Biodiversity Development Assessment Report

Lot 46 & 47 DP751395 Miles Street Yamba: Proposed Subdivision

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

PO Box 1267
Armidale NSW 2350
T 0488 677 666

info@geolink.net.au

Prepared for: Garrard Building Pty Ltd

Certification

I certify this BDAR (Case 14715) has been prepared in accordance with requirements of the on the basis of the requirements of (and information provided under) the biodiversity assessment method 2020 as at 21/07/2023.

David Havilah
Biodiversity Accredited Assessor (BAAS18129)

Date: 21/07/2023

***NOTE*: This BDAR must be submitted must be within 14 days of the date shown on the finalised credit report generated using the BAM Calculator (refer to Appendix H).**

UPR	*Description*	*Date Issued*	*Issued By*
3041-1058	First Issue	04/06/2021	ILC
3041-1079	Final Issue	07/06/2021	ILC
3041-1082	V3	19/08/2022	DGH
3041-1100	V4	23/12/2022	DGH
3041-1106	V5	21/07/2023	DGH

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Executive Summary

This Biodiversity Development Assessment Report (BDAR) has been prepared for Garrard Building Pty Ltd with regard to the future subdivision and development of Lot 46 & 47 DP751395 Miles Street, Yamba. The BDAR is required due to native vegetation removal exceeding the thresholds in the Biodiversity Offsets Scheme (BOS). On this basis, this BDAR has been prepared to address the requirements of the *Biodiversity Conservation Act 2016* (BC Act) and Biodiversity Assessment Method (BAM) 2020.

The site comprises historically cleared and disturbed grazing land which has been substantially filled under recent development applications/modifications. Vegetation occurs as fragmented and scattered areas in various stages of maturity and modification.

Field assessment identified five Plant Community Types (PCTs) at the site:

- PCT 837 Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion.
- PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion.
- PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion.
- PCT 1235 Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion.
- PCT 780 Coastal floodplain sedgelands, rushlands, and forblands of the North Coast.

Native vegetation at the site is floristically characteristic of four threatened ecological communities (TECs) associated with alluvial floodplains listed in the BC Act:

- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (floristically analogous with PCT 837 and PCT 1227).
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (floristically analogous with PCT 1064).
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (floristically analogous with PCT 1235).
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (floristically analogous with PCT 780).

All native vegetation on the site has been acknowledged as being TEC.

The proposed development will affect small areas of all five PCTs, with the majority of better quality native vegetation retained within undeveloped (residual) land.

Two threatened flora species were recorded at the site:

- Rotala (*Rotala tripartita*).
- Spider Orchid (*Dendrobium tetragonum* var. *melaleucaphilum*).

The above species were not detected within the development footprint despite extensive survey effort. Threatened species polygons were created for both threatened species depicting ‘suitable habitat’, Minor areas of suitable habitat for both species would be impacted by the proposal.

No threatened fauna were recorded however, one candidate threatened species was assumed to be present on the site, Southern Myotis. A species polygon was prepared for Southern Myotis and credis obligations determined in accordance with the BAM.

Following input of plot data into the BAM-C, lists of threatened species with potential to occur at the site were generated. Assessments of habitat suitability for 'ecosystem credit species' (predicted threatened species) and 'species credit species' (candidate threatened species) were completed. As required under the BAM, targeted surveys for candidate threatened flora species with potential to occur at the site were undertaken in accordance with relevant survey guidelines. Targeted survey for threatened fauna species was not completed, rather, those species for which suitable habitat occurs were accepted as being present.

Following the input of field data into the BAM-C, credit requirements were determined as follows:

PCT/species	***Credit requirements***
Ecosystem credits	
780	6
837	43
1064	9
1227	3
1235	5
Sub-total	**66**
Species credits	
Spider Orchid	8
Rotala tripartita	11
Southern Myotis	67
Sub-total	**86**
TOTAL	**152**

Other relevant statutory matters addressed in this BDAR include:

- State Environmental Planning Policy (Koala Habitat Protection) 2021: A Koala Assessment Report has been completed and core Koala habitat does not occur at the site.
- *Environment Protection and Biodiversity Conservation Act 1999*: under the bilateral agreement between the NSW State Government and federal Government, no further consideration of the Act is required.

1. Introduction

1.1 Overview

This *Biodiversity Development Assessment Report* (BDAR) has been prepared for Garrard Building Pty Ltd with regard to the future subdivision and development of Lot 46 & 47 DP751395 Miles Street, Yamba ('the site'). The BDAR is required to support a Statement of Environmental Effects (SEE) for a development application submitted to Clarence Valley Council (CVC).

The BDAR is required due to the proposed development of the site exceeding clearing thresholds in the Biodiversity Offsets Scheme (BOS) established in the *Biodiversity Conservation Act 2016* (BC Act). A minimum lot size (MLS) is not prescribed for the site in the Clarence Valley Local Environmental Plan 2011. In these instances the MLS is taken to be the size of the site itself. Collectively the site (as two lots) covers ~ 42.7 ha. However, where multiple lots are subject to a development, the MLS is based on the smallest size of any of the lots (i.e. the lots are not considered in combination). Each of the subject lots are the same size (~ 21.3 ha) and so the BOS clearing threshold is 0.5 ha. The proposed development will exceed this clearing threshold.

Details of the project are summarised below:

Site details	Lots 46 & 46 DP751395 Miles Street Yamba
LGA	Clarence Valley Council (CVC)
Area	~42.7 ha within the West Yamba Urban Release Area (WYURA)
Zoning	R1 General Residential - Clarence Valley Local Environmental Plan 2011 (CVLEP)
Min. Lot size	Not prescribed
Future development type	Residential subdivision

Illustration 1.1 shows the site location and **Illustration 1.2** shows the site itself.

1.2 Background and Approvals

The site has been subject to several development applications and approvals over the past few years, and GeoLINK has completed a BDAR for Lot 46 which was submitted to CVC and then withdrawn. Recent approvals for the site include:

1. DA2018/0553 provided consent for filling works in the north of the site over an area of 12 ha as modified by MOD2019/0019 (granted 30 April 2019). These works have been completed. DA2018/0553 also allows for the removal of trees and vegetation within a designated development area as per a Biodiversity Assessment by GeoLINK (2018). Consent condition 7 allows for the removal of native vegetation within this designated area and tree removal has largely been completed. A financial offset required for all permitted tree removal has been paid

to CVC. On this basis this BDAR does not apply to any areas within the site within the designated development area (refer **Figure 1.1**) as native vegetation loss within this land has been approved and filling has occurred.

2. DA2019/0492 provided consent for the additional filling of 20,000m³ of land within Lot 46. These works have commenced but have not been completed. Similarly, this BDAR does not apply to this additional area where filling has been approved.
3. A condition of consent for DA2019/0492 required the preparation of a Vegetation Management Plan (VMP) for a Controlled Activity Approval (CAA) under the *Water Management Act 2000* (WM Act). The VMP was prepared by GeoLINK (August 2020) and submitted to the Natural Resources Access Regulator (NRAR). The CAA (and supporting VMP) were approved by NRAR on 23 December 2020.

A historic consent (DA2015/0432) remains valid for the filling of approximately 3870 m² along the northern boundary of Lot 47. This work has not been completed.

Stamped approval plans are provided at **Appendix A**.

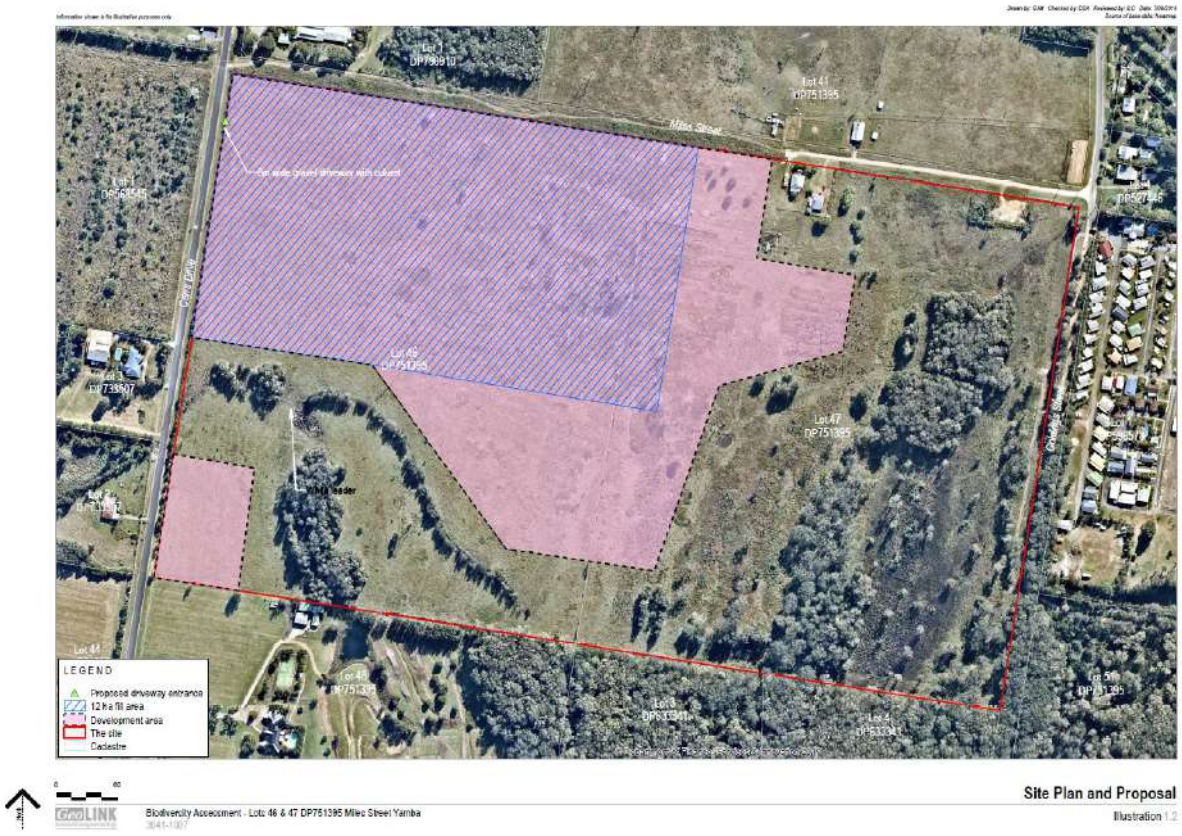

Figure 1.1 Approved filling and vegetation removal area as per DA2018/0553

1.3 Site Description

The site compromises agricultural land which has been historically cleared and modified with part of the site formerly supporting sugar cane production. The site has been under a grazing management regime for many years, with stock still maintained at the site. The majority of the northern portion of Lot 46 has been filled as permitted under DA2018/0553 and DA2019/0492; all vegetation has been removed within this area (refer **Illustration 1.2**).

The balance of the site is mostly improved pasture, with several scattered patches of native vegetation occurring in the south of Lot 46 and more extensive areas of vegetation in the east of Lot 47. Two dwellings and a dam occur at Lot 47. No infrastructure occurs within Lot 46.

In the south of Lot 46, a narrow, forked drainage line occurs and appears to receive surface flows funnelled down the eastern side of Carrs Drive (refer to **Illustration 1.2**). One branch of the drainage line flows into a small wetland within an isolated patch of swamp sclerophyll forest before draining surface flow into adjacent land to the south (second order stream). A minor watercourse (first order stream) branches off to the east and terminates within the site.

Within Lot 47 a constructed drainage line occurs in the north-east corner and receives surface run off from Golding Street and flows into a substantial wetland area which drains to the south. This area is identified as a floodway in the *West Yamba Urban Release Area Flood Impact Assessment* (BMT WBM 2018) and is also referenced in the Residential Zones Development Control Plan 2011 (Figure 1.3). An additional constructed drain directs water to the small dam. Both drains are relics of land modification completed as part of historic sugar cane forming in this portion of the site.

While estuarine systems occur in close proximity to the site, no estuarine waters enter the site.

1.4 Proposed Development

The proposed development comprises a residential subdivision of 279 lots over an area of approximately 28.2 ha (refer **Illustration 1.3**). The proposal includes two constructed stormwater detention basins:

- Eastern detention basin (approximately 4725 m²; proposed Lot 902) with 1:6 batters and maintained as a grassed area with open space/passive recreation potential. This basin discharges to an area of residue land (identified as a floodway in the Clarence Residential Zones Development Control Plan (2011). This land will be maintained in its current state.
- Western detention basin (proposed Lot 901) with same features and potential as eastern basin plus attached second order stream with vegetated buffers totalling 40 m width from streambanks as approved by the natural resources access regulator (NRAR) under controlled activity approval 30 CX 324288/AO 24687.

The development will require the removal of all native vegetation within the development footprint to allow filling which has previously been approved over 12 ha of the site and is nearing completion.

Vehicle access to the site will be from two intersections with Miles Street (as yet unformed).

The proposal excludes two substantial portions of the site from residential development:

- The eastern portion of Lot 47 (proposed Lot 903) has been excluded from the proposal as it forms a strategic floodway as identified in the Residential Zones Development Control Plan (2011). It is intended that this land is dedicated to Council and managed under a Vegetation Management Plan which has been prepared as part of the development application.
- The south-western portion of Lot 46 will be retained in ownership by the proponent as proposed Lot 900.

Detailed subdivision plans are provided at **Appendix B**.

Bushfire Provisions

A *Bushfire Risk Management Plan* (BushfireSafe Aust 2021) has been prepared for the proposal. The Plan notes the following:

- A perimeter road has been designed along the entire length of the floodway (eastern side of development.
- The development has been designed with a 21 metre wide perimeter road along the bushfire hazard interface.
- A minimum 25 metre Asset Protection Zone (APZ) along the forest vegetation adjacent to the southwestern margins of the site and a minimum 9 metre APZ from the remnant and riparian vegetation areas is prescribed.

Stormwater Management

Stormwater quality will be managed by bioretention street pods located within the internal road reserves which will treat stormwater before discharging to one of two constructed detention basins (the eastern basin).

Stormwater quantity will be managed by the two detention basins with the eastern basin discharging via a grass swale into the floodway and the western basin discharging into the second order stream. The stormwater outlet for the eastern basin consists of both pipe (1x450mm RCP) and weir flow. As the invert of the basin and subsequent downstream invert of the pipe outlet is quite low (0.8m AHD), construction of a shallow swale is required to outlet this pipe within the floodway. The swale will be approximately 60 m from the piped outlet (refer **Figure 1.2**) and have a 2.5 m base. The swale has been designed as grassed/vegetated and will convey approximately 0.5m³/s. **Figure 1.3** shows the preliminary design of the proposed swale.

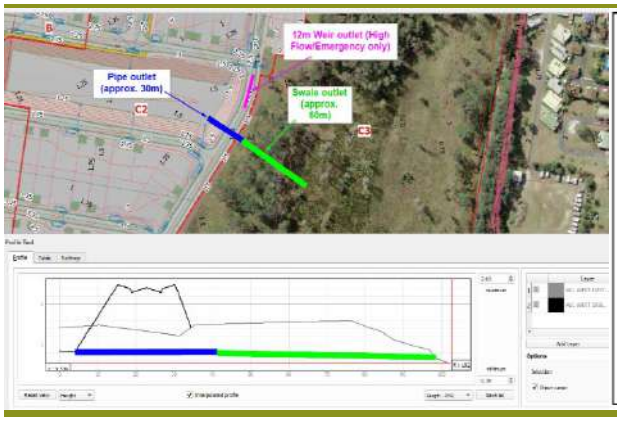

Figure 1.2 Detail of Proposed Eastern Swale

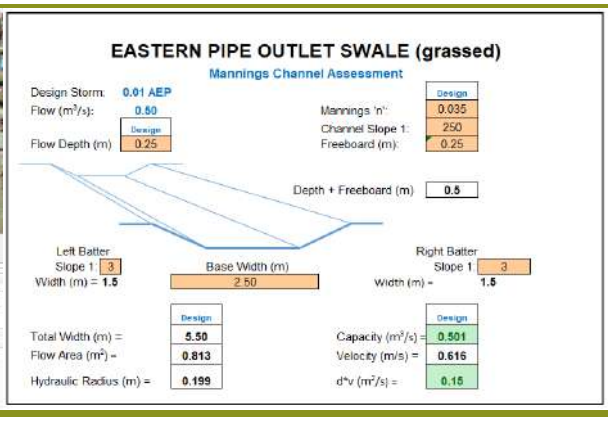

Figure 1.3 Design of Proposed Eastern Swale

1.5 Previous Biodiversity Assessments

GeoLINK has completed biodiversity assessments at the site over several years. A summary of assessments is provided below:

- July/ August 2018: site reconnaissance and eight vegetation integrity plots completed for all of site BDAR.
- July 2018: BAR prepared and submitted to CVC for filling of grassland areas at the site.
- October 2019 - February 2019: targeted survey for BDAR.
- All of site BDAR put on hold, following initial targeted surveys and recording population of the threatened herb *Rotala tripartita*.
- March - July 2019: Revised scope - BDAR prepared for Lot 46 only and submitted to CVC. Development application withdrawn following feedback from NRAR regarding filling of watercourses.
- September 2019 - February 2021: Additional fieldwork and reporting for a BAR for Lot 46 due to reduced development (to accommodate NRAR advice).
- March 2021: revised scope - BDAR resurrected for all of site (Lots 46 & 47) with revised layout (this report). Further field assessment and vegetation integrity plots completed.
- July 2022: Additional vegetation integrity plots completed within cleared grassland areas on the site.

During the entire period of assessment the site has been surveyed on numerous occasions, with the most significant findings being the recording of two threatened flora species - *Rotala tripartita* and Spider Orchid (*Dendrobium tetragonum* var. *melaleucaphilum*, formerly known as *Dendrobium melaleucaphilum*). Recording of these biodiversity constraints early in the assessment process has led to a refinement of development concepts for the site over time which avoids know habitat for these threatened species (refer to **Section 5.2**).

1.6 Information Sources

Data and resources used or consulted in this assessment include:

- The Biodiversity Assessment Method (DPIE 2020).
- The Biodiversity Assessment Method Operational Manual – Stage 1 (DPIE 2020).
- The Biodiversity Assessment Method Operational Manual – Stage 2 (EES 2019a).
- BioNet Vegetation Classification.
- BioNet Threatened Biodiversity Data Collection (TBDC).
- Biodiversity Assessment Method Calculator.
- BioNet Threatened Species Profiles.
- PlantNET NSW.
- Biodiversity Offsets and Agreement Management System (BOAMS).

Spatial data used in this report has included data from the following sources:

- NSW Department of Finance and Services (via Six Maps).
- NSW Native Vegetation Extent v1.2.
- IBRA Regions and Subregions (OEH 2016).
- NSW (Mitchell) Landscapes - Version 3.1 (OEH 2016).
- Directory of Important Wetlands in Australia (Department of the Environment and Energy).

- Fauna Corridors for North East NSW (OEH 2010).
- Acid Sulfate Soils Risk map (DPIE 2020/eSPADE).
- Nearmap (aerial imagery).

Other reports and documents reviewed for this BDAR have included:

- An ecological constraint assessment of the site by James Warren & Associates (2010).
- An approved BDAR completed for a nearby site (Lot 1 DP568545) on Cars Drive by GHD (2018) on behalf of Mavid Developments Gold Coast Pty Ltd.
- Additional information on ecology, impact and management of a population of the endangered plant species *Rotala tripartition* a proposed residential subdivision at 52-54 Miles Street Yamba (Ecos Environmental, 2023).

1.7 Personnel

This BDAR was prepared by accredited assessors Ian Colvin (BAAS18055) and David Havilah (BAAS 18129). All content and fieldwork are in accordance with the Biodiversity Assessment Method (BAM) 2020.

1.8 Report Scope and Limitations

This BDAR has been prepared based on field assessment and use of the BAM Calculator (BAM-C) and is based on the assumption that all native vegetation at the site would be removed for any future development of the site. Biodiversity credits were generated by utilising the BAM-C, which is established and managed by NSW Environment, Energy and Science (EES). GeoLINK has entered data in the BAM-C in good faith and any errors or deficiencies in the calculator results are attributed to EES.

GDA 1994 MGA Zone 56

LEGEND

- The site
- 1500 m buffer
- SEPP Coastal wetland
- Proximity area for SEPP Coastal wetland

0 0.55 Km

Locality Plan - Illustration 1.1

GeoLINK environmental management and design

Biodiversity Development Assessment Report
Lots 46 & 47 DP751395 Miles Street Yamba
3041-1060

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GDA 1994 MGA Zone 56

LEGEND

- The site
- Cadastre
- Watercourse

0 100 Metres

Site Plan - Illustration 1.2

GeoLINK environment | engineering | planning | design

Biodiversity Development Assessment Report
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3041-1101

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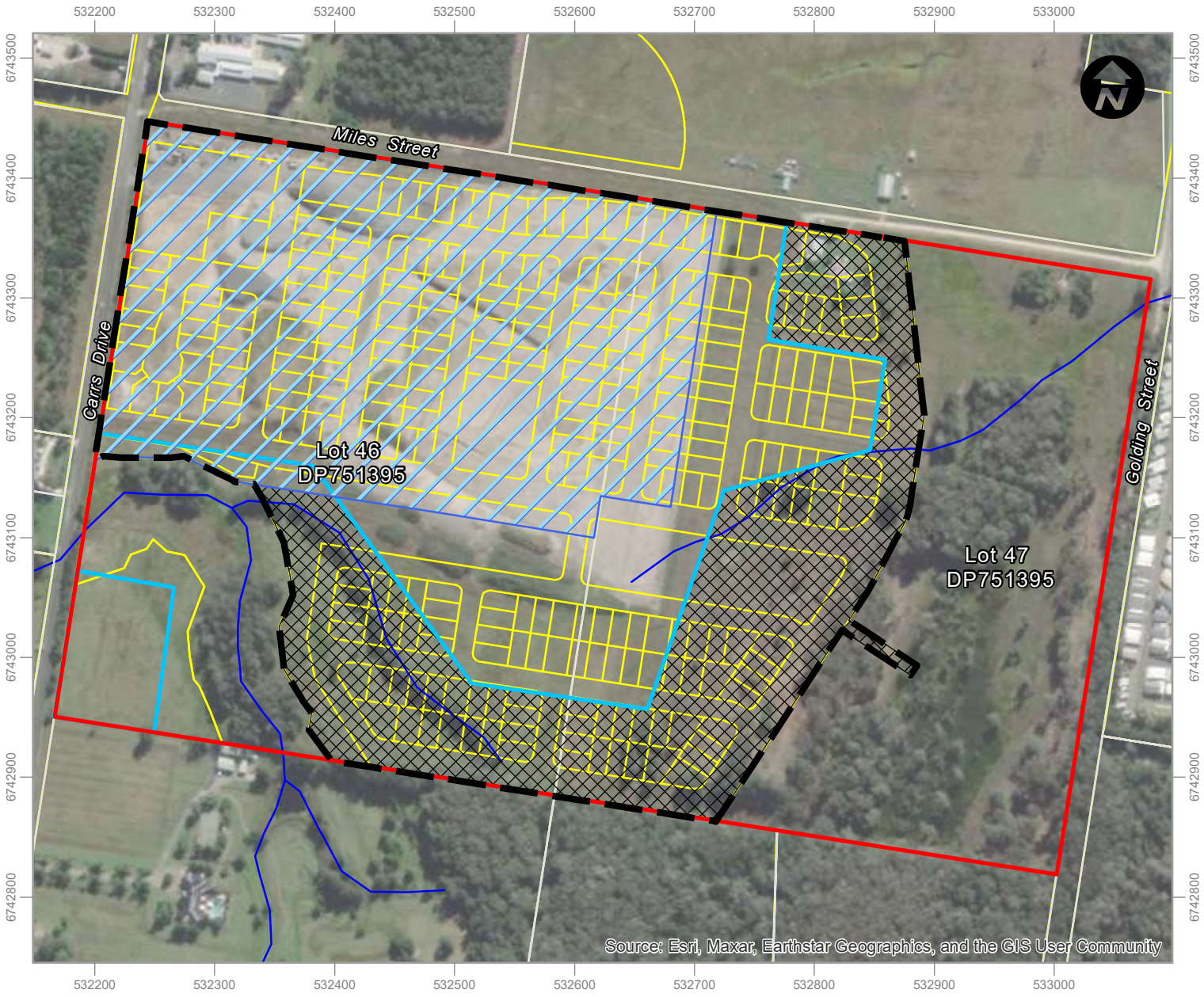

GDA 1994 MGA Zone 56

LEGEND

- The site
- Cadastre
- Development area
- Land impacted by the proposal
- Consolidated fill (previous approval)
- Approved development area 2018 (DA2018/0553)
- Watercourse
- Proposed lot subdivision

0 100 Metres

Proposed Development - Illustration 1.3

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Lots 46 & 47 DP751395 Miles Street Yamba
3041-1098

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2. Landscape Features

2.1 Bioregion and Mitchell Landscape

The site occurs within the Clarence Lowlands (Interim Biogeographic Regionalisation for Australia [IBRA]) subregion of the South Eastern Queensland IBRA bioregion. At a local level, the site forms part of the 'Clarence- Richmond Barriers and Beaches' Mitchell Landscape (DECC 2008a). The sites position within the IBRA and Mitchell landscapes is shown at **Illustration 2.1**.

2.2 Native Vegetation Extent

As per the BAM 2020 methodology (Section 4.3.2) a buffer of 1500 metres was established around the site and a calculation of native vegetation cover was derived using native vegetation mapping (NSW Native Vegetation Extent v1.2 2017) summing values of 'tree cover' and 'tree cover matrix' values. Approximately 480 ha of native vegetation was identified within 1500 m of the site, therefore a native vegetation cover of 41.6% applies.

Percent native vegetation cover is shown at **Illustration 2.2**.

2.3 Cleared Areas

As shown by **Illustration 2.2**, much of the study area comprises cleared vegetation occupied by urban areas, roads, open space and infrastructure. Of the ~42.7 ha of the site, approximately 29.4 ha (68.76%) comprises fill or pasture, where former areas of vegetation have been cleared for agriculture or development.

2.4 Water Features

In the south of Lot 46 a narrow, forked drainage line occurs and appears to receive surface flows funnelled down the eastern side of Carrs Drive (refer to **Illustration 1.2**). One branch of the drainage line flows into a small wetland within an isolated patch of swamp sclerophyll forest before draining surface flow into adjacent land to the south (second order stream). A minor watercourse (first order stream) branches off the east and terminates within the site.

Within Lot 47 a drainage line occurs in the north-east corner and receives surface run off from Golding Street and flows into a substantial wetland area which drains to the south. This area is identified as a floodway in the *West Yamba Urban Release Area Flood Impact Assessment* (BMT WBM 2018).

A small reach of the Oyster Channel, a branch of the Clarence River occurs approximately 720 m west of the site. Oyster Channel is an estuarine system and terminates in Wooloweyah Lagoon ('Lake Wooloweyah'), a significant estuarine lake which lies approximately 1.5 km south of the site. While estuarine systems occur in close proximity to the site, no estuarine waters enter the site.

Illustration 2.3 shows the location of water features at and in proximity to the site.

2.5 Connectivity

The site has poor connectivity to the north east and west largely due to adjacent cleared agricultural land (to the north), Carrs Drive and small landholdings (to the west) and Yamba Water Holiday Park (to the east). The site has good connectivity to the south and south-east where it adjoins private land which supports extensive areas of swamp forest, extending south to the foreshore of Wooloweyah Lagoon and south-east to Angourie Road.

The site occurs within the Iluka-Yuraygir Regional Corridor which also connects with the Tyndale Swamp Regional Corridor as per Scotts (2003). Together these modelled corridors connect north to the Clarence River (and beyond) and south to Yuraygir National Park. A coarse polygon of 'key habitat' is mapped in the south-east of the site (where vegetation is retained); key habitat is also extensively mapped across adjacent areas of contiguous forest cover to the south, south-east and south-west.

Illustration 2.4 shows the connectivity of the site in a local context.

2.6 Geology and Soils

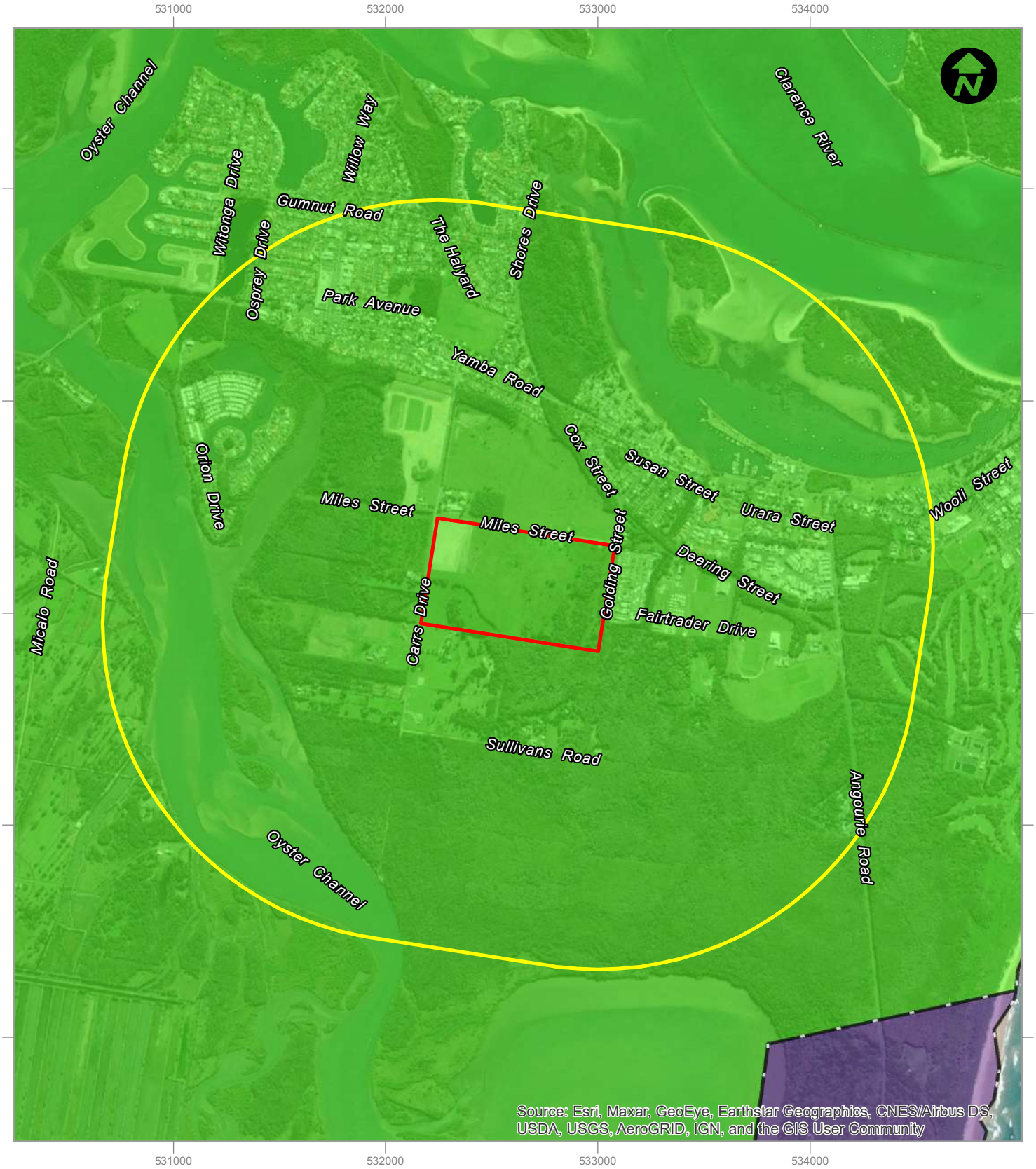
The site is located on Quaternary sand sheets within the Bundjalung Dunefield and the Clarence Estuarine Plain Morand (2001). Soil mapping (Morand 2001) indicates the site lies within the Iluka soil landscape, characterised by deep (>200 cm), well-drained Aeric Podosols (Humus Podzols) and deep (>200 cm), poorly drained Aquic/ Semiaquic Podosols (Humus Podzols). These are acid highly erodible non-cohesive spoils with very low waterholding capacity and high permeability.

Soil and geological mapping for the site and surrounds is shown at **Illustration 2.5**.

Acid sulphate soil (ASS) risk mapping (eSpade) shows the site as having a low probability of ASS, with ASS likely >3 m below ground surface (refer to **Illustration 2.6**).

2.7 Site Components

The site contains two dwellings, a constructed dam, a dividing boundary fence between the lots and substantial areas of consolidated fill within Lot 46 (as per DA2018/0553 and DA2019/0492).



GDA 1994 MGA Zone 56

LEGEND

- The site
- 1500 m buffer
- IBRA Bioregion boundary

IBRA Subgregion

- Clarence Lowlands
- Yuraygir

0 490 Metres

IBRA LAndscapes - Illustration 2.1

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Lots 46 & 47 DP751395 Miles Street Yamba
3041-1062

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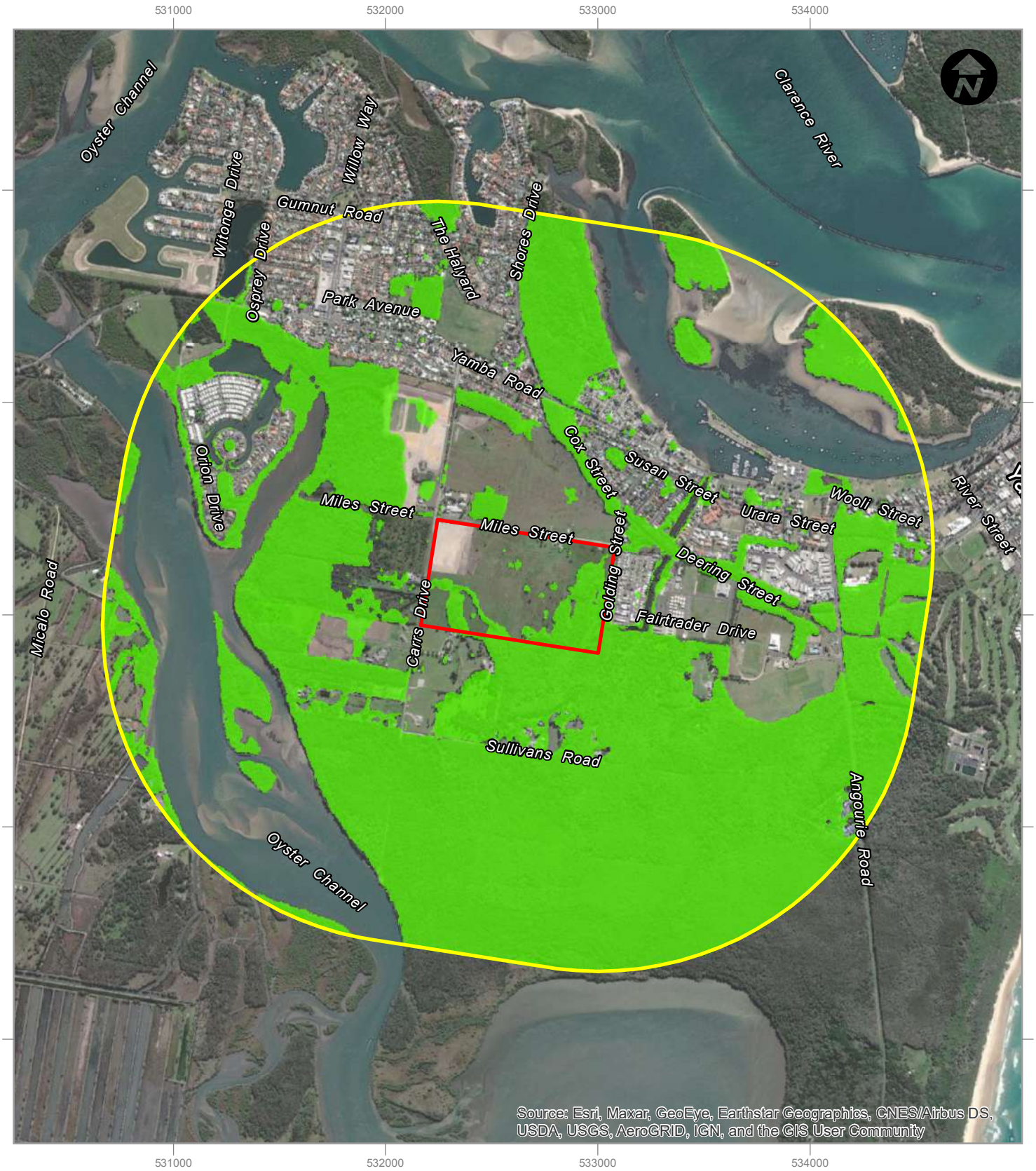

GDA 1994 MGA Zone 56

LEGEND

- The site
- 1500 m buffer
- Native vegetation extent

0 490 Metres

Native Vegetation Extent - Illustration 2.2

GeoLINK environmental management and design

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Lots 46 & 47 DP751395 Miles Street Yamba
3041-1063

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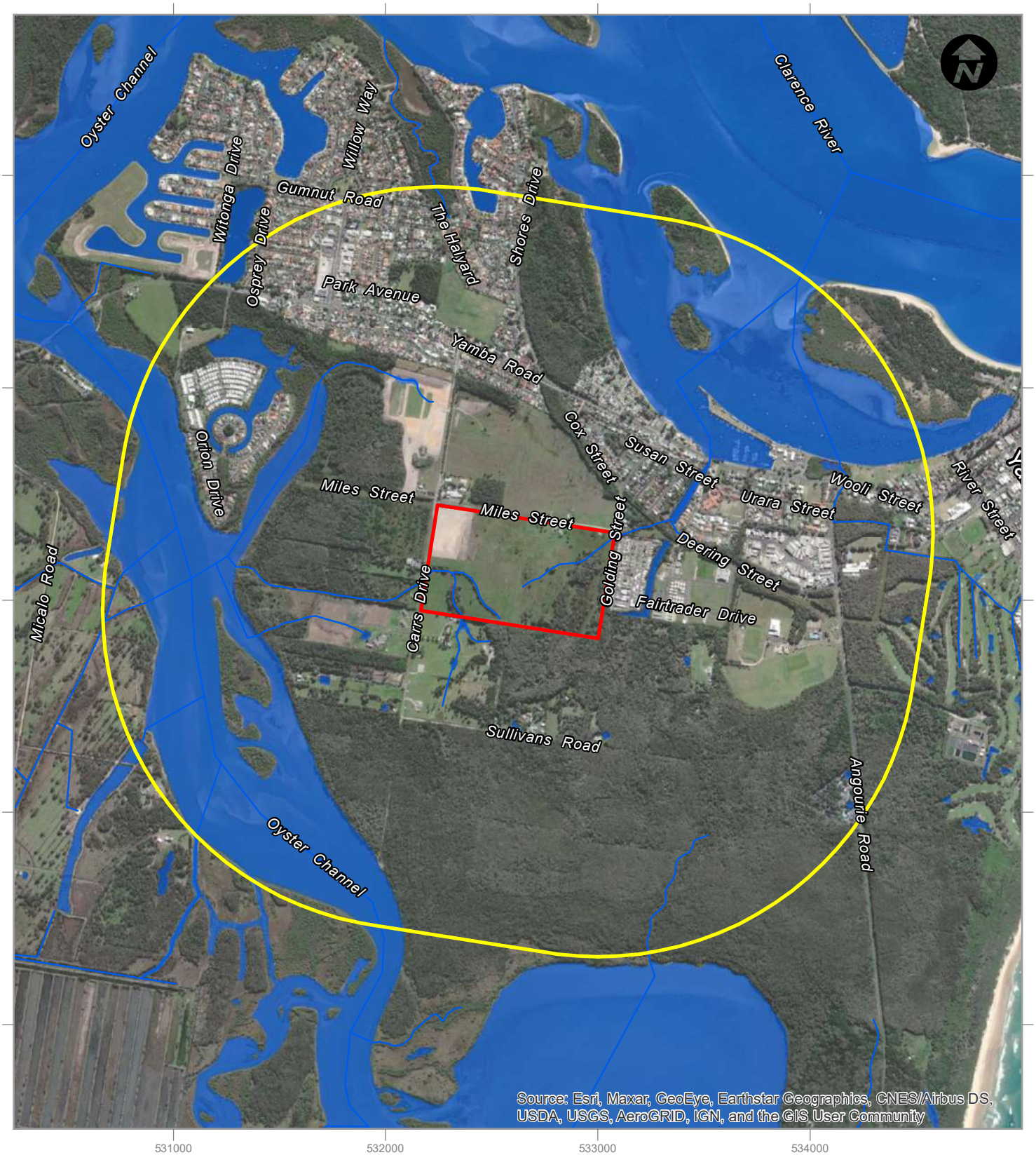

