suitable habitat present. Potentially occurring.

		wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh. They have also been recorded roosting in mangroves in Inverloch, Victoria.	
Dusky Woodswallow *Artamus cyanopterus cyanopterus*	Vulnerable NSW BC Act	The Dusky Woodswallow is often reported in woodlands is eastern, southern and southwestern Australia. In New South Wales it is widespread from coast to inland, including the western slopes of the great Diving Range and farther west. It is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalyptus, including mallee associations. It have also been recorded in shrublands and heathlands and carious modified habitats including regenerating forests; very occasionally in moist forests of rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath. The ground cover may consist of grasses, sedges or open ground, often with course woody debris. Birds are often observed in farmland usually at the edges of forests, woodlands or in roadside remnants or wind breaks with dead timber. Nesting occurs from late September to late February, with eggs present between October and early December. They nest in an open shallow untidy cup, frequently in an open hollow, crevice or stump.	No – no habitat present
Eastern Osprey *Pandion cristatus*	*NSW* BC *Act* Vulnerable	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Potentially occurring but unlikely to be impacted in any way by the proposed works. The species are transient and far ranging. The species may fly over the site and feed nearby but is unlikely to utilise habitats available on site. No large nests were observed during site inspections and trees on site are low and do not offer high positions for nesting. The proposed activity is unlikely to impact the species as the area does

			not provide important or useful habitat for the species. Further consideration via a Test of Significance is not warranted.
Gang-gang Cockatoo *Callocephalon fimbriatum*	*Vulnerable NSW* BC *Act*	Tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. Favours old growth attributes for nesting and roosting	No – no habitat present
Glossy Black-cockatoo *Calyptorhynchus lathami*	Vulnerable *NSW BC Act*	The GBC inhabits open forest and woodlands of the coast where stands of she-oak occur. In the Jervis Bay region they feed almost exclusively on the seeds of the black she-oak *Allocasuarina littoralis*, shredding the cones with their bill	No – no habitat present
Greater Sand-plover *Charadrius leschenaultii*	Vulnerable *NSW* BC *Act* *Vulnerable EPBC Act*	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders. Diet includes insects, crustaceans, polychaete worms and molluscs. Prey is detected visually by running a short distance, stopping to look, then running to collect the prey	Suitable habitat present. Potentially occurring.
Great Knot *Calidris tenuirostris*	Vulnerable *NSW* BC *Act* Migratory *EPBC Act*	In Australasia, the species typically prefers sheltered coastal habitats, with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near	Suitable habitat present. Potentially occurring.

		the coast, saltlakes and non-tidal lagoons. The Great Knot rarely occurs on inland lakes and swamps. Typically, the Great Knot roosts in large groups in open areas, often at the waters edge or in shallow water close to feeding grounds. It is known that in hot conditions, waders prefer to roost where a damp substrate lowers the local temperature.	
Hooded Plover *Thinornis rubricollis*	*NSW* BC *Act* Critically Endangered Vulnerable *EPBC Act*	In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beachcast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh. Hooded Plovers forage in sand at all levels of the zone of wave wash during low and mid-tide or among seaweed at high-tide, and occasionally in dune blowouts after rain. At night they favour the upper zones of beaches for roosting. When on rocks they forage in crevices in the wave-wash or spray zone, avoiding elevated rocky areas and boulder fields. In coastal lagoons they forage in damp or dry substrates and in shallow water, depending on the season and water levels. In eastern Australia, Hooded Plovers usually breed from August to March on sandy ocean beaches strewn with beachcast seaweed, in a narrow strip between the high-water mark and the base of the fore-dunes. They often nest within 6 m of the fore-dune, mostly within 5 m of the high-water mark, but occasionally among or behind dunes.	Suitable habitat present. Potentially occurring.

