Merimbula Sewage Treatment Plant Upgrade and Ocean Outfall

Appendix H

Part A: Biodiversity Assessment Report

Contents

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
BBAM	Biobanking Assessment Methodology
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BBCC	Biobanking credit calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BVSC	Bega Valley Shire Council
CEEC	Critically Endangered Ecological Community
DoAWE	Commonwealth Department of the Agriculture, Water and Environment (formerly DotE)
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FBA	Framework for Biodiversity Assessment
FM Act	NSW *Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystem
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPWS	NSW National Parks and Wildlife Service (part of OEH)
PCT	Plant community type
OEH	NSW Office of Environment and Heritage (formerly Department of Environment Climate Change and Water, DECCW)
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
SSI	State Significant Infrastructure
STP	Sewage treatment plant
TEC	Threatened Ecological Community
VIS	Vegetation Information System

Executive Summary

Bega Valley Shire Council (BVSC) is proposing an upgrade to the Merimbula Sewage Treatment Plant (STP) including a new ocean outfall in Merimbula Bay (the Project). The Project would be located between Merimbula and Pambula on Arthur Kaine Drive, within the Bega Valley Shire local government area (LGA). The Merimbula STP is bounded by the Pambula Merimbula Golf Club to the south, Merimbula Lake to the west, Merimbula Airport to the north and Arthur Kaine Drive to the east. The Merimbula STP is accessed via Arthur Kaine Drive, which links to Princes Highway to the west and providing direct access to Merimbula Airport in the north.

The Project would involve an upgrade of sewage treatment at the Merimbula STP and replacement of the existing beach face outfall and dunal exfiltration ponds with an ocean outfall in Merimbula Bay. Specifically, the Project would involve:

- upgrade of the STP to improve the quality of treated wastewater (including for beneficial re-use);
- decommissioning of the beach-face outfall, as well as an STP effluent pond;
- discontinuing the use of the dunal exfiltration ponds;
- installation of a secondary disposal mechanism - an ocean outfall pipeline about 3.5 km in length to convey treated wastewater to a submerged diffuser;
- installation of upgraded pumps; and
- continuation of the beneficial re-use irrigation scheme at the PMGC grounds and the Oaklands agricultural area, with treated wastewater of improved quality.

The Project area comprises the existing Merimbula STP site and ocean outfall alignment, as well as areas required for construction, including laydown areas within the adjacent PMGC grounds and on Merimbula Beach (with access via Pambula Beach).

The Project is aimed at reducing the environmental and health impacts of current operations, by providing a higher level of treatment and a superior mode of discharge/ dispersion of the treated wastewater via an ocean outfall in Merimbula Bay. The upgraded STP would be operated with the additional treatment processes which would improve the quality of the treated wastewater.

Eco Logical Australia Pty Ltd (ELA) was engaged by AECOM Australia Pty Ltd to undertake an assessment of potential impacts of the proposed Merimbula sewage treatment plant (STP) upgrade and ocean outfall on terrestrial biodiversity values in accordance with the Framework for Biodiversity Assessment (FBA). Consistent with the FBA a Biodiversity Assessment Report (BAR) has been prepared for the Project.

Whilst the Project involves multiple elements, this BAR relates only to those elements that will or may result in impacts on terrestrial habitats and associated biodiversity.

Preliminary assessment of the terrestrial biodiversity values within the study area identified a number of biodiversity constraints including:

- Endangered ecological communities (EEC);
- Coastal wetlands; and
- Known and potential threatened species habitats.

These biodiversity constraints influenced the Project design, which has been designed to avoid and minimise impacts on terrestrial biodiversity. This has primarily been achieved by:

- Largely restricting the footprint of the proposed works to the footprint of the existing STP
- Constructing the 0.8 km onshore component of the proposed outfall pipeline using an underground trenchless drilling method.

As a result of the impact avoidance and minimisation strategies which have been incorporated into the Project design, the impact on terrestrial vegetation and associated habitats has been limited to:

- the removal of approximately 217 m^2 of vegetation in the hind dune of Pambula Beach to enable construction access to Pambula Beach and the location where the pipeline reaches the beach;
- the removal of approximately 47 m^2 of vegetation on the dune of Merimbula Beach to enable the decommissioning of the existing beach-face outfall; and
- the removal of approximately 2,464 m^2 of regrowth scrub within the existing STP site for the access from the stockpile site, to the north of the STP, and for the access through to the temporary construction laydown area on the Pambula Merimbula Golf Club (PMGC) grounds.

A total of five plant community types (PCTs) in various condition states were identified within the Project area. However, only two PCTs occur within the development footprint, and would be affected by the Project (the other PCTs have been avoided as a result of the Project design, particularly the use of the direction drilling method):

- PCT 772 - Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion; and
- PCT 777 - Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion.

The remainder of the development footprint has been so heavily modified as to not support native vegetation or comprises beach sand. Whilst three EECs were detected within the Project area, the Project has been designed to avoid any impacts on them.

In total, the Project would involve the clearing of approximately 0.28 ha of highly modified native vegetation that is of negligible conservation significance.

The Project area was found to provide a range of habitats for threatened flora and fauna. As such, the Project was designed to avoid and minimise impacts on fauna habitats such that impacts would be limited to a small amount of foraging and sheltering habitat. The main potentially adverse impact associated with the Project is the potential for the loss of one hollow-bearing tree, that is also a known Yellow-bellied Glider sap feeding tree, in association with the upgrading of the vehicle access at the entry to the STP off Arthur Kaine Drive.

As a result of the impact avoidance and minimisation strategies which have been incorporated into the Project design, the impacts on fauna habitats would be limited to approximately 0.28 ha of vegetation, much of which is already highly modified. This is a small area in the context of the extent of similar habitats in contiguous vegetation. None of the higher quality vegetation and habitats within the Project area would be affected by the Project.

There would be a minor loss in habitat for waterbirds and amphibians in association with the proposed decommissioning of the STP effluent pond. However, this is not considered to comprise a significant adverse impact given the small area of relatively low quality habitat to be affected relative to the extent of similar and superior habitats locally.

Potential temporary impacts on shorebirds associated with construction activities along Merimbula and Pambula Beach are expected to be minor and can be mitigated by appropriate measures prior to and during the construction phase of the Project.

The Project has been designed such that connectivity between habitats to the north and south of the Project area would be largely unaffected.

This BAR outlines the measures taken to avoid, minimise and mitigate impacts to the vegetation and habitats present within the development footprint during the design, construction and operation of the Project. The residual unavoidable impacts of the Project were calculated in accordance with the Biobanking Assessment Methodology (BBAM) and the Biobanking credit calculator (BBCC). The BBCC calculated that a total of four ecosystem credit and 12 species credits are required to offset the unavoidable impacts to the vegetation and habitat present.

Following consideration of the administrative guidelines for determining significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), it is concluded that the Project is unlikely to have a significant impact on matters of national environmental significance (MNES) or Commonwealth land.

1. Introduction

Bega Valley Shire Council (BVSC) is proposing an upgrade to the Merimbula Sewage Treatment Plant (STP) including a new ocean outfall in Merimbula Bay (the Project). The Project would be located between Merimbula and Pambula, within the Bega Valley Shire local government area (LGA) (refer **Figure 1**).

The Project would address the current situation whereby treated effluent discharges into existing dunal exfiltration ponds and onto Merimbula Beach. The Project would reduce the environmental and health impacts of the current operations, by providing a higher level of treatment and a superior mode of discharge/dispersion of the treated wastewater via the ocean outfall offshore in Merimbula Bay.

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were first issued in July 2016. Revised SEARs were issued on 4 February 2019. The revised SEARs reaffirmed the requirement to undertake an assessment of potential impacts of the Project on biodiversity values in accordance with the FBA.

This report satisfies the requirement to produce a BAR in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act). **Appendix A** provides details of how this report meets the layout and requirements of a BAR, as specified in **Table 20** (stage 1) and **Table 21** (stage 2) of the FBA. The FBA accredited assessor was Ryan Smithers (accreditation number 0067).

1.1 The Project

A full description of the Project is provided in the Environmental Impact Statement (EIS) in **Chapter 2 Project description** (AECOM 2020a). In summary the Project involves:

- upgrade of the STP to improve the quality of treated wastewater (including for beneficial re-use);
- decommissioning of the beach-face outfall, as well as an STP effluent storage pond;
- discontinuing the use of the dunal exfiltration ponds;
- installation of a secondary disposal mechanism - an ocean outfall pipeline about 3.5 km in length to convey treated wastewater to a submerged diffuser;
- installation of upgraded pumps; and
- continuation of the beneficial re-use irrigation scheme at the PMGC grounds and nearby Oaklands agricultural area with treated wastewater of improved quality.

Upgrades to the STP and the ocean outfall would reduce the environmental and health risks and impacts of the current operations, by providing a higher level of treatment and a superior mode of discharge/ dispersion of the treated wastewater via an ocean outfall offshore in Merimbula Bay.

The Project area is shown on **Figure 1**, and comprises the existing Merimbula STP site and the proposed outfall pipeline alignment. The Project construction areas would include areas within the Merimbula STP, temporary laydown areas on the adjacent PMGC grounds and on Merimbula Beach (with associated access from Pambula).

The outfall pipeline would be up to 450 mm in diameter and consist of pipeline lengths welded together. From the STP to a location beyond the surf zone the pipeline would be constructed using an underground trenchless drilling method. From the surf zone to the offshore pipeline termination point the pipeline would be laid on the seabed floor.

Whilst the Project involves multiple elements, this BAR relates only to those elements that would or may result in impacts on terrestrial habitats and associated biodiversity.

Preliminary assessment of the terrestrial biodiversity values identified a number of biodiversity constraints including:

- Endangered ecological communities (EECs);
- Coastal Wetlands; and
- Known and potential threatened species habitats.

These biodiversity constraints influenced the Project design, which has been designed to avoid and minimise impacts on terrestrial biodiversity. This has primarily been achieved by:

- largely restricting the footprint of the proposed works to the footprint of the existing STP; and
- constructing the 0.8 km onshore component of the proposed outfall pipeline using an underground trenchless drilling method.

As a result of the impact avoidance and minimisation strategies which have been incorporated into the Project design, the impact on terrestrial vegetation and associated habitats have been limited to:

- the removal of approximately 217 m^2 of vegetation in the hind dune of Pambula Beach to enable construction access to Pambula Beach;
- the removal of approximately 47 m^2 of vegetation on the dune of Merimbula Beach to enable the decommissioning of the existing beach-face outfall; and
- the removal of approximately 2,464 m^2 of regrowth scrub within the existing STP site for the access from the stockpile site, to the north of the STP, and for the access through to the temporary construction laydown area on the PMGC grounds.

The Project is further identified in **Figure 1** and **Photos 1 to 6**.

1.2 Study area

The existing Merimbula STP is located between Merimbula and Pambula on the western side of Arthur Kaine Drive, approximately 3.5 kilometres south of the Merimbula town centre and 2.5 kilometres north of Pambula village.

The Project area encompasses the existing Merimbula STP, the proposed outfall pipeline route and the areas required for construction of the Project, as identified in **Figure 1**.

A preliminary study area was identified at the commencement of the preliminary design for the Project. This comprised those onshore areas that were initially considered likely to have been affected by the Project and comprised the Merimbula STP and the land to the east between the STP and Merimbula Beach, as shown in **Figure 2**. At the outset of this assessment, survey and assessment was concentrated within the preliminary study area.

The study area and development footprint for the purpose of this assessment, that is the above-ground footprint that would be affected by construction and/or operation of the Project, comprises those areas affected by the terrestrial vegetation impacts described above, and shown in **Figure 3**. In addition to parts of the preliminary study area, it includes:

- a small area of vegetation between Pambula Surf Life Saving Club (SLSC) and Pambula Beach that would require clearing to provide construction access to Pambula Beach;
- Pambula Beach extending north to the location where the proposed pipeline would meet the beach. This is for temporary access during construction; and
- parts of the PMGC grounds which would be used for a temporary laydown area during construction.

Notably it does not include the below ground portion of the proposed ocean outfall pipeline, which has been chosen to be installed with directional drilling to avoid biodiversity values (as well as Aboriginal heritage values)

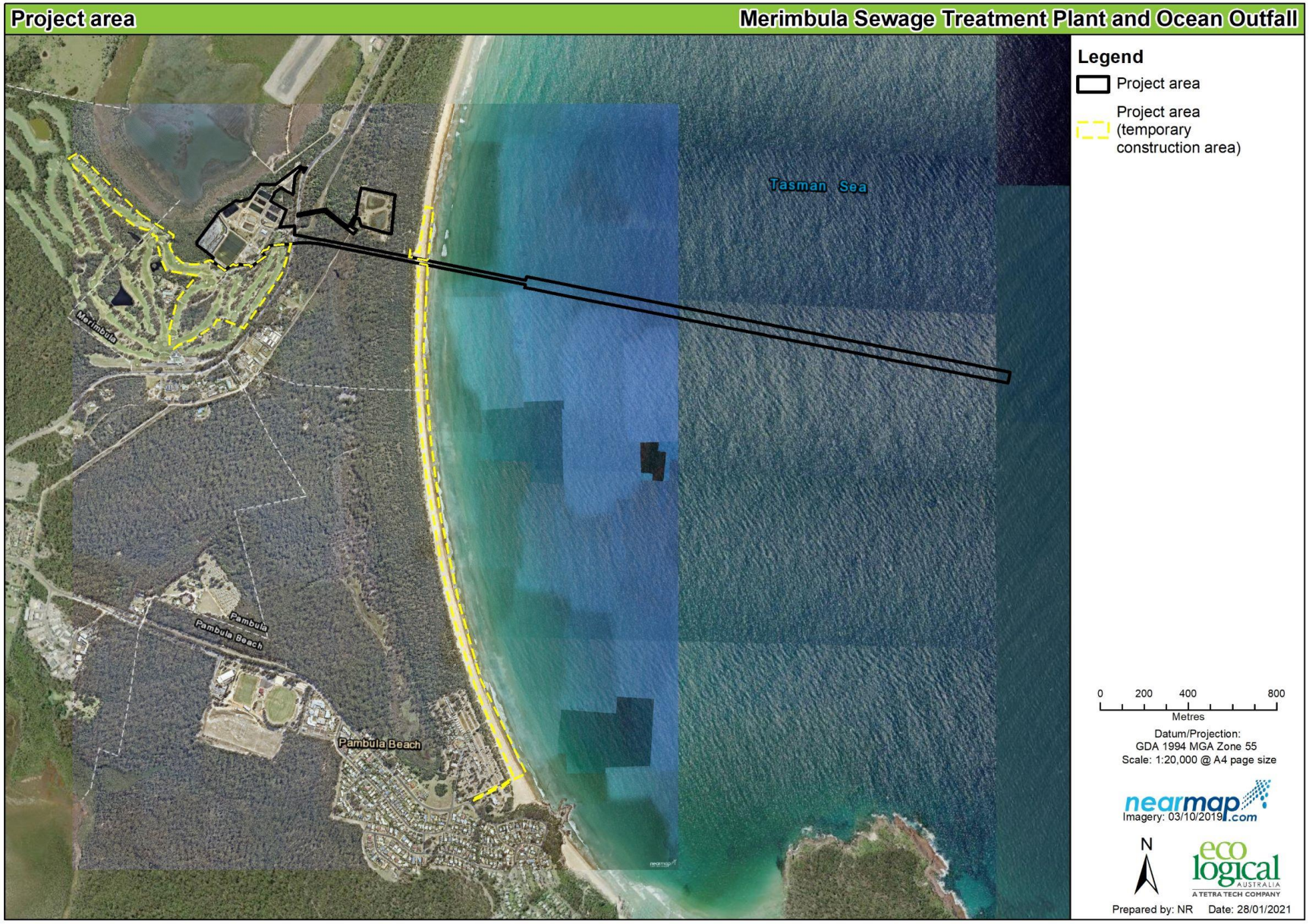

Figure 1: The Project area.