GDA 1994 MGA Zone 56

LEGEND

- The site
- 1500 m buffer
- Water body
- Watercourse

0 490 Metres

Water Features - Illustration 2.3

GeoLINK environmental management and design

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Lots 46 & 47 DP751395 Miles Street Yamba
3041-1064

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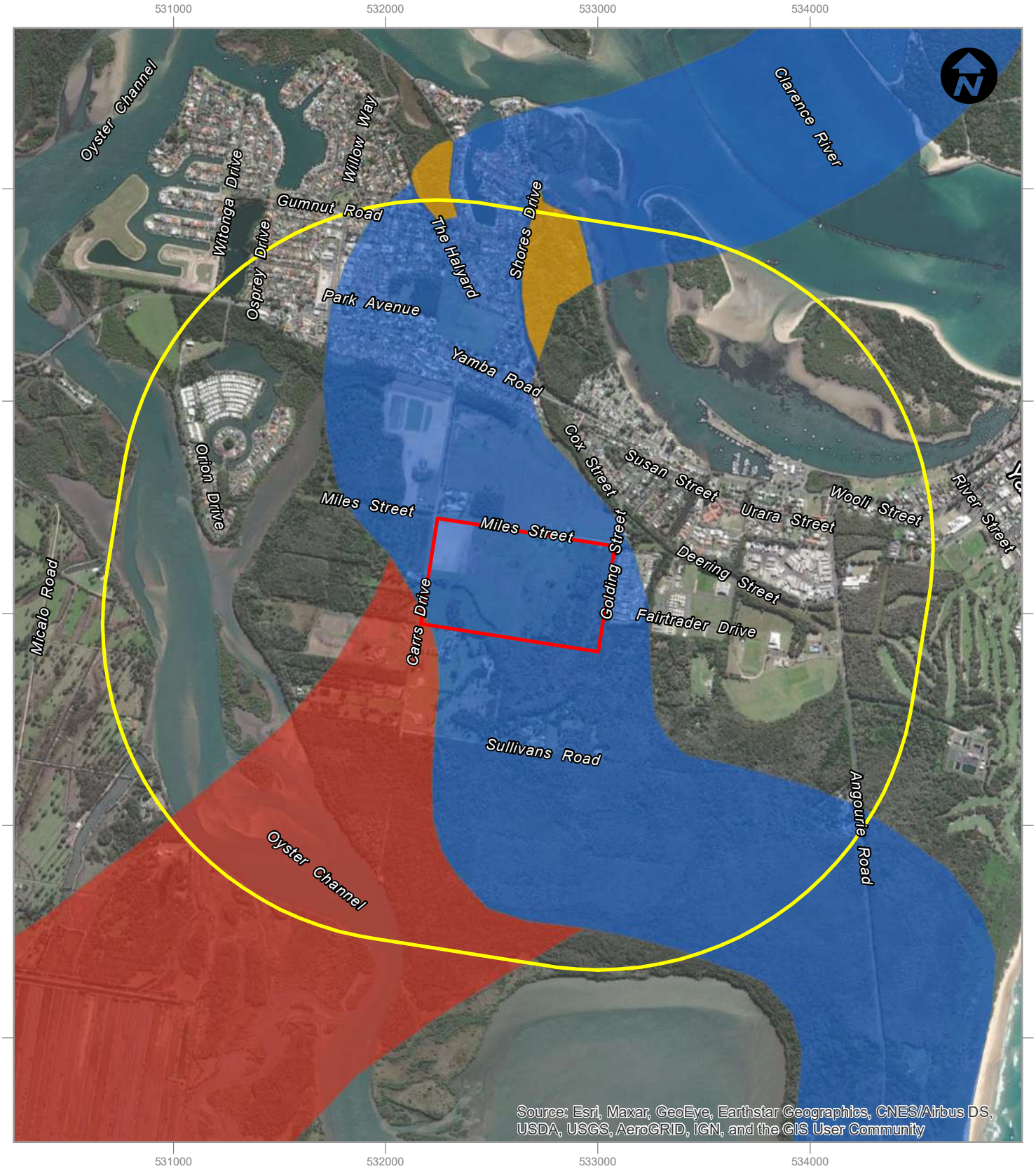


GDA 1994 MGA Zone 56

LEGEND

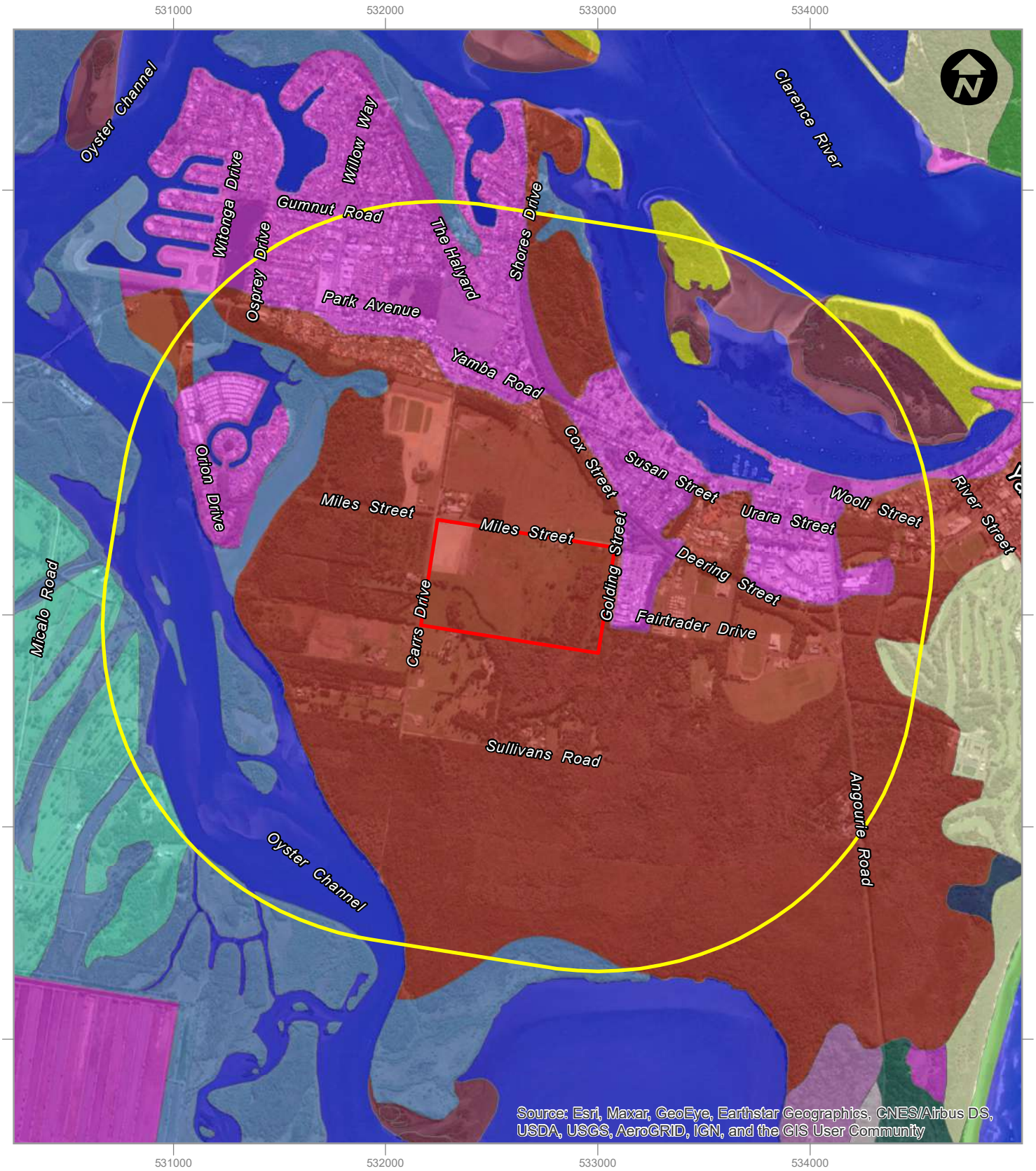
The site
1500 m buffer

Fauna Corridor Name, Class, Focal Species

Clarence NR, regional, no focal species
Iluka-Yuray, regional, Northern Long-eared Bat
Tyndale swamp, regional, Yellow-bellied Glider/Rufous Bettong

0 490 Metres

Connectivity - Illustration 2.4



GDA 1994 MGA Zone 56

LEGEND

- The site
- 1500 m buffer

Soil Landscape

- Angel Beach
- Angel Beach variant a
- Angourie
- Disturbed Terrain
- Disturbed Terrain variant a
- Gulmarrad variant b
- Iluka
- Iluka variant a
- Palmers Island variant b
- Romiaka
- Romiaka variant a
- Water
- Weapons Range
- Weapons Range variant a

0 490 Metres

Geology and Soils - Illustration 2.5

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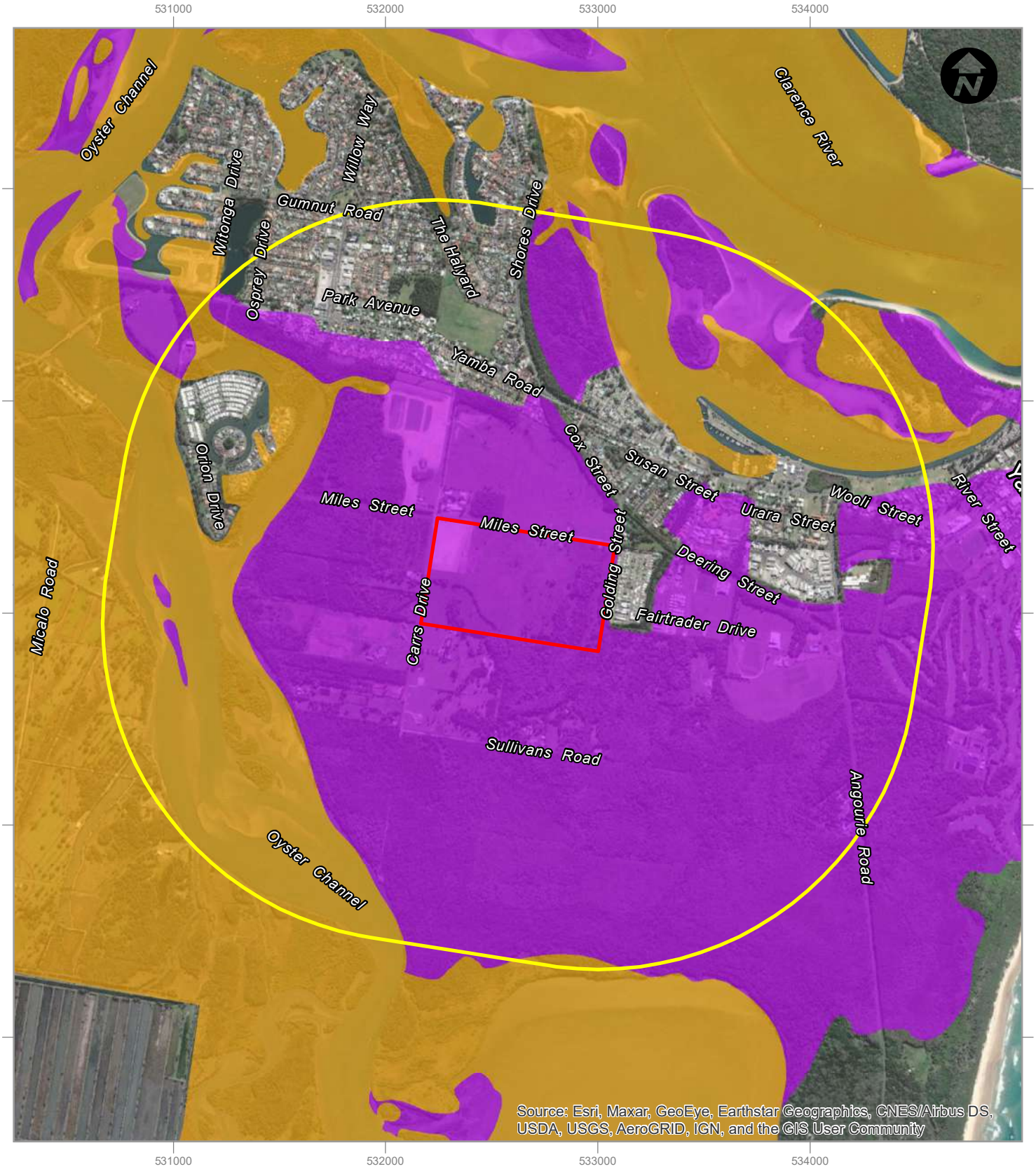

GDA 1994 MGA Zone 56

LEGEND

- The site
- 1500 m buffer

0 490 Metres

Acid Sulfate Soils - Illustration 2.6

GeoLINK environmental management and design

Biodiversity Development Assessment Report
Lots 46 & 47 DP751395 Miles Street Yamba
3041-1067

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3. Native Vegetation

3.1 Vegetation in the Locality

Vegetation in the locality typically comprises swamp sclerophyll forest dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) and/or Swamp Oak (*Casuarina glauca*). Other vegetation types in the Yamba area include littoral rainforest and wetland communities including freshwater wetlands, and estuarine vegetation including mangroves and saltmarsh.

Vegetation in the south-east of the site has good connectivity to more extensive areas of contiguous swamp forest communities to the south and east. As noted, all vegetation communities at the site are associated with freshwater systems and no marine or saline-influenced vegetation occurs.

3.2 Vegetation at the Site

3.2.1 Methodology

As noted in **Section 1.5**, field assessment of the site has been completed on numerous occasions over more than three years, with vegetation integrity plots completed to sample PCTs at the site in 2018.

With the revised development footprint for the proposal, the following approach was taken:

- Utilise data from vegetation plots completed in 2018 for any PCTs affected by the proposal (plots 1, 2 & 3).
- Complete four new vegetation plots (20/04/2021; plots 4, 5, 6, 7) to address any areas not previously assessed within the development footprint.

In Response to comments on the BDAR received from the Biodiversity and Conservation Division (BCD) of the Biodiversity, Conservation and Science Directorate in the Environment and Heritage Group of the Department of Planning and Environment, an additional three VI plots were surveyed within cleared grassland parts of the site.

Vegetation integrity plots are shown at **Illustration 3.1**.

Most plots utilised the BAM 2020 methodology (20 x 50 m plot), with exceptions being:

- Plot 3: plot of 100 m x 5 m to capture a narrow linear band of Swamp Oak regrowth.
- Plot 6: floristic plot dimensions of 16 x 25 m (400 m²) - vegetation function scores are not relevant to wetland communities where these attributes are absent; hence the plot size is suitable.
- Plot 7: plot dimensions of 25 x 40 m to capture five scattered Coast Banksia within pasture.

Plot data is provided at **Appendix C**. Photographs of the plots are provided at **Plate 3.1** to **Plate 3.10**.

Data from plots 1-3 (2018) was collated by hand for entry into the BAM-C. Plot data from 2021 (plots 4 - 7) and 2023 (plots 8-10) were entered into a purpose-built spreadsheet (MS Excel) cross-linked to 'growth form' and 'HTE' spreadsheets (BioNet), formulated to collate and score data values requiring input into the BAM-C (composition condition score, structure condition score, function condition score).

Spreadsheet entry and collation reduces potential for human error when entering data and ensures that score values are collated accurately. Following this, scored values were then entered into the BAM-C (Case 14715) in accordance with the BAM methodology.

Native vegetation not affected by the proposal was not entered into the BAM-C.

Plate 3.1 Plot 1 - PCT 837: Zone 1 (Lot 47)

Plate 3.2 Plot 2 - PCT 1064 (Lot 47)

Plate 3.3 Plot 3 - PCT 1235 (Lot 46)

Plate 3.4 Plot 4 - PCT 1227 (Lot 47)

Plate 3.5 Plot 5 - PCT 837: Zone 2 (Lot 47)

Plate 3.6 Plot 6 - PCT 780 (Lot 47)

Plate 3.7 Plot 7 - PCT 837: Zone 3 (Lot 47)

Plate 3.8 Plot 8 - PCT 1064: Zone 3

Plate 3.9 Plot 9 - PCT 1064: Zone 3

Plate 3.10 Plot 10 - PCT 1064: Zone 3

3.2.2 Plant Community Types

While the site has been significantly cleared and modified, scattered areas of native vegetation occur within grazed pasture. These communities are generally disturbed from grazing, thinning and clearing and/or routine slashing. Plant community types (PCTs) as per the BioNet Vegetation Classification were interrogated for vegetation formations in the Clarence Lowlands subregion and assigned on a 'best fit' basis based on floristics and landscape occurrence.

The available choices for each PCT in the BAM-C are set out in **Table 3.1**, with selected PCTs shown in bold. Selections for vegetation communities were allocated by species based on VI plots. PCT 837 was not easily allocated due to the substantial dominance of Pink Bloodwood and low frequency of other canopy species, however Pink Bloodwood is a characteristic species of PCT 837, and so the PCT was allocated on this basis (in combination with landform etc).

For Swamp Oak regrowth, a choice between two different PCTs for Swamp Oak (PCT 1145, PCT 1235) was available. Due to (seemingly) incorrect data (eucalypt species) allocated to PCT 1145, PCT 1235 was chosen. For freshwater wetlands there were two choices (within different formations and classes - PCT 780, PCT 782). PCT 780 was selected based on landscape position, the occurrence of *Baumea* and *Eleocharis* spp. and historic aerial photography indicating these areas were formerly dominated by swamp sclerophyll forest until at least 1978 until removal in the 1980's. On this basis,

the ‘wet meadow’ complex described by PCT 782 is not present at the site nor has it been on a historical basis.

For the two small patches of Coast Banksia at the site, assigning a PCT was not straightforward. While these patches have floristic similarities associated with coastal heath communities, the site is not associated with coastal headlands (e.g. PCT 784 Coastal headland heaths of the NSW North Coast Bioregion) and no other heathland related vegetation occurs. Coast Banksia can be an infrequent element of dry sclerophyll forests near the coast (pers. obs.), and so on this basis Coast Banksia patches were assigned to PCT 837, but as a distinct vegetation zone.

Several planted Mango trees occur around the two dwellings in Lot 47; as non-native vegetation these trees are not included in the BDAR. Additionally, two planted native trees occur as landscape trees at the dwellings - Flame Tree (*Brachychiton acerifolius*) and a Plum Pine (*Podocarpus elatus*); refer **Illustration 3.1**).These trees will be impacted by the proposed development and were assessed under Appendix D of BAM 2020 as they are singular isolated planted native trees which do not form a PCT.

Using the decision-making key in Appendix D of BAM 2020 it is evident that the trees were planted for horticultural/aesthetic reasons (D.1 step 5), leading to the assessment process in step D.2.

Table 3.1 PCT Selection

Plot	*Dominant Species*	*Vegetation Formation and Class (from BAM-C)*	*PCT Choices in Clarence Lowlands Subregion*
1	Trees: *Corymbia intermedia* Shrubs: *Austromyrtus dulcis* Groundcover: *Imperata cylindrica* Other: nil	Grassy Woodlands/Coastal Valley Grassy Woodlands	*PCT 762: Cabbage Gum open forest or woodland on flats of the North Coast* ***PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion*** *PCT 848: Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast* *PCT 971: Narrow-leaved Red Gum woodlands of the lowlands of the North Coast*
2	Trees: *Melaleuca quinquenervia, Casuarina glauca* Shrubs: *Callistemon salignus* Groundcover: *Baumea juncea* Other: *Parsonsia straminea, Maclura cochinchinensis*	Forested Wetlands/Coastal Swamp Forests	***PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion*** *PCT1227: Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion* *PCT 1230: Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion*
3	Trees: *Casuarina glauca, Melaleuca quinquenervia* Shrubs: nil Groundcover: *Schoneplectiella mucronata, Cynodon dactylon, Eleocharis acuta* Other: nil	Forested Wetlands/Coastal Floodplain Wetlands	*PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast* *PCT 1145: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion*

Plot	Dominant Species	Vegetation Formation and Class (from BAM-C)	PCT Choices in Clarence Lowlands Subregion
			PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
4	Trees: nil Shrubs: *Lophostemon confertus* Groundcover: *Cenchrus clandestinum**, *Sacciolepis indica, Cyperus polystachyos* Other: nil	Forested Wetlands/Coastal Swamp Forests	*PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion* ***PCT1227: Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion*** *PCT 1230: Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion*
5	Trees: nil Shrubs: nil Groundcover: *Cenchrus clandestinum**, *Imperata cylindrica, Cynodon dactylon, Pteridium esculentum*, pasture grasses Other: nil	Grassy Woodlands/Coastal Valley Grassy Woodlands	As for Plot 3 Note: this is a derived form of PCT 837 (formerly cleared forest with occasionally Blady Grass and Bracken) and represents Zone 2 of PCT 837.
6	Trees: nil Shrubs: nil Groundcover: *Eleocharis philippinensis, Philydrum lanuginosum, Baumea rubiginosa* Other: nil	Forested Wetlands/Coastal Floodplain Wetlands	***PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast*** *PCT 1145: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion* *PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion*
		Freshwater Wetlands/Coastal Freshwater Lagoons	*PCT 782: Coastal freshwater meadows and forblands of lagoons and wetlands* *PCT 1808: Common Reed on the margins of estuaries and brackish lagoons along the New South Wales coastline* *PCT 1911: Red-fruit Saw-sedge - Baumea - Coral Fern shrubby sedgeland on the margins of freshwater coastal lagoons along* the New South Wales coastline
7	Trees: *Banksia integrifolia subsp. integrifolia* Shrubs: nil Groundcover: *Cuphea carthagenensis*, Cenchrus clandestinum** Other: nil	Grassy Woodlands/Coastal Valley Grassy Woodlands	*PCT 762: Cabbage Gum open forest or woodland on flats of the North Coast* ***PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion*** *PCT 848: Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast*

Plot	Dominant Species	Vegetation Formation and Class (from BAM-C)	PCT Choices in Clarence Lowlands Subregion
			PCT 971: Narrow-leaved Red Gum woodlands of the lowlands of the North Coast
8-10	Regrowth trees: *Melaleuca quinquenervia, Casuarina glauca, Lophostemon suaveolens* Groundcover: *Axonopus fissifolius, Cynodon dactylon, Juncus usitatus*	Forested Wetlands/Coastal Swamp Forests	***PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion*** *PCT1227: Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion* *PCT 1230: Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion*

*selection in bold indicates PCT used in the BAM-C

Plant Community Types over the entire site are described in **Table 3.2** and mapped at **Illustration 3.1**. Patch class sizes have been allocated to each PCT based on aerial mapping and in accordance with Section 4.3.2 of the BAM and Section 3.3.3 of the Operation Manual 2020 (Stage 1).

Table 3.2 Plant Community Types

Plant Community Type	*Comments & Patch Size #*	*Area (ha)*	*Affected by proposal?*
PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion Zone 1: Open woodland dominated by Pink Bloodwood (*Corymbia intermedia*). Midstorey absent. Groundcover slashed/grazed Blady Grass (*Imperata cylindrica*), pasture grasses. Zone 2 (derived): formerly cleared areas with Blady Grass, Bracken and other herbs in the ground layer in addition to pasture grasses (Kikuyu). Zone 3 (derived): Isolated regrowth Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*) within pasture.	Zone 1: Highly modified disjunct area with widely scattered trees. Zone 2: derived grassland where trees have been cleared. Zone 3: Two small patches of Coast Banksia (5 in each). Patch size class: ≥100 ha	Zone 1: 2.72 Zone 2: 1.94 Zone 3: 0.06	**Zone 1 - yes (0.45 ha)** **Zone 2 - yes (1.64 ha)** **Zone 3 - yes (0.06 ha)**
PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion Zone 1: Dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) with occasional Swamp Oak (*Casuarina glauca*). Midstorey sparse - occasional Cheese Tree (*Glochidion* sp.). Groundcover sparse or with Bare Twigrush (*Machaerina juncea*). Zone 2: Regrowth of Prickly Paperbark (*M. styphelioides*) +/- Broad-leaved Paperbark within sedgelend of *Machaerina rubiginosa, M. juncea* and *M. articulata*. Zone 3: Areas of cleared pasture land which are regularly slashed, dominated by Narrow-leaved Carpet Grass and Couch with regrowth Broad-leaved Paperbark, Swamp Box and Swamp Oak.	Zone 1: Good condition in established patches – some cattle disturbance. Zone 2: regeneration within formerly cleared areas. Minor regrowth along fence lines in the south of Lot 47 Zone 2: post-clearing regrowth; disturbed by cattle Zone 3: post-clearing regrowth; disturbed by cattle/ slashing. Patch size class: ≥100 ha	Zone 1: 2.56 Zone 2: 3.13 Zone 3: 15.97 ha	**Zone 1 - yes (0.17 ha)** **Zone 2 - yes (0.02 ha)** **Zone 3 – yes (5.99 ha)**
PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (derived) Dominated by Swamp Oak, with infrequent Broad-leaved Paperbark. Midstorey absent. Groundcover of Couch (*Cynodon dactylon*) and Bare Twigrush. Central drain of mixed aquatic species: *Baumea articulata*, *Eleocharis acuta, Enydra woollsii, Philydrum lanuginosum, Schoneplectiella mucronata.*	Narrow linear regrowth along drainage line. High edge to core ratio, low species diversity. Patch size class: ≥100 ha	0.35	**Yes (0.33 ha)**

Plant Community Type	*Comments & Patch Size #*	*Area (ha)*	*Affected by proposal?*
PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion Zone 1: regrowth of Swamp Box with agricultural weeds and grasses (*Setaria sphacelata*, Melinis repens*, Macroptilium atropurpureum**) in filled area. Zone 2: minor regeneration of Swamp Box within formerly cleared land.	Zone 1: regrowth around a small area of filled land. Zone 2: post-slashing regeneration. Patch size class: ≥100 ha	Zone 1: 0.23 Zone 2: 0.09	Zone 1 - no **Zone 2 - yes (0.21 ha)**
PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast Disturbed ephemeral wetland (slashed, grazed). Trees and shrubs absent. Typical species: *Baumea rubiginosa, B. articulata*, *Eleocharis philippinensis, Philydrum lanuginosum, Persicaria strigosa, Juncus usitatus*. Cuphea* (*Cuphea carthagenensis*) is a common weed species.	Small disjunct disturbed patches associated with low-lying and drainage areas - cattle disturbance. Patch size class: ≥100 ha	2.33	**Yes (0.38 ha)**
	TOTAL	**13.42**	**9.25**

* Exotic species

Refer to Section 5.3.2 of BAM 2020

3.2.3 Threatened Ecological Communities

3.2.3.1 Biodiversity Conservation Act 2016

Native vegetation at the site is floristically characteristic of four threatened ecological communities (TECs) associated with alluvial floodplains listed in the BC Act:

- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (floristically analogous with PCT 837 and PCT 1227).
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (floristically analogous with PCT 1064).
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (floristically analogous with PCT 1235).
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (floristically analogous with PCT 780).

All native vegetation on the site has been acknowledged as being TEC.

3.2.3.2 Environment Protection and Biodiversity Conservation Act 1999

Swamp Oak forest is also listed in the EPBC Act (as the TEC *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland*) it is subject to condition thresholds, where a minimum patch size of 0.5 ha applies. The small patch of Swamp Oak at the site is <0.3 ha and hence does not meet condition thresholds as per the EPBC Act listed community.

3.2.4 Vegetation Integrity

A summary of plot data as per the BAM-C is provided at **Table 3.3** (refer plot data sheets for individual details).

Table 3.3 Plot Data Summary

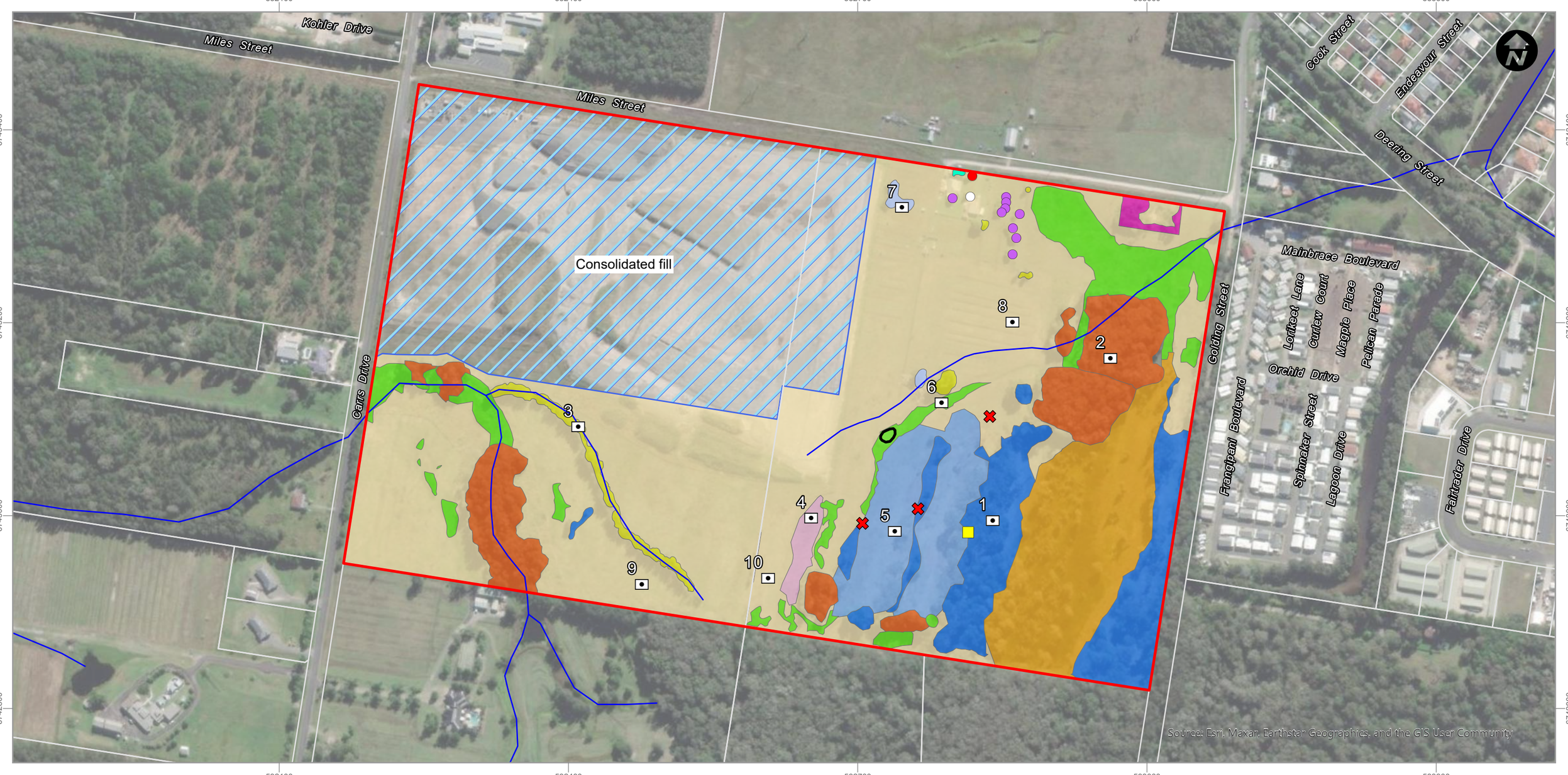
Plot	*PCT*	*Composition condition score*	*Structure condition score*	*Function condition score*	*Vegetation integrity score**
1	837 (Zone 1)	52.1	68.9	65.8	61.8
2	1064 (Zone 1)	94.1	80.2	100	91
3	1235	45.6	23.9	30.7	32.2
4	1227 (Zone 2)	43.6	48.7	15.1	31.7
5	837 (Zone 2)	36.8	42.8	34.1	33.6
6	780	41.3	62.4	15	33.8
7	837 (Zone 3)	11.7	25.3	17.7	17.4
8	1064 (Zone 3)	19.4	1	17.3	6.9
9					
10					

***NOTE**: As per Section 9.2.1 of BAM 2020, an offset for impacts of a proposal on PCTs is required for vegetation with a VI score of:*

a. *≥15, where the PCT is representative of an EEC or a CEEC*

b. *≥17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community*

c. *≥20, where the PCT does not represent a TEC and is not associated with threatened species habitat.*



LEGEND

- The site
- Cadastre
- Consolidated fill - all vegetation removed
- Dam
- Watercourse

- Non-native vegetation (landscaping)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 1)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 2)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 3)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 1)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 2)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 3)
- PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Zone 1)
- PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Zone 2)
- PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
- PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

- Non-native Tree (Mango)
- Planted Native Vegetation (Flame Tree)
- Planted Native Vegetation (Plum Pine)
- Raptor nest
- Stag (no hollows)
- Vegetation plot

0 80 Metres

Plant Community Types - Illustration 3.1

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: DGH
Source of base data: ESRI World Imagery
Date: 19/07/2023
Revision: B

4. Threatened Species

4.1 Introduction

Following input of all plot data into the BAM Calculator, a list of threatened species with potential to occur at the site ('candidate threatened species') was generated.

The BAM Calculator sorts threatened species into two biodiversity credit classes as follows:

1. Ecosystem credit species: *Threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection, are identified in the Threatened Biodiversity Data Collection as ecosystem credit species. Targeted survey is not required for these species.*
2. Species credit species: *Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits.*

   The BAM provides three options for determining species presence: targeted survey, an expert report or assuming presence:

Targeted Survey

The objective of the targeted survey is to identify, with a high level of confidence, the presence or absence of a species on the subject land and, if present, the abundance or area of suitable habitat (as a surrogate for abundance). The survey aims to minimise 'false-negatives' (i.e. when a species is reported as absent from a site when it is present). It can also provide additional information on habitat use and distribution of the species across the subject land.

The assessor must undertake targeted threatened species survey using a scientifically robust, fit-for-purpose and repeatable method. Surveys are to be conducted in accordance with the taxa-specific guidelines that are available. Surveys must be conducted at the optimum time for detecting the species. Optimum survey months for a species are automatically populated in the Calculator.

Expert Report

An expert report may be relied upon in place of targeted surveys, in accordance with Subsection 6.5.2 of the BAM. An expert report can only be prepared by a person who, in the opinion of the Environment Agency Head, is suitable (Subsection 6.5.2 of the BAM). The expert must determine the likely presence/absence of the species, and if present, is responsible for mapping the species polygon. The expert must author the expert report. If the survey or expert report confirms that the target species is present or likely to use the potential habitat on the subject land, the species or its habitat requires further assessment.

If the survey or expert report confirms that the target species is unlikely to be present (absent), no further assessment is required.

Assuming Presence

As an alternative to targeted survey or an expert report, an assessor may choose to assume species are present on the subject land. Assuming species' presence or using an expert report may be appropriate where:

- The target species is cryptic and therefore difficult to identify via survey
- The optimal survey time for the species has been missed (e.g. where the assessor would prefer that an expert report be prepared rather than wait for the appropriate survey season).

Candidate threatened species are further discussed in **Section 4.3** and **4.4**.

4.2 Assessment of Habitat Suitability

Resources at the site which are of benefit to threatened fauna species include:

- Flowering Broad-leaved Paperbark and Pink Bloodwood (nectar resources) within PCT 1064 and PCT 837.
- Four hollow-bearing trees (all Broad-leaved Paperbark) associated with PCT 1064 in the west of the site (refer to **Illustration 3.1**).
- Small areas of ephemeral wetland within disturbed pasture.
- A larger area of swamp forest/wetland in the east of the site (point of discharge for stormwater).

Due to the highly modified nature of much of the proposed development area (filled land, pasture, absence of a well-developed litter and shrub layer, no fallen logs or coarse woody debris) and the lack of hollow-bearing trees, there are few resources of significance for threatened fauna species.

As demonstrated by the results of field survey, wetland areas (PCT 780 and to a lesser extent PCT 1064 - Zone 2) provide habitat for Rotala, with PCT 1064 – Zone 1 providing habitat for the Spider Orchid. Suitable habitats for threatened flora within the proposed development area are generally absent.

4.3 Ecosystem Credit Species

An assessment of habitat suitability was undertaken for the list of predicted threatened species (ecosystem credit species) generated by the BAM-C (refer to **Appendix D**). Species were classified either as 'potential occurrences on-site' or 'unlikely to occur on the site'. In accordance with the BAM, ecosystem credit species can only be excluded from consideration based on existing geographic and/ or habitat constraints identified in the Threatened Biodiversity Database Collection (TBDC). Based on this assessment, a final list of ecosystem credit species was generated and input into the BAM-C. As prescribed within BAM 2020, targeted survey for ecosystem credit species is not required.

4.4 Species Credit Species

An assessment of habitat suitability was undertaken for the list of candidate threatened species (species credit species) generated by the BAM-C (refer to **Appendix E**). Species were classified either as 'potential occurrences on-site' or 'unlikely to occur on the site'. Based on this assessment, a final list of candidate threatened species was generated in the BAM-C and is provided in **Table 4.1**.

Table 4.1 Final List of Candidate Species Credit Species

Scientific name	*Common name*
FLORA	
Centranthera cochinchinensis	Swamp Foxglove
Cyperus aquatilis	Water Nutgrass
Dendrobium melaleucaphilum	Spider Orchid
Eleocharis tetraquetra	Square-stemmed Spike-rush
Maundia triglochinoides	Maundia
Persicaria elatior	Tall Knotweed
Rotala tripartita	Rotala
FAUNA	
Gavicalis fasciogularis	Mangrove Honeyeater
Myotis macropus	Southern Myotis
Petalura litorea	Coastal Petaltail

As prescribed within BAM 2020, targeted survey or an expert report is required for candidate threatened species unless they are assumed present on-site. Details of targeted surveys undertaken for candidate threatened species are included below in **Section 4.5**.

4.5 Habitat Surveys

4.5.1 Introduction

A summary of field assessment up to commencement of this BDAR (to support other BDARs and BARs) is provided at **Table 4.2**. Much of this information is present and discussed in the BDAR prepared for Lot 46 (GeoLINK reference 3041-1045), which was withdrawn after submission to Council.

