APPENDIX H

Biodiversity Development Assessment Report

Biodiversity Development Assessment Report

Clarrie Hall Dam Raising Project

Prepared for Tweed Shire Council

September 2024

Biodiversity Development Assessment Report

Clarrie Hall Dam Raising Project

Tweed Shire Council

E230037 RP#6

September 2024

Version	Date	Prepared by	Reviewed by	Comments
V1	28 June 2024	Eugene Dodd Madeleine Hunt	Sarah Perry	Chapter 1-6 draft for KBR and Tweed Shire Council review
V2	4 July 2024	Eugene Dodd Madeleine Hunt	Hayden Beck	Full draft report for client review
V3	12 August 2024	Eugene Dodd Madeleine Hunt	Sarah Perry	Final draft for client review
V4	22 August 2024	Eugene Dodd Madeleine Hunt	Sarah Perry	Final report
V5	27 August 2024	Eugene Dodd Madeleine Hunt	Sarah Perry	Final report
V6	11 September 2024	Eugene Dodd Madeleine Hunt	Sarah Perry	Final report – updated BDAR declaration

Approved by

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11 September 2024

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BDAR declaration

Certification under clause 6.15 Biodiversity Conservation Act 2016 and conflict of interest

I certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the *Biodiversity Conservation Act 2016* (BC Act).

Signature:

Date: 11/09/2024

BAM Assessor Accreditation no: BAAS17009

This BDAR has been prepared to meet the requirements of BAM 2020.

Actual, perceived or potential conflict of interest

A potential conflict of interest of the client for this report with another EMM client was identified. This was disclosed to all parties and assurance was sought from these parties that this would not be perceived as a conflict of interest.

Details and experience of author/s and contributors

In this report an assessment of the biodiversity values and impacts associated with the proposal have been undertaken in accordance with the Biodiversity Assessment Method 2020 (DPIE, 2020). The Biodiversity Development Assessment Report (BDAR) has been prepared by accredited assessor Eugene Dodd (BAAS17009). A number of staff contributed to fieldwork and data collection as identified in the table below.

Contributors to the BDAR

Personnel	Qualifications	Experience	Tasks carried out
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Contributors to the BDAR

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Harris Crettenden	BA (Geography), BSc (Geology)	5 years	• GIS analyst

Executive Summary

ES1 Introduction

Clarrie Hall Dam (the Dam) is a 16,000 megalitre (ML) dam located 15 kilometres (km) southwest of Murwillumbah, on the New South Wales (NSW) far north coast. The Tweed River is the main water supply for the Tweed Shire, and during periods of reduced water levels, the Dam supplements the supply.

Tweed Shire Council proposes to raise the height of the Dam wall (the Proposal) by 8.5 metres (m) to a height of 70 m Australian Height Datum (AHD). The increase in wall height will increase the capacity of the Dam to 42,300 ML and ensure the ongoing supply of water to the Tweed Shire catchment until at least 2065.

The Proposal is declared State significant infrastructure (SSI) and requires the approval of the NSW Minister for Planning and Public Spaces under Part 5, Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

EMM Consulting Pty Limited (EMM) were commissioned by KBR Pty Ltd (KBR) on behalf of Tweed Shire Council to prepare this biodiversity development assessment report (BDAR) to accompany an environmental impact statement (EIS) for development consent.

This BDAR has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued for the Proposal on 31 May 2024. The revised SEARs include assessment requirements for Matters of National Environmental Significance (MNES) identified by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As such, this BDAR conforms with the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act), the Biodiversity Assessment Method (BAM) (DPIE, 2020) and the EPBC Act.

ES2 Landscape features

The Proposal is located within the Scenic Rim Interim Biogeographic Regionalisation of Australia (IBRA) subregion of the South Eastern Queensland IBRA bioregion, and within the Mount Warning Exhumed Slopes NSW Landscape.

The subject land is located within the Tweed catchment, the northern most coastal catchment of NSW covering an area of 1,326 square kilometres (km^2). The Dam is located on Doon Doon Creek and is surrounded by a large number of mostly small and ephemeral watercourses. The Dam is listed on the NSW Wetlands map (DCCEEW, 2010) as a reservoir, however does not contain any internationally important wetlands (RAMSAR), or Nationally Important Wetlands listed in the Directory of Important Wetlands (DIWA) (DCCEEW, 2019).

There are no karst, caves, crevices, cliffs, or other areas of geological significance, nor any Areas of Outstanding Biodiversity Value (AOBV) or soil hazards within the subject land.

The subject land is connected to surrounding vegetation, including the adjacent Mount Jerusalem National Park and nearby Nightcap National Park, Wollumbin National Park and Mebbin National Park. The southern portion of the subject land consists of mostly cleared pastures maintained for agriculture and recreational purposes.

The percentage of native vegetation cover within a 1,500 m buffer of the subject land is estimated to be approximately 67.2% of the total area, with the patch size calculated to be greater than 100 ha due to the contiguity of vegetation in the subject land with nearby vegetation within the region.

ES3 Native vegetation

Whilst most areas of existing native vegetation within the subject land are in moderate to good condition, the vegetation reflects past land uses and disturbances, including historical forestry activities, the 2019/2020 bushfires that impacted a portion of the western bank of the Dam, and the maintenance of pastures towards the southern end of the Dam.

Three plant community types (PCTs) occur within the subject land:

- PCT 827 - Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast
- PCT 1073 - Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
- PCT 1302 - White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion.

PCT 1302 within the subject land conforms to the final determinations for the Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions endangered ecological community (EEC) listed under the BC Act and the Lowland Rainforest of Subtropical Australia critically endangered ecological community (CEEC) listed under the EPBC Act.

Distinct areas to the south of the Dam are historical plantations of Dunn's White Gum (*Eucalyptus dunni*) and Hoop Pine (*Araucaria cunninghamii*). Plantations do not conform to any PCT and have been assessed in accordance with the streamlined assessment module for planted native vegetation (DPIE, 2020).

ES4 Threatened species

Substantial survey effort has been undertaken across the subject land to date, with targeted flora and fauna surveys occurring between 2016 and 2024.

Targeted surveys within the subject land confirmed the presence of the following species credit species:

- Pouched Frog (*Assa darlingtoni*)
- White-eared Monarch (*Carterornis leucotis*)
- Corokia (*Corokia whiteana*)
- Thorny Pea (*Desmodium acanthocladum*)
- Basket Fern (*Drynaria rigidula*)
- Rusty Rose Walnut (*Endiandra hayesii*)
- Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*)
- Narrow leaf Finger Fern (*Grammitis stenophylla*)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*)
- Red Boppel Nut (*Hicksbeachia pinnatifolia*)
- Fine-leaved Tuckeroo (*Lepiderema pulchella*)

- Rough-shelled Bush Nut (*Macadamia tetraphylla*)
- Slender Marsdenia (*Marsdenia longiloba*)
- Albert's Lyrebird (*Menura alberti*)
- Giant Barred Frog (*Mixophyes iteratus*)
- Southern Myotis (*Myotis macropus*)
- Koala (*Phascolarctos cinereus*)
- Loveridge's Frog (*Philoria loveridgei*)
- Scrub Turpentine (*Rhodamnia rubescens*)
- Native Guava (*Rhodomyrtus psidioides*)
- Red Lilly Pilly (*Syzygium hodgkinsoniae*)
- Durobby (*Szygium moorei*)
- Mitchell's Rainforest Snail (*Thersites mitchellae*)
- Masked Owl (*Tyto novaehollandiae*)
- Sooty Owl (*Tyto tenebricosa*).

The presence of the Southern Pink Underwing Moth (*Phyllodes imperialis smithersi*) has been assumed at two locations within the subject land due to the presence of the larval food plant *Carronia multisepalea*.

ES5 Groundwater dependent ecosystems

Impacts to potential groundwater dependent ecosystems (GDEs) resulting from changes to groundwater levels and/or groundwater quality are unlikely to occur as a result of the Proposal. This is due to an absence of potential GDEs (both terrestrial and aquatic), likely owing to the regional high rainfall volumes, the significant depth of groundwater (17 metres below ground level), and the predominance of groundwater occurrence in fracture networks. There may be some opportunistic use of groundwater from the shallow alluvium by riparian vegetation upstream of the existing Dam, however these areas are recharged by river flow and rainfall, and thus not solely groundwater dependent.

ES6 Avoidance, minimisation and mitigation

An assessment was completed to identify and analyse suitable water supply augmentation options for the Tweed District. A range of technical studies were commissioned by Tweed Shire Council from 2007-2010 to identify suitable water supply augmentation opportunities, including:

- raise Clarrie Hall Dam
- build a small Byrrill Creek Dam
- build a small Byrrill Creek Dam then raise it
- build a large Byrrill Creek Dam

- link to SEQ Water
- link to Gold Coast City Council.

It was resolved by Tweed Shire Council to adopt Clarrie Hall Dam raising (the Proposal) as the preferred option due to longer water security, cheaper costs, greater certainty of impacts and preferences of previous studies.

Avoidance and minimisation have been used in the design of the Proposal. Measures have been taken to avoid biodiversity values within the construction footprint by locating most of the infrastructure at the northern end of the Dam, which is considerably disturbed by past construction activities due to existing hardscaping for the current Dam infrastructure and will require less vegetation clearing to facilitate the new and upgraded infrastructure.

Due to the nature of the Proposal, avoidance of the biodiversity values within the operational footprint of the subject land is limited. As the Proposal sets out to increase the water supply yield of the current Dam, inundation of the surrounding land is required to achieve a greater full supply level (FSL). As such, impacts to vegetation and fauna habitats located between the current and proposed future FSL cannot be avoided. Consideration was given, however, to minimising these impacts by adjusting the Dam height and FSL. Hydrological models were examined to investigate whether an inflection point exists in the level of biodiversity impacts commensurate to the inundation level of the Dam. Levels greater than the proposed 70 m AHD were investigated, and the results indicated a linear increase in impacts to the vegetation commensurate to the height of inundation. Furthermore, the topography above a FSL of 70 m AHD presented design limitations. In response to this, the FSL has been retained at 70 m AHD and therefore avoids greater impact.

The Proposal also proposes to raise the Dam wall in one stage to minimise the duration of disturbance to biodiversity values retained in the adjacent vegetation.

ES7 Impact assessment

The Proposal will result in the following direct impacts:

- loss of 246 ha of native vegetation and threatened species habitat, consisting of:
    - 221.67 ha of PCT 827 - Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast (inclusive of 68.64 of pasture and sedgeland of poor condition which does not require offsetting)
    - 2.67 ha of PCT 1073 - Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
    - 8.77 ha of PCT 1302 - White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion, which conforms to:
        - Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC listed under the BC Act
        - Lowland Rainforest of Subtropical Australia Critically CEEC listed under the EPBC Act
    - 13.00 ha of planted native vegetation assessed under the streamlined assessment modules which does not require offsetting.

Thirteen species that are candidate entities for serious and irreversible impacts (SAII) were recorded within the subject land. An impact is to be regarded as SAII if it is likely to contribute significantly to the risk of a threatened species (including endangered populations) or an ecological community becoming extinct in accordance with Clause 6.7 of the NSW Biodiversity Conservation Regulation 2017 (BC Regulation). Of the thirteen SAII candidate entities recorded within the subject land, nine required further detailed assessment to assist the decision maker in determining the likelihood of an SAII occurring due to the Proposal.

Under the BAM (DPIE, 2020), potential uncertain and prescribed impacts must be assessed as per clause 6.1 of the BC Regulation, which includes impacts to waterbodies, water quality and hydrological processes. Indirect impacts of the Proposal are considered relatively low with mitigation actions recommended to address management of the uncertain and prescribed impacts.

ES8 Biodiversity offsets

To compensate for the residual impacts of the Proposal, 4,994 ecosystem credits are required to compensate for impacts on native PCTs and ecosystem credit species. In addition to ecosystem credits, the Proposal also requires a total of 35,133 species credits. Tweed Shire Council owns significant areas of land adjacent to the Dam and in the broader area that will be used to compensate for these residual impacts through the implementation of a biodiversity offset strategy.

Several areas of vegetation were recorded which do not require offsets. This includes planted native vegetation assessed under the relevant streamlined assessment module, and areas of pasture and derived sedgeland which are below the offset threshold under the BAM (DPIE, 2020) due to poor condition. Additional areas which do not require offsetting include existing cleared access tracks and watercourses, both of which occur within the subject land.

ES9 Assessment of other relevant biodiversity legislation

This BDAR assesses impacts to species listed under the EPBC Act. Significant impact assessments conclude that the Proposal has potential to cause significant impacts to:

- Lowland Rainforest of Subtropical Australia
- Pouched Frog (*Assa darlingtoni*)
- South-eastern Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*)
- Corokia (*Corokia whiteana*)
- Thorny Pea (*Desmodium acanthocladum*)
- Slender Marsdenia (*Marsdenia longiloba*)
- Giant Barred Frog (*Mixophyes iteratus*)
- Koala (*Phascolarctos cinereus*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Scrub Turpentine (*Rhodamnia rubescens*)
- Native Guava (*Rhodomyrtus psidioides*)
- Red Lilly Pilly (*Syzygium hodgkinsoniae*)

- Mitchell's Rainforest Snail (*Thersites mitchellae*).

The Proposal will be assessed in accordance with the bilateral agreement made between the NSW and the Commonwealth under Section 45 of the EPBC Act.

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1 Introduction

1.1 Background

Clarrie Hall Dam (the Dam) is a 16,000 megalitre (ML) dam located 15 kilometres (km) southwest of Murwillumbah, on the New South Wales (NSW) far north coast (Figure 1.1). The Dam is situated on Doon Doon Creek, a tributary of the Tweed River. The Tweed River is the main water supply for the Tweed Shire, and during periods of reduced water levels, the Dam supplements the supply.