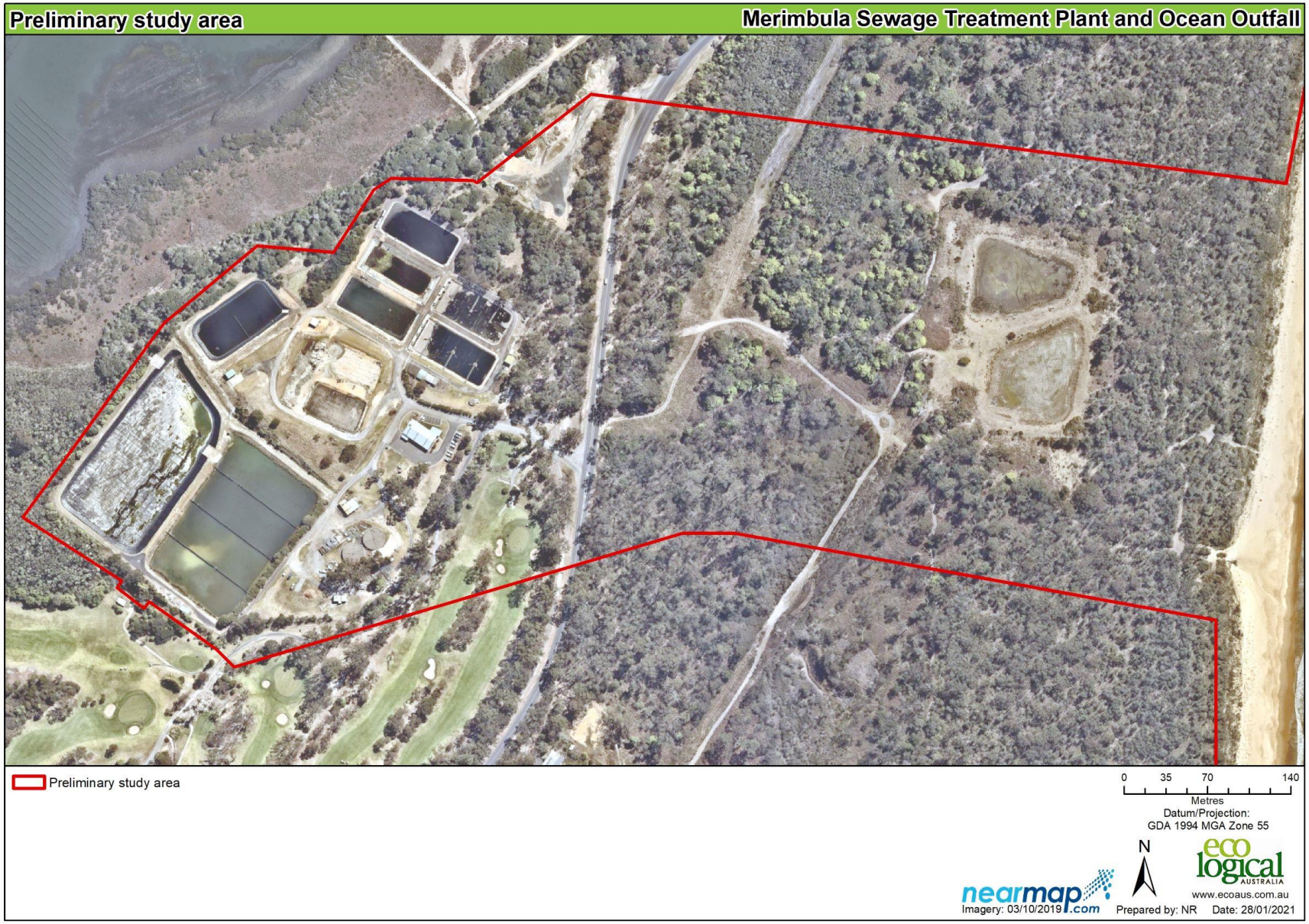

Figure 2: Preliminary study area

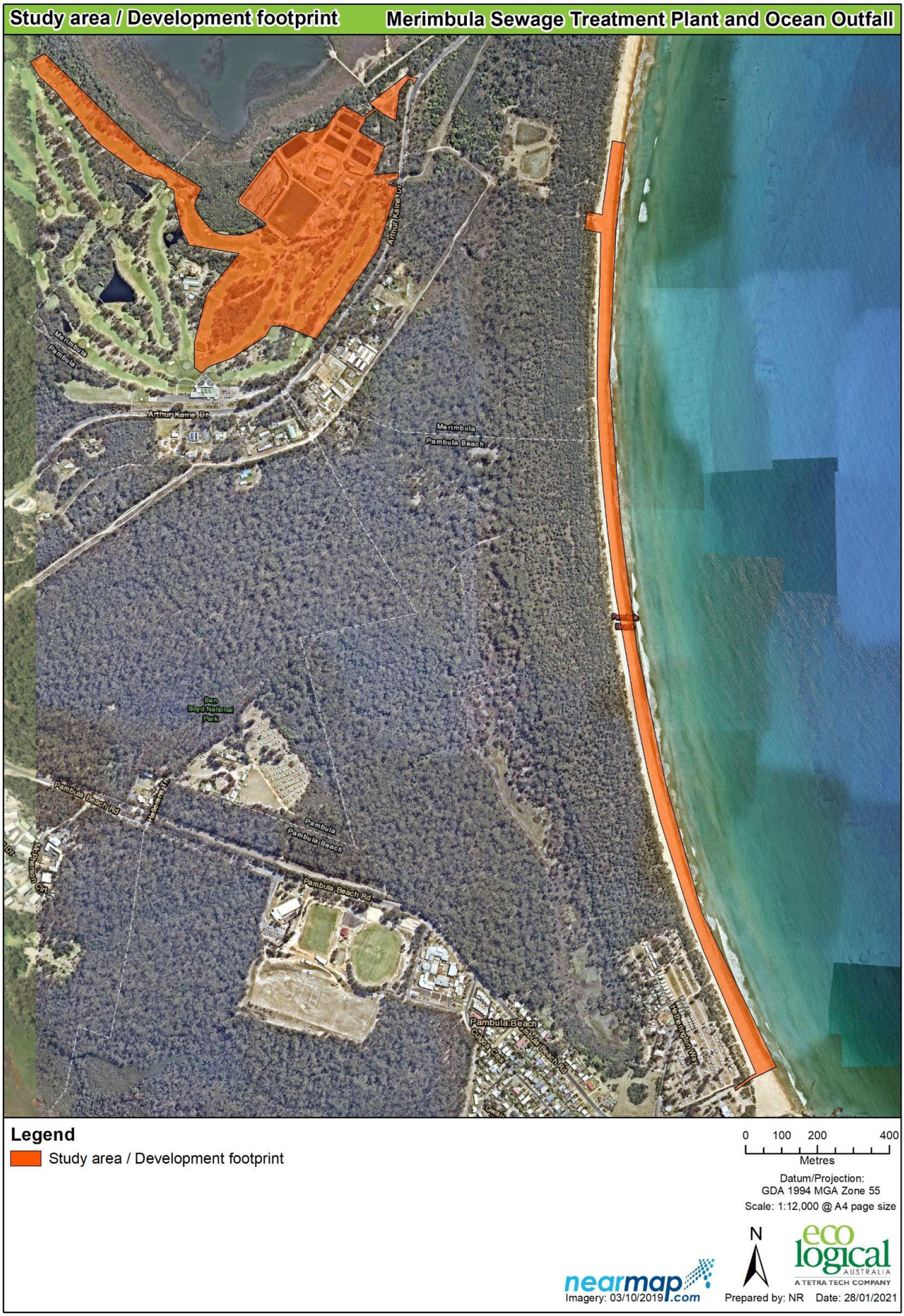

Figure 3: Study area / Development footprint

Photo 1: The existing Merimbula STP looking east towards the entrance off Arthur Kaine Drive

Photo 2: The dunal exfiltration ponds east off Arthur Kaine Drive. This photo was taken after significant rain in October 2020.

Photo 3: The existing beach-face outfall onto Merimbula Beach.

Photo 4: Looking north along Pambula Beach towards the proposed pipeline location. This photo was taken after a major storm in February 2020.

Photo 5: Dunal vegetation that would be removed for construction access to Pambula Beach.

Photo 6: Pambula-Merimbula Golf Club fairways would be used for a temporary laydown area (e.g. for pipe strings) during construction. There is ample room to lay down pipes without adversely affecting the native vegetation which occurs on the edges of the fairways in places.

1.3 Context of the Biodiversity Assessment Report

The NSW Government has developed a NSW Biodiversity Offsets Policy for Major Projects, including State Significant Development (SSD) and State Significant Infrastructure (SSI). As part of an application for a Major Project under the EP&A Act, a proponent must prepare an EIS that addresses the SEARs provided by the NSW Department of Planning, Industry and Environment (DPIE).

Under the NSW Biodiversity Offsets Policy for Major Projects, the SEARs require the Framework for Biodiversity Assessment to be applied to assess impacts on biodiversity. The FBA outlines the assessment methodology to quantify and describe the biodiversity values on the development footprint, and the biodiversity offsets required for any unavoidable impacts.

The FBA negates the need to conduct Assessments or Test of Significance (formerly 7-part tests under the TSC Act). However, the FBA requires proponents to identify and assess the impacts on all *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed threatened species and ecological communities that may be on the development footprint. These have been assessed in **Appendix B** and **Appendix C** according to EPBC Act impact assessment processes.

The FBA applies only to terrestrial impacts. Section 115ZG of the EP&A Act states that permits under section 201, 205 or 219 of the *Fisheries Management Act 1994* do not apply to SSI. These permits relate to dredging work, harm to marine vegetation and blocking of fish passage. However, the potential impacts on marine and freshwater aquatic environments and on groundwater dependent ecosystems (GDEs) have been considered in other specialist studies prepared for the Project EIS (Elgin Associates 2020 and ELA 2020).

2. Methodology

2.1 Background information

A number of database searches, aerial photographs, previous reports and studies were used in this assessment. These are discussed below.

2.1.1 Assessment guidelines

The assessment was undertaken in accordance with the survey guidelines specified by the SEARs. These included:

- NSW offset policy for major projects (State significant development and State significant infrastructure) (OEH 2014a);
- NSW Framework for Biodiversity Assessment (OEH 2014b);
- The Biodiversity Assessment Method and Offset Rules (OEH 2017); and
- Draft Threatened Species Survey and Assessment: Guidelines (NSW Department of Environment and Conservation 2004).

2.1.2 Database searches

ELA reviewed aerial photography as well as the following vegetation datasets which overlap with the study area:

- Vegetation of South East NSW: a revised classification and map for the coast and eastern tablelands (Tozer et al 2010); and
- Biometric vegetation types of the Shoalhaven, Eurobodalla and Bega Valley local government areas GIS layer (OEH 2013).

The following threatened species databases were reviewed for the locality:

- Bionet Atlas of NSW Wildlife (10 kilometre radius search), accessed 22 January 2020; and
- EPBC Act Protected Matters Search Tool (10 kilometre radius search) (DoAWE 22 January 2020).

2.1.3 Previous reports

ELA reviewed relevant reports covering the Project or study area and immediate surrounds including:

- Draft Environmental Impact Review – Merimbula Sewage Treatment Plant Upgrade and Deep Ocean Outfall – Concept Design and Environmental Impact Statement (AECOM 2017);
- Draft Ecological Desktop Assessment – Merimbula Effluent Management Strategy (AECOM 2012); and
- Review of Environmental Factors – Proposed Dunal Exfiltration Investigations Merimbula STP (NGH 2009).

2.2 Assessment methodology

The assessment presented in this BAR was undertaken in accordance with the survey guidelines specified by the SEARs, which is outlined in **Section 2.1.1**. In addition, the number of vegetation plots/transects utilised in this assessment meets or exceeds the FBA minimum number of plots required (OEH 2014b).

2.2.1 Field surveys

The field survey methods ELA employed to undertake the field assessment of the biodiversity values of the study area are outlined below. The surveys conducted considered the relevant survey guidelines for various threatened species. If information was not available on whether or not threatened species occurred within the study area, then a precautionary approach was adopted, whereby the presence of the species was assumed. This approach is consistent with the SEARs, FBA, and relevant impact assessment guidelines.

The methods used and rationale behind their selection is described below, with field survey locations shown in **Figure 4**.

2.2.1.1 Preliminary vegetation mapping and habitat assessment

In August 2017 a preliminary assessment was undertaken within the preliminary study area over two days by ELA ecologists Ryan Smithers and Sarah Dickson-Hoyle. Consistent with the FBA the preliminary assessment mapped the vegetation within the study area into vegetation zones. Preliminary surveys were also undertaken for threatened flora and fauna habitats, in particular the location of hollow-bearing trees, sheltering habitats, feed trees and other foraging resources, and other potentially important habitat resources, such as wetlands, were mapped.

Once vegetation communities were identified from a combination of floristic surveys and transect traverses, plant community types (PCT) were assigned to vegetation mapping units from the published PCTs for the South east corner bioregion. This was done by comparing the floristics, structure, general descriptions of location, soil type and other attributes as described in (Tozer et al. 2010) and DPIE online VIS classification database (OEH 2015b).

2.2.1.2 Biometric plots

Biometric plots were undertaken in accordance with the FBA. The plots included a 20 m by 20 m full floristic plot and a 20 m by 50 m plot identifying number of hollow bearing trees and length of fallen wood. They also included a 50 m transect to collect data on canopy cover, midstorey cover, and ground cover for native and exotic species. The plot for Zone 7 (Plot 1) (refer **Section 4.2** for description of vegetation zones identified, and **Figure 4** for plot location) was located just beyond the development footprint, as those parts of Zone 7 within the development footprint comprised small patches that were too small to accommodate a 20 m by 50 m plot. Similarly Plot 2 and Plot 3 were located immediately adjacent to the development footprint in order to locate a plot within an area that was representative of the zone.

2.2.1.3 Targeted flora surveys

Targeted searches for threatened species potentially occurring in the study area were undertaken within the development footprint and immediate surrounds.

2.2.1.4 Opportunistic fauna surveys

The fauna surveys undertaken by ELA consisted of opportunistic sightings whilst conducting other surveys i.e. plot surveys, and random meanders. Evidence of fauna usage was noted, for example diggings, evidence of foraging, and scats. Given the impact avoidance and minimisation strategies which have been incorporated into the Project design and the subsequent minimal potential impacts on terrestrial vegetation and associated habitats, targeted fauna surveys were not undertaken for the Project.

Figure 4: Field survey locations

2.2.1.5 Fauna habitat assessment

Fauna habitat assessments identifying potential habitat for threatened fauna species, including marking of habitat features i.e. hollow bearing trees, water habitats and foraging substrates. In the absence of targeted fauna surveys, habitat assessments identify important habitat features that may provide potential habitat for threatened fauna.

2.2.2 Survey effort

A summary of the field survey effort for each survey method is provided in **Table 1**.

All surveys were diurnal surveys and were conducted over four days, two days in August 2017, one day in January 2020, and on in October 2020. Weather conditions were warm to hot and dry during each survey period.

Table 1: Survey effort

Method	Person hours	Dates
Vegetation mapping and attribution	16	8 and 9 August 2017
Biometric plots	8	9 August 2017 and 11 February 2020
Fauna habitat assessment and hollow bearing tree survey	8	8 and 9 August 2017
Targeted flora survey for threatened flora	2	11 February 2020
Fauna habitat assessment and hollow bearing tree survey of affected parts of the PMGC grounds	3	9 October 2020

2.2.3 Project personnel

This assessment was carried out by appropriately qualified and experienced ecologists and environmental professionals as demonstrated in **Table 2**.

Table 2: Personnel and qualifications

Name	Role	Qualifications
Ryan Smithers	Project manager and lead ecologist	BEvSc (Hons), University of Wollongong, 1995 Accredited BAM, Biobanking and major projects assessor
Dr Meredith Henderson	Project Director and Quality Assurance	PhD, Victoria University, Melbourne, 2003 Accredited BAM, Biobanking and major projects assessor
Michelle Frolich	Biobanking tool operation	Accredited BAM, Biobanking and major projects assessor
Dr Frank Lemckert	Advice with respect to amphibians	PhD, University of Newcastle, 2009 (Management of forest frogs in timber production forests of NSW)
Sarah Dickson-Hoyle	Ecologist	Master of Forest Ecosystem Science, University of Melbourne Bachelor of Arts/Bachelor of Science, University of Melbourne
Nial Roder	GIS analysis	Bachelor Environmental Science - Land Resource Management (Honours) University of Wollongong

2.3 Limitations

The flora and fauna surveys for this assessment have been limited to the study area / development footprint. Given the impact avoidance and minimisation strategies which have been incorporated into the Project design and the subsequent minimal potential impacts on terrestrial vegetation and associated habitats, targeted surveys for threatened fauna species were not undertaken.

This assessment relies on other studies undertaken for the Project (Elgin Associates, 2020; AECOM, 2020b; and GDE ELA, 2020) that found that the proposed underground trenchless drilling method would not result in subsidence that would impact terrestrial vegetation or other adverse impacts on terrestrial vegetation and habitats.

This assessment has not included any targeted surveys for shorebirds or other fauna species that may utilise Merimbula Beach and Pambula Beach, however the possibility of their presence has been accounted for in the assessment and mitigation measures recommended. Only diurnal surveys have been undertaken for amphibians given the nature of the habitats within the development footprint and the limited impacts of the Project on habitats for amphibians.

This assessment does not include potential impacts on marine or estuarine habitats or the species that are associated with them. The potential impacts on marine or estuarine habitats are assessed in Elgin Associates (2020).

3. Landscape features

The study area and immediate surrounds are characterised, as is much of the coastal parts of the bioregion, by extensive areas of remnant native vegetation, with patches of urban and semi-rural development.

The landscape features of the study area are shown in **Figure 5**, and the figure (including assessment circles) is explained further in **Section 3.8**.

3.1 IBRA bioregions and subregions

The study area is contained wholly within the South East Corner Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion and South East Coastal Ranges IBRA subregion.

3.2 Mitchell landscapes

The study area is located within the Bodalla-Nadgee Coastal Sands Mitchell landscape.

3.3 Soil landscapes

The study area is predominately located on the Holocene sand sheet between Merimbula Beach and Merimbula Lake, which is described by Tulau (1997) as the Wallagoot foredune soil landscape. The western parts of the study area are underlain by metasediments (Pambula soil landscape), within the STP, and on the western margins of the STP by estuarine sediments (Nelson Lagoon soil landscape).

3.4 Rivers, stream and estuaries

The Project area does not support any watercourses identified on the Pambula 1:25,000 topographical map and none were identified in the field.

3.5 Wetlands

3.5.1 Directory of Nationally Important Wetlands Australia (DIWA)

Merimbula Lake, which adjoins the study area, is a nationally important wetland (DIWA wetland).

3.5.2 Coastal Wetlands SEPP

The Project area includes two separate areas mapped as 'Coastal Wetlands' or as a 'Proximity Area to Coastal Wetlands' under the *State Environment Planning Policy (Coastal Management) 2018* (SEPP Coastal Management 2018)

The estuarine habitats of Merimbula Lake are mapped as Coastal Wetlands. The Project area does not intersect with the mapped Coastal Wetlands associated with Merimbula Lake however the western parts of the Project area are mapped as a Proximity Area to Coastal Wetlands, as shown in **Figure 6**.

The wetland that occurs in the hind dunes of Merimbula Beach and extends from the Project area south to Pambula is also mapped as a Coastal Wetland. The Project area intersects with this Coastal Wetland and the Proximity Area, as shown in **Figure 6**. The Project has been designed such that the outfall pipeline would be constructed using the underground trenchless drilling method where it traverses this Coastal Wetland and Proximity Area, such that no adverse impacts on the wetland are anticipated.

3.6 Groundwater dependent ecosystems

GDEs are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function.

In Australia, the majority of ecosystems have little to no dependence on groundwater, although the full understanding of the role of groundwater in maintaining ecosystems is generally poor. The exception to this is wetland communities, for which it is thought that most have some level of dependence on groundwater resources.

GDEs are generally classified into six categories:

- Terrestrial vegetation – forests and woodland which develop a permanent or seasonal dependence on groundwater, often by extending roots into the water table;
- Base Flow in streams – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow;
- Aquifer and cave systems – aquatic ecosystems that occupy caves or aquifers;
- Wetlands – aquatic communities and fringing vegetation that depend on groundwater fed lakes and wetlands;
- Estuarine and near shore marine ecosystems – various ecosystems including mangroves, salt marsh and seagrass, whose ecological function has some dependence on groundwater discharge; and
- Terrestrial fauna – fauna species assemblages reliant on groundwater for drinking water.

A final category is also recognised ‘not apparently dependant’. This category acknowledges that some ecosystems, particularly wetland and riparian vegetation, might superficially appear to be groundwater dependent while in fact they are dependent entirely on surface flows and or rainfall.

A GDE assessment was undertaken for the Project (ELA 2020). This assessment identified a number of aquatic and terrestrial GDEs within or immediately adjacent to the Project area including:

- Merimbula Lake;
- coastal wetland vegetation on the shore of Merimbula Lake;
- terrestrial vegetation; and
- a wetland in the back-dunes of Merimbula Beach and extending south from the Project area.

3.7 Biodiversity links

The development site is adjacent to Merimbula Lake which is a Coastal Wetland mapped under SEPP (Coastal Management) 2018. The development footprint is also part of a local biodiversity corridor, namely the vegetated north-south corridor between Merimbula Beach and Merimbula Airport, as shown in **Figure 5**.