Table 4.2 Summary of Field Assessment

Date	*Site assessed*	*Task*
26/06/2018	Lots 46 and 47	Initial assessment and stratification, VI plots, incidental fauna survey
16/07/2018	Lots 46 and 47	VI plots, incidental fauna survey
17/07/2018	Lots 46 and 47	Paddock tree survey for DA2018/0553, incidental fauna survey, GPS PCT 780 boundaries
30/10/2018	Lots 46 and 47	Targeted flora surveys, stick nest survey, bird census x 2, incidental fauna survey
31/10/2018	Lots 46 and 47	bird census x 2, incidental fauna survey
8/11/2018	Lots 46 and 47	Target flora surveys (Rotala, Maundia), incidental fauna survey
28/01/2018	Lots 46 and 47	Coastal Petaltail survey # 1, Rotala inspection, incidental fauna survey
8/02/2018	Lots 46 and 47	Coastal Petaltail survey # 2, Rotala inspection, incidental fauna survey
28/03/2019	Lot 46 only	Target flora surveys (SSSR, Swamp Foxglove, Tall Knotweed), incidental fauna survey, Rotala inspection
5/8/2020	Lot 46 only	Vegetation assessment for BAR, Rotala inspection (both lots), incidental fauna survey
30/9/2020	Lot 46 only	Vegetation assessment for VMP, Rotala inspection (both lots), incidental fauna survey
20/10/2020	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey
01/12/2020	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey

Date	Site assessed	Task
28/01/2021	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey
28/02/2021	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey
20/04/2021	Lots 46 and 47	Vegetation assessment and mapping, additional VI plots, SAT plot, wetland flora survey, incidental fauna survey
6/07/2023	Lot 46	Additional VI plots in cleared grassland areas on the site

Many of the repeat site visits were completed to assess the status of Rotala at the site. Following the initial recording of a population on Lot 47 and a single plant within Lot 46 in November 2018, the species was observed as being absent within habitat areas by February 2019 and was not recorded again. A final targeted survey within Lot 46 completed 28/02/2021 to support a BAR (now replaced by this BDAR) recorded a number of scattered plants within Lot 46, but none within the former habitat areas within Lot 47.

Throughout all field assessment an extensive incidental fauna observation log has been maintained.

Additional field assessment (20/04/2021) was completed for this BDAR to fill information gaps, and included:

- Completion of additional vegetation integrity plots (4, 5, 6, 7).
- GPS mapping of patches of PCT 780 and areas of regrowth PCT 1064.
- Random meander searches for Rotala (and other threatened wetland flora) within areas of PCT 780.
- Incidental fauna survey.
- GPS mapping of stags within the proposal footprint.
- Koala SAT survey.

Details of the methodology are provided in the following sections.

4.5.2 Methodology

4.5.2.1 Targeted Threatened Flora

Rotala

Following initial finding of the species in November 2018 (and confirmation by the NSW Herbarium), further research was completed to determine appropriate survey times.

Rotala can be a difficult species to survey for as it is an annual or short-lived perennial responsive to rainfall and seasonal conditions. During inappropriate conditions the species lies dormant in the seed bank and is not detectable. The Threatened Biodiversity Data Collection (TBDC) prescribes a survey period for Rotala as between December and March and notes:

"Survey within about 6 months of soaking rainfall. Species will be absent above ground if the habitat remains dry for over 6 months. Short-lived perennial, easily overlooked in the field in the dense habitat that it occurs."

The species listing in the BC Act also states:

> *There appear to be extreme fluctuations in abundance of the species, with plants observed to germinate prolifically and establish in large numbers after substantial rainfall. Individuals disappear above-ground during dry periods and may only persist during these times in the seed-bank.*

Review of records in the BioNet database indicates Rotala has been recorded over various times of the year during the warmer months: January (Black Swamp), March (Shannondale, Black Swamp), April (Pillar Valley, Rappville), September (Casino), October (Pacific Highway [Devils Pulpit]), November (Shannondale, the site).

The species is also known to occur at two other sites (Mongogarie, Dilkoon), with plants recorded in April 2021.

The established population at Lot 47 (recorded November 2018) was used as a population indicator and was inspected on the following occasions: 29/01/2019, 8/02/2019, 28/03/2019, 5/8/2020, 30/9/2020, 20/10/2020, 01/12/2020, 28/01/2021. No plants were ever recorded during these times, and it was assumed that suitable prior rainfall had not occurred to create favourable conditions for the species.

Rotala was recorded on Lot 46 outside of the development footprint on 28/01/2021 but was absent within the more substantial known habitat at Lot 47; the reasons for this are not known.

Further incidental assessment on 20/04/2021 involved a random meander through the NE corner of Lot 47 (previous Rotala records) and small isolated patches of PCT 780 as part of habitat mapping.

Other Threatened Flora

Other threatened flora were surveyed for during 2018 and 2019 using transect surveys consistent with the methodology for surveying threatened plants (DPIE 2020); individuals of Spider Orchid within Lot 47 were identified during this time and recorded by GPS.

An additional survey for Square-stemmed Spike-rush (SSSR) was completed 28 March 2019 using the same methodology as for other wetland threatened flora species (transect surveys within wetland environments). While the survey was outside the accepted target survey period for the species as per the BAM-C (January, February and December), a visit to a known population of SSSR (Epiq Estate, Lennox Head) in the week prior to survey recorded the species in seed with growth up to one metre in height. GeoLINK has monitored the SSSR population at Epiq Estate for many years and both project ecologists are familiar with the species. On this basis, the SSSR survey timing is considered adequate; in the BAM-C, surveys were ticked as being completed in February.

Swamp Foxglove and SSSR was targeted surveyed in Lot 46 in accordance with timing requirements. Further assessment within Lot 47 in April 2021 was outside the prescribed survey period, however a population north of Grafton was known to be flowering at this time (pers. data) as were SSSR at Lennox Head and hence if the species were present they would have been detectable.

Targeted survey effort is depicted at **Illustration 4.1** and summarised in **Table 4.2**. Over the total assessment period, the site has been traversed on foot by experienced assessors on numerous occasions and all areas of suitable habitat for threatened flora have been assessed.

4.5.2.2 Targeted Threatened Fauna

Targeted survey for threatened fauna included:

- Identification and GPS survey of hollow-bearing trees.
- Searches for raptor stick nests within PCT 837.
- Incidental observations during all fieldwork events over a period of nearly 30 months.
- Two bird census events (evening and morning).
- Two surveys for Coastal Petaltail (based on an original layout which utilised the entire site). Surveys were completed in appropriate conditions and following confirmation of the species being active at the Chaffin Creek site at Tucabia (refer to Baird and Andren 2017). Two surveyors walked parallel transects through wetland habitats with butterfly nets and binoculars. Any dragonflies observed were watched with binoculars and/or captured for identification. Surveyor David Havilah has observed the species in the hand and taken several photographs of the species and so is well-versed in identification. At the first survey shallow water was present within sedgeland and swamp areas; by the second survey no standing water was present due to hot and dry conditions. Discussion with Coastal Petaltail expert Dr Ian Baird confirmed that survey within dry conditions was adequate.
- Koala surveys, with one SAT plot assessed within Lot 47 (April 2021); as per Phillips & Callaghan 2011). SAT surveys were not suitable to complete within areas of PCT 1064 as these areas were inundated over several months in early 2021. Based on extremely low records of Koalas in the locality (refer **Section 4.5.3** and **7.1**, this effort is considered sufficient)

A summary of survey effort is shown at **Table 4.3** and depicted at **Illustration 4.1**.

Table 4.3 Summary of Targeted Fauna Survey

Target species	*Survey method*	*Date*	*Effort*
Raptors	Bird census	30/10/2018, 31/10/2018	40 minutes
	Stick nest survey	17/07/2018	One hour
Other birds	Incidental survey	(refer **Table 4.1**)	Many hours over numerous site visits over 30 months
Coastal Petaltail	Searches of wetland communities (two people)	28/11/2018, 8/02/2019	Eight hours (total)
Koala	SAT plot x 1	20/04/2021	1 hrs

Survey for threatened fauna included incidental observations during all fieldwork (refer **Table 4.2**) during numerous site visits over a 30 month period. Other than for the Koala, Coastal Petaltail and birds, no targeted field survey for fauna was completed. Resources at the site may be used opportunistically by several threatened fauna species only and these were acknowledged in the BAM-C as ecosystem credit species and hence no surveys were required.

4.5.3 Survey Results

4.5.3.1 Threatened Flora

Rotala tripartita

Rotala was recorded at the site in November 2018, with an estimated 650 plants recorded. Further targeted surveys on numerous occasions failed to detect the species since this time, until a small population was detected in association with several melonhole depressions in the south-west of Lot 46 on 28/01/2021. An estimated 45 plants were recorded, the majority of which are up to 20 cm in height; only one plant was in fruit. Plants were typically within dense Setaria. Despite the good conditions and regular summer rain, no Rotala was recorded within Lot 47 on this same occasion where a robust population was previously recorded in 2018. A species polygon has been prepared for *Rotala tripartita* which maps areas of 'suitable habitat' and is shown in **Illustration 4.1**. The polygon includes all areas of PCT 780 within the development footprint and all areas of PCT 1064 (Zone 2) on the basis that:

- These zones were confirmed as the predominant habitat for the species based on the mapped distribution of the species (refer to **Illustration 4.1**).
- Based on records on the site and another known location at Mongagarie the species appears to be associated with open areas and not beneath areas with tree canopy cover.

It is noted that no Rotala was detected within the development footprint despite extensive survey effort. Indirect impacts to the Rotala population which occurs predominantly offsite (on proposed Lot 47) is discussed further in **Section 5.3.2**.

Spider Orchid (Dendrobium tetragonum var. melaleucaphilum)

Several Spider Orchids were recorded in the east of Lot 47 within paperbark forest (PCT 1064) on 30 October 2018; this habitat lies outside the development area and will be retained in-situ. A species polygon has been prepared for Spider Orchid which identifies all areas of 'suitable habitat' for the species and is shown in **Illustration 4.1**. The polygon includes all areas of PCT 1064 - Zone 1 on the basis that:

- This zone includes all areas of mature Paperbarks which are the host tree for all Spider Orchids recorded within Lot 47.

It is noted that no Spider Orchids were detected within the development footprint despite extensive survey effort.

4.5.3.2 Threatened fauna

No threatened fauna species were recorded. An inventory of all fauna records from the multiple site visits undertaken is provided at **Appendix F**.

While the site is significantly modified and cleared, native vegetation provides a range of habitat within grassland, open woodland (since cleared) and swamp sclerophyll forests, with areas of wetlands and wet pasture providing foraging habitat for a range of common wetland birds. These wetland environments also provide habitat for a range of common frog species. Connectivity to areas of adjacent swamp forest to the south and east provides linkages for arboreal mammals such as possums (ringtail, brushtail) and gliders (sugar, feathertail, squirrel). A range of microchiropteran bats may utilise the site for foraging, with flying-foxes likely to forage on flowering paperbark/bloodwood on an opportunistic

basis. Eastern Grey Kangaroos utilise the site, and other ground-dwelling mammals may include species such as bandicoots and other macropods (Red-necked Wallaby, Swamp Wallaby).

Very few preferred Koala feed trees occur (two Forest Red Gum) and the site provides poor Koala habitat due to the absence of suitable habitat and the absence of recent local records in BioNet. Recent Council reporting (Clarence Valley Koalas: Sighting Data Analysis July 2020) indicates that a resident Koala population does not occur around Yamba township.

Four hollow-bearing trees (all Broad-leaved Paperbark) occur within PCT 1064 (refer to **Illustration 4.3**) outside the development footprint and will be retained in-situ. The mature Forest Red Gum (paddock tree) in the west of the site contains several termitaria, one of which supports a hollow (most likely used for nesting by Sacred Kingfishers). All hollow-bearing trees within PCT 1064 will be retained. The termitaria within the paddock tree will be removed.

While disturbed habitat for the Coastal Petaltail occurs, habitat surveys completed in accordance with required methods did not detect the species.

4.5.4 SAII Entities

Rotala is listed as an SAII entity in the Threatened Biodiversity Data Collection (TBDC).

Section 3.2 of the Operational Manual (Stage 2) notes that SAII entities must be assessed in accordance with section 10.2 of the BAM 2020, with TECs at risk of an SAII assessed as per Subsection 10.2.2 of the BAM 2020, and species assessed as per Subsection 10.2.3.

An assessment of the proposal against SAII entities was completed in accordance with the BAM and the EES (2019b) guideline: *Guidance to assist a decision-maker to determine a serious and irreversible impact* (refer to **Appendix G**).

The assessment concluded the proposed development would be unlikely to result in serious and irreversible impacts on biodiversity.

As part of a review of the BDAR, BCD requested additional information in relation to likely impacts of the proposal on Rotala as follows:

3. A suitably qualified expert in wetland biology and ecology assesses the likely impacts from filling the proposed development areas on the adjoining wetland areas to help Council determine whether the proposal is likely to have a serious and irreversible impact (SAII) on Rotala tripartite. The report should address but not be limited to:

a) The change in landscape morphology

b) Hydrological impacts such as quality and quantity of stormwater inflow, altered water flow and altered wetting and drying regimes of the wetland.

c) Consideration of whether the impacts are likely to result in the decline of the Rotala population on the subject land.

Ecologist/ botanist Dr Andrew Benwell was engaged by the proponent to address this being one of the only local ecologists with experience in managing *Rotala tripartita*. Dr Benwell's report is included as **Appendix I** and concludes:

"*Assuming (i) the accuracy of hydrological models used in reports to assess hydrological impacts, reviewed above; and (ii) application of habitat management measures as described in Section 5, the likelihood of the residential development having a Serious and Irreversible Impact (SAII) on the Rotala population, resulting in a significant decline in the population, is considered to be low.*

There is unlikely to be any major change in depth and duration flooding due to run-off from the filled residential area but data presented in reports indicate that stormwater discharged to low lying wetland habitat containing the Rotala records, will have about twice the concentration of N and P as pre-development run-off. However, as the quantity of nutrient in terms of kg/yr added to the low lying area is relatively small, the risk of eutrophication of habitat is also considered to be low.

Implementation of the habitat management regime described in Section 5 would increase the likelihood of the species persisting on the site. There is no certainty of outcome as the extent of the dormant Rotala seedbank on the Subject Site, which is crucial to the continued presence of Rotala, is largely unknown and simply assumed to be present based on where the species has previously been recorded.

A monitoring strategy is essential to determine how stormwater treatment and habitat management measures affect the Rotala population and wetland plant communities".

4.6 Summary

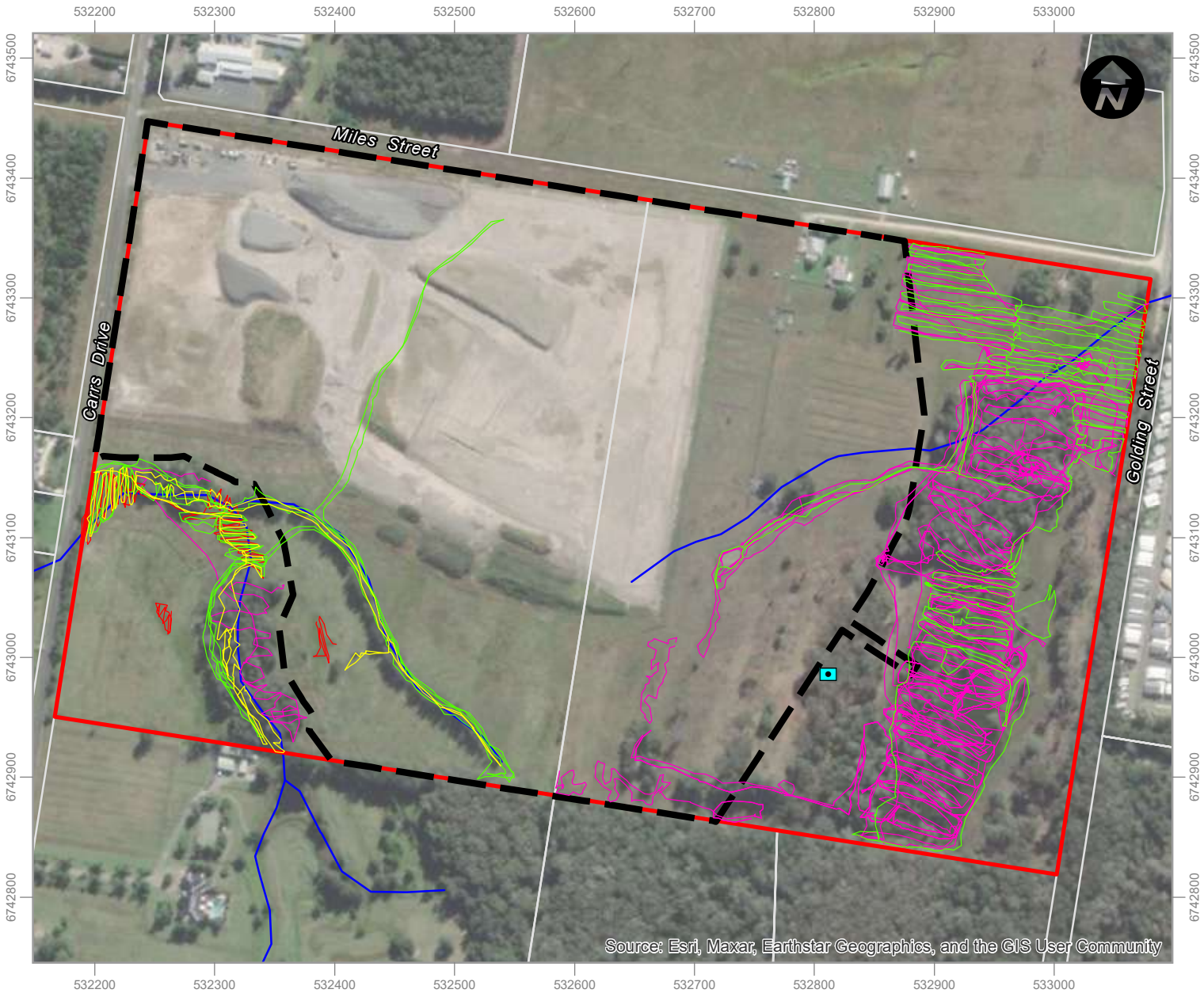
Following the potential occurrence assessment (candidate species credit species; refer **Table 4.1**) and field survey, one species was accepted in the BAM-C as being impacted by the proposal (refer **Table 4.4**).

Table 4.4 Species Credit Species Impacted by the Proposal

Species	*Comments*
Myotis Macropus **Southern Myotis**	The farm dam within Lot 47 represents potential foraging habitat for Myotis and the species was assumed present **Illustration 4.3** shows a species polygon based on advice in the TBDC *"All habitat on the subject land where the subject land is within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject land must be mapped".* Based on this species polygon a total area of 4.79 ha of Myotis foraging habitat was entered into the BAM-C as shown in **Table 4.5**.

Table 4.5 Myotis Habitat Loss within Foraging Habitat

PCT	*Area (ha)*
PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 1)	0.15
PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 2)	0.02
PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 3)	2
PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Zone 2)	0.21
PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	0.04
PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	0.27
PCT 837: Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 1)	0.42
PCT 837: Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 2)	1.64
PCT 837: Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 3)	0.02
TOTAL	**4.79**



GDA 1994 MGA Zone 56

LEGEND

- The site
- Cadastre
- Development area
- Watercourse
- Targeted surveys - Eleocharis tetraquetra, Centranthera cochinchinensis, Persicaria elatior 28 03 2019
- Targeted surveys - Maundia triglochinoides, Rotala tripartita 08 11 2018
- Targeted surveys - Rotala tripartita 01 12 2020
- Flora survey transect
- SAT

0 100 Metres

Survey Effort - Illustration 4.1

532100 532400 532700 533000

6743400 6743200 6743000

Miles Street

Cairs Drive

Golding Street

Mainbrace Boulevard

Lorikeet Lane

Curlew Court

Magpie Place

Orchid Drive

Frangipani Boulevard

Spinnaker Street

Lagoon Drive

Whiting Circuit

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

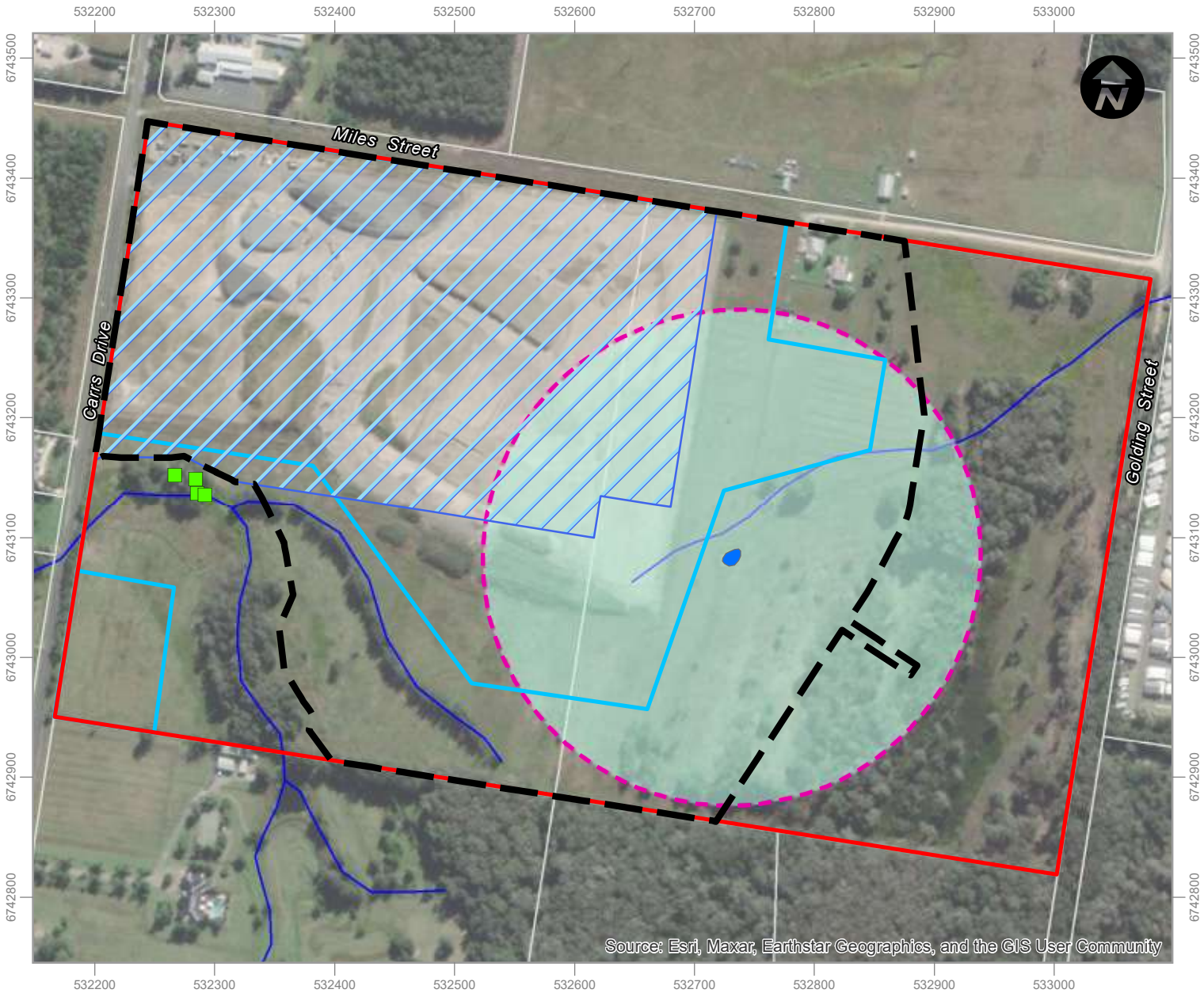
LEGEND

- The site
- Cadastre
- Development area
- *Rotala tripartita* species polygon
- Spider Orchid species polygon
- Spider Orchid
- Rotala tripartita
- Watercourse

0 60 Metres

Threatened Flora - Illustration 4.2

Information shown is for illustrative purposes only
Drawn by: AB Reviewed by: DGH
Source of base data: ESRI World Imagery
Date: 19/07/2023
Revision: C



GDA 1994 MGA Zone 56

LEGEND

- The site
- Development area
- Consolidated fill (previous approval)
- Southern Myotis foraging habitat (200m buffer to water body)
- Dam
- Approved development area 2018 (DA2018/0553)
- Hollow-bearing Tree
- Watercourse

0 100 Metres

Threatened Fauna Habitat - Illustration 4.3

Biodiversity Development Assessment Report
Lots 46 & 47 DP751395 Miles Street Yamba
3041-1097

Information shown is for illustrative purposes only
Drawn by: AB Reviewed by: DGH
Source of base data: ESRI World Imagery
Date: 20/12/2022
Revision: B

5. Impact Assessment

5.1 Introduction

Under the BAM 2020, the proponent must apply the key principle of avoiding or minimising the direct, indirect and prescribed impacts on biodiversity values in accordance with section 6.12 of the BC Act. As per the Stage 2 Operational Manual (DPIE 2019) the proponent and assessor must seek to avoid the impacts of a development on all biodiversity values, including:

- TECs.
- All native vegetation.
- Habitat for threatened species and TECs including those described as prescribed impacts.
- Individuals of threatened species and populations.

The avoid and minimise principle must be applied to direct impacts, indirect impacts and prescribed impacts (as per cl. 6.1 of the BC Regulation) and is detailed in the following sections.

5.2 Avoiding and Minimising Impacts

The design of the proposal has changed substantially since 2018, when all vegetation over the entire site was proposed for removal (with the exception of the eastern portion where Councils floodway is proposed); refer to **Figure 5.1**. Since preliminary findings and assessment (and identification of the Rotala population), the development area has been significantly reduced, most of which comprises filled land under previous consents, and with relatively minor loss of native vegetation/habitat. The majority of habitat at the site now falls outside the development footprint and areas of known Rotala and Spider Orchid habitat are retained in-situ.

Figure 5.1 Initial Development Proposal (September 2018)

The larger area of residue land in the east of the site (proposed Lot 903) is proposed for dedication to Council as part of future floodway planning subject to negotiation between the landowner and Council. An alternative situation may be that some or all of proposed Lot 903 is retained in private ownership with maintenance responsibilities. There are opportunities to allow for regeneration of part of this area to improve biodiversity values (namely areas of PCT 837 and PCT 780 which have been historically modified and/or cleared).

On this basis, the proposal avoids and minimises biodiversity impacts by:

- Utilising the main portion of the site for which consents for filling and vegetation removal have already been approved and land is highly disturbed/ modified.
- Retaining all areas of known Rotala habitat and Spider Orchid habitat.
- Retaining larger patches of native vegetation in the east and south-west of the site.

Vegetation loss for the proposal are considered acceptable in the context of being small in area, of poor quality (or regrowth) and within highly modified habitats.

Measures for mitigation of identified biodiversity impacts (additional to the retirement of any identified credits) are further discussed in **Section 6**.

5.3 Impact Summary

5.3.1 Direct Impacts

The proposal will result in direct and permanent impacts to biodiversity from construction and operation (in perpetuity) of the proposed development. As a result of filling of the development site, all native vegetation within the development footprint requires removal. As noted, previous approvals apply to the development for filling and vegetation removal (refer **Section 1.2**) and hence vegetation within these areas has not been included in calculations. Vegetation and biodiversity impacts are shown at **Illustration 5.1**.

Direct biodiversity impacts are likely to include:

1. Loss of native vegetation. Based on **Table 5.1**, a total of 9.25 ha of native vegetation across five PCTs will be impacted by the proposal.
2. Impacts to 0.4 ha of PCTs representing 'suitable habitat' for *Rotala tripartita*.
3. Impacts to 0.17 ha of PCTs representing 'suitable habitat' for Spider Orchid.
4. Impacts to 4.79 ha of PCTs representing potential foraging habitat for the Southern Myotis.
5. Loss of three non-hollow bearing stags.
6. Minor loss of fauna resources (based on the above).
7. Disturbance (noise, human activity, machine operations) to locally occurring urban-adapted fauna species during development and construction.

Table 5.1 Vegetation Impacts

PCT	*Description*	*Area impacted (ha)*
837	Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion **ZONE 1**	0.45
837	Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion **ZONE 2**	1.64
837	Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion **ZONE 3**	0.06
1064	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion **ZONE 1**	0.17
1064	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion **ZONE 2**	0.02
1064	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion **ZONE 3**	5.99
1235	Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	0.33
780	Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	0.38
1227	Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion	0.21
	TOTAL	**9.25**

5.3.2 Indirect Impacts

Indirect impacts are development related activities not associated with clearing for the development footprint and may include matters such as increased noise, dust, light spill, weeds and pathogens and edge effects that can be reasonably attributed to the development. As the site occurs adjacent to contiguous habitats, consideration of indirect impacts is important.

Based on the construction requirements and nature of the development (residential dwellings), anticipated indirect development may include:

1. Trampling and degradation of native vegetation and threatened flora habitat within residual land by trespassing residents.
2. Increased noise and activity which may negatively affect native fauna.
3. Introduction of weed propagules to residue land from illegal dumping.
4. Ongoing disturbance to local fauna during occupation of the site from noise, light and human presence.
5. Impacts on fauna habitat from roaming domestic pets (dogs, cats).

Internal roads of the development will be low speed (50 km/hr) urban roads. While the proposal would increase traffic volumes, traffic would be moving at low speeds and risks to fauna from vehicle collision are unlikely to be significant.

In addition to the above the proposal has the potential to have indirect impacts on adjacent areas containing biodiversity values associated with changes in hydrology associated with stormwater and/ or groundwater. A discussion on the likelihood of such impacts is included overleaf.

5.3.3 Stormwater Impacts

Regarding the timing of flows within the floodway – depending on the event, critical storms (i.e. with the highest flows) have a duration between 3-6 hours, meaning the storm peak flow will generally be reached after about 3 hours from the onset of the storm. Based on 1D modelling, the floodway flows generally subside after around 10 hours from the onset of the storm.

Water quality objectives will be met through the utilisation of bioretention street pods to treat stormwater prior to discharge into the eastern stormwater basin. The stormwater basin will provide detention of flows, thereby ensuring that the peak flows leaving the site in the post-development situation do not exceed the peak flows in the pre-development situation, for a range of storm events.

A simulation of pre and post construction flood inundation was undertaken by Biome Consulting for the Q2 and Q100 events at the following locations as shown in **Figure 5.2**:

- Site 1 – fork of branched waterway in the south-west corner of the site subject to VMP.
- Site 2 – first order waterway in northern part of floodway representing threatened flora habitat subject to VMP.

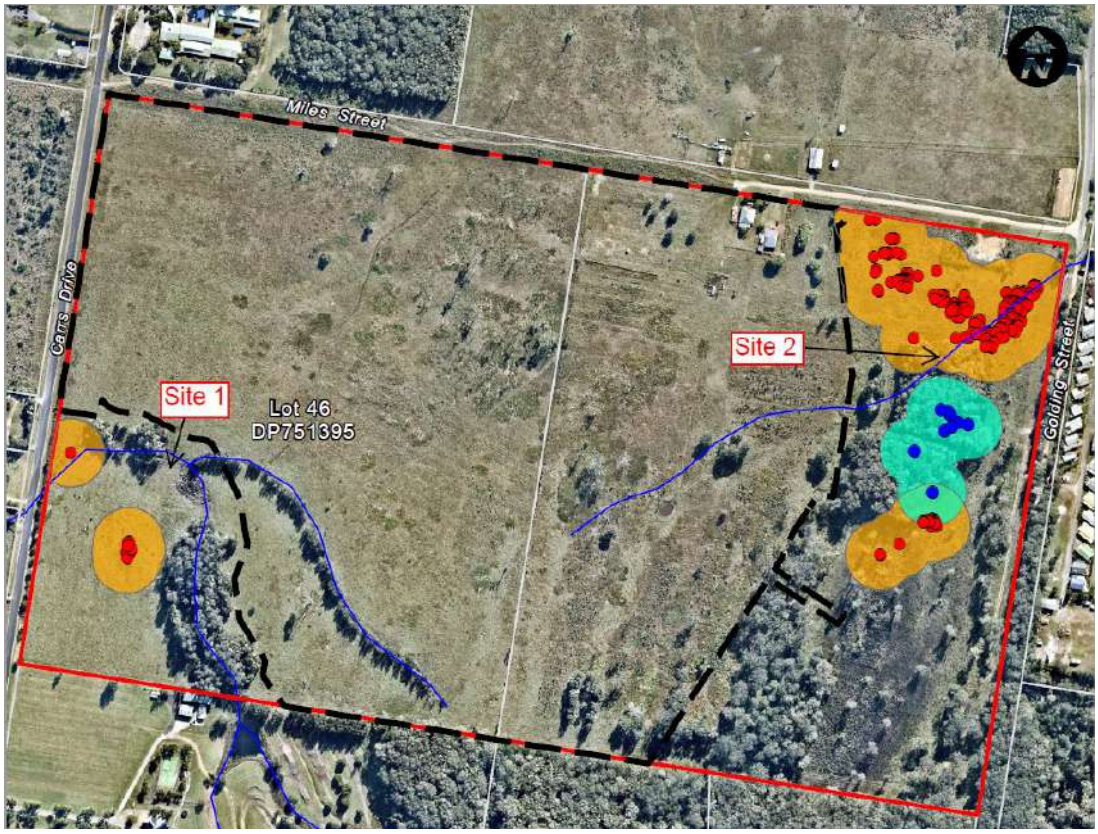


Figure 5.2 Locations where flood inundation analysis was undertaken

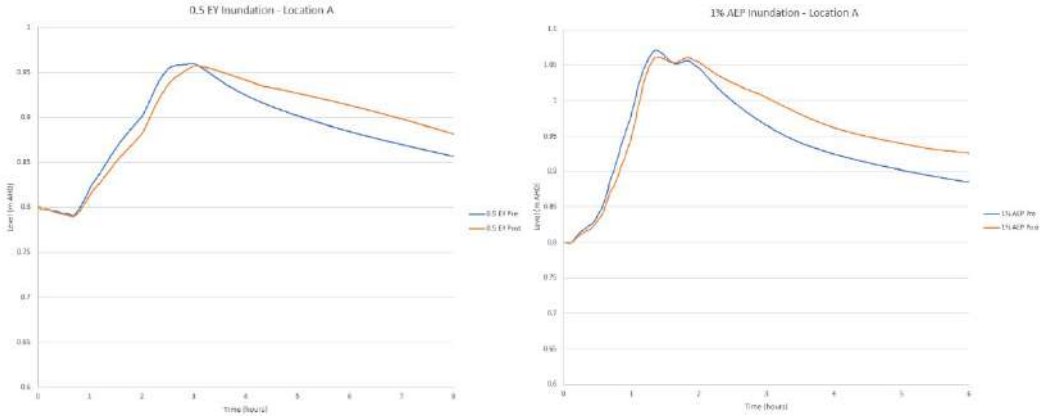


Figure 5.3 Hydrograph showing pre and post-construction (Q2 and Q100) flood inundation levels for Site 1

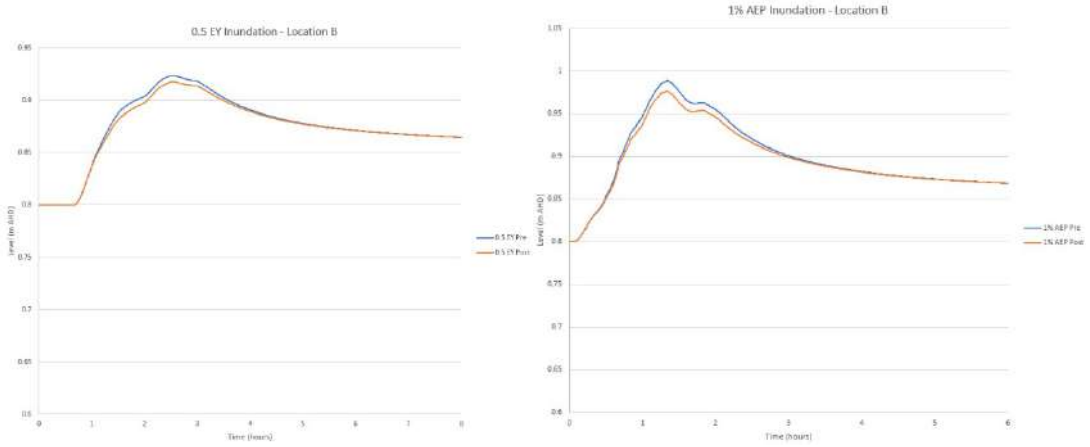


Figure 5.4 Hydrograph showing pre and post-construction (Q2 and Q100) flood inundation levels for Site 2

For site 1, **Figure 5.2** indicates flood peak levels for Q2 and Q100 events being the same but with slightly increased water heights after the peak for a period of time. Such a minor change would be unlikely to affect ecological values associated with the waterway in the south west of the site.

For site 2, **Figure 5.3** indicates very similar flood peaks and duration for the Q2 and Q100 events suggesting that the frequency and duration of flows entering the receiving environment will be similar to the pre-development situation.

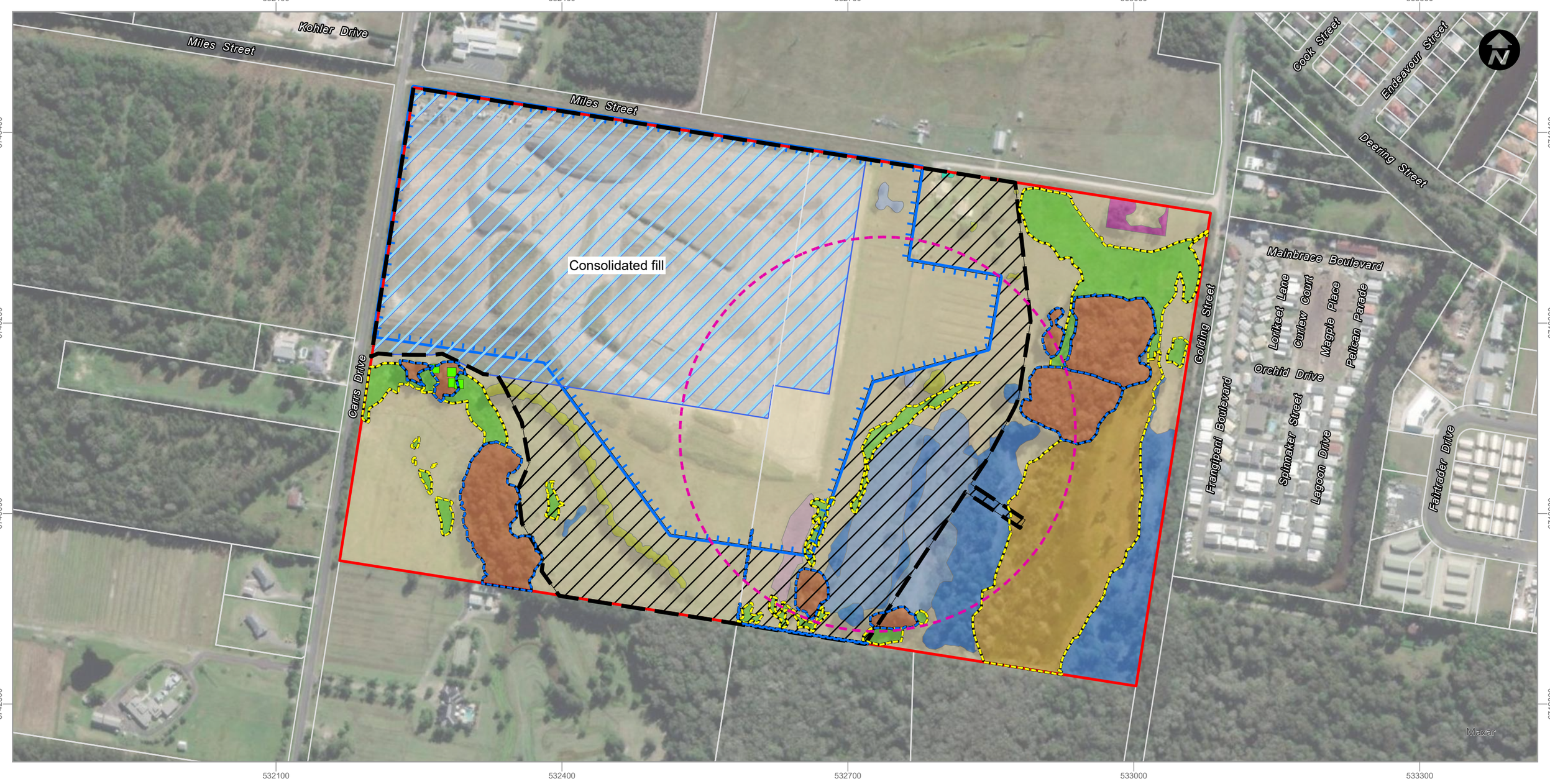
It is noted that drainage of the floodway appears to occur north to south with the proposed stormwater outlet from the site positioned south of threatened flora habitat further attenuating the risk of impacts to threatened flora habitat from changes in hydrology.