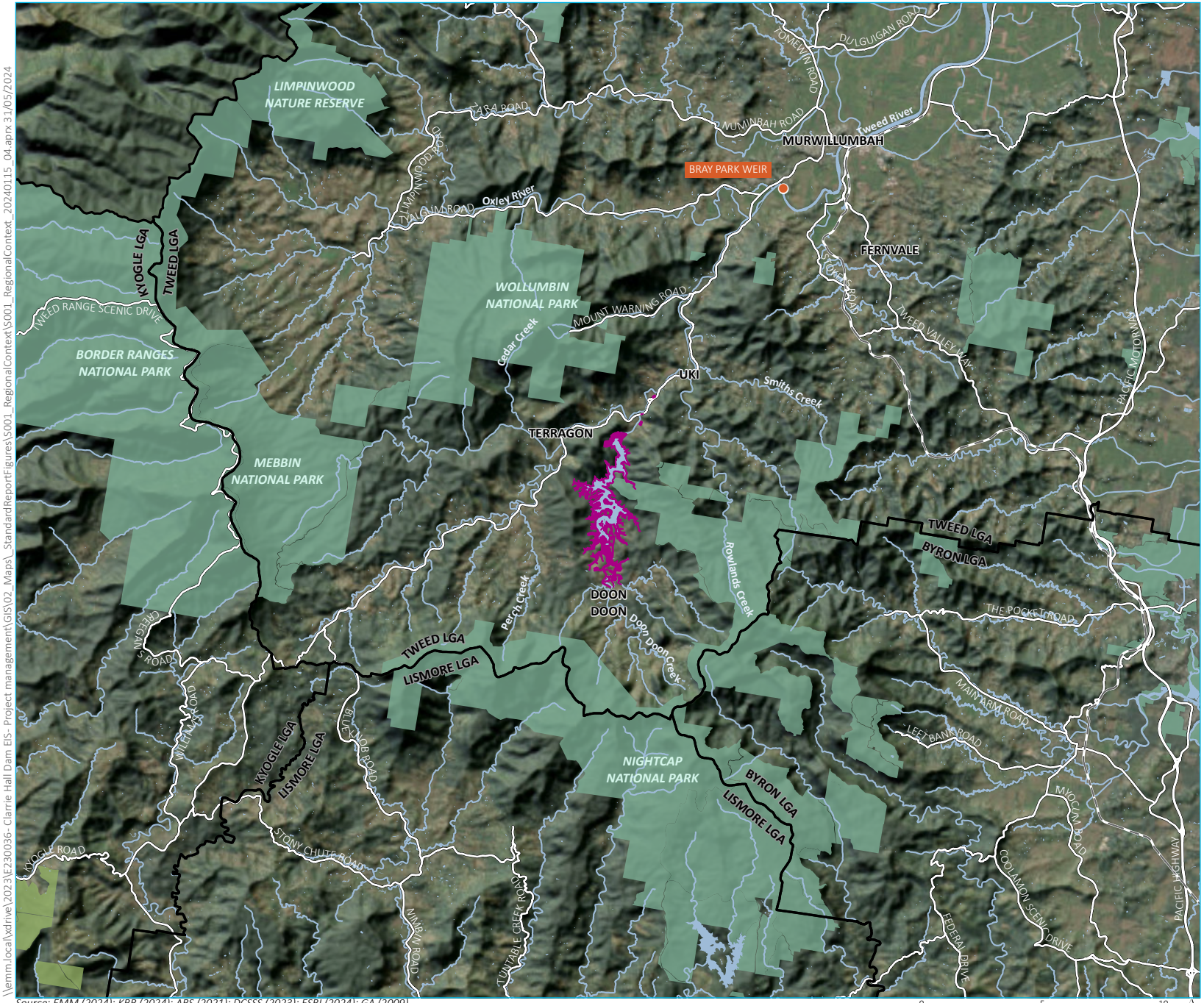
The Dam was constructed in 1983 by the NSW Department of Public Works and has since been owned and operated by the Tweed Shire Council for the primary purpose of providing a drinking water supply to the Tweed Shire region. Population predictions for the far north coast indicating substantial growth to the region, coupled with uncertainties surrounding climate change impacts to water supply yield, have necessitated the augmentation of the Dam to ensure ongoing water security.

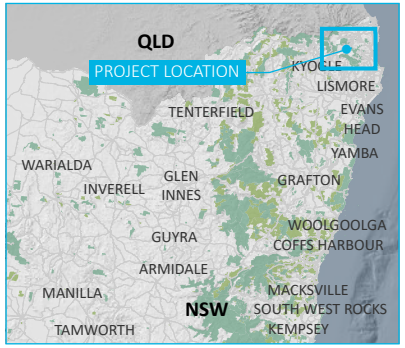
1.2 The Proposal

Tweed Shire Council proposes to raise the height of the Dam wall (the Proposal) by 8.5 metres (m) to a height of 70 m Australian Height Datum (AHD). The increase in wall height will increase the capacity of the Dam to 42,300 ML and ensure the ongoing supply of water to the Tweed Shire catchment until at least 2065.

EMM Consulting Pty Limited (EMM) were commissioned by KBR Pty Ltd (KBR) on behalf of Tweed Shire Council to prepare this biodiversity development assessment report (BDAR) to accompany an environmental impact statement (EIS) for development consent under Part 5, Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Proposal is classified as State significant infrastructure (SSI) and requires the approval of the NSW Minister for Planning and Public Spaces.

In addition to requiring approval from the NSW Minister for Planning and Public Spaces, the Proposal has been deemed a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and requires approval from the Commonwealth Minister for the Environment and Water. The Minister for Environment and Water has accredited the NSW planning process for the assessment of the Proposal under the bilateral agreement. Therefore, a single EIS has been prepared to address the requirements set out by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) and the Commonwealth DCCEEW.





KEY

- Subject land
- Bray Park weir

Existing environment

- Rail line
- Major road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest
- Local government area

INSET KEY

- Major road
- NPWS reserve
- State forest

Source: EMM (2024); KBR (2024); ABS (2021); DCSSS (2023); ESRI (2024); GA (2009)

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Regional context

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 1.1

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1.3 Proposal description

Tweed Shire Council is seeking consent to raise the Dam wall by 8.5 m to a height of 70 m AHD, thereby increasing the capacity of the Dam from 16,000 ML to approximately 42,300 ML.

The Proposal footprint, herein referred to as the subject land, covers an area of 252.27 hectares (ha) surrounding the existing Dam, and consists of the construction and operational footprints for the Proposal.

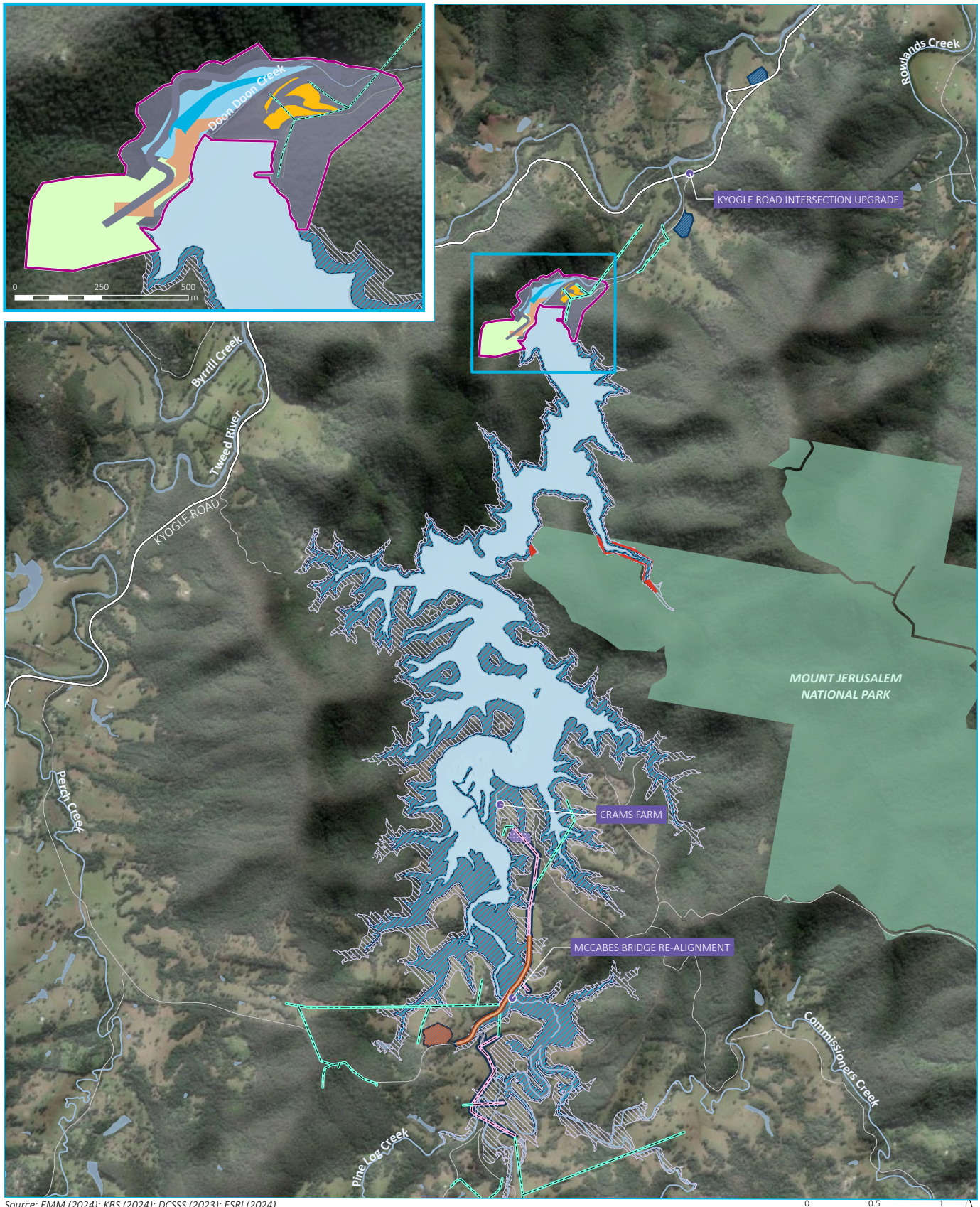
The construction footprint will consist of:

- raising the Dam wall by 8.5 m
- a new spillway channel constructed higher in the left abutment with a flip bucket at the downstream end
- re-establishment of the quarry used to construct the existing Dam for the purpose of sourcing rock material to raise the Dam wall
- construction of associated haul roads to transport quarry material for the proposed raising of the Dam wall
- establishment of a construction area for plant, equipment, storage, material handling and offices
- establishment of stockpile sites associated with construction
- construction of work compounds and site offices
- establishment of materials storage and handling facilities
- construction of workers accommodation
- construction of a concrete batching plant
- realignment of Clarrie Hall Dam Road higher in the right abutment
- raising of the existing intake tower and bridge
- decommissioning of existing recreational facilities at the Dam wall area
- construction of new dam operational facilities including signage, car parking, security fences, lighting, monitoring equipment and a boat ramp
- removing or reconstructing impacted recreational infrastructure and facilities at Crams Farm
- upgrading the Kyogle Road and Clarrie Hall Dam Road intersection
- replacing McCabes Bridge and realignment of Commissioners Creek Road
- relocating existing power and telecommunications utilities
- construction of new recreation facilities including an amenities block, public shelters, viewing areas, interpretation signage, paths, car parks, and landscaping.

The operational footprint will consist of:

- the area that will be subject to inundation, inclusive of the full supply level (FSL) and consideration of flooding events above FSL
- downstream areas likely to experience hydrological changes due to alterations to water flow as a result of the Proposal.

An overview of the Proposal layout is provided in Figure 1.2.



Source: EMM (2024); KBS (2024); DCSSS (2023); ESRI (2024)

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GDA2020 MGA Zone 56

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KEY

- Construction disturbance footprint
- Subject land
- Existing inundation
- Inundation to FSL (61.5- 70 m AHD)
- FSL to PMF (70-77 m AHD)
- Infrastructure upgrade location

Proposed layout

- Haul Road- option 1
- Haul Road- option 2
- Construction compound
- Potential McCabes Bridge stockpile and construction office complex
- Quarry impact area
- Proposed spillway
- Spillway impact area
- Concrete batching plant or workers accommodation
- Potential McCabes Bridge stockpile and construction office
- Land pending transfer from Mt Jersalem National Park to Tweed Shire Council
- McCabes Bridge proposed realignment

Transmission line

- Existing
- New

Existing environment

- Major road
- Minor road
- Named watercourse
- NPWS reserve

The Proposal

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 1.2

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1.4 Survey history

Tweed Shire Council has been working to assess the impacts of the proposed increase in the capacity of the Dam for eight years. Over this period, the subject land and adjacent lands have undergone significant survey effort, with biodiversity field studies for the Proposal commencing in 2016 and continuing until 2024. Over the lifetime of the Proposal, multiple organisations have been engaged to conduct biodiversity field surveys surrounding the Dam.

Preliminary surveys were undertaken by Tweed Shire Council in 2016 and 2017. Tweed Shire Council conducted habitat assessments as well as targeted flora and fauna surveys to provide a baseline understanding of the biodiversity values across the subject land and surrounding area. These surveys were conducted in accordance with the Biodiversity Assessment Method (BAM) 2017.

In 2020, Eco Logical Australia Pty Ltd (ELA) was engaged by Tweed Shire Council to progress the biodiversity assessment in accordance with the newly released BAM 2020 (DPIE, 2020). Additional flora and fauna surveys and habitat assessments were undertaken across the subject land. These surveys were conducted to supplement the existing survey effort, particularly for the taxa for which BAM specific survey guidelines were released.

EMM was subsequently engaged in 2023 to conduct a gap analysis, complete any residual survey effort required to satisfy the requirements of the BAM (DPIE, 2020), and prepare this BDAR to accompany the EIS for the Proposal.

Since inception of the Proposal, multiple technical reports have been prepared by the different organisations. A comprehensive list of these documents, which have been utilised throughout the preparation of this BDAR, is provided in Section 1.9.2.

Whilst different organisations have conducted the work for the Proposal, the survey effort is described cumulatively. Detailed survey methods and effort are provided in Section 4 and Section 5.

1.4.1 Survey data currency

In accordance with the BAM Operation Manual – Stage 1 (OEH, 2018), survey data collected more than five years prior to EIS submission can be used to inform the biodiversity assessment, however, cannot be applied to the assessment in place of more recent targeted survey data.

Due to the long history of survey for the Proposal, a substantial amount of the fauna survey effort was conducted more than five years prior to the time of EIS submission. Approval has been granted by the North East Branch of the Biodiversity and Conservation Division (BCD) to utilise all fauna survey data collected since the commencement of targeted survey in 2016, in a BDAR that is to be submitted prior to 30 September 2024. This approval was granted as the vegetation surrounding the Dam has remained relatively unchanged since the commencement of ecological surveys and continues to provide comparable habitat values for native fauna. Where environmental conditions had changed, additional survey was conducted. This is true of a portion of vegetation in the northwest of the subject land that was subject to a low-intensity bushfire in 2019.

An overview of the key consultation undertaken with BCD is provided in Section 1.7.4, with records of the consultation provided in Appendix B.

1.5 Key terminology

The key terminology and Proposal elements referred to in this BDAR are described in Table 1.1.

Table 1.1 Key terminology and Proposal elements

Proposal element	Definition
The Proposal	The Clarrie Hall Dam Raising Proposal. This includes all the construction and operational footprint elements listed in Section 1.3.
Subject land	The proposed disturbance footprint within which all development activities will be contained. This includes the construction and operational footprints subject to direct impacts.
Study area	The area of land that was surveyed for ecological values. This includes the subject land and additional adjacent and downstream areas to provide context for impacts.
Assessment area	The subject land and the area of land within a 1,500 m buffer zone of the subject land. The assessment area was selected in accordance with the BAM (DPIE, 2020).
Locality	The subject land and the area of land within a 10 km buffer zone of the subject land. This is the area used in database searches.

