Kiama Vegetation Study

DRAFT REPORT

Prepared for Kiama Municipal Council

5 October 2022

Biosis offices

NEW SOUTH WALES

Albury
Phone: (02) 6069 9200
Email: albury@biosis.com.au

Newcastle
Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney
Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Western Sydney
Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong
Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

VICTORIA

Ballarat
Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne
Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta
Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

Document information

Report to:	Kiama Municipal Council
Prepared by:	Rebecca Dwyer Joel Nicholson Dr Caragh Heenan Felicity Williams Callan Wharfe
Biosis project no.:	36080

File name: 36080.Kiama.Vegetation.Mapping.Study.FIN.20221004

Citation: Biosis 2022. Kiama Vegetation Study. Report for Kiama Municipal Council. Dwyer. R, Nicholson. J. Biosis Pty Ltd. Wollongong, NSW. Project no.36080

Document control

Version	Internal reviewer	Date issued
Draft version 01	Rebecca Dwyer	23/05/2022
Draft version 02	Rebecca Dwyer	01/09/2022
Final version 01	Jane Raithby-Veall	30/09/2022

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Kiama Municipal Council.
- Department of Climate Change, Energy, the Environment and Water for access to the Protected Matters Search Tool of the Australian Government.
- NSW Department of Planning and Environment Group for access to the BioNet Atlas of NSW Wildlife.

Biosis staff involved in this project were:

- Rebecca Dwyer and Joel Nicholson (assistance in the field).
- Joel Nicholson and James Shepherd (mapping).
- Lew Short – BlackAsh Bushfire Consulting for vegetation assessment, grassland determination and Bushfire Prone Mapping.

Contents

Tables

Figures

Glossary

BC Act	NSW *Biodiversity Conservation Act 2016*
BFPM Guideline	*Guide for Bush Fire Prone Land Mapping 2015*
Biosecurity Act	*Biosecurity Act 2015*
BV Map	Biodiversity Values Map
CBD	Central Business District
CEEC	Critically Endangered Ecological Community
DCP	Development Control Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPI	Department of Primary Industries
DPE	NSW Department of Planning and Environment
EEC	Endangered Ecological Community
EES	NSW Environment, Energy and Science Group
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GIS	Geographic Information System
HEV	High Ecological Value
LEP	Local Environmental Plan
LGA	Local Government Area
LLS	Local Land Services
Matters of NES	Matters of National Environmental Significance
NPW Act	*National Parks and Wildlife Act 1974*
NSW	New South Wales
PCT	Plant Community Type
RFS	NSW Rural Fire Service
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy
study area	Kiama LGA
TEC	Threatened Ecological Community

Summary

Biosis Pty Ltd was commissioned by Kiama Municipal Council (Council) to undertake a Municipal wide vegetation study to meet the objectives of the *Kiama Local Strategic Planning Statement 2020* (LSPS). The two key priorities relating to climate change and protecting our environment within the LSPS are:

- Planning Priority 10 to 'Conserve areas of environmental significance'.
- Planning Priority 12 to 'Plan for and adapt to the impacts of natural hazards and the changing climate'.

To achieve these objectives, a municipal wide vegetation study was undertaken by Biosis Pty Ltd and Blackash Bushfire Consulting Pty Ltd to ensure that biodiversity corridor and bush fire mapping is accurate.

The vegetation study was completed by collating relevant datasets and creating a canopy height model (CHM) using 1 metre light detection and ranging (LIDAR) data. The data was compiled into a single geographic information system (GIS) map and the study area divided up into 500 metre by 500 metre grid squares. Two Biosis botanists with extensive experience across the Sydney Basin Bioregion assessed each section of the map and assigned Plant Community Types (PCT) by overlaying and assessing any overlapping or nearby vegetation from previous mapping projects, or based on a visual inspection of the soils, geology, NearMap imagery as well as CHM. PCTs potentially present within the study area were determined using the BioNet PCT identification tool and the Tozer-types PCT identification tool, as well interrogation of BioNet data and existing vegetation mapping projects.

Following the desktop vegetation mapping, a field investigation of the LGA was undertaken on 23, 28, 29 March, and 6, 9 May 2022, by Rebecca Dwyer (Principal Ecologist) and Joel Nicholson (Zoologist). Vegetation within the study area was surveyed using the random meander technique (Cropper 1993) over 75 person hours. The PCTs and condition with a 'low-moderate' confidence rate following the desktop mapping were targeted within publicly accessible land within the study area, to address critical uncertainties in the data, particularly in relation to PCTs, native vegetation condition and grasslands. Following completion of the Municipal wide vegetation study, Blackash Bushfire Consulting Pty Ltd updated the existing Bush Fire Prone Land Map, in accordance with NSW Rural Fire Service's requirements, to ensure land use planning decisions are made utilising current data.

A total of 14,148 hectares of native vegetation was mapped within the Kiama Local Government Area (LGA), consisting of 27 different PCTs, with each PCT categorised into three different condition classes (High, Moderate and Low). An additional 99 hectares of Urban Native/Exotic vegetation and 9,742 hectares of grassland was also mapped within the Kiama LGA.

Nine *Biodiversity Conservation Act 2016* (BC Act) listed and nine *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) listed Threatened Ecological Communities (TECs) were mapped within the Kiama LGA. The BC Act listed TECs covered a total of 4,641 hectares of vegetation, constituting 32.50 % of the total native vegetation within the Kiama LGA. The EPBC Act TECs covered a total of 3,977 hectares of vegetation, constituting 28.10 % of the total native vegetation within the Kiama LGA.

A total of 3,481 hectares of native vegetation was mapped within the Kiama LGA, as containing areas mapped as Biodiversity Values (BV) under Part 7 of the BC Act.

A total of 14,286 hectares of native vegetation was mapped within the Kiama LGA, as containing areas of biodiversity significance in accordance with the Standard Instrument Local Environmental Plan and associated guidelines/standards. The areas of biodiversity significance were classified into three categories;

Low, Moderate, and High. The areas of Low biodiversity significance mapped within the Kiama LGA covered an area of 257 hectares and consisted of attributes such as small / isolated patches (<5 hectares) of native vegetation, non-threatened native vegetation in lower condition states and non-native vegetation. The remaining areas of High and Moderate biodiversity significance mapped within the Kiama LGA were based on the *High Environmental Value (HEV) for Strategic Planning - Mapping and Governance Guide* (OEH 2015), including identification of key species and relevant biodiversity mapping layers as outlined in the methodology provided in Chapter 4 below. The areas of Moderate biodiversity significance mapped within the Kiama LGA covered an area of 472 hectares, with the High biodiversity significance areas covering 13,557 hectares.

Biosis has assessed the Kiama LGA against the *Guidelines for interpreting listing criteria for AOBV under the BC Act and the Biodiversity Conservation Regulation 2017* (DPIE 2021). An area proposed for listing as an Area of Outstanding Biodiversity Value under the BC Act must be assessed under Division 3.1 of the BC Regulation. An area is eligible for listing if it meets any one of the criteria in clause 3.1(1)(b), provided it is also significant at the NSW state or wider scale (clause 3.1(1)(a)).

Any AOBV must be important at either (or all) a State, National or global scale. For species and ecological communities, those endemic to NSW are considered to be of global significance, as they are found nowhere else in the world. For species and ecological communities not endemic to NSW, their State significance, and hence eligibility must be justified with reference to the relative importance of populations (species) or distribution and species composition (ecological communities) in NSW as compared to elsewhere.

There are four possible pathways by which an area must make a significant contribution to persistence of biodiversity in NSW to be eligible as an AOBV. These four are:

- Multiple species or at least one threatened species or ecological community.
- Irreplaceable biological distinctiveness.
- Ecological processes or ecological integrity.
- Outstanding ecological value for education or scientific research.

An assessment against the four possible pathways for the key threatened species and threatened ecological communities identified as part of the BV mapping undertaken in Section 4.1, within Kiama LGA is provided in Figure 7. The assessment found that the Barren Grounds Nature Reserve and Budderoo National Park within Kiama LGA, are considered likely to meet the criteria for listing as an AOBV.

The Budderoo National Park and Barren Grounds Nature Reserve are likely to be considered significant at the global, National and State scale as the area:

- Contains populations of Nationally significant species listed under the EPBC Act.
- Contains populations of species endemic to NSW and therefore of global significance.
- Contains species with greater than 66 % of their distribution occurring in NSW and that are therefore of State significance.
- Contains occurrence of ecological communities that, relative to other occurrences of the ecological community are distinctive in taxonomic composition, habitat structure or biology or ecological function.

Assessment of vegetation for the determination of Bush Fire Prone Land has been completed in accordance with the NSW Rural Fire Service (RFS) document Guide for Bush Fire Prone Land Mapping 2015 (BFPM Guideline). Bush Fire Prone Land is an area of land that can support a bush fire or is likely to be subject to bush fire attack, as designated on a bush fire prone land map.

1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Council to undertake a municipal wide vegetation survey of Kiama Municipal Region (the project) in New South Wales (NSW).

Biosis understands that Council has recently prepared and adopted the *Kiama Local Strategic Planning Statement 2020* (LSPS). Throughout the community consultation process, two key priorities relating to climate change and protecting our environment, were identified as part of the LSPS:

- Planning Priority 10 to 'Conserve areas of environmental significance'.
- Planning Priority 12 to 'Plan for and adapt to the impacts of natural hazards and the changing climate'.

The following actions have been included in the LSPS to achieve this:

- Undertake a Municipal wide vegetation study to ensure biodiversity corridor and bush fire mapping is accurate.
- Following completion of the Municipal wide vegetation study, review environmental zonings and terrestrial biodiversity layers of the *Kiama Local Environmental Plan 2011* (LEP) to ensure environmental lands are appropriately zoned.
- Review land use tables of environmental zonings in the LEP to ensure appropriate mix of uses permitted in environmental zones.
- Following completion of the Municipal wide vegetation study update existing Bush Fire Prone Land Map, in accordance with NSW Rural Fire Service's requirements, to ensure land use planning decisions are made utilising up-to-date/current data.

The *Natural Vegetation in the Municipality of Kiama New South Wales* was previously prepared by (Kevin Mills & Associates Pty Ltd 2007). The report, and associated maps, formed the basis of current environmental zoning and terrestrial biodiversity corridors as mapped by the LEP. Since the publication of the 2008 Kiama Bush Fire Prone Land map, changes have occurred to the NSW Rural Fire Services standards which include, but are not limited to, the need to identify grassland as a bush fire hazard.

The broad strategic aims of this project include to following:

- Identification of the different vegetation types throughout the Municipality of Kiama.
- Identification of TECs listed under the BC Act and EPBC Act and any areas of 'Outstanding Biodiversity Value' and their distribution within the municipality.
- Provide an update to the Bush Fire Prone Land Map.

1.2 Location of the study area

Kiama LGA covers approximately 256 square kilometres and encompasses several major suburbs including; Kiama, Gerringong, Jamberoo and Minnamurra. Kiama is located near the Minnamurra River along the Princes Highway, approximately 40 kilometres south of Wollongong Central Business District (CBD) and 88 kilometres south of Sydney CBD (Figure 1).

The study area is within the:

- Sydney Basin Bioregion.
- Shoalhaven River Basin (Shoalhaven catchment).
- South East Local Land Services (LLS) Management Area.
- Municipality of Kiama or LGA.

biosis

Figure 1 Location of the study area

Matter: 36080
Date: 20 May 2022,
Checked by: Drawn by: JMS, Checked by: JN, Last edited by: jshepherd
Location:P:\36000s\36080\Mapping\

0 1,000 2,000 3,000 4,000 5,000
Metres

N

Scale 1:150,000 @ A4, GDA 1994 MGA Zone 56

2 Methods – Vegetation Mapping (Biosis)

2.1 Database and literature review

Prior to completing the field investigation, information provided by Council as well as other key information was reviewed, including:

- Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool for matters protected by the EPBC Act (Commonwealth of Australia 2022).
- NSW Department of Planning and Environment (DPE) BioNet Atlas of NSW Wildlife, for items listed under the BC Act (DPE 2022).
- The NSW Department of Primary Industry (DPI) Spatial Data Portal for *Fisheries Management Act 1994* (FM Act) listed threatened species, populations and communities.
- NSW DPI WeedWise database for *Biosecurity Act 2015* listed priority listed weeds for the Greater Sydney Local Land Services (LLS) area within the Sydney region.
- *Kiama Local Environmental Plan 2011.*
- *Natural Vegetation in the Municipality of Kiama New South Wales* (Kevin Mills & Associates Pty Ltd 2007).
- *Southeast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230* (DPE 2010).
- BioNet Vegetation Classification NSW Plant Community Types (PCT) identification tool.
- Coastal wetlands and littoral rainforest mapping as identified under the Coastal Management State Environmental Planning Policy (SEPP).
- Identification of biodiversity corridors as well as existing conservation areas, National Parks and/or biobank/stewardship sites.
- *Guidelines for interpreting listing criteria for AOBV under the BC Act and the Biodiversity Conservation Regulation 2017* (DPIE 2021).
- The NSW Biodiversity Values Map and Threshold Tool.
- NSW soils datasets at 1:100,000 from the EES data portal (Hazelton 1992).
- NSW geology datasets at 1:250,000 from the DPIE data portal (Bowman 1971).
- Additional topographic data obtained from LiDAR data.
- Hydrological modelling derived from LiDAR data.
- A Canopy Height Model (CHM) will be created using 1 m LiDAR data from DPIE (2018).
- Recent NearMap imagery for the study area at 15 cm resolution.
- Topographic information, including height and slope, obtained from LiDAR data.
- Review of GIS data layers including seeking grassland layer from the Rural Fire Service (RFS).
- Existing digital layer for the Bush Fire Prone Land Map.

2.2 Desktop vegetation mapping

The vegetation mapping for the Kiama Municipal project utilised a similar methodology to that undertaken for a strategic scale project, such as the *Cumberland Plain Conservation Plan Assessment Report* (Biosis & Open Lines 2021). This method is outlined below.

2.2.1 Preparation of draft PCT map based on desktop analysis

A draft PCT map will be prepared by GIS staff via the following steps:

Step 1: Collate relevant datasets and GIS layers including:

- Recent Nearmap imagery of the study area at 15 cm resolution.
- NSW Landuse Mapping 2017 v1.2 (DPIE 2020a).
- NSW soils datasets at 1:100,000 from the NSW Government data portal (Hazelton 1992).
- NSW geology datasets at 1:250,000 from the NSW Government data portal (Bowman 1971).

Step 2: Review existing DPE maps of native vegetation within the Kiama LGA (DPIE 2010, Kevin Mills & Associates Pty Ltd 2007) and clip the layers to the study area boundary.

Step 3: Create a canopy height model (CHM) using 1 m light detection and ranging (LIDAR) data.

Step 4: Process the CHM into amalgamated canopy polygons for vegetation over 1 m in height (exotic vegetation only).

Step 5: Manually create and attribute GIS polygons to accurately capture native vegetation extent, type and condition.

Step 6: Compile the data into a single GIS map for the study area.

Rule set for mapping native vegetation

The following rule-set was utilised to ensure mapping of native vegetation was consistent and precautionary across the mapping area:

- Map vegetation to canopy extent with a +/-2m buffer where grassland surrounds the mapped polygon.
- Consider visible changes in condition and obvious changes to vegetation type (PCTs).
- Include gaps within surrounding polygons where:
  - Gaps are ≤60 m wide and surrounded by intact vegetation, except where significant disturbance is evident.
  - Gaps are ≤30 m wide and surrounded by thinned vegetation (or partly surrounded by thinned and partly by intact), except where significant disturbance is evident.
- Map scattered trees comprising mature gum trees as a single polygon where trees occur ≤60 m apart and the internal area is +/- uniform grassland.
- Map scattered trees comprising shrubs or scattered regrowth as separate polygons where separated by ≥10 m.
- Map a 30 m buffer along the edges of intact and/or thinned vegetation in grassland areas that appear to have lower levels of disturbance history (i.e., these areas may comprise derived native grassland).

- Excise roads and waterbodies, but map canopy overhanging.
- Map aquatic vegetation where it is contiguous with vegetation on the adjacent bank.

The extent of native vegetation within the study area was reviewed by Biosis botanists using purpose-built GIS web apps supporting hi-definition aerial imagery. This was done to ensure accuracy of tree canopies versus shadows, extents of more disturbed shrubby areas, and extents of dynamic wetland / swampy areas. A grid-based approach was used whereby Biosis mapping staff would systematically move through the gridded study area, drawing vegetation extent polygons to accurately capture areas of vegetation, and then subsequently attribute (and/or cut) polygons with vegetation type (PCT) and condition data. Where PCT and/or condition of a contiguous patch of vegetation changed between grids and the transition between the vegetation zones was not clear from desktop analysis, the grid boundaries were used to split the polygons.

Existing vegetation mapping (DPIE 2010, Kevin Mills & Associates Pty Ltd 2007) was used as a guide, but was not be relied upon to determine native vegetation cover and extant. LiDAR derived datasets including a CHM and digital elevation model was also used to differentiate types of vegetation.

Identification of PCT

PCTs potentially present within the study area were determined using the BioNet PCT identification tool and the Tozer-types PCT identification tool, as well as interrogation of BioNet data and existing vegetation mapping projects (DPIE 2010, Kevin Mills & Associates Pty Ltd 2007) for vegetation communities of the Sydney Basin Bioregion.

Botanists experienced in the survey and identification of the PCTs of the Sydney Basin Bioregion attributed updated vegetation polygons that accurately represent vegetation extent with the appropriate PCTs based on consideration of landscape and location specific factors. Existing vegetation mapping was used as a basis for PCT attribution. The accuracy of the mapping was assessed and the 'best fit' PCT for each vegetation polygon was determined through:

- API of high resolution Nearmap (over multiple capture dates and seasons).
- Consideration of landform and landscape positioning.
- Consideration of soil and geology mapping.
- LiDAR derived datasets including CHM and digital elevation model.
- BioNet floristic data, as well as site visits where publicly available, all with reference to BioNet data PCT descriptions and vegetation mapping PCT profiles.

Determination of vegetation condition

A condition type for each vegetation polygon was assigned through analysis of canopy structure using LiDAR, the CHM, air photo interpretation of Nearmap imagery, and field-based visual inspection of the vegetation where appropriate and accessible. The condition states that were applied to each vegetation polygon were consistent with those utilised in the BAM (DPIE 2020b) as follows:

- **High:** Assigned to areas of wooded vegetation community, including regrowth that displays a range of structural layers and habitat features (e.g., tree hollows and large trees, fallen timber, leaf litter), with a largely unmodified canopy density and a range of age classes and species present. This condition state is assigned to areas where the Nearmap imagery indicates significant patches of continuous canopy, and the CHM indicates vegetation in both the upper and middle storeys.
- **Moderate:** Assigned to native vegetation in various states of modification, including:

  - Wooded vegetation with a partly cleared canopy and a more open structure compared to the intact high quality PCT.
  - Wooded vegetation that has been potentially under scrubbed or historically thinned. This condition state is assigned to areas where the Nearmap imagery indicates patches of notably reduced canopy density, which is typically where the CHM indicates canopy and visible ground only, with no discernible shrub layer or structural complexity.
- **Low:** This condition state includes a single tree or small group of trees surrounded by native or exotic pasture or areas of cultivation. Other structural components of the vegetation have typically been removed. This condition state is assigned to areas where the Nearmap imagery and LiDAR canopy polygons indicate one or a few likely native trees surrounded by cleared land.

In determining vegetation condition in accordance with these definitions for each vegetation polygon, a rule-set was considered to ensure this work is consistent and precautionary across the mapping area. This rule set included the following:

- Using all available data sources when considering PCT; existing mapping, soils layer, geology layer, LiDAR derived layers, watercourses, slope/topography, aspect, mapping profiles, etc.
- Consideration of the expected density of tree and shrub layers for each PCT when assigning condition and considering evidence for disturbance. For example, PCT 882 in high condition may regularly have gaps in vegetation layers whereas this is less likely for PCT 1245.
- Including confidence level fields in the data and providing regular feedback to botanists about low confidence areas that would benefit from field verification (if possible).

2.3 Field validation

Following the desktop vegetation mapping, a field investigation of the LGA was undertaken on 23, 28, 29 March, and 6, 9 May 2022, by Rebecca Dwyer (Principal Ecologist) and Joel Nicholson (Zoologist). Vegetation within the study area was surveyed using the random meander technique (Cropper 1993) over 75 person hours.

The PCTs and condition with a 'low-moderate' confidence rate following the desktop mapping were targeted within publicly accessible land within the study area, to address critical uncertainties in the data, particularly in relation to PCTs, native vegetation condition and grasslands.

The vegetation types, within the study area, were stratified into PCTs broadly based on previous vegetation mapping, and the vegetation boundaries marked using a digital field data app, Field Maps, in the field. Appropriate PCTs were selected on the basis of species composition and structure, landscape position, underlying geology, soil type, and any other diagnostic features.

2.4 Integration of field data and update desktop native vegetation mapping

Following the field validation, the vegetation mapping data layers were updated for native vegetation extent, type (PCT) and condition where appropriate on the basis of the field survey, and a final digital native vegetation mapping for the Kiama Municipal Region was prepared.

3 Methods – Bush Fire prone vegetation mapping (BlackAsh)

3.1 Bush Fire prone vegetation mapping

The methodology Blackash applied for the bush fire prone vegetation mapping was in accordance with the *NSW Rural Fire Service Guide for Bush fire Prone Land Mapping version 5b November 2015* (Mapping Guidelines).

Part of the Mapping Guideline process that has been considered is to provide a Bush Fire Prone Changes Map that identifies the approved (as is) certified map with the proposed changes (to be). This will provide visibility to Council as to the proposed changes that will need to be reviewed by the NSW Rural Fire Service (RFS).

The revised mapping guidelines included provision for the new Category 3 Vegetation which includes grassland areas. The Mapping Guidelines define Vegetation Category 3 (p. 11) as:

- *is considered to be medium bush fire risk vegetation. It is higher in bush fire risk than category 2 (and the excluded areas) but lower than Category 1. It is represented as dark orange on a Bush Fire Prone Land map and will be given a 30 metre buffer. This category consists of:*
  - *Grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands.*

The delineation of grassland areas is a broad category and includes native grassland and grassland including pasture, cropped areas and grazing country. The key consideration in the assessment of Category 3 vegetation is the potential of the land to be considered bush fire prone as defined in the Mapping Guidelines (p. 4) being:

- *An area of land that can support a bush fire or is likely to be subject to bush fire attack, as designated on a bush fire prone land map.*

As part of the assessment process, BlackAsh held conversations with the RFS to determine the extent of new mapping and considerations of the new Category 3 vegetation. This included conversations with RFS Head Office and local RFS staff. Many grassland areas were extensively burnt and impacted during the 2019 – 2020 bush fires. The inclusion of the Category 3 in the new Mapping Guidelines requires expert opinion on the potential of areas to carry grass fire. Extensive field inspections were completed as part of the verification process and areas that were clearly managed were excluded while areas that could carry a grass fire were designated as being bush fire prone.