On the basis of the above it appears that impacts associated with stormwater are unlikely to affect off site areas including habitat for threatened flora species within the proposed floodway.

An additional assessment of indirect impacts on *Rotala tripartita* provided by expert, Dr Andrew Benwell is provided in **Appendix I**.

5.3.4 Groundwater Impacts

A Geotechnical Assessment was undertaken for the proposal by Regional Geotechnical Solutions. In relation to the influence of fill surcharge on groundwater levels the report found that: …"*due to the limited predicted consolidation settlement, the influence of the fill surcharge on the groundwater levels on surrounding sites is expected to be negligible*".



LEGEND

- The site
- Cadastre
- Development area
- Approved development area 2018 (DA2018/0553)
- Consolidated fill - all vegetation removed
- Land impacted by the proposal
- Non-native vegetation (landscaping)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 1)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 2)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 3)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 1)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 2)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 3)
- PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Zone 1)
- PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Zone 2)
- PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
- PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
- Southern Myotis foraging habitat (200m buffer to water body)
- Spider Orchid species polygon
- *Rotala tripartita* species polygon
- Hollow-bearing Tree

0 80 Metres

Biodiversity Impacts - Illustration 5.1

Information shown is for illustrative purposes only
Drawn by: AB Reviewed by: DGH
Source of base data: ESRI World Imagery
Date: 21/07/2023
Revision: C

5.3.5 Prescribed Impacts

Prescribed impacts are those that may affect biodiversity values in addition to, or instead of, impacts from clearing vegetation, and include (as per cl. 6.1 of the BC Regulation):

- *the impacts of development on the habitat of threatened species or ecological communities associated with:*
  - *karst, caves, crevices, cliffs and other geological features of significance.*
  - *Rocks.*
  - *human made structures.*
  - *non-native vegetation.*
- *the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.*
- *the impacts of development on movement of threatened species that maintains their life cycle.*
- *the impacts of development on water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development).*
- *the impacts of wind turbine strikes on protected animals.*
- *the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.*

An analysis of prescribed impacts is detailed in **Table 5.2**.

Table 5.2 Prescribed Impacts

Prescribed impact	*Response*
the impacts of development on the habitat of threatened species or ecological communities associated with: *- karst, caves, crevices, cliffs and other geological features of significance* *- rocks* *- human made structures* *- non-native vegetation*	The site does not support karst geology and rock features are absent within the development area. Human-made structures include two existing dwellings and outbuildings. These structures do not appear to provide habitat for any significant resident fauna such as microbats. Non-native vegetation includes established pasture grassland, occasional exotic grasses (Paspalum, Setaria, Carpet Grass), wetland weeds (Lippia, Cuphea) and infrequent woody weeds (Lantana, Groundsel, Winter Senna). None of these weed species provides any significant resources (refuge, breeding habitat, food resources) for threatened species.
the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	The site as a whole has good connectivity to significant swamp sclerophyll habitats to the south-east and south. The proposal will not result in any permanent barriers which would affect any threatened species across its range.
the impacts of development on movement of threatened species that maintains their life cycle	No threatened fauna species are likely to be resident within the development footprint. While the proposal will remove a small area of resources (~ 2.6 ha of flowering/fruiting vegetation), this is negligible in terms of the overall site, and given the modified nature of the development site no significant refuge, roosting

Prescribed impact	*Response*
	or breeding areas would be affected. The site residue provides potential habitat for threatened fauna and contains resources which are absent within the development area. Any threatened fauna which may occasionally access the development area (eg. foraging microbats) are unlikely to meet any significant restrictions to movement/dispersal.
the impacts of development on water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development)	The hydrology of the site will not be significantly affected, and stormwater detention will minimise releases of large volumes of untreated water to the environment. On this basis, pre-development hydrology is expected to be largely unchanged. Drainage regimes from the east (via Golding Street) and the west (from Carrs Drive) will remain unaffected. Impacts on water quality will be mitigated by implementation of erosion and sedimented control measures during the construction phase.
the impacts of wind turbine strikes on protected animals	The proposal is not a wind farm development.
the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community	The proposal will result in an increase in vehicular traffic to the site which increases potential for roadkill of fauna. However, the internal road system comprises low speed urban roads (50 km/hr) and so the potential for roadkill is substantially reduced.

5.4 Credit Requirements

Following the input of data into the BAM-C, a number of credits are required to offset biodiversity impacts associated with the proposal (refer to **Table 5.3**); BAM-C outputs are provided at **Appendix H**.

Table 5.3 Credit Requirements

PCT/species	*Credit requirements*
Ecosystem credits	
780	6
837	43
1064	9
1227	3
1235	5
Sub-total	**66**
Species credits	
Spider Orchid	8
Rotala tripartita	11
Southern Myotis	67
Sub-total	**86**
TOTAL	**152**

6. Mitigation

6.1 Mitigation

While credits have been identified to offset biodiversity impacts of the proposed development (refer to **Section 5.4**), additional measures to minimise biodiversity impacts during construction and operation of the proposal are prescribed in **Table 6.1** for Council's consideration when determining conditions of consent.

Table 6.1 Mitigation Measures

Impact	*Mitigation*	*Responsibility*
CONSTRUCTION		
	1. The extent of the proposal must be clearly pegged/marked on site by a registered surveyor, consistent with final approved plans/designs.	Project contractor
	2. Vegetation removal must be completed sensitively using appropriate equipment and to the minimum extent necessary.	Project contractor
	3. Prior to any woody vegetation removal, an ecologist is to examine all affected areas for active nests or dreys. Clearing may only commence to the satisfaction of the project ecologist.	Project contractor/ ecologist
	4. Vegetation to be cleared should not be pushed into adjacent vegetation but be chipped and mulch retained for use-onsite.	Project contractor
	5. No burning or other disposal of cleared vegetation shall occur.	Project contractor
	6. If lopping or pruning of any vegetation is required it must be completed by a certified and experienced arborist in accordance with *AS 4970-2009 Protection of trees on development sites*.	Project contractor/arborist
Soil and water	7. Appropriate soil and erosion control measures must be implemented and maintained for the duration of construction.	Project contractor
Biosecurity	8. Measures must be implemented during construction works so that machinery and plant do not introduce weed seed or propagules to the site (eg. by adoption and implementation of the 'Arrive Clean, Leave Clean' guidelines (DoE 2015).	Project contractor
OPERATION/OCCUPATION		
Native vegetation loss and disturbance	9. Vegetation Management Plans (VMPs) have been prepared separately for retained areas within Lot 46 and Lot 47. These include management measures to be implemented to	Landowner

Impact	Mitigation	Responsibility
	maintain threatened species habitat for Rotala and Spider Orchid. Implementation of the VMPs will be included as a condition of consent to the DA.	
Fauna disturbance	10. Exterior lighting must be designed and installed in accordance with 'soft lighting' principles to limit spill into adjacent habitats.	Developer/appointed contractor
Habitat degradation	11. Signage must be installed along boundaries with residue land stating '*Environmental Protection - No Entry*' or words of similar intention.	Developer/CVC
	12. Stormwater swale and outlet works must be completed to minimise disturbance to native vegetation and appropriate erosion and sediment controls are installed and maintained.	Developer/appointed contractor

6.2 Compensation

Compensation for the loss of vegetation for the filling approval was based on a financial contribution (based on tree loss numbers) to CVC as part of the consent conditions. It is expected that a similar approach would apply to the current application, or alternatively, the proponent could fund vegetation management works (weed control, planting) within proposed Lot 903 subject to Council agreement.

7. Other Statutory Considerations

7.1 State Environmental Planning Policy (Koala Habitat Protection) 2021

State Environmental Planning Policy (Koala Habitat Protection) 2021 (Koala SEPP) commenced 17 March 2021. NSW. This Policy aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline.

The Koala SEPP 2021 reinstates the policy framework of SEPP Koala Habitat Protection 2019 to 83 Local Government Areas (LGA) in NSW. At this stage:

- In nine of these LGAs – Metropolitan Sydney (Blue Mountains, Campbelltown, Hawkesbury, Ku-Ring-Gai, Liverpool, Northern Beaches, Hornsby, Wollondilly) and the Central Coast LGA – Koala SEPP 2021 applies to all zones.
- In all other identified LGAs, Koala SEPP 2021 does not apply to land zoned RU1 Primary Production, RU2 Rural Landscape or RU3.

The subject site is zoned R1 under the Clarence Valley Local Environment Plan 2011 therefore the Koala SEPP 2021 applies to the proposal.

As the proposal will impacts areas of native vegetation, investigation is required to determine whether 'core Koala habitat' is present. The Policy defines 'core Koala habitat' as:

a) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or

b) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas have been recorded as being present in the previous 18 years.

'Highly suitable habitat' is where 15% or greater of the total number of trees within any Plant Community Type (PCT) are the regionally relevant species of those listed in Schedule 2 of the SEPP.

The proposal footprint contains small areas of disjunct vegetation (PCT 1235, PCT 837 (derived), PCT 1064 and pasture grass) and Koala resources are negligible and limited to two Forest Red Gum in the south-east of Lot 46. When looking at the site as a whole, both PCT 1064 and PCT 837 meet the definitions of *'Highly suitable habitat'*; PCT 1064 on the basis of dominance by Broad-leaved Paperbark (est. 90% cover), and PCT 837 on the basis of by Pink Bloodwood (est. 90% cover).

In the absence of any formalised guidelines to support the Policy, the following assessment process was completed:

1. Analysis of Koala records in BioNET with regard to any Koala records within 2.5 km of the site in the last 18 years (accepted as being three Koala generations) and where records have a locational accuracy < 1,000 metres.

2. Completion of a single Koala survey plot using the Spot Assessment Technique ('SAT') as per Phillips & Callaghan 2011, sampling PCT 837 (refer **Illustration 4.1**); targeted searches under 2 x paddock trees of Forest Red Gum on numerous occasions.

Based on step 1, BioNET records indicate a single Koala record within 2.5 kms of the site, an adult sighted within bushland within the Deering Street Road Reserve 3 Cox Street, Yamba (approximately 400 km north of the site) on 31/12/2008 (refer **Illustration 7.1**). This single record is from 12 years ago and appears to be an aberrant record of a lone animal, which is unlikely to be persistent in the wild based on typical adult life spans of up to 15 years.

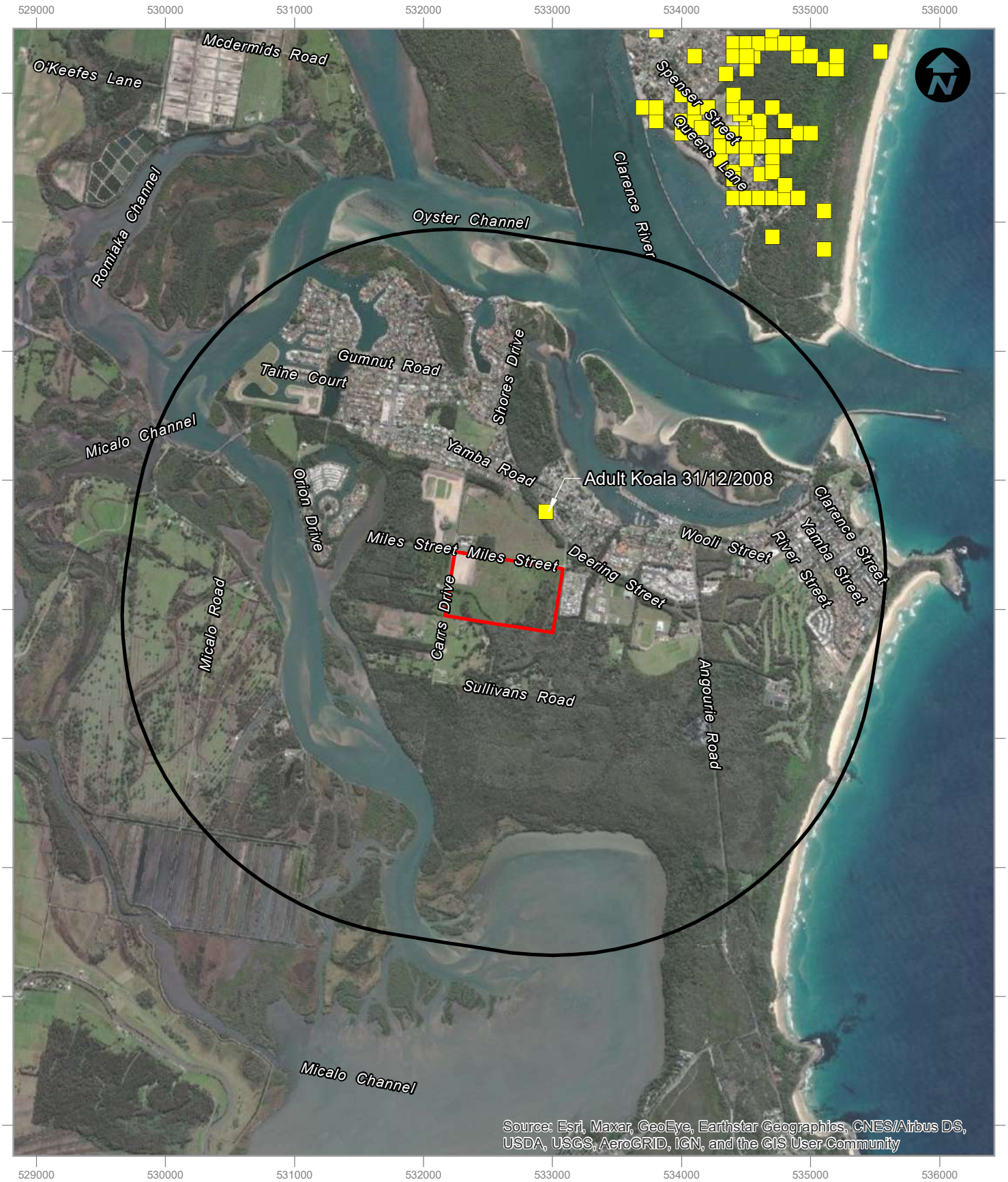
The lack of Koala records in the broader locality supports evidence that a Koala population does not currently reside within or proximate to Yamba township, as supported by recent Council reporting (Clarence Valley Koalas: Sighting Data Analysis July 2020).

Step 2 (SAT survey plot) did return any signs of Koalas (faecal pellets, sightings, scratches on smooth-barked trees). Results are reflective of the local of Koala records in the locality (as above)

As native vegetation is being removed (including two Forest Red Gum), the proposal requires the preparation of a Koala Assessment Report (KAR) which must address five key principles:

1. *Understand Koala habitat values,*
2. *Avoid intensifying land use in Koala habitat areas through appropriate landscape planning and site selection,*
3. *Encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas,*
4. *Minimise potential direct impacts to Koalas though koala sensitive design, and*
5. *Implement best practice measures for the management of identified risks to Koalas.*

A KAR has been prepared in table format to address the requirements set out in the *Koala SEPP 2021 FAQs — development applications* guideline (DPIE 2021); refer **Table 7.1**.



GDA 1994 MGA Zone 56

LEGEND

- The site
- 2.5 km site buffer
- Bionet Koala record

0 800 Metres

Koala Records within 2.5 km of the Site - Illustration 7.1

GeoLINK environmental management and design

Biodiversity Development Assessment Report
Lots 46 & 47 DP751395 Miles Street Yamba
3041-1059

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: ILC
Source of base data: ESRI World Imagery, OEH
Date: 29/03/2021

Table 7.1 Koala Assessment Report

KAR Requirement	*Response*
Principle 1. Understand Koala habitat values	
What is known about the size, health and viability of the koala population?	There is no evidence of a Koala population currently residing within the Yamba locality.
What is known about the generational persistence of the local koala populations? This should be informed by a record analysis to determine population trends and persistence over time.	There is no evidence of a Koala population currently residing within the Yamba locality, as supported by BioNET records.
What is the broader landscape context of the habitat within the site area? For instance, is it contiguous with broader areas of habitat or relatively isolated, and what are the likely regional movement patterns of koalas using the site area?	Habitat south of the site connects into extensive areas of conservation reserve within Yuraygir National Park. Koala records within this landscape are very few, with a single record from 2004 between Yamba and Brooms Head (BioNET). This supports the theory that there is no Koala population within the Yamba locality and the likelihood of animals immigrating into the area and establishing a population are extremely low.
Does the site area contain particular values likely to serve an important ecological function for koalas? For instance, does it provide linkage between other habitats or serve as a habitat buffer to broader areas?	The site provides poor foraging habitat, moderate refuge habitat and has high connectivity values. However, with no resident Koala population, these values are essentially void.
Could the habitat area and/or koala population using the site area be important to the recovery of the koala? For instance, does the habitat contain features that might provide refuge during droughts, extreme heat, or fire? Or is the population considered to be healthy, robust or showing relatively low incidence of disease?	There is no evidence of a Koala population currently residing within the Yamba locality.
Drawing on evidence presented, what significance are the values of the site to preserving the existing Koala population and supporting recovering and expanding populations?	The site contains poor resources for Koala, with only two trees being preferred Koala food trees, and other vegetation being small in area and of reduced quality for foraging or refuge.
Principle 2. Avoid intensifying land use in Koala habitat areas through appropriate landscape planning and site selection	
How has the development footprint avoided core Koala habitat?	The proposal has been designed to occur within more modified areas of the site where potential Koala refuge habitat is absent.
What feasible alternative site selections were assessed as part of the process?	The proposal has been amended to avoid more vegetated parts of the site where Koala may seek refuge.
Principle 3. Encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas	
Development avoids the direct loss of core Koala habitat within the site area and avoids fragmentation	Core Koala habitat does not occur at the site; no fragmentation of consolidated areas of potential habitat would occur as a result of the proposal.

KAR Requirement	Response
Core Koala habitat is excluded from the development footprint	Core Koala habitat does not occur at the site; no significant Koala habitat occurs within or will be affected by the proposed development.
Principle 4. Minimise potential direct impacts to Koalas through koala sensitive design	
Development avoids direct impacts to core Koala habitat within the site area.	n/a; core Koala habitat is absent from the site.
Where some loss of core Koala habitat cannot be avoided (and provided it is consistent with all other criteria), development is designed in a way that retains higher value areas across the site and avoids fragmentation of habitat within the site area and more broadly within the region.	n/a; core Koala habitat is absent from the site.
Development is undertaken in a way that maintains the potential function of the core Koala habitat.	Potential Koala refuge areas are maintained within residue land outside the development footprint.
Principle 5. Implement best practice measures for the management of identified risks to Koalas.	
All relevant indirect impacts to Koalas and Koala habitat associated with the development are identified.	Few indirect impacts to Koalas are likely given the lack of a local population. The incidence of road kill is likely to be low given the site is an urban area and roads will be low speed (50 km/hr). Other potential indirect impacts such as dog attack are not relevant given the absence of a local Koala population.
Development uses best practice management measures to address the potential impacts considered likely to pose an increased risk to Koalas or their habitat.	n/a - residue land will continue to provide limited resources to any roaming Koalas in the locality.

Based on BioNET results and site investigations, Koalas are unlikely to occur at the site. The KAR notes that the site does not contain core Koala habitat and impacts to Koalas and their habitats are negligible. On this basis the Policy has been satisfactorily addressed and there are no further requirements.

7.2 Environment Protection and Biodiversity Conservation Act 1999

An amending agreement to update the assessment bilateral relating to environmental assessment that the NSW Government has with the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) has been released for public consultation until 21 February 2019. Through the revised agreement the Australian Government is seeking to endorse the NSW Biodiversity Offset Scheme. OEH and DPE are working with the Australian Government to identify the best way to formally align the NSW Scheme to the EPBC Act environmental offsets policy.

The current bilateral agreement remains operational and will continue to be used for projects that are being assessed under the *Biodiversity Conservation Act 2016* transitional arrangements. Further, the Commonwealth is continuing to accredit use of the BAM for assessment of impacts on EPBC Act listed entities on a project-by-project basis.

Glossary of Terms and Acronyms

Term or acronym	*Meaning*
AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method 2020
BAM-C	BAM Calculator
BC Act	*Biodiversity Conservation Act 2016*
BC Regulation	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offsets Scheme
CVC	Clarence Valley Council
EES	(NSW) Environment, Energy and Science (formerly OEH)
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	(Cth) *Environment Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
OEH	Office of Environment and Heritage
PCT	Plant Community Type
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community listed in the BC Act and/or EPBC Act
VI	Vegetation Integrity

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Appendix A

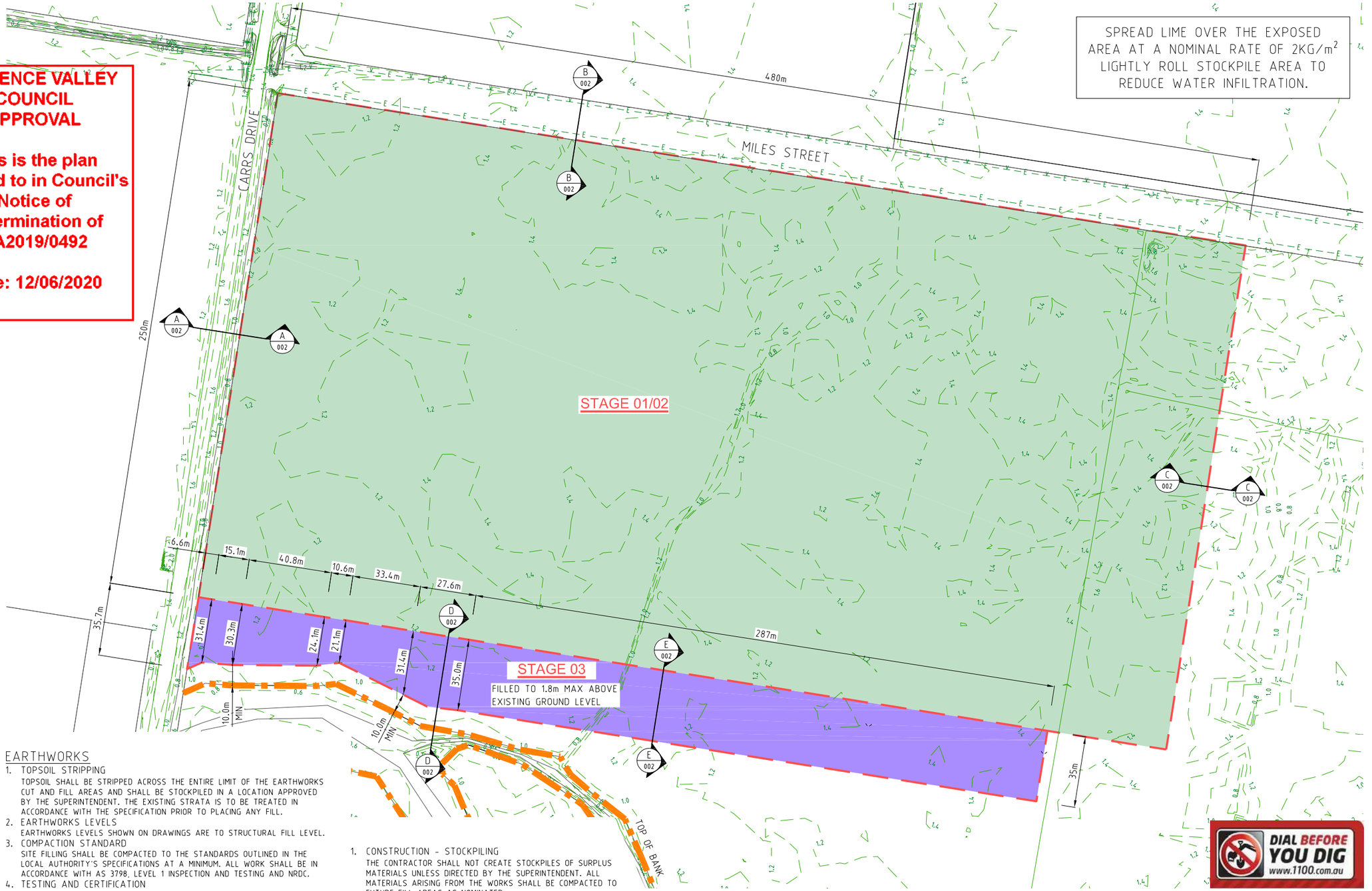
Approved Consents

CLARENCE VALLEY COUNCIL APPROVAL

This is the plan referred to in Council's Notice of Determination of DA2019/0492

Date: 12/06/2020

SPREAD LIME OVER THE EXPOSED AREA AT A NOMINAL RATE OF 2KG/m^2 LIGHTLY ROLL STOCKPILE AREA TO REDUCE WATER INFILTRATION.



EARTHWORKS

1. TOPSOIL STRIPPING
   TOPSOIL SHALL BE STRIPPED ACROSS THE ENTIRE LIMIT OF THE EARTHWORKS CUT AND FILL AREAS AND SHALL BE STOCKPILED IN A LOCATION APPROVED BY THE SUPERINTENDENT. THE EXISTING STRATA IS TO BE TREATED IN ACCORDANCE WITH THE SPECIFICATION PRIOR TO PLACING ANY FILL.
2. EARTHWORKS LEVELS
   EARTHWORKS LEVELS SHOWN ON DRAWINGS ARE TO STRUCTURAL FILL LEVEL.
3. COMPACTION STANDARD
   SITE FILLING SHALL BE COMPACTED TO THE STANDARDS OUTLINED IN THE LOCAL AUTHORITY'S SPECIFICATIONS AT A MINIMUM. ALL WORK SHALL BE IN ACCORDANCE WITH AS 3798, LEVEL 1 INSPECTION AND TESTING AND NRDC.
4. TESTING AND CERTIFICATION
   ALL COMPACTION TESTING SHALL BE CARRIED OUT BY AN APPROVED N.A.T.A. TESTING AUTHORITY. ALL SITE FILLING SHALL BE TESTED AT LEVEL 1 REQUIREMENTS. THE CONTRACTOR IS TO PROVIDE ALL REQUIRED EARTHWORKS CERTIFICATIONS IN ACCORDANCE WITH THE APPROVAL CONDITIONS.
5. TOPSOIL REPLACEMENT
   ALL FOOTPATHS, BATTERS AND ALLOTMENT CUT & FILL AREAS SHALL BE TOPSOILED WITH TOPSOIL FROM ONSITE STOCKPILES, AND AMELIORATE SOIL AS NECESSARY TO ENSURE GRASS STRIKE.
6. GRASSING
   ALL CUT/FILL AREAS, DISTURBED AREAS AND TRENCHED AREAS SHALL BE GRASSED TO THE SATISFACTION OF THE SUPERINTENDENT AND LOCAL AUTHORITY.
7. ROCK
   THE CONTRACTOR IS TO INCLUDE ROCK EXCAVATION AS PART OF THEIR EARTHWORKS RATE.
8. EARTHWORKS ZONE
   THE FOLLOWING ACTIVITIES ARE PROHIBITED OUTSIDE THE EARTHWORKS ZONE - STORAGE AND MIXING OF MATERIALS, VEHICLE PARKING, LIQUID DISPOSAL, MACHINERY REPAIRS/REFUELING, PLACEMENT OF SITE OFFICES OR SHEDS, COMBUSTION OF ANY MATERIAL, STOCKPILING OF SOIL, RUBBLE OR DEBRIS, ANY FILLING OR EXCAVATION INCLUDING TRENCHES, TOPSOIL, SKIMMING AND/OR SURFACE EXCAVATION UNLESS OTHERWISE APPROVED BY THE RELEVANT AUTHORITY.

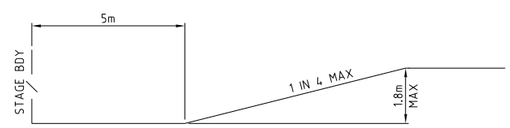
1. CONSTRUCTION - STOCKPILING
   THE CONTRACTOR SHALL NOT CREATE STOCKPILES OF SURPLUS MATERIALS UNLESS DIRECTED BY THE SUPERINTENDENT. ALL MATERIALS ARISING FROM THE WORKS SHALL BE COMPACTED TO FUTURE FILL AREAS AS NOMINATED.
2. TOPSOIL SCREENING
   TOPSOIL SHALL BE SCREENED BY THE CONTRACTOR WHEN DIRECTED BY THE SUPERINTENDENT. ALL UNSUITABLE MATERIAL SCREENED FROM THE TOPSOIL WILL BE TAKEN TO AN OFFSITE TIP BY THE CONTRACTOR AT THE CONTRACTORS EXPENSE.
3. RECORDS
   RECORD DETAILS OF ALL EARTHWORKS, INCLUDING TEMPORARY STOCKPILE LOCATIONS, APPROXIMATE VOLUMES, TREATMENT UNDERTAKEN, IF ANY, AND MONITORING RESULTS.
   THE FOLLOWING MONITORING REGIME IS RECOMMENDED:
   - REGULAR VISUAL MONITORING DURING EXCAVATION TO NOTE THE PRESENCE PF ANY DARK GREY SANDS OR DARK GREY CLAYS THAT REPRESENT POTENTIAL ASS.
   - ACTION - THERE ENCOUNTERED EXCAVATION WORKS SHOULD TEMPORARILY CEASE AND AN ASSESSMENT OF THE EXCAVATION BE MADE BY A GEOTECHNICAL ENGINEER.

   IF ANY ACIDIC TOPSOIL IS TO BE TAKEN OFF SITE AND REQUIRE NEUTRALISATION TO PH 7 AT A LIMING LATE OF 6KG $CaCO_3$/TON DRY WEIGHT AND ASSESSMENT IN ACCORDANCE WITH NSW EPA REQUIREMENTS.

LEGEND

- EXISTING PROPERTY LINE
- 1.0 EXISTING CONTOURS MAJOR
- 1.5 EXISTING CONTOURS MINOR
- SURVEYED TOP OF BANK LINE
- STAGE BOUNDARY
- STAGE 02 (FILLED TO 1.8m MAX)
- STAGE 03

NOTE:
CONTRACTOR TO MAKE ALL NECESSARY ALLOWANCES FOR EXISTING SERVICES DURING ALL WORKS.



TYPICAL SECTION AT EDGE OF WORKS
SCALE 1:100 - A1 (1:200 - A3)

DIAL BEFORE YOU DIG www.1100.com.au

PROJECT NAME

YAMBA GARDENS

EARTHWORKS SKETCH

CLIENT

KAHUNA NO. 1 PTY LTD

NORTH

0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

B	03-04-20	DETAILS REVISED
A	01-10-19	PRELIMINARY ISSUE
PRE	DATE	AMENDMENT

ASSOCIATED CONSULTANTS

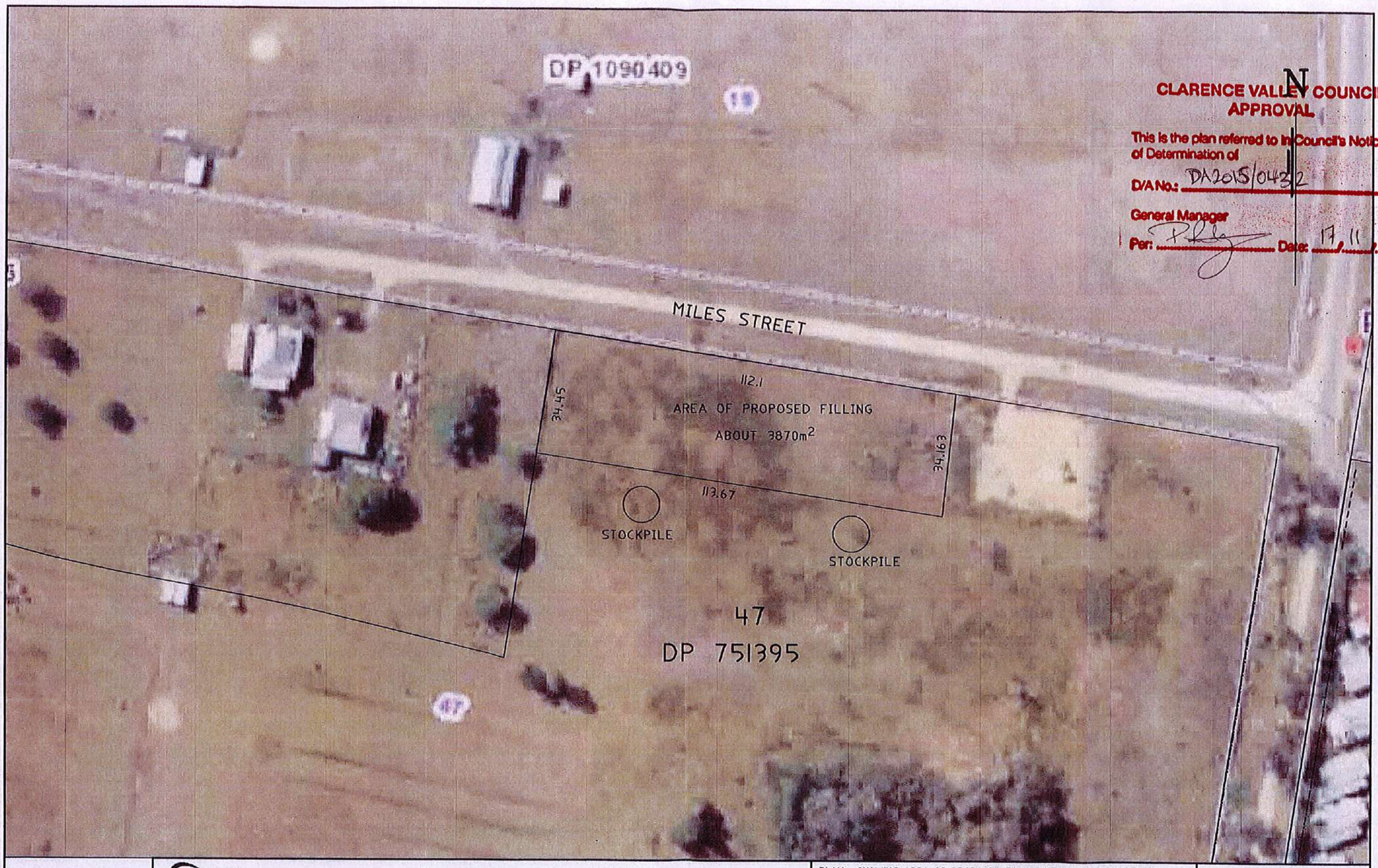
DRAWING TITLE

BULK EARTHWORKS STAGING AND FILLING SKETCH

MORTONS urbansolutions
Urban & Regional Planning
Civil Engineering
Project Coordination
MUS Pty Ltd T/As:
Mortons-Urban Solutions
ABN: 39 116 375 065
mortons@urbansolutions.net.au
www.urbansolutions.net.au
Tel 07 5571 1099
Postal Address
PO Box 2484
Southport QLD 4215
Gold Coast Office
Suite 9, 19 Short St
Southport QLD 4215

DESIGNED PP	DRAWN CB
APPROVED	RPEQ 4706 DATE 03-04-20

DRAWING NUMBER	AMEND.
33801-EWMP-SK001	B



CLARENCE VALLEY COUNCIL
APPROVAL

This is the plan referred to in Council's Notice of Determination of

D/A No.: DA2015/0432

General Manager

Per: ..... Date: 17/11/15

HARRISON SHEPHERD PTY.LTD.
Professional Surveyors and Consultants
Incorporating Peter M. Williamson

CONSULTING SURVEYORS AUSTRALIA HARRISON SHEPHERD PTY LTD ABN 42 074 364 123

3/19 Coldstream Street
YAMBA NSW 2464
(02)66461692 Fax(02)66468088
email:surveyl@bigpond.com

Cnr Tweed & Fawcett Streets
BRUNSWICK HEADS NSW 2483
Ph/Fax (02)66851477

121 Alcorn Street
SUFFOLK PARK NSW 2481
Ph/ Fax(02) 66857277

PLAN : SHOWING AREA OF PROPOSED FILLING UPON LOT 47 DP751395

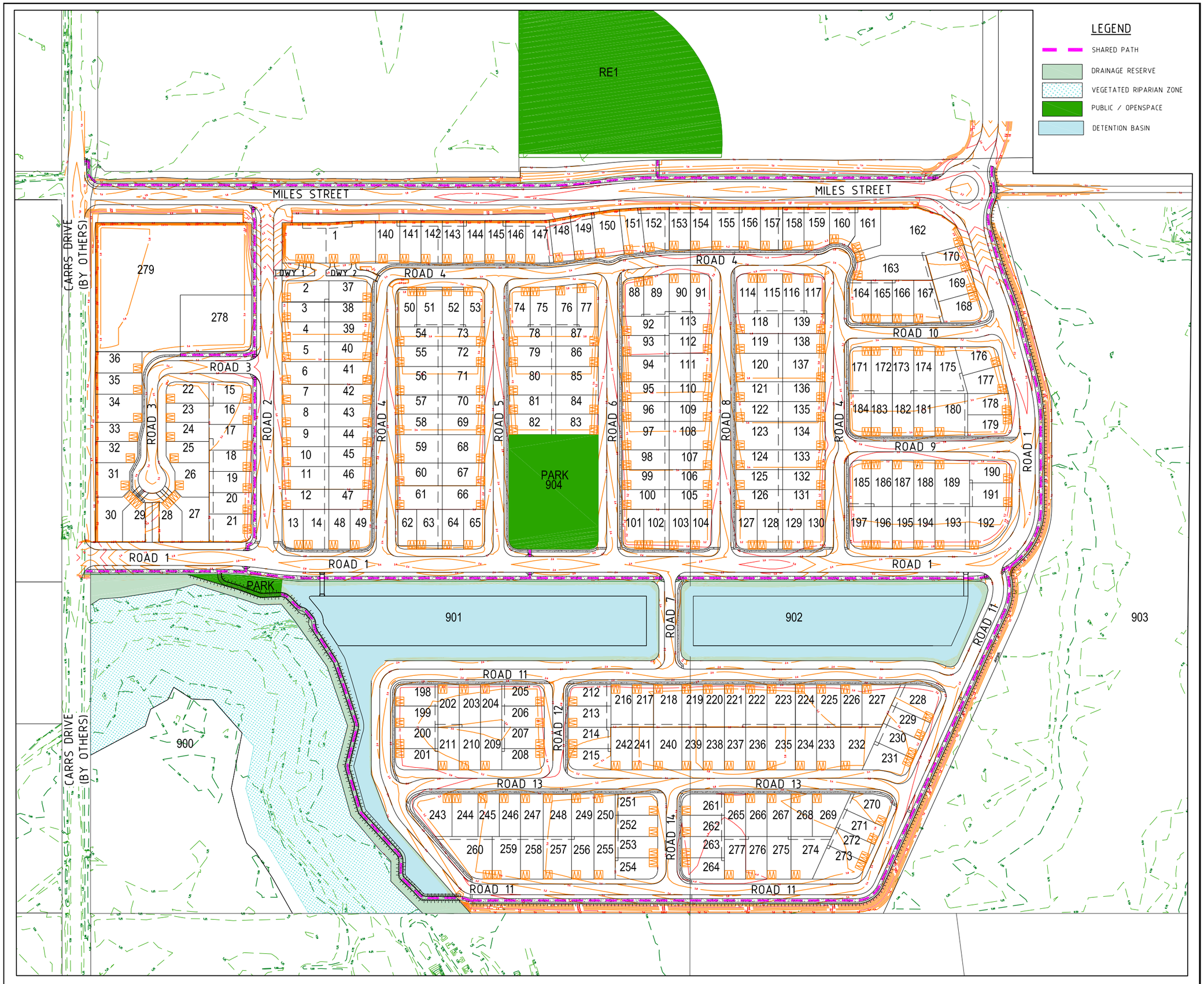
CLIENT :KAHUNA NO. 1 PTY LTD

REF. No. DWG. No.
15043/FILLINGDIAGRAM

DESIGN	×
DRAWN	WS
CHECKED	×
APPROVED	×
DATE	31/07/2015
R.R.	1:1000@A3
DATUM	×

Appendix B

Proposed Development



PROJECT NAME

YAMBA GARDENS

OVERALL SKETCH

RP DESCRIPTION
Lot 46 on DP751395,
& Lot 47 on DP751395
MILES ST, YAMBA NSW 2464
LOCALITY OF CLARENCE VALLEY

CLIENT

KAHUNA NO. 1 PTY LTD

NORTH

0 12.5 25 37.5 50 62.5m
Scale 1:1250 - A1 (1:2500 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