1.6 Existing environment

1.6.1 Location and land use

The Dam is located in Doon Doon, approximately 15 km southwest of Murwillumbah and 4 km southwest of Uki in the Tweed Shire Local Government Area (LGA). The subject land consists of private and public land holdings, predominantly owned by Tweed Shire Council.

The northern extent of the Dam containing the Dam wall and spillway area is accessible via Clarrie Hall Dam Road, which runs south from Kyogle Road. Access to the southern portion of the Dam is via Crams Farm, a recreational area operated by the Tweed Shire Council, located north from Commissioners Creek Road.

Within the subject land, the land is zoned as SP2 (Infrastructure; Water Supply System), C1 (National Parks and Nature Reserves), RU2 (Rural Landscape) and DM (Deferred Matter).

1.6.2 Vegetation

Within the subject land, the predominant vegetation is wet sclerophyll forest with smaller patches of lowland rainforest. Historically, the vegetation surrounding the Dam has been subject to vegetation clearance and forestry activities, with the more recent fires in 2019 subjecting the vegetation in the northwest extent of the Dam to more recent disturbance. At the southern end of the Dam, much of the vegetation is highly modified with areas of maintained pasture, patches of regrowth forest as well as the presence of historical tree plantations.

The vegetation within the subject land occurs in a mostly moderate to good condition, with patches of cleared and modified vegetation. Owing to past and ongoing disturbance, exotic species are found throughout the subject land, inclusive of several High Threat Weed (HTW) species. Exotic and HTW species are particularly prevalent towards the southern end of the subject land, where paddocks are maintained for recreational and agricultural purposes, and as such, are subject to continuing and frequent disturbance. Areas of the subject land that adjoin current and historical private land holdings also exhibit a higher cover and composition of exotic and HTW species, likely as the result of plantings and garden escapees.

1.6.3 Mount Jerusalem National Park

A small portion of the subject land (1.91 ha) along the Eastern bank of the Dam was part of Mount Jerusalem National Park. On 25 November 2020, this portion of the National Park was revoked under the *National Parks and Wildlife Act 1974* (NPW Act) pending transfer of ownership to Tweed Shire Council. The revoked land is undifferentiated from surrounding vegetation, containing both wet sclerophyll forest and patches of lowland rainforest, consistent with the adjacent areas of the subject land.

1.6.4 Connectivity

The subject land is highly connected to surrounding vegetation, with the region consisting of large remnants of intact and mostly contiguous vegetation interspersed with farmland and cleared pastures.

The northern, western and Eastern banks of the Dam are substantially vegetated with habitat connectivity to surrounding national parks. Mount Jerusalem National Park located to the east of the subject land extends south to Nightcap National Park, Goonengerry National Park and Whian Whian State Conservation Area. Vegetation along the western bank of the Dam connects to the Wollumbin National Park and the Mebbin National Park extending westward into the Border Ranges.

The southern portion of the subject land consists of mostly cleared pastures within Crams Farm maintained by the Tweed Shire Council for recreational purposes and surrounding private landholdings utilised for agricultural practices. There is limited vegetation connectivity in these areas.

Regional fauna corridors occur within and adjacent to the subject land, extending in both the north-south and east-west directions. These fauna corridors connect the broader vegetation surrounding the Dam, facilitating movement within and between areas of habitat (DECCW NSW, 2010).

1.7 Assessment requirements

1.7.1 Consideration of BOS triggers

The Proposal was declared SSI under Part 5, Division 5.2 of the EP&A Act. For SSI, assessment in accordance with the Biodiversity Offset Scheme (BOS) and BAM (DPIE, 2020) is mandatory. Accordingly, this BDAR has been prepared.

1.7.2 Secretary's Environment Assessment Requirements

The NSW Planning Secretary's Environment Assessment Requirements (SEARs) were initially issued for the Proposal on 23 April 2019.

The Proposal was also declared a controlled action under the Commonwealth EPBC Act. The SEARs were updated in response to this declaration and the Proposal will be assessed under the bilateral agreement between NSW and the Commonwealth, with impacts to Matters of National Environmental Significance (MNES) assessed via the BAM (DPIE, 2020) and documented in the BDAR.

Revised SEARs were issued on 22 December 2023 due to the expiration of the initial SEARs. These SEARs were subsequently reissued on 31 May 2024 to incorporate updates to the requirements for sensitive and protected lands, as well as account for administrative edits. The reissued SEARs include assessment requirements for MNES identified by the Australian Government under the EPBC Act.

Table 1.2 lists the relevant terrestrial biodiversity assessment requirements for the Proposal and describes where these are addressed in the BDAR.

Table 1.2 Secretary's Environmental Assessment Requirements

Requirement	Section addressed
Biodiversity impacts related to the proposal are to be assessed in accordance with section 7.9 of the Biodiversity Conservation Act 2016, the Biodiversity Assessment Method 2020 (BAM) and documented in a Biodiversity Development Assessment Report (BDAR).	This BDAR
The BDAR must include information in the form detailed in the Biodiversity Conservation Act 2016 (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method, unless OEH and the Department determine that the proposed development is not likely to have any significant impacts on biodiversity values.	This BDAR
Assessment of terrestrial, riparian and floodplain biodiversity and ecology that addresses all direct, indirect, and prescribed impacts of the Proposal on flora and fauna, threatened species, populations, and communities for the construction and operation of the asset, including flow dependent and groundwater dependent ecosystems.	Section 3 – Landscape features Section 4 – Native vegetation Section 5 – Threatened species Section 6 – Groundwater dependent ecosystems Section 7 – Impact assessment
The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM.	Section 7 – Impact assessment
The BDAR must include details of the measures proposed to address the offset obligation as follows: • the total number and classes of biodiversity credits required to be retired for the proposal • the number and classes of like-for-like biodiversity credits proposed to be retired • the number and classes of biodiversity credits proposed to be retired in accordance with the variation rules • any proposal to fund a biodiversity conservation action • any proposal to make a payment to the Biodiversity Conservation Fund • If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	Section 8.3 – Biodiversity offset strategy
The BDAR must be submitted with all spatial data associated with the survey and assessment as per Appendix 10 of the BAM.	All spatial data will be submitted to the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment (DPE) via the Biodiversity Offsets and Agreement Management System upon submission of this BDAR.
The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.	Details of the accredited assessor are provided at the beginning of this BDAR.
The EIS should map habitat (actual and predicted) for the Giant Barred Frog (*Mixophyes iterates*) and calculate the area of this habitat to be directly or indirectly impacted. Other threatened frogs known, or with potential to occur, or with potential to be indirectly impacted, should also be discussed and assessed in terms of the spatial extent of actual or potential habitat in the locality and whether these areas will be indirectly impacted. Species that should also be considered for inclusion in this list are Pouched Frog (*Assa darlingtonia*), Loveridge's Frog (*Philoria loveridgei*) and Fleay's Barred Frog (*Mixophyes fleayi*).	Section 5.4.6 – Species polygons Section 7.2.2 – Waterbodies, water quality and hydrological processes Section 9.1.2 – Impact assessments for MNES
An assessment of the numbers of Red Lilly Pilly (*Syzygium hodgkinsoniae*) likely to be directly or indirectly impacted by the proposal should also be included in the EIS. The spatial extent of this habitat should be provided as a map and a calculated area.	Section 5.4.6 – Species polygons Section 9.1.2 – Impact assessments for MNES

Requirement	Section addressed
The Lowland Rainforest Threatened Ecological Community should be clearly mapped and the extent of likely direct and indirect impacts from the proposal should be assessed.	Figure 4.1 – Plant community types Section 9.1.2 – Impact assessments for MNES

1.7.3 Agency engagement

Additional engagement has been undertaken with relevant government agencies and stakeholders. Advice received from these agencies applicable to the terrestrial biodiversity assessment have been included in Table 1.3, with a description of where these are addressed in the BDAR.

Table 1.3 Agency advice

Comment	Section addressed
BCD of the Department of Planning and Environment (DPE) – 8 December 2023	
The EIS must assess biodiversity impacts related to the Proposal in accordance with Section 7.9 of the Biodiversity Conservation Act 2017 using the Biodiversity Assessment Method (BAM) and must document this assessment in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the Biodiversity Conservation Act 2016 (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and the BAM, unless the Biodiversity and Conservation Division and Planning and Assessment Group determine that the Proposal is not likely to have any significant impacts on biodiversity values.	This BDAR
The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM.	Section 7 – Impact assessment
The BDAR must include details of the measures proposed to address the offset obligation as follows: • The total number and classes of biodiversity credits required to be retired for the project; • The number and classes of like-for-like biodiversity credits proposed to be retired; • The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; • Any proposal to fund a biodiversity conservation action; • Any proposal to conduct ecological rehabilitation (if a mining project); • Any proposal to make a payment to the Biodiversity Conservation Fund. If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	Section 8.3 – Biodiversity offset strategy
The BDAR must be submitted with all spatial data associated with the survey and assessment as per Appendix 11 of the BAM.	All spatial data will be submitted to the BCD via the Biodiversity Offsets and Agreement Management System upon submission of this BDAR.
The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.	BDAR certification and the details of the accredited person have been provided at the beginning of this BDAR.

Comment	Section addressed
The EIS must: a) include an assessment of the nature, extent and duration of any potential direct or indirect impacts on Mount Jerusalem National Park, addressing all matters outlined in Developments adjacent to National Parks and Wildlife Service lands: guidelines for consent and planning authorities (DPIE-NPWS 2020); b) identify measures proposed to prevent, control, abate, minimise and manage any potential direct and indirect impacts on the park[s], including an evaluation of the effectiveness and reliability of the proposed measures; c) quantify any residual impacts to the park; d) be prepared in consultation with NPWS, with initial contact with NPWS Tweed Byron Area at npws.tweedbyron@environment.nsw.gov.au; and e) consider impacts within the expanded inundation zone, noting that any survey or investigation within the land that has been revoked from Mount Jerusalem National Park is subject to NPWS consent.	Section 7.1.3iig – Indirect impacts to Mount Jerusalem National Park Section 7.3 – Mitigation and management
In the case of the revocation of lands reserved under the NPW Act or transfer of lands vested in the Minister for the Environment under the NPW Act, the EIS must provide: f) A full account of the biological and cultural values of the land subject to the revocation/transfer; g) An evaluation of the contribution of the impacted land to the biological and cultural values of the neighbouring park; and h) details of any compensation proposal, consistent with the NPWS Revocation, recategorisation and road adjustment policy, including an assessment of the biological and cultural values of the proposed offset.	Section 3.3.1 – Mount Jerusalem National Park revoked land Section 4.4.6 – Vegetation within the Mount Jerusalem National Park revoked land Section 5.4.5 – Threatened species recorded within the Mount Jerusalem National Park revoked land
Department of Primary Industries (DPI) – 29 November 2023	
A biosecurity (pests, weeds, and disease) risk assessment outlining the likely plant, animal, and disease risks in relation to surrounding agricultural land uses should be prepared as part of the EIS. The assessment should include details of how the proposal will deal with the identified biosecurity risks as well as contingency plans for any failures. Details of monitoring and mitigation measures for weed and pest management during construction and operation should also be included. The relevant weed or pest animals for a region are addressed in the regional plans or strategies issued by NSW Local Lands Services.	Section 7 – Impact assessment Section 9.2 – Biosecurity Act 2015

1.7.4 Consultation with BCD and the BOS Helpdesk

Consultation with the North East Branch of the BCD and the BOS Helpdesk was conducted throughout the planning of surveys and the preparation of this BDAR. Key consultation items discussed and the outcomes achieved are summarised in Table 1.4. Records of the correspondence are provided in Appendix B.

Table 1.4 Consultation with BCD and the BOS Helpdesk

Item number	Consultation topic and date
1	On 3 September 2020, ELA consulted with BCD on the adequacy of the survey methods and effort undertaken to date, and to gain support for the survey methods proposed to complete the residual survey effort. BCD provided advice on 29 September 2020.
2	On 24 June 2021, Tweed Shire Council consulted with BCD to clarify the assessment of species habitats on the subject land and the potential use of local data and scientific literature to support the assessments. Additionally, Tweed Shire Council requested clarification on defining and assessing populations and ranges for Serious and Irreversible Impact (SAII) assessments and significant impact assessments. BCD provided advice via a meeting conducted with Tweed Shire Council on 1 July 2021, and by email on 14 July 2021.

Item number	Consultation topic and date
3	On 6 July 2021, Tweed Shire Council consulted with BCD on reporting requirements regarding offsetting the impacts of a development. BCD provided advice to Tweed Shire Council via a meeting on 9 July 2021.
4	On 20 July 2021, Tweed Shire Council requested clarification from BCD regarding the five-year expiry of survey data under the BAM (DPIE, 2020). BCD provided a response on 10 August 2021. On 7 March 2022, Tweed Shire Council consulted with BCD regarding obtaining an extension of time on the survey data collected in the 2016-2017 period past the five-year data expiry. On 29 April 2022, BCD responded with a request for information (RFI).
5	On 5 August 2021, Tweed Shire Council and ELA met with BCD to discuss the development of species polygons for species that were not detected during targeted surveys. Tweed Shire Council followed up with BCD on 25 August 2021. BCD provided a response on 3 September 2021. Clarification was subsequently sought on 6 October 2021, regarding the application of species polygons upon the transition from the BAM 2017 to the BAM 2020 (DPIE, 2020). BCD provided advice on 21 October 2021.
6	On 2 August 2022, Tweed Shire Council followed up with BCD regarding obtaining an extension of time on survey data by providing the additional information requested in the RFI outlined above (item number 4). BCD provided advice on 19 September 2022 in which they would accept the use of survey data from the 2016-2017 period in a BDAR that is to be submitted in 2022.
7	On 19 September 2022, Tweed Shire Council followed up with BCD with supplementary information regarding the status of the biodiversity assessment and the progression of the BDAR. Tweed Shire Council requested clarification on the timeframe in which the extension of time for survey data was valid. BCD provided advice on 24 October 2022, stating that fauna survey data collected in the 2016-2017 period will be accepted for inclusion in the BDAR up until a submission date of 19 September 2023.
8	On 30 June 2023, Tweed Shire Council requested feedback from BCD regarding a gap analysis prepared by EMM of the biodiversity assessment completed for the Proposal up to the date of consultation. On 26 July 2023, BCD provided comprehensive recommendations to Tweed Shire Council on the matters discussed in the gap analysis.
9	On 10 July 2023, Tweed Shire Council consulted with BCD regarding obtaining an additional extension of time on the survey data collected in the 2016-2017 period, to be used in a BDAR to be submitted in 2024. In the same letter in which BCD provided recommendations for the gap analysis on 26 July 2023 above, BCD also provided advice on the survey data timeframe. BCD supported the inclusion of species survey data collected in 2016/2017, into a BDAR that is to be submitted no later than 30 September 2024.
10	On 22 August 2023, EMM provided a response to the gap analysis recommendations received from BCD on 26 July 2023 (item number 8).
11	On 1 November 2023, Tweed Shire Council consulted with BCD to obtain advice regarding the survey effort required to undertake camera trapping for arboreal and terrestrial mammals. BCD provided advice on 10 November 2023.