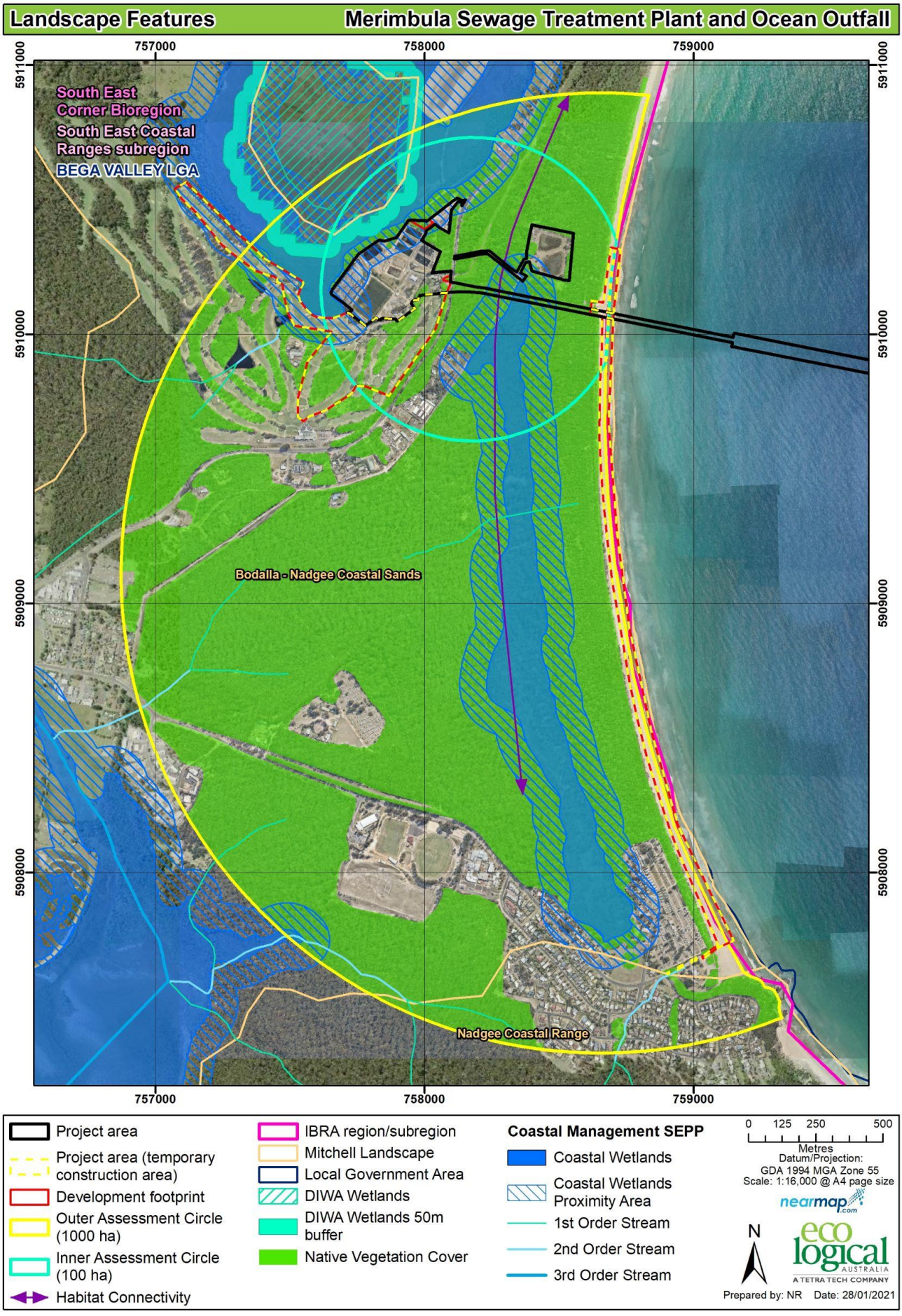

Figure 5: Landscape Features

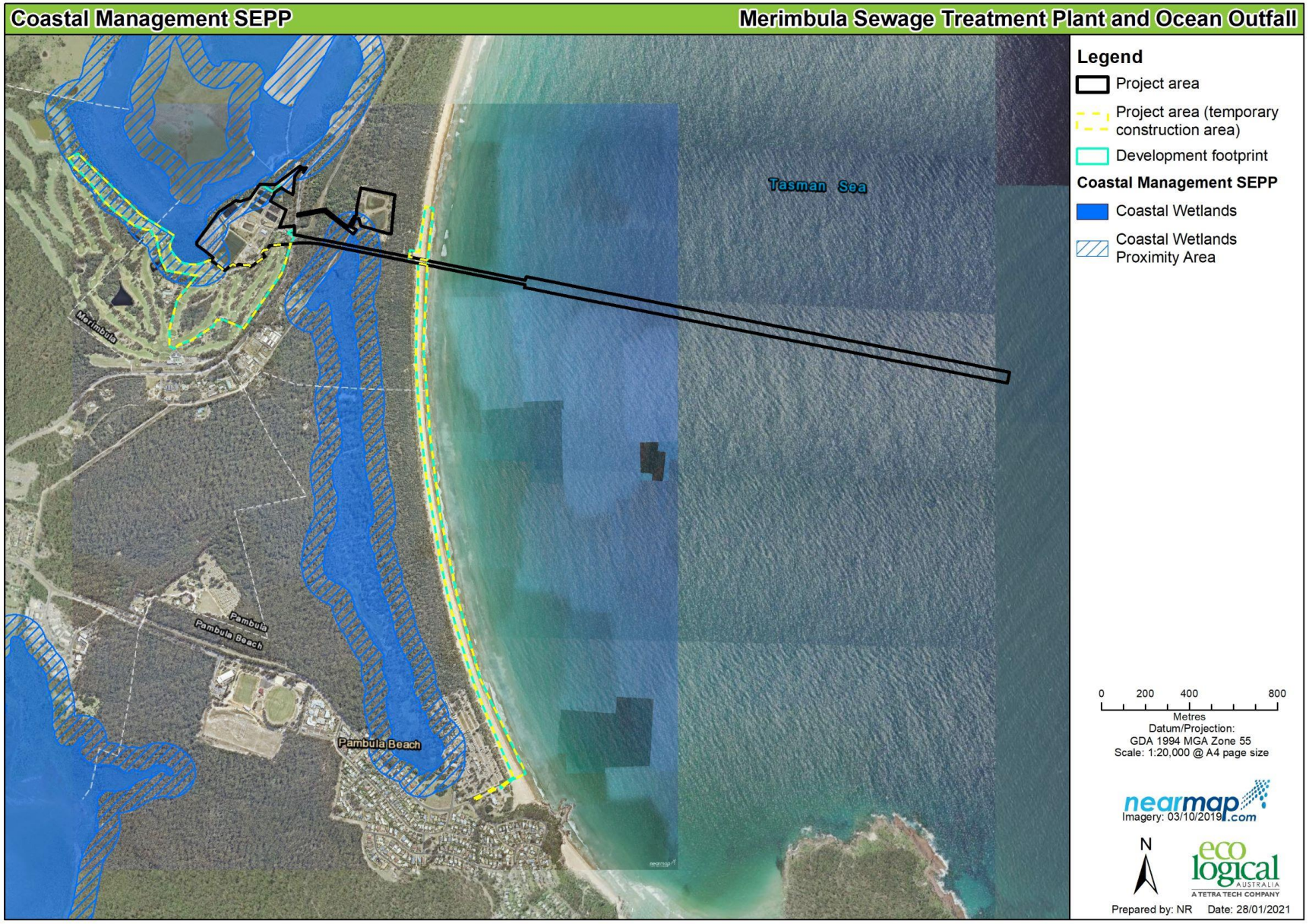

Figure 6: Coastal Management SEPP layers

3.8 Landscape value score

The assessment method was chosen in accordance with the site-based assessment outlined in the FBA.

Assessment circles with a radius of 1,784 m (1,000 ha) and 564 m (100 ha) are used to assess the impact of proposals on the surrounding vegetation cover at a landscape and local scale (respectively), as shown in **Figure 5**.

The amount of vegetation within the 100 ha and 1,000 ha assessment circles was calculated using ArcGIS and the Biometric vegetation types of the Shoalhaven, Eurobodalla and Bega Valley local government areas GIS layer (OEH 2013). The assessment excluded the non-native vegetation categories and the data was updated to better reflect the extent of native vegetation as identified by analysis of recent aerial photography.

Where the circles intersected with the ocean or Merimbula Lake, the area was subtracted from the calculations. To determine the native vegetation cover after development in the 1,000 ha circle, the total amount of clearing was subtracted from the pre-development cover. The development footprint was then used to calculate the amount of vegetation loss for each 100 ha circle. **Table 3** outlines the vegetation in each circle, before and after development, and the average and associated Native Vegetation Cover Class (per cent) to be entered into the Credit Calculator.

Table 3: Area of vegetation in each assessment circle

Circle	Native Vegetation Cover (Before Development)	Native Vegetation Cover (After Development)
1 000 ha circle	412 ha (73.31%) (71-75%)	411 ha (73.13%) (71-75%)
100 ha circle	70 ha (71.43%) (71-75%)	69.5 ha (70.92%) (71-75%)

3.8.1 Connectivity width assessment

The development footprint includes areas within a 50 m buffer of a wetland mapped under SEPP (Coastal Management) 2018 and is therefore part of a State significant biodiversity link, as per Table 10 of the FBA.

3.8.1.1 Patch size

The vegetation that would be impacted is adjacent to large patches of vegetation with an area of greater than 1001 hectares, and thus the adjacent remnant area and patch size for all threatened species sub-zones was entered as the maximum 1001 hectares.

4. Native vegetation

4.1 Vegetation communities within the study area

A total of five PCTs in various condition states occur within the Project area as described below and in **Table 4** and **Figure 7**. However, only two PCTs occur within the development footprint, and would be affected by the Project.

4.1.1 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (PCT 772)

This PCT is in the Sydney Coastal Heaths class and is not a threatened ecological community (TEC). It dominates the far eastern parts of the study area on the fore and hind dunes of Merimbula Beach. It is typically in excellent condition, as shown in **Photo 7**.

The canopy is dominated by *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia) with occasional scattered *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus baxteri* (Brown Stringybark). The understorey is dominated by *Acacia longifolia* subsp. *sophorae* (Coastal Wattle) with occasional *Monotoca elliptica* (Tree Broom-heath) and *Pittosporum undulatum* (Sweet Pittosporum). The groundcover is dominated by *Lepidosperma gladiatum,* and to a lesser extent *Lomandra longifolia* (Spiny-headed Mat-rush), with species such as *Imperata cylindrica* (Blady Grass), *Pteridium esculentum* (Bracken), *Dichondra repens* (Kidney weed), and *Rhagodia candolleana* subsp. *candolleana* (Coastal Saltbush) occurring patchily with significantly less cover. The weedy grass *Ehrharta erecta* (Panic Veldtgrass) is common.

4.1.2 Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion (PCT 777)

This community occurs where the metasediments outcrop in the western parts of the study area, on the higher ground adjacent to Arthur Kaine Drive and in the STP and PMGC grounds. It is typically in good condition, apart from where it has been modified by the STP (see Photos 8 and 9) and golf course development. The canopy is dominated by *Eucalyptus longifolia* (Woollybutt), *Corymbia gummifera*, and *Eucalyptus pilularis* (Blackbutt) but also includes *Eucalyptus bosistoana* (Coast Grey Box), *Eucalyptus cypellocarpa* (Monkey Gum)*,* and *Angophora floribunda* (Rough-barked Apple). There is a patchy sub-canopy of, *Acacia mearnsii* (Black Wattle), *Exocarpos cupressiformis* (Cherry Ballart), *Pittosporum undulatum*, and *Acacia implexa* (Hickory).

The dense understorey includes a diverse range of typically mesic shrubs and small trees the most common of which include *Pittosporum revolutum* (Rough fruit Pittosporum), *Notelaea venosa* (Mock Olive), *Cassinia longifolia*, *Breynia oblongifolia* (Coffee Bush), *Pomaderris aspera* (Hazel Pomaderris), *Acmena smithii* (Lilly Pilly), *Gahnia melanocarpa* (Black Fruit Saw-sedge)*, Senecio linearifolius* (Fireweed Groundsel), *Cyathea australis (*Rough Tree-fern) and *Ozothamnus diosmifolius* (White Dogwood)*.*

The groundcover includes a range of herbs, grasses, sedges, ferns, climbers and creepers associated with mesic habitats such as *Oplismenus* spp. (Basket Grass), *Gahnia radula*, *Schelhammera undulata, Doodia aspera* (Rasp Fern), *Geitonoplesium cymosum* (Scrambling Lily), *Sarcopetalum harveyanum* (Pearl Vine), *Smilax australis* (Lawyer Vine), *Pandorea pandorana* (Wonga-wonga Vine), *Marsdenia rostrata* (Milk Vine), *Cissus hypoglauca* (Water Vine), *Eustrephus latifolius* (Wombat Berry), *Morinda jasminoides* (Sweet Morinda)*, Stephania japonica* (Snake Vine), and *Tylophora barbata* (Bearded Tylophora).

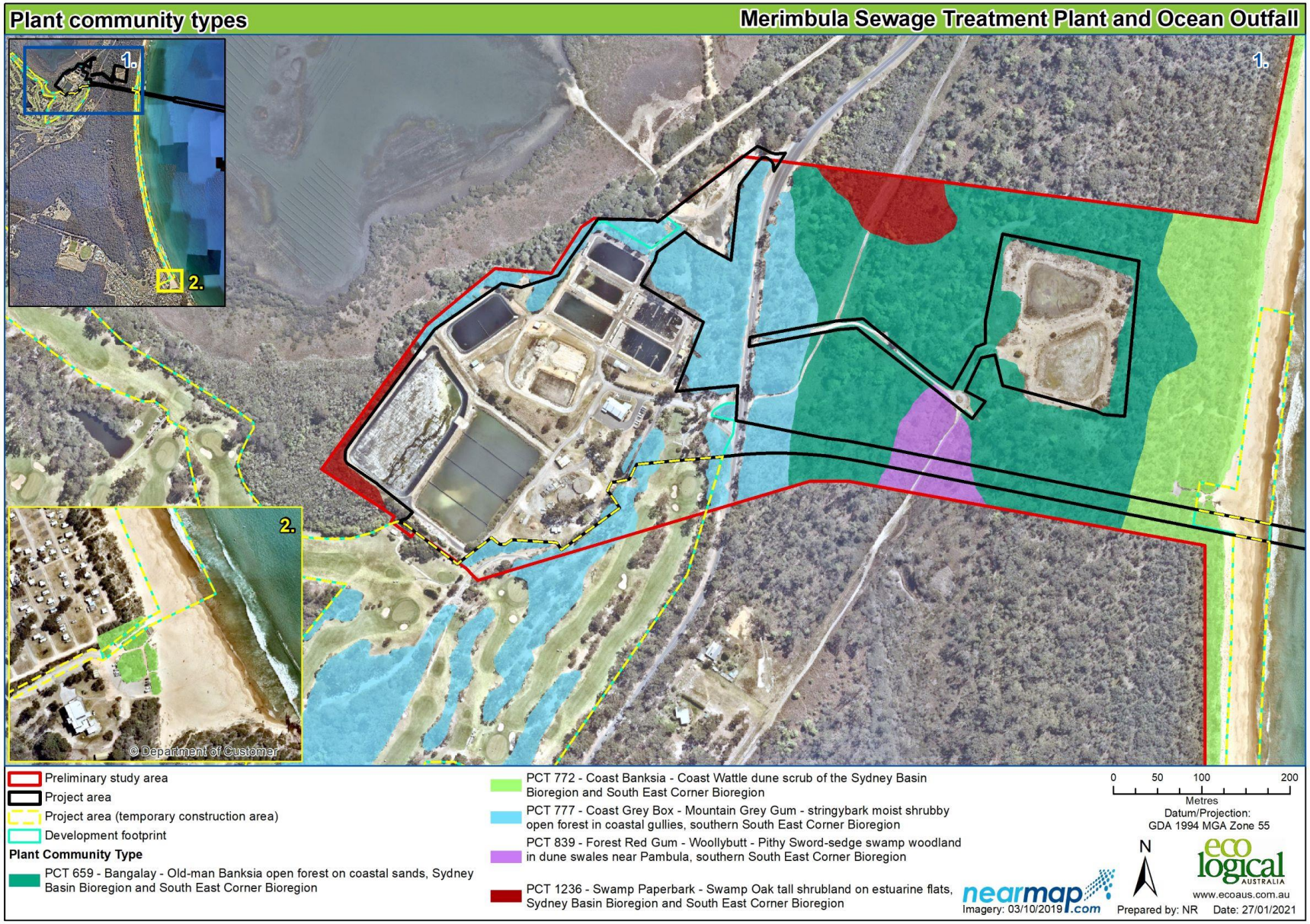

Figure 7: Plant Community Types within the development footprint and immediate surrounds

Table 4: Vegetation communities within the development footprint and immediate surrounds

Vegetation community (Tozer et al. 2010)	Biometric Vegetation Type (BVT)	Plant Community Type (PCT)	Vegetation Class	Vegetation Formation	Percentage Cleared %	Threatened Ecological Community
Coastal Foredune Scrub	SR 531	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (PCT 772)	Heathlands	Sydney Coastal Heath	65	No
Southeast Coastal Gully Shrub Forest	SR 533	Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion (PCT 777)	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Lowland Wet Sclerophyll forests	15	No
Coastal Sand Forest	SR 512	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion (PCT 659)	Dry Sclerophyll Forests (Shrubby sub-formation)	South Coast Sands Dry Sclerophyll Forests	50	Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions
NA	SR 546	Forest Red Gum - Woollybutt - Pithy Sword-sedge swamp woodland in dune swales near Pambula, southern South East Corner Bioregion (PCT 839)	Forested Wetland	Coastal Swamp Forests	80	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
Estuarine Creekflat Scrub	SR 651	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1236)	Forested Wetland	Coastal Floodplain Wetlands	32	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act) Coastal Swamp Oak Forest of New South Wales and South East Queensland (EPBC Act)

Photo 7: Within the Project area PCT 772 is generally in excellent condition

Photo 8: Within the Project area PCT 777 occurs in various conditions states, including as scattered remnant trees and small patches of remnant vegetation. More intact and better condition occurrences of PCT 777 occur east of Arthur Kaine Drive

Photo 9: PCT 777 occurs as a relatively young regrowth scrub where it has historically been heavily disturbed in association with the construction of the STP

Photo 10: PCT 659 is extensive in the eastern parts of the Project area where it is typically in good condition. The Project has been designed to avoid impacts on PCT 659, which comprises the Bangalay Sand Forest EEC.

4.1.3 Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion (PCT 659)

This community dominates the central parts of the vegetation between Merimbula Beach and Arthur Kaine Drive, and is associated with the Holocene sands which characterise the study area east of Arthur Kaine Drive. It is also known as the Bangalay Sand Forest and comprises an EEC listed under the BC Act. It is in the South Coast Sands Dry Sclerophyll Forest class. Within the vicinity of the Project area (within the preliminary study area) the community is typically in excellent condition, as shown in **Photo 10**, except where it has been converted to a derived shrubland through slashing adjacent to tracks and powerlines.

Eucalyptus botryoides (Bangalay) is not present within the canopy, which is typically dominated by species such as *Eucalyptus pilularis* and *Corymbia gummifera*, and in the eastern extremities *Eucalyptus sieberi* (Silvertop Ash), *Eucalyptus tereticornis* and *Eucalyptus baxteri*. There is a patchy but often dense sub-canopy of *Pittosporum undulatum*, *Banksia serrata* (Saw Banksia), *Allocasuarina littoralis* (Black She-oak) and *Acacia mearnsii*.

The understorey is typically dominated by *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle), although a relatively diverse range of other shrubs is scattered throughout. The groundcover is dominated by *Pteridium esculentum, Imperata cylindrica* and *Lomandra longifolia* but also includes species such as *Microlaena stipoides* var. *stipoides* (Weeping Meadow Grass)*, Entolasia marginata* (Bordered Panic), *Hibbertia empetrifolia, Epacris impressa* (Common Heath), *Schelhammera undulata* (Lilac Lily)*,* and *Dianella caerulea* (Paroo Lily).

The Project has been designed to avoid impacts on PCT 659.

4.1.4 Forest Red Gum - Woollybutt - Pithy Sword-sedge swamp woodland in dune swales near Pambula, southern South East Corner Bioregion (PCT 839)

This community is associated with the wetland that occurs in the hind dune swale behind Merimbula Beach and extends from the Project area south to Pambula Beach. It is typically in excellent condition, as shown in **Photo 11**, although it has been converted to a derived sedgeland where it has been slashed under the powerlines. It is characterised by a sparse canopy dominated by *Eucalyptus tereticornis* above a dense understorey dominated by *Lepidosperma longitudinale* (Pithy Sword-sedge), and on the margins, *Kunzea ericoides* (Burgan). PCT 839 comprises the Swamp Sclerophyll Forest EEC listed under the BC Act.

The Project has been designed to avoid impacts on PCT 839.

4.1.5 Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1236)

This community occurs in the estuarine habitats on outside of the western and northern margins of the Project area. It is in excellent condition apart from where it has been cleared for powerlines, as shown in Photo 12. The canopy is dominated by *Melaleuca ericifolia* (Swamp Paperbark) typically with a dense understorey dominated by *Gahnia clarkei* (Tall Saw-sedge). The community comprises the Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC (Swamp Oak Floodplain Forest), which is listed under the NSW BC Act ,and the Coastal Swamp Oak Forest of New South Wales and South East Queensland (Coastal Swamp Oak Forest), which is listed under the Commonwealth EPBC Act.

The Project has been designed to avoid impacts on PCT 1236.

Photo 11: PCT 839 occurs in a narrow band from the exfiltration ponds south towards Pambula Beach. The Project has been designed to avoid impacts on this community, which comprises the Swamp Sclerophyll Forest EEC, primarily by utilising the underground trenchless drilling method to drill under the swamp rather than trench through it.

Photo 12: PCT 1236 occurs immediately beyond the Project area in the estuarine habitats associated with Lake Merimbula. It will not be affected by the Project.

4.2 Vegetation zones

The PCTs in and just beyond the Project area occur in a range of condition states and have been split into vegetation zones as described above, in **Table 5**, and **Figure 8**. The Project has been designed such that impacts on vegetation are limited to approximately 0.28 ha of native vegetation spread over two vegetation zones.

Table 5: Vegetation Zones within the Project area and immediate surrounds.

Zone	PCT No.	Plant community type	Ancillary Code	Area affected (ha)	Plots required	Plots collected
1	772	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Excellent condition	0.03	1	1
2	659	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion	Excellent condition	0.0	0	0
3	659	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion	Derived Shrubland	0.0	0	0
4	839	Forest Red Gum - Woollybutt - Pithy Sword-sedge swamp woodland in dune swales near Pambula, southern South East Corner Bioregion	Excellent condition	0.0	0	0
5	839	Forest Red Gum - Woollybutt - Pithy Sword-sedge swamp woodland in dune swales near Pambula, southern South East Corner Bioregion	Derived Sedgeland	0.0	0	0
6	1236	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Excellent condition	0.0	0	0
7	777	Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion	Good condition	0.0	0	1
8	777	Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion	Derived Shrubland	0.0	0	0
9	777	Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion	Regrowth Scrub	0.25	1	1
10	1236	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Derived Shrubland	0.0	0	0
8	777	Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion	Remnant Trees	0.0	0	0
Total	-	-	-	**0.28**	**2**	**3**

4.3 Threatened ecological communities

Three TECs occur within the study area in various condition states, as identified in **Table 4**, **Table 5** and **Figure 9**. The Project has been designed to avoid impacts on the TECs within the study area, as identified in **Figure 9**.