The Bush Fire Prone Map is not a risk-based map. It is intended to identify vegetation within the LGA that has the potential to support a bush fire. The bush fire prone land map is the trigger for the consideration of bush fire protection measures for *Planning for Bush Fire Protection 2019 and Australian Standard 3959-2018 – Construction of buildings in bush fire prone areas).*

Bush Fire Prone Land maps are required to be reviewed at least every five years. As required by the Mapping Guidelines, BlackAsh have used the most up to date aerial photography (NearMap) and where necessary field inspection/ground-truthing to ensure accuracy.

The steps to determine Bush Fire Prone Vegetation include:

- **Step 1:** Identification Bush Fire Prone Vegetation.
- **Step 2:** Prepare the Bush Fire Prone Land Map.
- **Step 3:** Application of the buffering criteria.

A detailed methodology to determine Bush Fire Prone Vegetation is provided below.

3.1.1 Step 1 Identification of Bush Fire Prone Vegetation

Identification of BFPV using the vegetation study review which is categorised into Keith classes for easy comparison with the requirements of Planning for Bushfire Protection 2019 (PBP).

Vegetation is classified into the following categories based on vegetation types and potential risk.

Vegetation Category 1

Vegetation Category 1 is considered to be the highest risk for bush fire. It is represented as red on the bush fire prone land map and will be given a 100 metre buffer. This vegetation category has the highest combustibility and likelihood of forming fully developed fires including heavy ember production. Vegetation Category 1 consists of; areas of forest, woodlands, heaths (tall and short), forested wetlands and timber plantations.

Vegetation Category 2

Vegetation Category 2 is considered to be a lower bush fire risk than Category 1 and Category 3 but higher than the excluded areas. It is represented as light orange on a bush fire prone land map and will be given a 30 metre buffer. This vegetation category has lower combustibility and/or limited potential fire size due to the vegetation area shape and size, land geography and management practices. Vegetation Category 2 consists of:

- Rainforests.
- Lower risk vegetation parcels.

These vegetation parcels represent a lower bush fire risk to surrounding development and consist of:

- Remnant vegetation.
- Land with ongoing land management practices that actively reduces bush fire risk.

These areas must be subject to a plan of management or similar that demonstrates that the risk of bush fire is offset by strategies that reduce bush fire risk, these include:

- Discrete urban reserve/s.
- Parcels that are isolated from larger uninterrupted tracts of vegetation and known fire paths.
- Shapes and topographies which do not permit significant upslope fire runs towards development.
- Suitable access and adequate infrastructure to support suppression by firefighters.
- Vegetation that represents a lower likelihood of ignitions because the vegetation is surrounded by development in such a way that an ignition in any part of the vegetation has a higher likelihood of detection.

Vegetation Category 3

Vegetation Category 3 is considered to be medium bush fire risk vegetation. It is higher in bush fire risk than Category 2 (and the excluded areas) but lower than Category 1. It is represented as dark orange on a Bush Fire Prone Land map and will be given a 30 metre buffer. This category consists of; grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands.

Vegetation excluded from being mapped as bush fire prone includes:

- Single areas of vegetation less than 1 hectare in area and greater than 100 m separation from other areas of Category 1, 2 or 3 vegetation.

- Multiple areas of vegetation less than 0.25 ha in area and not within 30 m of each other.
- Strips of vegetation less than 20 m in width, regardless of length and not within 20 m of other areas of Category 1, 2 or 3 vegetation.
- Areas of "managed grassland" including grassland on, but not limited to, recreational areas, commercial/industrial land, residential land, airports/airstrips, maintained public reserves and parklands, commercial nurseries and the like.
- Areas of managed gardens and lawns within curtilage of buildings.
- Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.
- Managed botanical gardens.
- Agricultural lands used for annual and/or perennial cropping, orchard, market gardens, nurseries and the likes are excluded.
- Saline wetlands including mangroves.
- Other areas that, due to their size, shape and overall risk are not considered Category 1, 2 or 3 vegetation.

BlackAsh reviewed the draft map to ensure application of vegetation exclusions as per the Mapping Guidelines.

3.1.2 Step 2 Prepare the Bush Fire Prone Land Map

Once BlackAsh revised the draft vegetation layers with Biosis and Council, they prepared the Bush Fire Prone Land Map which included a Changes Map. Following acceptance from Council and Biosis, BlackAsh applied the buffers as required in the Mapping Guidelines and prepared the data set for Council so the Draft map could be sent to the RFS for review and Certification.

3.1.3 Step 3 Application of the buffering criteria

Once areas of vegetation were defined and the appropriate bush fire vegetation categories were applied, it was necessary to apply the buffering criteria.

The method for the determination of bush fire vegetation buffering was as follows:

- BFPV Category 1 – apply a 100 m external buffer to each vegetation polygon.
- BFPV Category 2 – apply a 30 m external buffer to each vegetation polygon.
- BFPV Category 3 – apply a 30 m external buffer to each vegetation polygon.

At the conclusion of this process there was one dataset; comprising of four parts; Vegetation Category 1, Vegetation Category 2, Vegetation Category 3 and Buffer. This was used to define 'Bush Fire Prone Land' and is displayed on a map across the LGA.

4 Methods – Areas of biodiversity value and significance

4.1 Identification of Biodiversity Values Mapping within the LGA

The Biodiversity Values Map (BV Map) identifies land with high biodiversity value that is particularly sensitive to impacts from development and clearing. The map forms part of the Biodiversity Offsets Scheme (BOS) threshold, which is one of the factors for determining whether the BOS applies to a clearing or development proposal. The map is prepared by the DPE under Part 7 of the BC Act.

A current BV Map layer was downloaded from the Biodiversity Values Map and Threshold (BMAT) tool ((NSW Department of Planning and Environment 2022) and overlaid with vegetation mapping completed by Biosis in the method provide above in Section 2, to determine the area of Biodiversity Values within the Kiama LGA.

4.2 Identification of Areas of Moderate or High Biodiversity Value

The method for mapping areas of High and Moderate biodiversity significance, broadly aligns with the key principles of the Part 6.4 Terrestrial Biodiversity of the LEP. The final native vegetation and TEC extent layer was used to develop a biodiversity significance matrix, with reference to NSW OEH *Developing Maps of High Environmental Value (HEV) for Strategic Planning - Mapping and Governance Guide* (OEH 2015), in consultation with Council, through implementation of the following processes:

Baseline Updated Kiama LGA vegetation layer (Biosis 2022).

Step 1: Identify area 'key threatened species habitat' through implementation of steps 2-6 below. Key species are those considered to be of High or Moderate biodiversity significance. As noted in the HEV guidelines (OEH 2015) the inclusion of 'all threatened species habitat' is likely to be too broad, as it could be interpreted to include all extant vegetation. Examples of key species habitat, could include:

- Key breeding habitats with known breeding occurrence.
- BAM mapped important habitat areas.
- Habitat for known populations of site-managed species.
- Extant populations of species with a higher conservation significance.
- Species endemic to, or rare within the, Kiama LGA.

Step 2: Generate a threatened species list to include all records (DPE 2022b) within the Kiama LGA and any species listed as potential Serious and Irreversible Impact (SAII) entities under BAM.

Step 3: Filter threatened flora records to exclude species that have not been recorded within the LGA in the last 20 years.

High biodiversity value flora rule point: All remaining flora species are to be defined as high biodiversity value.

Step 4: Filter the threatened fauna records for marine/pelagic and/or migratory species, unless it is a Saving Our Species (SOS) listed species.

Lower biodiversity value fauna rule point: All fauna species meeting the above criteria are to be defined as lower biodiversity value.

Step 5: Filter the remaining threatened fauna records for species with more than ten records, or are listed as a SAII, Endangered, Critically Endangered species, Endangered population despite the number of records.

High biodiversity value fauna rule point: All fauna species that are listed as a SOS species, SAII, Endangered, Critically Endangered species, and/or Endangered populations, and have records within the LGA, are to be defined as high biodiversity value.

Moderate biodiversity value fauna rule point: All fauna species that are not yet listed as 'high' or "lower' biodiversity value are defined as moderate biodiversity value.

Step 6: Key species are considered to be all those identified as high biodiversity value, and those species of moderate biodiversity significance that are species credit species and have more than 10 records within the LGA. Areas of key habitat were defined and mapped as per the species-specific mapping methodology for outlined in Appendix 1 (flora) and Appendix 2 (fauna).

Step 7: Areas of vegetation that were found to support habitat for seven or more species were determined as being of High Biodiversity Significance, with areas supporting habitat for of six or less key species were deemed of Moderate Biodiversity Significance.

Step 8: Identify areas mapped as BC Act and EPBC Act Threatened Ecological Communities (TECs) and assign High Biodiversity Significance. The methodology for mapping the TECs is outlined in Appendix 3.

Step 9: Identify Coastal Wetlands areas mapped on the Coastal Management SEPP, wetlands listed on the Directory of Important Wetlands of Australia (DIWA), and wetlands mapped in the NSW (2006) wetlands spatial layer as High Biodiversity Significance.

Step 10: Identify and map large patches (>100 ha, as per the BAM) of native vegetation as High Biodiversity Significance. Medium sized patches (<100 ha to ≥5 ha) were deemed of Moderate Biodiversity Significance, and small patches (<5 ha) were considered of Low Biodiversity Significance.

Step 11: Areas of larger, or otherwise significant, populations of threatened flora (not already determined to by of High Biodiversity Significance) were selected as mapped as High Biodiversity Significance.

Step 12: Areas of "Over-cleared vegetation types" (>70 % from pre-European extent) and "Native vegetation on over-cleared landscapes" (native vegetation on Mitchell Landscape noted as >70 % cleared) were mapped as High Biodiversity Significance.

Step 13: Identify and map areas of DPE Biodiversity Values as at least Moderate Biodiversity Significance.

Following implementation of the above steps the biodiversity values present across the Kiama LGA were assigned to a Biodiversity Significance value of either High or Moderate, with any areas not meeting the above criteria considered to be of Lower Biodiversity Significance.

5 Results

5.1 Vegetation communities

A total of 14,148 hectares of native vegetation was mapped within the Kiama LGA, consisting of 27 different PCTs (Figure 2). PCT's were categorised into three different condition classes (High, Moderate and Low). An additional 99 hectares of Urban Native/Exotic vegetation, and approximately 9,742 hectares of Grassland consistent with Category 3 bush fire prone vegetation was mapped within the Kiama LGA.

The PCT's mapped within the Kiama LGA are listed in Table 1. PCT classifications in NSW are currently in a transition period which has resulted in the current PCT's being listed as Decommissioned in BioNET. When a PCT is replaced by a new type(s), it is no longer in use and is called 'Decommissioned'. Decommissioned PCTs remain visible in the BioNet Vegetation Classification application. Information is recorded in the application to track the relationships between the old (Decommissioned) and new (Approved) PCTs. These are known as 'lineage transformations'. Individual profiles on each of the 27 PCTs have been provided from Table 2 to Table 28. The new PCT number, name and justification for the selected PCT has also been provided in the vegetation community profiles provided below. A map of the current and new PCT's are shown in Figure 3.

Table 1 PCTs mapped within the Kiama LGA (Biosis 2022)

PCT number	PCT name	Total mapped area (ha)
659	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion (Table 2).	285
662	Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion (Table 3).	9
694	Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion (Table 4).	135
720	Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion (Table 5).	89
767	Coachwood - Brown Possumwood warm temperate rainforest in sheltered gullies of the Illawarra Escarpment, southern Sydney Basin Bioregion (Table 6)	167
769	Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion (Table 7).	51
771	Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion (Table 8).	29
772	Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion (Table 9).	83
838	Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (Table 10).	28
878	Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion (Table 11).	1,437
882	Hairpin Banksia - Slender Tea-tree heath on coastal sandstone plateaux, Sydney Basin Bioregion (Table 12).	595

PCT number	PCT name	Total mapped area (ha)
905	Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion (Table 13).	302
906	Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion (Table 14).	152
907	Lilly Pilly - Sassafras warm temperate rainforest in moist sheltered gullies, Sydney Basin Bioregion and South East Corner Bioregion (Table 15).	570
920	Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Table 16).	54
1078	Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion (Table 17)	1,387
1082	Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion (Table 18).	287
1126	Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Table 19).	17
1128	Sassafras - Blackwood - Lilly Pilly temperate rainforest of the Robertson area, Sydney Basin Bioregion (Table 20).	50
1156	Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion (Table 21).	1,891
1232	Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (Table 22).	161
1234	Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (Table 23).	24
1245	Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion (Table 24).	3,897
1254	Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion (Table 25).	11
1300	Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion (Table 24).	2,422
1326	Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (Table 27).	15
Urban Native/Exotic	Urban Native/Exotic (Table 28).	99
Grassland	Grassland consistent with Category 3 bush fire prone vegetation.	9,742
Total		**23,989**

Table 2 PCT 659 Bangalay – Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion

PCT 659: *Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion*	
PCT	PCT 659 *Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin Bioregion and South East Corner Bioregion*
New PCT	PCT 3638 *South Coast Sands Bangalay Forest*
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	South Coast Sands Dry Sclerophyll Forests
Percent cleared	50 %
Extent within study area	Approximately 285 ha of PCT 659 was recorded within the Kiama LGA.
Description	The canopy comprises of Bangalay *Eucalyptus botryoides,* Old-Man Banksia *Banksia serrata,* Coastal Banksia *Banksia integrifolia* subsp. *Integrifolia,* Blackbutt *Eucalyptus pilularis,* Rough-Barked Apple *Angophora floribunda,* Red Bloodwood *Corymbia gummifera,* and Swamp Mahogany *Eucalyptus robusta.* The mid stratum is dominated by Black She-Oak *Allocasuarina littoralis,* Coffee Bush *Breynia oblongifolia,* Cheese Tree *Glochidion ferdinandi,* Burrawang *Macrozamia communis and* Shrubby Platysace *Platysace lanceolata.* The ground cover comprises species including, Blue Flax-Lily *Dianella caerulea,* False Sarsparilla *Hardenbergia violacea,* Spiny-Headed Mat-Rush *Lomandra longifolia,* Pomax *Pomax umbellata,* Bracken *Pteridium esculentum* and Blady Grass *Imperata cylindrica* var. *major.*
Justification for New PCT listing	PCT 3638 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion in coastal areas with elevation of less than 40 m, which is consistent with the Kiama LGA. Some of the most dominant canopy, midstorey and ground cover species of this PCT include *Eucalyptus botryoides, Eucalyptus pilularis, Banksia serrata, Banksia integrifolia* subsp. i*ntegrifolia, Allocasuarina littoralis, Breynia oblongifolia, Platysace lanceolata, Glochidion ferdinandi, Dianella caerulea, Hardenbergia violacea, Lomandra longifolia* and *Imperata cylindrica* which are consistent with the species in the PCT 659 vegetation mapped in the Kiama LGA.
Condition	The community occurs three conditions: • 255 ha of High condition. • 7 ha of Moderate condition. • 23 ha of Low condition.
Associated soils, rainfall and landscape position	Occurs in near coastal areas on the Central and South Coast on deep coastal sands.
Threatened ecological community	Assigned TEC: • *Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions* (Endangered, BC Act).

Table 3 PCT 662 Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion

PCT 662: Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion	
PCT	PCT 662 Banksia - Red Bloodwood - Hard-leaved Scribbly Gum heathy open woodland on sandstone plateaux, southern Sydney Basin Bioregion.
New PCT	PCT 3588 *Shoalhaven Foothills Bloodwood Heathy Forest*
Vegetation formation	Heathlands
Vegetation class	Sydney Montane Heaths
Percent cleared	5 %
Extent within study area	Approximately 8 ha of PCT 662 was recorded within the Kiama LGA.
Description	The canopy comprises of Scribbly Gum *Eucalyptus sclerophylla,* Red Bloodwood *Corymbia gummifera,* Yertchuk *Eucalyptus consideniana* and Port Jackson Mallee *Eucalyptus obstans.* The mid stratum is dominated by Heath-leaved Banksia *Banksia ericifolia,* Marsh Banksia *Banksia paludosa,* Hairpin Banksia *Banksia spinulosa,* Coral Heath *Epacris microphylla,* Dagger Hakea *Hakea teretifolia,* Broad-leaved Drumsticks *Isopogon anemonifolius,* Mountain Devil *Lambertia formosa* and Slender Tea-tree *Leptospermum trinervium*. The ground cover comprises Common Raspwort *Gonocarpus tetragynus,* Daisy Goodenia *Goodenia bellidifolia, Lepyrodia scariosa,* Screw Fern *Lindsaea linearis,* Silky Purple-flag *Patersonia sericea* and *Ptilothrix deusta.*
Justification for New PCT listing	PCT 3588 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion on sandstone soils. The canopy layer is dominated by *Corymbia gummifera, Eucalyptus sclerophylla* and sometimes *Eucalyptus consideniana*. The mid layer is dominated by *Lambertia formosa* and *Leptospermum trinervium* along with *Banksia spinulosa* and *Hakea dactyloides* which are almost always present. Species such as *Isopogon anemonifolius* and *Hakea teretifolia* are also present frequently. Ground layer species such as; *Gonocarpus tetragynus*, *Patersonia sericea, Lomandra obliqua* and *Entolasia stricta* occur in high frequencies, with *Lindsaea linearis* and *Goodenia bellidifolia* also commonly present. The distribution, dominant canopy species and some of the dominant mid and ground layer species are consistent with the PCT 662 vegetation mapped within the Kiama LGA.
Condition	The community occurs in two conditions: • 6 ha of High condition. • 2 ha of Low condition.
Associated soils, rainfall and landscape position	Occurs on the Morton plateau from Tallong south to Wog Wog and east to Yerriyong and Porters Creek, extending east to the coast, where it is scattered from Booderee to Meroo Point.
Threatened ecological community	There are currently no TECs associated with this PCT.

Table 4 PCT 694 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion

PCT 694 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion	
PCT	PCT 694 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion.
New PCT	PCT 3154 *Illawarra Blackbutt Moist Forest*
Vegetation formation	Wet Sclerophyll Forests (Shrubby sub formation)
Vegetation class	North Coast Wet Sclerophyll Forests
Percent cleared	50 %
Extent within study area	Approximately 135 ha of PCT 694 was recorded within the Kiama LGA.
Description	The canopy comprises of Blackbutt *Eucalyptus pilularis* and Turpentine *Syncarpia glomulifera*, with Grey Ironbark *Eucalyptus paniculata* subsp*. paniculata,* Bangalay *Eucalyptus botryoides* and Sydney Red Gum *Angophora costata* occurring less frequently. The mid stratum comprises of; Cabbage Palm *Livistona australis,* Coast Banksia *Banksia integrifolia,* Scentless Rosewood *Synoum glandulosum,* Coffee Bush *Breynia oblongifolia,* Large Mock-Olive *Notelaea longifolia,* Lilly Pilly *Acmena smithii, Myrsine variabilis,* Coast Teatree *Leptospermum laevigatum* and Sweet Pittosporum *Pittosporum undulatum.* The ground cover consists of; Spiny-Headed Mat-Rush *Lomandra longifolia,* Bracken *Pteridium esculentum,* Blue Flax-lily *Dianella caerulea,* Wiry Panic *Entolasia stricta,* Basket Grass *Oplismenus imbecillis,* Blady Grass *Imperata cylindrica* var. *major,* Pastel Flower *Pseuderanthemum variabile* and Kidney Weed *Dichondra repens.*
Justification for New PCT listing	PCT 3154 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion on escarpment slopes and coastal hills. The canopy typically includes a high cover of *Eucalyptus pilularis* and *Syncarpia glomulifera*, along with *Eucalyptus botryoides*, and far less frequently, *Eucalyptus paniculata* subsp. *paniculata* and *Angophora costata*. Mid stratum is comprised of a sparse to dense cover of *Livistona australis* and occasionally; *Synoum glandulosum, Breynia oblongifolia, Acmena smithii* and *Myrsine variabilis*. *Pittosporum undulatum* is less common. The ground layer is dense and almost always includes *Lomandra longifolia* and *Pteridium esculentum*. Common grasses include *Entolasia stricta, Oplismenus imbecillis* and *Imperata cylindrica* var. *major*, with *Dianella caerulea* and *Dichondra repens* the common forbs. The dominant species and distribution are consistent with PCT 694 that was mapped within the Kiama LGA.
Condition	The community occurs in two conditions: • 85 ha of Moderate condition. • 50 ha of Low condition.
Associated soils, rainfall and landscape position	Occurs from the Hacking River catchment along the Illawarra scarp south to Mt Keira, on coastal lowlands near Berry, and scattered through coastal foothills and lowlands from Nowra south to Batemans Bay. Restricted to deep red-brown-coloured clay soils derived from the layer of Narrabeen shale, and Narrabeen claystones beneath the Hawkesbury sandstone plateau. The escarpment here is exposed to the open ocean and the full force of the prevailing southerly winds and a mix of rainforest species is retained by a combination of the fertile soils and very high mean annual rainfall. Most locations are close to the open ocean extending from sea level to the top of the escarpment at elevations around 250 m above sea level.

PCT 694 - Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin Bioregion	
Threatened ecological community	There are currently no TECs associated with this PCT.
Photo: PCT 694	

Table 5 PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion

PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion	
PCT	PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion.
New PCT	PCT 3872 *Illawarra Basalt Melaleuca Scrub*
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Southern Montane Heaths
Percent cleared	75 %
Extent within study area	Approximately 89 ha of PCT 720 was recorded within the Kiama LGA.
Description	This community exists with an absent canopy. The mid stratum comprises of Silver-Stemmed Wattle *Acacia parvipinnula,* Australian Indigo *Indigofera australis,* Prickly Beard Heath *Leucopogon juniperinus,* Illawarra Zieria *Zieria granulata and* Bracelet Honey-Myrtle *Melaleuca armillaris.* The ground cover comprises of; Rock Fern *Cheilanthes sieberi* subsp. *sieberi,* Paddock Lovegrass *Eragrostis leptostachya,* Common Fringe-Sedge *Fimbristylis dichotoma,* Long-Leaved Wallaby Grass *Notodanthonia longifolia, Plectranthus graveolens,* Slender Rat's Tail Grass *Sporobolus creber* and Golden Everlasting *Bracteantha bracteata.*
Justification for New PCT listing	PCT 3872 is only distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion and occurs on shallow rocky soil on the coastal plain at Dunmore. This community is typically characterised by a high cover of *Melaleuca armillaris* subsp. *armillaris* with *Leucopogon juniperinus* scattered throughout. *Breynia oblongifolia* is very frequent and Acacia species are commonly present within the mid stratum. The ground layer is grassy, comprised mostly of grasses and forbs. *Microlaena stipoides* is almost always present, while *Eragrostis leptostachya, Cheilanthes sieberi* subsp. *sieberi, Rytidosperma longifolium, Poa labillardierei* var. *labillardierei* and *Xerochrysum bracteatum* are very frequent. This PCT in areas with a mean annual rainfall exceeding 1300 mm usually at elevations below 150m. The dominance of *Melaleuca*, *Leucopogon* and *Acacia*, along with the grassy ground layer observed in the vegetation mapped as PCT 720 is consistent with PCT 3872.
Condition	The community occurs in three conditions: • 65 ha of High condition. • 22 ha of Moderate condition. • 2 ha of Low condition.
Associated soils, rainfall and landscape position	All occurrences are in the coastal hinterland near Jamberoo and west of Milton. Exposed rocky ridgetops on volcanic substrates between 100-200 m in the Kiama and Milton hinterlands.
Threatened ecological community	Associated TECs: • *Melaleuca armillaris Tall Shrubland in the Sydney Basin Bioregion* (Critically Endangered, BC Act).