1.8 Purpose of this report

The specific objectives of this BDAR are to:

- describe the biodiversity values of the subject land
- assess the likelihood that threatened species and communities (threatened biodiversity) listed under the relevant NSW *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) could occur in the subject land
- document the strategies implemented to avoid and/or minimise impacts of the Proposal on threatened biodiversity
- assess residual threatened biodiversity impacts, after avoidance and minimisation strategies have been implemented
- provide environmental safeguards to mitigate threatened biodiversity impacts during construction and operation
- describe the biodiversity offsets required under the BAM (DPIE, 2020) and EPBC Act for residual threatened biodiversity impacts.

1.9 Information sources

1.9.1 Publications and databases

In order to provide context for the Proposal, information about flora and fauna species, populations, communities and habitats from the locality (within 10 km of the subject land) was obtained from the following databases:

- NSW BioNet (DCCEEW, 2024b) for:
  - Atlas of NSW Wildlife for threatened species records
  - threatened species profiles
  - threatened biodiversity data collection
  - Vegetation Classification database for information on plant community types (PCTs).
- Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) (DCCEEW, 2023c) likely to occur within the study area.
- Commonwealth DCCEEW Species Profile and Threats Database (DCCEEW, 2022).
- National Flying-fox monitoring viewer (DCCEEW, 2022c).
- New South Wales Flora Online (PlantNET) (Royal Botanic Gardens and Domain Trust, n.d.).
- Fisheries Spatial Data Portal (DPI, n.d.) for:
  - Key Fish Habitat (KFH) mapping
  - threatened species distributions

- NSW Weedwise (DPI, n.d.).

1.9.2 Other relevant reports

This biodiversity assessment has been prepared with reference to other technical reports that were prepared as part of the Proposal. The other relevant reports referenced in this BDAR include:

- Flora and Fauna Survey and Preliminary Impact Assessment for the Proposed Raising of Clarrie Hall Dam, Tweed Shire, NSW (Tweed Shire Council, 2017)
- Clarrie Hall Dam Raising State Significant Infrastructure Applications – Preliminary Environmental Assessment, July 2018 (Tweed Shire Council, 2018a)
- Further Investigation to the Occupancy of *Mixophyes iteratus* within the Doon Doon Catchment (Tweed Shire Council, 2018b)
- Targeted Survey and Revised Impact Assessment for Red Lilly Pilly and Lowland Rainforest, Doon Doon Catchment – Addendum to the Flora and Fauna Assessment for the Proposed Raising of Clarrie Hall Dam (Tweed Shire Council, 2018c)
- Clarrie Hall Dam Raising Preliminary Draft Biodiversity Development Assessment Report, Unpublished Report (ELA, 2021).

1.9.3 Spatial data

Spatial data encompassing the subject land was obtained from KBR and Tweed Shire Council. Base map data was obtained from Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from the Department of Primary Industries (DPI).

The following spatial datasets were utilised during the development of this report:

- Mitchell Landscapes Version V3.1 (DCCEEW, 2016)
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DCCEEW, 2024)
- NSW State Vegetation Type Map (DCCEEW 2022)
- Directory of Important Wetlands (DCCEEW, 2019)
- NSW Wetlands (DCCEEW, 2010).

Other relevant datasets were accessed via the following viewers:

- eSPADE (DPIE, 2024)
- NSW SEED (NSW Government, 2024).

Mapping undertaken during the field assessment was conducted using a hand-held GPS unit, mobile tablet computers running Collector for ArcGIS™ and Survey123 for ArcGIS™ and aerial photo interpretation. Accuracy is subject to accuracy of GPS devices, generally ± 5 m. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.5).

Spatial data relevant to this BDAR has been provided to the NSW DCCEEW following lodgement of the BDAR.

2 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 Commonwealth

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as Matters of National Environmental Significance (MNES) under the EPBC Act. These are:

- world heritage properties
- places listed on the National Heritage Register
- Ramsar wetlands of international significance
- threatened flora and fauna species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment and Water. An action that may potentially have a significant impact on a MNES is to be referred to DCCEEW for determination as to whether or not it is a controlled action. If deemed a controlled action the Proposal is assessed under the EPBC Act and a decision made as to whether or not to grant approval.

On 27 February 2019, the Assistant Secretary of the Assessment and Waste Branch (decision-maker) determined the Clarrie Hall Dam Raising Proposal to be a controlled action under Section 75 and Section 87 of the EPBC Act (EPBC: 2018-8339). The relevant controlling provision for the controlled action is listed threatened species and communities (Section 18 & Section 18A).

The Proposal will be assessed under Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Proposal will be assessed under the bilateral agreement between the Commonwealth and NSW.

2.2 State

2.2.1 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is the legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the *Biodiversity Conservation Regulation 2017* (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the BAM (DPIE, 2020) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities (TECs) and their habitats and determine offset requirements. For SSI Proposals, use of the BAM is mandatory, unless a BDAR waiver is granted.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land in order to:

- identify the biodiversity values on land subject to proposed development area
- determine the impacts of a proposed development, following all measures to avoid, minimise and mitigate impacts
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

This biodiversity assessment has been undertaken in accordance with the requirements of the BAM (DPIE, 2020).

2.2.2 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning, Industry and Environment (DPIE).

The EP&A Act provides the overarching structure for planning in NSW; however, is supported by other statutory environmental planning instruments (EPIs) including State Environmental Planning Policies (SEPPs). EPIs relevant to the natural environment are outlined further below.

i State Environmental Planning Policies (Planning Systems) 2021

The State Environmental Planning Policies (Planning Systems) 2021 (Planning Systems SEPP) is the relevant SEPP which declares the Proposal as SSI.

In accordance with the Planning Systems SEPP, development is declared, pursuant to Section 5.12(2) of the Act, to be SSI for the purpose of the Act if:

- the development on the land concerned is, by operation of a SEPP, permissible without development consent under Part 4 of the Act, and
- the development is specified in Schedule 3.

Schedule 3 declares water storage facilities to be SSI if:

- development for the purpose of water storage or water treatment facilities (not including desalination plants) carried out by or on behalf of a public authority that has an estimated development cost of more than $30 million.

The Proposal is declared as SSI in accordance with the above classification and requires the approval of the NSW Minister for Planning and Public Spaces under the provisions of Part 5, Division 5.2 of the EP&A Act.

ii State Environment Planning Policy (Biodiversity and Conservation) 2021

Chapter 3 (Koala Habitat Protection 2020) and Chapter 4 (Koala Habitat Protection 2021) of the State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP) together aim to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline.

In nine metropolitan Sydney LGA (Blue Mountains, Campbelltown, Hawkesbury, Ku Ring Gai, Liverpool, Northern Beaches, Hornsby, Wollondilly) and the Central Coast LGA, Koala Habitat Protection 2021 applies to all land use zones. Outside of these areas, Koala Habitat Protection 2020 continues to apply to all land zoned RU1, RU2, and RU3.

As the Proposal is SSI, approval is not required from Council, and consideration of Koala Habitat Protection 2020 and 2021 is not triggered. Nonetheless, consideration has been given to the potential occurrence and impacts upon the Koala (*Phascolarctos cinereus*) within this BDAR (Sections 5, 6 and 7).

2.3 Fisheries Management Act 1994

The NSW *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates, and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in section 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve key fish habitat (KFH). These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in Section 3.2.1 and 3.2.2 of the Policy and Guidelines for Fish Conservation and Management (DPI, 2013).

The impact of the Proposal on threatened aquatic species, populations, communities, habitats and KFH have been assessed separately and are considered in the Aquatic Ecology Assessment (Austral Research and Consulting, 2024) undertaken for the Proposal.

2.4 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* (Biosecurity Act) has superseded the *Noxious Weeds Act 1993*, which has now been repealed.

The primary objective of the Biosecurity Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about
- applies to all land within NSW and all waters within the limits of the State
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The Biosecurity Act places restrictions on the trade and movement of plants that harm the NSW environment, economy, and community. Those plants are called 'priority weeds' and the restrictions on trade and movement apply to all parts of the plant including cuts, cultivars, and hybrids. Priority weeds are any weeds identified in a local strategic plan that has been approved by the Minister under Division 2 of Part 4 of *the Local Land Services Act 2013*.

The North Coast Regional Strategic Weed Management Plan 2023-2027 (LLS, 2022) supports regional implementation of the Biosecurity Act by articulating the shared responsibility principle of the Biosecurity Act and communicating weed control obligations. The plan identifies weed management requirements in the region, weed risk assessment and prioritisation, actions, and measures proposed to increase the chance of success and for continuous improvement.

The provisions of the Biosecurity Act are discussed further in Section 9.1.2iiic.

2.5 Water Management Act 2000

Division 6 of the *Water Management Act 2000* (WM Act) requires consideration of controlled activities (i.e. activities within 40 m of riparian land) and aquifer interference activities. In accordance with Section 5.23 of the EP&A Act, approved SSI projects do not require a water use approval under Section 89, a water management work approval under Section 90 nor an activity approval (unless interfering with an aquifer) under Section 91 of the WM Act. As the Proposal has been deemed as SSI, consideration of the WM Act is not required.

The NSW Aquifer Interference Policy (NOW, 2012) requires an assessment of potential impacts on groundwater users, including groundwater dependent ecosystems. Impacts on groundwater dependent ecosystems are considered in Section 6 of this report.

3 Landscape features

The identification of landscape features was undertaken within a 1,500 m buffer of the subject land (herein referred to as the assessment area) in accordance with Section 3.1 of the BAM (DPIE, 2020). The following sections provide detail on the landscape features identified within the assessment area.

3.1 Bioregions and landscapes

The assessment area and subject land are within the Scenic Rim Interim Biogeographic Regionalisation of Australia (IBRA) region. Within the assessment area, two IBRA subregions occur, consisting of:

- Burringbar-Conondale Ranges
- Scenic Rim.

The assessment area is located over two NSW (Mitchell) Landscapes, consisting of:

- Mount Warning Exhumed Slopes
- Mount Warning Plugs.

The subject land is located wholly within the Scenic Rim IBRA subregion and the Mount Warning Exhumed Slopes NSW Landscape (refer to Figure 3.1 and Figure 3.2).

3.2 Rivers, streams, estuaries and wetlands

3.2.1 Rivers and streams

The assessment area is located within the Tweed catchment, the northern most coastal catchment of NSW covering an area of 1,326 square kilometres (km^2). The water supply within the Tweed catchment is sourced from the Tweed River, with the Dam providing additional water supply during drier periods with reduced water levels in the river. The Dam is located on Doon Doon Creek and is surrounded by a large number of watercourses varying in Strahler stream order and flow regime.

Rivers, creeks and minor watercourses within the assessment area are described in Table 3.1 and shown on Figure 3.1 and Figure 3.2.

Table 3.1 Watercourses in the assessment area

Strahler stream order	Assessment area	Probable flow regime
Sixth order	Tweed River	Perennial
	2 unnamed streams	Perennial
Fifth order	Doon Doon Creek (within subject land)	Perennial
	Byrrill Creek	Perennial
	Rowlands Creek	Perennial

Strahler stream order	Assessment area	Probable flow regime
Fourth order	Griers Creek	Intermittent
	Pine Log Creek (within subject land)	Intermittent
	Commissioners Creek (within subject land)	Intermittent
	2 unnamed streams (1 within subject land)	Intermittent
Third order	Doughboy Creek	Intermittent
	12 unnamed streams (2 within subject land)	Intermittent
Second order	81 unnamed streams (11 within subject land)	Ephemeral
First order	359 unnamed streams (78 within subject land)	Ephemeral

3.2.2 Estuaries and wetlands

The Dam is listed on the NSW Wetlands map (DCCEEW, 2010) as a reservoir. A reservoir is classified as a man-made waterbody and is usually created by the construction of a wall or levee (Kingsford, et al., 2004).

The assessment area does not contain any internationally important wetlands (Ramsar), or Nationally Important Wetlands listed in the Directory of Important Wetlands (DIWA) (DCCEEW, 2019).

Stotts Island Nature Reserve, a Nationally Important Wetland classified in the DIWA, is located approximately 33 km downstream of the subject land within the alluvial flood plain system of the Tweed River (DCCEEW, 2019), and is the nearest wetland to the subject land listed on this directory.

3.3 Connectivity

3.3.1 Mount Jerusalem National Park revoked land

Along the Eastern bank of the Dam, 1.91 ha of Mount Jerusalem National Park has been revoked under the National Parks and Wildlife Act 1974 (NPW Act) pending transfer of ownership to Tweed Shire Council. These areas that have been revoked are no longer considered as National Park.

The revoked land is undifferentiated from surrounding vegetation, containing both wet sclerophyll forest and patches of lowland rainforest, consistent with the adjacent areas of the subject land in both condition of vegetation and species composition. The subject land will maintain connectivity to the broader Mount Jerusalem National Park.

3.3.2 Broader environment

Significant proportions of the assessment area contain intact native vegetation, with connectivity to the broader landscape, inclusive of surrounding National Parks. Interspersed within the intact vegetation are cleared areas utilised for agriculture, plantation timber production and recreational purposes.

The northern, western and Eastern banks of the Dam are substantially vegetated with habitat connectivity to surrounding national parks. Mount Jerusalem National Park located to the east of the subject land extends south to Nightcap National Park, Goonengerry National Park and Whian Whian State Conservation Area. Vegetation along the western bank of the Dam connects to the Wollumbin National Park and the Mebbin National Park extending westward into the Border Ranges.

The southern portion of the subject land consists of mostly cleared pastures within Crams Farm maintained by the Tweed Shire Council for recreational purposes and surrounding private landholdings utilising the land for agricultural practices.

Regional fauna corridors occur within and adjacent to the subject land, extending in both the north-south and east-west directions. These fauna corridors connect the broader vegetation surrounding the Dam, facilitating movement within and between areas of habitat (DECCW NSW, 2010). Fauna corridors provide means for dispersal and genetic exchange between populations of fauna species.

3.4 Areas of geological significance and soil hazard

There are no karst, caves, crevices, cliffs, or other areas of geological significance within the subject land or assessment area. The Dam wall at the northern extent of the Dam provides an artificial rock face constructed of aggregate materials. Inspection of the wall identified an absence of caves or crevices that would provide high quality sheltering habitat for threatened species.

No soil hazard features are identified within the assessment area or subject land.

3.5 Areas of outstanding biodiversity value

No Areas of Outstanding Biodiversity Value (AOBV) occur within the assessment area.