B	12-12-22	PARK DECKS REMOVED, KERB & FOOTPATH ADDED
A	01-12-22	ISSUED FOR APPROVAL
PRE	DATE	AMENDMENT

ASSOCIATED CONSULTANTS

DRAWING TITLE

LOCAL
PARK/PATH
PROPOSAL PLAN

MORTONS urbansolutions
Urban & Regional Planning
Civil Engineering
Project Coordination
MUS Pty Ltd T/As
Mortons Urban Solutions
ABN 39 116 375 065
mortons@urbansolutions.net.au
www.urbansolutions.net.au
Tel 07 5571 1099
Postal Address
PO Box 2484
Southport QLD 4215
Gold Coast Office
Suite 9, 19 Short St
Southport QLD 4215

DESIGNED	PP	DRAWN	JB
APPROVED		NER 906726	DATE 01-12-22

DRAWING NUMBER	AMEND.
33801-ALL-SK045	B

Appendix C

Plot Data

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BAM Site – Field Survey Form

Site Sheet no: 1 of 1

Survey Name	Zone ID	Recorders
Yamba		ILC DGH

Date	16/7/18	Zone	56	Datum		Plot ID	~~3~~ 1
Easting	532840	Northing	6742995	IBRA region			
Plot dimensions	20x50	Photo #	✓	1+2			
Midline bearing from 0 m	10° Magnetic						
Vegetation Class						Confidence: H M L	
Plant Community Type	PCT 837			EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	5
	Shrubs	2
	Grasses etc.	5
	Forbs	5
	Ferns	1
	Other	3
Sum of Cover of native vascular plants by growth form group	Trees	30.3
	Shrubs	1.1
	Grasses etc.	95.6
	Forbs	0.5
	Ferns	0.2
	Other	0.3
High Threat Weed cover		0.5

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	1	
50 – 79 cm	1111	
30 – 49 cm	✓	
20 – 29 cm	✓	
10 – 19 cm	✓	
5 – 9 cm	✓	
< 5 cm	✓	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	nil	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	10 | 5 | 10 | 1 | 15	a b c d e	a b c d e	a b c d e
Average of the 5 subplots	8.2			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope	Flat	Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	2	NR	
Cultivation (inc. pasture)	–	–	
Soil erosion	–	–	
Firewood / CWD removal	–	–	
Grazing (identify native/stock)	2	R	
Fire damage	–	–	
Storm damage	–	–	
Weediness	1	R	
Other			Recently slashed. Historically cleared + understocked

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

4

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U/M/G

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 16/7/2018	Yamba	3	LC DGH

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
GG	1 Blady Grass	N	95	1000	G	
FG	2 Desmodium rhytidophyllum	N	0.1	5	G	
EG	3 Pteridium esculentum	N	0.2	20	G	
D	4 Cenchrus clandestinum	HTE	0.2	100	G	
TG	5 Mel. quinquenervia	N	5	1	U	
TG	6 Acacia melanoxylon	N	0.1	3	M	
D	7 Bidens pilosa	HTE	0.1	1	G	
	8 Setaria sphacelata	E	0.1	5	G	
OG	9 Hibertia scandens	N	0.1	15	G	
TG	10 Alphitonia excelsa	N	0.1	5	M	
SG	11 Acacia disparrima	N	1	4	M	
FG	12 Oxalis perennans	N	0.1	10	G	
	13 Paspalum urvillei	E	0.1	1	G	
OG	14 Geitonoplesium cymosum	N	0.1	10	G	
SG	15 Breynia oblongifolia	N	0.1	1	M	
OG	16 Glycine clandestina	N	0.1	10	G	
FG	17 Hydrocotyl laxiflora	N	0.1	30	G	
	18 ~~Gamochaeta sp. (weed)~~					
	19 Hypochaeris radicata (Flatweed)	E	0.1	40	G	
GG	20 Lomandra longifolia	N	0.2	10	G	
FG	21 Pratia purpurascens	N	0.1	10	G	
D	22 Lantana camara	HTE	0.1	1	M	
FG	23 Pimea umbellata	N	0.1	1	G	
GG	24 Saccolepis indica	N	0.1	3	G	
TG	25 Corymbia intermedia	N	25	2	G	
OG	26 Gahnia clarkei	N	0.1	1	G	
GG	27 Themeda australis	N	0.2	20	G	
TG	28 Cupaniopsis anacardioides	N	0.1	1	G	
D	29 Andropogon virginicus	HTE	0.1	10	G	
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

2

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

		Survey Name	Zone ID	Recorders			
Date	16/7/18	Yamba		ILC DGH			
Zone	Datum	Plot ID	~~1~~ 2	Plot dimensions	20×50	Photo #	✓ 3 & 4.
Easting 532962	Northing 6743163	IBRA region		Midline bearing from 0 m	0° North.	Magnetic	
Vegetation Class						Confidence: H M L	
Plant Community Type		PCT 1724 1064		EEC: tick		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	11
	Shrubs	8
	Grasses etc.	4
	Forbs	6
	Ferns	3
	Other	~~8~~ 7
Sum of Cover of native vascular plants by growth form group	Trees	94.6
	Shrubs	21.6
	Grasses etc.	46.3
	Forbs	10.9
	Ferns	1.6
	Other	1.3
High Threat Weed cover		0.9

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	—	
50 – 79 cm	//////	
30 – 49 cm	✓	
20 – 29 cm	✓	
10 – 19 cm	✓	
5 – 9 cm	✓	
< 5 cm	✓	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	36, 6, 2.4, 7.4, 9.5, 10.8, 1.7, 0.5, 3.5, 2.7, 5, 7.2, 1.2, 2.9, 2.2, 1, 0.9, 24, 1.2, 9.8, 1, 0.8, 1, 2, 0.8, 0.9, 12.8, 3.6, 1.3, 9.5	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead** and may be shrubs.

TOTAL LOGS: 148

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Subplot score (% in each)	90	95	75	70	80															
Average of the 5 subplots	82																			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	1		
Cultivation (inc. pasture)	0		
Soil erosion	0		
Firewood / CWD removal	0		
Grazing (identify native/stock)	1		
Fire damage	0		
Storm damage	0		
Weediness	1		
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date __/__/__			

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
OG	1 Scrambling Lily	N	0.2	100	G.	
D	2 Coastal Morning Glory	HTE	0.2	50	M.	
SG	3 Melaleuca styphelioides	N	20.	10	M.	
FG	4 Viola hederacea	N	10	1000	G	
OG	5 Pandorea jasminoides.	N	0.1	10	G.	
OG	6 Banksia spinulosa.	N	40	1000	G.	
TG	7 Melaleuca quinquenervia	N	75	20	M.	
OG	8 Cockspur.	N	0.1	10	G.	
TG	9 Cheese Tree.	N	8	10	M.	
SG	10 Hairy Psychotria.	N	0.1	10	G.	
D	11 Lantana camara.	HTE	0.1	2	G.	
QG	12 Dendrobium linguiforme	N	0.2	50	G.M	
	13 ~~Epidendrum ciliare~~.					
TG	14 Ficus watkinsoniana.	N	5.	2	M.	
OG	15 Parsonsia straminea.	N	0.5	20	M.	
TG	16 Umbrella Cheese Tree.	N	3	10.	M.	
GG	17 Carex appressa.	N	5.	50	G.	
SG	18 Ficus coronata.	N	1	10	M.	
FG	19 Commelina.	N	0.1	10.	G.	
FG	20 Arthropodium minus.	N	0.5	100	G.	
D	21 Senna pendula.	HTE	0.1	2	G.M	
SG	22 Bush Mutton wood.	N	0.1	4	G.	
	23 Coral Berry (Rivina).	E	0.1	1	G.	
EG	24 Blechnum indicum.	N	0.5	100	G.	
OG	25 Cordyline stricta.	N	0.1	5.	M.	
OG	26 Smilax australis	N	0.1	5.	M.	
TG	27 Acmena smithii	N	2	10	M.	
EG	28 Skeleton Fork fern.	N	0.1	2	G.	
FG	29 Pratia.	N	0.1	10	G.	
GG	30 Entolasia marginata.	N	0.1	50	G.	
D	31 Asparagus aethiopicus.	HTE	0.1	5	G.	
TG	32 Pink Endia.	N	0.2	5	M.	
D	33 Cherry Guava.	HTE	0.5	5	M.	
SG	34 Bleeding Heart.	N	0.1	1	G.	
FG	35 Ranunculus inundatus.	N	0.1	10	G.	
GG	36 Baumea rubiginosa.	N	0.2	100	G.	
TG	37 Casuarina glauca	N	0.1	1	G.	
FG	38 Hydrocotyl. vittacilata.	N	0.1	10	G.	
EG	39 Hypolepis.	N	1	100 30	G	
GG	40 Bindy Grass	N	1	100	G.	

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date		2	

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
TG	1 ~~Eto~~ Cryptocarya triplinervis.	N	1	2.	M.	
D	2 Bacharis halimifolia.	HTE	0.1	1	G.	
D	3 Camphora Cinnamomum	HTE	0.1	5.	M	
TG	4 Cupaniopsis anacardioides.	N	0.1	1	G.	
SG	5 Rubus molucanna .	N	0.1	1	G.	
D	6 Ochana cerulata.	HTE	0.1	1	G.	
TG	7 Red Ash	N	0.1	5	G.	
TG	8 Syzygium francissii.	N	0.1	2	G.	
SG	9 Breynia oblongifolia.	N	0.1	2	G.	
SG	10 Callistemon salignus.	N	0.1	1	M.	
	11 ~~Umbrella Cheese Tree.~~					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
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	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no: 2 of 2

		Survey Name	Zone ID	Recorders			
Date	16/7/18		Yamba.	ILC, DGH.			
Zone	Datum	Plot ID	4	Plot dimensions		Photo #	
Easting	Northing	IBRA region		Midline bearing from 0 m		Magnetic /	
Vegetation Class						Confidence: H M L	
Plant Community Type				EEC:		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm		
50 – 79 cm		
30 – 49 cm		
20 – 29 cm		
10 – 19 cm		
5 – 9 cm		
< 5 cm		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	Tally space	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots																				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

NB: 100+5m plot

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Lot 46

BAM Site – Field Survey Form

Site Sheet no: 1 of

Survey Name	Zone ID	Recorders
Yamba	Casdaran	LC DGH

Date	16/7/18	Plot ID	~~8~~ 3	Plot dimensions		Photo # 11 – 14 13
Zone	Datum					
Easting	Northing	IBRA region		Midline bearing from 0 m	140 Magnetic ?	
532410	6743092					
Vegetation Class						Confidence: H M L
Plant Community Type	1235			EEC: tick		Confidence: H M L

ap-842

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	2
	Shrubs	–
	Grasses etc.	11
	Forbs	11
	Ferns	–
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	97
	Shrubs	–
	Grasses etc.	14.9
	Forbs	14.2
	Ferns	–
	Other	0.1
High Threat Weed cover		5.3

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	✓	✓
50 – 79 cm	✓	✓
30 – 49 cm	✓	
20 – 29 cm	✓	
10 – 19 cm	✓	
5 – 9 cm	✓	
< 5 cm	✓	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	2.5 Tally space	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

10, 30, 50, 70, 90m.

water + seeps

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	a: 0 b: 0 c: 0 d: 0 e: 1	a: b: c: d: e:	a: b: c: d: e:	a: b: c: d: e:
Average of the 5 subplots	0.2			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	1	O	
Cultivation (inc. pasture)	–	–	
Soil erosion	–	–	
Firewood / CWD removal	–	–	
Grazing (identify native/stock)	–	–	
Fire damage	–	–	
Storm damage	–	–	
Weediness	1		generally good cond. Some Aster, pasture species.
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

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JA to J

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 16-7-18	Yamba	8	DGH + ILC.

GF Code		Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
TG	1	Cas. glauca	N	90	250	U	
TG	2	Mel byrsquenervia	N	7	10	U	
	3	Cyphea carthagenensis	E	0.1	5	G	
FG	4	Philydrum lanuginosum	N	0.2	20	G	
GG	5	Schoenoplectralla mucronata.	N	5	100	G	
FG	6	Ottelia ovalifolia (Potamogeton tricarinatus)	N	3	50	G	
FG	7	Bacopa monnieri	N	0.1	50	G	
	8	Aster subulatus.	E	0.1	20	G	
GG	9	Fimbristylis nutans	N	0.1	10	G	
GG	10	Impeata cylindrica.	N	0.1	5	G	
FG	11	Eryda knollsii	N	5	100	G	
FG	12	Vida hederaceae.	N	0.1	50	G	
D	13	Centhus clandestinus	HTE	5	200	G	
	14	Trifolium repens	E	0.1	10	G	
FG	15	Ludwigia peploides.	N	0.3	50	G	
GG	16	Eleocharis equisetina	N	3	300	G	
GG	17	Baumea rubiginosa	N	0.5	100	G	
FG	18	Ranunculus inundatus.	N	01	5	G	
D	19	Senecio madagascariensis	HTE	0.1	5	G	
FG	20	Triglochin procera	N	5	100	G	
	21	* Creeper (Asteraceae) from prev.	N	0.1	10	G	✓ Phyla nodiflora
GG	22	Baumea juncea.	N	0.2	30	G	
OG	23	Parsonsia straminea	N	0.1	10	G	
GG	24	Cynodon dactylon.	N	5	100	G	
GG	25	Juncus polyanthemos	N	0.1	10	G	
GG	26	Typha orientalis.	N	0.1	5	G	
FG	27	Centella asiatica	N	0.1	100	G	
	28	Polygala paniculata (multicaul)	N	0.1	20	G	
GG	29	Cyperus polystachyos.	N	0.1	20	G	
D	30	Andropogon virginicus	HTE	0.1	10	G	
D	31	Senna pendula.	HTE	0.1	1	M	
FG	32	Persicaria strigosa.	N	0.2	50	G	
D	33	Ipomoea cairica.	HTE	0.1	1	G	
GG	34	Bolboschoenus fluviatilis	N	0.1	5	G	
FG	35	Persicaria decipiens.	N	0.1	1	G	
	36						
	37						
	38						
	39						
	40						

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Plot 4

Date							
20/04/2021							
Zone	Datum	Survey Name	Zone ID				
56	MGA94	Yamba	A				
Start Easting	Start Northing	Start WP	Recorders	IBRA region (in m)	Plot dimensions	Photo #	Midline bearing from 0 m (magnetic ^{0})
532652	6742997	200	ILC	SEQ	20 x 50	1	175
End Easting	End Northing	End WP					
		Confidence					
Vegetation Class	Coastal Swamp Forests	High					
Plant Community Type	1227	High	**EEC?**	No			
Plant Community Name	Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion	High					

BAM Attribute (400 m^2 plot)		Sum values
Count of **Native Richness**	**Trees**	3
	Shrubs	0
	Grasses etc.	8
	Forbs	5
	Ferns	0
	Other	0
Sum of **Cover** of native vascular plants by growth form group	**Trees**	60.6
	Shrubs	0
	Grasses etc.	30.5
	Forbs	1.4
	Ferns	0
	Other	0
High Threat Exotic cover		55.6

Codes for formulas
Tree (TG)
Shrub (SG)
Grass & grasslike (GG)
Forb (FG)
Fern (EG)
Other (OG)
N
E
HTE

BAM Attribute (1000 m^2 plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 - 79 cm	0	0
30 - 49 cm	N	0
20 - 29 cm	N	0
10 - 19 cm	N	0
5 - 9 cm	N	0
< 5 cm	Y	n/a
Length of logs (m) (≥ 10 cm in diameter, >50cm in length)		0

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)				
Subplot score (% in each)	2	1	7	1	2					
Average of the 5 subplots	2.6					#DIV/0!				

GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Natives below this line (see row 89 for exotics). *NB search for species in "Native Species by Growth Form" sheet and copy/paste exact spelling of species name.* **If unsure in field use common name/ field notes then enter species name at office.**							
Tree (TG)	Melaleuca quinquenervia		N	0.5	10	M	
Grass & grasslike (GG)	Cyperus polystachyos		N	10	300	G	
Tree (TG)	Lophostemon confertus		N	60	100	M	
Grass & grasslike (GG)	Sacciolepis indica		N	15	300	G	
Forb (FG)	Centella asiatica		N	1	50	G	
Forb (FG)	Stylidium debile		N	0.1	5	G	
Forb (FG)	Philydrum lanuginosum		N	0.1	3	G	
Grass & grasslike (GG)	Cyperus haspan		N	0.1	20	G	
Tree (TG)	Banksia integrifolia subsp. integrifolia		N	0.1	2	G	
Grass & grasslike (GG)	Juncus usitatus		N	0.1	5	G	
Forb (FG)	Goodenia paniculata		N	0.1	10	G	
Grass & grasslike (GG)	Xyris complanata		N	0.1	15	G	
Grass & grasslike (GG)	Fimbristylis dichotoma		N	0.1	10	G	
Forb (FG)	Pratia purpurascens		N	0.1	1	G	
Grass & grasslike (GG)	Cynodon dactylon		N	5	50	G	
Grass & grasslike (GG)	Fuirena ciliaris		N	0.1	1	G	
GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Exotics (both E and HTE) below this line. *NB search for species in "High Threat Weeds" sheet and if a match, copy/paste exact spelling of species name.* If unsure in field use common name/ field notes then enter species name at office.							
	Cenchrus clandestinum		HTE	50	500	G	
	Setaria sphacelata		E	5	20	G	
	Andropogon virginicus		HTE	5	20	G	
	Hypochaeris radicata		E	0.2	20	G	
	Senecio madagascarensis		HTE	0.1	2	G	
	Cyperus sesquiflorus		E	0.1	1	G	
	Cuphea carthagenensis		E	0.1	5	G	
	Paspalum urvillei		E	0.1	1	G	
	Axonopus fissifolius		HTE	0.5	20	G	

Plot 5

Date							
20/04/2021							
Zone	Datum	Survey Name	Zone ID				
56	MGA94	Yamba	B				
Start Easting	Start Northing	Start WP	Recorders	IBRA region (in m)	Plot dimensions	Photo #	Midline bearing from 0 m (magnetic ^{0})
532738	6742983	201	ILC	SEQ	20 x 50	1	10
End Easting	End Northing	End WP					

		Confidence		
Vegetation Class	Coastal Valley Grassy Woodlands	High		
Plant Community Type	837	High	**EEC?**	No
Plant Community Name	Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	High		

BAM Attribute (400 m^2 plot)		Sum values
Count of **Native Richness**	**Trees**	3
	Shrubs	2
	Grasses etc.	6
	Forbs	4
	Ferns	1
	Other	0
Sum of **Cover** of native vascular plants by growth form group	**Trees**	0.4
	Shrubs	0.2
	Grasses etc.	55.3
	Forbs	0.8
	Ferns	5
	Other	0
High Threat Exotic cover		37.4

Codes for formulas
Tree (TG)
Shrub (SG)
Grass & grasslike (GG)
Forb (FG)
Fern (EG)
Other (OG)
N
E
HTE

BAM Attribute (1000 m^2 plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 - 79 cm	0	0
30 - 49 cm	N	0
20 - 29 cm	N	0
10 - 19 cm	N	0
5 - 9 cm	N	0
< 5 cm	Y	n/a
Length of logs (m) (≥ 10 cm in diameter, >50cm in length)		0

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)				
Subplot score (% in each)	70	40	2	5	10					
Average of the 5 subplots	25.4					#DIV/0!				

GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Natives below this line (see row 89 for exotics). *NB search for species in "Native Species by Growth Form" sheet and copy/paste exact spelling of species name.* **If unsure in field use common name/ field notes then enter species name at office.**							
Grass & grasslike (GG)	Cynodon dactylon		N	15	100	G	
Grass & grasslike (GG)	Imperata cylindrica		N	35	100	G	
Fern (EG)	Pteridium esculentum		N	5	50	G	
Forb (FG)	Pratia purpurascens		N	0.3	50	G	
Forb (FG)	Dichondra repens		N	0.2	50	G	
Grass & grasslike (GG)	Sacciolepis indica		N	5	50	G	
Forb (FG)	Centella asiatica		N	0.2	20	G	
Tree (TG)	Corymbia intermedia		N	0.2	5	G	
Tree (TG)	Lophostemon confertus		N	0.1	5	G	
Tree (TG)	Alphitonia excelsa		N	0.1	3	G	
Grass & grasslike (GG)	Cyperus polystachyos		N	0.1	5	G	
Grass & grasslike (GG)	Fimbristylis dichotoma		N	0.1	10	G	
Grass & grasslike (GG)	Lomandra longifolia		N	0.1	2	G	
Shrub (SG)	Platylobium formosum		N	0.1	1	G	
Shrub (SG)	Acacia disparrima subsp. disparrima		N	0.1	1	G	
Forb (FG)	Desmodium rhytidophyllum		N	0.1	1	G	
GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Exotics (both E and HTE) below this line. *NB search for species in "High Threat Weeds" sheet and if a match, copy/paste exact spelling of species name.* If unsure in field use common name/ field notes then enter species name at office.							
	Cenchrus clandestinum		HTE	35	100	G	
	Richardia brasiliensis		E	0.5	50	G	
	Setaria sphacelata		E	0.2	10	G	
	Ageratum houstonianum		E	0.1	5	G	
	Hypochaeris radicata		E	0.1	5	G	
	Polygala paniculata		E	0.1	1	G	
	Bidens spp.		HTE	0.1	5	G	
	Andropogon virginicus		HTE	0.3	10	G	
	Axonopus fissifolius		HTE	2	50	G	

Plot 6

Date							
20/04/2021							
Zone	Datum	Survey Name	Zone ID				
56	MGA94	Yamba	C				
Start Easting	Start Northing	Start WP	Recorders	IBRA region (in m)	Plot dimensions	Photo #	Midline bearing from 0 m (magnetic ^{0})
532787	6743117	202	ILC	SEQ	16 x 25	1	60
End Easting	End Northing	End WP					
		Confidence					
Vegetation Class	Coastal Floodplain Wetlands	High					
Plant Community Type	780	High	**EEC?**	No			
Plant Community Name	Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	High					

BAM Attribute (400 m^2 plot)		**Sum values**
Count of **Native Richness**	**Trees**	2
	Shrubs	0
	Grasses etc.	10
	Forbs	4
	Ferns	0
	Other	0
Sum of **Cover** of native vascular plants by growth form group	**Trees**	0.2
	Shrubs	0
	Grasses etc.	75.2
	Forbs	17
	Ferns	0
	Other	0
High Threat Exotic cover		2.1

Codes for formulas
Tree (TG)
Shrub (SG)
Grass & grasslike (GG)
Forb (FG)
Fern (EG)
Other (OG)
N
E
HTE

BAM Attribute (1000 m^2 plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 - 79 cm	0	0
30 - 49 cm	N	0
20 - 29 cm	N	0
10 - 19 cm	N	0
5 - 9 cm	N	0
< 5 cm	Y	n/a
Length of logs (m) (≥ 10 cm in diameter, >50cm in length)		0

BAM Attribute (1 x 1 m plots)	**Litter cover (%)**					**Bare ground cover (%)**				
Subplot score (% in each)	0	0	0	0	0					
Average of the 5 subplots	0					#DIV/0!				

GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Natives below this line (see row 89 for exotics). *NB search for species in "Native Species by Growth Form" sheet and copy/paste exact spelling of species name.* **If unsure in field use common name/ field notes then enter species name at office.**							
Grass & grasslike (GG)	Baumea rubiginosa		N	10	70	G	
Grass & grasslike (GG)	Fuirena ciliaris		N	0.2	5	G	
Grass & grasslike (GG)	Cyperus haspan		N	0.2	10	G	
Forb (FG)	Philydrum lanuginosum		N	10	50	G	
Grass & grasslike (GG)	Eleocharis philippinensis		N	60	300	G	
Forb (FG)	Persicaria decipiens		N	1	10	G	
Forb (FG)	Triglochin procera		N	3	50	G	
Forb (FG)	Persicaria strigosa		N	3	50	G	
Grass & grasslike (GG)	Paspalum distichum		N	0.1	10	G	
Grass & grasslike (GG)	Eleocharis equisetina		N	0.5	20	G	
Grass & grasslike (GG)	Fimbristylis dichotoma		N	0.1	10	G	
Grass & grasslike (GG)	Sacciolepis indica		N	2	50	G	
Tree (TG)	Casuarina glauca		N	0.1	2	G	
Grass & grasslike (GG)	Schoenoplectus mucronatus		N	2	20	G	
Tree (TG)	Lophostemon confertus		N	0.1	1	G	
Grass & grasslike (GG)	Xyris complanata		N	0.1	1	G	
GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Exotics (both E and HTE) below this line. *NB search for species in "High Threat Weeds" sheet and if a match, copy/paste exact spelling of species name.* If unsure in field use common name/ field notes then enter species name at office.							
	Cuphea carthagenensis		E	5	100	G	
	Paspalum urvillei		E	0.1	3	G	
	Juncus cognatus		E	0.1	5	G	
	Ludwigia longifolia		E	0.2	10	G	
	Axonopus fissifolius		HTE	2	10	G	
	Andropogon virginicus		HTE	0.1	3	G	

Plot 7

Date							
20/04/2021							
Zone	Datum	Survey Name	Zone ID				
56	MGA94	Yamba	D				
Start Easting	Start Northing	Start WP	Recorders	IBRA region (in m)	Plot dimensions	Photo #	Midline bearing from 0 m (magnetic ^{0})
532746	6743319	203	ILC	SEQ	25 x 40	1	3
End Easting	End Northing	End WP					

		Confidence		
Vegetation Class	Coastal Valley Grassy Woodlands	Medium		
Plant Community Type	837	Medium	**EEC?**	No
Plant Community Name	Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Medium		

BAM Attribute (400 m^2 plot)		Sum values
Count of **Native Richness**	**Trees**	2
	Shrubs	0
	Grasses etc.	4
	Forbs	1
	Ferns	0
	Other	0
Sum of **Cover** of native vascular plants by growth form group	**Trees**	18
	Shrubs	0
	Grasses etc.	30.2
	Forbs	0.1
	Ferns	0
	Other	0
High Threat Exotic cover		15.6

Codes for formulas
Tree (TG)
Shrub (SG)
Grass & grasslike (GG)
Forb (FG)
Fern (EG)
Other (OG)
N
E
HTE

BAM Attribute (1000 m^2 plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 - 79 cm	0	0
30 - 49 cm	N	0
20 - 29 cm	N	0
10 - 19 cm	N	0
5 - 9 cm	N	0
< 5 cm	Y	n/a
Length of logs (m) (≥ 10 cm in diameter, >50cm in length)		0

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)				
Subplot score (% in each)	5	10	20	0	0					
Average of the 5 subplots	7					#DIV/0!				

GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Natives below this line (see row 89 for exotics). *NB search for species in "Native Species by Growth Form" sheet and copy/paste exact spelling of species name.* **If unsure in field use common name/ field notes then enter species name at office.**							
Tree (TG)	Banksia integrifolia subsp. integrifolia		N	15	3	U	
Grass & grasslike (GG)	Cyperus polystachyos		N	10	100	G	
Grass & grasslike (GG)	Cynodon dactylon		N	20	300	G	
Forb (FG)	Centella asiatica		N	0.1	10	G	
Grass & grasslike (GG)	Fimbristylis dichotoma		N	0.1	3	G	
Grass & grasslike (GG)	Juncus usitatus		N	0.1	1	G	
Tree (TG)	Lophostemon confertus		N	3	13	G	
GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	stratum	voucher
Exotics (both E and HTE) below this line. *NB search for species in "High Threat Weeds" sheet and if a match, copy/paste exact spelling of species name.* If unsure in field use common name/ field notes then enter species name at office.							
	Cenchrus clandestinum		HTE	15	100	G	
	Bidens spp.		HTE	0.5	20	G	
	Hypochaeris radicata		E	0.1	2	G	
	Sporobolus africanus		E	3	50	G	
	Senecio madagascarensis		HTE	0.1	5	G	
	Cuphea carthagenensis		E	40	200	G	
	Conyza bonariensis		E	0.1	1	G	
	Sida rhombifolia		E	0.1	3	G	
	Asclepias curassavica		E	0.1	1	G	
	Juncus cognatus		E	0.1	5	G	
	Cyperus sesquiflorus		E	0.1	5	G	
	Aster subulatus		E	0.1	3	G	
	Eragrostis cilianensis		E	0.1	2	G	
			E				

Plot 8

Date							
6/07/2023							
Zone	Datum	Survey Name	Zone ID				
56	MGA94	Miles St		*Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.*			
Start Easting	Start Northing	Start WP	Recorders	IBRA region	Plot dimensions	Photo #	Midline bearing (degrees)
			DH		20x50		187
End Easting	End Northing	End WP					

Vegetation Class		Confidence	
Plant Community Type		EEC?	
Plant Community Name			

BAM Attribute (400 m² plot)		Sum values
Count of **Native Richness**	Trees	3
	Shrubs	0
	Grasses etc.	3
	Forbs	0
	Ferns	0
	Other	0
Sum of **Cover** of native vascular plants by growth form group	Trees	5.5
	Shrubs	0
	Grasses etc.	6.1
	Forbs	0
	Ferns	0
	Other	0
High Threat Exotic cover		103.1

Codes for formulas
Tree (TG)
Shrub (SG)
Grass & grasslike (GG)
Forb (FG)
Fern (EG)
Other (OG)
N
E
HTE

*10, 20, 30…, 100, 200, 300…). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.***

*For **hollows**, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.*

BAM Attribute (1000 m² plot) DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 - 79 cm	0	
30 - 49 cm	absent	
20 - 29 cm	absent	
10 - 19 cm	absent	
5 - 9 cm	absent	
< 5 cm	present	n/a
Length of logs (m) (≥ 10 cm in diameter, >50cm in length)		0

Field Notes

Log length tally	
0	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot score (% in each)	5	2	0	5	5
Average of the 5 subplots	3.4				

Cover: 0.1, 0.2, 0.3, …, 1, 2, 3, …, 5, 10, 15, 20, 25, …100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, …, 10, 20, 30, … 100, 200, …, 1000, …

GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	Stratum	Voucher
Natives below this line (see orange row for exotics). *Note: search for species in "Native Species by Growth Form" sheet and copy/paste exact spelling. If unsure when in the field use the 'common name/ field notes'*							
Tree (TG)	Melaleuca quinquenervia		N	5	50		
Tree (TG)	Lophostemon suaveolens		N	0.3	10		
Tree (TG)	Corymbia gummifera		N	0.2	10		
Grass & grasslike (GG)	Imperata cylindrica		N	1	10		
Grass & grasslike (GG)	Cynodon dactylon		N	5	10000		
Grass & grasslike (GG)	Isolepis spp.		N	0.1	10		
GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	Stratum	Voucher
Exotics (both E and HTE) below this line. *Note: search for species in "High Threat Weeds" sheet and if a match, copy/paste exact spelling of species name. If unsure when in the field, use 'common name/ field notes'*							
	Andropogon virginicus		HTE	10	300		
	Senecio madagascariensis		HTE	0.1	10		
	Cyperus eragrostis		HTE	10	500		
	Axonopus fissifolius		HTE	80	10000		
	Setaria sphacelata		E	1	100		
	Hypochaeris radicata		E	0.1	50		
	Cuphea carthagensis		E	0.1	10		
	Cenchrus clandestinus		HTE	3	1000		
	Polygala paniculata		E	0.1	5		
			E				

Plot 9

Date				
6/07/2023				
Zone	Datum	Survey Name	Zone ID	
56	MGA94	Miles St		
Start Easting	Start Northing	Start WP	Recorders	
End Easting	End Northing	End WP		

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

IBRA region	Plot dimensions	Photo #	Midline bearing (degrees)
	20x50		275

Vegetation Class		**Confidence**	
Plant Community Type		**EEC?**	
Plant Community Name			

BAM Attribute (400 m² plot)		Sum values
Count of **Native Richness**	**Trees**	2
	Shrubs	1
	Grasses etc.	4
	Forbs	2
	Ferns	0
	Other	0
Sum of **Cover** of native vascular plants by growth form group	**Trees**	0.5
	Shrubs	1
	Grasses etc.	8.2
	Forbs	0.2
	Ferns	0
	Other	0
High Threat Exotic cover		91.8

Codes for formulas
Tree (TG)
Shrub (SG)
Grass & grasslike (GG)
Forb (FG)
Fern (EG)
Other (OG)
N
E
HTE

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30…, 100, 200, 300…). For a ***multi-stemmed tree****, only the largest living stem is included in the For* ***hollows****, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.*

BAM Attribute (1000 m² plot) DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 - 79 cm	0	
30 - 49 cm	absent	
20 - 29 cm	absent	
10 - 19 cm	absent	
5 - 9 cm	absent	
< 5 cm	present	n/a
Length of logs (m) (≥ 10 cm in diameter, >50cm in length)		0

Log length tally	
0	

Field Notes

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot score (% in each)	0	5	5	0	0
Average of the 5 subplots	2				

Cover: 0.1, 0.2, 0.3, …, 1, 2, 3, …, 5, 10, 15, 20, 25, …100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, …, 10, 20, 30, … 100, 200, …, 1000, …

GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	Stratum	Voucher
Natives below this line (see orange row for exotics). *Note: search for species in "Native Species by Growth Form" sheet and copy/paste exact spelling. If unsure when in the field use the 'common name/ field notes' column*							
Tree (TG)	Melaleuca quinquenervia		N	0.5	12		
Shrub (SG)	Melaleuca styphelioides		N	1	7		
Tree (TG)	Casuarina glauca		N	0	10		
Grass & grasslike (GG)	Baumea rubiginosa		N	2	50		
Grass & grasslike (GG)	Juncus usitatus		N	1	50		
Grass & grasslike (GG)	Imperata cylindrica		N	5	100		
Forb (FG)	Centella asiatica		N	0.1	50		
Grass & grasslike (GG)	Cynodon dactylon		N	0.2	20		
Forb (FG)	Goodenia spp.		N	0.1	10		
GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	Stratum	Voucher
Exotics (both E and HTE) below this line. *Note: search for species in "High Threat Weeds" sheet and if a match, copy/paste exact spelling of species name. If unsure when in the field, use 'common name/ field notes' column*							
	Asclepias curassavica		E	0.1	5		
	Cuphea carthagensis		E	0.1	10		
	Sporobolus spp		E	0.1	30		
	Cyperus eragrostis		HTE	1	100		
	Axonopus fissifolius		HTE	90	10000		
	Hypochaeris radicata		E	0.1	100		
	Setaria sphacelata		E	0.1	10		
	Cenchrus clandestinus		HTE	0.5	100		
	Senecio madagascariensis		HTE	0.1	5		
	Sonchus oleraceus		E	0.1	10		
	Chloris gayana		HTE	0.1	1		
	Andropogon virginicus		HTE	0.1	20		
			E				

Plot 10

Date				
6/07/2023				
Zone	Datum	Survey Name	Zone ID	
56	MGA94	Miles St		*Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.*
Start Easting	Start Northing	Start WP	Recorders	
			DH	
End Easting	End Northing	End WP		

IBRA region	Plot dimensions	Photo #	Midline bearing (degrees)
	20x50		274

Vegetation Class		**Confidence**	
Plant Community Type		**EEC?**	
Plant Community Name			

BAM Attribute (400 m^2 plot)		Sum values
Count of **Native Richness**	**Trees**	3
	Shrubs	1
	Grasses etc.	3
	Forbs	1
	Ferns	0
	Other	0
Sum of **Cover** of native vascular plants by growth form group	**Trees**	7.1
	Shrubs	0.5
	Grasses etc.	0.8
	Forbs	0.5
	Ferns	0
	Other	0
High Threat Exotic cover		92.6

Codes for formulas
Tree (TG)
Shrub (SG)
Grass & grasslike (GG)
Forb (FG)
Fern (EG)
Other (OG)
N
E
HTE

*(eg. 10, 20, 30…, 100, 200, 300…). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.***

*For **hollows**, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.*

BAM Attribute (1000 m^2 plot) DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 - 79 cm	0	
30 - 49 cm	absent	
20 - 29 cm	present	
10 - 19 cm	present	
5 - 9 cm	present	
< 5 cm	present	n/a
Length of logs (m) (≥ 10 cm in diameter, >50cm in length)		0

Log length tally	
0	

Field Notes

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot score (% in each)	5	0	10	5	5
Average of the 5 subplots	5				

Cover: 0.1, 0.2, 0.3, …, 1, 2, 3, …, 5, 10, 15, 20, 25, …100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m. Abundance: 1, 2, 3, …, 10, 20, 30, … 100, 200, …, 1000, …

GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	Stratum	Voucher
Natives below this line (see orange row for exotics). *Note: search for species in "Native Species by Growth Form" sheet and copy/paste exact spelling. If unsure when in the field use the 'common name/ field notes'*							
Tree (TG)	Melaleuca quinquenervia		N	5	20		
Tree (TG)	Casuarina glauca		N	2	5		
Shrub (SG)	Callistemon salignus		N	0.5	2		
Tree (TG)	Lophostemon suaveolens		N	0.1	5		
Grass & grasslike (GG)	Juncus usitatus		N	0.2	10		
Grass & grasslike (GG)	Sacciolepis indica		N	0.1	1		
Grass & grasslike (GG)	Cynodon dactylon		N	0.5	100		
Forb (FG)	Philydrum lanuginosum		N	0.5	10		
#N/A			#N/A				
GF Code	Species name	Common name/ field notes	N,E or HTE	Cover	Abund	Stratum	Voucher
Exotics (both E and HTE) below this line. *Note: search for species in "High Threat Weeds" sheet and if a match, copy/paste exact spelling of species name. If unsure when in the field, use 'common name/ field notes'*							
	Andropogon virginicus		HTE	2	20		
	Sporobolus spp		E	0.1	10		
	Polygala paniculata		E	0.3	50		
	Axonopus fissifolius		HTE	90	10000		
	Cyperus eragrostis		HTE	0.1	10		
	Setaria sphacelata		E	0.1	10		
	Cuphea carthagensis		E	0.5	10		
	Cenchrus clandestinus		HTE	0.5	100		
			E				

Appendix D

Assessment of Habitat Suitability – Ecosystem Credit Species

Table D1. Assessment of Habitat Suitability for Predicted Threatened Species (Ecosystem Credit Species)

NOTE: Species which have been accepted as 'Confirmed Predicted Species' shown in grey