PCT 720 Bracelet Honey-myrtle - Australian Indigo dry shrubland on volcanics, southern Sydney Basin Bioregion	
Photo: PCT 720	

Table 6 PCT 767 Coachwood - Brown Possumwood warm temperate rainforest in sheltered gullies of the Illawarra Escarpment, southern Sydney Basin Bioregion

PCT 767 Coachwood - Brown Possumwood warm temperate rainforest in sheltered gullies of the Illawarra Escarpment, southern Sydney Basin Bioregion	
PCT	PCT 767 Coachwood - Brown Possumwood warm temperate rainforest in sheltered gullies of the Illawarra Escarpment, southern Sydney Basin Bioregion.
New PCT	PCT 4106 *Illawarra Escarpment Cool Temperate Rainforest*
Vegetation formation	Rainforests
Vegetation class	Southern Warm Temperate Rainforests
Percent cleared	5 %
Extent within study area	Approximately 167 ha of PCT 767 was recorded within the Kiama LGA.
Description	The canopy comprises of Coachwood *Ceratopetalum apetalum,* Possumwood *Quintinia sieberi* and Pinkwood *Eucryphia moorei.* The mid stratum is dominated by Brush Cherry *Syzygium australe,* Mountain Water Gum *Tristaniopsis collina,* Prickly Currant Bush *Coprosma quadrifida, Dracophyllum secundum,* Fuchsia Heath *Epacris longiflora,* Brush Pepperbush *Tasmannia insipida, Tmesipteris truncata,* and King Fern *Todea Barbara.* The ground cover comprises Red-fruit Saw-sedge *Gahnia sieberiana,* Scrambling Coral Fern *Gleichenia microphylla,* Finger Fern *Grammitis billardierei* and Rock Felt Fern *Pyrrosia rupestris.*
Justification for New PCT listing	PCT 4106 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion, and occurs in cool, wet locations. The canopy is comprised of; *Ceratopetalum apetalum, Eucryphia moorei* and *Quintinia sieberi*. Frequently occurring mid stratum species include; *Acmena smithii, Dracophyllum secundum, Epacris longiflora, Tasmannia insipida* and *Todea barbara*, rarely *Banksia serrata* and *Banksia spinulosa*. The ground layer is comprised of various ferns and *Gahnia sieberiana*. The dominant species within the canopy and mid stratum observed during vegetation mapping, along with the various ferns observed in the ground layer is consistent with PCT 4106.
Condition	The community occurs in three conditions: • 143 ha of High condition. • 21 ha of Moderate condition. • 3 ha of Low condition.
Associated soils, rainfall and landscape position	Moist gullies below sandstone cliffs, 450-650 m, Mt Kembla to Budderoo.
Threatened ecological community	There are currently no TECs associated with this PCT.

Table 7 PCT 769 Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion

PCT 769 Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion	
PCT	PCT 769 Coachwood - Lilly Pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion.
New PCT	PCT 3041 *Sydney Sandstone Coachwood-Grey Myrtle Rainforest*
Vegetation formation	Rainforests
Vegetation class	Northern Warm Temperate Rainforests
Percent cleared	5 %
Extent within study area	Approximately 51 ha of PCT 769 was recorded within the Kiama LGA.
Description	The canopy comprises of Coachwood *Ceratopetalum apetalum,* Lilly Pilly *Syzygium smithii,* Sassafras *Doryphora sassafras* and Mountain Cedar *Acacia elata*. The mid stratum is dominated by; Grey Myrtle *Backhousia myrtifolia,* Black Wattle *Callicoma serratifolia,* Rough Tree Fern *Cyathea australis,* Sweet Morinda *Morinda jasminoides,* Native Sarsparilla *Smilax australis,* Brush Pepperbush *Tasmannia insipida* and King Fern *Todea barbara.* The ground cover comprises species including Gristle Fern *Blechnum cartilagineum.*
Justification for New PCT listing	PCT 3041 is widely distributed, including throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion, occurring along creeks or moist gullies, on the coast and foothills. The tree canopy is dominated by *Ceratopetalum apetalum* and Lilly Pilly, with *Acacia elata, Notelaea longifolia* and *Tristaniopsis laurina* occurring frequently. *Doryphora sassafras* is also sometimes present. In the mid stratum, *Backhousia myrtifolia* often has high foliage cover, while *Callicoma serratifolia* occurs frequently. The ground layer can be sparse to dense, mostly comprised of ferns, where *Blechnum cartilagineum* is almost always present in high frequency. *Sticherus flabellatus* occurs very frequently, *Todea barbara* and *Lomandra longifolia* are also common. The IBRA region and subregion, and the dominant tree and mid stratum species, along with the abundance of ferns in the ground layer are consistent with the vegetation mapped as PCT 769 in the study area.
Condition	The community occurs in three conditions: • 27 ha of High condition. • 19 ha of Moderate condition. • 5 ha of Low condition.
Associated soils, rainfall and landscape position	Occurs in moist gully heads and sheltered slopes below sandstone cliffs between 400 m and 800 m altitude.
Threatened ecological community	There are currently no TECs associated with this PCT.

Table 8 PCT 771 - Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion

PCT 771 - Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 771 - Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 3546 *Coastal Sands Littoral Scrub-Forest*
Vegetation formation	Heathland
Vegetation class	Coastal Headland Heaths
Percent cleared	50 %
Extent within study area	Approximately 29 ha of PCT 771 was recorded within the Kiama LGA.
Description	The canopy comprises of species Bangalay *Eucalyptus botryoides,* Blackbutt *Eucalyptus pilularis,* Rough-Barked Apple *Angophora floribunda,* Red Bloodwood *Corymbia gummifera,* and Swamp Mahogany *Eucalyptus robusta.* The mid stratum is dominated by Black She-Oak *Allocasuarina littoralis,* Old-Man Banksia *Banksia serrata,* Coastal Banksia *Banksia integrifolia* subsp. *integrifolia,* Coffee Bush *Breynia oblongifolia,* Cheese Tree *Glochidion ferdinandi,* Burrawang *Macrozamia communis* and Shrubby Platysace *Platysace lanceolata.* The ground cover comprises; Blue Flax-Lily *Dianella caerulea,* False Sarsparilla *Hardenbergia violacea,* Spiny-Headed Mat-Rush *Lomandra longifolia,* Pomax *Pomax umbellata,* Bracken *Pteridium esculentum* and Blady Grass *Imperata cylindrica* var. *major.*
Justification for New PCT listing	PCT 3546 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion, occupying the littoral zone on coastal dunes and rarely headlands in the Illawarra. The upper stratum almost always includes *Banksia integrifolia* subsp. *integrifolia*, with a mix of *Leptospermum laevigatum* and *Pittosporum undulatum*, and rarely *Casuarina glauca* and *Glochidion ferdinandi*. Rarely, a Eucalypt canopy may be present consisting mostly of *Eucalyptus botryoides* or *Eucalyptus pilularis. Breynia oblongifolia* is a very common shrub species in this community, while Acacia longifolia is also common. The ground layer is dominated by *Lomandra longifolia*, while *Pteridium esculentum* is commonly present. *Imperata cylindrica, Commelina cyanea* and *Dianella caerulea* are occasionally present. Climbers such as *Hibbertia scandens* and *Geitonoplesium cymosum* are also common. Based on the distribution, habitat and dominant species of each stratum, this PCT aligns with the vegetation mapped as PCT 771 in the study area.
Condition	The community occurs in two conditions: • 11 ha of Moderate condition. • 18 ha of Low condition.
Associated soils, rainfall and landscape position	Occupies coastal foredunes and beach ridges near the open ocean. Despite the exposed locations there is usually some development of a soil profile as a result of clay influence in a sandstone headland or of sheltering and protection from leeward scrubs on dune systems. The scrub has a small and patchy distribution along the coastal zone of the Sydney region between Port Stephens and Wollongong. Elsewhere it is found on the NSW south coast.
Threatened ecological community	There are currently no TECs associated with this PCT.

PCT 771 - Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion	
Photo: PCT 771	

Table 9 PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion

PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 3788 Coastal Foredune Wattle Scrub
Vegetation formation	Heathland
Vegetation class	Sydney Coastal Heaths
Percent cleared	65 %
Extent within study area	Approximately 83 ha of PCT 772 was recorded within the Kiama LGA.
Description	The canopy is dominated by Coastal Banksia *Banksia integrifolia* subsp. *integrifolia* and Coast Teatree *Leptospermum laevigatum.* The mid stratum comprises Coastal Wattle *Acacia longifolia* subsp. *sophorae,* Coastal Beard-Heath *Leucopogon parviflorus, Rhagodia candolleana* subsp. *candolleana,* Coffee Bush *Breynia oblongifolia* and Tree Broom-Heath *Monotoca elliptica.* The ground cover comprises Dune Thistle *Actites megalocarpa,* Pigface *Carpobrotus glaucescens,* Knobby Club-Rush *Isolepis nodosa,* Spiny-Headed Mat-Rush *Lomandra longifolia,* Climbing Lignum *Muehlenbeckia adpressa, Oxalis perennans,* Hairy Spinifex *Spinifex sericeus,* Prickly Couch *Zoysia macrantha* and Bracken *Pteridium esculentum.*
Justification for New PCT listing	PCT 3041 is widely distributed, including throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion, on coastal foredunes along the entire NSW coast. The shrub layer is variable in both height and cover, typically including a patchy cover of Acacia longifolia, *Leptospermum laevigatum* and *Banksia integrifolia* subsp. *integrifolia*. Mid stratum species occasionally present are *Leucopogon parviflorus* and *Monotoca elliptica*, while *Scaevola calendulacea, Correa alba* var. *alba, Breynia oblongifolia* and *Rhagodia candolleana* subsp *candolleana* occur less frequently. The ground layer is highly variable, typically including salt tolerant grasses and forbs. Common ground layer species include *Spinifex sericeus, Carpobrotus glaucescens, Ficinia nodosa* and less commonly *Zoysia macrantha* and *Lomandra longifolia*. Species such as *Actites megalocarpa, Dianella caerulea* and *Oxalis perennans* occur rarely. This PCT is consistent with the vegetation mapped as PCT 772 in the study area.
Condition	The community occurs in three conditions: • 44 ha in High condition. • 36 ha of Moderate condition. • 3 ha of Low condition.
Associated soils, rainfall and landscape position	Found on coastal sand mass frontal dunes and beach ridges along the eastern coastline of New South Wales and are naturally pruned by the prevailing winds that buffet these exposed scarped areas. Some of the small patches that remain are derived from native plantings as part of dune stabilisation works and bush regeneration. As a result, some patches are species poor. More diverse remnants include salt-tolerant succulent herbs and grasses, several of which are unique to these environments.
Threatened ecological community	There are currently no TECs associated with this PCT.

PCT 772 Coast Banksia - Coast Wattle dune scrub of the Sydney Basin Bioregion and South East Corner Bioregion	
Photo: PCT 772	

Table 10 PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
PCT	PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion.
New PCT	PCT 3078 *Illawarra Lowland Wet Vine Forest*
Vegetation formation	Grassy Woodland
Vegetation class	Coastal Valley Grassy Woodland
Percent cleared	85 %
Extent within study area	Approximately 28 ha of PCT 838 was recorded within the Kiama LGA.
Description	The canopy is dominated by Forest Red Gum *Eucalyptus tereticornis,* Woollybutt *Eucalyptus longifolia*, Coast Grey Box *Eucalyptus bosistoana* and Thin-Leaved Stringybark *Eucalyptus eugenioides.* The mid stratum comprises of; White Feather Honey-myrtle *Melaleuca decora,* Coffee Bush *Breynia oblongifolia,* Wombat Berry *Eustrephus latifolius,* Scrambling Lily *Geitonoplesium cymosum, Myrsine variabilis,* Wonga Wonga Vine *Pandorea pandorana* and Sweet Pittosporum *Pittosporum undulatum.* The ground cover comprises; *Carex longebrachiata,* Native Wandering Dew *Commelina cyanea,* Slender Tick-Trefoil *Desmodium gunnii,* Kidney Weed *Dichondra repens,* Weeping Grass *Microlaena stipoides* var. *stipoides, Oplismenus imbecillis,* Tussock *Poa labillardierei* var. *labillardierei,* Whiteroot *Lobelia purpurascens* and Kangaroo Grass *Themeda triandra.*
Justification for New PCT listing	PCT 3078 is only distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion, occurring between Wollongong and Nowra on fertile soils. The canopy layer commonly includes *Eucalyptus tereticornis* and/or *Eucalyptus quadrangulata* which make up the highest foliage cover. Several other Eucalypt species are sometimes present, such as; *Eucalyptus eugenioides, Eucalyptus bosistoana, Eucalyptus saligna* and *Eucalyptus botryoides*, but at much lower frequencies. Common mid stratum species include; *Pittosporum multiflorum, Notelaea venosa, Pittosporum undulatum* and *Breynia oblongifolia*. Vines such as *Eustrephus latifolius, Pandorea pandorana* and *Marsdenia rostrata* often occur in low abundance. The sparse to dense ground layer very frequently includes; *Oplismenus imbecillis, Pseuderanthemum variabile*, *Dichondra repens* and *Pellaea falcata*, while *Carex longebrachiata, Poa labillardierei* var. *labillardierei, Commelina cyanea* and *Microlaena stipoides* are occasionally present. The distribution and species composition of this PCT is consistent with the vegetation mapped as PCT838 in the study area.
Condition	The community occurs in two conditions: • 27 ha of Moderate condition. • 1 ha of Low condition.
Associated soils, rainfall and landscape position	Occurs on lower slopes in coastal rainshadow valleys, below 350 m ASL, from Wollongong to Milton and west to Yalwal.
Threatened ecological community	Associated TECs: • *Illawarra and south coast lowland forest and woodland ecological community* (Critically Endangered, EPBC Act). • *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion* (Endangered, BC Act).

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
Photo: PCT 838	

Table 11 PCT 878 Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion

PCT 878 Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion	
PCT	PCT 878 Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion.
New PCT	PCT 3213 *Illawarra Southern Escarpment Wet Forest*
Vegetation formation	Southern Escarpment Wet Sclerophyll Forests
Vegetation class	Wet Sclerophyll Forests (Shrubby sub-formation)
Percent cleared	10 %
Extent within study area	Approximately 1,437 ha of PCT 878 was recorded within the Kiama LGA.
Description	The canopy is dominated by Ironbark Peppermint *Eucalyptus smithii,* Sydney Peppermint *Eucalyptus piperita* and Yellow Stringybark *Eucalyptus muelleriana.* The mid stratum comprises Blueberry Ash *Elaeocarpus reticulatus,* Veined Mock-Olive *Notelaea venosa,* Wonga Wonga Vine *Pandorea pandorana,* Lawyer Vine *Smilax australis,* Scentless Rosewood *Synoum glandulosum.* The ground cover consists of Blue Flax-Lily *Dianella caerulea,* Wombat Berry *Eustrephus latifolius,* Scrambling Lily *Geitonoplesium cymosum,* Twining Guinea Flower *Hibbertia dentata,* Weeping Grass *Microlaena stipoides* var. *stipoides, Oplismenus imbecillis,* Bracken *Pteridium esculentum* and Bearded Tylophora *Tylophora barbata.*
Justification for New PCT listing	PCT 3213 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion and is characterised by a sclerophyll open forest found on upper escarpment slopes and crests along the southern Illawarra escarpment between Wollongong and Kangaroo Valley on a mix of sediments. The tree canopy is comprised of a mix of eucalypt species, which are inconsistently recorded. *Eucalyptus smithii* is common in high densities, sometimes accompanied or replaced occasionally by *Eucalyptus fastigata*, *Eucalyptus piperita* or *Eucalyptus muelleriana*. The layered mid-stratum almost always includes a sparse cover of; *Acacia binervata* with *Synoum glandulosum* subsp. *glandulosum*, *Elaeocarpus reticulatus, Acmena smithii* or *Notelaea venosa*. A sparse cover of *Cryptocarya glaucescens* and *Livistona australis* are also common. The ground layer is a mid-dense cover of ferns, climbers and forbs. Common species with a high cover include *Calochlaena dubia, Pteridium esculentum*, very frequently with clumps of *Lomandra longifolia. Eustrephus latifolius, Tylophora barbata* and *Smilax australis* are almost always present, and common grasses include *Oplismenus imbecillis* and *Microlaena stipoides*. The distribution and dominant species of each stratum of this PCT is consistent with the vegetation mapped as PCT878 in the study area.
Condition	The community occurs in three conditions: • 1,314 ha in High condition. • 108 ha of Moderate condition. • 15 ha of Low condition.
Associated soils, rainfall and landscape position	Occurs on moist sheltered escarpment slopes between 100 and 650 m from the northern Illawarra to the Moreton Plateau.
Threatened ecological community	There are currently no TECs associated with this PCT.

PCT 878 Gully Gum - Sydney Peppermint - Yellow Stringybark moist open forest of coastal escarpments, southern Sydney Basin Bioregion	
Photo: PCT 878	

Table 12 PCT 882 Hairpin Banksia - Slender Tea-tree heath on coastal sandstone plateaux, Sydney Basin Bioregion

PCT 882 Hairpin Banksia - Slender Tea-tree heath on coastal sandstone plateaux, Sydney Basin Bioregion	
PCT	PCT 882 Hairpin Banksia - Slender Tea-tree heath on coastal sandstone plateaux, Sydney Basin Bioregion.
New PCT	PCT 3896 Budderoo-Morton Damp Swamp Heath
Vegetation formation	Wet Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Southern Escarpment Wet Sclerophyll Forests
Percent cleared	10 %
Extent within study area	Approximately 595 ha of PCT 882 was recorded within the Kiama LGA.
Description	The canopy consists of tall open forest comprising dominant species Red Bloodwood *Corymbia gummifera.* The mid stratum comprises; Heath-Leaved Banksia *Banksia ericifolia,* Fern-Leaved Banksia *Banksia oblongifolia,* Hairpin Banksia *Banksia spinulosa,* Coral Heath *Epacris microphylla, Hakea laevipes,* Needlebush *Hakea teretifolia,* Broad-Leaf Drumsticks *Isopogon anemonifolius,* Mountain Devil *Lambertia formosa,* Slender Tea-Tree *Leptospermum trinervium,* Conesticks *Petrophile pulchella,* Slender Rice Flower *Pimelea linifolia, Pultenaea elliptica* and *Xanthorrhoea resinifera.* The ground cover comprises Lesser Flannel Flower *Actinotus minor, Cyathochaeta diandra, Dampiera stricta,* Wiry Panic *Entolasia stricta, Lepyrodia scariosa* and Screw Fern *Lindsaea linearis.*
Justification for New PCT listing	PCT 3896 is distributed throughout the Sydney Basin IBRA bio-region and the Illawarra, Jervis and Moss vale sub-bioregions, and the Kiama LGA. It is a structurally variable coastal swamp heath including a mid-high to extremely tall heathland or closed heathland, with a mid-stratum of heath shrubs and sedges. This PCT is found on damp sandy peats accumulated on Permo-Triassic sandstones above the southern Illawarra and Shoalhaven escarpment. Eucalypts are occasionally present either as an emergent layer or tree canopy and may include a sparse cover of *Corymbia gummifera*, *Eucalyptus consideniana* and/or *Eucalyptus sieberi*. Several mallee eucalypts are also known to occur including *Eucalyptus ligustrina*, *Eucalyptus dendromorpha* and *Eucalyptus stricta*. The mid-dense to dense shrub canopy very frequently includes *Hakea dactyloides*, *Leptospermum trinervium*, *Dillwynia floribunda* and *Isopogon anemonifolius* commonly with a higher cover of *Banksia ericifolia* and/or *Banksia paludosa*. Other common shrubs include *Hakea teretifolia*, *Persoonia mollis* and *Persoonia levis*. The ground layer is characterised by a mid-dense to dense cover of sedges together with a sparse cover of small ferns and shrubs. Sedge species very frequently or commonly recorded include *Leptocarpus tenax*, *Empodisma minus* and *Lepyrodia scariosa*, the latter with a higher cover. The small ferns *Lindsaea linearis* and *Gleichenia dicarpa* are very frequent, together with the small shrubs *Dampiera stricta* and *Pimelea linifolia*. The distribution and dominant species of each stratum of this PCT is consistent with the vegetation mapped as PCT 882 within the study area.
Condition	The community occurs in High condition.
Associated soils, rainfall and landscape position	Occurs on moist sheltered escarpment slopes between 100 and 650 m from the northern Illawarra to the Moreton Plateau.
Threatened ecological community	There are currently no TECs associated with this PCT.