Stotts Island Nature Reserve located approximately 33 km downstream of the subject land, is declared by the NSW Minister for the Environment as critical habitat for the Mitchell's Rainforest Snail (*Thersites mitchellae*) on the register for AOBV (DCCEEW, 2024). Mitchell's Rainforest Snail is listed as Endangered under the BC Act and Critically Endangered under the EPBC Act, and has been deemed as an entity at risk of SAII.

3.6 Assessment of site context

3.6.1 Native vegetation cover

Vegetation mapping undertaken across the subject land in conjunction with analysis of regional vegetation mapping datasets (NSW State Vegetation Type Map, (DCCEEW, 2022)for areas outside of the subject land, identified a range of vegetation communities. The extent of native vegetation cover based on these data sources is displayed on Figure 3.1, with the percentage of native vegetation cover outlined in Table 3.2.

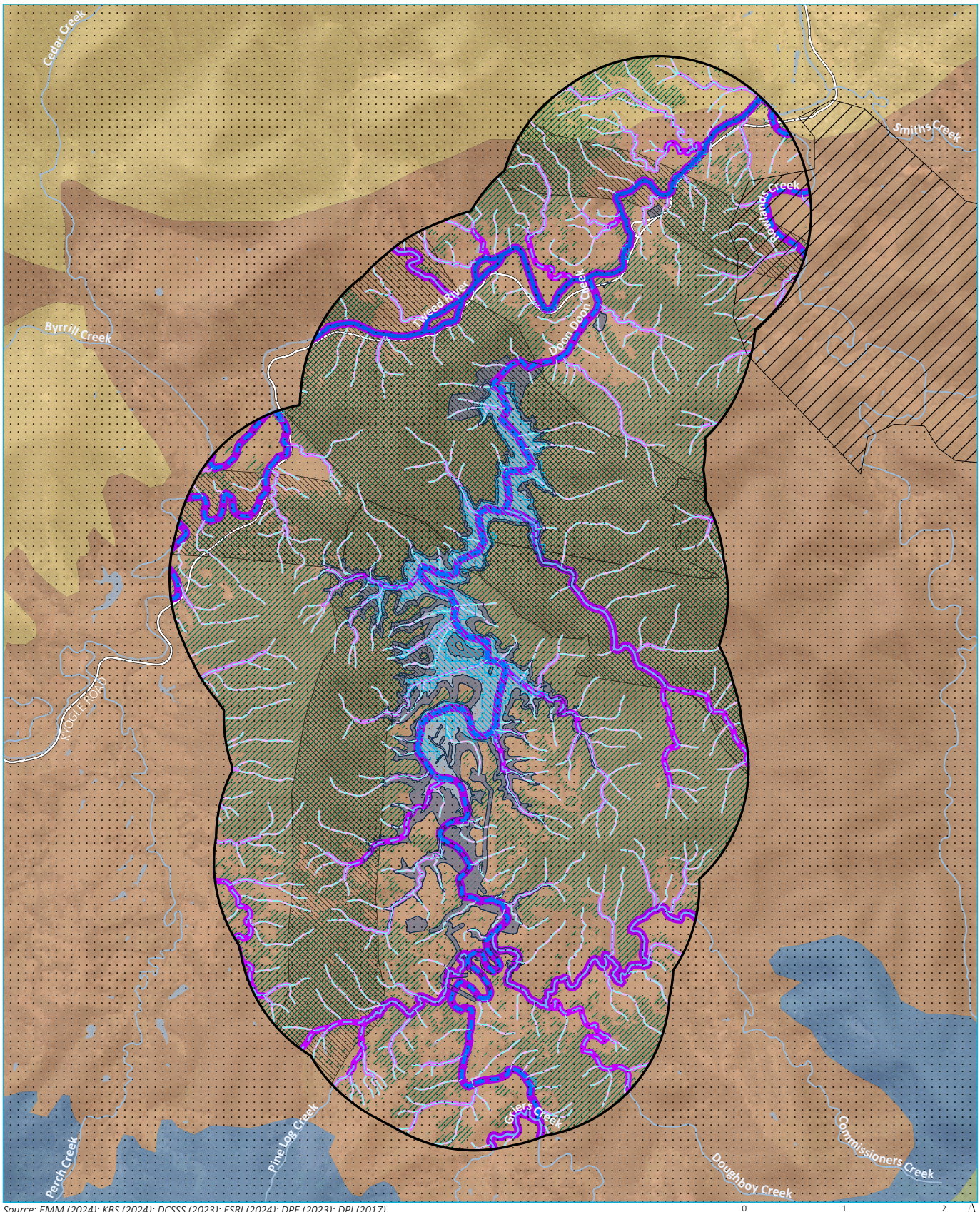
To calculate the native vegetation cover and patch size, a 1,500 m buffer area was applied to the subject land in accordance with Section 3.2 of the BAM (DPIE, 2020). All patches of native vegetation within this buffer area were mapped and a total percentage cover of native vegetation was calculated.

Table 3.2 Percentage native vegetation cover

Assessment area (ha)	Native vegetation in the assessment area (ha)	Approximate percentage of native vegetation in assessment area
4,971.6	3,339.1	67.2%

3.6.2 Patch size

The patch size was assumed to be >100 ha for every vegetation zone as a conservative approach to threatened species assessment. This enabled the BAM Calculator (BAM-C) to filter in the maximum number of candidate species for consideration. Candidate threatened species are assessed in Section 5.



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Source: EMM (2024); KBS (2024); DCSSS (2023); ESRI (2024); DPE (2023); DPI (2017)
NOTE: Entire extent of the project is within Tweed LGA

KEY

- Subject land
- 1500 m project buffer
- Wildlife corridor
- NSW wetland
- Native vegetation

IBRA region | South Eastern QLD

- Sub-region | Burringbar-Conondale Ranges
- Sub-region | Scenic Rim

NSW landscape

- Lamington Volcanic Slopes
- Mount Warning Exhumed Slopes
- Mount Warning Plugs
- Nimbin Ridges

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order

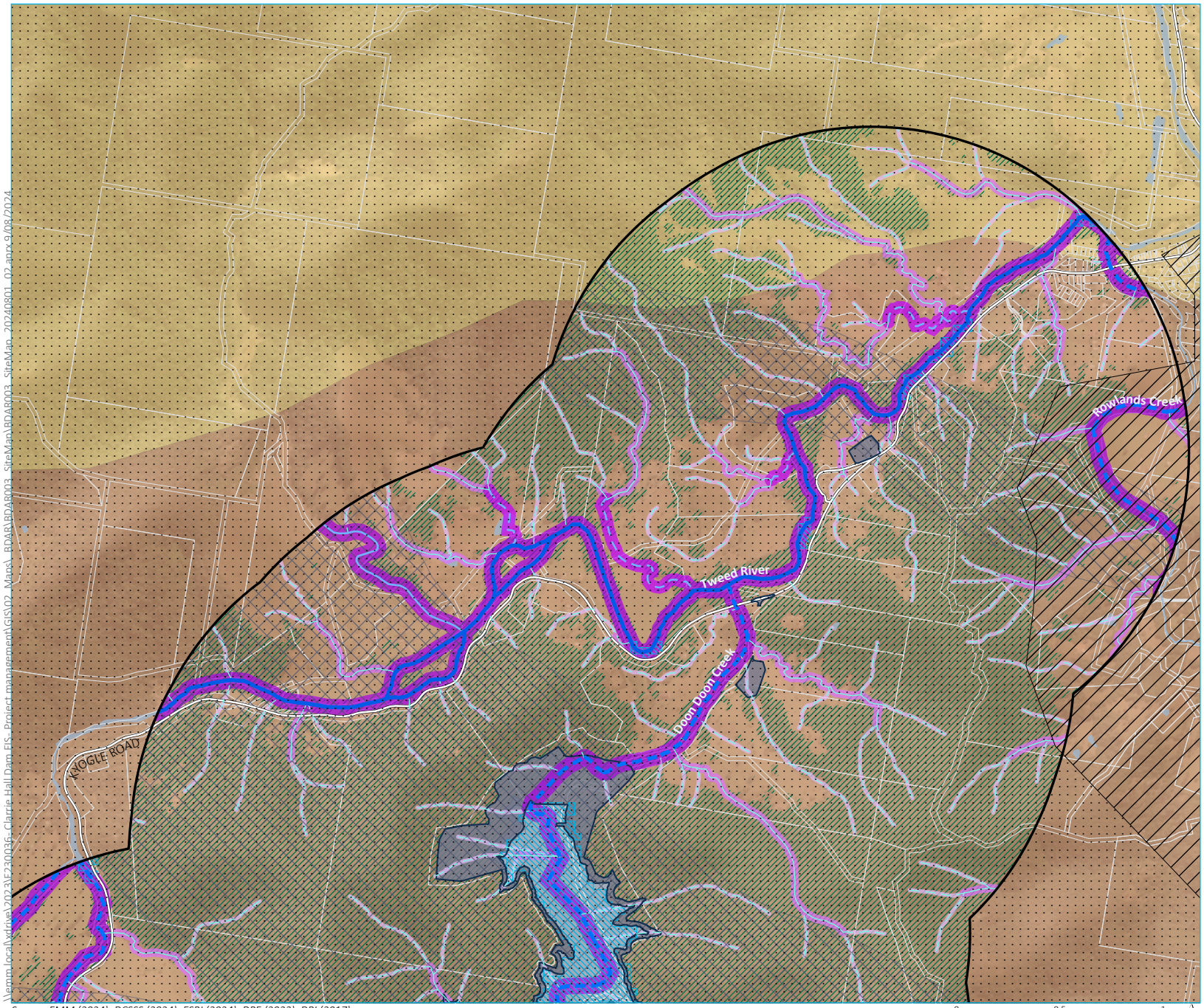
Existing environment

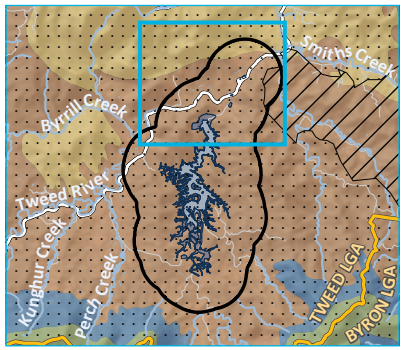
- Major road
- Named watercourse

Location map

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 3.1

EMM
creating opportunities





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NSW landscape

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- Mount Warning Plugs

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order

Existing environment

- Major road
- Named watercourse
- Waterbody
- Cadastral boundary
- Local Government Area

Source: EMM (2024); DCSSS (2024); ESRI (2024); DPE (2023); DPI (2017)

0 0.5 1 km

GDA2020 MGA Zone 56

N

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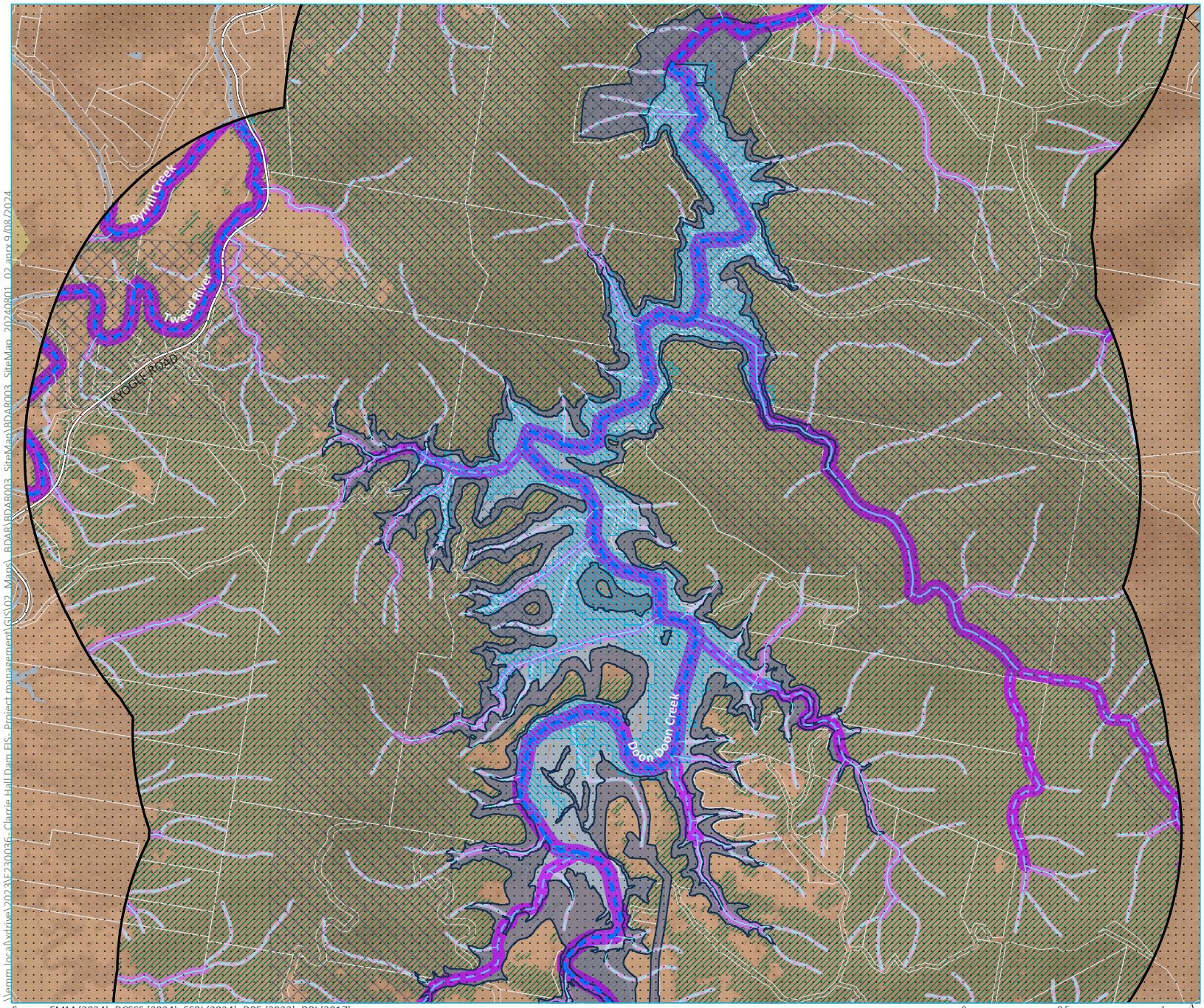
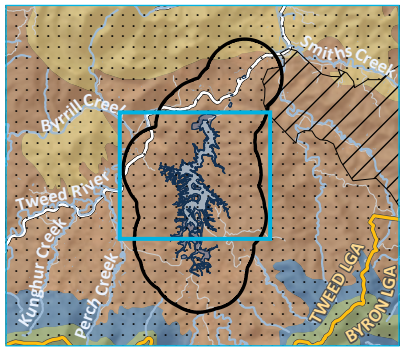
Site map
Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 3.2