Scientific name	*Common name*	*Habitat Requirement*	*Listed Habitat/ Geographic Constraints (BAM-C)*	*Confirmed Predicted Species*
Anseranas semipalmata	Magpie Goose	Mainly found in shallow wetlands (less than one metre deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off. Often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation. Nests in large rush/sedge swamps but forage broadly in wet grassland habitat often a significant distance from nesting locations.	-	Yes
Anthochaera phrygia	Regent Honeyeater (Foraging)	Typically inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Preferred habitat has significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Non-breeding flocks forage in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast.	-	Yes
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Primarily inhabits dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and groundcover of grasses or sedges and fallen woody debris. Also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland. Paddock trees may be used for nesting	-	Yes
Botaurus poiciloptilus	Australasian Bittern	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.).	• Waterbodies • Brackish or freshwater wetlands	Yes
Calidris canutus	Red Knot (Foraging)	Sheltered coasts on mudflats and sandbars of estuaries, harbors, lagoons; occasionally on beaches, reefs.	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
Calyptorhynchus lathami	Glossy Black-Cockatoo (Foraging)	Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods.	• Presence of *Allocasuarina* and *Casuarina* species	Yes
Chalinolobus nigrogriseus	Hoary Wattled Bat	In NSW the Hoary Wattled Bat occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Forests with naturally sparse understorey layers may provide the best habitat. Will occupy urban areas with suitable habitat. Roosts in hollows and rock crevices. Roost requirements poorly known, paddock trees should be flagged as potential roosts.	-	Yes
Circus assimilis	Spotted Harrier	Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. Most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	-	Yes
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding. Hollows in standing dead or live trees and tree stumps are essential for nesting.	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
Coracina lineata	Barred Cuckoo-shrike	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. They are usually seen in pairs or small flocks foraging among foliage of trees for insects and fruit.	-	Yes
Daphoenositta chrysoptera	Varied Sittella	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	-	Yes
Dasyurus maculatus	Spotted-tailed Quoll	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges of 200-500 ha, while males occupy very large home ranges from 500 to over 4000 ha. Are known to traverse their home ranges along densely vegetated creeklines. The species has been shown to use small patches and highly fragmented landscapes. Paddock trees can be used for denning in cleared landscape, as can other habitat (e.g. windrows). Males will disperse long distances however females remain close to maternal home range and are unlikely to disperse more than 10 km.	-	Yes
Ephippiorhynchus asiaticus	Black-necked Stork	Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Forages in the many small wet habitats, within a large home range, that in total form an important resource. Generally nests in isolated paddock trees or on the fringing vegetation of waterbodies.	-	Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Roost requirements poorly known; paddock trees should be flagged as potential roosts.	-	Yes
Glossopsitta pusilla	Little Lorikeet	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
		soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (three centimetres) and usually high above the ground (2 to 15 m).		
Grus rubicunda	Brolga	Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged. The nest comprises a platform of grasses and sticks, augmented with mud, on an island or in the water. Two eggs are laid from winter to autumn.	-	Yes
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	■ Waterbodies ■ Within 1kmof a river, lakes, large dams or creeks, wetlands and coastlines	Yes
Hieraaetus morphnoides	Little Eagle (Foraging)	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	-	Yes
Hirundapus caudacutus	White-throated Needletail	Most often recorded aerial foraging above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy. Breeding does not occur in Australia.	-	Yes
Irediparra gallinacea	Comb-crested Jacana	Inhabits permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation. Comb-crested Jacanas are dispersive, moving about in response to the condition of wetlands, and occasionally turn up well beyond normal range.	■ Waterbodies ■ Freshwater Wetlands with a good surface cover of floating aquatic vegetation	No. Habitat constraints not present at the site

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
Ixobrychus flavicollis	Black Bittern	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Primarily a vagrant in NSW.	▪ Waterbodies ▪ Land within 40m of freshwater and estuarine wetlands in areas of permanent water and dense vegetation	Yes
Lathamus discolor	Swift Parrot (Foraging)	Foraging habitat includes areas where eucalypts are flowering profusely or where abundant lerp infestations occur. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Forest Red Gum *E. tereticornis*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Inland Grey Box *E. microcarpa*, Grey Box *E. moluccana*, Blackbutt *E. pilularis* and Yellow *Box E. melliodora*.	-	Yes
Limosa lapponica baueri	Bar-tailed Godwit (Foraging)	Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms.	-	Yes
Lophoictinia isura	Square-tailed Kite (Foraging)	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Home ranges can extend over at least 100 km².	-	Yes
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. Paddock trees can be important for this species as they can link remnant foraging habitat.	-	Yes
Melithreptus gularis gularis	Black-chinned Honeyeater	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
	(eastern subspecies)	Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.		
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually change breeding sites regularly (every few days), rendering it very difficult to confirm breeding sites. Known to occasionally aggregate in large breeding groups (including in buildings). The species has been found to use paddock trees at Ravensworth SF in Hunter Valley, may provide critical roosts in some areas.	-	Yes
Miniopterus australis	Little Bentwing-bat (Foraging)	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas.	-	Yes
Miniopterus orianae oceanensis	Large Bentwing-bat (Foraging)	Hunts in forested areas, catching moths and other flying insects above the tree canopy.	-	Yes
Ninox connivens	Barking Owl (Foraging)	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. Requires very large permanent territories in most habitats due to sparse prey densities.	-	Yes
Ninox strenua	Powerful Owl (Foraging)	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
		day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species.		
	Eastern Curlew (Foraging)		-	Yes
Nyctophilus bifax	Eastern Long-eared Bat	Lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. Coastal rainforest and patches of coastal scrub are particularly favoured. Roosts in tree hollows, the hanging foliage of palms, in dense clumps of foliage of rainforest trees, under bark and in shallow depressions on trunks and branches, among epiphytes, in the roots of strangler figs, among dead fronds of tree ferns and less often in buildings.	-	Yes
Oxyura australis	Blue-billed Duck	Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer.	-	Yes
Ozimops lumsdenae	Northern Free-tailed Bat	A range of vegetation types in northern Australia, from rainforests to open forests and woodlands; often recorded along watercourses. They can also occur in towns and cities. Roost mainly in tree hollows but relatively large colonies have been found under house roofs in urban areas in Queensland. Paddock trees are potentially used for roosting and breeding.	-	Yes
Pandion cristatus	Eastern Osprey (Foraging)	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feeds on fish over clear, open water.	-	Yes
Petaurus australis	Yellow-bellied Glider	Occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Den, often in family groups, in hollows of large trees. Very mobile and occupy large home ranges	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
		between 20 to 85 ha to encompass dispersed and seasonally variable food resources. Dispersal requires continuous habitat connectivity (gliding distance around 120m).		
Petroica boodang	Scarlet Robin	Occurs in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. Both mature and regrowth vegetation are utilised. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Abundant logs and fallen timber are important habitat components. Primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees. Paddock trees are used for roosting and foraging.	-	Yes
Petroica phoenicea	Flame Robin	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains). In winter occurs in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees; occasionally seen in heathland or other shrublands in coastal areas. Breeding and non-breeding habitat is very different. The species will occupy smaller patches outside breeding season. Paddock trees are used for roosting and foraging.	-	Yes
Phoniscus papuensis	Golden-tipped Bat	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000 m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Will fly up to two kilometres from roosts to forage in rainforest and sclerophyll forest on mid and upper-slopes. Roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests. May also roost under thick moss on tree trunks, in tree hollows,	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
		dense foliage and epiphytes. Bats will use multiple roost and change roosts regularly. Bats roost individually or in small colonies which can contain up to approximately 20 bats of both males and females or just a single sex.		
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Inhabits open Box-Gum Woodlands on the slopes, Box-Cypress-pine and open Box Woodlands on alluvial plains and woodlands on fertile soils in coastal regions. Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. Nests are usually located in shrubs or sapling eucalypts, although may be built in the outermost leaves of low branches of large eucalypts. Territories range from 1 to 50 ha (usually around 10 ha) and are defended all year. Paddock trees can be important for this species as they can link remnant foraging habitat.	-	Yes
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again. Generally only located in large patches.	-	Yes
Pseudomys novaehollandiae	New Holland Mouse	Occurs in open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	-	Yes
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	-	Yes
Ptilinopus superbus	Superb Fruit-Dove	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. May also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic.	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
Rostratula australis	Australian Painted Snipe	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	-	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn. Paddock trees should be flagged as potential roosts.	-	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	-	Yes
Stagonopleura guttata	Diamond Firetail	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Appears to be sedentary, though some populations move locally, especially those in the south. Has been recorded in some towns and near farm houses.	-	Yes
Stictonetta naevosa	Freckled Duck	Prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	-	Yes
Syconycteris australis	Common Blossom-bat	Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of other vegetation communities, such as subtropical rainforest, wet sclerophyll forest and other coastal forests. They generally roost individually in dense foliage and vine thickets of the sub-canopy, staying in the same general area for a season. They change roost sites daily, but each roost site is generally only 50 m or so away from other recent roosts. Favoured feeding sites are repeatedly	-	Yes

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints (BAM-C)	Confirmed Predicted Species
		visited on consecutive nights within a flowering season and revisited over several years. They require a year round supply of nectar and pollen which is gathered from a mosaic of coastal complex vegetation types. When these vegetation types are in short supply of nectar and pollen (Nov/Dec in northern NSW) Common Blossom-bats have been known to utilise riverine areas containing Black Bean, Silky Oak and Weeping Bottlebrush.		
Tyto longimembris	Eastern Grass Owl	Areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	-	Yes
Tyto novaehollandiae	Masked Owl (Foraging)	Dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. Pairs have a large home-range of 500 to 1000 ha. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Will use areas that are quite small, especially as foraging habitat but also as roosting habitat and occasionally as breeding habitat. Dead stags are especially popular for roosting/breeding habitat and are a limited resource due to natural attrition.	-	Yes
Xenus cinereus	Terek Sandpiper (Foraging)	Coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.	▪ Tidal influenced waterbodies within 15 km of coast	No. Habitat constraints not present at the site.

Appendix E

Assessment of Habitat Suitability – Species Credit Species

Table E1. Assessment of Habitat Suitability for Candidate Threatened Species (Species Credit Species)

NOTE: Species which may occur are shaded in grey

Scientific name	*Common name*	*Habitat Requirement*	*Listed Habitat/ Geographic Constraints*	*Confirmed Candidate Species*
Acronychia littoralis	Scented Acronychia	Mainly occurs within two kilometres from the coast on sandy soil in transition zones between littoral rainforest and swamp sclerophyll forest, between littoral and coastal cypress pine communities and margins of littoral forest.	■ Within 5km of coast	No. Suitable habitat is absent. No *Acronychia* sp. present at site.
Aepyprymnus rufescens	Rufous Bettong	Inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter.	-	No. Suitable habitat is absent. Grassland and forest degraded, slashed and grazed. No shelter habitat occurs.
Allocasuarina defungens	Dwarf Heath Casuarina	Tall heath on sand, also on clay and sandstone. Habitat also extends onto exposed nearby-coastal hills or headlands adjacent to sandplains.	■ Within 15km of coast	No. Suitable habitat is absent.
Ancistrachne maidenii	Ancistrachne	Dry sclerophyll forest on sandstone-derived soils.	-	No. Suitable habitat is absent.
Anthochaera phrygia	Regent Honeyeater (Breeding)	Typically inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Preferred habitat has significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Non-breeding flocks forage in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Two known key breeding areas occur in NSW (Capertee Valley and Bundarra-Barraba regions).	As per Important Habitat Map	No. Suitable habitat is absent. No recent local records. The site is not within proximity to key known breeding sites or included on Important Habitat Mapping for the species.
Archidendron hendersonii	White Lace Flower	Riverine and lowland subtropical rainforest, littoral rainforest, coastal cypress pine forest and their ecotones. Occurs on a variety of soils including coastal sands and those derived from basalt and metasediments.	-	No. Suitable habitat is absent.
Argynnis hyperbius	Laced Fritillary	Open swampy coastal habitat where the caterpillar's food plant, Arrowhead Violet (*Viola betonicifolia*) occurs	■ Arrowhead Violet	No. Suitable habitat is absent; no *Viola betonicifolia* on-site.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
		in the vegetation ground layer beneath grasses and mat-rushes (*Lomandra* spp.). Laced Fritillary require a high watertable and high water nutrient load and is a 'boom and bust' species, triggered by flooding.	■ Within 15km of coast	
Arthraxon hispidus	Hairy Jointgrass	Moist shady places in or on the edges of rainforest and wet eucalypt forest, often near creeks or swamps.	-	No. Suitable habitat is absent. No BioNet records in Yamba locality. Grassland and sedgeland habitats degraded and modified; typical companion species Swamp Foxtail is absent (refer White *et al.* 2019).
Burhinus grallarius	Bush Stone-curlew	Lightly timbered open forest and woodland and partly cleared farmland with woodland remnants, preferring areas with dry leaf-litter, fallen timber and sparse ground cover.	■ Fallen/ standing dead timber including logs	No. Suitable habitat is absent; no recent records in Yamba locality. Grassland and woodland habitats degraded and modified (slashing/grazing).
Cacophis harriettae	White-crowned Snake	Low to mid-elevation dry eucalypt forest and woodland with well-developed litter layer. Also occasionally found in moist eucalypt forest and coastal heathland.	■ Litter/ rocky areas ■ Surface rocks/ fallen/ standing dead timber including logs ■ Or within 50m of fallen timber including logs	No. Suitable habitat is absent. Grassland and woodland habitats degraded and modified (slashing/grazing).
Calidris canutus	Red Knot (Breeding)	Sheltered coasts on mudflats and sandbars of estuaries, harbors, lagoons; occasionally on beaches, reefs.	■ As per Important Habitat Map	No. Site not included on Important Habitat Map.
Callistemon linearifolius	Netted Bottle Brush	Dry sclerophyll forest on the coast and adjacent ranges.	-	No. Suitable habitat is absent. No BioNet records in Yamba locality.
Calyptorhynchus banksii banksii	Red-tailed Black-Cockatoo (coastal subspecies)	Dry open forest and areas of mixed rainforest-eucalypt forest. Almost certainly extinct in NSW.	-	No. Suitable habitat is absent. Listed as extinct in NSW.
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Dependent on large hollow-bearing eucalypts for nest sites.	■ Hollow-bearing trees ■ Living or dead tree with hollows	No. No hollow trees of suitable dimensions occur; other preferred breeding features are absent.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
			greater than 15cm diam and greater than 8m above ground	
Carterornis leucotis	White-eared Monarch	Occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. They appear to prefer the ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads.	-	No. PCT 1064 lacks suitable structure and is isolated and small in area.
Centranthera cochinchinensis	Swamp Foxglove	Swampy areas and other moist sites.	■ Semi-permanent/ ephemeral wet areas ■ Or within 50 m buffer of Swamps ■ Or within a 50m buffer of waterbodies ■ Including wetlands or within a 50m buffer	Yes. Suitable (albeit degraded and disturbed) habitat occurs.
Cercartetus nanus	Eastern Pygmy-possum	Inhabits a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	-	No. Suitable habitat is absent.
Chalinolobus dwyeri	Large-eared Pied Bat	Found in well-timbered areas containing gullies. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin, frequenting low to mid-elevation dry open forest and woodland close to these features.	■ Cliffs ■ Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops or	No. Suitable habitat is absent.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
			crevices or within 2 km of old mines or tunnels	
Crinia tinnula	Wallum Froglet	Usually associated with acidic swamps on coastal sand plains; typically occur in sedgelands and wet heathlands. Also found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. Breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches.	■ Within 30km of coast	No. Suitable habitat is absent; watercourses are not permanent. No recent BioNet records in Yamba locality.
Cyperus aquatilis	Water Nutgrass	Appears as an annual during the wet summer period within ephemerally wet sites, such as roadside ditches and seepage areas from small cliffs; sandstone areas.	-	Yes. Suitable (albeit degraded and disturbed) habitat occurs.
Davidsonia jerseyana	Davidson's Plum	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300 m). Restricted to north-east NSW to as far south as Wardell.	■ North of Ballina	No. Suitable habitat is absent within development site; site outside natural range. No BioNet records in LGA.
Dendrobium melaleucaphilum	Spider Orchid	Grows frequently on *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks in coastal districts.	-	Yes. Suitable habitat occurs. Plants within larger patches of PCT 1064 on Lot 47.
Desmodium acanthocladum	Thorny Pea	Dry rainforest and fringes of riverine subtropical rainforest on basalt-derived soils at low elevations.	-	No. Suitable habitat is absent.
Diploglottis campbellii	Small-leaved Tamarind	Habitat varies from lowland subtropical rainforest to drier subtropical rainforest with a Brush Box open overstorey. Occurs on basalt-derived soils and also on poorer soils such as those derived from quartz monzonite.	■ North of Ballina	No. Suitable habitat is absent.
Dromaius novaehollandiae - endangered population	Emu population in the NSW North Coast Bioregion and Port Stephens LGA	On the NSW north coast, Emus occur in a range of predominantly open lowland habitats, including grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities, as well as the ecotones between these habitats. They also occur in plantations of tea-tree and open farmland, and occasionally in littoral rainforest.	-	No. Suitable habitat is absent. No recent BioNet records in Yamba locality.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
Drynaria rigidula	Basket Fern	Usually found in rainforest but also in moist eucalypt and Swamp Oak forest. Grows on plants, rocks or ground in rainforest and moist eucalypt forest.	-	No. Suitable habitat is absent. No BioNet records in Yamba locality.
Eleocharis tetraquetra	Square-stemmed Spike-rush	Damp locations on stream edges and in and on the margins of freshwater swamps.	■ Semi-permanent/ ephemeral wet areas ■ In small drainage depressions	Yes. Suitable habitat occurs. No recent BioNet records in Yamba locality. A species with a sporadic distribution and known top occur in disturbed areas.
Elionurus citreus	Lemon-scented Grass	Associated with sandy soils near rivers or along the coast in wallum areas or sand dunes (including in infertile white sands).	-	No. Suitable habitat is absent.
Endiandra muelleri subsp. *bracteata*	Green-leaved Rose Walnut	Subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats. Records are usually from poorer soils derived from sedimentary, metamorphic or acid volcanic rocks, chiefly at lower altitudes.	-	No. Suitable habitat is absent.
Eucalyptus glaucina	Slaty Red Gum	Grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.	-	No. Suitable habitat is absent. No BioNet records in Yamba locality.
Eucalyptus tetrapleura	Square-fruited Ironbark	Dry or moist eucalypt forest on moderately fertile soil, often in low areas with poor drainage.	-	No. Suitable habitat is absent; no ironbark on-site. No BioNet records in Yamba locality.
Geodorum densiflorum	Pink Nodding Orchid	Dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand.	-	No. Suitable habitat is absent.
Gossia fragrantissima	Sweet Myrtle	Dry subtropical and riverine rainforest, isolated plants can be found in paddocks from regrowth mostly on basalt-derived soils.	■ North of Evans Head	No. Suitable habitat is absent. No BioNet records in LGA.
Grevillea masonii	Mason's Grevillea	Occurs on gravely loam soils and in sand in open eucalypt woodland.	■ Grafton formation geology	No. Suitable habitat is absent. No BioNet records in Yamba locality.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs,	■ Living or dead mature trees within suitable vegetation within 1 km of a river, lake, large	No. No stick nests occur within the development site.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
		billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat is live large old trees within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period.	dam or creek, wetland and coastlines.	
Hieraaetus morphnoides	Little Eagle (Breeding)	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. Paddock trees can provide important breeding habitat.	■ Nest trees	No. No stick nests occur within the development site.
Hoplocephalus bitorquatus	Pale-headed Snake	Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas.	-	No. Suitable habitat is absent. PCT 837 provides unsuitable habitat due to its isolation, small size and lack of structural complexity. Woodland habitat degraded and modified (slashing/grazing).
Indigofera baileyi	Bailey's Indigo	Open woodlands on loam and clay loam soils, typically from granite or basalt, but also from sediments in the Clarence lowlands.	-	No. Suitable habitat is absent. No BioNet records in Yamba locality.
Lathamus discolor	Swift Parrot (Breeding)	On mainland Australia only present in non-breeding season (breeding occurs in Tasmania only).	■ As per Important Habitat Map	No. No breeding occurs in NSW. Site is not included on Important Habitat Map.
Lichenostomus fasciogularis	Mangrove Honeyeater	Primary habitat is mangrove woodlands and shrublands but Mangrove Honeyeaters also range into adjacent forests, woodlands and shrublands, including casuarina and paperbark swamp forests and associations dominated by eucalypts or banksias.	■ Within 10 km of coast	Yes. Potential opportunistic foraging habitat.
Limosa lapponica baueri	Bar-tailed Godwit (Breeding)	Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms.	■ As per Important Habitat Map	No. Site is not included on Important Habitat Map.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
Lindernia alsinoides	Noah's False Chickweed	Swamp forests and wetlands along coastal and hinterland creeks.	■ Damp areas or adjacent to riparian areas ■ Shallow, freshwater areas	No. Wetland areas (PCT 780) are degraded from grazing and slashing; no BioNet records in the Yamba locality.
Lindsaea incisa	Slender Screw Fern	Dry eucalypt forest on sandstone and moist shrubby eucalypt forest on metasediments. Waterlogged or poorly drained sites along creeks, where ferns, sedges and shrubs grow thickly.	-	No. Suitable habitat is absent as all drainage areas are highly modified. No BioNet records in Yamba locality.
Litoria aurea	Green and Golden Bell Frog	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.	■ Within 1 km of wet areas/ swamps ■ Within 1 km of swamp/ waterbodies	No. Suitable habitat is absent. No recent BioNet records in Yamba locality. Wetland areas (PCT 780) are degraded from grazing and slashing.
Litoria brevipalmata	Green-thighed Frog	Occurs in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. They prefer wetter forests in the south of the range but extend into drier forests in northern NSW and southern Queensland.	■ Semi-permanent/ ephemeral wet areas	No. Suitable habitat is absent. No recent BioNet records in Yamba locality. Woodland and Wetland areas (PCT 837 and 780) are degraded from grazing and slashing.
Litoria olongburensis	Olongburra Frog	Confined to coastal sandplain wallum swamps within acidic pH (2.8-5.5) wetlands. Frogs are highest in abundance in relatively undisturbed wallum swamps.	■ Within 10 km of coast	No. Suitable habitat is absent. No recent BioNet records in Yamba locality.
Lophoictinia isura	Square-tailed Kite (Breeding)	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Home ranges can extend over at least 100 km². Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	■ Nest trees	No. No stick nests occur within the development site.
Macadamia tetraphylla	Rough-shelled Bush Nut	Subtropical rainforest usually near the coast.	■ North of Coraki	No. Suitable habitat is absent.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
Maundia triglochinoides	Maundia	Swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Associated with wetland species e.g. *Cycnogeton procerum*.	■ Riparian areas/ drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep	Yes. PCTs 1235 and 780 provide potential habitat where *Cycnogeton procerum* occurs.
Melaleuca irbyana	Weeping Paperbark	Open eucalypt forest in poorly drained, usually clay, sandstone or alluvial soils.	-	No. Suitable habitat is absent. No BioNet records in Yamba locality. Potential habitat (PCT 837) degraded from grazing and slashing and no shrub layer occurs.
Miniopterus australis	Little Bentwing-bat (Breeding)	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. They often share roosting sites with the Large Bentwing-bat and, in winter, the two species may form mixed clusters. Maternity colonies form in spring and birthing occurs in early summer. Only five nursery sites/maternity colonies are known in Australia.	■ Caves ■ Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	No. No suitable breeding habitat present.
Miniopterus orianae oceanensis	Large Bentwing-bat (Breeding)	Hunts in forested areas, catching moths and other flying insects above the tree tops. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves.	■ Caves ■ Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	No. No suitable breeding habitat present.
Mixophyes iteratus	Giant Barred Frog	Freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured habitat.	■ Land within 50m of semi permanent	No. Suitable habitat is absent.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
			and permanent drainages	
Myotis macropus	Southern Myotis	Generally roosts in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish by raking their feet across the water surface. Dependent on waterways with pools of three metres wide or greater for foraging. Dependent on waterways with pools of three metres wide or greater for foraging, habitat surrounding waterways is used for breeding and roosting.	■ Waterbodies ■ Waterbodies with permanent pools/ stretches 3 m or wider including rivers, large creeks, billabongs, lagoons, estuaries, dams.	Yes. Potential foraging habitat is present within the farm dam on Lot 47. Small stretches of open water occur within the ephemeral drain bisecting regrowth Swamp Oak (PCT 1235). While much of the waterway may contain macrophytes, an estimated 100 m² (50 m x 2 m width) of open water occurs which provides poor foraging opportunities and only when the drain holds water. Sedgeland (PCT 780) is also unsuitable foraging habitat due to the lack of open water and ephemeral nature of fragmented patches. No hollow-bearing trees occur within the development site. No breeding habitat is present.
Myrsine richmondensis	Ripple-leaf Muttonwood	Subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil and alluvial deposits.	-	No. Suitable habitat is absent. No BioNet records in LGA.
Nettapus coromandelianus	Cotton Pygmy-Goose	Freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. This species is vagrant in NSW, an occasional visitor to northern NSW from South-east Qld. Although they breed in tree hollows there are no breeding records in NSW.	■ Waterbodies ■ Deep permanent fresh waters on floodplains with floating and submergent vegetation	No. Suitable habitat is absent. No BioNet records in LGA, vagrant in NSW.
Ninox connivens	Barking Owl (Breeding)	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils. Roost in shaded portions of tree canopies,	■ Hollow-bearing trees ■ Living or dead trees with hollows greater than 20cm diameter and	No. No hollow trees of suitable dimensions occur; other preferred breeding features are absent.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
		including tall midstorey trees with dense foliage such as Acacia and Casuarina species. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 ha, with 2000 ha being more typical in NSW habitats. Two or three eggs are laid in hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators (e.g. goannas). Breeding is identified by suitable habitat and presence of male and female or calling to each other (duetting) or presence of a nest or existing breeding habitat identified.	greater than 4m above the ground	
Ninox strenua	Powerful Owl (Breeding)	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species. Nesting occurs in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. The species can breed and forage in very small patches of vegetation, although this is hugely variable across their range. Breeding can be identified by suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified.	■ Hollow-bearing trees ■ Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground	No. No hollow trees of suitable dimensions occur; other preferred breeding features are absent.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
Numenius madagascariensis	Eastern Curlew (Breeding habitat)	Occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts.	▪ As per Important Habitat Map	No. Site does not occur on Important Habitat Map.
Oberonia complanata	Yellow-flowered King of the Fairies	Grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes (including stabilised sands), stream-side areas, swampy forests and mangroves.	-	No Suitable habitat is absent; no BioNet records in the Yamba locality, with only one record in the LGA (east of Grafton).
Oberonia titania	Red-flowered King of the Fairies	Littoral and subtropical rainforest and paperbark swamps; may also occur in eucalypt-forested gorges and in mangroves.	-	No. Suitable habitat is absent; no BioNet records in the Yamba locality, with only two records in the LGA (near Woolgoolga).
Ochrosia moorei	Southern Ochrosia	Riverine and lowland subtropical rainforest.	▪ North of Richmond River	No. Suitable habitat is absent.
Olax angulata	Square-stemmed Olax	Low-lying coastal heaths and heathy woodlands on sandy soils near swamps, often in association with Wallum Banksia (*Banksia aemula*).	-	No. Suitable habitat is absent.
Oldenlandia galioides	Oldenlandia	Margins of seasonally inundated wetlands in paperbark swamps and Forest Red Gum (*Eucalyptus tereticornis*) woodlands.	-	No. Suitable habitat is absent; no known BioNet records in the LGA.
Pandion cristatus	Eastern Osprey (Breeding)	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breeds from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. This species can nest in isolated trees.	▪ Presence of stick nests in living and dead trees (>15m) or artificial	No. No stick nests occur at within the development site.
Peristeranthus hillii	Brown Fairy-chain Orchid	Restricted to coastal and near-coastal environments, particularly littoral rainforest and lowland rainforest on floodplain.	▪ Within 5 km of coast	No. Suitable habitat is absent; only one BioNet record in the LGA from littoral rainforest at Iluka.
Persicaria elatior	Tall Knotweed	Typically grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	▪ Semi-permanent/ ephemeral wet areas ▪ Or within 50m of swamps	Yes. Potential habitat within PCT 780 and adjacent wet pasture (although both habitats degraded and modified). Numerous records along the W2B highway upgrade associated with areas of swampy pasture.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
			■ Or within 50m of waterbodies	
Petalura litorea	Coastal Petaltail	Permanent wetlands, swamps and bogs with some free water and open vegetation. Restricted to coastal and near coastal lowlands between Coffs Harbour and Byron Bay; known from a very small number of locations, including Brooms Head, Tucabia, Diggers Camp and Bonville.	■ Swamps ■ Vegetation within 500m of swamps	Yes. Very marginal suitable habitat within development site; PCT 780 represents degraded habitat which is disturbed by grazing. Potential habitat within eastern residue land.
Petauroides volans	Greater Glider	Ranges and coastal plains of eastern Australia, where it inhabits a variety of eucalypt forests and woodlands.	-	No. No suitable sized denning hollows on the site.
Petaurus norfolcensis	Squirrel Glider	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Relies on large old trees with hollows for breeding and nesting. These trees are also critical for movement and typically need to be closely-connected (i.e. no more than 50 m apart).	-	No. While there are records of Squirrel Glider in Yamba township in association with swamp forest, resources within the development site are small in area, isolated and have a fragmented connection to substantial areas of habitat to the south of the site. These adjacent habitats provide large areas of well-connected structurally complex open forest. In contrast, PCT 837 at the site is highly modified to a woodland type formation with large gaps between trees within the development site. Patches of PCT 1064 within the development site are very small in area and are isolated/fragmented and comprise poorly developed regrowth. No hollow-bearing trees (potential den trees) occur within the development site.
Phaius australis	Southern Swamp Orchid	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest mostly in coastal areas.	-	No. Known populations around Yamba from swamp sclerophyll forest along Angourie Road, however no suitable habitat occurs within the development site, which has been significantly disturbed and modified.
Phascogale tapoatafa	Brush-tailed Phascogale	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll	■ Hollow-bearing trees	No. Suitable habitat is absent. PCT 837 provides unsuitable habitat due to its isolation, small size and lack of den trees.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
		forest. Nest and shelter in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span.		
Phascolarctos cinereus	Koala (Breeding)	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Preferred (primary) food tree species in coastal parts of the Clarence LGA include Tallowwood, Swamp Mahogany, Forest Red Gum, Small-fruited Grey Gum, Orange Gum and Cabbage Gum (refer to *Comprehensive Koala Plan of Management for the Ashby, Woombah and Iluka localities in the Clarence Valley LGA*; Clarence Valley Council 2015).	■ Presence of koala use trees	No. Suitable habitat is absent and there are no recent local records (BioNet).
Phyllanthus microcladus	Brush Sauropus	Banks of creeks and rivers, in streamside rainforest or dry rainforest.	-	No. Suitable habitat is absent.
Planigale maculata	Common Planigale	Inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. Habitat includes hollow logs, under bark, rocks, cracks in soil, grass tussocks or building debris.	-	No. Suitable habitat is absent. Vegetation is too disturbed from regular grazing and occasional slashing, logs and debris are absent and structural complexity is very low.
Polygala linariifolia	Native Milkwort	Sandy soils in dry eucalypt forest and woodland with a sparse understorey. Typically associated with inland habitats (Pilliga, Torrington districts).	-	No. Suitable habitat is absent, site is outside known range; no known BioNet records in the LGA.
Potorous tridactylus	Long-nosed Potoroo	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas.	■ Dense shrub layer or alternatively high canopy cover exceeding 70%	No. Suitable habitat is absent.
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a	■ Breeding camps	No. No suitable breeding habitat on-site due to very small degraded areas of vegetation. There are no historical records of a camp at the site.

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
		regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.		
Rotala tripartita	Rotala	Riparian species that grows in free-standing water with sedges. Individuals disappear above-ground during dry periods and may only persist during these times in the soil seed-bank. Also known from Melaleuca freshwater coastal wetland.	▪ Shallow swampy or poorly drained areas including gilgai	Yes. Potential habitat within PCT 780; known records from parts of the site outside the development footprint.
Syzygium hodgkinsoniae	Red Lilly Pilly	Riverine and subtropical rainforest on rich alluvial or basaltic soils.	▪ North of Richmond River	No. Suitable habitat is absent, site is outside known range; no known BioNet records in the LGA.
Thersites mitchellae	Mitchell's Rainforest Snail	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils. Slightly higher ground around the edges of wetlands with palms and fig trees are particularly favoured habitat. Typically found amongst leaf litter on the forest floor, and occasionally under bark in trees. The species is almost entirely known from the coastal plains and hills in swamp forests, which is a peripheral vegetation to its true core habitat, the lowland subtropical rainforest, which has been removed/cleared. There have been increasingly more sites discovered due to increased survey/observation, particularly in and around Kingscliff and Byron areas.	-	No. The site is out of the species natural range; not recorded within the LGA (BioNet).
Todiramphus chloris	Collared Kingfisher	Virtually restricted to mangrove associations of estuaries, inlets, sheltered bays and islands, and the tidal flats and littoral zone bordering mangroves. They sometimes occur in terrestrial forests or woodlands bordering mangroves, where they will nest in holes in trees or in arboreal termitaria. Occasionally observed in streets or gardens in built-up areas bordering mangrove vegetation.	▪ Within 5 km of coast and tidal ▪ Hollow-bearing trees	No. Suitable habitat is absent; the site is isolated from mangroves 800 m to the west at Oyster Channel.
Turnix maculosus	Red-backed Button-quail	In NSW Red-backed Button-quail occur in grasslands, heath and crops, preferring sites close to water, especially when breeding. The species has been observed associated with the following grasses (in	-	No. Suitable habitat is absent; habitats are too disturbed/degraded; no local records (BioNet).

Scientific name	Common name	Habitat Requirement	Listed Habitat/ Geographic Constraints	Confirmed Candidate Species
		various vegetation formations): speargrass *Heteropogon*, Blady Grass *Imperata cylindrica, Triodia, Sorghum*, and Buffel Grass *Cenchrus ciliaris*.		
Tyto novaehollandiae	Masked Owl (Breeding)	Dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. Pairs have a large home-range of 500 to 1000 ha. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Will use areas that are quite small, especially as foraging habitat but also as roosting habitat and occasionally as breeding habitat. Dead stags are especially popular for roosting/breeding habitat and are a limited resource due to natural attrition.	■ Hollow-bearing trees ■ Living or dead trees with hollows greater than 20cm diameter.	No. No hollow trees of suitable dimensions occur; other preferred breeding features are absent.
Vespadelus troughtoni	Eastern Cave Bat	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; occasionally found along cliff-lines in wet eucalypt forest and rainforest.	■ Caves ■ Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles.	No. Suitable habitat is absent.
Xenus cinereus	Terek Sandpiper (Breeding)	Coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.	■ Tidal influenced water bodies within 15km of coast ■ As per Important Habitat Map	No. Site is not mapped as Important Habitat.

Appendix F

Fauna Inventory

Table F1. Fauna inventory*

***Based on field assessment over various site visits from July 2018 to present**

Scientific name	*Common name*	*Record*
Amphibians		
*Bufo marinus**	Cane Toad	O
Crinia parinsignifera	Beeping Froglet	C
Crinia signifera	Common Eastern Froglet	C
Reptiles		
Dendrelaphis punctulata	Green Tree Snake	O
Lampropholis delicata	Grass Skink	O
Birds		
Acanthiza pusilla	Brown Thornbill	C
Accipiter fasciatus	Brown Goshawk	O
*Acridotheres tristis**	Common Myna	O
Anas superciliosa	Pacific Black Duck	O
Anthus novaeseelandiae	Australasian Pipit	O
Ardea ibis	Cattle Egret	O
Ardea pacifica	White-necked Heron	O
Artamus leucorynchus	White-breasted Woodswallow	O
Cacatua galerita	Sulphur-crested Cockatoo	C
Cacomantis variolosus	Brush Cuckoo	C
Centropus phasianinus	Pheasant Coucal	C
Chenonetta jubata	Australian Wood Duck	O
Chroicocephalus novaehollandiae	Silver Gull	O
Chrysococcyx lucidus	Shining Bronze-cuckoo	C
Cisticola exilis	Golden-headed Cisticola	O
Colluricincla harmonica	Grey Shrike-Thrush	C
Columba leucomela	White-headed Pigeon	C
Coracina novaehollandiae	Black-faced Cuckoo-shrike	C
Coracina tenuirostris	Cicadabird	C
Corvus orru	Torresian Crow	O
Coturnix ypsilophora	Brown Quail	O
Cracticus nigrogularis	Pied Butcherbird	O
Cracticus tibicen	Australian Magpie	O
Cracticus torquatus	Grey Butcherbird	O
Dacelo novaeguineae	Laughing Kookaburra	O
Dicaeum hirundinaceum	Mistletoebird	C
Dicrurus bracteatus	Spangled Drongo	O
Egretta novaehollandiae	White-faced Heron	O
Elanus axillaris	Black-shouldered Kite	O
Entomyzon cyanotis	Blue-faced Honeyeater	O
Eolophus roseicapilla	Galah	O

Scientific name	Common name	Record
Eopsaltria australis	Eastern Yellow Robin	C
Eudynamys scolopaceus	Eastern Koel	C
Eurystomus orientalis	Dollarbird	O
Falco berigora	Brown Falcon	O
Falco longipennis	Australian Hobby	O
Gallinago hardwickii	Latham's Snipe	O
Gallirallus philippensis	Buff-banded Rail	O
Geopelia humeralis	Bar-shouldered Dove	O
Geopelia placida	Peaceful Dove	O
Grallina cyanoleuca	Magpie Lark	O
Hirundo neoxena	Welcome Swallow	O
Lalage leucomela	Varied Triller	O
Lichmera indistincta	Brown Honeyeater	O
Lopholaimus antarcticus	Topknot Pigeon	O
Malurus cyaneus	Superb Fairy-wren	O
Malurus melanocephalus	Red-backed Fairy-wren	O
Manorina melanocephala	Noisy Miner	O
Meliphaga lewinii	Lewin's Honeyeater	O
Merops ornatus	Rainbow Bee-eater	O
Myzomela sanguinolenta	Scarlet Honeyeater	O
Neochmia temporalis	Red-browed Finch	O
Ocyphaps lophotes	Crested Pigeon	O
Oriolus sagittatus	Olive-backed Oriole	O
Pachycephala pectoralis	Golden Whistler	O
Pachycephala rufiventris	Rufous Whistler	C
Pardalotus striatus	Striated Pardalote	C
Pelecanus conspicillatus	Australian Pelican	O
Philemon corniculatus	Noisy Friarbird	O
Platycercus eximius	Eastern Rosella	O
Porphyrio porphyrio	Purple Swamphen	O
Psophodes olivaceus	Eastern Whipbird	C
Rhipidura albiscapa	Grey Fantail	O
Rhipidura leucophrys	Willie Wagtail	O
Rhipidura rufifrons	Rufous Fantail	O
Sphecotheres vieilloti	Australasian Figbird	O
*Spilopelia chinensis**	Spotted Turtle-dove	O
Strepera graculina	Pied Currawong	O
Threskiornis molucca	Australian White Ibis	O
Threskiornis spinicollis	Straw-necked Ibis	O
Todiramphus sanctus	Sacred Kingfisher	O
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	O
Trichoglossus haematodus	Rainbow Lorikeet	O
Vanellus miles	Masked Lapwing	O
Zosterops lateralis	Eastern Silvereye	C
Mammals		
*Lepus europaeus**	European Hare	O
Macropus giganteus	Eastern Grey Kangaroo	O

C= Call; O = Observed; *Introduced species

Appendix G

SAII Assessment

The Threatened Biodiversity Data Collection (TBDC) identifies Rotala as being an SAII entity. Extinction risks to SAII species is evidence of:

- rapid decline
- small population size
- limited geographic distribution
- the species being unlikely to respond to management.