PCT 882 Hairpin Banksia - Slender Tea-tree heath on coastal sandstone plateaux, Sydney Basin Bioregion	
Photo: PCT 882	

Table 13 PCT 905 Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion

PCT 905 Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 905 Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 3028 Illawarra Escarpment Warm Temperate Rainforest
Vegetation formation	Rainforests
Vegetation class	Northern Warm Temperate Rainforests
Percent cleared	21 %
Extent within study area	Approximately 302 ha of PCT 905 was recorded within the Kiama LGA.
Description	The canopy is dominated by Scentless Rosewood *Synoum glandulosum*, Cheese Tree *Glochidion ferdinandi,* Coachwood *Ceratopetalum apetalum,* Lilly Pilly *Acmena smithii* and Cabbage Tree Palm *Livistona australis*, with occasional emergent Eucalyptus sp. The mid stratum comprises *S*weet Pittosporum *Pittosporum undulatum,* Rough Treefern *Cyathea australis,* Brush Pepperbush *Tasmannia insipida,* Bolwarra *Eupomatia laurina,* Creek Sandpaper Fig *Ficus coronata* and Hairy Psychotria *Psychotria loniceroides.* The ground cover consists of Creeping Shield Fern *Lastreopsis microsora,* Gristle Fern *Blechnum cartilagineum,* Strap Water Fern *Blechnum patersonii,* Bird's Nest fern *Asplenium australasicum* and *Doodia aspera.*
Justification for New PCT listing	PCT 3028 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra and Moss vale sub-bioregions which occurs mainly on the Illawarra escarpment and nearby areas between Royal National Park and Nowra. The community is characterised by a tall to very tall dense rainforest, or rarely very tall to extremely tall eucalypt open forest with rainforest sub-canopy. The tree canopy is comprised of a dominant canopy of *Ceratopetalum apetalum*, with a reduced sub canopy of *Cryptocarya glaucescens* and *Polyosma cunninghamii*. On occasions where the canopy is represented by a mix of eucalypt species, species such as *Eucalyptus quadrangulata*, *Eucalyptus smithii* are evident. The mid storey stratum is frequently represented by *Livistona australis* and *Tasmannia insipida* that is supported by a range rainforest vine species for which include; *Gynochthodes jasminoides*, *Palmeria scandens*, *Pandorea pandorana*, *Smilax australis*, *Marsdenia rostrata* and *Parsonsia straminea*. The ground layer stratum is generally sparse and represented by a number of fern species for which includes; *Blechnum cartilagineum*, *Lastreopsis microsora*, *Lastreopsis decomposita* and *Adiantum hispidulum*. The distribution and dominant species of each stratum of this PCT is consistent with the vegetation mapped as PCT 905 within the study area.
Condition	The community occurs in three conditions: • 233 ha in High condition. • 61 ha in Moderate condition. • 8 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs between Newcastle and Batemans Bay in the Sydney Basin Bioregion, on protected escarpment slopes and gullies along the NSW coast. The community is found up to four kilometres from the coastline but only where mean annual rainfall exceeds 1200 mm and elevation is less than 140 m above sea level. It prefers clay soils that derive either from shale layers in sandstone bedrock or from down-slope enrichment from shale capping above.
Threatened ecological community	There are currently no TECs associated with this PCT.

Table 14 PCT 906 Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion

PCT 906 Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion	
PCT	PCT 906 Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion.
New PCT	PCT 3013 Illawarra Lowland Subtropical Rainforest
Vegetation formation	Rainforests
Vegetation class	Subtropical Rainforests
Percent cleared	50 %
Extent within study area	Approximately 152 ha of PCT 906 was recorded within the Kiama LGA.
Description	The canopy comprises Whale Bone Tree *Streblus brunonianus,* Wild Quince *Alectryon subcinereus,* Sweet Pittosporum *Pittosporum undulatum*, and Black Plum *Diospyros australis* The mid stratum is dominated by; Smooth Mock-olive *Notelaea venosa,* Red Olive-berry *Cassine australis,* Hairy Clairy *Clerodendrum tomentosum,* Orange Thorn *Pittosporum multiflorum,* Coffee Bush *Breynia oblongifolia,* Green Native Cascarilla *Croton verreauxii,* Muttonwood *Rapanea variabilis* and Cockspur Thorn *Maclura cochinchinensis.* The ground cover comprises; Creeping Beard Grass *Oplismenus imbecillis,* Sickle Fern *Pellaea falcata,* Pastel Flower *Pseuderanthemum variabile,* Necklace Fern *Asplenium flabellifolium,* Giant Maidenhair Fern *Adiantum formosum,* Settler's Flax *Gymnostachys anceps* and Prickly Rasp Fern *Doodia aspera.*
Justification for New PCT listing	PCT 3013 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion, comprised of sclerophyll open forest with a dense rainforest sub-canopy on basalt or sheltered sites on clay rich sediments. Canopy composition is diverse and variable. Rainforest trees in the canopy or sub-canopy very frequently include *Streblus brunonianus, Diospyros australis, Acmena smithii* and *Elaeodendron australe*; and are sometimes locally abundant. *Pittosporum undulatum, Pittosporum multiflorum* and *Alectryon subcinereus* are also common. The mid stratum is often dominated by *Clerodendrum tomentosum*, while the palm *Livistona australis* is also very frequent and *Notelaea venosa* and *Breynia oblongifolia* occur less frequently. The climbing epiphytic fern *Arthropteris tenella* and vines *Eustrephus latifolius, Marsdenia rostrata, Pandorea pandorana* and *Gynochthodes jasminoides* are all very frequent, usually with low abundance. The ground cover is often sparse and typically includes the fern *Adiantum formosum* and the forb *Gymnostachys anceps. Arthropteris tenella* typically occurs in a high frequency, along with *Pseuderanthemum variabile*. Vine species such as *Eustrephus latifolius* and *Marsdenia rostrata occur* in a high frequency, and grasses such as *Oplismenus imbecillis* are less frequent.
Condition	The community occurs in three conditions: • 60 ha in High condition. • 91 ha in Moderate condition. • 1 ha in Low condition.
Associated soils, rainfall and landscape position	Occupies the Illawarra coastal plain and escarpment foothills, rarely extending onto the upper escarpment slopes. Usually found on Permian volcanic rocks but can occur on a range of rock types. Restricted to soils derived from Gerringong Volcanics near Kiama, soils derived from monzonite in gullies around Milton, and slopes and benches of the Illawarra scarp from 0 – 300 m ASL where latite, shale and coal seams are exposed.

PCT 906 Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion	
Threatened ecological community	Associated TECs: • *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (Endangered, BC Act). • Illa*warra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion* (Critically Endangered, EPBC Act).

Table 15 PCT 907 Lilly Pilly - Sassafras warm temperate rainforest in moist sheltered gullies, Sydney Basin Bioregion and South East Corner Bioregion

PCT 907 Lilly Pilly - Sassafras warm temperate rainforest in moist sheltered gullies, Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 907 Lilly Pilly - Sassafras warm temperate rainforest in moist sheltered gullies, Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 3036 *South Coast Warm Temperate-Subtropical Rainforest*
Vegetation formation	Rainforests
Vegetation class	Southern Warm Temperate Rainforests
Percent cleared	25 %
Extent within study area	Approximately 570 ha of PCT 907 was recorded within the Kiama LGA.
Description	The canopy comprises; Lilly Pilly *Syzygium smithii,* Blackwood *Acacia melanoxylon and* Giant Stinging Tree *Dendrocnide excelsa.* The mid stratum comprises; Grey Myrtle *Backhousia myrtifolia,* Prickly Current Bush *Coprosma quadrifida,* Rough Treefern *Cyathea australis,* Milk Vine *Marsdenia rostrata,* Fragrant Fern *Microsorum scandens,* Brush Muttonwood *Myrsine howittiana,* Veined Mock-Olive *Notelaea venosa,* Wonga Wonga Vine *Pandorea pandorana,* Sweet Pittosporum *Pittosporum undulatum* and Lawyer Vine *Smilax australis.* The ground cover includes; Necklace Fern *Asplenium flabellifolium,* Wombat Berry *Eustrephus latifolius,* Shiny Shield Fern *Lastreopsis acuminata,* Sweet Morinda *Morinda jasminoides and* Bearded Tylophora *Tylophora barbata.*
Justification for New PCT listing	PCT 3036 is widely distributed, including throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion, exists as tall rainforest in wet locations throughout the Illawarra. The canopy almost always includes *Doryphora sassafras*, often with the highest foliage cover. *Acmena smithii* and *Cryptocarya glaucescens* are also very frequent, sometimes with high foliage cover. *Livistona australis* is also very frequent, although usually with low abundance, while *Microsorum scandens* is also very frequent. Other species with variable cover commonly include; *Ceratopetalum apetalum, Ficus coronata, Diospyros australis, Polyosma cunninghamii, Pennantia cunninghamii* and *Dendrocnide excelsa*. The fern Microsorum scandens is almost always present and occasionally abundant.
Condition	The community occurs in three conditions: • 368 ha in High condition. • 196 ha in Moderate condition. • 5 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs in moist sheltered gullies of the foothills and escarpment mainly between 300 and 750 m.
Threatened ecological community	There are currently no TECs associated with this PCT.

PCT 907 Lilly Pilly - Sassafras warm temperate rainforest in moist sheltered gullies, Sydney Basin Bioregion and South East Corner Bioregion	
Picture: PCT 907	

Table 16 PCT 920 Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

PCT 920 Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 920 Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 4091 *Grey Mangrove-River Mangrove Forest*
Vegetation formation	Saline Wetlands
Vegetation class	Mangrove Swamps
Percent cleared	86 %
Extent within study area	Approximately 54 ha of PCT 920 was recorded within the Kiama LGA.
Description	The canopy predominantly comprises of Grey Mangrove *Avicennia marina* and River Mangrove *Aegiceras corniculatum* with very few species other than the canopy. The groundcover mostly occurs as an open mudflat occasionally with scattered saltmarsh herbs. The saltmarsh comprises of; Bearded Samphire *Sarcocornia quinqueflora,* Bare Twig-Rush *Baumea juncea*, Sea Rush *Juncus kraussii* subsp*. australiensis*, Marine Couch *Sporobolus virginicus*, Streaked Arrowgrass *Triglochin striata*, Knobby Club-rush *Ficinia nodosa*, Creeping Brookweed *Samolus repens*, Swamp Weed *Selliera radicans*, Seablite *Suaeda australis* and Prickly Couch *Zoysia macrantha*.
Justification for New PCT listing	PCT 4091 is a low, mid-high or tall mangrove open forest or woodland, sometimes including a saltmarsh ground layer, occurring on tidal flats of the NSW coast. It has a wide distribution, including throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion. The tree canopy is almost always dominated by grey mangrove *Avicennia marina* subsp. *australasica*. River mangrove *Aegiceras corniculatum* is common, however foliage cover usually sparser than *Avicennia marina* subsp. *australasica*. Other trees are rare, but may include *Rhizophora stylosa*, or *Casuarina glauca, Melaleuca linariifolia* or *Ficus rubiginosa* on mangrove fringes. Where present, the ground layer is sparse to mid-dense. *Sarcocornia quinqueflora* subsp. *quinqueflora* occasionally occurs with sparse cover, while *Sporobolus virginicus* or *Samolus repens* rarely occur however generally with higher foliage cover. Other rare species with variable cover include; *Juncus kraussii* subsp. *australiensis, Baumea juncea, Tecticornia arbuscula, Sesuvium portulacastrum* and *Spergularia marina.*
Condition	The community occurs in two conditions: • 53 ha in High condition. • 1 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs where freshwater influences from runoff or rivers cause lower salinity levels. The distribution of mangrove appears dynamic. Estuaries have been extensively cleared and infilled for industrial and urban development. Stands of mangroves were also cleared and used to fuel lime kilns during early settlement. Since then there is evidence that mangroves have colonised areas formerly occupied by saltmarsh (Haworth 2002, Williams et al. 2004) and have established on sites of recent sediment accumulation.
Threatened ecological community	Associated TECs: • *Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered, BC Act). • Partially subset of *Subtropical and Temperate Coastal Saltmarsh* (Vulnerable, EPBC Act).

PCT 920 Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	
Photo: PCT 920	

Table 17 PCT 1078 Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion

PCT 1078 Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion	
PCT	PCT 1078 Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion.
New PCT	PCT 3925 *Sydney Sandstone Button Grass Sedgeland*
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Heath Swamps
Percent cleared	5 %
Extent within study area	Approximately 1,387 ha of PCT 1078 was recorded within the Kiama LGA.
Description	The understory consists of an open shrub canopy comprising species; Weeping Baeckea *Baeckea linifolia,* Heath-Leaved Banksia *Banksia ericifolia,* Blunt-Leaf Heath, *Epacris obtusifolia,* Needlebush *Hakea teretifolia,* Prickly-Tea tree *Leptospermum juniperinum* and Pink Swamp Heath *Sprengelia incarnata.* The ground cover includes dense sedges and forbs such as; Forked Sundew *Drosera binata, Empodisma minus,* Button Grass *Gymnoschoenus sphaerocephalus, Lepidosperma limicola, Leptocarpus tenax* and *Xyris operculata.* TEC *Coastal Upland Swamp* is characterised by open graminiod heath, sedgeland and tall scrub associated with waterlogged zones of the larger swamps have deep peaty soils, dominated by various combinations of; *Leptospermum juniperinum, L. grandifolium, Melaleuca squarrosa, Banksia robur* and *Epacris paludosa,* often with a dense layer of Gleichenia spp. and/or sedges including *Gahnia sieberiana, Baumea teretifolia, Chorizandra sphaerocephala* and *Empodisma minus*, and the grass *Tetrarrhena turfosa*. In some locations the woody species are sparse and the vegetation comprises ferns and sedges. In zones where the water table is less frequently sustained near the surface, the peaty soil horizon is shallower, with more mineral content, and the vegetation is more typically an open graminoid heath dominated by an open layer of shrubs that may include; *Banksia robur, Leptospermum juniperinum, Almaleea paludosa* and/or *Hakea teretifolia,* sometimes with *Banskia ericifolia.* A dense matrix between the shrubs is dominated by large cyperaceous sedges that may include; *Lepidosperma limicola, Chorizandra sphaerocephala, Baumea teretifolia, Gymnoschoenus sphaerocephalus and Schoenus brevifolius,* and the woody non-arborescent grass tree *Xanthorrhoea resinosa*. Smaller sedges, cord rushes, such as; *Empodisma minus, Lepyrodia scariosa and Leptocarpus tenax, grasses, Entolasia stricta* and *Tetrarrhena turfosa*, and forbs including *Xyris operculata*, may also be present in variable abundance. *Coastal Upland Swamp* is generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. The vegetation of the Coastal Upland Swamp may include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands. Larger examples may include a complex of these structural forms. The flora comprising the upland swamp is diverse there are 73 plant species listed as characterising the ecological community. The total species list is much greater and is likely to exceed 200 species of vascular plants. The Coastal Upland Swamp is endemic to NSW and confined to the Sydney Basin Bioregion. It occurs in the eastern Sydney Basin from the Somersby district in the north to the Robertson district in the south. In the north it occurs on the Somersby-Hornsby plateaux, in the south it occurs on the Woronora plateau.

PCT 1078 Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion	
	It occurs in elevations from 20 metres to over 600 metres above sea level, with the majority of swamps occurring within 200 and 450 metres elevation
Justification for New PCT listing	PCT 3925 is found in the Sydney Basin IBRA Region, in the Illawarra sub region. This PCT is typically a tall to very tall sedgeland or closed sedgeland, occasionally with shrub or small tree emergents, or a tall heathland with a dense ground cover of sedges. It is found on boggy and sandy peats accumulated in small depressions, drainage lines and gully heads on the sandstone plateaus of the Sydney Basin. *Gymnoschoenus sphaerocephalus* is very frequently recorded with a high cover along with *Lepidosperma limicola, Leptocarpus tenax* and *Empodisma minus*. Where present, the shrub canopy very frequently includes a sparse to patchy cover of Lep*tospermum juniperinum, Banksia ericifolia, Hakea teretifolia, Baeckea linifolia* and *Sprengelia incarnata. Epacris obtusifolia* is commonly present.
Condition	The community occurs in two conditions: • 1365 ha in High condition. • 22 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs from the Blue Mountains to the Morton Plateau on humic sandstone soils in headwater valleys of sandstone plateaux at altitudes of 450 to 1100 m.
Threatened ecological community	Associated TECs: • *Temperate Highland Peat Swamps on Sandstone* (Endangered, EPBC Act). • *Coastal Upland Swamp in the Sydney Basin Bioregion* (Endangered EPBC Act). • *Coastal Upland Swamp in the Sydney Basin Bioregion* (Endangered, BC Act).
Picture: PCT 1078	

Table 18 PCT 1082 Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion

PCT 1082 Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion	
PCT	PCT 1082 Red Bloodwood - Hard-leaved Scribbly Gum - Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion.
New PCT	PCT 3588 *Shoalhaven Foothills Bloodwood Heathy Forest*
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	South East Dry Sclerophyll Forests
Percent cleared	20 %
Extent within study area	Approximately 287 ha of PCT 1082 was recorded within the Kiama LGA.
Description	The canopy comprises; Red Bloodwood *Corymbia gummifera,* Hard-leaved Scribbly Gum *Eucalyptus sclerophylla,* Silvertop Ash *Eucalyptus sieberi,* Sydney Peppermint *Eucalyptus piperita*, Yertchuk *Eucalyptus consideniana* and Blue-leaved Stringybark *Eucalyptus agglomerate*. The understory is dominated by Hairpin Banksia *Banksia spinulosa,* Variable Bossiaea *Bossiaea heterophylla, Hakea laevipes,* Mountain Devil *Lambertia formosa* and Slender Tea-tree *Leptospermum trinervium.* The ground cover includes Curly Wig *Caustis flexuosa, Cyathochaeta diandra,* Wiry Panic *Entolasia stricta, Lomandra obliqua* and Silky Purple-Flag *Patersonia sericea.*
Justification for New PCT listing	PCT 3588 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion on sandstone soils. The canopy layer is dominated by *Corymbia gummifera, Eucalyptus sclerophylla* and sometimes *Eucalyptus consideniana*. The mid layer is dominated by Banksia spinulosa, *Lambertia formosa* and *Hakea dactyloides* which are almost always present and *Leptospermum trinervium, Persoonia levis* and *Petrophile pedunculata* both very frequently recorded. The open ground cover typically includes *Lomandra obliqua, Entolasia stricta, Patersonia sericea* and *Cyathochaeta diandra*, which are very commonly present.
Condition	The community occurs in two conditions: • 286 ha in High condition. • 1 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs on sandstone plateaux up to 700m elevation in the lower Shoalhaven area.
Threatened ecological community	There are currently no TECs associated with this PCT.

Table 19 PCT 1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

PCT 1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 4103 *Sporobolus virginicus Saltmarsh*
Vegetation formation	Saline Wetlands
Vegetation class	Saltmarshes
Percent cleared	56 %
Extent within study area	Approximately 17 ha of PCT 1126 was recorded within the Kiama LGA.
Description	Occurs as an absent canopy and mid stratum. The ground cover consists of low succulent herbs and rushes on tidally inundated land, species include; *Baumea juncea*, Sea Rush *Juncus kraussii* subsp. *australiensis*, Samphire *Sarcocornia quinqueflora* subsp. *quinqueflora*, Marine Couch *Sporobolus virginicus*, Streaked Arrowgrass *Triglochin striata*, Knobby Club-rush *Ficinia nodosa*, Creeping Brookweed *Samolus repens*, Swamp Weed *Selliera radicans*, Seablite *Suaeda australis* and Prickly Couch *Zoysia macrantha.* Chenopod species dominate areas more frequently inundated by the tides, while Sea Rush occupies the more elevated terrestrial margin. Tall reeds may also occur, as well as salt pans.
Justification for New PCT listing	PCT4103 is widely distributed, including throughout the Sydney Basin IBRA Bioregion and Illawarra sub region. This PCT is characterised by a mid-high saline grassland or closed grassland on littoral salt flats, estuaries, saline lagoons or tidal creek flats along the NSW coast. The ground layer is typically dominated by *Sporobolus virginicus*, which almost always forms a mid-dense or dense ground layer in the saltmarsh. *Juncus kraussii* subsp. *australiensis* and/or *Sarcocornia quinqueflora* subsp. *quinqueflora* commonly occur as well, however the cover is sparser.
Condition	The community occurs in High condition.
Associated soils, rainfall and landscape position	Like many estuarine vegetation communities, large areas have been reclaimed for industrial, recreational and urban land use. Many examples that remain in Sydney are small in size, highly fragmented and patchy in distribution. Historical photographs taken in 1943 across much of the Sydney area (LPI 2013) clearly indicates that some former saltmarshes and mud flats are now colonised by dense stands of mangroves.
Threatened ecological community	Associated TECs: • *Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered, BC Act). • *Subtropical and Temperate Coastal Saltmarsh* (Vulnerable, EPBC Act).

PCT 1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	
Photo: PCT 1126	

Table 20 PCT 1128 Sassafras - Blackwood - Lilly Pilly temperate rainforest of the Robertson area, Sydney Basin Bioregion

PCT 1128 Sassafras - Blackwood - Lilly Pilly temperate rainforest of the Robertson area, Sydney Basin Bioregion	
PCT	PCT 1128 Sassafras - Blackwood - Lilly Pilly temperate rainforest of the Robertson area, Sydney Basin Bioregion.
Vegetation formation	Saline Wetlands
Vegetation class	Saltmarsh
Percent cleared	85 %
Extent within study area	Approximately 50 ha of PCT 1128 was recorded within the Kiama LGA.
Description	The canopy consists of Silvertop Ash *Eucalyptus sieberi,* Red Bloodwood *Corymbia gummifera,* Sydney Peppermint *Eucalyptus piperita* and Giant Mallee Ash *Eucalyptus dendromorpha.* The mid stratum consists of dense sclerophyll shrub species including; Blunt Leaf Wattle *Acacia obtusifolia,* Broom Spurge *Amperea xiphoclada, Aotus ericoides,* Swamp Banksia *Banksia paludosa,* Old-Man Banksia *Banksia serrata, Bossiaea kiamensis and* Slender Tea-tree *Leptospermum trinervium.* The groundcover is dominated by sedges including; Spreading Rope-rush *Empodisma minus,* Red-fruit Saw-sedge *Gahnia sieberiana,* Pouched Coral Fern *Gleichenia dicarpa and* Spiny-Headed Mat-rush *Lomandra longifolia.*
Condition	The community occurs in two conditions: • 42 ha in High condition. • 8 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs on moist soils derived from basalt on the Robertson Plateau between 650 and 800 m.
Threatened ecological community	Associated TECs: • *Robertson Rainforest in the Sydney Basin Bioregion* (Endangered, BC Act and Critically Endangered, EPBC Act).

Table 21 PCT 1156 Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

PCT 1156 Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion	
PCT	PCT 1156 Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion.
New PCT	PCT 3585 *Morton Plateau Shrub Forest*
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
Percent cleared	20 %
Extent within study area	Approximately 1,891 ha of PCT 1156 was recorded within the Kiama LGA.
Description	The canopy consists of open forest comprising Silvertop Ash *Eucalyptus sieberi,* Red Bloodwood *Corymbia gummifera,* Sydney Peppermint *Eucalyptus piperita* and *Eucalyptus dendromorpha.* The mid stratum consists of *Acacia obtusifolia, Amperea xiphoclada, Aotus ericoides, Banksia paludosa,* Old-Man Banksia *Banksia serrata, Bossiaea kiamensis and* Slender Tea-Tree *Leptospermum trinervium.* The groundcover consists of; *Empodisma minus,* Red-Fruit Saw-Sedge *Gahnia sieberiana,* Pouched Coral Fern *Gleichenia dicarpa and* Spiny-Headed Mat-Rush *Lomandra longifolia.*
Justification for New PCT listing	PCT 3585 is distributed throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion on sandstones. The tree canopy is very frequently dominated by *Eucalyptus sieberi*, and often with *Corymbia gummifera* and occasionally *Eucalyptus piperita* or *Eucalyptus dendromorpha*. The mid stratum is dense to mid-dense with several heath species which almost always includes; *Leptospermum trinervium* and *Bossiaea kiamensis*. *Banksia paludosa, Banksia ericifolia, Banksia serrata, Persoonia mollis* and *Leptospermum rotundifolium* are also very common. The ground layer typically includes *Lomandra longifolia*, as well as *Gahnia sieberiana, Empodisma minus* and *Lepyrodia scariosa* which occur less frequently.
Condition	The community occurs in three conditions: • 1,853 ha in High condition. • 31 ha in Moderate condition. • 7 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs on periodically damp, elevated sandstone plateaux between 550 and 1000 m on the Budderoo and Morton plateaux.
Threatened ecological community	There are currently no TECs associated with this PCT.