EMM
creating opportunities





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- Sub-region | Scenic Rim

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- Mount Warning Plugs

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order

Existing environment

- Major road
- Named watercourse
- Waterbody
- Cadastral boundary
- Local Government Area

Source: EMM (2024); DCSSS (2024); ESRI (2024); DPE (2023); DPI (2017)

0 0.5 1 km

GDA2020 MGA Zone 56

N

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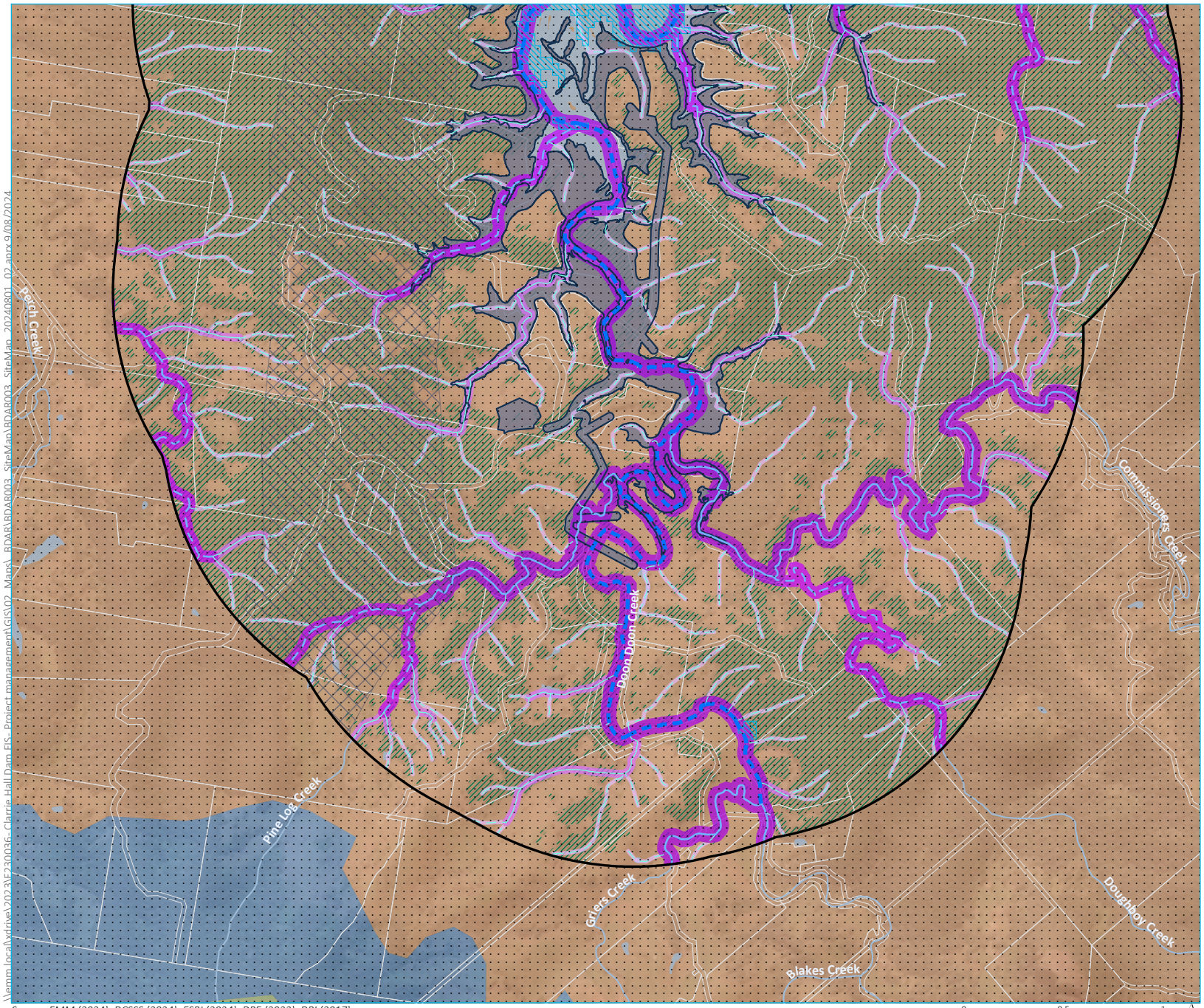
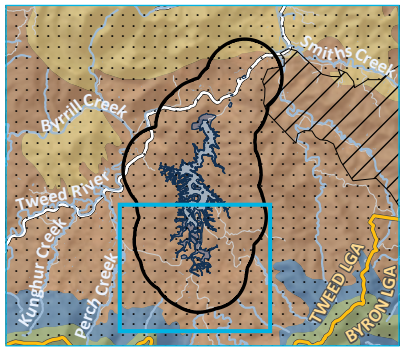
Site map
Page 2 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 3.2

EMM
creating opportunities





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- 4th order
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Existing environment

- Major road
- Named watercourse
- Waterbody
- Cadastral boundary
- Local Government Area

Source: EMM (2024); DCSSS (2024); ESRI (2024); DPE (2023); DPI (2017)

0 0.5 1 km

GDA2020 MGA Zone 56

N

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Site map
Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 3.2

EMM
creating opportunities

4 Native vegetation

An assessment of native vegetation within the disturbance footprint was undertaken in accordance with Section 4 of the BAM (DPIE, 2020), and is summarised within this chapter.

4.1 Background review

A review of existing information was undertaken to obtain a broad understanding of the regional vegetation types within the locality, with particular focus on the studies previously undertaken within the subject land. This included a review of the following data sources and reference literature:

- NSW State Vegetation Type Map (DCCEEW 2022).
- Spatial data provided by Tweed Shire Council pertaining to vegetation mapping, floristic and vegetation integrity surveys and threatened species targeted surveys.
- Spatial data provided by Eco Logical Australia pertaining to vegetation mapping, floristic and vegetation integrity surveys and threatened species targeted surveys.
- Flora and Fauna Survey and Preliminary Impact Assessment for the Proposed Raising of Clarrie Hall Dam, Tweed Shire, NSW (Tweed Shire Council, 2017).
- Clarrie Hall Dam Raising State Significant Infrastructure Applications – Preliminary Environmental Assessment, July 2018 (Tweed Shire Council, 2018a).
- Targeted Survey and Revised Impact Assessment for Red Lilly Pilly and Lowland Rainforest, Doon Doon Catchment – Addendum to the Flora and Fauna Assessment for the Proposed Raising of Clarrie Hall Dam (Tweed Shire Council, 2018c).
- Clarrie Hall Dam Raising Preliminary Draft Biodiversity Development Assessment Report, Unpublished Report (ELA, 2021).

Preliminary vegetation assessments were undertaken in 2016 and 2017 which involved vegetation integrity assessments, vegetation mapping and the development of a preliminary plant community type (PCT) map for the subject land. Six PCTs were initially identified by Tweed Shire Council within the subject land, consisting of open forest and rainforest communities, with additional areas identified as cleared vegetation and plantations. These preliminary PCTs informed the initial targeted field surveys undertaken across the subject land.

Subsequent adjustments to the PCT mapping were undertaken by ELA over the 2020–2021 period, with refinements made to the PCT assignment and stratification. Five of the PCTs previously identified by Tweed Shire Council were retained in this iteration of the vegetation mapping, with one previously identified PCT amalgamated into another community.

A review of the previous vegetation integrity surveys and vegetation mapping was undertaken by EMM. Further refinements were made to the PCT assignment, stratification by condition, and linework in vegetation mapping. Upon analysis of the floristic composition across the subject land, it was determined that three PCTs are present within the subject land. These PCTs are described in Section 4.4.

4.2 Climatic context

Following the initial surveys conducted in 2016 and 2017 across the subject land, the far north coast region experienced a period of drought, though the vegetation within the subject site did not experience any significant drought related impacts such as dieback. Additionally, an area of vegetation at the Dam was subject to an uncontrolled bushfire in August 2019. The fire extent within the subject land constituted a portion of vegetation to the northwest of the existing Dam. The fire was a relatively cool burn, largely restricted to the understorey and midstorey strata. Subsequently, the region experienced an extended period of above average rainfall, typical of the La Nina climatic pattern declared from 2020 to March 2023. To capture and assess the recovery of bushfire affected areas, additional vegetation plot surveys were completed in these areas in 2023 and 2024. Vegetation condition in the fire affected area in 2024 was largely comparable to that in 2016 and 2017 having substantially recovered from fire.

4.3 Methods

4.3.1 Field survey dates

Vegetation surveys were conducted on the dates outlined in Table 4.1.

Table 4.1 Vegetation surveys

Dates	Surveys completed
31 October to 3 November 2016	Vegetation mapping, rapid vegetation assessments
8 to 11 November 2016	Vegetation mapping, rapid vegetation assessments
14 and 16 to 18 November 2016	Vegetation mapping, rapid vegetation assessments
29 November to 2 December 2016	Vegetation mapping, rapid vegetation assessments
7 to 8 June 2017	Vegetation mapping, rapid vegetation assessments
16 to 18 January 2020	BAM plots, rapid vegetation assessments
13 to 17 April 2020	BAM plots, rapid vegetation assessments
8 to 12 June 2020	BAM plots, rapid vegetation assessments
24 May 2021	BAM plot
17 to 22 September 2023	Vegetation mapping and verification
15 to 19 January 2024	BAM plots
25 January 2024	BAM plot
15 February 2024	BAM plots

4.3.2 Vegetation mapping and stratification

Vegetation mapping and PCT alignment were undertaken across the subject land over repeat visits between 2016 and 2024. The subject land was traversed on foot and by vehicle, with vegetation mapped and aligned with NSW PCTs. Where there was some uncertainty about correct PCT alignment, or to justify PCT alignment, a series of rapid vegetation assessments (RVAs) were undertaken, with the three dominant species in the overstorey, midstorey and groundcover recorded.

PCTs were stratified into vegetation zones based on broad condition state using the definitions in Table 4.2.

Table 4.2 Definitions used in delineation of vegetation zones

Condition class	Description
High	Largely intact with all strata present and minimal recent disturbance (includes areas which were logged historically)
Moderate	Some elements or strata missing or immature, but minimal disturbance.
Burnt	Regeneration is occurring in the midstorey and groundcover strata due to previous impacts from fire in 2019. Minimal disturbance was experienced by the upper stratum and the canopy remains mostly intact.
Low	Upper stratum present, but understorey vegetation degraded due to weeds or other major disturbance.
Planted	All strata present, though modified somewhat due to historic plantings. Plantings include a mixture of indigenous and non-indigenous native species. This vegetation zone contains species with some exotic species.
Pasture	Upper stratum and mid stratum absent through vegetation clearing and pasture maintenance. Exotic grasses and forbs typically dominate. Native vegetation is limited to grasses and forbs and diversity is low.
Derived sedgeland	Low lying cleared areas with an abundance of sedges, rushes and some grasses. Few native species are present with exotic forbs prevalent. Upper stratum and mid stratum are absent.
Plantation	This vegetation zone contains planted native vegetation, representative of historical commercial plantations for logging practices. The areas are highly disturbed with a largely exotic and weedy groundcover is occurring.

Vegetation was mapped using hand-held GPS units, and mobile tablet computers running ArcGIS Field Maps™ and Survey123 for ArcGIS™. Accuracy is subject to accuracy of GPS devices, generally ±5 m. The vegetation mapping dataset has been produced using ArcGIS™ 10.8.1.

4.3.3 Vegetation integrity assessment

Following the stratification of vegetation zones within the subject land, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlined in Section 4.2.1, 4.3.3 and 4.3.4 of the BAM (DPIE, 2020). Plot data was collected from the subject land between 2020 and 2024. At each plot location the following was undertaken:

- one 20 x 20 m plot, for assessment of composition and structure
- one 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1 to 5%) or estimated to the nearest 5% (5 to 100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000 etc. The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 3 of the BAM (DPIE, 2020). A total of 54 plots were undertaken within or in close proximity to the subject land. Of the total plots completed, 43 plots have been used for the assessment of

vegetation integrity. Several plots were excluded from the assessment owing to adjustments in vegetation mapping throughout the life of the Proposal and being superseded with more recent plots in the case of those areas affected by the 2019 bushfire. Datasheets are provided in Appendix C and the compiled plot data is provided in Appendix D.

Surveys for flora and vegetation communities conducted by EMM were completed under the authority of Scientific License (SL100409). A list of flora species was compiled for each plot and PCT. Records of all flora species will be submitted to BCD for incorporation into the Atlas of NSW Wildlife.

4.3.4 Limitations and assumptions

i Revised PCTs in Eastern NSW

Revised PCTs for Eastern NSW were introduced to the BOS and BAM (DPIE, 2020) in 2023. The revised PCTs were publicly released on 24 June 2022 and were made available to the BAM-C on 14 April 2023. For assessments that had commenced a BAM-C case prior to the introduction of revised PCTs, transitional arrangements were made available. The transitional arrangements allowed assessments the option to opt in to use the revised PCTs or continue to use the legacy PCT data. In order to meet the requirements of the transitional arrangements, BAM-C assessments must be finalised before 14 April 2025.

As the BAM-C case associated with the Proposal was initiated prior to the introduction of the revised Eastern NSW PCTs, the transitional arrangements are applicable. The legacy PCTs have been selected within the BAM-C case for the Proposal owing to the substantial amount of work progressed prior to June 2022.

ii Survey validation by BCD

Consultation has been undertaken with the North East Branch of the BCD throughout vegetation surveys. Survey methods have been validated by BCD as per the correspondence summarised in Table 1.4 and provided in Appendix B.

iii Species identification

The majority of plots were completed in spring and summer, therefore the flowering period for most understorey species was captured. For any species that were not identifiable to species level, a conservative approach was taken, and the species were recorded as native with the relevant growth form assigned in accordance with the BAM (DPIE, 2020).

4.4 Results

4.4.1 Vegetation description

Within the subject land, the predominant vegetation is wet sclerophyll forest with smaller patches of lowland rainforest. Historically, the vegetation surrounding the Dam has been subject to vegetation clearance and forestry activities. A bushfire in 2019 subjected a portion of the vegetation in the northwest extent of the Dam to more recent disturbance, however this is now largely recovered. At the southern end of the Dam, much of the vegetation is highly modified with areas of maintained pasture, patches of regrowth forest as well as the presence of historical tree plantations.

The wet sclerophyll forest is dominated by two species, Brush Box (*Lophostemon confertus*) and Flooded Gum (*Eucalyptus grandis*) which either occur as individual dominant species or co-dominant species. The midstorey is relatively dense with a high diversity of rainforest species. In slightly more exposed slopes, ridgelines and elevations the wet sclerophyll forest transitions into a community dominated by Tallowwood (*Eucalyptus*

microcorys) and Pink Bloodwood (*Corymbia intermedia*). Whilst this latter composition occurs in a few isolated areas of the subject land, it is likely to be prevalent at slightly higher elevations.