Lesser Sand-plover *Charadrius mongolus*	Vulnerable *NSW BC Act* Migratory *EPBC Act*	In non-breeding grounds in Australia, this species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometime occurs in short saltmarsh or among mangroves. The species feeds mostly on extensive, freshly-exposed areas of intertidal sandflats and mudflats in estuaries or beaches, or in shallow ponds in saltworks. hey roost near foraging areas, on beaches, banks, spits and banks of sand or shells and occasionally on rocky spits, islets or reefs. The species does not breed in Australia.	Suitable habitat present. Potentially occurring.
Little Eagle *Hieraaetus morphnoides*	Vulnerable *NSW BC Act*	Occupies open eucalypt forest, woodland or open woodland. She-oak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter	No – no habitat present
Little Lorikeet *Glossopsitta pusilla*	Vulnerable *NSW BC ACT*	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the	No – no habitat present

		ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees often chosen, including species like Allocasuarina	
Little Tern *Sternula albifrons*	Endangered *NSW BC Act*	Mostly exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above the high tide mark near estuary mouths or adjacent to coastal lakes and islands. Nests in a scrape in the sand, which may be lined with shell grit, seaweed or small pebbles.	Suitable habitat present. Potentially occurring.
Orange-bellied Parrot *Neophema chrysogaster*	Critically endangered *NSW BC Act* Critically Endangered *EPBC Act*	On the mainland, the Orange-bellied Parrot spends winter mostly within 3 km of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes and saltmarshes. The species also inhabits small islands and peninsulas and occasionally saltworks and golf courses. Birds forage in low samphire herbland or taller coastal shrubland. Diet mainly comprises seeds and fruits of sedges and salt-tolerant coastal and saltmarsh plants. Occasionally, flowers and stems are eaten. Orange-bellied Parrots are known to forage among flocks of Blue-winged Parrots. Recent records from unexpected places, including Shellharbour and Maroubra suggest that the species may be expanding their selection of habitats and foraging plant species. Birds seen in NSW in 2003 were foraging on weed species several hundred metres from the coast.	Potentially occurring. Highly mobile and transient species. No breeding habitat. Species may visit site occasionally. No important habitat required for the survival of the species occurs on site or will be impacted by the proposed works.
Pied Oystercatcher *Haematopus longirostris*	Endangered *NSW BC Act*	Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. Nests mostly on coastal or estuarine beaches although	Suitable habitat present. Potentially occurring.

		occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.	
Sanderling *Calidris alba*	Vulnerable *NSW* BC *Act*	Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Generally occurs in small flocks, however may associate freely with other waders. Individuals run behind receding waves, darting after insects, larvae and other small invertebrates in the sand, then dart back up the beach as each wave breaks. Also feeds on plants, seeds, worms, crustaceans, spiders, jellyfish and fish, foraging around rotting heaps of kelp, at the edges of shallow pools on sandspits and on nearby mudflats. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes. Breeding occurs in the Northern Hemisphere.	Suitable habitat present. Potentially occurring.
Sooty Oystercatcher *Haematopus fuliginosus*	Vulnerable *NSW BC Act*	Shore bird – breeds in sand or coral scrapes on offshore islands	Suitable habitat present. Potentially occurring.
Swift Parrot *Lathamus discolour*	Endangered *EPBC Act* Endangered *NSW* BC *Act*	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (E. albens). Commonly used lerp infested trees include Inland Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis. Return to some foraging sites on a cyclic basis depending on food	No – no habitat present

		availability. 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 Eucalyptus globulus.	
Terek Sandpiper *Xenus cinereus*	Vulnerable *NSW* BC *Act* Migratory EPBC Act	The Terek Sandpiper mostly forages in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons. The species has also been recorded on islets, mudbanks, sandbanks and spits, and near mangroves and occasionally in samphire (*Halosarcia* spp.). Birds are seldom near the edge of water, however, birds may wade into the water. Occasionally, on sandy beaches, among seaweed and other debris and in rocky areas, Terek Sandpipers will use the supralittoral or upper littoral zone, where a film of water covers the sand. However, on exposed rock platforms, the species forages in the lower littoral zone and not the supralittoral or upper littoral zones. Less often seen on sandy or shingle beaches, or on rock or coral reefs or platforms, Terek Sandpipers are occasionally sighted around drying sewage ponds and saltpans if surrounded by mudflats. The species is also found around brackish coastal swamps, lagoons and dune-lakes; and also on gravel or rocky edges of estuarine pools and freshwater river-pools. Very occasionally, birds use swampy, grassy or cultivated paddocks near the coast. Preferring to roost in or among mangroves, birds may perch in branches or roots up to 2 m from the ground, or beneath them in the shade on hot days. Occasionally, they roost in dead trees or among tangled driftwood.	Suitable habitat present. Potentially occurring.