PCT 1156 Silvertop Ash - Red Bloodwood - Sydney Peppermint heathy open forest on moist sandstone plateaux, southern Sydney Basin Bioregion

Photo: PCT 1156

Table 22 PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 4028 *Estuarine Swamp Oak Twig-rush Forest*
Vegetation formation	Forested Wetlands
Vegetation class	Coastal Swamp Forests
Percent cleared	95 %
Extent within study area	Approximately 161 ha of PCT 1232 was recorded within the Kiama LGA.
Description	The canopy consists of Swamp She-Oak *Casuarina glauca* and Broad-Leaved Paperbark *Melaleuca quinquenervia.* The mid stratum is very sparse, consisting of Boobialla *Myoporum* spp., Swamp Paperbark *Melaleuca ericifolia* and Prickly-leaved Tea Tree *Melaleuca styphelioides.* The groundcover consists of; Sea Rush *Juncus kraussii,* Creeping Brookweed *Samolus repens,* Samphire *Sarcocornia quinqueflora,* Seablite *Suaeda australis,* Bare Twig-rush *Machaerina juncea,* Common Couch *Cynodon dactylon,* Lesser Joyweed *Alternanthera denticulata,* Tall Sedge *Carex appressa,* Indian Pennywort *Centella asiatica,* Native Wandering Jew *Commelina cyanea* and Common Reed *Phragmites australis.*
Justification for New PCT listing	PCT 4028 is distributed along the coast, including throughout the Sydney Basin IBRA bioregion and the Illawarra sub-bioregion. It exists as a tall open forest or woodland, on the edges of tidal estuarian flats and tidal creek flats. *Casuarina glauca* forms a dense tree layer, rarely accompanied by other tree species, including *Melaleuca quinquenervia*. A sparse mid layer of shrubs is occasionally present, mostly including *Melaleuca ericifolia*, which other species rarely occur. The ground layer is predominantly made up of a mid-dense layer of sedges, rushes, grasses and reeds, most frequently including *Baumea juncea* and *Juncus kraussii* subsp. *australiensis. Phragmites australis* is also common, while *Samolus repens, Lobelia anceps* and *Gahnia clarkei* occasionally occur.
Condition	The community occurs in three conditions: • 89 ha in High condition. • 42 ha in Moderate condition. • 29 ha in Low condition.
Associated soils, rainfall and landscape position	Found across the coastal plain and hinterland of the Sydney metropolitan area. It is not restricted to particular substrates. While it is commonly found on floodplains it also occurs near freshwater lagoons associated with sand deposits, poorly drained shale depressions on the Cumberland Plain and freshwater fed backswamps near coastal estuaries. Sample sites within the Sydney area lie within an elevational range of two to 10 m above sea level and a mean annual rainfall range of 850 to 1250 mm.
Threatened ecological community	Associated TECs: • *Coastal Swamp-Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (Endangered, EPBC Act). • *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered BC Act). • *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered BC Act).

PCT 1232 Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion	
Photo: PCT 1232	

Table 23 PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion

PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 1234 Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 4026 *Estuarine Sea Rush Swamp Oak Forest*
Vegetation formation	Forested Wetlands
Vegetation class	Coastal Floodplain Wetlands
Percent cleared	90 %
Extent within study area	Approximately 24 ha of PCT 1234 was recorded within the Kiama LGA.
Description	The canopy is dominated by Swamp Oak *Casuarina glauca* and forms dense monospecific stands. The mid stratum comprises; Grey Mangrove *Avicennia marina,* Hop Goodenia *Goodenia ovata,* Seablite *Suaeda australis* and Boobialla *Myoporum acuminatum.* The ground cover comprises of a thick layer of salt-tolerant herbs, rushes and sedges including; Sea Rush *Juncus kraussii* subsp. *australiensis,* Bare Twig-rush *Baumea juncea,* Creeping Brookweed *Samolus repens,* Common Reed *Phragmites australis,* Marine Couch *Sporobolus virginicus,* Orache Saltbush *Atriplex australasica,* Bearded Samphire *Sarcocornia quinqueflora* and Bermuda Grass *Cynodon dactylon.*
Justification for New PCT listing	PCT 4026 is widely distributed, including throughout the Sydney Basin IBRA Bioregion and Illawarra sub bioregion. A key characteristic of this PCT is a mid-dense to dense ground layer of *Juncus kraussii* subsp. *australiensis*. The tree layer is sparse, frequently including *Casuarina glauca*. Other woody species are rare but may include *Melaleuca quinquenervia, Avicennia marina* subsp. *australasica* and *Melaleuca nodosa*. Other species commonly occurring in the ground layer include *Sporobolus virginicus* and *Baumea juncea*, occasionally with Phragmites australis.
Condition	The community occurs in High condition.
Associated soils, rainfall and landscape position	In the zonation from mangroves to terrestrial sclerophyll and mesophyll forests and woodlands, Estuarine Swamp Oak Forest occurs immediately above tidal influence. It fringes the margins of saline waterbodies that include rivers, lagoons and tidal lakes. Estuarine Swamp Oak Forest is widespread along the coast of the Sydney basin where it is rarely found at more than two meters above sea level.
Threatened ecological community	Associated TECs: • *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered, BC Act).

Table 24 PCT 1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion

PCT 1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	
PCT	PCT 1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion.
New PCT	PCT 3153 *Illawarra Escarpment Bangalay x Blue Gum Wet Forest*
Vegetation formation	Wet Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	North Coast Wet Sclerophyll Forests
Percent cleared	43 %
Extent within study area	Approximately 3,897 ha of PCT 1245 was recorded within the Kiama LGA.
Description	The canopy is dominated by the hybrid Sydney Blue Gum *Eucalyptus botryoides Eucalyptus saligna* and/or Bangalay *Eucalyptus botryoides*. Co-dominant species may include Coastal Grey Box *Eucalyptus quadrangulata*, Turpentine *Syncarpia glomulifera* and Blackbutt *Eucalyptus pilularis*. A complex warm temperate rainforest sub-canopy includes Sassafras *Doryphora sassafras*, Laurels *Cryptocarya* spp., Red Cedar *Toona ciliata* and Cabbage Tree Palm *Livistona australis*. The mid stratum comprises; Lilly Pilly *Acmena smithii*, Bastard Rosewood *Synoum glandulosum,* Hairy Clairy *Clerodendrum tomentosum,* Bolwarra *Eupomatia laurina* and Mock Olive *Notelaea venosa*. The ground cover includes; Prickly Rasp Fern *Doodia aspera,* Pastel Flower *Pseuderanthemum variabile,* Creeping Beard Grass *Oplismenus imbecillis,* Settler's Twine *Gymnostachys anceps,* Gristle Fern *Blechnum cartilagineum,* Giant Maidenhair *Adiantum formosum* and Soft Bracken *Calochlaena dubia.*
Justification for New PCT listing	PCT 3153 occurs throughout the Sydney Basin IBRA bioregion, and the Illawarra sub bioregion. It occurs as a tall open sclerophyll forest on low to mid-elevation escarpment benches, slopes and gullies on the Illawarra Escarpment and hills on the Illawarra coastal plain. The tree canopy very frequently has a high cover of one or more species from the *Eucalyptus saligna - botryoides* complex, occasionally with *Syncarpia glomulifera* and *Eucalyptus pilularis*, rarely with *Eucalyptus quadrangulata*. The mid stratum typically includes *Acmena smithii* with a high cover, along with *Livistona australis. Pittosporum undulatum* and *Cryptocarya glaucescens* are common, while *Doryphora sassafras* occasionally occurs and *Claoxylon australe* is rarely present. Other frequent shrubs include; *Synoum glandulosum* subsp. *glandulosum, Notelaea venosa* and *Eupomatia laurina* and occasionally *Cryptocarya microneura*. The ground layer very frequently includes; *Blechnum neohollandicum, Adiantum aethiopicum, Gymnostachys anceps* and *Oplismenus imbecillis*, while *Lomandra longifolia, Gynochthodes jasminoides, Smilax australis* and *Pandorea pandorana* subsp. *pandorana* may also be present.
Condition	The community occurs in three conditions: • 2,661 ha in High condition. • 958 ha in Moderate condition. • 278 ha in Low condition.
Associated soils, rainfall and landscape position	This forest is associated with high rainfall (greater than 1400 mm) and deep chocolate clay soils on escarpment benches, alluvial flats and protected gullies of the Illawarra escarpment (NPWS 2002). The Hacking River valley is the northern limit of the community. It extends southwards along the escarpment to Nowra (Tozer et al. 2010) where it is distributed between 60 and 300 m above sea level on Narrabeen group sediments or on Illawarra Coal Measures.

PCT 1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	
Threatened ecological community	There are currently no TECs associated with this PCT.
Photo: PCT 1245	

Table 25 PCT 1254 Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion

PCT 1254 Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion	
PCT	PCT 1254 Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion.
New PCT	PCT 3223 *Southern Highlands Shale-Basalt Wet Forest*
Vegetation formation	Wet Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Southern Escarpment Wet Sclerophyll Forests
Percent cleared	80 %
Extent within study area	Approximately 11 ha of PCT 1254 was recorded within the Kiama LGA.
Description	The canopy consists of tall open forest including Sydney Peppermint *Eucalyptus piperita,* White Stringybark *Eucalyptus globoidea,* Mountain Gum *Eucalyptus cypellocarpa,* Messmate Stringybark *Eucalyptus obliqua* and Gully Gum *Eucalyptus smithii.* The mid stratum consists of; Australian Clematis *Clematis aristata,* Wombat Berry *Eustrephus latifolius,* Hop Goodenia *Goodenia ovata,* Austral Indigo *Indigofera australis,* Lance-Beard Heath *Leucopogon lanceolatus,* Veined Mock-Olive *Notelaea venosa* and Elderberry Panax *Polyscias sambucifolia* subsp. *A.* The ground cover comprises; Common Maidenhair Fern *Adiantum aethiopicum,* Gristle Fern *Blechnum cartilagineum,* Blue Flax-Lily *Dianella caerulea,* Kidney Weed *Dichondra repens,* Prickly Rasp Fern *Doodia aspera,* Twining Glycine *Glycine clandestina,* Spiny-Head Mat-Rush *Lomandra longifolia,* Weeping Grass *Microlaena stipoides* var. *stipoides,* White Root *Lobelia purpurascens,* Bracken Fern *Pteridium esculentum,* Lawyer Vine *Smilax australis,* Bearded Tylophora *Tylophora barbata,* Pennywort *Hydrocotyle peduncularis* and Native Violet *Viola hederacea.*
Justification for New PCT listing	PCT 3223 occurs throughout the Sydney Basin IBRA bioregion, and the Illawarra sub bioregion. It occurs as a tall moist eucalypt sclerophyll open forest on deep fertile soils. The mid-dense tree canopy commonly contains *Eucalyptus cypellocarpa* with occasional *Eucalyptus obliqua, Eucalyptus fastigata, Eucalyptus piperita* or *Eucalyptus radiata*. Smaller trees commonly include *Acacia melanoxylon*, rarely with *Synoum glandulosum* subsp. *glandulosum, Pittosporum undulatum* or *Acacia binervata*. Smaller shrub species are scattered and commonly include *Leucopogon lanceolatus* and occasionally *Coprosma quadrifida*. The ground layer is dominated by *Pteridium esculentum*, while *Lomandra longifolia, Dianella caerulea* and *Dichondra repens* are very common. *Microlaena stipoides* and *Poa labillardierei* var. *labillardierei* are also common, while *Blechnum cartilagineum* occurs less frequently.
Condition	The community occurs in two conditions: • 9 ha in High condition. • 2 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs on shale and the shale/basalt boundary at altitudes between 450 and 900 m in the Blue Mountains and Southern Highlands.
Threatened ecological community	Associated TECs: • *Turpentine-Ironbark Forest of the Sydney Basin Bioregion* (Critically Endangered, EPBC Act). • *Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion* (Endangered, EPBC Act). • *Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions* (Endangered, BC Act).

PCT 1254 Sydney Peppermint - White Stringybark moist shrubby forest on elevated ridges, Sydney Basin Bioregion

Photo: PCT 1254

Table 26 PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion

PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	
PCT	PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion.
New PCT	PCT 3077 *Illawarra Complex Dry Rainforest*
Vegetation formation	Rainforests
Vegetation class	Dry Rainforests
Percent cleared	90 %
Extent within study area	Approximately 2,422 ha of PCT 1300 was recorded within the Kiama LGA.
Description	The canopy consists of low closed forest including; Whalebone Tree *Streblus brunonianus,* Native Quince *Alectryon subcinereus,* Sweet Pittosporum *Pittosporum undulatum,* Black Plum *Diospyros australis,* Red Ash *Alphitonia excelsa,* Maiden's Wattle *Acacia maidenii,* and Black Apple *Pouteria australis.* The mid stratum consists of; Cinnamon Myrtle *Backhousia myrtifolia,* Wild Quince *Guioa semiglauca,* Coffee Bush *Breynia oblongifolia,* Hairy Clairy *Clerodendrum tomentosum,* Green Native Cascarilla *Croton verreauxii,* Wombat Berry *Eustrephus latifolius,* Scrambling Lily *Geitonoplesium cymosum,* Cockspur Thorn *Maclura cochinchinensis,* Veined Mock-olive *Notelaea venosa,* Wonga Wonga Vine *Pandorea pandorana,* Common Silkpod *Parsonsia straminea,* Orange Thorn *Pittosporum multiflorum,* Rough fruit Pittosporum *Pittosporum revolutum,* Lawyer Vine *Smilax australis* and Red Olive-Berry *Cassine australis.* The ground cover comprises; Necklace Fern *Asplenium flabellifolium,* Prickly Rasp Fern *Doodia aspera,* Settler's Twine *Gymnostachys anceps,* Creeping Beard Grass *Oplismenus imbecillis,* Sickle Fern *Pellaea falcata* and Pastel Flower *Pseuderanthemum variabile.*
Justification for New PCT listing	PCT 3077 occurs in the Sydney Basin IBRA bioregion, and the Illawarra sub bioregion. It occurs on the coast and foothills of the Illawarra area between Wollongong and Nowra, with a limited occurrence in Milton. This PCT may rarely have a Eucalypt canopy, where *Eucalyptus quadrangulata* and *Eucalyptus tereticornis* are most frequent. The rainforest tree species very frequently includes *Streblus brunonianus* and *Elaeodendron australe*, either of which may have high foliage cover. Other species that only sometimes have a high cover frequently include *Notelaea venosa*, and commonly *Alectryon subcinereus, Pittosporum undulatum, Alphitonia excelsa* and *Diospyros australis*. Among the vines, *Eustrephus latifolius* is almost always present, very frequently with *Pandorea pandorana* and *Geitonoplesium cymosum* as well as the shrub *Pittosporum multiflorum*, all of which have low abundance. The sparse to dense ground layer is very frequently comprised of species including *Pseuderanthemum variabile, Oplismenus imbecillis* and *Pellaea falcata. Gymnostachys anceps* is also common in the ground layer.
Condition	The community occurs in three conditions: • 691 ha in High condition. • 1,426 in Moderate condition. • 304 ha in Low condition.
Associated soils, rainfall and landscape position	Occurs mainly on dry slopes on fertile soils below about 300 m in the Illawarra-Kiama and Milton areas.
Threatened ecological community	Associated TECs: • *Illawarra Subtropical Rainforest in the Sydney Basin Bioregion* (Endangered, BC Act).

PCT 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	
	• *Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion* (Critically Endangered, EPBC Act).
Photo: PCT 1300	

Table 27 PCT 1326 Woollybutt White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion

PCT 1326 Woollybutt White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	
PCT	PCT 1326 Woollybutt White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion.
New PCT	PCT 3330 *South Coast Lowland Woollybutt Grassy Forest*
Vegetation formation	Grassy Woodlands
Vegetation class	Coastal Valley Grassy Woodlands
Percent cleared	95 %
Extent within study area	Approximately 15 ha of PCT 1326 was recorded within the Kiama LGA.
Description	The canopy comprises; White Stringybark *Eucalyptus globoidea,* Woollybutt *Eucalyptus longifolia,* Forest Red Gum *Eucalyptus tereticornis* and Spotted Gum *Corymbia maculata.* The mid stratum comprises of; Twining Glycine *Glycine clandestina,* Variable Glycine *Glycine tabacina,* Prickly Beard-Heath *Leucopogon juniperinus, Melaleuca decora,* White Dogwood *Ozothamnus diosmifolius* and Sweet Pittosporum *Pittosporum undulatum.* The ground cover comprises species including; Rock Fern *Cheilanthes sieberi subsp. sieberi,* Barbed Wire Grass *Cymbopogon refractus,* Blueberry Lily *Dianella longifolia,* Bushy-Hedgehog Grass *Echinopogon caespitosus,* Wiry Panic *Entolasia stricta,* Paddock Lovegrass *Eragrostis leptostachya,* Variable Sword-Sedge *Lepidosperma laterale,* Weeping Grass *Microlaena stipoides var. stipoides,* Whiteroot *Lobelia purpurascens, Themeda australis,* Trailing Speedwell *Veronica plebeia,* Blady Grass *Imperata cylindrica* var. *major.*
Justification for New PCT listing	PCT 3330 occurs in the Sydney Basin IBRA bioregion, and the Illawarra sub bioregion and exits as a tall sclerophyll open forest. The canopy very frequently includes Eucalyptus longifolia, *Eucalyptus globoidea* or *Eucalyptus eugenioides*, and is commonly associated with *Eucalyptus tereticornis*. The distinct mid stratum almost always includes Acacia, with Acacia longifolia and *Acacia binervata* being the most frequent. Other common mid stratum species include *Leucopogon juniperinus* and *Pittosporum undulatum*, while species such as Melaleuca decora and *Ozothamnus diosmifolius* are less common. The dense ground layer is comprised of species such as; *Entolasia stricta, Microlaena stipoides, Cymbopogon refractus, Echinopogon caespitosus, Dichondra repens, Cheilanthes sieberi* subsp. s*ieberi, Eragrostis leptostachya, Lomandra longifolia* and *Themeda triandra* which are very frequent.
Condition	The community occurs in two conditions: • 14 ha in Moderate condition. • 1 ha in Low condition.
Associated soils, rainfall and landscape position	Restricted to flats below 100 m ASL with sandy loam soils and partially impeded drainage mainly between the Illawarra and Moruya.
Threatened ecological community	Associated TECs: • *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion* (Endangered, BC Act). • *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered, BC Act). • Ill*awarra and south coast lowland forest and woodland ecological community* (Critically Endangered, EPBC Act). • Partially subset of *River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria* (Critically Endangered, EPBC Act).

Table 28 Urban Native/Exotic vegetation

Urban Native/Exotic Vegetation	
PCT	No associated PCT
Common name	Urban Native/Exotic (UNE)
Extent within study area	Approximately 99 ha of Urban Native/Exotic vegetation was recorded within the Kiama LGA.
Description	This vegetation type consisted predominantly of Urban Native/Exotic planted vegetation. Whilst native flora species were observed within this vegetation type, their presence was not significant and as such, this vegetation did not conform to a recognisable PCT. The vegetation assigned UNE either has no native over storey or mid storey cover that met the definition of non-native vegetation / cleared land and was not mapped as native vegetation. The UNE vegetation has been highly disturbed and subjected to weed ingress, and does not provide habitat features suitable for threatened species or forms a recognisable PCT.
Photo: Urban Native/Exotic vegetation	

5.2 Threatened Ecological Communities

A total of nine BC Act listed TECs were mapped within the Kiama LGA covering an area of 4,641 hectares constituting 32.50% of the total native vegetation within the Kiama LGA (Table 29) (Figure 4).

Table 29 BC Act Threatened Ecological Communities mapped within the Kiama LGA (Biosis 2022)

Associated PCT number	BC Act listed TEC name	Total mapped area (ha)
659 (Table 2)	*Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions*	285
720 (Table 5)	*Melaleuca armillaris Tall Shrubland in the Sydney Basin Bioregion*	89
838 (Table 10) 1326 (Table 27)	*Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion*	43
906 (Table 14) 1300 (Table 26)	*Illawarra Subtropical Rainforest in the Sydney Basin Bioregion*	2,573
920 (Table 16) 1126 (Table 19)	*Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	17
1078 (Table 17)	*Coastal Upland Swamp in the Sydney Basin Bioregion*	1,389
1128 (Table 20)	*Robertson Rainforest in the Sydney Basin Bioregion*	50
1232 (Table 22) 1234 (Table 23)	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	185
1254 (Table 25)	*Southern Highlands Shale Woodlands in the Sydney Basin Bioregion*	11
Total		**4,642**

A total of nine EPBC Act listed TECs were mapped within the Kiama LGA covering an area of 3,977 hectares constituting 28.10% of the total native vegetation within the Kiama LGA (Table 30) (Figure 5).

Table 30 EPBC Act Threatened Ecological Communities mapped within the Kiama LGA (Biosis 2022)

Associated PCT number	EPBC Act listed TEC name	Total mapped area (ha)
1232 (Table 22)	*Coastal Swamp-Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*	135
906 (Table 14) 1300 (Table 26)	*Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion*	2,268
838 (Table 10) 1326 (Table 27)	*Illawarra and south coast lowland forest and woodland ecological community*	41

Associated PCT number	EPBC Act listed TEC name	Total mapped area (ha)
1326 (Table 27)	*River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria*	15
1128 (Table 20)	*Robertson Rainforest in the Sydney Basin Bioregion*	50
920 (Table 16) 1126 (Table 19)	*Subtropical and Temperate Coastal Saltmarsh*	72
1078 (Table 17)	*Temperate Highland Peat Swamps on Sandstone /Coastal Upland Swamps in the Sydney Basin Bioregion*	1,389
1254 (Table 25)	*Turpentine-Ironbark Forest of the Sydney Basin Bioregion/Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion*	8
1254 (Table 25)	*Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion*	1
Total		**3,979**

5.3 Biodiversity Values Mapping under the BC Act

A total of 3,481 hectares of native vegetation was mapped within the Kiama LGA, as containing areas mapped as Biodiversity Value under Part 7 of the BC Act (Figure 6). Six Biodiversity Values classifications were identified and are outlined in Table 31.