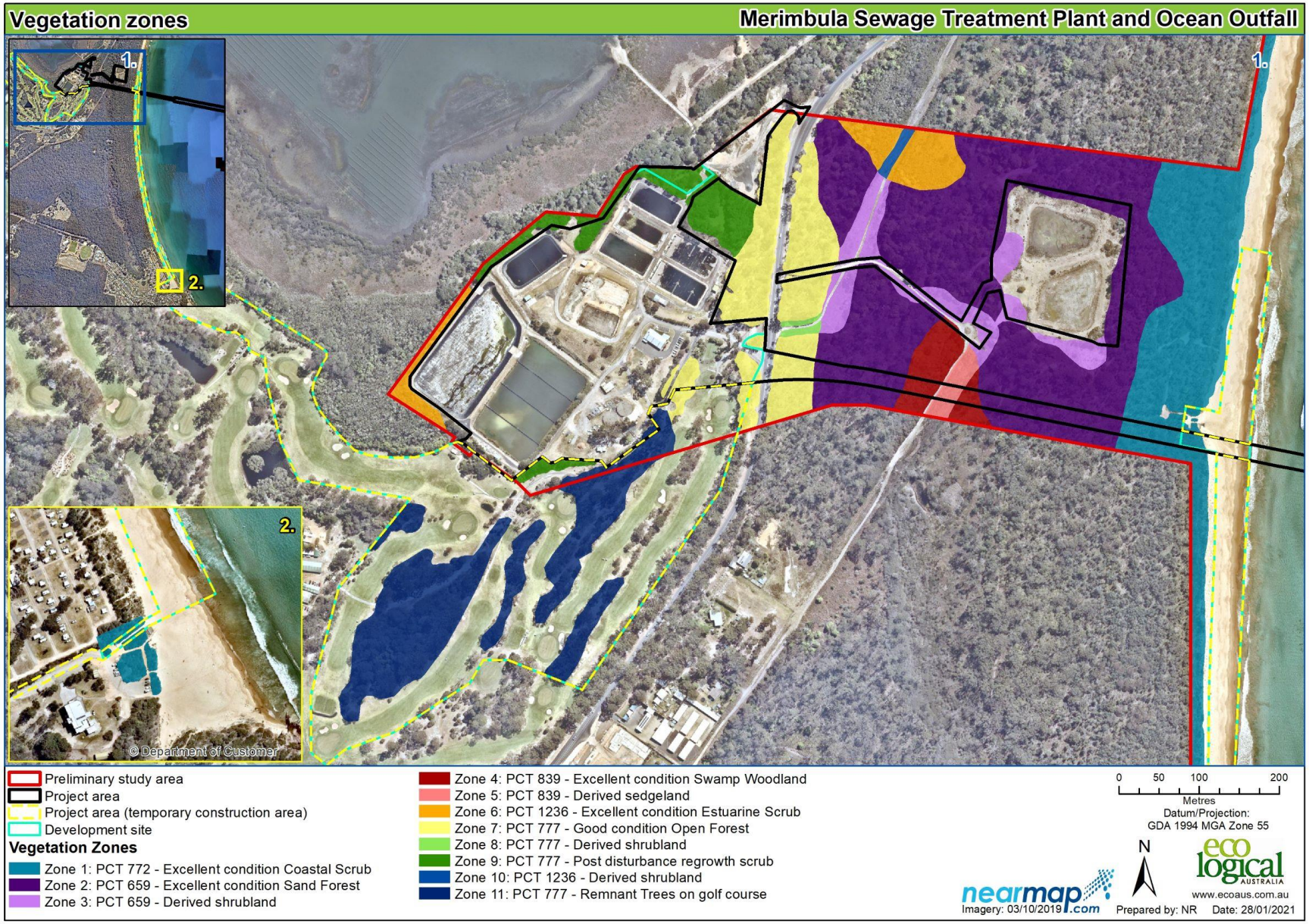

Figure 8: Vegetation zones

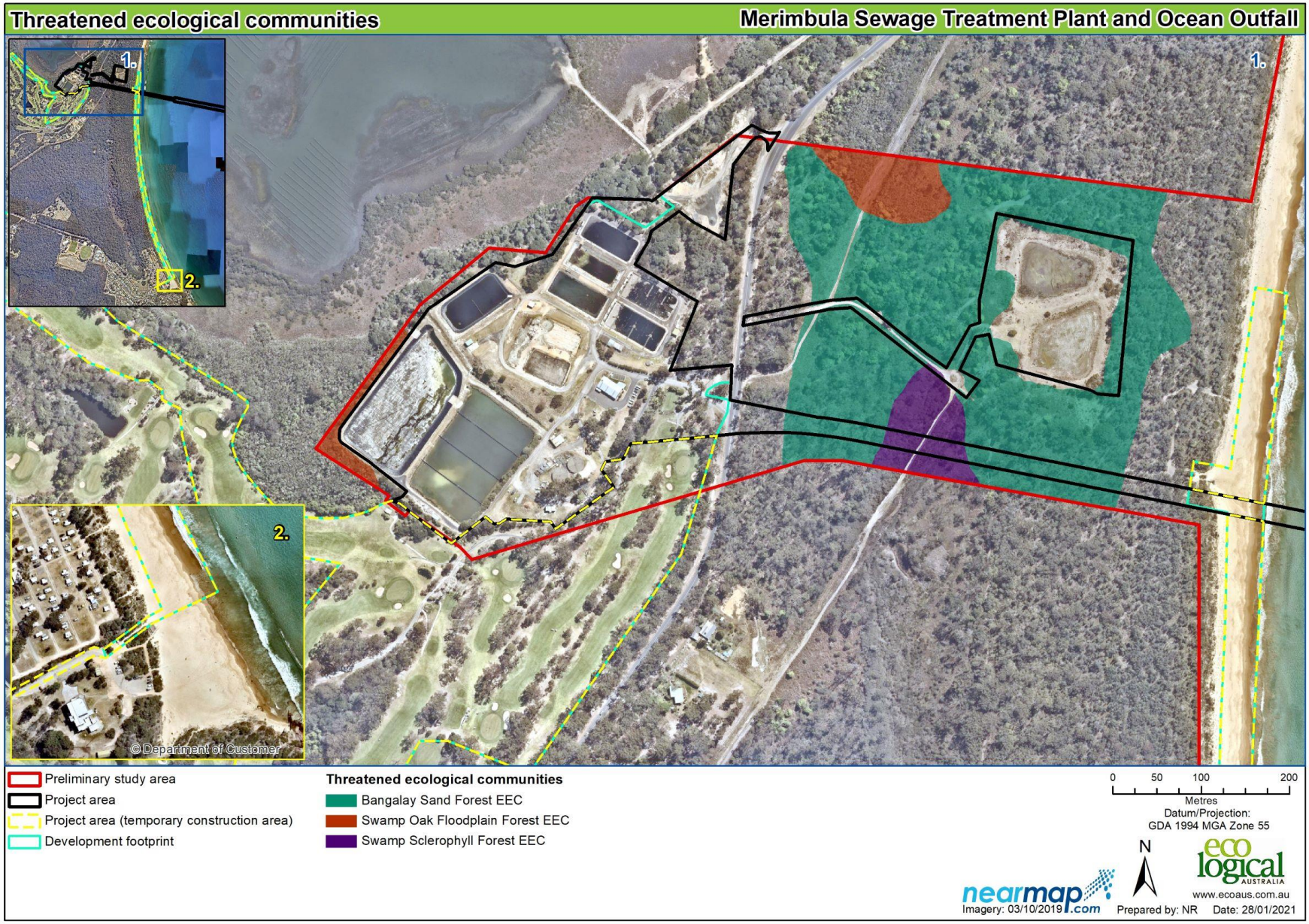

Figure 9: Threatened ecological communities

5. Threatened species and populations

As discussed above, the preliminary assessment of the terrestrial biodiversity values that was undertaken at the outset of the Project identified a number of biodiversity constraints including a range of known and potential threatened species habitats. These biodiversity constraints, and some additional constraints that were detected during subsequent surveys, are identified in **Figure 10**. These constraints influenced the Project design, which has been designed to largely avoid and minimise impacts on terrestrial biodiversity, including threatened species habitats.

Two threatened fauna species were detected during the surveys undertaken for this assessment; *Artamus cyanopterus* (Dusky Woodswallow) and *Petaurus australis* (Yellow-bellied Glider), and one individual of the threatened plant *Syzygium paniculatum*. In August 2017 a pair of Dusky Woodswallows were observed near the exfiltration ponds. Dusky Woodswallows are relatively common in coastal habitats on the far south coast. In October 2020 a *Haliastur sphenurus* (Whistling Kite) nest was observed just beyond the STP in a large tree within the golf course. Whistling Kites are not a threatened species and are a common raptor on the south coast. They appear to be very tolerant of disturbance when nesting relative to some other raptors, such as *Haliaeetus leucogaster* (White-bellied Sea-eagle), given the presence of nests locally on golf courses and in caravan parks.

The Yellow-bellied Gliders characteristic sap feeding incisions were observed on a number of trees within the study area, as shown in **Figure 10** and **Photo 13**, generally in locations where potential dens for the species also occurred nearby. The Yellow-bellied Glider is well known from the forests to the south of the STP with many recent records, and is relatively common in coastal forests on the south coast.

Parts of the preliminary study area support hollow-bearing trees which provide potential habitat for a range of hollow-dependent fauna, as shown in **Photo 14** and **Figure 10**, including threatened species such as the Yellow-bellied Glider and threatened owls and microchiropteran bats. There are also many stags (standing dead hollow-bearing trees) which are likely associated with the Bell Miner colony which occurs within the study area, as shown in **Photo 15**. The less modified parts of the preliminary study area also provide good potential habitat for a number of other hollow-dependent threatened fauna species, some of which, such as *Tyto novaehollandiae* (Masked Owl), *Cercartetus nanus* (Eastern Pygmy-possum) and *Phascogale tapoatafa* (Brush-tailed Phascogale), are ecosystem and species credit species under the FBA.

The water habitats within and adjoining the Project area include the STP ponds, the exfiltration ponds, the coastal wetlands and estuarine habitats. These habitats provide a range of habitat types for waterbirds and amphibians. Most of the STP ponds are regularly drained and biosolids removed and are actively used in sewage treatment. As such the water levels and quality are highly variable and they typically do not support important microhabitats such as emergent vegetation (see Photo 16). This reduces the quality of the ponds within the STP as habitats for threatened waterbirds and amphibians. The exception is the STP effluent pond, which has a small amount of fringing vegetation, and typically supports water, as shown in **Photo 18**. The other water habitats near the STP provide better quality habitats, given the better water quality and lower disturbance levels. The coastal wetlands, estuarine habitats, exfiltration ponds and the water features within the golf course, all provide potential habitat for a range of amphibians and wetland birds. Notwithstanding the relative abundance of good quality water habitats locally, the Project has been designed to avoid adverse impacts on the water habitats within the Project area, in particular by using the underground trenchless drilling method to avoid the need to trench through the coastal wetland in the east of the Project area for construction of the ocean outfall pipeline. Impacts have also been mitigated by retaining the ephemeral water habitats associated with the exfiltration ponds (which would cease to be used, but may still support water during wet weather periods). However, the Project does include the loss of some marginal amphibian habitat in association with the proposed decommissioning of the STP effluent pond.

The proposed construction access along Pambula Beach would affect potential habitat for a number of threatened shorebirds, including *Sterna albifrons* (Little Tern), *Thinornis rubricollis* (Hooded Plover), *Haematopus longirostris* (Pied Oystercatcher) and *Haematopus fuliginosus* (Sooty Oystercatcher). Whilst it is possible that these species may utilise the habitats on the beach from time to time, particularly the Pied Oystercatcher and Sooty Oystercatcher, it is unlikely that they would breed there or that the beach would comprise important habitat for these or any other threatened or listed migratory shorebirds (see **Photo 19**).

The beach habitats within the development footprint have not been identified as an important shorebird area despite a long-term shorebird recovery and monitoring program on the south coast (the *South Coast Shorebird Recovery Program*) (S. Hall-Aspland pers. comm. 2020). Whilst it is possible that species such as the Hooded Plover or Little Tern could breed there, it is unlikely, and there are no records of these species on this area of beach let alone nesting there. Whilst the Pied Oystercatcher and Sooty Oystercatcher may occur on this section of beach from time to time, as they do on most beaches on the south coast, they wouldn't breed there given the absence of suitable breeding habitat.

Notwithstanding the limited potential for adverse impacts on shorebirds, it is recommended that pre-construction targeted surveys be undertaken to ensure the affected areas are not being used by threatened shorebirds.

The Impacts on fauna habitats associated with the Project would be limited to a small amount of foraging and sheltering habitat. The main potential adverse impact is the potential for the loss of one tree at the entrance to the STP which supports hollows and is a known Yellow-bellied Glider sap feeing tree (see **Photo 20**). Although this assessment accounts for the removal of this tree, it is considered unlikely that this tree would need to be removed in association with any potential upgrade to the vehicle access at the entry to the STP off Arthur Kaine Drive. The access to the STP is already wide enough for trucks and large vehicles and as such is it considered unlikely that further tree and vegetation removal would be required.

One individual of *Syzygium paniculatum* (Magenta Lilly Pilly), which is considered an endangered species in NSW (and vulnerable at a commonwealth level), was detected within the study area, see Photo 15 and **Figure 10**. The *Syzygium paniculatum* individual detected within the study area would be derived from ornamental specimens in nearby residential areas, as Merimbula is more than 200km south of the species known southern limit. It will not be affected by the proposed development.

No other threatened flora species were observed within the development footprint despite targeted surveys within the development footprint and none are considered likely to occur there. Whilst the study area does provide some potential habitat for threatened flora species, such as *Persicaria elatior* (Tall Knotweed) and *Amphibromus fluitans* (River Swamp Wallaby-grass), the Project has been designed to avoid impacts on the potential habitats for these species.

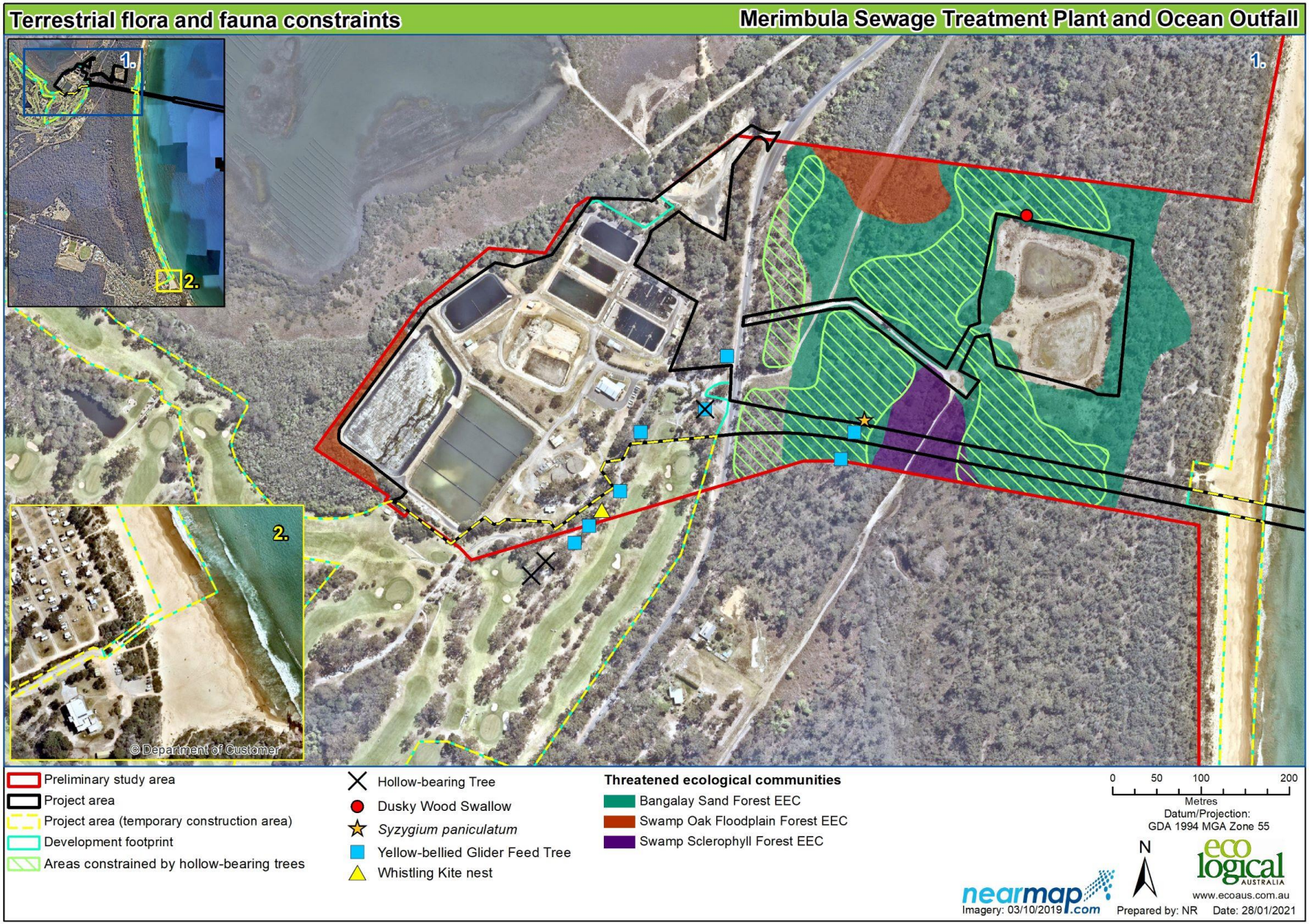

Figure 10: Terrestrial flora and fauna constraints

Photo 13: Active sap feeding incisions and scars were observed on a number of trees within the study area. It is possible that one of the identified sap feeding trees may need to be removed for upgrading vehicle access to the STP. However design modifications to enable its retention are being explored.

Photo 14: Large hollow-bearing Red Bloodwood and Blackbutt trees are fairly common in the forests to the east of the STP and provide habitat for the Yellow-bellied Glider and a range of other hollow-dependent fauna species. The vast majority of the hollow-bearing trees in the Project area have been protected by the Project design.

Photo 15: Parts of the preliminary study area support patches of stags, some of which are hollow-bearing and provide potential habitat for a range of hollow-dependent fauna, including species such as the Masked Owl and microchiropteran bats. These patches of stags are probably resultant from the Bell Minor colony which inhabits the area.

Photo 16: One *Syzygium paniculatum* individual was detected within the preliminary study area and is likely derived from ornamental specimens in nearby residential areas.

Photo 17: The ponds within the STP are typically devoid of emergent vegetation and regularly emptied which limits the habitat they provide for threatened waterbirds and amphibians.

Photo 18: The STP effluent pond has a narrow band of fringing rushes.

Photo 19: Merimbula Beach at the existing beach-face outfall in February 2020 showing the high energy beach (with bushfire ash strands) which provides marginal potential breeding habitat for shorebirds.

Photo 20: This tree at the entrance to the STP supports hollows and is a known Yellow-bellied Glider sap feeing tree. It has been assessed as being removed but should be able to be retained to enable construction access.

5.1 Ecosystem credit species

Ecosystem credit species associated with PCTs in the development footprint are outlined below in **Table 6**. No predicted ecosystem credit species were excluded.

Table 6: Predicted ecosystem credit species

Species	Common Name	NSW listing status	EPBC Listing status	Inclusion	Justification for exclusion
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Not Listed	Yes	NA
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Not Listed	Yes	NA
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Not Listed	Yes	NA
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered	Yes	NA
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	Not Listed	Yes	NA
Hieraaetus morphnoides	Little Eagle	Vulnerable	Not Listed	Yes	NA
Lathamus discolor	Swift Parrot	Endangered	Critically Endangered	Yes	NA
Pachycephala olivacea	Olive Whistler	Vulnerable	Not Listed	Yes	NA
Petaurus australis	Yellow-bellied Glider	Vulnerable	Not Listed	Yes	NA
Tyto novaehollandiae	Masked Owl	Vulnerable	Not Listed	Yes	NA

5.2 Species credit species

The candidate species credits species within the development footprint are identified in **Table 7** as is the justification for the exclusion of one candidate species, the Koala. The species credit polygons are identified in **Figure 11**.

Table 7: Candidate species credit species

Species	Common Name	NSW listing status	EPBC Listing status	Inclusion	Justification for exclusion
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	Not Listed	Yes	NA
Phascogale tapoatafa	Brush-tailed Phascogale	Vulnerable	Not Listed	Yes	NA
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable	No	There are no recent records of the Koala in the Merimbula-Pambula area and it is highly unlikely that Koalas would occur within the development footprint given the absence of any records of the species in recent decades within 7 km of the site, the small size of the development footprint and the nature of the habitats there.