Varied Sittella *Daphoenositta chrysoptera*	Vulnerable *NSW* BC *Act*	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland	No – no habitat present
White-bellied Sea-Eagle *Haliaeetus leucogaster*	*NSW* BC *Act* Vulnerable Migratory *EPBC Act*	Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterized by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats. The species is mostly recorded in coastal lowlands, but can occupy habitats up to 1400 m above sea level on the Northern Tablelands of NSW and up to 800 m above sea level in Tasmania and South Australia. Birds have been recorded at or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs, saltmarsh and sewage ponds. They also occur at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas. Breeding has been recorded on the coast, at inland sites, and on offshore islands. Breeding territories are located close to water, and mainly in tall open forest or woodland, although nests are sometimes located in other habitats such as dense forest (including rainforest), closed scrub or in remnant trees on cleared land. Forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore, where they forage over in-shore waters. However, the White-bellied Sea-Eagle will also forage over open	Potentially occurring but unlikely to be impacted in any way by the proposed works. The species are transient and far ranging. The species may fly over the site and feed nearby but is unlikely to utilise habitats available on site. No large nests were observed during site inspections and trees on site are low and do not offer high positions for nesting. The proposed activity is unlikely to impact the species as the area does not provide important or useful habitat for the species. Further consideration via a Test of Significance is not warranted.

		terrestrial habitats (such as grasslands). Birds may move to and congregate in favorable sites during drought or food shortage.	
White-fronted Chat *Epthianura albifrons*	Vulnerable *NSW BC Act*	Commonly occurring in the saltmarshes of southern Australia, the White-fronted Chat is often seen foraging for insects and their larvae among the succulent leaves and stems of stunted saltmarsh plants.	No – no habitat present
MAMMALS			
Australian Fur-seal *Arctocephalus pusillus doriferus*	Vulnerable *NSW* BC *Act*	Prefers rocky parts of islands with flat, open terrain. They occupy flatter areas than do New Zealand Fur-seals where they occur together.	No – no habitat present
Greater Glider *Petauroides volans*	Vulnerable EPBC Act	Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha. Give birth to a single young in late autumn or early winter which remains in the pouch for approximately 4 months and is independent at 9 months of age. Usually solitary, though mated pairs and offspring will share a den during the breeding season and until the young are independent. Can glide up to a horizontal distance of 100m including changes of direction of as much as 90 degrees. Very loyal to their territory.	No – no habitat present
Grey-headed Flying-fox *Pteropus poliocephalus*	Vulnerable *EPBC Act* Vulnerable *NSW* BC *Act*	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Possible – but not likely to be affected by the proposed activity. The species are transient and far ranging. It is possible that the species would fly over the site from time to time or to rest briefly. The proposed activity is unlikely to impact the species as the area does not provide important or useful habitat for the species. The species use of the site (flying over

			or resting) would not be affected by the proposal. Further consideration via a Test of Significance is not warranted.
Humpback Whale *Megaptera novaeangliae*	Vulnerable EPBC Act Vulnerable NSW BC Act	The population of Australia's east coast migrates from summer cold-water feeding grounds in Subantarctic waters to warm-water winter breeding grounds in the central Great Barrier Reef. They are regularly observed in NSW waters in June and July, on northward migration and October and November, on southward migration	No – no habitat present
Koala *Phascolarctos cinereus*	Vulnerable NSW BC Act	Eucalypt woodland and forest Home range sizes vary with quality of habitat ranging from less than two ha to several hundred ha. Preferred tree species on the south coast are *Eucalyptus amplifolia, E.viminalis, & E.tereticornis* but numerous other species also known food trees.	No – no habitat present
Spotted-tailed Quoll *Dasyurus maculatus*	Endangered *EPBC Act* Vulnerable *NSW* BC *Act*	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and will hunt possums and gliders in tree hollows and prey on roosting birds. Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. Are	No – no habitat present

		known to traverse their home ranges along densely vegetated creeklines.	