Table 31 Biodiversity Values mapped within the Kiama LGA

Biodiversity Classification	Total mapped area (ha)
Biodiverse riparian land	636
Coastal Management Act – Littoral Rainforest	21
Coastal Management Act – Wetlands	204
Identified Old Growth Forest	73
Identified Rainforest	2,321
Threatened Species or communities with potential for serious and irreversible impacts	226
Total	**3,481**

5.4 Areas of Biodiversity Significance

A total of 14,286 hectares of native vegetation was mapped within the Kiama LGA, as containing areas of biodiversity significance in accordance with the Standard Instrument Local Environmental Plan and associated guidelines/standards (Table 32). The areas of biodiversity significance were classified into three categories: Low, Moderate, and High. The areas of Low biodiversity significance mapped within the LGA covered an area of 257 hectares and consisted of attributes such as small / isolated patches (<5 hectares) of native vegetation, non-threatened native vegetation in lower condition states and non-native vegetation. The remaining areas of High and Moderate biodiversity significance mapped within the LGA were based on the High Environmental Value (HEV) for Strategic Planning - Mapping and Governance Guide (OEH 2015), including identification of key species and relevant biodiversity mapping layers as outlined in the methodology provided in Chapter 4 below. The areas of Moderate biodiversity significance mapped within the LGA covered an area of 472 hectares, with the High biodiversity significance areas covering 13,557 hectares.

Table 32 Areas of biodiversity significance mapped within the Kiama LGA (Biosis 2022)

Biodiversity Classification	Total mapped area (ha)
High	13,557
Moderate	257
Low	472
Total	**14,286**

5.5 Areas of Outstanding Biodiversity Value

Areas of Outstanding Biodiversity Value (AOBV) are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. The BC Act gives the Minister for the Environment the power to declare AOBV. The purpose of declaring AOBV is to identify, highlight and effectively manage sites that make significant contributions to the persistence of biodiversity in NSW Australia and globally. AOBV are a priority for private land conservation investment under the Biodiversity Conservation Investment Strategy.

Biosis has assessed the Kiama LGA against the *Guidelines for interpreting listing criteria for AOBV under the BC Act and the Biodiversity Conservation Regulation 2017* (DPIE 2021). An area proposed for listing as an Area of Outstanding Biodiversity Value under the BC Act must be assessed under Division 3.1 of the BC Regulation. An area is eligible for listing if it meets any one of the criteria in clause 3.1(1)(b), provided it is also significant at the NSW state or wider scale (clause 3.1(1)(a)).

Any AOBV must be important at either (or all) a State, National or global scale. For species and ecological communities, those endemic to NSW are considered to be of global significance, as they are found nowhere else in the world. For species and ecological communities not endemic to NSW, their State significance, and hence eligibility must be justified with reference to the relative importance of populations (species) or distribution and species composition (ecological communities) in NSW as compared to elsewhere.

There are four possible pathways by which an area must make a significant contribution to persistence of biodiversity in NSW to be eligible as an AOBV. These four are:

- Multiple species or at least one threatened species or ecological community.
- Irreplaceable biological distinctiveness.
- Ecological processes or ecological integrity.
- Outstanding ecological value for education or scientific research.

An assessment against the four possible pathways for the key threatened species and threatened ecological communities identified as part of the BV mapping undertaken in Section 4.1, within Kiama LGA is provided in Figure 7. The assessment found that the Barren Grounds Nature Reserve and Budderoo National Park within Kiama LGA, are considered likely to meet the criteria for listing as an AOBV.

The Budderoo National Park and Barren Grounds Nature Reserve are likely to be considered significant at the global, National and State scale as the area:

- Contains populations of Nationally significant species listed under the EPBC Act.
- Contains populations of species endemic to NSW and therefore of global significance.
- Contains species with greater than 66 % of their distribution occurring in NSW and that are therefore of State significance.
- Contains occurrence of ecological communities that, relative to other occurrences of the ecological community are distinctive in taxonomic composition, habitat structure or biology or ecological function.

5.6 Bush Fire Prone Vegetation

Blackash Pty Ltd has updated the Bush Fire Prone Land Mapping using the vegetation study completed by Biosis and assigned the vegetation category and buffer. The draft Bush Fire Prone Land Maps for the Kiama Municipal region are provided below in Figure 8 and Figure **9**.

5.7 Limitations

The accuracy of the vegetation mapping and PCT allocation was limited by access. Biosis were unable to entirely observe the vegetation communities along the face of the Illawarra Escarpment as they could only be accessed via private land. Similarly, PCTs such as PCT 878 and PCT 906 were mapped along the top of the escarpment ridges which were considered to geographically locked for field verification due to a lack of private land access and the terrain being unsafe for field staff.

Over the fence surveys were undertaken to validate PCT and condition where access was not granted, and sufficient visibility was available.

Where access was not granted, PCT's were assumed to be correct where native vegetation extent aligns with PCTs existing vegetation mapping (DPIE 2010, Kevin Mills & Associates Pty Ltd 2007) and soil and landscape mapping also aligned with the PCT description.

Vegetation mapping and biodiversity significance mapping was undertaken using a range of data sources, and not all habitat was validated on ground due to access restrictions. The final outputs from the data analysis will be limited by the input data. Poor quality (i.e., inaccurate species data, soil mapping or vegetation mapping) or missing data may result in the identification of conservation priorities or potential development impacts that do not align with the on-ground environment.

Due to time and access restrictions of the project, targeted flora and fauna surveys were not undertaken in accordance with relevant survey guidelines. Therefore, for many species, only potential habitat could be confirmed. Using the precautionary principle, if habitat occurred, the species was also assumed to be present.

TEC mapping is based on a precautionary principle and desktop mapping. Assumptions were made regarding condition of the vegetation where access was not permitted and therefore some areas of TEC mapping may be overestimated, being precautionary.

Legend

Study area

PCT ID

659	906
662	907
694	920
720	1078
767	1082
769	1126
771	1128
772	1156
838	1232
878	1234
882	1245
905	1254
	1300
	1326

Figure 2 Plant Community Type (PCT) mapping within the Kiama LGA

0 750 1,500 2,250 3,000 3,750

Metres

Scale: 1:80,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 36080, Date: 20 May 2022,
Drawn by: JMS, Checked by: JN, Last edited by: jshepherd
Layout: 36080_F2_PCTs
Project: P:\36000s\36080\Mapping\
36080_Kiama_VegetationStudy.aprx

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © NSW topo vector tile v2: ; NSW Public Imagery: © Department of Customer Service 2020

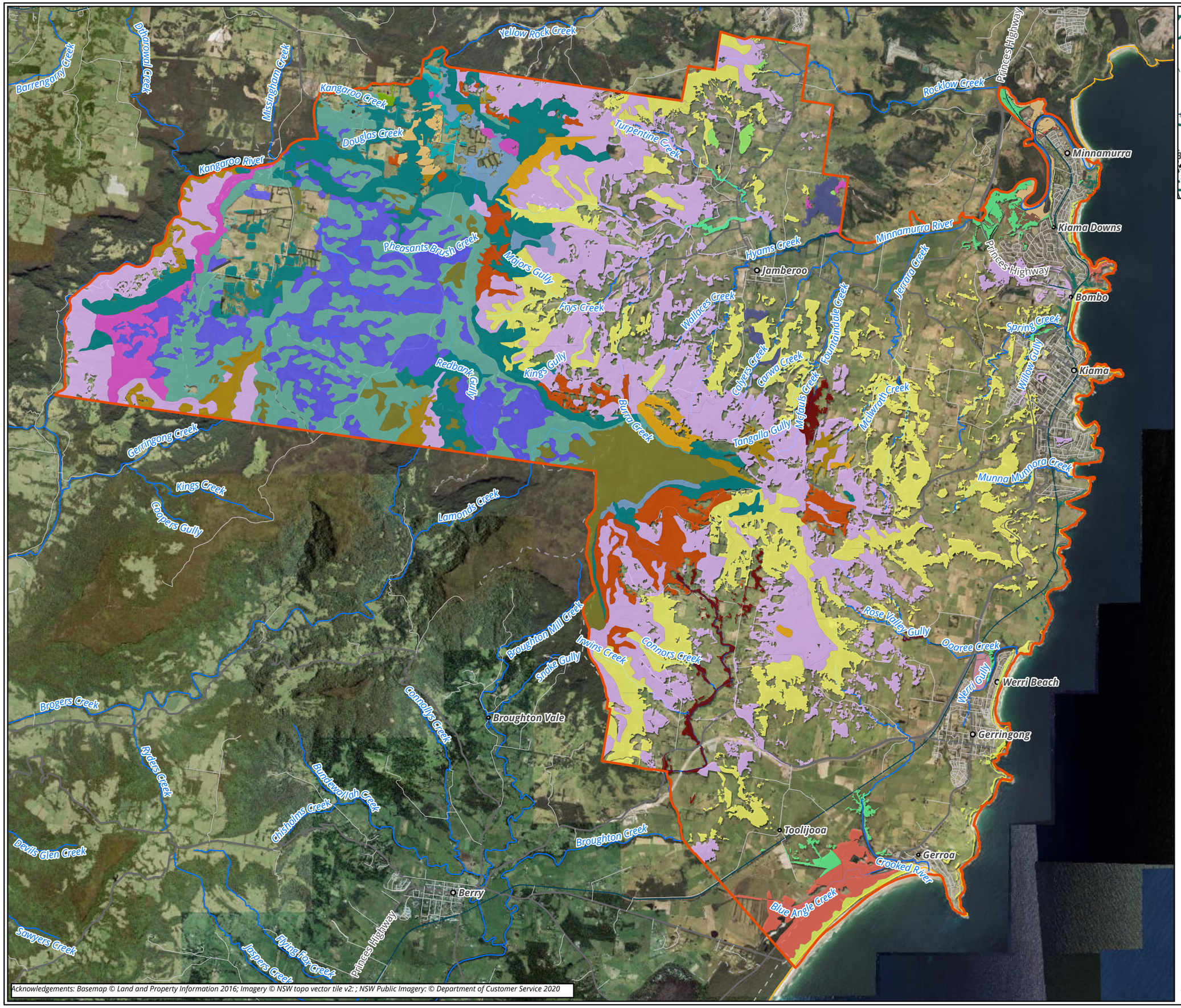
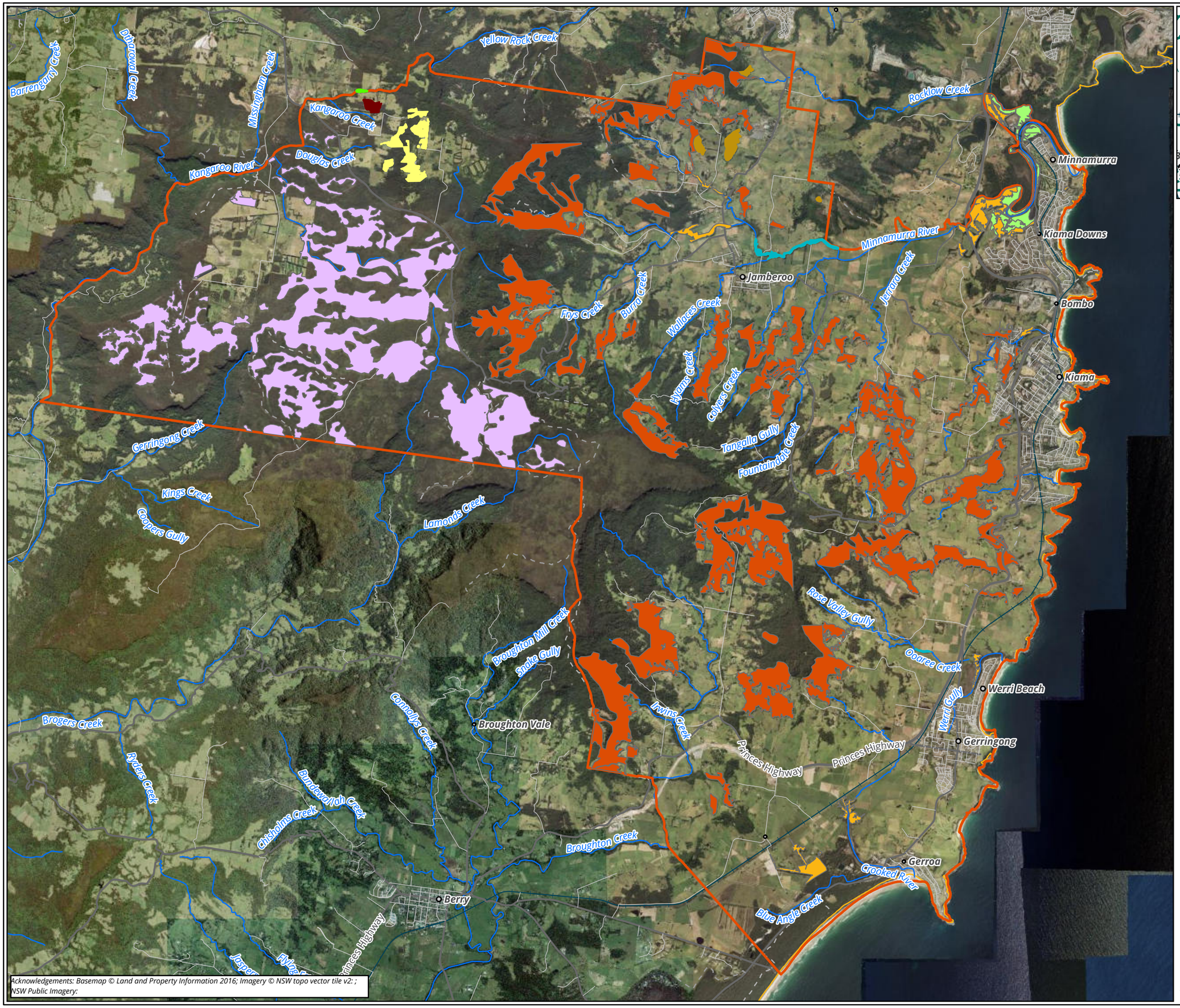


Figure 3 Plant Community Type (PCT) mapping within the Kiama LGA - 2022 PCT associations



Legend

Study area

EPBC TECs

- Coastal Swamp-Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
- Illawarra and south coast lowland forest and woodland ecological community
- Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
- Robertson Rainforest in the Sydney Basin Bioregion
- Subtropical and Temperate Coastal Saltmarsh
- Temperate Highland Peat Swamps on Sandstone /Coastal Upland Swamps in the Sydney Basin Bioregion
- Turpentine-Ironbark Forest of the Sydney Basin Bioregion/Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion

Figure 4 EPBC listed Threatened Ecological Communities within the Kiama Local Government Area

0 750 1,500 2,250 3,000 3,750

Metres

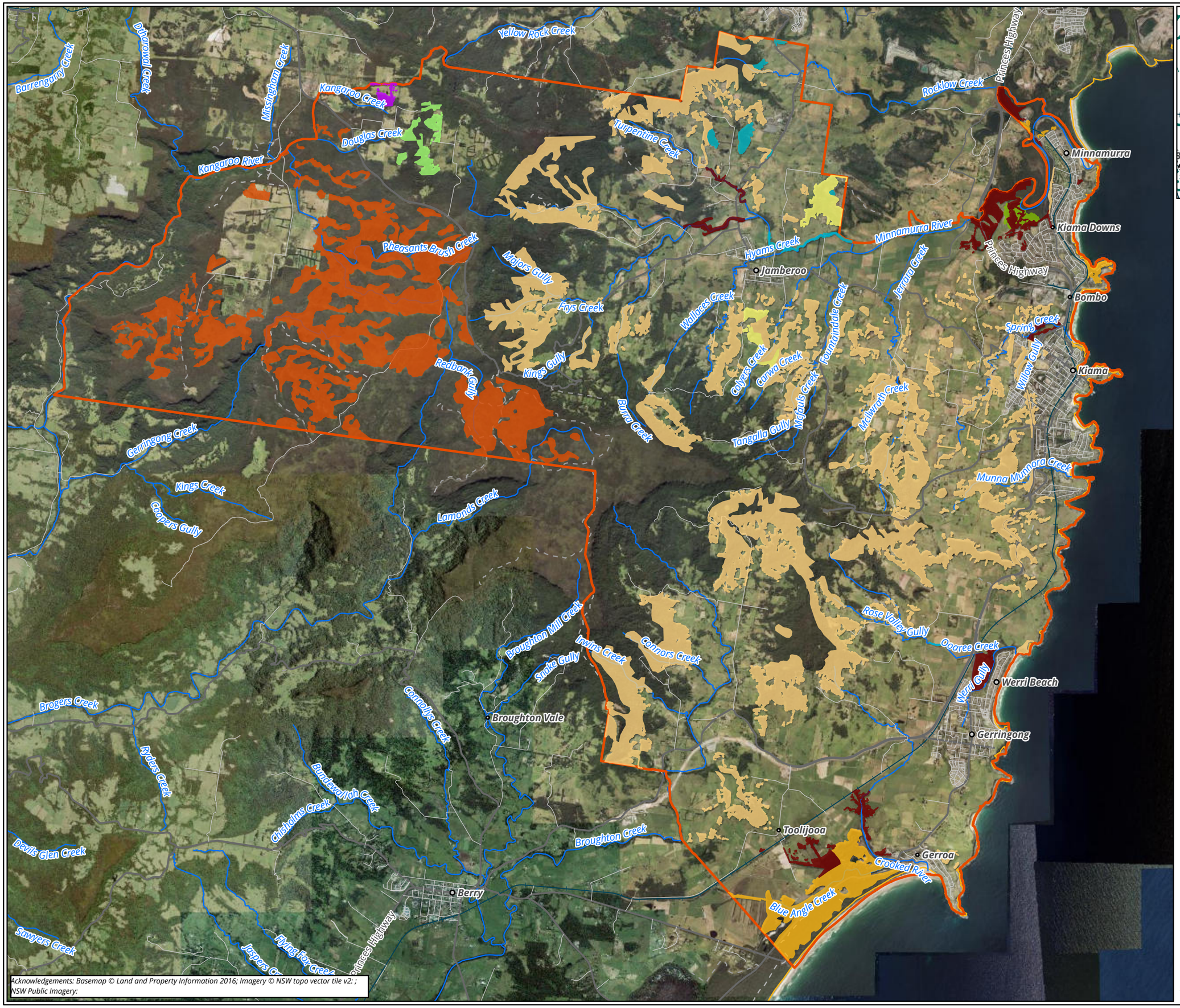
Scale: 1:80,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 36080, Date: 23 August 2022,
Drawn by: JMS, Checked by: RED, Last edited by: jshepherd
Layout: 36080_F4_EPBC_TECs
Project: P:\36000s\36080\Mapping\
36080_Kiama_VegetationStudy.aprx



Legend

Study area

BC Act TEC

- Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Coastal Upland Swamp in the Sydney Basin Bioregion
- Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion
- Illawarra Subtropical Rainforest in the Sydney Basin Bioregion
- Melaleuca armillaris Tall Shrubland in the Sydney Basin Bioregion
- Robertson Rainforest in the Sydney Basin Bioregion
- Southern Highlands Shale Woodlands in the Sydney Basin Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Figure 5 BC listed Threatened Ecological Communities within the Kiama Local Government Area

0 750 1,500 2,250 3,000 3,750 N

Metres

Scale: 1:80,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 36080, Date: 26 August 2022,
Drawn by: JMS, Checked by: RED, Last edited by: jshepherd
Layout: 36080_F5_BC_TECs
Project: P:\36000s\36080\Mapping\
36080_Kiama_VegetationStudy.aprx

Legend

- Study area

Biodiversity Values

BOSET Class

- Biodiverse riparian land
- Coastal Management Act - Littoral Rainforest
- Coastal Management Act - Wetlands
- Identified Old Growth Forest
- Identified Rainforest
- Threatened species or communities with potential for serious and irreversible impacts

Figure 6 Biodiversity Values Map BOSET classes in the Kiama LGA

0 750 1,500 2,250 3,000 3,750

Metres

N

Scale: 1:80,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

biosis

Matter: 36080, Date: 26 August 2022,
Drawn by: JMS, Checked by: JN, Last edited by: jshepherd
Layout: 36080_F6_BV_Map
Project: P:\36000s\36080\Mapping\36080_Kiama_VegetationStudy.aprx