Figure 11: Species credit species polygons

6. Avoidance and mitigation measures

6.1 Avoidance of impacts

Avoidance strategies incorporated into the Project included:

- preliminary constraints analysis;
- examining alternate designs and construction methods;
- utilising existing access tracks and stockpiling locations; and
- using the golf course fairways for pipe laydown during construction.

6.1.1 Preliminary constraints analysis

As identified in **Section 1.1** and **Section 2**, a preliminary assessment of the terrestrial biodiversity values was undertaken out the outset of the Project. The preliminary assessment identified a number of biodiversity constraints at the outset of the assessment process including:

- EECs;
- coastal Wetlands; and
- known and potential threatened species habitats.

6.1.2 Alternate designs and construction methods

The biodiversity constraints identified during the preliminary assessment influenced the Project design, which has been designed to avoid and minimise impacts on terrestrial biodiversity. This has primarily been achieved by:

- largely restricting the footprint of the proposed works to the footprint of the existing STP; and
- constructing the 0.8 km onshore component of the proposed outfall pipeline using the underground trenchless drilling method.

The design and construction methods have avoided and mitigated impacts significantly relative to other design options which were considered, such as trenching for the pipeline. If trenching was the preferred construction method for the pipeline, and a disturbance corridor of 660 m x 15 m was assumed (from the STP to the beach), approximately 1 ha of native vegetation would be directly impacted, including two EECs in excellent condition, hollow-bearing trees and other habitat resources.

6.1.3 Utilising access tracks and roads

The Project would utilise existing access roads and tracks as far as possible to avoid the need to construct new roads and associated vegetation disturbance. Some minor amounts of tree and vegetation removal may be required to improve vehicular access to the STP and for access to Pambula Beach. However, it is considered unlikely that any hollow-bearing or Yellow-bellied Glider feed trees would need to be removed to provide construction access to the STP.

6.1.4 Stockpiling locations

The location of stockpiles and material storage areas would utilise existing disturbed/cleared areas or areas within the existing STP that support regrowth scrub. No relatively undisturbed native vegetation would be cleared for stockpiling.

6.2 Mitigation measures

Mitigation measures aim to reduce the ecological impacts of the Project to the greatest extent practicable. The relevant ecological impacts and associated mitigation measures and protocols (standard and Project specific) are identified in **Table 8** and described in detail below. Standard control measures (i.e. inductions etc.) would be incorporated in a flora and fauna management plan which would comprise part of the construction environmental management plan (CEMP).

6.2.1 Standard mitigation measures

The mitigation and management measures would be detailed within a flora and fauna management plan, which would be prepared consistent with relevant guidelines. The measures would include, but are not limited, to the following:

- the disturbance and clearance of native vegetation would be minimised as far as is possible;
- exclusion zones would be identified to protect against accidental vegetation damage ;
- vegetation clearing would be undertaken so as to avoid impacts on adjoining retained vegetation;
- sediment and erosion management;
- weed and pathogen management;
- rehabilitation efforts to restore disturbed areas to pre-disturbance condition;
- preclearing surveys;
- any handling of fauna would be carried out by an appropriately licenced or experienced person and undertaken in accordance with relevant guidelines;
- potential chemical pollutants (e.g. fuels, oils, lubricants, paints etc.) would be stored in appropriate containers within bunded areas within construction compounds to minimise the risk of the pollution of aquatic environments;
- water quality would be protected through the implementation of suitable erosion and sediment control measures; and
- limiting works to standard hours.

6.2.2 Project specific measures

Project specific measures are recommended for species where impacts would remain after the implementation of measures detailed in **Section 6.2.1**, or where additional mitigation measures would further reduce the ecological impact. The Project specific mitigation measures are controls or protocols which would seek to further reduce impacts on threatened species, native vegetation, or other habitats.

The flora and fauna management plan would include measures to minimise the impacts on all the adjoining vegetation by including measures such as:

- The underground trenchless drilling and other construction activities should be undertaken such that there are no adverse impacts on surface or subsurface hydrology;
- Pre-construction targeted surveys should be undertaken at the Pambula Beach construction access proposed, to ensure the affected areas are not being used by threatened shorebirds;
- Beach access should avoid foredune and other vegetated parts of the beach;
- The minor impacts on PCT 772 associated with construction access to Pambula Beach should be rehabilitated post construction;

- Construction access to the STP should be designed to avoid the hollow bearing and Yellow-bellied Glider feed trees that occur near the STP and to minimise or avoid the need to remove trees and native vegetation as far as is possible;
- Pre-construction targeted surveys should be undertaken prior to the decommissioning of the STP effluent pond to ensure the pond is not being used by threatened amphibians and particularly the Green and Golden Bell Frog;
- the following pre-clearing and clearing protocols (or any other protocols that are conditions of project approval) should be incorporated into any clearing that may affect hollow-bearing trees.

  a. Felling should be supervised by a fauna specialist appropriately licensed under the NSW *National Parks and Wildlife Act 1974*, for the purpose of rescuing displaced fauna.

  b. The fauna specialist should be suitably attired with protective clothing and have suitable equipment to undertake the work. A "green card" from an Occupational Health and Safety Induction Training Course for Construction Work should also be held by the fauna specialist, who may also need to be suitably vaccinated (especially if there is potential for handling bats).

  c. An appropriately skilled local wildlife carer must be notified at least 24 hours prior to the tree felling, that animals may be captured and that these animals may need care.

  d Vegetation around the tree to be removed should be removed at least a day prior to the tree removal to encourage any fauna to vacate the tree

  e. Prior to felling of any identified and marked hollow-bearing tree, the trees will be shaken or nudged by tree-felling equipment to encourage any fauna to vacate the trees.

  f. If no animals emerge from the hollows after shaking or nudging, then the tree may be felled and hollow sections lowered to the ground carefully.

  g. If an animal emerges from a hollow following shaking or nudging of the tree, then at least 30 minutes must be allowed for the animal to leave the tree. If the animal comes to the ground, or when it is on the lower trunk, attempts should be made to capture the animal using a net. Captured animals should be immediately transferred to a suitably sized cotton bag and checked for obvious injury during the transfer process.

  h. Captured animals should be placed in individual bags unless they are a family group to which separation would risk the survival of the young (i.e. a lactating female with young).

  i. Once the tree has been felled, a search should be made of the branches around the tree for any fleeing fauna and hollows should be inspected with a torch for the presence of any animals. Attempts should be made to capture any fleeing fauna with a net, and animals inside hollows should be extracted by hand. Captured animals should be immediately transferred to a suitably sized cotton bag and checked for obvious injury during the transfer process.

  j. Injured, shocked or immature captured animals should be placed in a cotton bag secured at the top. Bags should be wrapped in appropriate insulating material such as blankets and placed in a quiet, warm and preferably dark place until the wildlife carer can collect them.

  k. Uninjured animals should be released in appropriate habitat as soon as practicable (at night for nocturnal species).

- Use flagging tape to delineate the boundary of the wetland in the central parts of the study area (Zone 4 and Zone 5) to protect it from any adverse impacts during construction.

Table 8: Mitigation measures

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Limiting displacement of resident fauna	Medium	Low	The limits of the vegetation to be removed or modified for the Project should be clearly marked such that those undertaking the proposed clearing do not remove vegetation that should be retained Pre-construction targeted surveys should be undertaken at the proposed Pambula Beach construction access to ensure the affected areas are not being used by threatened shorebirds and/or access Beach access should avoid foredune and other vegetated parts of the beach Truck movements should be speed limited to reduce the risk of vehicle strike or otherwise adverse impacts on fauna Pre-construction targeted surveys should be undertaken prior to the decommissioning of the STP effluent pond to ensure the pond is not being used by threatened amphibians and particularly the Green and Golden Bell Frog.	The potential for adverse impacts on fauna is minimised	Prior to and during construction	BVSC and contractor
Timing works to avoid critical life cycle events such as breeding or nursing	Medium	Low	Pre-construction targeted surveys should be undertaken at the proposed Pambula Beach construction access to ensure the affected areas are not being used by threatened shorebirds	The potential for adverse impacts on fauna is minimised	Prior to and during construction	BVSC and contractor
Limiting potential for adverse hydrological impacts	Medium	Low	The underground trenchless drilling and other construction activities should be undertaken such that there are no adverse impacts on surface or subsurface hydrology	The potential for adverse impacts on hydrology is minimised	Prior to and during construction	Contractor
Instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological	Medium	Low	Pre-clearing and clearing protocols should be incorporated into any clearing that may affect a hollow-bearing tree	Impacts on hollow-dependent fauna are avoided	Prior to clearing	Contractor

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
or licensed wildlife handler during clearing events						
Installing artificial habitats for fauna in adjacent retained vegetation and habitat or human made structures to replace the habitat resources lost and encourage animals to move from the development footprint, e.g. nest boxes	Low	Low	None proposed	NA	NA	NA
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	Low	Low	The limits of the vegetation to be removed or modified for the Project should be clearly marked such that those undertaking the proposed clearing do not remove vegetation that should be retained	Clearing and tree removal is limited to that proposed	During construction	Contractor
Sediment barriers or sedimentation ponds to control the quality of water released from the development footprint into the receiving environment	Medium	Low	Sediment and water control measures as necessary such as fencing and hay bales Appropriate water, pollution and sediment controls are incorporated in the CEMP	Risk of sedimentation of water quality impacts substantially reduced	During and post-construction	Contractor
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	Low	Low	Restrict work to daylight hours except during the pull through	Noise impacts mitigated	During construction	Contractor
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	Low	Low	Restrict work to daylight hours except during the pull through	Light impacts mitigated	During construction	Contractor
Adaptive dust monitoring programs to control air quality	Low	Low	None proposed	NA	NA	NA

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Programming construction activities to avoid impacts; for example, timing construction activities for when migratory species are absent from the development footprint, or when particular species known to or likely to use the habitat on the development footprint are not breeding or nesting	Medium	Low	Pre-construction targeted surveys should be undertaken at the proposed Pambula Beach construction access to ensure the affected areas are not being used by threatened shorebirds	The potential for adverse impacts on fauna is minimised	Prior to and during construction	BVSC and contractor
Temporary fencing to protect significant environmental features such as wetlands	Low	Low	Use flagging tape to delineate the boundary of the wetland in the central parts of the Project area (Zone 4 and Zone 5) to protect it from any adverse impacts	Wetland protected	During construction	Contractor
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Medium	Low	Appropriate hygiene protocols (DPIE 2020) should be incorporated into the Project to avoid the spread of weeds such as African Lovegrass and any pathogens such as Chytrid Fungus, Phytopthora and Myrtle Rust Known weed or invasive species should not be planted for landscaping purposes	Risk of weed spread substantially reduced	During and post construction	BVSC and contractor
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Medium	Low	The vegetation to be removed should be clearly marked such that those undertaking the proposed clearing do not remove trees that should be retained Staff should be inducted as to the biodiversity values of the Project area and mitigation measures to protect these values	Clearing and tree removal is limited to that proposed Biodiversity values of the Project area protected from inadvertent adverse impacts	During construction	Contractor
Making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development footprint	Medium	Low	Manage retained vegetation sympathetically with its conservation Avoid any clearing, exotic plantings, or tree removal beyond what is proposed Rehabilitate post construction cleared vegetation at the Pambula Beach access and at the existing beach-face outfall onto Merimbula Beach	Maintain current level of biodiversity value in retained vegetation Rehabilitate disturbed areas	Post construction	BVSC and contractor

7. Assessment of Impacts

Impacts have been identified as both direct, such as direct clearing of vegetation, and indirect such as increases in noise, lighting, vehicle movements which may affect fauna behaviour and indirect impacts on receiving waters.

The selection of the proposed underground trenchless drilling method and concentrating other works within the existing STP has meant that the impacts on vegetation communities and associated habitat have been reduced to minor levels and concentrated in areas that are already heavily modified. The use of existing access tracks and roads has also avoided many of the potential impacts within the Project area.

The Project would have both direct and indirect impacts on a range of biodiversity values during the construction phase. Impacts are mainly associated with the Project footprint and associated vegetation clearing, however indirect impacts from other activities during the construction phase, such as vehicular movements, have also been considered. The level of indirect impacts is anticipated to be minimal given the mitigation measures to be implemented (**Section 6.2**).

The impact assessment has considered impacts during the construction of the Project and includes:

- clearing at the proposed Pambula Beach access (east of the Pambula SLSC);
- clearing to enable the decommissioning of the existing beach-face outfall onto Merimbula Beach;
- clearing for storage and the movement of material and spoil within the STP;
- clearing to enable access to the golf course (primarily to be used for pipe laydown); and
- construction access along Pambula Beach north to Merimbula Beach.

The direct impacts (**Section 7.1**) of the Project relate to:

- loss of vegetation/habitat.

Indirect impacts (**Section 7.2**) of the Project relate to:

- weed spread;
- pathogens and animal pests;
- impact on relevant Key Threatening Processes;
- wildlife connectivity;
- injury and mortality;
- noise, vibration and light; and
- GDEs.

7.1 Direct impacts

7.1.1 Loss of vegetation and/or habitat

The field survey identified the vegetation and fauna habitats present within the preliminary study area which included:

- three EECs;
- three threatened species; and
- a range of good quality threatened fauna habitats.

The Project has been designed to avoid the important biodiversity values identified during the assessment undertaken for the Project and as a result impacts on vegetation have been limited to just 0.28 ha of native vegetation, as shown in **Figure 12**, most of which is already highly modified. Similarly, it is unlikely that any hollow bearing or Yellow-bellied Glider feed trees or other potentially important habitats would be removed or otherwise adversely affected as a result of the Project. Notwithstanding the capacity to avoid and minimise impacts on fauna habitats, hollow-bearing trees in close proximity to the STP are unlikely to be important habitat for threatened fauna given their location on the edge of a busy road, within a golf course or STP, and in the context of the extent of superior resources in contiguous forests. The impacts on habitats for the Yellow-bellied Glider would be minor, with only a small amount of potential foraging habitat affected relative to the extensive areas of habitat for the species in contiguous forests.

Whilst the Project would result in the loss of some habitat for amphibians and waterbirds in association with the decommissioning of the STP effluent pond, it is unlikely that the STP effluent pond would comprise important habitat for amphibians or waterbirds given the small area and marginal nature of the habitat relative to that available in other wetlands locally such as in association with Merimbula lake, the golf course, and in the habitats east of Arthur Kaine Drive.

As a result of the avoidance and mitigation measures that have been incorporated into the Project design, the impacts of the Project on native vegetation and fauna habitats has been reduced to 0.28 ha of low quality habitat. The Project has been designed to avoid impacts on TECs and would be concentrated predominately in disturbed vegetation. No threatened flora species are likely to be affected by the Project.

7.2 Indirect impacts

7.2.1 Weeds

Weeds were generally restricted to the STP and other heavily modified areas. Some low threat environmental weeds such as Panic Veldt Grass are widespread in places. The main high threat weed species that occurs within the study area is *Eragrostis curvula* (African Love Grass), which is common on the edge of tracks and along the powerline easements. African Love Grass is abundant in places within the Bega Valley and common in sandy disturbed areas around Merimbula. Mitigation measures listed in **Section 6.2** and **Table 8** should be implemented to contain the spread of weeds during the Project.

7.2.2 Changes to hydrology

The Project is not expected to result in impacts to the hydrology of the Project area and immediate surrounds given the absence of watercourses within the Project area, the Project design, proposed mitigation measures and limited impacts (Elgin Associates 2020). It is unlikely that the proposed underground trenchless drilling method would lead to subsidence or other adverse impacts on the surface or sub-surface hydrological environment (AECOM 2020b and ELA 2020). The underground drilling method has been used successfully in many similar environments, without adverse impacts, and on the contrary, is an important and effective impact avoidance strategy.

Mitigation measures listed in **Section 6.2** should be implemented to minimise the potential for adverse impacts on hydrology as a result of the Project.

Figure 12: Vegetation impacts

7.2.3 Pathogens and animal pests

7.2.3.1 Pathogens

A number of pathogens are of concern in NSW that have the potential to impact on native flora and fauna. Activities that involve movement of equipment over large areas are of particular concern given the high potential for pathogen spread over large areas.

Although no sign of pathogen infection was identified during the field survey or literature search it is important to assess the potential impacts of these pathogens and mitigate against their spread. The main pathogens of concern are:

- Myrtle Rust (*Uredo rangelli*); and
- Chytrid Fungus (*Batrachochytrium dendrobatidis*).

A pathogen of lesser concern is Phytophthora (*Phytophthora cinnamomi*).

Myrtle Rust is an air-borne plant fungus that attacks the young leaves, shoot tips and stems of Myrtaceous plants eventually causing plant death. It is spread by movement of contaminated material such as clothing, infected plants, vehicles and equipment etc. The 'introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae' is a listed Key Threatening Process under the BC Act (OEH 2014c).

Chytrid fungus is a water-borne fungus that affects amphibians. It is spread by cross contamination of water bodies and improper handling of frogs. Chytridiomycosis is the infection that causes lethargy, emaciation, skin sloughing and a range of other symptoms that eventually result in death. The infection of frogs by amphibian chytrid fungus causing the disease Chytridiomycosis' is a listed Key Threatening Process under both the EPBC Act and the BC Act (OEH 2014d).

Phytophthora is a soil-borne fungus capable of causing tree death (dieback) by attacking the roots of native plants. Spores can be spread over large areas by water, vehicle and machinery movement as well as human and animal movement. 'Dieback caused by Phytophthora' is a listed Key Threatening Process under both the EPBC Act and the BC Act (OEH 2014e).

Given that the study area is already highly modified and/or subject to high levels of visitation it is unlikely that pathogens would have a significant impact on flora and fauna as part of this Project, provided the mitigation measures listed in **Section 6.2** are adopted to limit the introduction of pathogens.

7.2.3.2 Animal Pests

Given the study area is disturbed and in close proximity to urban areas it is likely that animal pests would be present within the study area. Most likely pests are:

- *Vulpes* (European Red Fox);
- *Oryctolagus cuniculus* (European Rabbit); and
- *Felis catus* (Feral Cat).

The European Red Fox can be found in a range of habitats. They prey on medium-sized ground-dwelling and semi-arboreal mammals and ground-nesting birds. 'Predation by the European Red Fox *Vulpes*' is a Key Threatening Process listed under both the EPBC Act and the BC Act. The Project is not likely to increase predation on native fauna by foxes as additional tracks would not be created which could facilitate movement of predators into otherwise uncleared or undisturbed vegetation.

The European Rabbit causes a number of environmental problems in the Australian landscape. The rabbit can increase the likelihood of soil erosion by creating numerous burrows, threaten the survival of a number of native animal species by altering habitat, reducing native food sources, displacing small animals from burrows and attracting introduced predators such as foxes. 'Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)' is a listed Key Threatening Process under both the EPBC Act and the BC Act. The Project is not likely to increase the presence of the European Rabbit within the study area as the Project is removing only small areas of native vegetation.

Cats can be found in almost all terrestrial environments in Australia. Predation by feral cats is a particular problem that affects native fauna such as small mammals (such as rodents, dasyurids, and burramyids) and ground-nesting birds. 'Predation by the feral cat (*Felis catus*)' is a listed Key Threatening Process under both the EPBC Act and the BC Act. No evidence of feral cats was identified during the field survey however feral and domesticated cats are likely to forage throughout the study area given nearby urban development. Given the presence of cats in the locality, and the nature of the impacts associated with the Project, the Project is unlikely to increase the abundance of cats, introduce them into new areas, or increase predation pressure on native fauna.

7.2.4 Impact on relevant Key Threatening Processes

A number of Key Threatening Processes have been identified as being relevant. The activities associated with the Project would either contribute to the Key Threatening Processes (known) or may potentially contribute to the Key Threatening Processes (potential). These are listed in **Table 9**.

7.2.5 Wildlife connectivity

Wildlife connectivity would not be significantly affected due to the small size of the proposed vegetation removal relative to the vegetation that remains in the north – south biodiversity corridor behind Merimbula Beach. The local north-south biodiversity link between Merimbula Beach and Merimbula Airport would not be severed or otherwise compromised by the proposed works.

7.2.6 Injury and mortality

Fauna injury or mortality could occur during the construction phase of the Project. The access roads would experience an increase in traffic including truck movements. However, truck movements would be speed limited and substantial adverse impacts to fauna are unlikely. During vegetation clearing, injury or mortality may occur. Although some mobile species may be able to move away quickly and easily such as some birds, others may be slower to move away or may not relocate at all such as some reptiles and amphibians, potentially resulting in injury or mortality of the individual.