Section 10.2 of the BAM 2020 prescribes additional impact assessment provisions for threatened species or populations where an entity is an SAII species or community. The BAM Operational Manual (Stage 2) and SAII guidance document (EES 2019b) were consulted to address SAII matters as below:

***Rotala tripartita* (Rotala) - species profile:**

- Status: Endangered (BC Act)
- Impact threshold (TBDC): not stated (under development)
- BioNet records: 309 records (as at 03/05/2021) from six broad locations (Casino [1999], east of Rappville - Ermelo stewardship site [April 2020], Jacky Bulbin Road, Mororo [2014], Yamba [the subject site], Tucabia [2016], Shannondale [2001, 2005]; refer **Figure F1**. One site (Jacky Bulbin Flat, where two plants were recorded) has been lost to redevelopment of the Pacific Highway; it is understood successful translocation of these plants was achieved (pers. comm. Dr Andrew Benwell 2020).
- Other data: Rotala has also been recorded at Mongogarie (SW of Casino) and Dilkoon (north of Grafton); pers. data.
- Population details: The closest record to the site is approximately 20 km to the north (Jacky Bulbin Flat – site cleared and plants translocated). The next closest population at Tucabia is ~33 km south of the site. On the basis of BioNet records, the population at the site is locally significant and unlikely to be related to any known populations of the species. The site is separated from the Casino and Shannondale populations by at least 60 km.

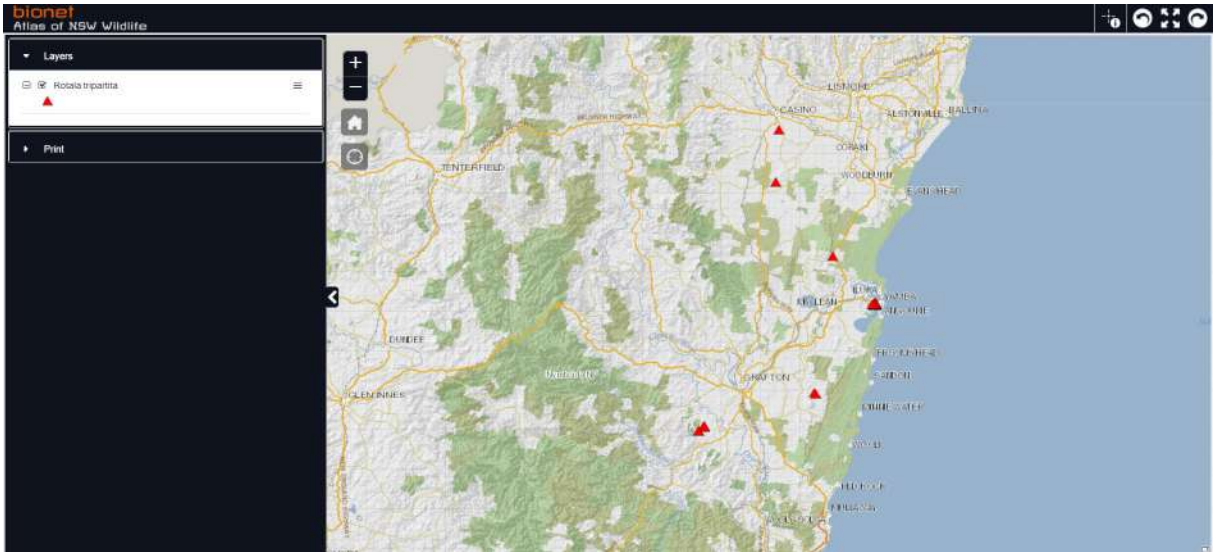


Figure F1. Rotala records in the BioNet Atlas

Field records:

Initial survey of sedgeland areas at adjacent Lot 47 detected Rotala almost immediately within disturbed sedgeland (slashed and grazed) dominated by *Baumea rubiginosa*. Samples were sent to the NSW Herbarium for confirmation before proceeding with further targeted survey. Following confirmation, targeted survey was completed of all wetland environments in Lots 46 and 47. Rotala was recorded extensively in Lot 47 where wetland communities are extensive and moist boggy areas with surface water and a high table water were present. Numerous seedlings were observed growing within tractor wheel ruts at some locations, while other plants also occurred in association with the margins of Broad-leaved Paperbark swamp forest. The concentrated population within the north-east of Lot 47 is extensive and significant in a local context. Within Lot 46, sedgeland areas are less well developed, more disturbed and species poor – a single plant was recorded.

As noted, following a hot and dry summer, all Rotala at the site had died, but had flowered and seeded prior to this time, suggesting that future plants are likely to germinate during suitable conditions. The site has been subject to ongoing slashing and grazing for many years (several decades). The fact that a Rotala population has persisted during this time suggests the species has some resilience.

It is suspected that other adjacent nearby allotments may also provide habitat for Rotala where wetland areas occur. Lot 18 DP1090409 and Lot 2 DP790910 (to the north of the site) support wetland and drainage areas and are considered highly likely to support Rotala populations. It is suspected seed from Rotala is dispersed in flood events, through surface water dispersal. However, patchy occurrences in the west of the site (Lot 46) which are disconnected from the main drainage area do not support this theory.

Assessment:

An assessment of Rotala with regard to the proposed development is provided at **Table G1**.

Table G1. Additional impact assessment provisions for threatened species or populations (as per Section 10.2.3 of the BAM)

BAM requirement	***Response***
10.2.3.1 The assessor is required to provide the following further information in the BDAR:	
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	All known Rotala habitat (inclusive of 30m species buffer) will be retained in-situ, with the development footprint specifically designed to avoid all Rotala habitat. The development footprint comprises more degraded habitats, with the species not recorded in wetland areas (which are less well connected to known population areas at the site). Indirect impacts are largely limited to human trespass, and this threat can be controlled via standard exclusion measures (fencing, signage) with a high level of confidence. Management of Rotala within residue land outside the development would remain the responsibility of the developer (proposed Lot 900) or CVC (proposed Lot 903). Management at each site would depend on the long-term outcomes for these land parcels; in the interim a combination of light grazing and annual slashing (consistent with management regimes over the past decade) would be expected to ensure conditions for Rotala remain suitable for the species to persist. Hydrology of the areas of the site where Rotala occurs would be unaffected from filling and management of stormwater. The north east population will continue to be serviced by surface flows from Golding Street (via a constructed drain) and groundwater, while the western population will be maintained from flows coming off Carrs Drive in combination with groundwater.

BAM requirement	Response
(b) the size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	The local population is all known plants of Rotala at the site. An estimated 650 plants were recorded in Lot 47 in 2018, with an estimated 45 plants recorded in Lot 46 in 2021. Based on species habitat polygon mapping (30m buffer around each plant), 3.28 ha of Rotala habitat is known at the site. None of the known population will be impacted by the proposal directly. While indirect impacts of the proposal could be attributed to the entire Rotala population at the site, appropriate management (including maintenance of surface flows) can be implemented with a high confidence of managing the Rotala population within residue land.
(c) the extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	No threshold for Rotala has been specified.
(d) the likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to:	
(i) an estimate of the change in habitat available to the local population as a result of the proposed development	No habitat for Rotala would be removed from within the development footprint. All known Rotala habitat would be retained in-situ within residual land (proposed Lots 900 and 903).
(ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and	The proposed development would not modify or destroy known Rotala habitat. Retained Rotala habitat in the eastern and western portions of the site are significantly fragmented and have no hydrological connection. The proposal will not further fragment these populations.
(iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.	The proposal would be unlikely to modify any habitat required for the maintenance of processes important to life cycle of Rotala. The proposed stormwater discharge into Proposed Lot 903 occurs downstream of known Rotala habitat and so has no potential to alter hydrological regimes which may influence the species' life cycle.
(e) the likely impact on the ecology of the local population:	
(ii) for flora, address how the proposal is likely to affect the ecology and biology of any residual plant population that will remain post development including where information is available: − ***pollination cycle*** − ***seedbanks*** − ***recruitment, and*** − ***interactions with other species (e.g. pollinators, host species, mycorrhizal associations)***	Due to avoidance of known Rotala habitat; the existing plant population would be retained in-situ within residue land post development. The proposed stormwater discharge into Proposed Lot 903 occurs downstream of known Rotala habitat and so has no potential to disrupt recruitment to this population or alter hydrological regimes for the species.

BAM requirement	Response
(f) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development	The local population (as known) collectively includes the scattered plants within Lot 46 (~ 45 plants) and the significantly larger population (est. 650 plants) at Lot 47. Plants within Lot 46 are already isolated from the core population. The sites do not share hydrology with regard to surface water flow (for seed dispersal) as each occurs within its own micro catchment – Lot 46 receives surface water from Carrs Drive Road reserve; Lot 47 receives surface water from a drainage channel in the north-east corner. The proposed stormwater discharge into Proposed Lot 903 occurs downstream of known Rotala habitat and so has no potential to disrupt recruitment to this population. On this basis, the proposed development would have no impacts on surface flow which may limit Rotala seed recruitment and hence fragment existing populations.
(g) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range	The local Yamba population (as documented in this BDAR) is ~ 20 km from the closest known population at Jacky Bulbin Flat (now removed). The Yamba population is unlikely to have any interaction with other known populations of the species due to geographic isolation. Based on existing records, the Yamba population is towards the southern distributional limit of the species known range.
(h) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	The Rotala populations within residue land would potentially be subject to impacts of adjacent urban development, such as human visitation, disturbance and/or track making. However, both proposed Lots (900, 903) would remain private or Council owned land utilised for stormwater treatment or grazing/agricultural purposes. Erection of boundary fencing and signage is likely to minimise any impacts to the Rotala population from human interference/disturbance.
(i) an estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion	All known BioNet populations occur within the south-eastern Queensland IBRA region (SEQ). Two of the known populations occur within the Clarence Lowlands IBRA Subregion (SEQ13) – the site also occurs within this Subregion. Two populations also occur within the Clarence sandstones IBRA Subregion (SEQ12). The proposed development would affect one of three known Rotala populations within the Clarence Lowlands IBRA Subregion (of which only two exist). Based on BioNet data, the Yamba population is highly significant (few individuals are known from the other two sites). The proposed development would result in intensive urban development adjacent to habitat of the largest known Rotala population within the Clarence Lowlands IBRA Subregion. Other populations in the subregion would not be affected.
(j) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.	No measures are proposed at this stage.

Conclusion

Based on the information above and with consideration of potential direct and indirect impacts on Rotala, it is considered unlikely that serious and irreversible impacts to the local Rotala population would occur as a result of the development proposal.

Appendix H

BAM Calculator Outputs

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00014715/BAAS18055/19/00014716

Proposal Name
Miles Street Yamba Subdivision

BAM data last updated *
22/06/2023

Assessor Name
David Havilah

Assessor Number
BAAS18129

BAM Data version *
61

Proponent Names
Neil Garrard

Report Created
21/07/2023

BAM Case Status
Finalised

Assessment Revision
9

Assessment Type
Part 4 Developments (General)

Date Finalised
21/07/2023

BOS entry trigger
BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Rotala tripartita / Rotala tripartita

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Irediparra gallinacea / Comb-crested Jacana
Xenus cinereus / Terek Sandpiper

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	6.2	0	9	9
1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.3	0	5	5
780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.4	0	6	6
1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	0.2	0	3	3
837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	2.2	0	43	43

780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911, 3958, 3962, 3964, 3965, 3967, 3971, 3973, 3975, 3976	-	780_mod01	No	6	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	837_derived01_	No	28	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	837_derived02_	No	1	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	837_low01_	No	14	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798, 3272, 3906, 3983, 3985, 3986, 3988, 3989, 3990, 3995, 3997, 3998, 4000, 4001, 4004, 4006, 4009, 4013, 4019, 4020, 4021, 4044, 4047, 4057	-	1064_mod01	No	9	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798, 3272, 3906, 3983, 3985, 3986, 3988, 3989, 3990, 3995, 3997, 3998, 4000, 4001, 4004, 4006, 4009, 4013, 4019, 4020, 4021, 4044, 4047, 4057	-	1064_derived01	No	0	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	1227_derived01	No	3	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808, 3962, 3963, 3985, 3987, 3993, 4016, 4023, 4026, 4027, 4028, 4030, 4035, 4038, 4040, 4048, 4049, 4050, 4056	-	1235_low01	No	5	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Dendrobium melaleucaphilum / Spider orchid	**1064_mod01**	0.2	8.00

Myotis macropus / Southern Myotis	**1064_mod01, 1235_low01, 780_mod01, 1227_derived01, 837_derived01_, 837_derived02_, 837_low01_, 1064_derived01**	4.8	67.00
Rotala tripartita / Rotala tripartita	**1064_mod01, 780_mod01**	0.4	11.00

Credit Retirement Options

Like-for-like credit retirement options

Dendrobium melaleucaphilum / Spider orchid	Spp	IBRA subregion
	Dendrobium melaleucaphilum / Spider orchid	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW
Rotala tripartita / Rotala tripartita	Spp	IBRA subregion
	Rotala tripartita / Rotala tripartita	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00014715/BAAS18055/19/00014716

Proposal Name
Miles Street Yamba Subdivision

BAM data last updated *
22/06/2023

Assessor Name
David Havilah

Assessor Number
BAAS18129

BAM Data version *
61

Proponent Name(s)
Neil Garrard

Report Created
21/07/2023

BAM Case Status
Finalised

Assessment Revision
9

Assessment Type
Part 4 Developments (General)

Date Finalised
21/07/2023

BOS entry trigger
BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Rotala tripartita / Rotala tripartita

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Irediparra gallinacea / Comb-crested Jacana
Xenus cinereus / Terek Sandpiper

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	6.2	0	9	9.00
1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.3	0	5	5.00
780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.4	0	6	6.00
1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	0.2	0	3	3.00
837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	2.2	0	43	43.00

780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 780, 781, 782, 828, 1071, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1911, 3958, 3962, 3964, 3965, 3967, 3971, 3973, 3975, 3976	-	780_mod01	No	6	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 3 or higher threat status	780_mod01	No	6	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	837_derived01_	No	28	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	837_derived02_	No	1	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	837__low01_	No	14	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Grassy Woodlands	Tier 3 or higher threat status	837_derived01_	No	28	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Grassy Woodlands	Tier 3 or higher threat status	837_derived02_	No	1	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Grassy Woodlands	Tier 3 or higher threat status	837__low01_	No	14	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798, 3272, 3906, 3983, 3985, 3986, 3988, 3989, 3990, 3995, 3997, 3998, 4000, 4001, 4004, 4006, 4009, 4013, 4019, 4020, 4021, 4044, 4047, 4057	-	1064__mod01	No	9	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798, 3272, 3906, 3983, 3985, 3986, 3988, 3989, 3990, 3995, 3997, 3998, 4000, 4001, 4004, 4006, 4009, 4013, 4019, 4020, 4021, 4044, 4047, 4057	-	1064_derived01	No	0	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Forested Wetlands	Tier 3 or higher threat status	1064_mod01	No	9	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Forested Wetlands	Tier 3 or higher threat status	1064_derived01	No	0	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion This includes PCT's: 621, 686, 761, 762, 837, 848, 852, 971, 1062, 1091, 1092, 1106, 1215, 1227, 1230, 1333, 1588, 1594, 1598, 3067, 3102, 3420, 3428, 3574, 3984, 4002, 4003, 4005, 4032, 4033, 4036, 4042, 4045, 4046	-	1227_derived01	No	3	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Forested Wetlands	Tier 3 or higher threat status	1227_derived01	No	3	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808, 3962, 3963, 3985, 3987, 3993, 4016, 4023, 4026, 4027, 4028, 4030, 4035, 4038, 4040, 4048, 4049, 4050, 4056	-	1235_low 01	No	5	Clarence Lowlands,Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Forested Wetlands	Tier 3 or higher threat status	1235_low 01	No	5	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Dendrobium melaleucaphilum / Spider orchid	**1064_mod01**	0.2	8.00

Myotis macropus / Southern Myotis	**1064_mod01, 1235_low01, 780_mod01, 1227_derived01, 837_derived01_, 837_derived02_, 837_low01_, 1064_derived01**	4.8	67.00
Rotala tripartita / Rotala tripartita	**1064_mod01, 780_mod01**	0.4	11.00

Credit Retirement Options

Like-for-like options

Dendrobium melaleucaphilum/ Spider orchid	Spp	IBRA region	
	Dendrobium melaleucaphilum/Spider orchid	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Endangered	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp	IBRA region	
	Myotis macropus/Southern Myotis	Any in NSW	
	Variation options		
	Kingdom	Any species with same or	IBRA region

		higher category of listing under Part 4 of the BC Act shown below	
	Fauna	Vulnerable	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Rotala tripartita/ Rotala tripartita	Spp	IBRA region	
	Rotala tripartita/Rotala tripartita	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Endangered	Clarence Lowlands, Clarence Sandstones, Scenic Rim, Woodenbong and Yuraygir. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Candidate Species Report

Proposal Details

Assessment Id 00014715/BAAS18055/19/00014716	Proposal Name Miles Street Yamba Subdivision	BAM data last updated * 22/06/2023
Assessor Name David Havilah	Report Created 21/07/2023	BAM Data version * 61
Assessor Number BAAS18129	Assessment Type Part 4 Developments (General)	BAM Case Status Finalised
Assessment Revision 9	Date Finalised 21/07/2023	BOS entry trigger BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

List of Species Requiring Survey

Name	Presence	Survey Months
Centranthera cochinchinensis Swamp Foxglove	No (surveyed) *Survey months are outside of the months specified in Bionet.	☐ Jan ☐ Feb ☐ Mar ☑ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☑ Survey month outside the specified months?
Cyperus aquatilis Water Nutgrass	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☑ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Dendrobium melaleucaphilum Spider orchid	Yes (surveyed) *Survey months are outside of the months specified in Bionet.	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☑ Survey month outside the specified months?

Eleocharis tetraquetra Square-stemmed Spike-rush	No (surveyed) *Survey months are outside of the months specified in Bionet.	☐ Jan ☐ Feb ☐ Mar ☑ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☑ Survey month outside the specified months?
Lichenostomus fasciogularis Mangrove Honeyeater	No (surveyed)	☐ Jan ☐ Feb ☑ Mar ☑ Apr ☐ May ☑ Jun ☑ Jul ☐ Aug ☐ Sep ☑ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Maundia triglochinoides Maundia triglochinoides	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Myotis macropus Southern Myotis	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Persicaria elatior Tall Knotweed	No (surveyed)	☐ Jan ☐ Feb ☑ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Petalura litorea Coastal Petaltail	No (surveyed)	☑ Jan ☑ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

BAM Candidate Species Report

Rotala tripartita Rotala tripartita	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?

Threatened species Manually Added

None added

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Ancistrachne maidenii	Ancistrachne maidenii	Refer to BAR
Bailey's Indigo	Indigofera baileyi	Refer to BAR
Barking Owl	Ninox connivens	Habitat constraints
Bar-tailed Godwit (baueri)	Limosa lapponica baueri	Refer to BAR
Basket Fern	Drynaria rigidula	Refer to BAR
Brown Fairy-chain Orchid	Peristeranthus hillii	Geographic limitations
Brush Sauropus	Phyllanthus microcladus	Refer to BAR
Brush-tailed Phascogale	Phascogale tapoatafa	Habitat constraints
Bush Stone-curlew	Burhinus grallarius	Habitat degraded Habitat constraints
Collared Kingfisher	Todiramphus chloris	Habitat constraints Geographic limitations
Common Planigale	Planigale maculata	Habitat degraded
Cotton Pygmy-Goose	Nettapus coromandelianus	Habitat degraded Species is vagrant
Davidson's Plum	Davidsonia jerseyana	Refer to BAR
Dwarf Heath Casuarina	Allocasuarina defungens	Geographic limitations
Eastern Cave Bat	Vespadelus troughtoni	Habitat constraints
Eastern Curlew	Numenius madagascariensis	Habitat constraints
Eastern Osprey	Pandion cristatus	Habitat constraints

Eastern Pygmy-possum	Cercartetus nanus	Refer to BAR
Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	Dromaius novaehollandiae - endangered population	Refer to BAR
Giant Barred Frog	Mixophyes iteratus	Habitat degraded Habitat constraints
Glossy Black-Cockatoo	Calyptorhynchus lathami	Refer to BAR
Green and Golden Bell Frog	Litoria aurea	Habitat degraded
Green-leaved Rose Walnut	Endiandra muelleri subsp. bracteata	Refer to BAR
Green-thighed Frog	Litoria brevipalmata	Habitat degraded
Grey-headed Flying-fox	Pteropus poliocephalus	Habitat degraded Habitat constraints
Hairy Jointgrass	Arthraxon hispidus	Refer to BAR
Koala	Phascolarctos cinereus	Habitat constraints
Laced Fritillary	Argynnis hyperbius	Habitat degraded Habitat constraints Geographic limitations
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat constraints
Large-eared Pied Bat	Chalinolobus dwyeri	Habitat constraints
Lemon-scented Grass	Elionurus citreus	Refer to BAR
Little Bent-winged Bat	Miniopterus australis	Habitat constraints
Little Eagle	Hieraaetus morphnoides	Habitat constraints
Long-nosed Potoroo	Potorous tridactylus	Habitat degraded Habitat constraints
Masked Owl	Tyto novaehollandiae	Habitat constraints
Mason's Grevillea	Grevillea masonii	Habitat constraints
Mitchell's Rainforest Snail	Thersites mitchellae	Habitat degraded
Native Milkwort	Polygala linariifolia	Habitat degraded
Netted Bottle Brush	Callistemon linearifolius	Refer to BAR
Noah's False Chickweed	Lindernia alsinoides	Habitat degraded
Olongburra Frog	Litoria olongburensis	Geographic limitations

Pale-headed Snake	Hoplocephalus bitorquatus	Habitat degraded
Pink Nodding Orchid	Geodorum densiflorum	Refer to BAR
Powerful Owl	Ninox strenua	Habitat constraints
Red Knot	Calidris canutus	Habitat constraints
Red Lilly Pilly	Syzygium hodgkinsoniae	Refer to BAR
Red-backed Button-quail	Turnix maculosus	Habitat degraded
Red-flowered King of the Fairies	Oberonia titania	Habitat degraded
Red-tailed Black-Cockatoo (coastal subspecies)	Calyptorhynchus banksii banksii	Refer to BAR
Regent Honeyeater	Anthochaera phrygia	Habitat constraints
Ripple-leaf Muttonwood	Myrsine richmondensis	Refer to BAR
Rough-shelled Bush Nut	Macadamia tetraphylla	Refer to BAR
Rufous Bettong	Aepyprymnus rufescens	Habitat degraded
Scented Acronychia	Acronychia littoralis	Geographic limitations
Slaty Red Gum	Eucalyptus glaucina	Refer to BAR
Slender Screw Fern	Lindsaea incisa	Habitat degraded
Small-leaved Tamarind	Diploglottis campbellii	Refer to BAR
Southern Greater Glider	Petauroides volans	Refer to BAR
Southern Ochrosia	Ochrosia moorei	Refer to BAR
Southern Swamp Orchid	Phaius australis	Refer to BAR
Square-fruited Ironbark	Eucalyptus tetrapleura	Refer to BAR
Square-stemmed Olax	Olax angulata	Refer to BAR
Square-tailed Kite	Lophoictinia isura	Habitat constraints
Squirrel Glider	Petaurus norfolcensis	Refer to BAR
Sweet False Galium	Oldenlandia galioides	Refer to BAR
Sweet Myrtle	Gossia fragrantissima	Refer to BAR
Swift Parrot	Lathamus discolor	Refer to BAR
Terek Sandpiper	Xenus cinereus	Habitat constraints
Thorny Pea	Desmodium acanthocladum	Refer to BAR

Wallum Froglet	Crinia tinnula	Geographic limitations
Weeping Paperbark	Melaleuca irbyana	Refer to BAR
White Lace Flower	Archidendron hendersonii	Refer to BAR
White-bellied Sea-Eagle	Haliaeetus leucogaster	Habitat constraints
White-crowned Snake	Cacophis harriettae	Habitat degraded
White-eared Monarch	Carterornis leucotis	Refer to BAR
Yellow-flowered King of the Fairies	Oberonia complanata	Habitat degraded

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00014715/BAAS18055/19/00014716	Miles Street Yamba Subdivision	22/06/2023
Assessor Name	Report Created	BAM Data version *
David Havilah	21/07/2023	61
Assessor Number	BAM Case Status	Date Finalised
BAAS18129	Finalised	21/07/2023
Assessment Revision	Assessment Type	BOS entry trigger
9	Part 4 Developments (General)	BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Coastal floodplain sedgelands, rushlands, and forblands of the North Coast												
3	780_mod 01	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	33.8	33.8	0.38	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		6
											Subtotal	**6**
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion												
5	837_derived01_	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	33.6	33.6	1.6	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		28

6	837_derived02_	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	17.4	17.4	0.06	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		1
7	837__low01_	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	61.8	61.8	0.45	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		14
											Subtotal	**43**
Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion												
1	1064__mod01	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	91	91.0	0.19	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		9

8	1064_derived01	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	6.9	6.9	6	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		0
											Subtotal	**9**
Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion												
4	1227_derived01	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	31.7	31.7	0.21	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		3
											Subtotal	**3**

Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion												
2	1235_low01	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	32.2	32.2	0.33	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		5
											Subtotal	**5**
											Total	**66**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Dendrobium melaleucaphilum / Spider orchid (Flora)									
1064_mod01	91.0	91.0	0.17			Endangered	Not Listed	False	8
								Subtotal	**8**
Myotis macropus / Southern Myotis (Fauna)									
1064_mod01	91.0	91.0	0.19			Vulnerable	Not Listed	False	9
1235_low01	32.2	32.2	0.04			Vulnerable	Not Listed	False	1
780_mod01	33.8	33.8	0.27			Vulnerable	Not Listed	False	5

1227__derived01	31.7	31.7	0.21			Vulnerable	Not Listed	False	3
837_derived01_	33.6	33.6	1.6			Vulnerable	Not Listed	False	28
837_derived02_	17.4	17.4	0.02			Vulnerable	Not Listed	False	1
837__low01_	61.8	61.8	0.42			Vulnerable	Not Listed	False	13
1064__derived01	6.9	6.9	2			Vulnerable	Not Listed	False	7
								Subtotal	**67**
Rotala tripartita / Rotala tripartita (Flora)									
1064__mod01	91.0	91.0	0.02			Endangered	Not Listed	True	1
780__mod01	33.8	33.8	0.38			Endangered	Not Listed	True	10
								Subtotal	**11**

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00014715/BAAS18055/19/00014716	Miles Street Yamba Subdivision	22/06/2023
Assessor Name	**Report Created**	**BAM Data version ***
David Havilah	21/07/2023	61
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS18129	Part 4 Developments (General)	Finalised
Assessment Revision	**BOS entry trigger**	**Date Finalised**
9	BOS Threshold: Area clearing threshold	21/07/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Australasian Bittern	Botaurus poiciloptilus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Australian Painted Snipe	Rostratula australis	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Barking Owl	Ninox connivens	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion

Barking Owl	Ninox connivens	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Barred Cuckoo-shrike	Coracina lineata	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Bar-tailed Godwit (baueri)	Limosa lapponica baueri	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Black Bittern	Ixobrychus flavicollis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Black-necked Stork	Ephippiorhynchus asiaticus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Blue-billed Duck	Oxyura australis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Brolga	Grus rubicunda	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Common Blossom-bat	Syconycteris australis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Diamond Firetail	Stagonopleura guttata	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Dusky Woodswallow	Artamus cyanopterus cyanopterus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Eastern Chestnut Mouse	Pseudomys gracilicaudatus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion

Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Eastern Curlew	Numenius madagascariensis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Eastern False Pipistrelle	Falsistrellus tasmaniensis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Eastern Grass Owl	Tyto longimembris	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Eastern Long-eared Bat	Nyctophilus bifax	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Eastern Osprey	Pandion cristatus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Flame Robin	Petroica phoenicea	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Freckled Duck	Stictonetta naevosa	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Glossy Black-Cockatoo	Calyptorhynchus lathami	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion

Golden-tipped Bat	Phoniscus papuensis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Greater Broad-nosed Bat	Scoteanax rueppellii	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Grey-headed Flying-fox	Pteropus poliocephalus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Hoary Wattled Bat	Chalinolobus nigrogriseus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Large Bent-winged Bat	Miniopterus orianae oceanensis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

Large Bent-winged Bat	Miniopterus orianae oceanensis	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Little Bent-winged Bat	Miniopterus australis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Little Eagle	Hieraaetus morphnoides	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Little Lorikeet	Glossopsitta pusilla	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Magpie Goose	Anseranas semipalmata	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Masked Owl	Tyto novaehollandiae	1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
New Holland Mouse	Pseudomys novaehollandiae	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

New Holland Mouse	Pseudomys novaehollandiae	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Northern Free-tailed Bat	Ozimops lumsdenae	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Powerful Owl	Ninox strenua	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Red Knot	Calidris canutus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Regent Honeyeater	Anthochaera phrygia	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Scarlet Robin	Petroica boodang	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Spotted Harrier	Circus assimilis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Spotted-tailed Quoll	Dasyurus maculatus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

Spotted-tailed Quoll	Dasyurus maculatus	1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Square-tailed Kite	Lophoictinia isura	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Superb Fruit-Dove	Ptilinopus superbus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Swift Parrot	Lathamus discolor	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Varied Sittella	Daphoenositta chrysoptera	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
White-bellied Sea-Eagle	Haliaeetus leucogaster	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
White-throated Needletail	Hirundapus caudacutus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

White-throated Needletail	Hirundapus caudacutus	1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Yellow-bellied Glider	Petaurus australis	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
		1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion

Threatened species Manually Added

None added

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Common Name	Scientific Name	Plant Community Type(s)
Comb-crested Jacana	Irediparra gallinacea	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Terek Sandpiper	Xenus cinereus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Comb-crested Jacana	Irediparra gallinacea	Habitat constraints
Terek Sandpiper	Xenus cinereus	Refer to BAR

BAM Vegetation Zones Report

Proposal Details

Assessment Id	Assessment name	BAM data last updated *
00014715/BAAS18055/19/00014716	Miles Street Yamba Subdivision	22/06/2023
Assessor Name	**Report Created**	**BAM Data version ***
David Havilah	21/07/2023	61
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS18129	Part 4 Developments (General)	Finalised
Assessment Revision	**Date Finalised**	**BOS entry trigger**
9	21/07/2023	BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones

1	1064__mod01	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	_mod01	0.19	1	
2	1235__low01	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	_low01	0.33	1	
3	780__mod01	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	_mod01	0.38	1	
4	1227__derived01	1227-Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion	_derived01	0.21	1	
5	837_derived01_	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	derived01_	1.64	1	
6	837_derived02_	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	derived02_	0.06	1	
7	837__low01_	837-Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	_low01_	0.45	1	
8	1064__derived01	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	_derived01	5.99	3	

Appendix I

Additional Information on Ecology, Impact and Management of *Rotala tripartita*

Additional information on ecology, impact and management of a population of the endangered plant species *Rotala tripartita* ('Rotala') on a proposed residential subdivision at 52-54 Miles Street, Yamba. Application No: SUB2023/0001

Prepared for:

Geolink

Level 1, 64 Ballina St

Lennox Head, NSW 2478

Prepared by:

Ecos Environmental (Dr Andrew Benwell)

3 Short St, New Brighton 2483

4/7/2023

Contents

1 Introduction

Ecos Environmental (Dr Andrew Benwell) has been engaged by Geolink to assess the impact of a proposed residential subdivision located at 52-54 Miles Street Yamba, NSW 2464, comprising Lot 46 DP 751395 and Lot 47 DP 751395 (the 'Subject Site') on the endangered plant species *Rotala tripartita* ('Rotala'), including whether there is likely to be a decline in the species, and to make recommendations on how to manage its habitat within the Subject Site.

Clarence Valley Council (CVC), the determining authority for the proposed sub-division, has requested this additional information on Rotala in relation to a letter from the Department of Planning and Environment – Biodiversity and Conservation Division dated 3 March 2023 recommending that several points of the Biodiversity Development Assessment Report (BDAR) and Vegetation Management Plan be revised.

Ecos Environmental has been engaged by Geolink to address Point 3 of BCD's letter:

> *3. A suitably qualified expert in wetland biology and ecology assesses the likely impacts from filling the proposed development areas on the adjoining wetland areas to help council determine whether the proposal is likely to have a serious and irreversible impact (SAII) on Rotala tripartita.*
>
> *The report should address but not be limited to:*
> *a. The change in landscape morphology.*
> *b. Hydrological impacts such as quality and quantity of stormwater inflow, altered water flow and altered wetting and drying regimes of the wetland.*
> *c. Consideration of whether the impacts are likely to result in the decline of the Rotala population on the subject land.*

All Rotala records from the Subject Site are on slightly lower terrain including a designated floodway and are excluded from the development area (Figure 1). The letter from BCD is concerned with possible indirect impacts *from filling the proposed development areas on the adjoining wetland areas* may cause a serious and irreversible impact (SAII) to the Rotala population.

Following this introduction, Section 2 presents brief background information on the development proposal and site. Section 3 contains an ecological profile of *Rotala tripartita* including its habitat requirements and life history. Section 4 describes the Rotala population. Section 5 examines the impact of development on the hydrology of Rotala habitat. Section 6 recommends management measures to maintain suitable habitat for Rotala and Section 7 presents the assessment conclusion.

The author (Dr Andrew Benwell) has professional experience in wetland plant ecology of the NSW North Coast including botanical survey, plant community mapping, threatened species recovery plans, specialist research, monitoring and translocation. Threatened wetland species he has worked on for the public and private sectors include *Eleocharis tetraquetra, Arthraxon hispidus, Maundia triglochinoides, Phaius australis, Persicaria elatior, Centranthera cochinchinensis, Cyperus aquatilis and Rotala tripartita.* A CV can be supplied on request.

2 Background

2.1 Development proposal

Application No: SUB2023/0001. The development proposal is for a 284 lot subdivision consisting of 277 low density residential lots, 1 medium density residential development lot, 1 commercial development lot, 1 low density development lot, 3 drainage reserve lots and 1 open space reserve lot (BDAR Geolink 2022). The total area of the property consisting of Lots 46 and 47 is approximately 42ha. About one third is excluded from development and includes a designated floodway and swampy drainage lines supporting freshwater wetland and paperbark in the north east and south west of the Subject Site where Rotala has been recorded (Figure 1). The northern side of the site adjoining Carr Dv and Miles St has already been filled with 3 m of material under a previous approval (see Figure 1 'consolidated fill').

2.2 Natural Environment

2.2.1 Landform

The proposal is located on the estuarine floodplain of the Clarence River and the topography is flat to very gently sloping with slightly lower terrain across the southern part of the property that acts as a floodway directing runoff during heavy rain southeast and south towards Lake Wooloweyah, a large lake connected to the Clarence River. Difference in elevation from the highest to lowest point of the site is approximately 1-2 m. The site is 3 km from the sea and underlain by Pleistocene marine sand and Recent estuarine clay and silt alluvium from the Clarence River deposited during floods.

2.2.2 Vegetation

Most of the site is cleared and has a long history of agricultural land use consisting mainly of cattle grazing, and sugar cane cultivation in the past is also reported. Remnants of *Melaleuca quinquenervia-M. stypheloides* swamp sclerophyll forest, disturbed *Lophostemon suaveolens* floodplain forest and freshwater wetland occur in the east, south and southwest of the site (see Figure 1).

Rotala is associated with the mapped plant communities *PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast*, and *PCT 1064 Paperbark swamp forest* (Figure 1), both excluded from the development footprint. Cattle appear to have grazed the whole property, including areas where Rotala has been recorded, for several decades and are still present.

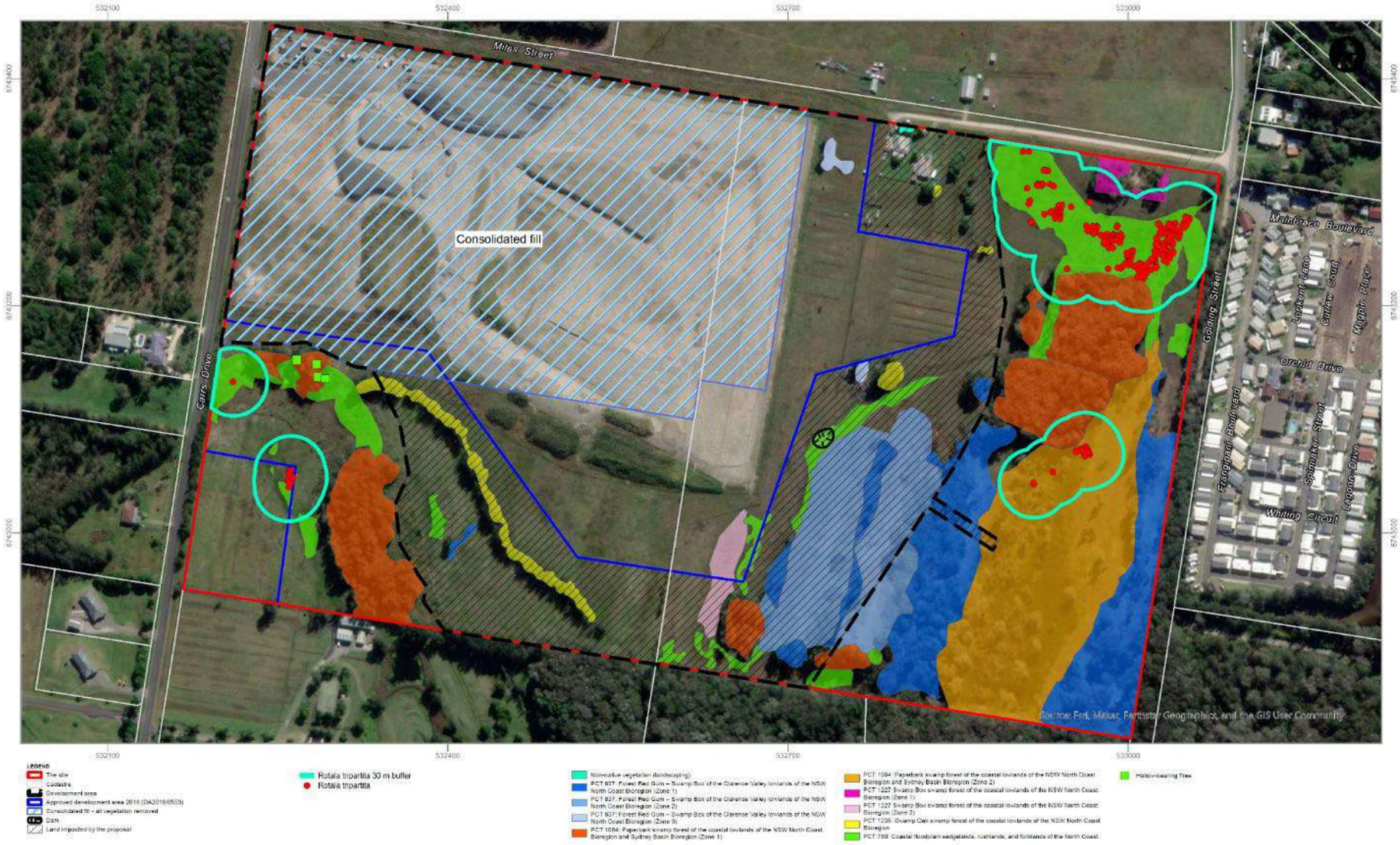


Figure 1: **The Subject Site, showing boundaries of the site (red line), development area (dashed black line), approved development area 2018 (blue line) and area impacted by this proposal (lighter hatching). Rotala records are red dots. See legend. Source: BDAR**

Biodiversity Impacts - Illustration 5.1

Information shown is for illustrative purposes only
Drawn by: AB Reviewed by: DGH
Source of base data: ESRI World Imagery
Date: 22/06/2023
Revision: C

2.2.3 Present drainage

The slightly lower relief along the eastern and southern sides of the Subject Site acts as a floodway directing runoff from the site and surrounding urban land from Golding Street south towards the Lake Wooloweyah basin. This is a designated floodway and excluded from development. The southwestern corner of the site is also slightly more low lying and receives runoff from Carr Drive, which is also directed southwards via a swampy drainage line and excluded from development (BDAR, Geolink 2022).