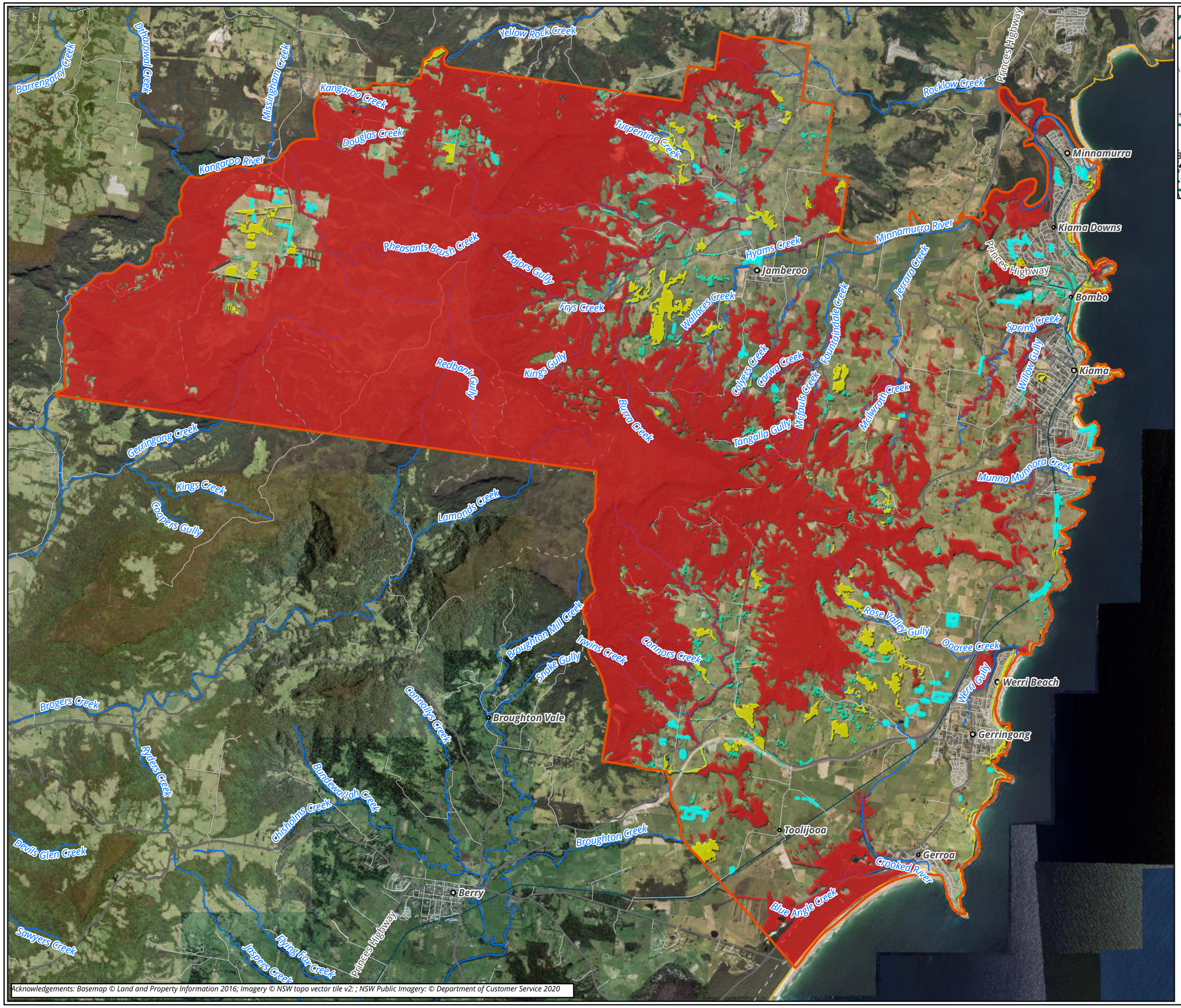


Figure 7 Biodiversity significance

BLACKASH
BUSHFIRE CONSULTING

Legend

Kiama LGA

Lot

Bushfire Prone Land

Vegetation Category 1

Vegetation Category 2

Vegetation Category 3

Vegetation Buffer

KNIGHTS HILL

CARRINGTON FALLS

CURRAMORE

JAMBEROO

KIAMA DOWNS

TERRAGONG SWAMP

PRIMROSE HILL

BOMBO

JERRARA

BARREN GROUNDS

SADDLEBACK MOUNTAIN

TOOTAWAHLIN GULLY

KIAMA HEIGHTS

FOXGROUND

ROSE VALLEY

OMEGA FLAT

WILLOW VALE

GERRINGONG

TOOLIJOOA

GERROA

N

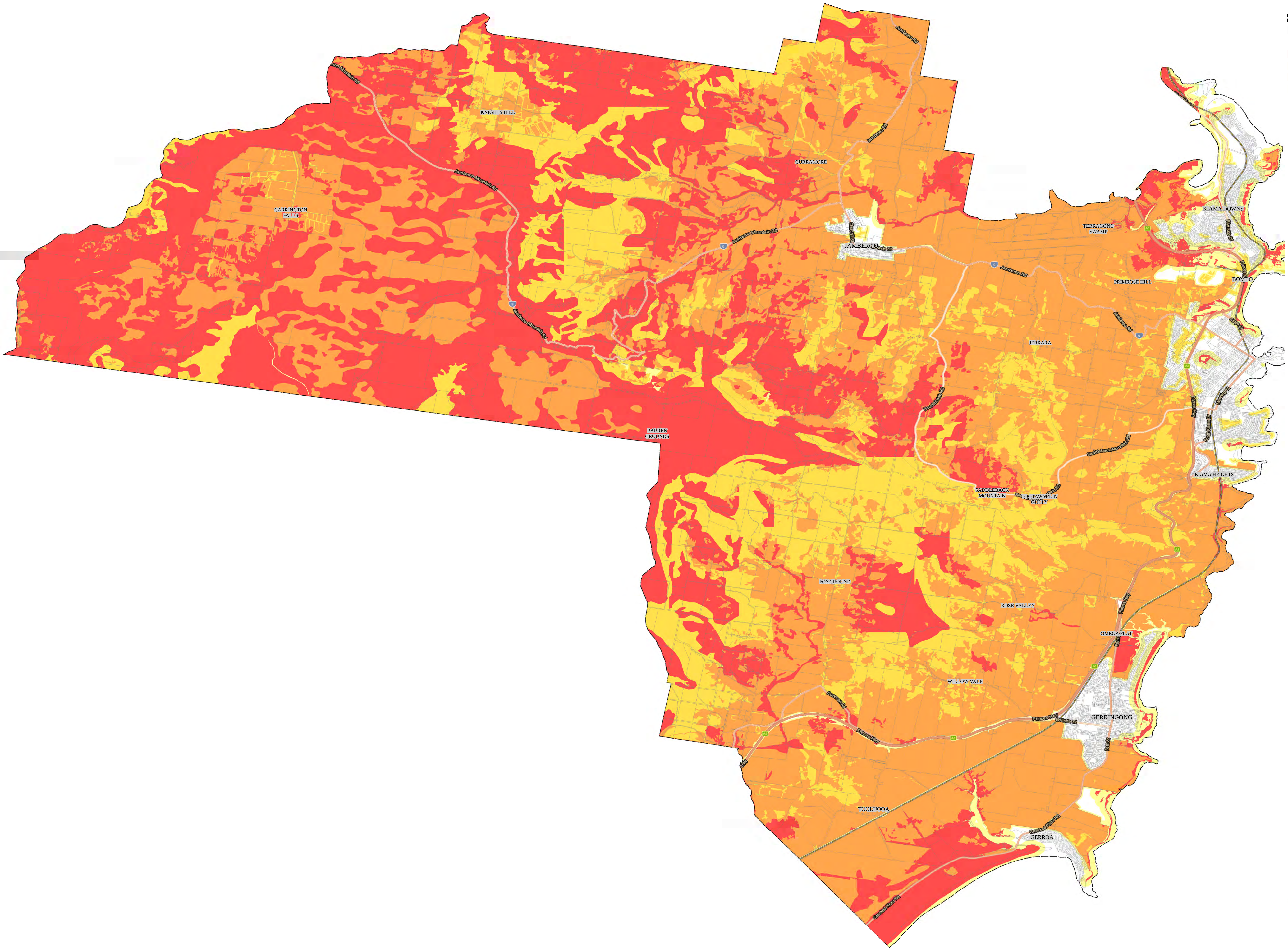
DKGIS

0 0.5 1 2
Kilometers

Date: 27/09/2022

Coordinate System: GCS GDA 1994

Figure 8: Rural Fire Service Draft Kiama Bushfire Prone Land Mapping



BLACKASH BUSHFIRE CONSULTING

Legend

Kiama LGA

Lot

Bushfire Prone Land

Vegetation Category 1

Vegetation Category 2

Vegetation Category 3

Vegetation Buffer

N

DKGIS

0 0.5 1 2 Kilometers

Date: 27/09/2022

Coordinate System: GCS GDA 1994

Figure 9: Blackash Kiama Bushfire Prone Land Mapping

6 Conclusion

Biosis has undertaken a Municipal wide vegetation study to identify the different vegetation types throughout the Municipality of Kiama and provided Kiama Municipal Council with an updated vegetation layer to assist in meeting the objectives of the *Kiama Local Strategic Planning Statement (LSPS) 2020.* BlackAsh Pty Ltd has provided an updated map to the Bush Fire Prone Land.

A total of 14,148 hectares of native vegetation was mapped within the Kiama LGA, consisting of 27 different PCTs, with each PCT categorised into three different condition classes (High, Moderate and Low). An additional 99 hectares of Urban Native/Exotic vegetation and 9,742 hectares of grassland was also mapped within the Kiama LGA.

Nine BC Act listed and nine EPBC Act listed TECs were mapped within the Kiama LGA. The BC Act listed TECs covered a total of 4,641 hectares, constituting 32.50 % of the total native vegetation within the Kiama LGA. The EPBC Act TECs covered a total of 3,977 hectares, constituting 28.10 % of the total native vegetation within the Kiama LGA.

A total of 3,481 hectares of native vegetation was mapped within the Kiama LGA, as containing Biodiversity Values under Part 7 of the BC Act.

A total of 14,286 hectares of native vegetation was mapped within the Kiama LGA, as containing areas of biodiversity significance in accordance with the Standard Instrument Local Environmental Plan and associated guidelines/standards. The areas of biodiversity significance were classified into three categories: Low, Moderate, and High. The areas of Low biodiversity significance mapped within the Kiama LGA covered an area of 257 hectares and consisted of attributes such as small / isolated patches (<5 hectares) of native vegetation, non-threatened native vegetation in lower condition states and non-native vegetation. The remaining areas of High and Moderate biodiversity significance mapped within the Kiama LGA were based on the HEV Guidelines (OEH 2015), including identification of key species and relevant biodiversity mapping layers as outlined in the methodology provided in Chapter 4. The areas of Moderate biodiversity significance mapped within the Kiama LGA covered an area of 472 hectares, with the High biodiversity significance areas covering 13,557 hectares.

Biosis has assessed the Kiama LGA against the Guidelines for interpreting listing criteria for AOBV under the BC Act and the Biodiversity Conservation Regulation 2017 (DPIE 2021). An assessment against the four possible pathways for the key threatened species and threatened ecological communities identified as part of the BV mapping undertaken in Section 4.1, within Kiama LGA is provided in Figure 7. The assessment found that the Barren Grounds Nature Reserve and Budderoo National Park within Kiama LGA, are considered likely to meet the criteria for listing as an AOBV. A full assessment is provided in Appendix 4.

Assessment of vegetation for the determination of Bush Fire Prone Land has been completed in accordance with the NSW Rural Fire Service (RFS) document Guide for Bush Fire Prone Land Mapping 2015 (BFPM Guideline). Bush Fire Prone Land is an area of land that can support a bush fire or is likely to be subject to bush fire attack, as designated on a bush fire prone land map. The majority of the Kiama LGA was mapped as Vegetation Category 1 and 2 on the Bush Fire Prone Land map requiring a 100m and 30m buffer respectively. Grassland areas, which includes native grassland and pasture grassland for grazing, are now included in the mapping guidelines for Bush Fire Prone Land, and is considered to be Category 3 bush fire risk vegetation, with a higher bush fire risk than category 2 (and the excluded areas) but lower than Category 1.

References

Baker et al. 1994. Ground Parrots and Fire at Barren Grounds, New South Wales: A Long-term Study and an Assessment of Management Implications.

Biosis & Open Lines 2021. *Cumberland Plain Conservation Plan Assessment Report*, Report for the NSW Department of Planning, Industry and Environment, Sydney, NSW.

BirdLife International 2021. *Important Bird Areas factsheet: Werribee and Avalon*, *Data Zone*, accessed 23 April 2021, http://datazone.birdlife.org/site/factsheet/werribee-and-avalon-iba-australia.

Bowman H 1971. *Geology of the Wollongong, Kiama and Robertson 1:50,000 Sheets, 9029-II and 9028-Iand IV*, Geological Survey of New South Wales, Department of Mines, New South Wales.

Commonwealth of Australia 2022. *Protected Matters Search Tool*, *Australian Government Department of the Environment, Water, Heritage & the Arts, Canberra*, https://www.environment.gov.au/epbc/protected-matters-search-tool.

DAWE 2020. *Rapid analysis of impacts of the 2019-20 fires on animal species, and prioritisation of species for management response*, Report prepared for the Wildlife and Threatened Species Bushfire Recovery Expert Panel. Department of Agriculture, Water and the Environment.

DCCEEW 2022. Conservation Advice for Pycnoptilus floccosus (Pilotbird).

Dolby T 2016. The Wonderful Barren Grounds, Budderoo National Park and Other Nearby Reserves, https://timothydolby.com/2016/05/11/1526/.

DPE 2010. Southeast NSW Native Vegetation Classification and Mapping - SCIVI. VIS_ID 2230, State Government of NSW Department of Planning and Environment.

DPE 2015. Remnant vegetation of the western Cumberland subregion, 2013 Update. VIS_ID 4207.

DPE 2016. *The Native Vegetation of the Sydney Metropolitan Area - Version 3.1*, Office of Environment and Heritage, NSW.

DPE 2022a. *NSW BioNet Vegetation Classification database*, *BioNet*, https://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx.

DPE 2022b. *BioNet the website for the Atlas of NSW Wildlife*, *Department of Planning and Environment. Sydney, NSW*, https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet/web-services.

DPIE 2014. Threatened species riches of Barren Grounds Nature Reserve and Budderoo National Park, https://www.environment.nsw.gov.au/news/threatened-species-riches-of-barren-grounds-nature-reserve-and-budderoo-national-park.

DPIE 2020a. NSW Landuse Mapping 2017 v1.2, Department of Planning, Industry and Environment. NSW. https://datasets.seed.nsw.gov.au/dataset/nsw-landuse-2017-v1p2-f0ed.

DPIE 2020b. *Biodiversity Assessment Method (BAM)*, Department of Planning, Industry & Environment, https://www.environment.nsw.gov.au/research-and-publications/publications-search/biodiversity-assessment-method-2020.

DPIE 2021. Guidelines for interpreting listing criteria for Areas of Outstanding Biodiversity Value, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/guidelines-interpreting-listing-criteria-areas-outstanding-biodiversity-value-200094.pdf.

Dutson et al. 2009. Australia's important bird areas: key sites for bird conservation. Birds Australia (RAOU) Conservation Statement No. 15.

Hazelton PA 1992. *Soil Landscapes of the Kiama 1:00,000 Sheet*, Department of Conservation and Land Management (incorporating the Soil Conservation Service of NSW), Sydney.

Kevin Mills & Associates Pty Ltd 2007. Natural Vegetation in the Municipality of Kiama New South Wales.

Mills K 2021. The Fern Flora of Barren Grounds Nature Reserve Central Tablelands, NSW, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://austplants.com.au/resources/Documents/Main-Site-Documents/Biennial%20Conference/IVS.96%20Barren%20Grounds%20Ferns.pdf.

NPWS 1998. BUDDEROO NATIONAL PARK, MACQUARIE PASS NATIONAL PARK, BARREN GROUNDS NATURE RESERVE AND ROBERTSON NATURE RESERVE PLAN OF MANAGEMENT, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Parks-plans-of-management/budderoo-macquarie-pass-barren-grounds-robertson-plan-of-management-981001.pdf.

NPWS 2022. Barren Grounds Nature Reserve, https://www.nationalparks.nsw.gov.au/visit-a-park/parks/barren-grounds-nature-reserve/learn-more#EC95348CEC5440EFB29ABCF728A986E5.

NSW Department of Planning and Environment 2022. Biodiversity Values Map and Threshold (BMAT) tool., https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap.

OEH 2012. National Recovery plan for the Eastern Bristlebird Dasyornis brachypterus, https://www.environment.gov.au/system/files/resources/7ca9c6cc-7225-4ca5-af9a-80bb28e47ae7/files/eastern-bristlebird-recovery-plan.pdf.

OEH 2015. *Developing Maps of High Environmental Value for Strategic Planning - Mapping and Governance Guide*, Office of Environment and Heritage (OEH) – Environmental Programs Branch (EPB).

Selwood et al. n.d. 'Emergency conservation interventions during times of crisis: A case study for a threatened bird species in the Australian Black Summer bushfires', accessed 28 September 2022, https://conbio.onlinelibrary.wiley.com/doi/pdf/10.1111/csp2.606.

Appendix 1 Flora Key Habitat Mapping

Table A 1 Key Habitat Mapping methodology for Threatened flora species

Scientific name	Common name	Associated PCTs within Kiama LGA	Method for Key habitat mapping
Arthropteris palisotii	Lesser Creeping Fern	767, 769, 905, 907	Map the area of vegetation of which the threatened species record occurs within.
Boronia deanei	Deane's Boronia	878, 882, 1078, 1082	Buffer each record by 200 m and map any associated PCTs within the buffer.
Cynanchum elegans	White-flowered Wax Plant	720, 771, 772, 838, 1300, 1326	Buffer each record by 200 m and map any associated PCTs within the buffer.
Daphnandra johnsonii	Illawarra Socketwood	1245, 1300	Buffer each record by 200 m and map any associated PCTs within the buffer.
Gossia acmenoides	Scrub Ironwood	None listed	Map the area of vegetation of which the threatened species record occurs and within a 200 m buffer.
Grevillea rivularis	Carrington Falls Grevillea	None listed	Map the area of vegetation of which the threatened species record occurs and within a 200 m buffer.
Irenepharsus trypherus	Illawarra Irene	878, 905, 906, 1245, 1300	Buffer each record by 200 m and map any associated PCTs within the buffer.
Pimelea spicata	Spiked Rice-flower	838	Map the area of vegetation of which the threatened species record occurs and within a 200 m buffer.
Pomaderris walshii	Carrington Falls Pomaderris	None listed	Buffer each record by 200 m and map PCTs 878 and 1156 within the buffer.
Pterostylis pulchella	Waterfall Greenhood	878	Buffer each record by 200 m and map PCTs 878 and 1156 within the buffer.
Rhodamnia rubescens	Scrub Turpentine	694, 769, 905, 906, 1245, 1300	Buffer each record by 200 m and map any associated PCTs within the buffer.
Solanum celatum	-	1245, 1300	Buffer each record by 200 m and map any associated PCTs within the buffer.
Zieria granulata	Illawarra Zieria	720, 838, 906, 907, 1245, 1300, 1326	Buffer each record by 200 m and map any associated PCTs within the buffer.

Appendix 2 Fauna Key Habitat Mapping

Table A 2 Key Habitat Mapping methodology for Threatened Fauna species

Scientific name	Common name	Associated PCTs within Kiama LGA	Method for Key habitat mapping
Anthochaera phrygia	Regent Honeyeater	-	Map the following high condition PCTs as habitat; 659 and 1326.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	659, 662, 694, 720, 767, 769, 771, 772, 838, 882, 905, 906, 920, 1078, 1082, 1126, 1156, 1232, 1234, 1245, 1254, 1300, 2326	Map associated PCTs in high condition as highest priority habitat.
Botaurus poiciloptilus	Australasian Bittern	920, 1126, 1232, 1234	Map associated PCTs in high condition as highest priority habitat.
Callocephalon fimbriatum	Gang-gang Cockatoo	659, 694, 767, 769, 838, 905, 906, 1078, 1082, 1156, 1234, 1245, 1254, 1300, 1326.	Map associated PCTs in high condition.
Calyptorhynchus lathami	Glossy Black-Cockatoo	659, 694, 769, 771, 772, 838, 882, 905, 1078, 1082, 1156, 1232, 1245, 1254, 1326.	Map PCT 859 in high condition.
Cercartetus nanus	Eastern Pygmy-possum	659, 662, 694, 720, 767, 769, 771, 772, 838, 882, 905, 906, 1078, 1082, 1156, 1234, 1245, 1254, 1300, 1326.	Map associated PCTs within Barren Ground NP and Budderoo NR or connected to these parks.
Chalinolobus dwyeri	Large-eared Pied Bat	659, 662, 694, 769, 772, 838, 882, 905, 920, 1078, 1082, 1156, 1232, 1234, 1245, 1254, 1300, 1326.	Map restricted to associated PCTS directly associated with caves and cliffs.
Daphoenositta chrysoptera	Varied Sittella	659, 662, 694, 769, 771, 772, 838, 882, 905, 1082, 1156, 1232, 1234, 1245, 1254, 1300, 1326.	Map associated PCTs in high condition as highest priority habitat.
Dasyornis brachypterus	Eastern Bristlebird	659, 662, 771, 772, 882, 1078, 1232	Map associated PCTs within Barren Ground NR and Budderoo NR (only known population of the species in this area).
Dasyurus maculatus	Spotted-tailed Quoll	659, 662, 694, 720, 767, 769, 771, 772, 838, 882, 905, 906, 920, 1078, 1082, 1156, 1232, 1234, 1245,	Map all areas of associated PCTs within Barren Ground NR and Budderoo NR. This is the stronghold habitat for the species in the LGA therefore the highest priority. Also map

Scientific name	Common name	Associated PCTs within Kiama LGA	Method for Key habitat mapping
		1254, 1300, 1326.	associated PCTs in high condition that extend from the NP in large tracts of vegetation (e.g. to Foxground).
Haematopus fuliginosus	Sooty Oystercatcher	1126	Map all areas of associated PCTs plus coastal / estuarine beaches / rocky platforms / mudflats. As per Pied Oystercatcher.
Haematopus longirostris	Pied Oystercatcher	920, 1126.	Map areas of associated estuarine PCTs plus coastal / estuarine beaches / rocky platforms / mudflats. Land subject to inundation and rock awash values from DLS layers.
Haliaeetus leucogaster	White-bellied Sea-Eagle	771, 772, 838, 882, 920, 1078, 1126, 1232, 1234, 1326.	Associated PCTs in high condition within 300m of a second order or greater watercourse.
Heleioporus australiacus	Giant Burrowing Frog	659, 662, 694, 769, 771, 772, 838, 882, 905, 1078, 1082, 1156, 1232, 1234, 1245, 1254, 1326.	Map a 300m buffer around any waterbody or creek line, incorporating the PCTs with which the species is associated.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	659, 771, 772, 882, 1078, 1232, 1234, 1254.	Map associated PCTs within Budderoo NP.
Lathamus discolor	Swift Parrot	-	Map the following high condition PCTs as habitat; 659, 694, 838, 1245 and 1326.
Litoria aurea	Green and Golden Bell Frog	659, 694, 771, 772, 882, 905, 920, 1126, 1232, 1234, 1245, 1300.	Map a 200m buffer around any waterbody or creek line, incorporating the PCTs with which the species is associated. Include minimum 50 m wide corridors of native and non-native vegetated areas linking the available water bodies where records are present.
Litoria littlejohni	Littlejohn's Tree Frog	662, 769, 882, 1078, 1082, 1156.	Buffer any waterbody or creek line by 300 m, incorporating the PCTS with which the species is associated.
Miniopterus orianae oceanensis	Large Bent-winged Bat	659, 662, 694, 767, 769, 771, 772, 838, 882, 905, 920, 1078, 1082, 1126, 1156, 1232, 1234, 1245, 1254, 1300, 1326.	Map restricted to associated PCTS directly associated with caves and cliffs.
Petauroides volans	Greater Glider	-	Map all vegetation polygons within the Mount Gibralter important population area mapping as long as they are connected to larger patches.
Petroica phoenicea	Flame Robin	838, 1078, 1082, 1234, 1254, 1326.	Map associated PCTs in high condition.

Scientific name	Common name	Associated PCTs within Kiama LGA	Method for Key habitat mapping
Pezoporus wallicus wallicus	Eastern Ground Parrot	720, 882, 1078, 1126	200m buffer around each known record.
Phascolarctos cinereus	Koala		Map the following high condition PCTs. High preferred use: 838, 1254 and 1326. High use: 1082.
Potorous tridactylus	Long-nosed Potoroo	659, 662, 767, 769, 771, 772, 882, 905, 906, 1078, 1082, 1156, 1234, 1245, 1300.	Map associated PCTs within Barren Grounds and Budderoo reserves.
Pteropus poliocephalus	Grey-headed Flying-fox		Map any camps in Kiama LGA as per https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf and match patches of vegetation to points on the website.
Sternula albifrons	Little Tern	920, 1126.	Map Associated PCTs which align with estuaries (any stream within 1 km of the coastline), and buffer by 200 m.