7.2.7 Noise, vibration and light

Indirect impacts on biodiversity caused by noise, vibration and light as part of the construction phase of the Project as well as changes in noise or lighting impacts post construction are likely. Certain threatened species are particularly vulnerable to these indirect impacts.

Works associated with construction should generally be confined to standard work hours comprising:

- 7am to 6pm Monday to Friday;
- 8am to 1pm Saturdays; and
- no work on Sundays or Public Holidays.

Certain works may need to occur outside standard construction hours for the safety of workers, in accordance with transport licence requirements, or for constructability reasons. Activities to be carried out during out of hours periods may include oversized load deliveries and pipeline pulling as part of the directional drilling (which would need to be undertaken continuously until completed, which may take up to 48 hours).

Table 9: Known and potential Key Threatening Processes and impacts on biodiversity

Key Threatening Process	Relevance to the Project	Potential or known
Clearing of native vegetation (BC Act) Land clearance (EPBC Act)	Clearing of vegetation including native vegetation would be undertaken as part of the Project. Only a very small amount of native vegetation (0.28 ha) will be cleared as a result of the Project, much of which is already heavily modified. The proposed clearing would also be offset.	Known
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	The Project has the potential to adversely affect the wetlands within and adjoining the Project area. With the implementation of appropriate mitigation measures listed in **Section 6.2** the risk is considered to be low.	Potential
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis (BC Act) Infection of amphibians with chytrid fungus resulting in chytridiomycosis (EPBC Act)	Potential habitat for frogs occurs within the study area. Movement of vehicles, equipment and people during the construction phase of the Project carries a risk of introduction and spread of the chytrid fungus in these habitats with potential to impact on frog species. With the implementation of appropriate mitigation measures listed in **Section 6.2** the risk is considered to be low.	Potential
Infection of native plants by *Phytophthora cinnamomi* (BC Act)	Movement of vehicles, equipment and people during the construction site establishment phase carries a risk of introduction and spread of the plant pathogen *Phytophthora cinnamomi.* Presence of the plant pathogen within the study area is unknown. With the implementation of appropriate mitigation measures listed in **Section 6.2** the risk is considered to be low.	Potential
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (BC Act)	Movement of vehicles, equipment and people during the construction site establishment phase carries a risk of introduction and spread of 'Myrtle Rust'. Presence of Myrtle Rust within the study area is unknown. With the implementation of appropriate mitigation measures listed in **Section 6.2** the risk is considered to be low.	Potential
Invasion and establishment of exotic vines and scramblers (BC Act)	Movement of vehicles, equipment and people during the construction site establishment phase carries a risk of introduction and spread of these exotic vines and scramblers and well as disturbing intact vegetation can increase the risk of weed infestations. Appropriate mitigation measures are to be implemented to limit the spread of weeds and reduce the risk of weed infestations of areas.	Potential
Invasion, establishment and spread of *Lantana camara* (BC Act)	Movement of vehicles, equipment and people carries a risk of introduction and spread of *L. camara* into unaffected areas. Appropriate mitigation measures are to be implemented to limit the spread of weeds and reduce the risk of weed infestations.	Potential
Invasion of native plant communities by *Chrysanthemoides monilifera* (BC Act)	The proposed works of the Project have the potential to lead to or exacerbate Bitou Bush infestations. Appropriate mitigation measures are to be implemented to limit the spread of weeds and reduce the risk of Bitou Bush infestations.	Potential
Invasion of native plant communities by exotic perennial grasses	African Lovegrass is abundant within the study area and the proposed works of the Project have the potential to exacerbate the existing infestations. Appropriate mitigation measures are to be implemented to reduce the risk of exacerbating African Lovegrass infestations.	Known
Loss of Hollow-bearing Trees (BC Act)	The Project may result in the removal of up to two hollow bearing trees. With the implementation of appropriate mitigation measures listed in **Section 6.2** the risk is considered to be low.	Known

Threatened species most at risk from indirect noise and vibration are:

- nocturnal birds (such as Powerful Owl and Masked Owl) may be affected by daily noise which could affect their behaviour;
- shorebirds that may be utilising the habitats on Merimbula Beach and Pambula Beach;
- Bats and nocturnal mammals within the study area could be affected by increased noise during construction of the Project; and
- diurnal birds may be indirectly affected by noise during the Project. Species such as small woodland birds are known to be impacted by noise associated with roads (Reijnen et al, 1995).

Noise and vibration impacts as a result of the Project are likely to affect fauna species that rely on sound to communicate or are nocturnal and sleep during the day when Project activities are at their peak. These may include bats and other nocturnal mammals and diurnal and nocturnal birds.

Changes to the availability of light as a result of vegetation clearance may potentially impact both flora and fauna species. The potential impacts are likely to be a result of:

- altering light regimes affecting plant growth; and
- changes to micro-climates caused by overshadowing or increased light potentially increasing the likelihood of weed invasion.

In general, noise, vibration and light are unlikely to have a significant effect on the diurnal and nocturnal threatened birds and diurnal and nocturnal mammals in the study area, because these areas already receive these types of indirect impacts from the existing STP, Arthur Kaine Drive, the Merimbula Airport and the Pambula urban area. Furthermore, the vegetation clearing and other works associated with the Project would be concentrated in areas that are already highly disturbed and where fauna habitats are lower quality. In addition, noise and vibration impacts will be temporary and are expected to be limited primarily to the construction phase.

The impacts on shorebirds would be dependent on the extent, timing and nature of the impacts to the habitats on Merimbula Beach and Pambula Beach. However they are expected to be minor given the short duration of the impacts, the absence of any breeding records for any threatened species, and the proposed mitigation measures.

A range of mitigation measures would be incorporated into the Project as identified in **Table 8**.

7.2.8 Groundwater dependent ecosystems

The GDE assessment undertaken for the Project (ELA 2020) concluded that the proposed outfall pipeline would be beneath the groundwater table and would have negligible impact on groundwater flow, quality, or level and thus would not have any adverse impacts on potentially groundwater dependent vegetation. It also concluded that there is unlikely to be any change to groundwater flow into Merimbula Lake. All GDEs present within or immediately surrounding the Project area are classified as Category 2 (Moderate Ecological Value) GDEs, and the risks associated with the STP development are classified as Category 1 (Minor Risks). The assessment concluded that given the low level of risk to GDEs, no ongoing monitoring is needed.

7.3 Impact summary

Although avoidance and mitigation measures have been considered and implemented during the design of the Project, impacts on native vegetation have been identified that require offsetting. The areas and credits required for offsets are outlined below.

Following implementation of the Biobanking Assessment Methodology (BBAM) and the Biobanking credit calculator (BBCC), the following impacts have been determined.

7.3.1 Areas not requiring assessment or offset

Areas not requiring assessment or offset were limited to those areas that were cleared and do not support native vegetation, such as the bulk of the areas that would be impacted within the existing STP and the beach areas that do not support native vegetation and only limited temporary impacts are proposed. These areas already support hard surfaces, buildings, ponds, lawns or sand. Areas not requiring assessment or offset comprise the vast majority of the development footprint.

7.3.2 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in **Table 10** and shown on **Figure 13**. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in **Table 11** and on **Figure 13**.

Table 10: Impacts to native vegetation that require offsets

Veg Zone	BVT ID	PCT ID	Plant Community Type	Condition	Site Value Score	Area (ha)	Credits	Credits/ha
1	SR531	772	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Moderate /Good	55.73	0.03	1	50
9	SR533	777	Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion	Low	21.70	0.25	3	12
						0.28	**4**	**62**

Table 11: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact habitat (ha)	Credits	Credits/ha
Cercartetus nanus	Eastern Pygmy-possum	0.28	6	21.42
Phascogale tapoatafa	Brush-tailed Phascogale	0.28	6	21.42

Figure 13: Impacts requiring offset

7.3.3 Impacts requiring further consideration

Matters for further consideration discussed below include:

- important wetland or its buffer; and
- impacts on species movements along corridors (state significant biodiversity link).

7.3.3.1 Coastal Wetlands

As identified in **Section 3.5** and **Figure 5** and **Figure 6** the development footprint intersects with the proximity area to the Coastal Wetland associated with Merimbula Lake. The proposed underground trenchless drilling would also traverse the Coastal Wetland and proximity area associated with the wetland that occurs in the hind dune swale behind Merimbula Beach and extends from the study area south to Pambula.

The Project has been designed to avoid adverse impacts on these Coastal Wetlands. This has primarily been achieved by:

- limiting the proposed STP upgrade works to the already highly disturbed STP site and thus avoiding any vegetation clearing or other adverse direct or indirect impacts on Merimbula Lake or associated estuarine habitats;
- utilising the underground trenchless drilling method for the ocean outfall pipeline and thus avoiding the need to remove or otherwise adversely affect the vegetation within the wetland in the hind dune swale behind Merimbula Beach or any other vegetation within the proximity area to this wetland; and
- incorporating into the design and construction methods appropriate mitigation measures and safeguards to avoid any adverse indirect impacts to these wetlands i.e. through spills, sedimentation or pollution.

The water quality (Elgin Associates 2020), groundwater (AECOM 2020b) and GDE (ELA 2020) impact assessments undertaken for the Project have all concluded that it is unlikely that the proposed underground trenchless drilling method would result in subsidence or other direct or indirect impacts that would adversely affect the biophysical, hydrological or ecological integrity of the wetland in the eastern parts of the Project area, or affect the quantity or quality of surface or groundwater flows. The underground drilling method has been used successfully in many similar environments, without adverse impacts, and on the contrary, is an important and effective impact avoidance strategy.

7.3.3.2 Biodiversity links

The Project has been designed to avoid, minimise and mitigate adverse impacts on terrestrial vegetation, including Coastal Wetlands. As a result, vegetation impacts have been limited to approximately 0.28 ha of vegetation, the bulk of which comprises regrowth scrub within the existing STP site. The minor impacts on PCT 772 associated with the construction phase of the Project would be rehabilitated post construction.

Under these circumstances the Project would have minor temporary impacts on biodiversity links and would not compromise the integrity of any state, regional or local biodiversity link.

7.3.4 Credit summary

The number of ecosystem credits required for the Project are outlined in **Table 12**. The number of species credits required for the Project are outlined in **Table 13**. A biodiversity credit report is included in **Appendix D**.

Table 12: Ecosystem credits required

PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	Credits required
772	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	Heathlands	0.03	1
777	Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion	Wet Sclerophyll Forests (Grassy sub-formation)	0.25	3

Table 13: Species credits required

Species	Common Name	Direct impact habitat (ha)	Credits required
Cercartetus nanus	Eastern Pygmy-possum	0.28	6
Phascogale tapoatafa	Brush-tailed Phascogale	0.28	6

8. EPBC Act Assessment

An impact assessment under the EPBC Act was undertaken on MNES known to occur within the development footprint or immediate surrounds or with potential to occur there. These MNES were:

- *Lathamus discolor* (Swift Parrot);
- *Anthochaera phrygia* (Regent Honeyeater);
- *Heleioporus australiacus* (Giant Burrowing Frog);
- *Litoria aurea* (Green and Golden Bell Frog);
- *Potorous tridactylus* (Long-nosed Potoroo);
- *Chalinolobus dwyeri* (Large-eared Pied Bat);
- *Pteropus poliocephalus* (Grey-headed Flying-fox);
- *Thinornis rubricollis* (Hooded Plover);
- *Sterna albifrons* (Little Tern);
- *Amphibromus fluitans* (River Swamp Wallaby-grass);
- *Persicaria elatior* (Tall Knotweed);
- *Calidrus ferruginea* (Curlew Sandpiper);
- *Limosa lapponica* (Bar-tailed Godwit);
- *Gallinago hardwickii* (Latham's Snipe);
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle);
- *Monarcha melanopsis* (Black-faced Monarch) ;
- *Myiagra cyanoleuca* (Satin Flycatcher); and
- *Rhipidura rufifrons* (Rufous Fantail).

The outcome of this assessment was that it is unlikely that the Project would significantly affect those MNES assessed (**Appendix C**).

9. Conclusion

ELA was engaged by AECOM to undertake an assessment of potential impacts of the proposed Merimbula STP Upgrade and Ocean Outfall (the Project) on terrestrial biodiversity values in accordance with the FBA. Consistent with the FBA a BAR has been prepared for the Project.

This BAR outlines the measures taken to avoid, minimise and mitigate impacts to the vegetation and habitats present within the development footprint during the design, construction and operation of the Project. The residual unavoidable impacts of the Project were calculated in accordance with the BBAM and the BBCC. The BBCC calculated that a total of four ecosystem credit and 12 species credits are required to offset the unavoidable impacts to the vegetation and habitat present within the development footprint.

Following consideration of the administrative guidelines for determining significance under the EPBC Act, it is concluded that the Project is unlikely to have a significant impact on MNES or Commonwealth land.

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Personal Communications

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Appendix A: FBA Methodology and where addressed in document

Report section	Information	Maps & data	FBA reference	Section in this Report
Introduction	Introduction to the biodiversity assessment including: • identification of Project footprint, including: ○ operational footprint ○ construction footprint indicating clearing associated with temporary construction facilities and infrastructure • general description of development footprint • sources of information used in the assessment, including reports and spatial data.	• Site Map (as described in Section 3.2) • Location Map (as described in Section 3.2) • Digital shape files for all maps and spatial data	Chapter 3 and Section 3.2	Chapter 1 – Introduction and Chapter 2 Methodology
Landscape features	Identification of landscape features at the development footprint, including: • IBRA bioregions and subregions, NSW landscape region and area (ha) • native vegetation extent in the outer assessment circle or buffer area • cleared areas • evidence to support differences between mapped vegetation extent and aerial imagery • rivers and streams classified according to stream order • wetlands within, adjacent to and downstream of development footprint • landscape value score components, including: ○ identification of method applied (i.e. linear or site-based) ○ percent native vegetation cover in the landscape ○ connectivity value ○ patch size ○ area to perimeter ration • landscape value score.	• IBRA bioregions and subregions (as described in Paragraphs 4.1.1.3–4) • NSW landscape regions (as described in Paragraphs 4.1.1.5– 6) • Rivers and streams (as described in Paragraphs 4.1.1.8–10 • Wetlands (as described in Paragraphs 4.1.1.11–13) • Other landscape features (as required by SEARs) • Native vegetation extent (as described in Paragraphs 4.1.1.12–15) • State, regional and local biodiversity links (as described in Paragraphs 4.1.1.16–17) • Regional vegetation used to calculate patch size	Section 4.1, Appendix 4 and Appendix 5	Chapter 3 – Landscape features

Report section	Information	Maps & data	FBA reference	Section in this Report
Native vegetation	Identify native vegetation extent within the development footprint, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery. Describe PCTs within the development footprint, including: • vegetation class • vegetation type • area (ha) for each vegetation type • species relied upon for identification of vegetation type and relative abundance • justification of evidence used to identify a PCT (as outlined in Paragraph 5.2.1.8) • EEC status (as outlined in Subsection 5.2.1) • estimate of percent cleared value of PCT. Describe vegetation zones within the development footprint, including: • condition class and subcategory (where relevant) • area (ha) for each vegetation zone • survey effort as described in Paragraphs 5.2.1.5–7 (number of plots/transects). Where use of local data is proposed: • identify relevant vegetation type • identify source of information for local benchmark data • justify use of local data in preference to database values.	• Map of native vegetation extent within the development footprint (as described in Section 5.1) • Map of PCTs within the development footprint • Map of condition class and subcategory (where relevant) • Map of plot and transect locations relative to PCTs and condition class • Map of EECs • Plot and transect field data (MS Excel format) • Plot and transect field data sheets • Table of current site value scores for each vegetation zone within the development footprint • Map of vegetation zones with a current site value score of <17.	Chapter 5	Chapter 2 – Methodology for details on methods, Appendix E for plot data. Chapter 4 – Native vegetation
Threatened species	Identify ecosystem credit species associated with PCTs on the development footprint as outlined in Section 6.3, including: • list of species derived • justification for exclusion of any ecosystem credit species predicted above. Identify species credit species on the development footprint as outlined in Sections 6.5 and 6.6, including: • list of candidate species • justification for inclusions and exclusions based on habitat features • indication of presence based on targeted survey or expert report	• Table of vegetation zones and landscape Tg values, particularly indicating where these have changed due to species exclusion • Targeted survey locations • Table detailing the list of species credit species and presence status on site as determined by targeted survey, indicating also where presence was assumed and/or where presence was determined by expert report	Chapter 6	Chapter 2 – methodology for survey details Chapter 5 – Threatened Species Appendix B likelihood of

Report section	Information	Maps & data	FBA reference	Section in this Report
	• details of targeted survey technique, effort, timing and weather • species polygons • species that cannot withstand a further loss. Where use of local data is proposed: • identify relevant species or population • identify aspect of species/population data • identify source of information for local data • justify use of local data in preference to database values. Where expert reports are used in place of targeted survey: • identify the relevant species or population • justify the use of an expert report • indicate and justify the likelihood of presence of the species or population and information considered in making this assessment • estimate the number of individuals or area of habitat (whichever unit of measurement applies to the species/individual) for the development footprint, including a description of how the estimate was made • identify the expert and provide evidence of their expert credentials.	• Species credit species polygons (as described in Paragraph 6.5.1.19) • Table detailing species and habitat feature/component associated with species and its abundance on site (as described in Paragraph 6.5.1.19) • Species polygons for species that cannot withstand a loss		occurrence for EPBC Act species.
Avoid and minimise impacts	Demonstration of efforts to avoid and minimise impact on biodiversity values in accordance with Section 8.3. Identification of final Project footprint during construction and operation in accordance with Subsection 8.3.3. Assessment of direct and indirect impacts unable to be avoided at the development footprint in accordance with Sections 8.3 and 8.4. The assessment would include but not be limited to: type, frequency, intensity, duration and consequence of impact. Statement of onsite measures proposed to avoid and minimise direct and indirect impacts of the Major Project.	• Table of measures to be implemented before, during and after construction to avoid and minimise the impacts of the Project, including action, outcome, timing and responsibility • Map of final Project footprint, including construction and operation • Maps demonstrating indirect impact zones where applicable	Chapter 8	Chapter 6 – Avoidance and mitigation measures Chapter 7 – Assessment of impacts

Appendix B Likelihood of occurrence of MNES

An assessment of the likelihood of occurrence was made for threatened and migratory species that are MNES listed under the Commonwealth EPBC Act and which have been identified as occurring or potentially occurring in the locality from the database search. Fish, marine species including marine mammals and seabirds, and waders have been omitted from the table due to lack of suitable habitat in the development footprint. Shorebirds which could potentially utilise the habitats on Pambula and Merimbula Beach, and wetland birds that could potentially utilise the swamp habitats within the Project area have been included.

Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

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

CE: Critically Endangered; E: Endangered; V: Vulnerable; M: Migratory

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
FLORA					
Amphibromus fluitans	River Swamp Wallaby-grass	V	V	Occurs in swamp margins, dam and tank beds and in semi-dry mud of lagoons with Potamogeton and Chamaeraphis species. In NSW, recorded recently in lagoons beside the Murray River near Cooks Lagoon, Mungabarina Reserve, East Albury, at Ettamogah, Thurgoona, near Narranderra, near Mathoura, and near Laggan. The species may potentially occur within the swamp habitats within the study area.	Potential
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Grassy sclerophyll woodland on clay loam or sandy soils, or low woodland with stony soil. Currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. There is no suitable habitat within the study area.	No
Correa baeuerlenii	Chef's Cap	V	V	This shrub to 2.5 m high with rusty stems commonly flowers in spring but may flower at most times of the year. The species has been recorded between the Batemans Bay and the Victorian border, mostly in damp gullies and on the banks of streams. It may also be found in near-coastal rocky sites. The nearest records are north of Tanja. There is no suitable habitat within the study area.	No
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	This terrestrial orchid grows in swamp-heath and heathy open forest on sandy and clay soils in coastal districts. The study area does not support suitable habitats for the species and it is considered highly unlikely that it would occur there.	Unlikely
Genoplesium rhyoliticum	Pambula Midge-orchid	E	E	Occurs in shallow soil overlying rhyolite rock in vegetation often dominated by lichens and/or moss. Endemic to a narrow strip of NSW south coast. There is no suitable habitat within the study area.	No
Leionema ralstonii	Ralston's Leionema	V	V	This shrub is endemic to the coastal ranges of south-east NSW between Eden and Pambula where it is largely confined to dry, rocky habitats. There is no suitable habitat within the study area.	No

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Persicaria elatior	Tall Knotweed	V	V	This erect herb grows in damp places in riparian forests, gallery rainforests, swamps, marshes, intermittent wetlands, aquatic environments, and disturbed areas at no particular altitude. The species may potentially occur within the swamp habitats within the study area.	Potential
Pomaderris bodalla	Bodalla Pomaderris	V	V	The species has been recorded between Batemans Bay and Merimbula, mostly in sheltered gullies and on the banks of streams. There is no suitable habitat for the species in the study area.	No
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	Cotoneaster Pomaderris is a shrub growing to 4 m tall. It has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs. There is no suitable habitat for the species in the study area.	No
Pomaderris parrisiae	Parris' Pomaderris	V	V	Parris' Pomaderris is a shrub or small tree to 9 m found on skeletal soils in rocky shrubland or tall open forest chiefly on escarpment ranges. There is no suitable habitat for the species in the study area.	No
Thesium australe	Austral Toadflax	V	V	This short-lived herbaceous shrub with wiry stems grows in grassland and grassy woodland habitats and is up to 30 cm in length. There is no suitable habitat for the species in the study area.	No
Zieria formosa	Shapely Zieria	E	E	This species is known from a single population at Lochiel, 6 km south-west of Pambula on the far south coast of NSW. The population is spread over approx. 1 ha on private property. It occurs on the north-easterly aspect of an upper, moderately steep slope of a breakaway area above a small valley. The soil is a skeletal, grey, sandy loam. The site is strewn with broken ignimbrite rocks and boulders and there is much exposed surface rock. There is no suitable habitat within the study area.	No

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
THREATENED ECOLOGICAL COMMUNITIES					
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia		E	CE	This community typically occurs as a closed canopy of trees that can be interspersed with canopy gaps that are common in exposed situations or with storm events. The canopy forms a mosaic due to canopy regeneration, typically in the form of basal coppice following canopy decapitation due to prevailing salt laden winds and storm events. Emergents such as Banksia or Eucalyptus spp may be present. The ground stratum of the vegetation typically is very sparse. It usually occurs within two km of the coast on dunes and flats, cheniers, berms, cobbles, headlands, scree, seacliffs, marginal bluffs, spits, deltaic deposits, coral rubble and islands.	No
Lowland Grassy Woodland in the South East Corner Bioregion		E	CE	This community typically occurs as a grassy woodland but may also exhibit a more open forest structure. The canopy is dominated by Eucalyptus tereticornis (Forest Red Gum) and/or Angophora floribunda (Rough-barked Apple). Associated tree species include E. globoidea (white stringybark) and E. bosistoana (coastal grey box). E. pauciflora (snow gum) or E. melliodora (yellow box) may be dominant in some areas. A shrub layer is often present as an open to sparse layer, typically with Acacia mearnsii (black wattle) or Ozothamnus diosmifolius (sago flower). Some patches havea dense shrub layer and consist mainly of Bursaria spinosa (sweet bursaria). Typically there is a near continuous groundcover dominated by grasses and forbs. Derived grasslands are included as part of the ecological community. Rainshadow areas of the south coast and hinterland of New South Wales. Currently known to occur within the Bega Valley, Eurobodalla and Palerang Local Government Areas. Typically occurs in undulating terrain up to 500 m in elevation on granitic substrates (e.g. adamellites, granites, granodiorites, gabbros, etc.) but may also occur on locally steep sites and on acid volcanic, alluvial and fine-grained sedimentary substrates.	No

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Subtropical and Temperate Coastal Saltmarsh		E	V	This ecological community consists mainly of salt-tolerant vegetation (halophytes) including grasses, herbs, sedges, rushes and shrubs. Succulent herbs, shrubs and grasses are generally dominant, and vegetation is usually of less than 0.5 m height (with the exception of some reeds and sedges). Many species of non-vascular plants are also found in saltmarsh, including epiphytic algae, diatoms and cyanobacterial mats. In New South Wales, the lower intertidal zone is often dominated by herbs and grasses (e.g. Sarcocornia quinqueflora, Sporobolus virginicus, Samolus repens and Triglochin striata), which give way to tall sedges and rushes in the landward sections of the intertidal zone. The community occurs within a relatively narrow margin of the Australian coastline, within the subtropical and temperate climatic zones south of the South-east Queensland IBRA bioregion. It is typically restricted to the upper intertidal environment and is mainly associated with the soft substrate shores of estuaries and embayments (sandy and/or muddy) and on some open, low wave energy coasts). The community is associated with Merimbula Lake but is not present within the study area.	No
FROGS					
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog is found in two distinct populations in south eastern NSW and Victoria: a northern population in the sandstone geology of the Sydney Basin as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Habitat includes heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeds in ephemeral streams with permanent or semi-permanent pools. There is a recent record just to the south of Pambula Lake. There is only a small area of potential habitat within the study area.	Potential

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Litoria aurea	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water. Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading. Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). The species was released in 2005 and 2008 into the Pambula wetlands to the south of the study area. It is not clear whether species has persisted there.	Potential
Litoria littlejohni	Littlejohn's Tree Frog	V	V	This species can be found on the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest in NSW south to Buchan in Victoria. It has only very recently been re-recorded in southern NSW within the last decade (Nadgee). It breeds in the upper reaches of permanent streams and perched swamps or in larger pools and dams. Non-breeding habitat includes heath-based forests and woodlands.	No
Mixophyes balbus	Stuttering Frog	E	V	A variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest that are generally characterised by deep leaf litter or thick cover from understorey vegetation. Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans or still water environments. The habitats within the study area are not suitable for the species. Suitable habitat is not present within the study area.	No

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
DIURNAL BIRDS					
Anthochaera phrygia	Regent Honeyeater	E	E, M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (Casuarina cunninghamiana) (Garnett 1993). Areas containing Swamp Mahogany (Eucalyptus robusta) and *Banksia integrifolia* in coastal areas have been observed to be utilised. The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000). Small amount of marginal potential habitat within the study area.	Potential
Dasyornis brachypterus	Eastern Bristlebird	E	E	In NSW, the species is known from Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP, Beecroft Peninsula and Nadgee NR. They inhabit heath and open woodland with a heathy understorey. There is no suitable habitat within the study area.	No
Grantiella picta	Painted Honeyeater	V	V	The Painted Honeyeater is a nomadic species that occurs predominantly on the inland slopes of the Great Dividing Range. It inhabits Boree (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias, preferring mistletoes of the genus Amyema. Nesting occurs from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping Eucalyptus spp., Allocasuarina and Casuarina spp. (Sheoaks), Melaleuca sp. (Paperbark) or Mistletoe branches. It is highly unlikely that the species would occur within the study area.	Unlikely

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Lathamus discolor	Swift Parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986; Forshaw and Cooper 1981). Hence, in this region, autumn and winter flowering eucalypts are important for this species. 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*). It is possible that the species would forage within the study area when present in the region.	Potential
Neophema chrysogaster	Orange-bellied Parrot	-	CE	The Orange-bellied Parrot breeds in the south-west of Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern South Australia and southern Victoria. There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. Typical winter habitat is saltmarsh and strandline/foredune vegetation communities either on coastlines or coastal lagoons. Spits and islands are favoured but they will turn up anywhere within these coastal regions. The species can be found foraging in weedy areas associated with these coastal habitats or even in totally modified landscapes such as pastures, seed crops and golf courses.	Unlikely
Rostratula australis	Australian Painted Snipe	E	E	In NSW, records of the Painted Snipe are from the Murray-Darling Basin, including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp, and swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. It prefers the fringes of swamps, dams and nearby marshy areas, where there is a cover of grasses, Lignum, low scrub or open timber. It nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. There is no suitable habitat for the species within the study area.	Unlikely

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Thinornis rubricollis	Hooded Plover	CE	V	The Hooded Plover is 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). 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. Whilst the species is well known from a number of beaches in the Bega Valley there are no records from Merimbula Beach, despite a long-term shorebird monitoring project on the far south coast.	Unlikely
Sterna albifrons	Little Tern	E	E	Whilst the species is well known from a number of beaches in the Bega Valley there are no records from Merimbula Beach, despite a long-term shorebird monitoring project on the far south coast. It is possible that the species may occur within the study area, particularly along the beach, however it is unlikely that the species would breed there.	Unlikely
Strenula nereis	Australian Fairy Tern	-	V	It is highly unlikely that the species would occur within the study area, given that it is rarely observed within NSW and it would not breed there given the absence of suitable habitats.	Unlikely
MAMMALS (EXCLUDING BATS)					
Dasyurus maculatus *Dasyurus maculatus maculatus*	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V —	— E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests, more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in. The Project area provides a very small amount of marginal potential habitat for this species.	Unlikely
Isoodon obesulus	Southern Brown Bandicoot	E	E	This species requires thick contiguous undergrowth where the soil is light and sandy. Within NSW it possibly only remains in the northern suburbs of Sydney and around the Eden area. Digging signs that may be attributable to the species were not observed in the study area, and it is considered highly unlikely that the species would occur within the study area.	Unlikely

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	In NSW, the Brush-tailed Rock-wallaby occurs from the Qld border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. It inhabits rocky escarpments, outcrops and cliffs, with a preference for complex structures with fissures, caves and ledges. Suitable habitat is not present within the Project area.	No
Potorous tridactylus *Potorous tridactylus*	Long-nosed Potoroo Long-nosed Potoroo (SE Mainland Population)	V —	— V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004). The species requires dense contiguous undergrowth and sandy substrate. There are recent records in the Tura Beach Flora Reserve to the north. The study area provides some potential habitat for the species.	Potential
Pseudomus fumeus	Smoky Mouse	E	E	The Smoky Mouse is currently limited to a small number of sites in western, southern and eastern Victoria, south-east NSW and the ACT. The Smoky Mouse appears to prefer heath habitat on ridge tops and slopes in sclerophyll forest, heathland and open-forest from the coast (in Victoria) to sub-alpine regions of up to 1800 m, but sometimes occurs in ferny gullies. The species is unlikely to occur within the study area given the absence of suitable habitats.	Unlikely
Pseudomys novaehollandiae	New Holland Mouse	—	V	This species has a fragmented distribution across its range and is known to inhabit open heathlands, open woodlands with heathland understorey, and vegetated sand dunes. The sites where the species is known from typically have very sandy soils. There are no records of the species within the Bega Valley Shire and it is considered highly unlikely that it would occur within the study area.	Unlikely
MAMMALS (BATS)					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998). The species may forage within the study area from time to time but would not roost there.	Potential Foraging only

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998). There are no camps in the Project area and the amount of available foraging habitat is very small compared to the vast home range of the species.	Potential
MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT					
Cuculus optatus	Oriental Cuckoo	—	M	Inhabits rainforest margins, monsoon forest, vine scrub, riverine thickets, wetter, densely canopied eucalypt forest, paperbark swamp and mangroves. It migrates from Eurasia. Some remain in Australia through winter, although it is uncommon.	Unlikely
Haliaeetus leucogaster	White-bellied Sea-Eagle	—	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	Likely
Hirundapus caudacutus	White-throated Needletail	—	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993). This species may forage over the study area from time to time but would be highly unlikely to roost there.	No
Merops ornatus	Rainbow Bee-eater	—	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Doyle 1988). Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (ibid). Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (ibid).	Unlikely

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Monarcha melanopsis	Black-faced Monarch	—	M	This migratory species is known to breed in damp forest types and forage in rainforest and eucalypt forest.	Potential
Monarcha trivirgatus	Spectacled Monarch	—	M	This species is usually found in rainforest, mangroves and moist gloomy gullies of dense eucalypt forest. The habitat within the study area is unsuitable for the species.	Unlikely
Myiagra cyanoleuca	Satin Flycatcher	—	M	This species inhabits lowland eucalypt forests. It is known to nest in dense gully vegetation.	Potential
Rhipidura rufifrons	Rufous Fantail	—	M	This migratory species forages by catching flying insects and is known to utilise the aerial foraging space above the dense understorey in damp forests or beside rivers.	Potential
Xanthomyza phrygia (Anthochaera phrygia)	Regent Honeyeater	E	E, M	SEE DIURNAL BIRDS ABOVE	Potential
MIGRATORY WETLAND SPECIES LISTED UNDER EPBC ACT					
Ardea alba	Great Egret	—	M	Has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). The species usually frequents shallow waters and may retreat to permanent wetlands or coastal areas when other wetlands are dry (for example, during drought).	Unlikely
Ardea ibis	Cattle Egret	—	M	Dry grassy habitats. It nests in colonies, often with other wading birds, usually on a platform of sticks in trees or shrubs.	Unlikely
Calidris ferruginea	Curlew Sandpiper	E	CE, M	The nearest records are well to the north of Merimbula around Wallagoot and Bournda lakes. It is possible that the species may occur within the study area, within the STP. It does not breed in Australia.	Potential
Gallinago hardwickii	Latham's Snipe	—	M	Any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture. It is possible that the species may occur within the study area, potentially within the STP. It does not breed in Australia.	Potential

Scientific Name	Common Name	BC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Limosa lapponica	Bar-tailed Godwit	-	M	There is one 2017 record from Merimbula Lake/Airport. It is possible that the species may occur within the study area, potentially within the STP. It does not breed in Australia.	Potential
Rostratula benghalensis s. lat.	Painted Snipe	E	E, M	This species occurs in wetlands with emergent vegetation, typically inland. It is unlikely that the species would occur within the study area.	Unlikely
Disclaimer: Data extracted from the Atlas of NSW Wildlife and DEW Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species', 'Migratory wetland species', and 'listed marine species' listed on the EPBC Act (and listed on the DEW protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine and wetland habitats.					

CE = Critically Endangered; E = Endangered; E2 = Endangered Population; V = Vulnerable; M = Migratory.

Appendix C: EPBC Act Significant Impact Criteria

The EPBC Act Administrative Guidelines on Significance set out 'Significant Impact Criteria' that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance. Matters listed under the EPBC Act as being of national environmental significance include:

- Listed threatened species and ecological communities;
- Listed migratory species;
- Wetlands of International Importance;
- The Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Nuclear actions; and
- Great Barrier Reef.

Specific 'Significant Impact Criteria' are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act.

The Commonwealth listed species which are known or considered to have the potential to occur within the study area are the:

- *Lathamus discolor* (Swift Parrot);
- *Anthochaera phrygia* (Regent Honeyeater);
- *Heleioporus australiacus* (Giant Burrowing Frog);
- *Litoria aurea* (Green and Golden Bell Frog);
- *Potorous tridactylus* (Long-nosed Potoroo);
- *Chalinolobus dwyeri* (Large-eared Pied Bat);
- *Pteropus poliocephalus* (Grey-headed Flying-fox);
- *Amphibromus fluitans* (River Swamp Wallaby-grass);
- *Persicaria elatior* (Tall Knotweed);
- *Calidrus ferruginea* (Curlew Sandpiper);
- *Limosa lapponica* (Bar-tailed Godwit);
- *Gallinago hardwickii* (Latham's Snipe);
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle);
- *Monarcha melanopsis* (Black-faced Monarch);
- *Myiagra cyanoleuca* (Satin Flycatcher); and
- *Rhipidura rufifrons* (Rufous Fantail).

The relevant Significant Impact Criteria have been applied to determine the significance of impacts associated with the Project.

Matters to be considered	Impact
Any environmental impact on a World Heritage Property or National Heritage Places	No. The proposed action does not impact on a World Heritage Property or a National Heritage Place. (listed natural: Australian Alpine National Parks and Reserves; nominated historic: Snowy Mountains Scheme NSW).
any environmental impact on Wetlands of International Importance	No. The Project would not affect any part of a Ramsar wetland.
any impact on Commonwealth Listed Critically Endangered or Endangered Species;	Yes. The study area does provide potential habitat for the following Commonwealth listed endangered species: Swift Parrot, Regent Honeyeater and Little Tern. The significant impact criteria for endangered species are discussed below: a. lead to a long-term decrease in the size a population of a species, The Project would result in the loss or substantial modification of approximately 0.28 ha of potential foraging habitat for the Swift Parrot and Regent Honeyeater. This area would not represent an area critical for the long-term survival of these species, as it comprises only a very small amount of the potential resources available to these species in contiguous habitat in the locality. The proposed construction beach access would affect some potential breeding habitat for the Little Tern. However, there are no records of the species breeding on the beach despite a long-term shorebird monitoring programme on the south coast. Under these circumstances, the Project is considered unlikely to lead to a long-term decrease in the size of a population of the Swift Parrot, Regent Honeyeater or Little Tern. b. reduce the area of occupancy of the species The Project would not substantially reduce potential habitat for the Swift Parrot, Regent Honeyeater or Little Tern which all have large migratory movements. Under these circumstances, the Project is considered unlikely to lead to reduce the area of occupancy of a population of the Swift Parrot, Regent Honeyeater or Little Tern. c. fragment an existing population into two or more populations The Project would not fragment an existing important population of the Swift Parrot, Regent Honeyeater or Little Tern into two or more populations. d. adversely affect habitat critical to the survival of a species No habitat within the development footprint is considered likely to be critical to the survival of the Swift Parrot, Regent Honeyeater or Little Tern. e. disrupt the breeding cycle of a population The Project would not affect any known breeding habitat for the Swift Parrot which does not breed on the mainland. Similarly, it is highly unlikely that the Regent Honeyeater would breed in the development footprint as its breeding areas are generally west of the Great Dividing Range. Whilst the Little Tern could theoretically breed within the development footprint, there are no records of the species breeding on Pambula Beach or Merimbula Beach despite a long-term shorebird monitoring programme on the south coast. f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline The loss or substantial modification of 0.28 ha of vegetation is considered to be a relatively small impact in the context of the available resources for the Swift Parrot and Regent Honeyeater in the locality. The temporary modification to the potential habitats on Merimbula and Pambula Beach are unlikely to adversely affect the Little Tern, as there is no evidence that these areas are important to the species.

Matters to be considered	Impact
	Under these circumstances, it is highly unlikely that the proposed action would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Swift Parrot, Regent Honeyeater or Little Tern are likely to decline. g. result in invasive species that are harmful to an endangered species becoming established in the endangered or critically endangered species' habitat The proposed action is unlikely to result in invasive species that are harmful becoming established in potential habitat of the Swift Parrot, Regent Honeyeater or Little Tern. h. introduce disease that may cause the species to decline The proposed action is unlikely to introduce disease that may cause the Swift Parrot, Regent Honeyeater or Little Tern to decline. i. interfere substantially with the recovery of the species. As the proposed action is not considered to decrease or fragment any existing populations, the recovery of the Swift Parrot, Regent Honeyeater and Little Tern are unlikely to be adversely impacted.
Any impact on Commonwealth Listed vulnerable Species;	Yes. The subject land provides potential habitat for the following Commonwealth listed vulnerable species: • Large-eared Pied Bat • Grey-headed Flying-Fox. • Giant Burrowing Frog • Green and Golden Bell Frog • Long-nosed Potoroo • Hooded Plover • River Swamp Wallaby-grass • Tall Knotweed The significant impact criteria in terms of the vulnerable species are discussed below: *a. lead to a long-term decrease in the size of an important population of a species,* The Project is highly unlikely to impact adversely on the Grey-headed Flying-Fox or Large-eared Pied Bat as it will affect only a relatively small amount of potential foraging habitat in the context of that available within the locality. No important populations of either species will be affected by the Project. It is considered unlikely although possible that the Giant Burrowing Frog, Green and Golden Bell Frog or Long-nosed Potoroo would occur within the development footprint. However, the Project would not adversely affect any potentially important habitats for these species, such as potentially important breeding or foraging habitats. Whilst it is possible that the Giant Burrowing Frog and Green and Golden Bell Frog could potentially breed within the wetlands within the Project area, and in the case of the Green and Golden Bell Frog, within the STP ponds, these habitats would generally be unaffected and remain available to these species. The exception being the STP effluent pond within the STP. The STP ponds, whilst they could potentially be used for breeding by the Green and Golden Bell Frog, they generally are not likely to be conducive to successful breeding events given their usage for sewage treatment. The maturation pond provides better quality potential breeding habitat, however it would only be used during a major breeding event during a very wet summer, when many waterbodies would be used for breeding. There are many similar and better quality water bodies in the locality, including within the golf course, and as such, the loss of the potential breeding habitat associated with the STP effluent pond is unlikely to comprise an adverse impact on any local population of the Green and Golden Bell Frog, if in fact, a local population exists. It is not clear whether attempts to reintroduce the Green and Golden Bell Frog locally in Pambula wetlands have been successful as there have been no recent records of the species in the area since 2008. It is unlikely that the STP effluent pond would comprise important refuge habitat given the small area and marginal nature of the emergent vegetation and associated basking habitat, particularly relative to that available in other wetlands locally such as on the golf course and east of Arthur Kaine Drive.