3 Ecological Profile of Rotala (*Rotala tripartita*)

3.1 Conservation Status

Endangered (NSW *BC Act*)

3.2 Description of species

Herbaceous, upright annual to 40 cm high, or decumbent perennial 10 -20 cm high with short stolons 10-40 cm long often present, producing short leafy shoots and flowers. Leaves glabrous, opposite, often decussate, sessile, ovate to lanceolate, 2-20 mm long and 1-5 mm wide, lower surface often paler than upper surface. Flowers sessile, solitary in axils of very small leafy bracts, dense along stems. Hypanthium c. 1 mm long. Sepals 3 or rarely 4, appendages longer than sepals. Petals 3 or rarely 4, elliptic, ± colourless to red. Stamens 3 or rarely 4, inserted near base of hypanthium. Style c. 0.5 mm long. Capsule globose, c. 1.5 mm long, 3-valved,

3.3 Distribution

NSW
Rare in NSW, known from fewer than 10 locations in a triangle between Casino, Grafton and Yamba, including Shannon Dam, Pillar Valley, Rappville, Pacific Highway Devils Pulpit, Mongogarie and Dilkoon (BDAR). Also in Qld and NT.

Local
The nearest known populations to Yamba are 20 km north at the intersection of Jacky Bulbin Flat Rd and the Pacific Highway (also referred to as Devils Pulpit, which is the adjacent range where the species does not occur), and Pillar Valley 30 km southwest, indicating the species' very sparse distribution.

3.4 Habitat and soil

Rotala tripartita appears to prefer marsh habitat where soil moisture persists for several months without extended periods of flooding and soil waterlogging. On coastal floodplains with a high water table and slight undulations and depressions, such as the Subject Site, marsh and swamp habitat are differentiated by subtle topographic–hydrological gradients. Marsh occurs on the margins of and slightly upslope of swamp habitat, and downslope of elevated, freely draining topsoil. Marsh, swamp and freely draining soils have different,

intergrading soil profiles and plant communities. Swamp soils ate generally peaty due to accumulation of organic matter under saturated, anaerobic conditions, and can form on alluvium or sand. A marsh soil is usually an organic loam with a lower organic matter and higher clay or sand content. Marsh habitat is flood prone, but surface water drains away rapidly and in the dry season it can dry out and carry fire.

3.5 Plant community

Rotala occurs in *PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast*, and to a lesser extent *PCT 1064 Paperbark swamp forest* on the Subject Site (Figure 1). Both of these plant communities have a modified species composition and structure as a result of clearing and grazing, and a high percentage exotic species in the ground layer.

Appendix 1 records the present species composition and structure of PCT 780 in two 20 m x 50 m plots in the northeast of Lot 47 and south west of Lot 46 where Rotala was recorded in June 2023.

3.6 Species life history

Bionet describes Rotala as an annual or short-lived perennial. The plants recorded on Lot 47 in November 2018 appeared to be annual as they died out in summer, 3-4 months after being recorded (BDAR, Geolink 2022). This is consistent with the species listing information which states: "There appear to be extreme fluctuations in abundance of the species, with plants observed to germinate prolifically and establish in large numbers after substantial rainfall. Individuals disappear above-ground during dry periods and may only persist during these times in the seed-bank."

By contrast, the author found that Rotala plants monitored on the W2B project at Jacky Bulbin Rd and the Pacific Highway were perennial, as they persisted in situ for 2 years in a cleared paddock, then for another 5 years after being translocated (Ecos Environmental 2021). More than half the translocated plants died, but some survived for five years. Many flowers were produced but no seedling recruitment was observed in five years. Plants spread 10-30 cm by prostrate stolons that took root at nodes. They died back during the year in dry or cold conditions and appeared to persist by means of leafless stolons (see Plate 8). Additional watering was carried out that may have prolonged their life span.

The Rotala plants recorded on Lots 46 and 47 in June 2023 by Ecos Environmental and Geolink (approx. 10) appeared to be older plants rather than recent seedlings (see Plates 1 and 2). They could have germinated in hoof depressions or tractor ruts in 2022 and gone undetected until June 2023, which would make them about 12 months old.

Photographs of Rotala at Mongogarie (south of Casino) supplied by David Havilah show dense, advanced Rotala seedlings that appear to have germinated after fire, as indicated by lack of dead grass and other litter, blackened litter on the ground, and new grass and sedge shoots (see Plates 6 and 7). David Havilah confirmed there was evidence of a recent fire at the Monogogarie location. Fire appears to remove the seed dormancy normally preventing

germination of most Rotala seed from the soil seedbank, thereby allowing mass seed germination to occur after rain.

The 'extreme' fluctuations in Rotala abundance referred to in the Bionet species profile is simply a natural expression of the life cycle of a short-lived disturbance specialist. Mass germination of seedlings after fire is typical of this class of plants. Occasional individuals may also germinate and establish in bare ground created by cattle hooves, tractor wheel ruts and other haphazard disturbances that remove plant cover from the soil surface (like fire), exposing seed to dormancy breaking light and warmth (and other cues). Flooding can also create 'gaps' in ground cover that trigger seed germination but has to be prolonged to kill ground layer plants, not just defoliate them (this is less likely in marsh habitat). Individuals can apparently persist as perennials but generally they are uncommon or rare.

4 Rotala population on the Subject Site

4.1 Population fluctuation

The biodiversity assessment surveys carried out by Geolink provide a record of the abundance and location of Rotala on the Subject Site over a five-year period, from 2018 to 2023 (Table 1). Rotala was first recorded in the southeast section of the Subject Site on Lot 47 in November 2018 (see Figure 1) then from summer 2019 was not recorded again on Lot 47 until the site inspection for this report in June 2023. The first record of Rotala on Lot 46 was in January 2021, then again in 2023.

The BDAR notes that: "Rotala can be a difficult species to survey for as it is an annual or short-lived perennial responsive to rainfall and seasonal conditions. During inappropriate conditions the species lies dormant in the seed bank and is not detectable. The Threatened Biodiversity Data Collection (TBDC) prescribes a survey period for Rotala as between December and March and notes: "Survey within about 6 months of soaking rainfall. Species will be absent above ground if the habitat remains dry for over 6 months. Short-lived perennial, easily overlooked in the field in the dense habitat that it occurs." The best time to survey for Rotala is in summer, but the species can be recorded throughout the year as shown by records from spring and autumn on Bionet and those from June 2023.

Geolink carried out frequent biodiversity assessment surveys that included flora or were specifically for Rotala (and timed for summer) from 2018 to 2021 (Table 1), so it can be assumed that the Rotala population data accurately record the Rotala population on the Subject Site.

Table 1: Biodiversity field surveys conducted by Geolink on Lots 46 and 47 between 2018 and 2023 (Source: BDAR; Table 4.2)

Date	Site Assessed	Task
26/06/2018	Lots 46 and 47	Initial assessment and stratification, VI plots, incidental fauna survey
16/07/2018	Lots 46 and 47	VI plots, incidental fauna survey
17/07/2018	Lots 46 and 47	Paddock tree survey for DA2018/0553, incidental fauna survey, GPS PCT 780 boundaries
30/10/2018	Lots 46 and 47	Targeted flora surveys, stick nest survey, bird census x 2, incidental fauna survey
31/10/2018	Lots 46 and 47	bird census x 2, incidental fauna survey. First recording of Rotala.
8/11/2018	Lots 46 and 47	Target flora surveys (Rotala, Maundia), incidental fauna survey
28/01/2018	Lots 46 and 47	Coastal Petaltail survey # 1, Rotala inspection, incidental fauna survey
8/02/2018	Lots 46 and 47	Coastal Petaltail survey # 2, Rotala inspection, incidental fauna survey
28/03/2019	Lot 46 only	Target flora surveys (SSSR, Swamp Foxglove, Tall Knotweed), incidental fauna survey, Rotala inspection
5/8/2020	Lot 46 only	Vegetation assessment for BAR, Rotala inspection (both lots), incidental fauna survey
30/9/2020	Lot 46 only	Vegetation assessment for VMP, Rotala inspection (both lots), incidental fauna survey
20/10/2020	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey
01/12/2020	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey
28/01/2021	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey
28/02/2021	Lots 46 and 47	Rotala inspection (both lots), incidental fauna survey
20/04/2021	Lots 46 and 47	Vegetation assessment and mapping, additional VI plots, SAT plot, wetland flora survey, incidental fauna survey
10/6/2023	Lots 46 and 47	Rotala inspection (both lots), Ecos Environmental and Geolink

Changes in the Rotala population on the Subject Site between 2018 and 2022 are described in the BDAR as follows: “Rotala (*Rotala tripartita*) was first recorded on the Subject Site on Lot 47 in November 2018, when an estimated population of 650 plants were present. Further targeted surveys on numerous occasions failed to detect the species since this time, until a small population was detected in association with several melonhole depressions in the south-west of Lot 46 on 28/01/2021. An estimated 45 plants were recorded, the majority of which are up to 20 cm in height; only one plant was in fruit. Plants were typically

within dense Setaria. Despite the good conditions and regular summer rain, no Rotala was recorded within Lot 47 on this same occasion where a robust population was previously recorded in 2018.

“The established population at Lot 47 (recorded November 2018) was used as a population indicator and was inspected on the following occasions: 29/01/2019, 8/02/2019, 28/03/2019, 5/8/2020, 30/9/2020, 20/10/2020, 01/12/2020, 28/01/2021. No plants were ever recorded during these times, and it was assumed that suitable prior rainfall had not occurred to create favourable conditions for the species. Rotala was recorded on Lot 46 outside of the development footprint on 28/01/2021 but was absent within the more substantial known habitat at Lot 47; the reasons for this are not known. Further incidental assessment on 20/04/2021 involved a random meander through the NE corner of Lot 47 (previous Rotala records) and small isolated patches of PCT 780 as part of habitat mapping.

“Rotala was recorded extensively in Lot 47 where wetland communities are extensive and moist boggy areas with surface water and a high table water were present. Numerous seedlings were observed growing within tractor wheel ruts at some locations, while other plants also occurred in association with the margins of Broad-leaved Paperbark swamp forest. As noted, following a hot and dry summer, all Rotala at the site had died, but had flowered and seeded prior to this time, suggesting that future plants are likely to germinate during suitable conditions. The site has been subject to ongoing slashing and grazing for many years (several decades).”

4.2 Germination trigger

Environmental processes that may trigger the germination of Rotala seed on the Subject Site include rainfall pattern, tractor slashing, grazing and fire. These processes or factors trigger seed germination by altering habitat and removing the dormancy mechanism normally preventing germination of Rotala seed in habitat unsuitable for seedling establishment.

The BDAR suggests that flooding rain was the environmental factor producing the large Rotala population recorded on Lot 47 in November 2018, but also notes that no plants appeared at the same location after flooding rain in 2021, even though some appeared on Lot 46. The BOM rainfall record in 2018 shows a spike of high rainfall in Aug-Sept/2018 (about 250 mm), followed by four major flood events in 2020-2022 (see Figure 2). Rotala was only recorded on Lot 47 after the spring 2018 rainfall event, not in the other years, for reasons that are not clear.

The photograph of Rotala on the Subject Site in 2018 supplied by Geolink (Plate 5) appears to show evidence of fire, similar to the photos from Mongogarie (Plates 6 and 7), which suggests plants recorded in 2018 on the Subject Site could have germinated after an earlier low intensity fire. Rotala plants in Plate 5 appear to be seedlings a few months old and may have germinated after heavy rain in Aug-Sept 2018 (Figure 2). This rainfall event was preceded by a drier than average period of about three months (conditions suitable for a pasture burn) and then another, more intense dry period extending into summer (Figure 2) when the population is reported to have died out . However, there is no mention of evidence of fire in the BDAR and David Havilah considered it unlikely (pers. comm.).

Generally, it appears that rainfall pattern, tractor slashing, grazing and fire can act as triggers to stimulate germination of Rotala seed. CVC will probably be responsible for site management of the floodway and areas outside the residential footprint and is unlikely to continue cattle grazing. That leaves tractor slashing and fire as strategies available for managing the site to maintain suitable habitat conditions for the Rotala population. Generally, the aim would be to maintain a fairly open ground layer with gaps to enable germination and seedling establishment, as described in Section 6 below.

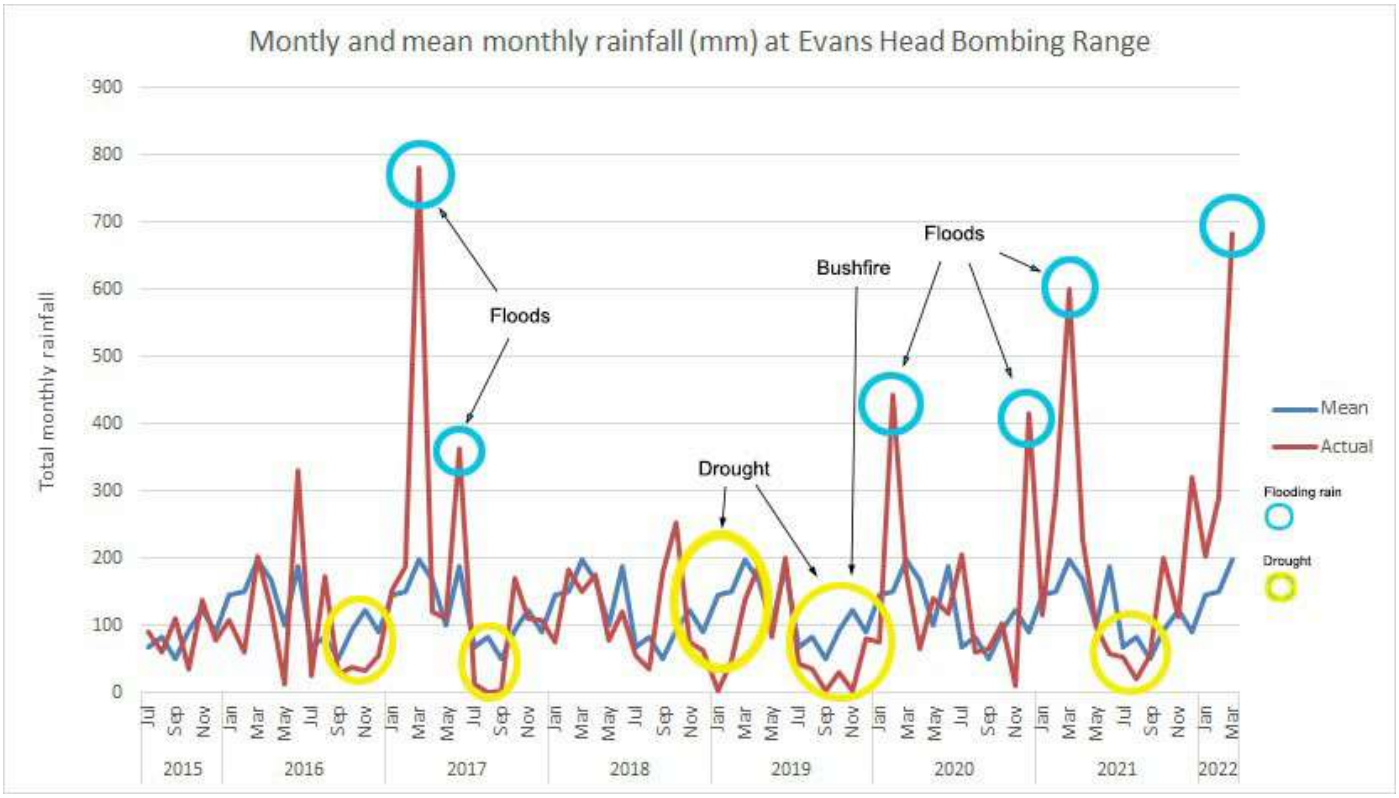


Figure 2: Monthly and mean monthly rainfall for Evans Head Bombing Range approximately 30 km north of Yamba, 2015 to 2022. The weather pattern was characterised by high rainfall variability with frequent droughts (defined as three or more months of below average rainfall) and floods (the bushfire shown in 2019 did not affect the Subject Site). Source: Ecos Environmental (2022).

5 Development impact on the hydrology of Rotala habitat

5.1 Introduction

Being a species of marshy habitat and adjoining an expanding urban area, the residential development has the potential to alter the hydrological regime of Rotala habitat, including depth and duration of flooding, and soil wetting and drying regime. This could cause change in germination conditions or survival of germinated seedlings, and possible decline (or increase) in Rotala abundance. In assessing the hydrological impact of the development on Rotala below, the reports prepared by expert hydrologists are relied on to indicate possible changes in the hydrological regime in Rotala habitat on the Subject Site.

The following issues relating to site hydrology that may impact on the Rotala population are examined below:

- Duration and height of flooding from stormwater run-off.
- Stormwater quality management (sedimentation and eutrophication).
- Groundwater Impacts.

5.2 Duration and height of flooding from stormwater run-off

The BDAR reporting on hydrology modelling by Biome Pty Ltd describes the impact of the proposal on duration and height of flooding from stormwater run-off as follows: “Regarding the timing of flows within the floodway, depending on the event, critical storms (i.e. with the highest flows) have a duration between 3-6 hours, meaning the storm peak flow will generally be reached after about 3 hours from the onset of the storm. Based on 1D modelling, the floodway flows generally subside after around 10 hours from the onset of the storm.

“The stormwater basin will provide detention of flows, thereby ensuring that the peak flows leaving the site in the post-development situation do not exceed the peak flows in the pre-development situation, for a range of storm events.

“A simulation of pre and post construction flood inundation was undertaken by Biome Consulting for the Q2 and Q100 events at two sites:
Site 1 – fork of branched waterway in the south-west corner of the site subject to VMP.
Site 2 – first order waterway in northern part of floodway representing threatened flora habitat subject to VMP.

For site 1, the model indicated that flood peak levels for Q2 and Q100 events being the same but with slightly increased water heights after the peak for a period of time. Such a minor change would be unlikely to affect ecological values associated with the waterway in the south west of the site.

For site 2, the model indicated very similar flood peaks and duration for the Q2 and Q100 events suggesting that the frequency and duration of flows entering the receiving environment will be similar to the pre-development situation.

Drainage of the floodway appears to occur north to south with the proposed stormwater outlet from the site positioned south of threatened flora habitat (see Figure 1, narrow projection on Lot 47 near Rotala habitat) further attenuating the risk of impacts to threatened flora habitat from changes in hydrology.

Conclusion

From the modelling studies carried out, there is unlikely to be a significant change in duration and height of flooding of off-site areas including habitat for threatened flora species within floodway as a result of stormwater run-off from the residential area.

5.3 Stormwater Management

Low lying areas are susceptible to changes in species composition caused by sedimentation and eutrophication originating in run-off from construction sites, roads, residential areas and other sites of soil disturbance associate with changes in land use (DPE 2022). Eutrophication of soil poses a significant risk to the long-term survival wetland threatened plant species such as Rotala and should be reduced as much as possible.

Management of stormwater run-off described in Geolink (2022) and Biome (2023) includes use of various structures including stormwater detention basins/bio-ponds/bio-retention ponds. Stormwater management will include two detention basins with the eastern basin discharging via a grass swale into the floodway and the western basin discharging into the second order stream. The stormwater outlet for the eastern basin consists of both pipe (1x450mm RCP) and weir flow. As the invert of the basin and subsequent downstream invert of the pipe outlet is quite low (0.8m AHD), construction of a shallow swale is required to outlet this pipe within the floodway (see Figure 1, narrow projection on Lot 47 near Rotala habitat). The swale will be approximately 60 m from the piped outlet and have a 2.5 m base. The swale has been designed as grassed/vegetated and will convey approximately 0.5m^3/s.

Water quality management described in Biome Consulting (2023) states on p. 2:
"The results of modelling including a comparison between the pre-developed, developed (untreated), and developed (treated) scenarios are summarised in the table below (i.e. Table 1). Treatment measures have been sized to achieve the water quality targets specified within Table H2 of the DCP and will ensure that surface water pollutant loads are reduced by at least 85%, 60% and 45% for TSS, TN and TP respectively of the developed flow.

Table 1 Pre-Development vs Developed (Untreated) vs Developed (Treated) Nutrient & Sediment Loads

Catchment ID	Pollutant	Pre-Development (kg/yr)	Developed (Untreated) (kg/yr)	Developed (Treated H2 requirments) (kg/yr)
Overall Site (TOTAL)	TSS	11,041	34,510	3,619
	TP	13	66	21.6
	TN	107	435	236

“In comparison to the pre-development scenario, whilst increases in nutrient loads (TN and TP) are expected as a result of urbanisation of the site, sediment loads are generally expected to largely decrease due to the inclusion of stormwater treatment measures within the development. To achieve a reduction in nutrient loads that would meet with pre-developed conditions an 80% reduction in TP and 75% reduction in TN would be required from the untreated developed flow.”

The report notes on p. 3 “bioretention performance as a ratio of bioretention treatment area exhibits a non-linear relationship comparable to a logarithmic regression. This relationship implies that treatment performance increases rapidly with treatment area size then reaches a point of ‘diminishing performance’ where incremental increases in basin size result in only marginal increases in bioretention performance.”

Regarding the size of bio-retention ponds, the report states: “ the most optimal treatment area is 1-2% of the total contributing catchment area. It is noted that whilst the information provided above represents catchments modelled within Queensland climates, it is deduced that a similar relationship would be prevelant for catchments within the site locality.

“The bioretention treatment measures for the proposed development have been sized to achieve the required load based reductions specified in Table H2 of the DCP. The resultant filter treatment areas equate to approximately 1.1% of the developed contributing catchment. It is therefore considered that the optimal treatment basin size has been provided for each catchment.

Furthermore, increasing the size of the basins would likely not offer a material change in of treatment efficiency but would result in large assets delivered to Council and therefore increase maintenance costs.

Attachment A of Biome Consulting (2023):

The current version of the Clarence Valley Council DCP as sourced from the link below specified the current water quality targets within TABLE H2.

https://www.clarence.nsw.gov.au/files/assets/public/building-and-development/files/development-control-plans/residential-dcp_29_july_2022.pdf

TABLE H2 Default Water Quality Targets

WATER QUALITY PARAMETER	DEFAULT TARGET
Gross Pollutants	90% of average annual load retained
Total Phosphorus (TP)	60% of average annual load retained
Total Nitrogen (TN)	45% of average annual load retained
Total Suspended Solids (TSS)	85% of average annual load retained

Appendix 2 at the end of this report includes diagrams showing the current design of two bio-retention basins and how they will linked with housing. This design is repeated across the site.

Summary comment

It appears from water quality performance measure for the Subject Site, intended to be consistent with those of CVC (see Table H2 above), after treatment of run-off in the system of bio-retention structures, 40% of Total Phosporus (TP) and and 60% Total Nitrogen (TN) will still remain in treated run-off from the construction site and later from the residential area, which will be discharged onto the floodway containing Rotala habitat and drain southwards.

Table 1 from the Biome report (see above) indicates that measured in kg/yr, P will increase from 13 kg/yr 'pre-development' to 21.6 kg/yr 'developed with treatment in the bio-ponds'; N will increase from 107 kg/yr pre-development to 236 kg/yr developed and after treatment in the bio-ponds. This is roughly a doubling of pre-development N and P concentration in run-off to the floodway.

If spread over the whole low lying area supporting wetland vegetation, including PCTs 780 and 1064 (i.e. ~10 ha), these increases in nutrient input (kg/yr) would probably have a relatively mild stimulating effect on plant growth. Any stimulating effect would probably attenuate rapidly with increasing distance from the discharge point so its position in relation to Rotala plants is important, which appears to have been considered. Concentrations of N and P in the present soil are already likely to be elevated as a result of the long history of cattle grazing, compared to a soil still in its natural state, unmodified by agriculture.

Vegetation and soil monitoring plots recorded during and after construction would be required to accurately determine the indirect effects of changes in land use (i.e. grazing and no grazing) and stormwater run-off (pre- and post-construction; before and after treatment) on plants communities and the Rotala population.

5.4 Groundwater Impacts

Regional Geotechnical Solutions Pty Ltd (RGS) carried out a geotechnical assessment of the residential subdivision that involves placement of between 1.5 and 3m of fill across the site. The impact of fill on groundwater conditions was assessed with regard to:

• The potential for consolidation settlement due to the placement of between 1.5 and 3m of controlled fill;

• An estimate of potential consolidation settlement, and the approximate lateral extents to which the settlement is predicted to occur; and

• Potential influence of the fill surcharge on existing groundwater levels.

The RGS report made the following findings: "The development includes the placement of up to about 3m of fill over the existing marine sand and silt deposits. The fill is expected to be placed progressively over many months with small height increases (i.e. fill lifts) applied over large areas, rather than the full surcharge being applied over a short period.

Groundwater was measured during the site investigation at depths of between 0.2 and 0.9m.

The marine soils below the groundwater level that underlie the site comprise two components – the soil particles themselves and water. Consolidation settlement occurs due to the reduction in volume of the saturated soil because of the increase in total stress and the drainage of excess pore water pressure. On this basis, at sites that experience large consolidation settlements there is the potential that the groundwater level surrounding the applied load/surcharge to be influenced and can rise. Groundwater levels would be expected to fluctuate at the site by up to about 1m due to tidal influences and in response to rainfall and particularly extended rainfall events.

Conclusion:

On this basis and due to the limited predicted consolidation settlement, the influence of the fill surcharge on the groundwater levels on surrounding sites is expected to be negligible.

5.5 Summary of hydrological impacts on Rotala habitat

The hydrological reports conclude that there will be no significant change in the height and duration of flooding in areas surrounding the residential development as a result of filling the residential footprint (as fill area is small in relation to the area of the surrounding Clarence floodplain), or to ground water levels from the weight of three metres of fill, which models show respond primarily to rainfall and tidal fluctuation.

The main hydrological risk to Rotala habitat from the development is change in water quality of storm water run-off, particularly elevated levels of major plant nutrients N and P remaining in stormwater after treatment in a network of bio-retention basins to be constructed in the residential area. Eutrophied run-off has the potential to produce changes in the structure and species composition of the wetland plant community PCT 780 which provides habitat for Rotala. Potential changes include (i) increased soil concentrations of major plant nutrients, (ii) increased biomass and density of herbaceous ground layer plants, and (iii) changes in species compostion including increase in exotic species.

The bio-retention technology to be applied to the residential development (Biome Pty Ltd 2023) appears to be state of the art and able to substantially reduce N and P concentration in run-off discharged to the floodway and Rotala habitat. Although substantially reduced, the data provided suggests that levels of N and P in stormwater run-off afterr treatment are likely to be twice those of run-off on the undeveloped site. However, in terms of (i) kg/yr of nutrient discharged to floodway, (ii) attenuation effects with increasing distance from the discharge point and (ii) previous cattle grazing, likely impact on Rotala habitat will probably be at the lower end of the scale (qualitatively speaking), but this is by no means certain, and may still have an adverse affect on the Rotala population on the Subject Site.

6 Maintenance of Rotala habitat

The maintain habitat conditions most likely to perpetuate a population of Rotala on the Subject Site, it is recommended that Rotala habitat areas by managed with a combination of tractor slashing and periodic, low intensity burning. 'Rotala habitat' is assumed to comprise all or most of the low-lying parts of the site excluded from development.

6.1 Tractor slashing

Tractor slashing has been carried out in recent years to suppress sapling regrowth on the designated floodway, and also appears to have helped maintain suitable habitat conditions for Rotala by reducing vegetation height and density, and forming micro-disturbance sites were Rotala seed can germinate, Observations showed that some Rotala seed germination occurs in tractor wheel ruts although generally only very sporadically and in low numbers.

Without slashing, the floodway and other open areas would rapidly regenerate to forest and displace the Rotala population. Small Melaleuca saplings were observed on the floodway during fieldwork in 2023.

Timing

Tractor slashing twice a year is recommended in Autumn and Spring. Summer slashing should be avoided to minimise disturbance to Rotala plants as they mature and produce seed.

After a winter-early spring burn, slashing would not be carried out before Rotala seedlings have set seed. Check by inspecting plants before slashing.

If slashing only is used to manage Rotala habitat, a small population may persist in tractor wheel ruts, or as dormant seed in the soil seedbank, but species seedbanks decay and need to renewed to prevent the species dying out. To maintain a healthy population of Rotala on the site, occasional burns are recommended, with aim of stimulating large scale seed germination.

6.2 Low intensity fire

Observations of the population ecology of Rotala on the Subject Site and other locations indicate that Rotala can appear in large number for a short period after fire disturbance, then die-off and persist as dormant seed, until the next disturbance. This is the natural life cycle of the species which is adapted to utilise open conditions in the earliest stages of plant community regrowth after fire.

To maintain a healthy population, the site should be burnt every 2 to 4 years in winter or early spring when conditions are favourable. The site should be burnt when fuel (i.e. ground layer vegetation and litter), weather and soil moisture conditions are suitable for a complete burn of ground layer, herbaceous plants. Advice can be sought NPWS rangers who carry out ecological burns in local National Parks. Fire breaks around the perimeter of the Subject Site are already planned as part of the Vegetation Management Plan.

A *Bushfire Risk Management Plan* (BushfireSafe Aust 2021) has been prepared for the proposal. The Plan notes the following:

- A perimeter road has been designed along the entire length of the floodway (eastern side of development.
- The development has been designed with a 21 metre wide perimeter road along the bushfire hazard interface.
- A minimum 25 metre Asset Protection Zone (APZ) along the forest vegetation adjacent to the southwestern margins of the site and a minimum 9 metre APZ from the remnant and riparian vegetation areas is prescribed.

6.3 Monitoring

As already emphasised, a monitoring strategy with clear objectives, methods and scheduling is essential to determine how treated stormwater run-off and site management measures (slashing and burns) affect the Rotala population and wetland habitat.

7 Conclusion

Assuming (i) the accuracy of hydrological models used in reports to assess hydrological impacts, reviewed above; and (ii) application of habitat management measures as described in Section 5, the likelihood of the residential development having a Serious and Irreversable Impact (SAII) on the Rotala population, resulting in a significant decline in the population, is considered to be low.

There is unlikely to be any major change in depth and duration flooding due to run-off from the filled residential area but data presented in reports indicate that stormwater discharged to low lying wetland habitat containing the Rotala records, will have about twice the concentration of N and P as pre-development run-off. However, as the quantity of nutrient in terms of kg/yr added to the low lying area is relatively small, the risk of eutrophication of habitat is also considered to be low.

Implementation of the habitat management regime described in Section 5 would increase the likelihood of the species persisting on the site. There is no certainty of outcome as the extent of the dormant Rotala seedbank on the Subject Site, which is crucial to the contined presence of Rotala, is largely unknown and simply assumed to be present based on where the species has previously been recorded.

A monitoring strategy is essential to determine how stormwater treatment and habitat management measures affect the Rotala population and wetland plant communities.

References

Biome (2023). Additional information request response – stormwater. Development Application Sub2023/0001, 52-54 Miles St, Yamba 2464/

Department of Planning and Environment (2022). Flood Impact and Risk Assessment: Flood Risk Management Guide LU01. NSW Gov.

Ecos Environmental (2021). Woolgoolga to Ballina Pacific Highway upgrade**.** Annual Threatened Flora Translocation Monitoring Report. Report to TfNSW.

Geolink (2022). Biodiversity Development Assessment Report. Lot 46 & 47 DP751395 Miles Street Yamba: Proposed Subdivision.

RGS (2022). Geotechnical Assessment Yamba Gardens Residential Estate 52-54 Miles St, Yamba, Report by Kahuna No. 1 Pty Ltd, Regional Geotechnical Solutions

Photographs

Plate 1: About 10 Rotala were recorded on Lot 47 in June 2023 in the same location plants were recorded in 2018. This plant has turned red and is starting to die back due to cold conditions.

Plate 2: A Rotala recorded on Lot 46 in June 2023 at the same location plants were recorded in 2021. This plant is turning brown and dying back due to cold conditions.

Plate 3: Wetland community PCT720 on Lot 47 in June 2023 dominated by the exotic herb *Cuphea carthegenicus*.

Plate 4: Wetland community PCT 720 on Lot 46 in June 2023, browning off due to cold temperatures.

Plate 5: Rotala seedlings on Lot 47 in November 2018. Photo supplied by D. Havilah.

Plate 6: Dense Rotala seedlings germinated after fire on a property at Mongogarie, south of Casino. Photo supplied by D. Havilah.

Plate 7: Rotala seedlings germinated after fire on a property at Mongogarie, south of Casino. Photo supplied by D. Havilah.

Plates 8-10: Rotala plants translocated from near the intersection of Jacky Bulbin Rd and the Pacific Highway to a recipient site 1 km south, for the Woolgoolga to Ballina project. Some plants survived for five years after being transplanted. **Plate 8** (top) – reddish stolons (prostrate, perennating stems) with small shoots. **Plates 9-10**. - clump of Rotala 3-5 cm high spreading by stolons and close up. Sept 2020

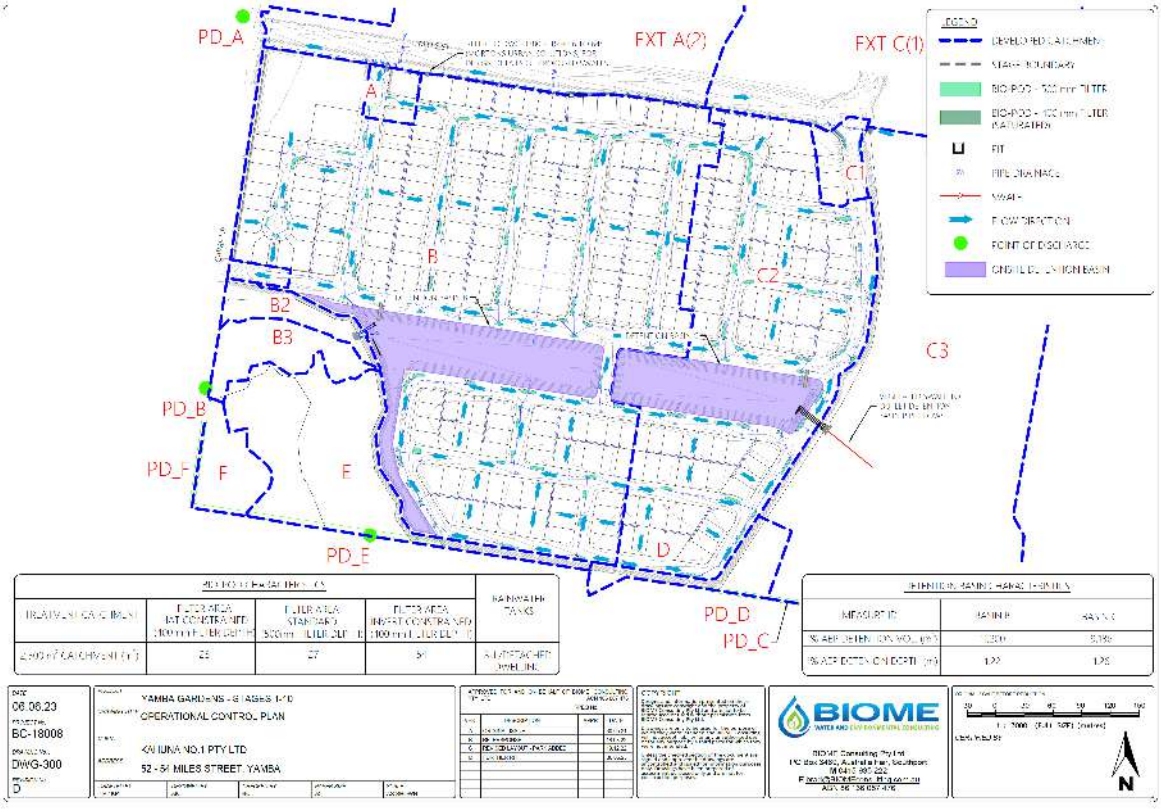
Appendix 1: Present species composition and structure of PCT 780 in two 20 m x 50 m plots in the northeast of Lot 47 and south west of Lot 46, at the locations where Rotala was recorded in June 2023.

Lot 47	0532986 6743264 (UTM, GDA)	20/6/2023
Plot = 20 m x 50 m	Miles St/Golding St	
Species	**Crown-cover**	**Native/Exotic**
Cuphea carthegenicus	4	e
Schoenus brevifolius	3	n
Cyperus polystachyos	3	n
Axonopus affine	3	e
Paspalum dilatatum	3	e
Polygala multiflora	2	e
Centella asiatica	2	n
Alternanthera denticulate	2	n
Cynodon dactylon	2	n
Philydrum lanuginosum	2	n
Aster subulatus	2	e
Juncus cognatus	2	e
Baumea articulata	2	n
Enydra fluctuans	2	n
Bacopa monneiri	2	n
Hypocheirus radicata	2	e
Melaleuca stypheloides	1	n
Asclepias currasavica	1	e
Cyperus rotundus	1	e
Christella sp.	1	n
Melaleuca quinquenervia	1	n
Andropogon virginicus	1	e
Rotala tripartita	1	n

Lot 46	0532217 6743126 (UTM, GDA)	20/6/2023
Plot = 20 m x 50 m	Carr Drive	
Species	**Crown-cover**	**Native/Exotic**
Eleocharis acuta	5	n
Cuphea carthegenics	4	e
Baumea articulata	3	n
Paspalum dilatatum	3	e
Philydrum lanuginosum	2	n
Baumea rubiginosa	2	n
Juncus ursitatus	2	n
Axonopus affine	2	e
Cyperus polystachyos	2	n
Schoenus brevifolius	2	n
Persicaria strigosa	2	n

Polygala multiflora	2	e
Ranunculatus inundatus	1	n
Christella sp.	1	n
Asclepias currasavica	1	e
Casuarina glauca	1	n
Cyperus rotundus	1	e
Senecio madagascarensis	1	e
Alternanthera denticulate	1	n
Rotala tripartita	1	n

Appendix 2: Location of two bio-retention basins and how they will be linked with housing. This design is repeated across the site. Below is the design the bioretention media which is a soil/particulate medium (source: Biome Pty Ltd 2023)



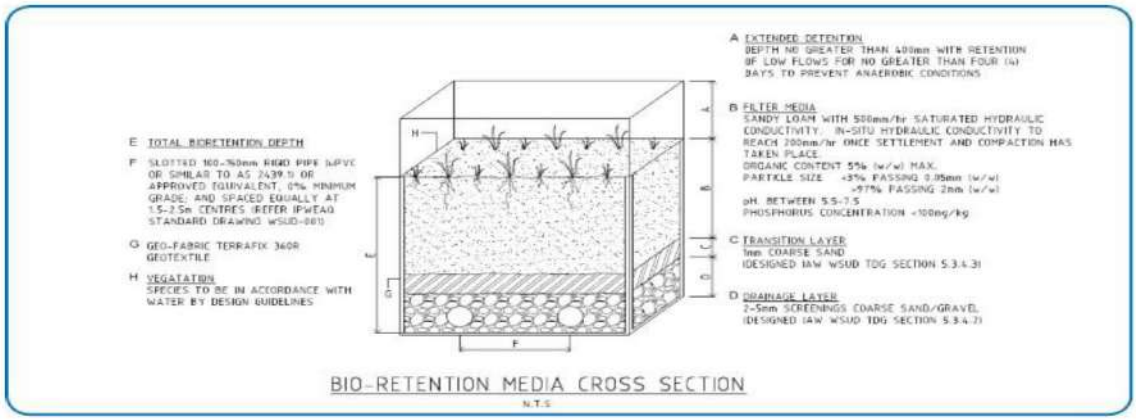


Figure 7.1 Bioretention specifications (Typical)