Appendix 3 Threatened Ecological Community Mapping

Table A 3 EPBC Act Listed Threatened Ecological Community Mapping methodology

EPBC TEC name	Associated PCTs within Kiama LGA	Method for TEC mapping
Illawarra and south coast lowland forest and woodland ecological community	PCT 838 PCT 1326	• PCT 838 Moderate AND patches ≥ 0.5 ha. • PCT 1326 Moderate AND patches ≥ 0.5 ha.
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion	PCT 906 PCT 1300	• PCT 906 Moderate and High AND patches ≥ 0.1 ha. • PCT 1300 Moderate and High AND patches ≥ 0.1 ha.
Subtropical and Temperate Coastal Saltmarsh	PCT 920 PCT 1126	• PCT 920 Low and High condition AND patches ≥ 0.1 ha OR multiple patches within 30 metres of each other within a mosaic that collectively are ≥ 0.1 ha. • PCT 1126 High condition AND patches ≥ 0.1 ha, OR multiple patches within 30 metres of each other within a mosaic that collectively are ≥ 0.1 ha.
Temperate Highland Peat Swamps on Sandstone	PCT 1078	• PCT 1078 Low and High condition.
Coastal Upland Swamps in the Sydney Basin Bioregion	PCT 1078	• PCT 1078 Low and High condition.
Robertson Rainforest in the Sydney Basin Bioregion	PCT 1128	• PCT 1128 Low and High condition AND patches ≥ 0.1 ha.
Coastal Swamp-Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	PCT 1232	• PCT 1232 Moderate and High condition AND patches ≥ 0.5 ha.
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	PCT 1254	• PCT 1254 Low condition AND patches ≥ 0.1 ha AND part of a remnant of native vegetation that is ≥ 5 ha. • PCT 1254 High condition AND patches ≥ 1 ha.
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	PCT 1254	• PCT 1254 Low condition AND patches ≥ 2 ha OR patches ≥ 0.5 ha that are part of a larger native vegetation remnant that is ≥ 2 ha. • PCT 1254 High condition AND patches ≥ 0.5 ha.
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	PCT 1326	• PCT 1326 Low and Moderate condition AND patches ≥ 0.5 ha.

Appendix 4 Areas of Outstanding Biodiversity Value

Areas of AOBV are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. The BC Act gives the Minister for the Environment the power to declare AOBV. The purpose of declaring AOBV is to identify, highlight and effectively manage sites that make significant contributions to the persistence of biodiversity in NSW Australia and globally. AOBV are a priority for private land conservation investment under the Biodiversity Conservation Investment Strategy.

There are four possible pathways by which an area must make a significant contribution to persistence of biodiversity in NSW to be eligible as an AOBV. These four are:

- Multiple species or at least one threatened species or ecological community.
- Irreplaceable biological distinctiveness.
- Ecological processes or ecological integrity.
- Outstanding ecological value for education or scientific research.

Bases on these four criteria, the Barren Grounds Nature Reserve and Budderoo National Park within Kiama LGA, are considered likely to meet the criteria for listing as an AOBV, outlined below.

Background information

The Barren Grounds Nature Reserve and Budderoo National Park and are located on plateau and escarpment country, roughly 30 kilometres southwest of Wollongong in the western portion of the Kiama LGA. The diverse landforms in the region have resulted in a variety of vegetation types ranging from the cool temperate rainforest, open forests, woodlands, heaths and sedgelands of the plateau to the tall open forests, warm temperate rainforest and subtropical rainforest of the slopes, gullies and ridges below the escarpment (NPWS 1998). A large number of threatened or regionally rare plants occur in these locations, including the Carrington Falls Grevillea *Grevillea rivularis* that is only known from Budderoo National Park.

Barren Grounds and Budderoo protect examples of the formerly extensive rainforests of the Illawarra area, which is the most southerly of the five major concentrations of rainforest vegetation in NSW. These are of particular significance given that much of these vegetation types have been cleared in the Illawarra and represent the southern limit for a significant number of subtropical flora species.

The varied and unusual habitats support a large number of native fauna including many threatened or uncommon species. The heathland of Barren Grounds and Budderoo is one of only four large areas of heath on the south coast and contains a number of threatened species restricted to these heathland environments. The plateau areas of Barren Grounds and Budderoo are important for conservation of the Ground Parrot *Pezoporus wallicus* and the Eastern Bristlebird *Dasyornis brachypterus* and the area is of regional significance for conservation of the Spotted-tailed Quoll *Dasyurus maculatus* and Long-nosed Potoroo *Potorous tridactylus* (NSW NPWS 1998).

Budderoo National Park was gazetted in 1986 and has an area of 5746 hectares. Barren Grounds Nature Reserve has an area of 2024 ha and was gazetted in 1956 from a crown reserve created in 1949, formally becoming Barren Grounds Nature Reserve in 1967 (Dolby 2016).

Budderoo and Barren Grounds was declared as an Important Birds Area (IBA) by Birdlife International in 2009 and a Key Biodiversity Area (KBA) in 2016 (BirdLife International 2022).

A number of aspects of the assessment and listing process for AOBVs under the BC Act are modelled on the IUCN KBA and IBA criteria as they provide an explicit, objective and widely understood framework that represents international best practice for identifying AOBVs (DPIE 2021).

Budderoo and Barren Grounds represent a mosaic of sandstone heath and eucalypt woodlands supporting large numbers of the endangered Eastern Bristlebird and smaller numbers of the restricted-range Rockwarbler and Pilotbird (BirdLife International 2021) and were found to meet the following IBA eligibility criteria:

- A1. Globally threatened species: The site is known or thought regularly to hold significant numbers of a globally threatened species.
- A2. Restricted-range species: The site is known or thought to hold a significant population of at least two range-restricted species.
- A3. Biome-restricted species: The site is known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome-realm.

IBAs have no legal implications however are recognised as sites that are internationally important for bird conservation and known to support key bird species. These areas, and their KBA successors, which encompass broader taxonomic groups, are areas recognised as high priority for conservation efforts and resources (Dutson et al. 2009).

Barren Grounds and Budderoo has been found to meet the following KBA criteria:

- A1. Threatened species
  - a) ≥ 0.5 % of the global population size AND ≥ 5 reproductive units of a Critically Endangered or Endangered species.
- B1. Individual geographically restricted species. Site regularly holds ≥ 10 % of the global population size AND ≥10 reproductive units of a species.

Recognition of Budderoo and Barren Grounds as an IBA and KBA, and gazettal as a National Park and Nature Reserve respectively, is a reflection of the importance of these sites for biodiversity conservation and their significance at both a State, National and global scale. It is therefore plausible that Budderoo and Barren Grounds would also be eligible for listing as an AOBV under the BC Act.

An assessment against the four possible pathways for known threatened species and ecological communities within Budderoo and Barren Grounds is provided below.

Clause 3.1(1) – the area is important at a State, National or global scale

Criteria	Response
Contains species endemic to NSW	Species occurring in the Barren Grounds Nature Reserve and Budderoo National Park that are endemic to NSW and therefore of global significance include: • Rockwarbler *Origma solitaria* • Carrington Falls Grevillea *Grevillea rivularis* • Carrington Falls Pomaderris *Pomaderris walshii*

Criteria	Response
Species or ecological communities with more than 66% of their population or distribution in NSW	The Barren Grounds Nature Reserve and Budderoo National Park contains the following species with more than 66 % of their population or distribution in NSW: • Eastern Bristlebird *Dasyornis brachypterus*. The total national population for this species is estimated at 2500 individuals, with the NSW population estimated at approximately 2100 individuals (OEH 2012). Approximately 90 % of the national population occurs in the two central populations within NSW, one within the Budderoo National Park and Barren Grounds Nature Reserve and the other at Jervis Bay. • Rockwarbler is a species that is endemic to NSW, thus the entire population resides in NSW. Data is still being gathered on the impacts that the 2019-20 bushfires had on this species, but it is considered a high priority for urgent management action having suffered at least a 30 % habitat reduction (Selwood et al. n.d.). • Carrington Falls Grevillea is a species with a highly restricted distribution that occurs only in NSW, and entirely within the Budderoo National Park. • Carrington Falls Pomaderris is a species with a highly restricted distribution that occurs only in NSW. It is represented by two small populations, one of which is located within Budderoo National Park. An additional species, the Pilotbird *Pycnoptilus floccosus* may also meet this criterion however, population data is lacking and it is difficult to be certain what percentage of the population resides in NSW. Pilotbird is endemic to south-east Australia. There are two recognised subspecies, Upland Pilotbird *P.f.floccosus* and Lowland Pilotbird *P.f.sandlandi*. Upland Pilotbird occurs over 600 m in the Brindabella Ranges in the Australian Capital Territory, and in the Snowy Mountains in NSW and north-east Victoria. Lowland Pilotbird occurs in forests from the Blue Mountains west of Newcastle, around the wetter forests of eastern Australia to Dandenong near Melbourne (DCCEEW 2022). Based on this distribution, it is possible that more than 66% of the population occurs in NSW.
Populations that, relative to other populations of the species outside NSW are distinctive in genetic composition, morphology, habitat biology, behaviour or their likely adaptive capacity under climate change	The population of the Eastern Bristlebird within Budderoo and Barren Grounds is morphologically distinctive from the Northern population and also considered the only stable population that is of a viable size, in contrast to the northern and southern populations of the species. The small size of the Eastern Bristlebird national population means that all extant populations are likely to be important to the long-term survival and recovery of the species. Translocation programs attempting to establish additional populations of the species within its original distribution have been able to move birds from this stronghold to seed new satellite populations. As such, the central populations are important in maintaining the genetic diversity of the species, enhancing its adaptive capacity by preventing genetic bottlenecks that are associated with small population sizes.
Occurrence of ecological communities that, relative to other occurrences of the ecological community are distinctive in taxonomic composition, habitat structure or biology or ecological function	The Illawarra Subtropical rainforest located within Barren Grounds Nature Reserve contains 51 % of the Illawarra region's native fern species. This diversity is due to the high altitude location and high rainfall received in this area, along with the variability in the sandstone and non-sandstone habitats (Mills 2021). Barren Grounds Nature Reserve and Budderoo National Park also supports nine of the 12 Filmy Ferns *Hymenophyllum* spp. occurring in the region; five of

Criteria	Response
	these are rare to very rare, some being rare in New South Wales. The Illawarra is the key area of occurrence in NSW for several species of Filmy Fern (Mills 2021).
Species listed as an MNES under the EPBC Act	The following species occur within the Barren Grounds Nature Reserve and Budderoo National Park that are listed under the EPBC Act, and therefore considered important at a national scale and a matter of National Environmental Significance: • Eastern Bristlebird *Dasyornis brachypterus* • Pilotbird *Pycnoptilus floccosus* • Gang-gang Cockatoo *Callocephalon fimbriatum* • Spotted-tailed Quoll *Dasyurus maculatus* • Greater Glider *Petauroides Volans* • Long-nosed Potoroo *Potorous tridactylus* • Giant Burrowing Frog *Heleioporus australiacus* Carrington Falls Grevillea *Grevillea rivularis*
Conclusion	The Budderoo National Park and Barren Grounds Nature Reserve are likely to be considered significant at the global, National and State scale as the area: • Contains populations of nationally significant species listed under the EPBC Act. • Contains populations of species endemic to NSW and therefore of global significance. • Contains species with greater than 66 % of their distribution occurring in NSW and that are therefore of State significance. • Contains occurrence of ecological communities that, relative to other occurrences of the ecological community are distinctive in taxonomic composition, habitat structure or biology or ecological function.

Clause 3.1(2) – persistence of multiple species or at least one threatened species or ecological community

Criteria	Response
Provides resilience during periods of environmental stress that is important for their continued existence	Thresholds for triggering this clause are: 1. That an area supports ≥10 % of the NSW, Australian or global population of one or more species during periods of environmental stress, or 2. That an area produces propagules, larvae or juveniles that maintain ≥10 % of the NSW, Australian or global population size of the species. There isn't enough evidence to support eligibility under this criterion.
Sustains adaptive capacity or evolutionary potential	This subclause deals with two overlapping components: 1. Areas with high levels of unique components of genetic or phenotypic diversity that will enable species to adapt to changing environments. 2. Areas that function as important ecological or evolutionary refugia able to sustain viable populations of species or viable ecological communities at risk due to climate change or other environmental

Criteria	Response
	stresses. Budderoo and Barren Grounds are likely to be eligible under this criterion due to the area sustaining the adaptive capacity and evolutionary potential of the threatened eastern Bristlebird. The national Eastern Bristlebird population has become severely fragmented, and the history and ecology of the species strongly suggests that as populations become small and fragmented, local extinctions quickly ensue (OEH 2012). Small, isolated populations with limited gene flow leads to inbreeding depression and reduced potential to adapt to environmental change (DPIE 2021). Populations that lack genetic variability are also prone to deleterious genetic consequences (OEH 2012). Remaining populations of the Eastern Bristlebird may also be occupying marginal habitats, thus rendering them increasingly susceptible to environmental changes such as those associated with climate change, including wildfire (OEH 2012). Eastern Bristlebirds are sedentary and have poor dispersal ability, making them less able to migrate to suitable habitats in the event of local changes to their environment. Stable populations, in areas of contiguous habitat such as the Budderoo and Barren Grounds areas, are therefore likely to be essential in maintaining genetic diversity, adaptive capacity and landscape resilience. The central population, divided into the Jervis Bay population and the Barren Grounds and Budderoo population, contains the largest pool of genetic variability for the species (OEH 2012). The small number of remaining populations means the species is highly susceptible to the emerging threats of climate change, particularly large scale wildfires. Emergency conservation interventions for the Eastern Bristlebird were required to be instigated during the Australian Black Summer Bushfires in 2019-20, when the entirety of the southern population in Victoria was in the path of an out-of-control fire front. Fifteen Eastern Bristlebird individuals were translocated from an area under threat to a captive institution to create a temporary ex situ insurance population (Selwood et al. n.d.). This demonstrates the vulnerability of extant populations of the Eastern Bristlebird to large-scale natural disasters that are likely to increase in frequency due to climate change, and the importance of preserving remaining populations to ensure the ongoing viability of the species. The population in Budderoo and Barren Grounds has also previously been used to source individuals into a satellite translocated population on the Woronora Plateau, thus acting as a refugia able to sustain a viable population of a species that is at risk due to climate change and other environmental stresses. The population is consistent with eligibility criteria that an area is eligible for listing if it supports'>10 % of the population size of one or more species during periods of environmental stress, for which historical evidence shows that it has served as a refugium in the past and for which there is evidence to suggest it would continue to do so in the foreseeable future at the species level.' Eastern Bristlebird has also been identified as a priority species requiring urgent management action in the next 12 months following impacts to its habitat as a result of the 2019-20 bushfires (DAWE 2020). This includes possible

Criteria	Response
	ex-situ actions whereby individuals would be salvaged into captive breeding or off-site holding facilities if ground surveys suggest the species or populations of the species are at high risk of extirpation.
Supports migration or dispersal of animals and plants	Unlikely to meet this criteria.
Is habitat critical for the survival of a threatened species	The small size of the Eastern Bristlebird national population means that all extant populations are likely to be important to the long-term survival and recovery of the species (OEH 2012). The Eastern Bristlebird distribution has contracted to three disjunct regions of south-eastern Australia: the northern population in southern Queensland / northern NSW, the central population in Jervis Bay and the Illawarra (including Barren Grounds and Budderoo) and the southern population on the NSW/Victorian border. Each of these geographically separate regional populations is comprised of one or more disjunct local populations, one of which is the population within Budderoo and Barren Grounds (OEH 2012).This population is estimated to support up to 1000 individuals, representing 40 % of the national population and 48 % of the NSW population. The key threats to the species have been identified as: • Habitat clearing • Fire • Predation • Habitat disturbance and degradation • Small sub-populations and genetic bottlenecks • Climate Change • Human disturbance The northern population has undergone a dramatic population decline and range contraction, and was estimated to include fewer than 40 individuals, a reduction of over 80 % of the population. The southern population was considered stable in the late 1990s, but vulnerable to local extinction because of its small size and the high likelihood of widespread catastrophic fire. Indeed, the 2019-20 bushfires resulted in an active fire front posing an immediate risk to the entire southern population of approximately 400 birds that resulted in an emergency conservation intervention to create an ex situ insurance population for the southern population (Selwood et al. n.d.). Over 50 % of the area occupied by the southern population of the Eastern Bristlebird was burnt during the fires, demonstrating the vulnerability of the species' remaining habitats to single, catastrophic events, and the critical nature of the remaining habitat and populations in ensuring the species' ongoing survival. The significant upland heath and swamp areas of Barren Grounds and Budderoo are also stronghold habitat for the Eastern Ground Parrot and the Long-nosed Potoroo and management for these species, in addition to the Eastern Bristlebird, has flow on effects for important populations of other threatened fauna as well including the Spotted-tailed Quoll, Eastern Pygmy-possum *Cercartetus nanus*, Littlejohn's treefrog *Litoria* littlejohni, Red-crowned

Criteria	Response
	Toadlet *Pseudophryne* australis, Giant Barred Frog *Mixophyes iteratus* and Powerful owl *Ninox strenua* (DPIE 2014). Budderoo also supports essential habitat for the survival of two threatened flora species, the Carrington Falls Grevillea and the Carrington Falls Pomaderris. Both species have highly restricted distributions, with the population of the Carrington Falls Grevillea occurring entirely within the Budderoo National Park in addition to approximately 30 % of the known population of the Carrington Falls Pomaderris.
Conclusion	The Budderoo and Barren Grounds area is important for the persistence of the threatened Eastern Bristlebird as it contains: • Habitat critical for the survival of threatened species. • Sustains adaptive capacity or evolutionary potential.

Clause 3.1(3) – persistence of irreplaceable biological distinctiveness

Criteria	Response
A very high structural, functional or compositional diversity	Unlikely to meet this criterion.
An essential site for the persistence of evolutionary or ecological distinctive species, endemic species or ecological communities	Unlikely to meet this criterion.
An essential site for the persistence of two or more threatened species or ecological communities in any combination	Budderoo and Barren Grounds contain essential habitat for the persistence of two or more threatened species as it contains ≥10 % of the State, National and global population and at least five reproductive units per species of: • Eastern Bristlebird • Carrington Falls Grevillea • Carrington Falls Pomaderris Both the Carrington Falls Grevillea and the Carrington Falls Pomaderris are highly range-restricted and therefore contribute significantly to the global persistence of biodiversity at the genetic, species and ecosystem levels.
Conclusion	Budderoo and Barren Grounds are likely to contribute to the persistence of irreplaceable biological distinctiveness as it is an essential site for the persistence of three threatened species.

Clause 3.1(4) – persistence of ecological processes or ecological integrity

Criteria	Response
It has ecological integrity i. **An outstanding, relatively intact example of a functioning ecosystem type** ii. **The most intact remaining site of a species occurrence that provides habitat requirements vital to the conservation of a species** **iii. The last known remaining site of a species occurrence**	The Carrington Falls Grevillea is confined to the Carrington Falls area on the upper Kangaroo River, within Budderoo National Park. This is the only known site for this endemic NSW species and therefore has State, National and global significance. Protection and conservation management of the area is necessary to prevent extinction and contribute to the global persistence of biodiversity.
A primary contributor to the continuation of essential ecological processes	Unlikely to meet this criterion.
Is an essential site for a significant proportion of the population of a species during one or more key life history stages or processes	To be eligible under this subclause an area would predictably hold one or more of the following: a) An aggregation representing ≥1% of the population size of a species over a season, and during one or more key stages of its life cycle. b) A number of mature individuals that ranks the site among the largest 10 aggregations known for the species. It is likely that Budderoo and Barren Grounds are eligible under this criterion given that it supports ≥1 % of the population of three threatened species: • Eastern Bristlebird (also in the top two largest aggregation of the species). • Carrington Falls Grevillea (the only aggregation of the species). • Carrington Falls Pomaderris (one of only two aggregations of the species).
Conclusion	Budderoo and Barren Grounds are likely to meet the criteria for contributing to the persistence of ecological processes or ecological integrity as it is the last known remaining site for the Carrington Falls Grevillea, and is an essential site for a significant proportion of three threatened species during one or more key life history stages or processs.

Clause 3.1(5) – persistence of outstanding ecological value for education or scientific research

Criteria	Response
Sites that make a significant contribution to the persistence of outstanding ecological value for education or scientific research	Barren Grounds may be eligible to trigger this clause due to its history as a scientific research facility and the long-term bird monitoring that has been undertaken within the reserve. Fauna reserves in NSW were first established under the *Fauna Protection Act of 1948*, which was replaced by the *National Parks and Wildlife Act 1967* which reclassified fauna reserves as nature reserves. The 1967 Act was superseded by the *National Parks and Wildlife Act 1974* (NPW Act). Under the NPW Act, nature reserves are areas of special scientific interest containing wildlife or natural environments or natural phenomena. Included in the definition under the act is that a nature reserve should be managed in accordance with the following principles: a) *the conservation of biodiversity, the maintenance of ecosystem function, the protection of geological and geomorphological features and natural phenomena,* b) *the conservation of places, objects, features and landscapes of cultural value,* c) *the promotion of public appreciation, enjoyment and understanding of the nature reserve's natural and cultural values,* d) *provision for appropriate research and monitoring.* Barren Grounds was originally gazetted for the purpose of preserving the habitat of the Ground Parrot and the Eastern Bristlebird (Baker et al. 1994). The site was formally managed under lease by the Royal Australasian Ornithologists Union (now part of Birdlife Australia) and had an operating bird observatory that consisted of a visitor information centre, wardens house and accommodation. It has been an important place for researchers and students alike, to record and learn about the biodiversity of the area (NPWS 2022). Bird tours are currently operated within the park, for the purpose of providing an educational experience to participants and the opportunity for public learning about the importance of the habitat for biodiversity and threatened species (NPWS 2022). As a result of its long history as a nature reserve, long-term ecological data for many bird species, particularly the Ground Parrot and the Eastern Bristlebird has been gathered within the reserve. This data provides an irreplaceable historic baseline, particularly for the Eastern Bristlebird, which has suffered significant habitat loss and population declines since monitoring began (Baker et al. 1994). The large amount of information collected in the reserve over time is valuable as base data for further research and in building understanding of the area's ecology. Together with Budderoo, these areas provide a range of environments and a reference area against the modified surrounding areas (NPWS 1998). The reserve has also been subject to a number of wildfires, with monitoring documenting the effect on biodiversity providing valuable insights into future threats and declines associated with increasing fire frequency and intensity in Australia. Barren Grounds is located in a popular tourist area within a day trip distance of Sydney and close proximity to Wollongong, making it a valuable location for

Criteria	Response
	educational use and the promotion of environment and conservation amongst the local community. The areas have interpretive walking tracks and suitable infrastructure for promoting education and raising awareness about the area's biodiversity values.
Conclusion	Barren Grounds has been gazetted as a nature reserve to ensure its longevity as a place of education, research and monitoring that protects important biodiversity. Its history as a bird observatory has ensured that long-term data exists for many bird species, including threatened species such as the Eastern Bristlebird and the Ground Parrot. Barren Grounds and Budderoo have been the subject of extensive long-term research and as such provide vital baseline data for future research, particularly in contrast to the cleared areas surrounding them. The location of Barren Grounds and Budderoo, within close proximity to urban centres of Sydney and Wollongong, makes them ideally suited for educational purposes, particularly given the existing infrastructure that supports public access and provides interpretive signage to facilitate community education.