The most sheltered and wet areas of the subject land such as south facing slopes and watercourse gullies, contain subtropical rainforest with a high diversity of species, a dense, multilayered canopy and a sub-canopy of smaller trees including palms.

Most areas of existing native vegetation are in moderate to good condition. Such areas have low levels of weed invasion however, due to a history of logging, are typically missing larger tree size classes and associated habitat values. Vegetation surrounding the existing Dam generally shows little to no intergrade with the Dam and ceases at an abrupt ecotone at the water's edge in most areas. There are occasional patches of weed invasion, particularly on the South Eastern portion of the Dam, which include Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camera*).

In the southern portion of the subject land, the vegetation is highly modified with large areas of paddocks, parkland associated with Crams Farm and plantations. Paddocks and parklands are maintained by regular slashing with occasional paddock trees, small patches of isolated regrowth and planted vegetation making a minor contribution to a largely treeless community of exotic grasses. The plantation areas are monoculture plantings of Dunn's White Gum (*Eucalyptus dunnii*) and Hoop Pine (*Araucaria cunninghamii*) with a high number of exotic species and occasional native species in the understorey.

This is true of the locations of the ancillary infrastructure proposed for the southern end of the subject land to support the Proposal, consisting of the realignment of power and telecommunication facilities, and the McCabes Bridge upgrade, the associated Commissioner's Creek Road realignment and a potential McCabes Bridge stockpile and construction office area. The vegetation within the footprint of the proposed ancillary infrastructure predominantly consists of maintained pasture with narrow remnants or isolated patches of wet sclerophyll forest.

Similarly, the vegetation within the footprints for the ancillary infrastructure in the north of the subject land consisting of the concrete batching plant (CBP) and additional workers accommodation, as well as the Kyogle Road and Clarrie Hall Dam Road intersection upgrade also consists of maintained pasture with isolated paddock trees.

A total of 497 plant species were recorded cumulatively across the subject land, comprising 390 native species and 107 introduced (i.e. non-native) species. Most of the flora species observed are typical of wet sclerophyll forests and rainforests, with the assemblage mostly represented by Poaceae (grass), Myrtaceae (tree), Asteraceae (daisy) and Lauraceae (trees and shrubs). Of the 108 introduced species, 23 species are high-threat weeds for the purpose of application of the BAM (DPIE, 2020).

4.4.2 Plant community types and vegetation zones

PCTs were identified through analysis of data collected during vegetation mapping surveys and were verified using floristic data collected during plot surveys. Three PCTs were identified within the disturbance footprint. These PCTs are summarised in Table 4.3 and displayed on Figure 4.1.

Table 4.3 PCTs and other land classifications in the subject land

Plant community types	Vegetation formation	Vegetation class	Percentage cleared (NSW)	Direct impacts (ha)
PCT 827 - Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Wet Sclerophyll Forests (Shrubby sub-formation),	North Coast Wet Sclerophyll Forests	55	221.67
PCT 1073 - Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	Wet Sclerophyll Forests (Shrubby sub-formation),	North Coast Wet Sclerophyll Forests	40	2.67

Plant community types	Vegetation formation	Vegetation class	Percentage cleared (NSW)	Direct impacts (ha)
PCT 1302 - White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	Rainforests	Subtropical Rainforests	75	8.77
Plantations	-	-	-	11.98
Planted native vegetation	-	-	-	1.02
Exotic trees	-	-	-	0.24
Cleared	-	-	-	5.69
Water	-	-	-	0.23
Total				**252.27 ha**

Vegetation zones were delineated by the presence/absence of canopy and the condition of various strata as detailed in Table 4.2. Details for each vegetation zone and PCT are summarised in Table 4.4, with descriptions of the PCTs presented in Table 4.4 to Table 4.7.

Table 4.4 Vegetation zones within the disturbance footprint

PCT ID	PCT name	Condition	Extent in direct impact area (ha)	Vegetation integrity score
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	High	72.13	68.9
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Moderate	31.27	60.5
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Burnt	19.04	92.3
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Low	25.50	56.1
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Planted	5.08	84.3
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Pasture	64.06	6.2
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Derived sedgeland	4.58	1.1
1073	Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	High	2.67	79.5
1302	White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	High	5.78	63.7
1302	White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	Moderate	2.99	54.7

Table 4.5 PCT 827 - Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast

Attribute	Description
PCT ID	827
Common name	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast
Vegetation formation, class	Wet Sclerophyll Forests (Shrubby sub-formation), North Coast Wet Sclerophyll Forests
Description	This is the dominant community throughout the much of Subject Land, occurring around much of the periphery of the Dam and would likely have occurred across much of the southern portion of the Subject Land prior to clearance. The community occurs on a variety of landform, typically grading into subtropical rainforest (PCT 1073) in the most sheltered locations and along watercourse. In these areas the transition between rainforest and wet sclerophyll forest can be fairly indistinct, marked primarily between a gradual change in dominance from a sclerophyll canopy to rainforest species. Much of the midstorey and ground cover species are shared between the more meisic areas of this PCT and rainforest. This community typically intergrades with PCT 1073 Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion PCT 1037 upslope and on ridgelines. The canopy is dominated by two key species Flooded Gum (*Eucalyptus grandis*) and Brush Box (*Lophostemon confertus*). Within the community either species can be highly dominant or occurring as co-dominants. Other canopy species occurring within the community include Turpentine (*Syncarpia glomulifera*), Tallowwood (*Eucalyptus microcorys*) and Grey Gum (*Eucalyptus propinqua*). The midstorey is typically highly diverse with a high proportion of rainforest species. Key species include Lilly Pilly (*Acmena smithii*), Native Walnut species (*Endiandra spp.*), Bangalow Palm (*Archontophoenix cunninghamiana*) *Cryptocarya* spp., Rose Myrtle (*Archirhodomyrtus beckleri*), Crabapple (*Schizomeria ovata*), Celery Wood (*Polyscias elegans*), Forest Oak (*Allocasuarina torulosa*) and Red Ash (*Alphitonia excelsa*). The ground layer is variable but generally has a high cover of Gristle Fern (*Blechnum cartilagineum*), Rainbow Fern (*Calochlaena dubia*) and Harsh Ground Fern (*Hypolepis muelleri*), with *Lomandra* spp. and Basket Grass (*Oplismenus imbecillis*) also common. Other ferns, herbs and grasses occur at lower levels including *Aneilema acuminatum,* Bordered Panic (*Entolasia marginata*) and Pastel Flower (*Pseuderanthemum variabile*). Climbers occurring include Native Grape (*Cissus* spp)., Native Yam (*Dioscorea transversa*), Scrambling Lilly (*Geitonoplesium cymosum*), Sweet Morinda (*Gynochthodes jasminoides*) and *Smilax* spp.
Extent within subject land	High: 72.13 ha Mod: 31.27 ha Burnt: 19.04 ha Low: 25.50 ha Planted: 5.08 ha Pasture: 64.06 ha Derived sedgeland: 4.58 ha **Total:** 221.67 ha
Survey effort	High: Plot 3, 5, 12, 19, 23, 28 Mod: Plot 4, 10, 18, 26, 31, 33 Burnt: Plot 56_827_B, 57_827_B, 58_827_B, 59_827_B Low: Plot 9, 11, 13, 55_827_L Planted: Plot 60_827_P, 61_827_P, 62_827_P Pasture: Plot 27, 32, 64_827_G, 65_827_G, 66_827_G Derived sedgeland: Plot 53_827_D, 54_827_D

Attribute	Description
Condition description	**High (VIS 68.9):** This vegetation is largely intact with well-developed canopy, midstorey and ground cover. Native flora diversity is high with exotic species largely absent. Weeds are largely absent. Disturbance is largely limited to historical loggings and associated access tracks which has reduced the amount of very large and old trees present, as a product, large fallen timber is also reduced. **Moderate (60.5):** This zone is similar to 'high' albeit with more recent disturbance increasing the amount of weeds present such as Camphor Laurel and Lantana. Species richness is still relatively high with three distinct strata still present in most areas **Burnt (92.3):** This zone is reflective of otherwise 'high' condition areas, which experienced bushfire in 2019. These areas have recovered with the main differentiator being the abundance and regrowth of midstorey species and groundcover. **Low (56.1**): These areas are composed of regrowth vegetation with a partially cleared canopy, often with Camphor Laurel present. Midstorey species diversity is depauperate compared to other vegetation zones and often weedy. Ground cover is a mixture of native grasses and forbs with a high abundance of exotic pasture grasses and weeds **Planted (84.3):** The planted vegetation ones include reasonably intact vegetation with some historical clearance of the midstorey. Regrowth of native species is present with the addition of a mixture of indigenous and non-indigenous planted species. In some areas some exotic species have also been planted however these do not form a dominant component of the zone **Pasture and derived sedgeland:** These areas no longer have any of the species indicative of the PCT and are considered irrevocably altered. Detailed description is provided in Table 4.8.
Justification of evidence and species used to identify the PCT	Within this PCT, Flooded Gum and Brush Box are highly dominant. There is only one other PCT for which these two species are characteristic of the upper canopy and are aligned with the geographic location of the subject land and the vegetation class (North Coast Wet Sclerophyll Forests): PCT 826 Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast. PCT 826 is a potential fit for the vegetation zone given that there is overlap in characteristic species composition. The primary difference between the two PCTs is their landscape position. PCT 826 occurs on sheltered valleys, creek flats or benches, whilst PCT 827 occurs in or near coastal valleys and foothills of the Nambucca, Bellinger, Orara and Tweed Valleys. Areas in consideration within the Subject Land predominately occur on slopes on the foothills of the Tweed Valley, rather than sheltered valleys or creek flats therefore PCT 827 is considered the most appropriate PCT.
Status	PCT 827 does not align with any TECs.
Estimate of percent cleared value of PCT	55%

Photograph 4.1 PCT 827 - high vegetation zone

Photograph 4.2 PCT 827 - burnt vegetation zone

Photograph 4.3 PCT 827 - planted vegetation zone

Table 4.6 PCT 1073 - Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion

Attribute	Description
PCT ID	1073
Common name	Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
Vegetation formation, class	Wet Sclerophyll Forests (Shrubby sub-formation), North Coast Wet Sclerophyll Forests
Description	This community is found in several discrete areas with the subject land. It occurs in positions which are slightly dryer and less sheltered than PCT 827, seemingly linked to topography and elevation. PCT 1073 often occurs upslope from PCT 827, intersecting with the subject land on the occasional ridgeline or where the subject land extends beyond the inundation area to higher elevation, such as the construction area. The mixed canopy includes the co-dominant Tallowwood (*Eucalyptus microcorys*), Pink Bloodwood (*Corymbia intermedia*), with Grey Gum, White Mahogany (*Eucalyptus acmenoides*) and Turpentine (*Syncarpia glomerifera*) also present. Occasional Brush Box and Flooded Gum are present in the ecotonal areas with PCT 827. The midstorey is dense with a high diversity of small trees and shrubs including Golden Pea (*Daviesia arborea*), Native Peach (*Trema tomentosa var. aspera*), Bluebery Ash (*Elaeocarpus reticulatus*), Celery Wood, Forest Oak and Tree Heath (*Trochocarpa laurina*). The ground layer is relatively diverse and often dominated by ground ferns such as Rainbow Fern (*Calochlaena dubia*) and Gristle Fern (*Blechnum cartilagineum*). Other species include *Lomandra spp*., Blue Flax-lily (*Dianella caerulea), Ottochloa gracillima,* and Native Ginger (*Alpinia caerulea*), Bordered Panic (*Entolasia marginata*). Climbing and trailing plants are abundant and diverse including Native Yam, Twining Lilly, Dusky Coral Pea (*Kennedia rubicunda*), Twining Guinea Flower (*Hibbertia dentata*) and Wombat Berry (*Eustrephus latifolius*).
Extent within subject land	High: 2.67 ha
Survey effort	High: Plot 6, 70_1073_H, 71_1073_H
Condition description	**High (VIS 79.5):** This vegetation is largely intact with well-developed canopy, midstorey and ground cover. Native flora diversity is high with exotic and weed species largely absent. Disturbance is largely limited to historical logging and associated access tracks which has reduced the amount of very large and old trees present, as a product, large fallen timber is also reduced.

Attribute	Description
Justification of evidence and species used to identify the PCT	A power query was used to filter PCTs which include Pink Bloodwood and Tallowwood, the two most dominant species, and the vegetation formation of Wet Sclerophyll Forests - Shrubby sub-formation. This presented five PCTs, all of which are in the North Coast Wet Sclerophyll Forests vegetation class. • 752 Brush Box - Turpentine shrubby open forest of the coastal ranges of the NSW North Coast Bioregion • 1073 Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion • 1265 Tallowwood - Sydney Blue Gum moist open forest of the northern ranges of the NSW North Coast Bioregion • 1266 Tallowwood - Turpentine moist open forest of the ranges of the Nymboida area of the NSW North Coast Bioregion • 1285 Turpentine moist open forest of the coastal hills and ranges of the NSW North Coast Bioregion. Three of these PCTs (PCT 752, 1265 and 1285) do not reflect the canopy composition of the vegetation within the subject land, given the lack of Pink Bloodwood as a characteristic canopy species listed in vegetation descriptions. Furthermore, each of these PCTs list specific geographic distributions in the vegetation descriptions which are distinct from the subject land. PCT 1285 is a relatively good match for the vegetation zone given the geographic position and considerable overlap in characteristic species listed in the description and recorded in the vegetation zone including Turpentine, Tallowwood, White Mahogany, Grey Gum and Pink Bloodwood. This PCT was not selected owing to several indications that this community occurs in slightly more sheltered sites and is more mesic than the vegetation within the subject land. This includes: • The PCT title 'Turpentine moist open forest' indicating a dominance of Turpentine, which was infrequent within the subject land vegetation. • The presence of both Flooded Gum and Sydney Blue Gum (*Eucalyptus saligna*) in the description yet these species are largely absent or absent in the subject land vegetation respectively. • The listed landscape position, 'widespread on sheltered slopes and in gullies of the coastal hills and escarpment ranges'. The vegetation in this landscape position within the subject land is largely PCT 827 or subtropical rainforest with this vegetation zone in question occurring high up slope or on ridges. PCT 1073 'Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion' in contrast indicates the dominance of both Pink Bloodwood and Tallowwood, matching the co-dominant species in the subject land. Furthermore, all of the six characteristic canopy species listed as characteristic species for PCT 1073 were recorded in the subject land vegetation zone. There is also significant overlap in the characteristic mid stratum and ground stratum species.
Status	PCT 1073 does not align with any TECs.
Estimate of percent cleared value of PCT	40%