Matters to be considered	Impact
	The Hooded Plover could potentially occur with the beach areas of the development footprint or potentially breed there. However there is no evidence of the site being an important area for the species despite a long-term shorebird monitoring program on the south coast. Tall Knotweed and River Swamp Wallaby-grass could possibly occur within the hind dune wetlands that occur within the study area. The Project has been designed to avoid any impacts on these habitats. Under these circumstances, it is considered highly unlikely that the Project will lead to a long-term decrease in the size of an important population of the Grey-headed Flying-Fox, Large-eared Pied Bat, Giant Burrowing Frog, Green and Golden Bell Frog, Long-nosed Potoroo, Hooded Plover, River Swamp Wallaby-grass or Tall Knotweed. *b. reduce the area of occupancy of an important population* The Project is highly unlikely to impact adversely on any of the species assessed as it will affect only a relatively small amount of potential habitat in the context of that available within the locality and would not result in the loss of potentially important resources such as important sheltering habitats or breeding habitats. While the development footprint may be utilized on occasion by these species, it is not considered likely to contain an important population of any of the species assessed. As such it will not reduce the area of occupancy of an important population for any of the species assessed. *c. fragment an existing important population into two or more populations* The development footprint would not support an important population of any of the species assessed. As such the proposed action would not fragment an existing important population of any of the species assessed into two or more populations. *d. adversely affect habitat critical to the survival of a species* No habitat within the development footprint is considered to be critical to the survival of any of the species assessed. *e. disrupt the breeding cycle of an important population* The proposed action is unlikely to affect any potentially important breeding habitat for the species assessed. Whilst it is possible that the Giant Burrowing Frog and Green and Golden Bell Frog could potentially breed within the wetlands within the study area, and in the case of the Green and Golden Bell Frog, within the STP ponds, the wetland habitat will either be unaffected and remain available to these species, or is not considered likely to be important to thses species given the extent of similar and superior habitat locally. The Hooded Plover could potentially occur with the beach areas of the development footprint or potentially breed there. However there is no evidence of the site being an important area for the species despite a long-term shorebird monitoring program on the south coast. Under these circumstances it is unlikely that the proposed action will disrupt the breeding cycle of an important population of the species assessed. *f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline* The Project is highly unlikely to impact adversely on the species assessed as it will affect only a relatively small amount of potential habitat in the context of that available within the locality and would not result in the loss of potentially important resources such as important sheltering habitats or breeding habitats. As such it will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that any of the species assessed is likely to decline. *g. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat* The Project will not increase the risk from invasive species that will affect the species assessed. *h. introduce disease that may cause the species to decline*

Matters to be considered	Impact
	The Project is highly unlikely to introduce any diseases. *j. interferes substantially with the recovery of the species.* As the Project is not considered to decrease or fragment existing populations, the recovery of the species assessed will not be substantially impacted.
Any environmental impact on Commonwealth Listed Migratory Species;	Seven Commonwealth Listed Migratory Species, the Curlew Sandpiper, Bar-tailed Godwit, Latham's Snipe, White-bellied Sea-Eagle, Black-faced Monarch, Satin Flycatcher, and Rufous Fantail may potentially roost or forage in the study area from time to time. There was no evidence of a Sea-eagle nest within or immediately surrounding the development footprint during the survey period and it is considered unlikely that the White-bellied Sea-Eagle would breed within the development footprint. A Whistling Kite nest is present in a tree just beyond the STP boundary. The tree would be retained within the development footprint. It is possible that the Black-faced Monarch, Satin Flycatcher, or Rufous Fantail may breed within the forested parts of the Project area and immediate surrounds. It is possible that the Curlew Sandpiper, Bar-tailed Godwit, and Latham's Snipe could occur within the study area from time to time but they would not breed there nor would it comprise an important habitat for these species. The Project area and development footprint does not support an ecologically significant portion of a population of any migratory species, and the proposed action is too small to have any substantially effects on these migratory species or their habitats.
Does any part of the Proposal involve a Nuclear Action;	No. The Project does not include a Nuclear Action.
Any environmental impact on a Commonwealth Marine Area;	No. There are no Commonwealth Marine Areas within the development footprint.
In addition, any direct or indirect impact on Commonwealth lands	No. The Project does not directly or indirectly affect Commonwealth land.

Appendix D: Biodiversity credit report

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 7/12/2020 Time: 4:45:20PM Calculator version: v4.0

Major Project details

Proposal ID:	0067/2020/5052MP
Proposal name:	Merimbula Sewage Treatment Plant Upgrade
Proposal address:	Arthur Kaine Drive Merimbula NSW 2548
Proponent name:	Bega Valley Shire Council
Proponent address:	PO Box 492 Bega NSW 2550
Proponent phone:	02 6499 2222
Assessor name:	Ryan Smithers
Assessor address:	20 Canty Street NAROOMA NSW 2546
Assessor phone:	4476 1151
Assessor accreditation:	0067

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	0.02	1.00
Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion	0.25	2.86
Total	0.27	4

Credit profiles

1. Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion, (SR533)

Number of ecosystem credits created	3
IBRA sub-region	South East Coastal Ranges (Part A)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Coast Grey Box - Mountain Grey Gum - stringybark moist shrubby open forest in coastal gullies, southern South East Corner Bioregion, (SR533) Red Bloodwood - Blackbutt - Spotted Gum shrubby open forest on coastal foothills, southern Sydney Basin Bioregion, (SR592) Spotted Gum - Blackbutt shrubby open forest on the coastal foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion, (SR641) Spotted Gum - Grey Ironbark - Woollybutt grassy open forest on coastal flats, southern Sydney Basin Bioregion and South East Corner Bioregion, (SR642) Spotted Gum - White Stringybark - Burrawang shrubby open forest on hinterland foothills, northern South East Corner Bioregion, (SR643) Turpentine - Red Bloodwood - Sydney Peppermint shrubby open forest on the foothills, southern Sydney Basin Bioregion and northern South East Corner Bioregion, (SR658)	South East Coastal Ranges (Part A) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion, (SR531)

Number of ecosystem credits created	1
IBRA sub-region	South East Coastal Ranges (Part A)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion, (SR531)	South East Coastal Ranges (Part A) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Brush-tailed Phascogale	Phascogale tapoatafa	0.27	5
Eastern Pygmy-possum	Cercartetus nanus	0.27	5

Appendix E: Vegetation plot data

Family	Species	Common Name	Exotic	Plot 1		Plot 2		Plot 3	
				Cover	Abundance	Cover	Abundance	Cover	Abundance
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle		<1	1	<1	2	0	0
Fabaceae (Mimosoideae)	*Acacia longifolia* subsp. *sophorae*	Coastal Wattle		0	0	3	3	0	0
Fabaceae (Mimosoideae)	*Acacia longifolia* subsp. *longifolia*	Sydney Golden Wattle		<1	2	0	0	1	5
Fabaceae (Mimosoideae)	*Acacia mearnsii*	Black Wattle		2	5	0	0	5	10
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses		0	0	0	0	0	0
Asteraceae	*Actites megalocarpus*	Dune Thistle		0	0	<1	2	0	0
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		0	0	0	0	0	0
	Anagallis arvensis		*	0	0	<1	1	0	0
Fabaceae (Faboideae)	*Aotus ericoides*			0	0	0	0	0	0
Aphanopetalaceae	*Aphanopetalum resinosum*	Gum Vine		0	0	0	0	0	0
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	*	0	0	0	0	0	0
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*	0	0	<1	10	0	0
Poaceae	*Austrostipa rudis* subsp. *nervosa*	A Speargrass		0	0	0	0	0	0
Proteaceae	*Banksia integrifolia*	Coast Banksia		0	0	25	20	0	0
Proteaceae	*Banksia serrata*	Old-man Banksia		0	0	0	0	0	0
Cyperaceae	*Baumea juncea*			0	0	0	0	0	0
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*	0	0	0	0	<1	20
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		<1	5	0	0	0	0
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern		0	0	0	0	0	0
Fabaceae (Faboideae)	*Bossiaea cinerea*			0	0	0	0	0	0
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		3	20	0	0	0	0

Family	Species	Common Name	Exotic	Plot 1			Plot 2				Plot 3
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn			0	0		0	0	0	0
Cyperaceae	*Carex appressa*	Tall Sedge			0	0		0	0	0	0
Aizoaceae	*Carpobrotus glaucescens*	Pigface			0	0		0	0	0	0
Lauraceae	*Cassytha pubescens*	Downy Dodder-laurel			0	0		0	0	0	0
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass			0	0		0	0	10	100
Apiaceae	*Centella asiatica*	Indian Pennywort			0	0		0	0	0	0
Asteraceae	*Cirsium vulgare*	Spear Thistle	*		0	0		0	<1		1
Ranunculaceae	*Clematis glycinoides*	Headache Vine			1	10		0	0	0	0
Commelinaceae	*Commelina cyanea*	Native Wandering Jew			0	0		0	0	0	0
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*		0	0	<1		1	0	0
Asteraceae	*Coronidium elatum*				0	0		0	0	0	0
Rutaceae	*Correa reflexa*	Native Fuschia			0	0		0	0	0	0
Myrtaceae	*Corymbia gummifera*	Red Bloodwood			15	10		0	0	0	0
Crassulaceae	*Crassula sieberiana*	Australian Stonecrop			0	0		0	0	0	0
Amaryllidaceae	*Crinum pedunculatum*	Swamp Lily			0	0		0	0	0	0
Asteraceae	*Cyanthillium cinereum* var. *cinereum*		*		<1	1		0	0	0	0
Poaceae	*Cynodon dactylon*	Common Couch			0	0		0	0	5	100
Fabaceae (Faboideae)	*Daviesia corymbosa*				0	0		0	0	0	0
Asteraceae	*Delairea odorata*	Cape Ivy	*		0	0		0	0	0	0
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil		<1		10	<1		1	0	0
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		<1		10		0	0	0	0
Convolvulaceae	*Dichondra repens*	Kidney Weed			0	0		2	100	0	0
Asteraceae	*Dimorphotheca ecklonis*	Cape Daisy	*		0	0		<1	10	0	0
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush			1	10		0	0	0	0
	Doodia aspera			<1		10		0	0	0	0
Droseraceae	*Drosera* sp.				0	0		0	0	0	0

Family	Species	Common Name	Exotic	Plot 1			Plot 2				Plot 3
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass			0	0		0	0	0	0
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*		0	0		15	1000	0	0
Poaceae	*Entolasia marginata*	Bordered Panic			2	500	<1		2	<1	5
Poaceae	*Eragrostis curvula*	African Lovegrass	*		0	0	<1		20	1	50
Myrtaceae	*Eucalyptus baxteri*	Brown Stringybark			0	0		0	0	0	0
Myrtaceae	*Eucalyptus botryoides*	Bangalay			0	0		0	0	0	0
Myrtaceae	*Eucalyptus longifolia*	Woollybutt		<1		1		0	0	0	0
Myrtaceae	*Eucalyptus pilularis*	Blackbutt			25	20		0	0	0	0
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum			0	0		0	0	0	0
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		<1		1		0	0	0	0
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart			0	0		0	0	0	0
Cyperaceae	*Ficinia nodosa*	Knobby Club-rush			0	0	<1		2	0	0
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge			0	0		0	0	0	0
Cyperaceae	*Gahnia radula*				5	100		0	0	0	0
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge			0	0		0	0	0	0
Rubiaceae	*Galium leiocarpum*				0	0		0	0	0	0
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily		<1		2		0	0	0	0
Geraniaceae	*Geranium homeanum*				0	0		0	0	0	0
Geraniaceae	*Geranium solanderi*	Native Geranium			0	0	<1		10	0	0
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine		<1		2	<1		10	0	0
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine			0	0	<1		1	0	0
Haloragaceae	*Gonocarpus micranthus*				0	0		0	0	0	0
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort			0	0		0	0	0	0
Goodeniaceae	*Goodenia ovata*	Hop Goodenia			0	0		0	0	0	0
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla			0	0		0	0	0	0
Dilleniaceae	*Hibbertia empetrifolia* subsp. *empetrifolia*			<1		5		0	0	0	0

Family	Species	Common Name	Exotic	Plot 1		Plot 2				Plot 3
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower			0	0	0	0	0	0
Dilleniaceae	*Hibbertia riparia*				0	0	0	0	0	0
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort			0	0	0	0	0	0
Araliaceae	*Hydrocotyle sibthorpioides*				0	0	0	0	0	0
Asteraceae	*Hypochaeris radicata*	Catsear	*		0	0	0	0	<1	20
Poaceae	*Imperata cylindrica*	Blady Grass		<1		100	2	100	0	0
Juncaceae	*Juncus kraussii* subsp. *australiensis*	Sea Rush			0	0	0	0	0	0
Juncaceae	*Juncus usitatus*				0	0	0	0	0	0
Fabaceae (Faboideae)	*Kennedia rubicunda*	Dusky Coral Pea			0	0	0	0	0	0
Myrtaceae	*Kunzea ericoides*	Burgan			0	0	0	0	2	10
Asteraceae	*Lagenophora stipitata*				0	0	0	0	0	0
Poaceae	*Lagurus ovatus*	Hare's Tail Grass	*		0	0	0	0	0	0
Cyperaceae	*Lepidosperma filiforme*				0	0	0	0	0	0
Cyperaceae	*Lepidosperma gladiatum*				0	0	40	500	0	0
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge			0	0	0	0	0	0
Cyperaceae	*Lepidosperma longitudinale*	Pithy Sword-sedge			0	0	0	0	0	0
Myrtaceae	*Leptospermum continentale*	Prickly Teatree			0	0	0	0	0	0
Campanulaceae	*Lobelia purpurascens*	Whiteroot			<1	50	<1	20	0	0
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		<1		3	20	100	<1	3
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*			<1		2	0	0	0	0
Caprifoliaceae	*Lonicera japonica*	Japanese Honeysuckle	*		0	0	0	0	0	0
Apocynaceae	*Marsdenia rostrata*	Milk Vine		<1		20	<1	1	0	0
Myrtaceae	*Melaleuca armillaris* subsp. *armillaris*	Bracelet Honey Myrtle			0	0	0	0	50	20

Family	Species	Common Name	Exotic	Plot 1		Plot 2				Plot 3
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark			0	0	0	0	0	0
Myrtaceae	*Melaleuca hypericifolia*	Hillock bush			0	0	0	0	0	0
Violaceae	*Melicytus dentatus*	Tree Violet			0	0	0	0	0	0
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass			5	1000	1	100	0	0
Ericaceae	*Monotoca elliptica*	Tree Broom-heath			0	0	3	10	0	0
Rubiaceae	*Gynochthodes jasminoides*	Sweet Morinda			0	0	0	0	0	0
Loranthaceae	*Muellerina celastroides*				0	0	0	0	0	0
Primulaceae	*Myrsine howittiana*	Brush Muttonwood			0	0	0	0	0	0
Oleaceae	*Notelaea venosa*	Veined Mock-olive			0	0	0	0	0	0
Rubiaceae	*Opercularia aspera*	Coarse Stinkweed			0	0	0	0	0	0
Poaceae	*Oplismenus aemulus*				0	0	<1	20	0	0
Poaceae	*Oplismenus imbecillis*			<1		50	0	0	0	0
Oxalidaceae	*Oxalis* sp.				0	0	0	0	<1	10
Oxalidaceae	*Oxalis rubens*				0	0	<1	2	0	0
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood			0	0	0	0	0	0
Passifloraceae	*Passiflora edulis*	Common Passionfruit	*	<1		1	0	0	0	0
Adiantaceae	*Pellaea falcata*	Sickle Fern			0	0	0	0	0	0
Poaceae	*Phragmites australis*	Common Reed			0	0	0	0	0	0
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge		<1		1	0	0	0	0
Solanaceae	*Physalis peruviana*	Cape Gooseberry	*		0	0	0	0	0	0
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower			0	0	0	0	0	0
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum			0	0	0	0	0	0
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum			5	20	2	1	1	20
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*		0	0	0	0	<1	3

Family	Species	Common Name	Exotic	Plot 1		Plot 2				Plot 3
Poaceae	*Poa meionectes*			<1	10	0	0	0		0
Poaceae	*Poa labillardierei* var. *labillardierei*	Tussock		0	0	0	0	0		0
Poaceae	*Poa poiformis* var. *poiformis*			0	0	0	0	0		0
Polygalaceae	*Polygala myrtifolia*		*	0	0	0	0	<1		5
Rhamnaceae	*Pomaderris aspera*	Hazel Pomaderris		0	0	0	0	0		0
Portulacaceae	*Portulaca oleracea*	Pigweed	*	0	0	0	0	<1		50
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		10	500	2	20	0		0
Orchidaceae	*Pterostylis* sp.	Greenhood		0	0	0	0	0		0
Chenopodiaceae	*Rhagodia candolleana Moq.* subsp. *candolleana*	Coastal Saltbush		0	0	5	20	<1		5
Rosaceae	*Rubus parvifolius*	Native Raspberry		<1	2	0	0	0		0
Poaceae	*Rytidosperma longifolium*	Long-leaved Wallaby Grass		10	500	0	0	0		0
Myrtaceae	*Sannantha pluriflora*			0	0	0	0	0		0
Uvulariaceae	*Schelhammera undulata*			0	0	0	0	0		0
Cyperaceae	*Schoenus brevifolius*			0	0	0	0	0		0
Asteraceae	*Senecio* sp.	Groundsel, Fireweed		0	0	0	0	<1		5
Asteraceae	*Senecio linearifolius*	Fireweed Groundsel		<1	1	0	0	0		0
Asteraceae	*Senecio madagascariensis*	Fireweed	*	0	0	0	0	0		0
Asteraceae	*Senecio prenanthoides*			0	0	0	0	0		0
Poaceae	*Setaria parviflora*		*	0	0	0	0	0		0
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*	0	0	0	0	<1		5
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	*	0	0	0	0	0		0
Solanaceae	*Solanum pungetium*	Eastern Nightshade		<1	1	<1	20	0		0

Family	Species	Common Name	Exotic	Plot 1			Plot 2				Plot 3
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*		0	0		0	0	<1	5
Poaceae	*Spinifex sericeus*	Hairy Spinifex			0	0		0	0	0	0
Poaceae	*Sporobolus africanus*	Parramatta Grass	*		0	0		0	0	0	0
Caryophyllaceae	*Stellaria flaccida*				0	0		0	0	0	0
Menispermaceae	*Stephania japonica*	Snake vine		<1		10	<1		5	0	0
Asteraceae	*Taraxacum officinale*	Dandelion	*		0	0		0	0	<1	5
Aizoaceae	*Tetragonia tetragonioides*	New Zealand Spinach			0	0		0	0	<1	3
Poaceae	*Themeda triandra*				1	50		0	0	0	0
Apiaceae	*Trachymene composita*				0	0		0	0	0	0
Cannabaceae	*Trema tomentosa* var. *aspera*	Peach-leaf Poison-bush			0	0		0	0	0	0
Apocynaceae	*Tylophora barbata*	Bearded Tylophora		<1		20		0	0	0	0
Urticaceae	*Urtica incisa*	Stinging Nettle			0	0	<1		20	0	0
Verbenaceae	*Verbena bonariensis*	Purpletop	*		0	0		0	0	<1	2
Plantaginaceae	*Veronica plebeia*	Trailing Speedwell			0	0		1	50	0	0
Violaceae	*Viola hederacea*	Ivy-leaved Violet		<1		1		0	0	0	0
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell			0	0		0	0	0	0
Iridaceae	*Watsonia* sp.		*		0	0		0	0	0	0
Xanthorrhoeaceae	*Xanthorrhoea resinosa*				0	0		0	0	0	0
Rutaceae	*Zieria smithii*	Sandfly Zieria			0	0		0	0	0	0
Poaceae	*Zoysia macrantha*	Prickly Couch			0	0		1	100	0	0

Plot	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone
1	38	27	5.5	36	0	20	0	2	1	17	758141	5910254	55
2	27	19	16	38	0	86	26	0	1	36	758628	5910093	55
3	10	0	61.5	0	4	0	44	0	1	5	758010	5910363	55

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