Photograph 4.4 PCT 1073 - high vegetation zone

Table 4.7 PCT 1302 - White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion

Attribute	Description
PCT ID	1302
Common name	White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Vegetation formation and class	Rainforests, Subtropical Rainforests
Description	Subtropical rainforest within the subject land is limited to sheltered slopes, and the slopes along watercourses. There are considerable similarities with PCT 827 in several areas, both sharing a rainforest midstorey. The two communities have been mapped primarily using dominance of the canopy species. Areas dominated by Flooded Gum and/or Brush Box have been mapped as wet sclerophyll forest (PCT 827) and where rainforest canopy species dominate, these areas are mapped as PCT 1302. The tall canopy is closed with emergent vegetation present. There is a high species diversity with no clear dominance of a single species. Canopy species include Pepperberry (*Cryptocarya obovata*), Foambark (*Jagera pseudorhus*), Black Walnut (*Endiandra globosa*), Cuddgerie (*Flindersia schottiana*), Coachwood (*Ceratopetalum apetalum*), Silky Oak (*Grevillea robusta*) and Hard Quandong (*Elaeocarpus obovatus*). The midstorey is relatively dense, with high diversity of small trees and large shrubs including Blue Lilly Pilly (*Syzygium oleosu*m), Scentless Rosewood (*Synoum glandulosum subsp. glandulosum*), Rough Fruit Pittosporum (*Pittosporum revolutum*), Small Psychotria (*Psychotria simmondsiana*), Forest Maple (*Cryptocarya rigida*), Long-leafed Tuckaroo (*Cupaniopsis newmanii*) and Veiny Wilkiea (*Wilkiea huegeliana*). Bangalow Palm is also a frequent component in the midstorey and is the dominant species where sand and other sediment collects along small watercourses. The ground layer cover is generally low but may comprise of ferns and grasslike plants including Gristle Fern, Rainbow Fern, Giant Maidenhair (*Adiantum formosum*) and *Lomandra* spp. Climbers include Native Grape (*Cissus hypoglauca*), Southern Lawyer Cane (*Calamus muelleri*) and Whip Vine (*Flagellaria indica*).
Extent within subject land	High: 5.78 ha Mod: 2.99 ha **Total**: 8.77 ha
Survey effort	High: Three plots (Plot 7, 17, 50_1302_H) Mod: Three Plots (Plot 24, 25, 51_1302_L)
Condition description	**High (VIS 63.7):** This vegetation is largely intact with well-developed canopy, midstorey and ground cover. Native flora diversity is high with exotic species largely absent. Weeds are largely absent. Disturbance is largely limited to historical loggings and associated access tracks which has reduced the amount of very large and old trees present, as a product, large fallen timber is also reduced. **Moderate (VIS 54.7):** This zone is similar to 'high' albeit with more recent disturbance and therefore an increase in the number of weeds present such as Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camara*). Species richness remains high with three distinct strata still present in most areas.

Attribute	Description
Justification of evidence and species used to identify the PCT	A PCT data power query was used to filter PCT to a shortlist. Filters included IBRA region with both NSW north coast and South Eastern Queensland selected given the close proximity to both. Vegetation formation was limited to 'Rainforests' and vegetation class to 'Subtropical Rainforests and Northern Warm Temperate Rainforests'. All decommissioned PCTs were excluded. Following this, PCTs were removed where they had clear descriptions which excluded them from being suitable, i.e. high altitude or a specific restricted location. This provides five potential PCTs. **PCT** / **PCT Name** / **Vegetation Class** 770 — Coachwood - Soft Corkwood - Crabapple warm temperate rainforest of the NSW North Coast Bioregion — Northern Warm Temperate Rainforests 1068 — Pepperberry - Giant Stinging Tree - Fig lowland rainforest in the NSW North Coast Bioregion — Subtropical Rainforests 1130 — Sassafras - Crabapple - Soft Corkwood warm temperate rainforest of the North Coast — Northern Warm Temperate Rainforests 1201 — Soft Corkwood - Yellow Carabeen - Cryptocarya spp. subtropical rainforest of the NSW North Coast Bioregion — Subtropical Rainforests 1302 — White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion — Subtropical Rainforests <u>Vegetation Class</u> The five PCTs belong to two vegetation classes: Northern Warm Temperate Rainforests and Subtropical Rainforests. The Northern Warm Temperate Rainforest Vegetation Class is characterised by a remarkably even canopy, generally lacking emergent species, and comprising 3 to 5 or rarely up to 15 tree species (Keith 2006). The midstorey is typically lacking with few epiphytes or palms. These rainforests occur on soils that are not fertile enough to support other rainforest types, such as Subtropical Rainforest. In contrast, Subtropical Rainforests have a dense, multilayered canopy and a sub-canopy of smaller trees including palms. Given the complex canopy and midstorey and diversity of the rainforest areas within the Subject Land, they should be assigned to a Subtropical Rainforest vegetation class, leaving the most appropriate PCT as either PCT 1068, 1201 or PCT 1302. <u>Landscape</u> PCT 1068 is a poor match given the community is described as occurring on fertile soils in lowland river valleys. This does not align with the landscape position on site, where rainforests occur on sheltered slopes or on the slopes adjacent to fairly incised watercourses. PCT 1201 is described as occurring at intermediate to high altitude in high rainfall areas on moderately fertile to fertile soils on plateau and high mountain gullies along the escarpment. PCT 1302 is considered the best fit given that its landscape position is described as 'low altitudes on fertile soils near sea level, in sheltered mid altitude valleys or on basalt terraces.' The low altitude/sheltered mid-altitude valleys description is closest aligned with the position of rainforest vegetation on site. <u>Characteristic species</u> Analysis of the plot data from the subject land for tree growth forms does not show a convincing match between any or the PCTs nor is particularly useful in selecting the best fit PCT. This can be explained by a juxtaposition between the sheer diversity of tree species found in subtropical rainforests (including those on the Subject Land) and the very short characteristic species list for each PCT. Analysis of the plot data for all other growth forms found 81 species present and was more revealing. Comparison of the species occupying 5% cover or more revealed that Bangalow Palm was dominant in two plots and the second most dominant coverage in one plot. This species is only aligned with PCT 1201 and 1302. PCT 1130 does not have any aligned species (occupying 5% cover or more) and appears to be the worst match. <u>Summary</u> PCT 1302 is selected as the best fit based on species, landscape position and vegetation class.

Attribute	Description
Status	BC Act - Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (Endangered) EPBC Act - Lowland Rainforest of Subtropical Australia (Critically Endangered) Refer to Section 4.4.4.
Estimate of percent cleared value of PCT	75%

Photograph 4.5 PCT 1302 - high vegetation zone

Photograph 4.6 PCT 1302 - moderate vegetation zone

Table 4.8 Pasture, Derived Sedgeland and Exotic Trees

Attribute	Description
PCT ID	The vegetation does not represent a naturally occurring PCT. For the purposes of assessing vegetation integrity, PCT 827 was assigned to both pasture and derived sedgeland based on landscape position and PCT 827 being the most prevalent community in the Subject Land. Both the derived sedgeland and pasture no longer have a species composition indicative of the PCT and are considered irrevocably altered.
Common name	• Pasture 64.06 ha • Derived Sedgeland 4.58 ha • Exotic Trees 0.24 ha
Vegetation formation and class	Wet Sclerophyll Forests (Shrubby sub-formation), North Coast Wet Sclerophyll Forests.
Description	Pasture is prevalent in the south of the subject land and is maintained for grazing of livestock but also for recreational purpose around Crams Farm. These areas have been cleared for a considerable period of time and are subject to continual disturbance including planting of exotic pasture species, grazing and mowing in the case of the recreational areas. Vegetation present is limited to grasses and herbaceous forbs which are predominantly exotic, including Kikuyu (*Cenchrus clandestinus*), *Paspalum dilatatum*, Broadleaf Paspalum (*Paspalum mandiocanum*), Giant Parramatta Grass (*Sporobolus fertilis*), White Clover (Trifolium repens), and Annual Ragweed (*Ambrosia artemisiifolia*). The native grass, Couch (*Cynodon dactylon*) was also recorded, which was dominant in some areas. This species is widely cultivated as a pasture grass and a lawn grass and is not associated with any of the PCTs within the subject land. One small patch of vegetation is mapped as exotic trees within the subject land. This is limited to a row of planted deciduous trees with an exotic grassland groundcover. Derived Sedgeland is a historically cleared area with similar disturbance as pasture, occurring in areas with a higher soil moisture. There is overlap with many of the exotic grass and forbs species recorded in pasture albeit with a higher prevalence of several native species including the rush, *Juncus usitatus*, Water Couch (*Paspalum distichum*) and Queensland Blue Couch (*Digitaria didactyla*). The vegetation integrity score for pasture and derived sedgeland is 6.2 and 1.1 respectively, well below the score of 20 required for offsetting under the BAM, reflecting the highly disturbed and exotic nature of the vegetation.
Extent within subject land	• Pasture: 64.06 ha • Derived Sedgeland: 4.58 ha • Exotic Trees: 0.25 ha
Survey effort	• Pasture: Five plots (27, 32, 64_827_G, 65_827_G, 66_827_G) • Derived Sedgeland: Two plots (53_827_D, 54_827_D)

Photograph 4.7 **Example of PCT 827 Derived Sedgeland vegetation zone**

Photograph 4.8 **Example of 827 Pasture within the subject land**

4.4.3 Planted native vegetation

Areas within the subject land are identified as plantations of Dunn's White Gum (*Eucalyptus dunni*) and Hoop Pine (*Araucaria cunninghamii*). Plantations do not conform to any PCT and are most appropriately assessed in accordance with the streamlined assessment module for planted native vegetation (DPIE, 2020).

In addition, discrete areas of planted native vegetation are mapped in the Cram's Farm recreational area. These areas are appropriate for assessment under the streamlined assessment module and are distinct from the vegetation zone PCT 827_planted. The latter is a mosaic of remnant vegetation and planted individuals and is considered under the BAM, refer to Section 4.4.4

A summary of characteristics of the planted native vegetation including plantations are provided in Table 4.9, Table 4.10, and Table 4.12.

Table 4.9 Dunn's White Gum (*Eucalyptus dunni*) Plantation

Attribute	Description
Assemblage and condition description	An area which has been previously cleared, converted to pasture and planted with Dunn White Gum for plantation purposes. The plantation has been periodically slashed, however maintenance appears to have lapsed with some regrowth of native pioneer species and weeds. These include the native Poison Peach (*Trema tomentosa*), Blackwood (*Acacia melanoxylon*), Cockspur Thorn (*Maclura cochinchinensis*) and the exotic Lantana and Camphor Laurel. The groundcover is largely exotic and dominated by Broad-leafed paspalum (*Paspalum mandiocanum*), Giant Parramatta Grass and South African Pigeon Grass (*Setaria sphacelata*). Given the relatively young age and small size of the trees, no tree hollows are present.
Extent within subject land	7.34 ha
Survey effort	Three plots were undertaken in 2020 to determine vegetation condition (Plot 30, 35, 36). These plots have not been used for the BAM-C given that the vegetation is assessed under the streamlined assessment module for planted native vegetation (DPIE, 2020).
Photograph of Dunn White Gum Plantation (ELA 2021)	 Source: ELA 2021

Table 4.10 Hoop Pine (*Araucaria cunninghamii*) Plantation

Attribute	Description
Assemblage and condition description	Areas which have been previously cleared, converted to pasture and planted with Hoop Pine for plantation purposes. The plantations are highly degraded with extensive dieback of Hoop Pine in several areas owing to smothering by sediment from floods during 2021 and 2022. The midstorey is largely absent with some regrowth of exotic weeds include Lantana and some native pioneer species. The groundcover is dense and largely exotic with an abundance of herbaceous weeds and grasses including Fleabanes (*Conyza spp.*), Purpletop (Verbena *bonariensis*), Broad-leafed paspalum (*Paspalum mandiocanum*), Giant Parramatta Grass and South African Pigeon Grass.
Extent within subject land	4.64 ha
Survey effort	Two plots (16, 43) were undertaken in 2020 to determine vegetation condition. These plots have not been used for the BAM-C given that the vegetation is assessed under the streamlined assessment module for planted native vegetation (DPIE, 2020).
Photograph of Hoop Pine Plantation Dieback	

Table 4.11 Native planted vegetation

Attribute	Description
Assemblage and condition description	Discrete islands of landscape planting in areas which have been previously cleared, converted to pasture then planted with an assortment of native indigenous and non-indigenous species. The assemblage consists primarily of lowland rainforest species including Silky Oak (*Grevillia robusta*), Crows Ash (*Flindersia australis*), Blue Quandong (*Elaeocarpus grandis*), Large Leaf Tamarind (*Diploglottis australis*), Foambark (*Jagera pseudorhus*) and Durobby (*Syzigium moorei*). The latter is a threatened species listed vulnerable under the BC and EPBC act. The species has only been recorded as planted individuals within the subject site. Given the planted nature and relatively young age of the vegetation, a multilayered strata typical of subtropical rainforests is absent. The groundcover is relatively sparse and include Saw Sedge *(Gahnia sp.*), Mat Rush (*Lomandra hystrix*) and Blue Flax Lilly (*Dianella caerulea*). A plaque in one of the planted areas pertaining to Durobby, lists the planting date of 1999. Based on the size of this particular tree being similar to the other planted trees, it can be assumed they were all planted during a similar period.
Extent within subject land	1.02
Survey effort	These areas were assessed and mapped during plant community type verification during 2023.
Photograph of native planted vegetation	

i Streamlined assessment module

Planted native vegetation and Plantations within the subject land do not conform to any PCTs and are most appropriately assessed in accordance with the streamlined assessment module for planted native vegetation (DPIE, 2020).

An assessment of the plantations against the decision-making key in Appendix D of the streamlined assessment module is outlined below (Table 4.12).

Table 4.12 Assessment against the planted native vegetation decision-making key

Question	Result	Justification
1. Does the planted native vegetation occur within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal?	ii. No ..... Go to 2.	The two plantations are discrete homogenous areas which were originally cleared of all remnant vegetation and subsequently planted for commercial production. As such they are not part of mosaic consisting of planted and remnant native vegetation. Dunn's White Gum (*Eucalyptus dunni*) and Hoop Pine (*Araucaria cunninghamii*) are both listed as occurring within several PCTs in the sub-region; however, these species have not been recorded in any of the naturally occurring vegetation surrounding the plantations, nor are characteristic of any of the PCTs mapped in the subject land. Areas of 'planted native vegetation' occur within areas that have been cleared of vegetation and converted to grassland. No remnant vegetation is present.
2. Is the planted native vegetation: a) Planted for the purpose of environmental rehabilitation or restoration under an existing conservation obligation listed in BAM Section 11.9(2.), and b) The primary objective was to replace or regenerate a plant community type or a threatened plant species population or its habitat?	ii. No ..... Go to 3.	No. The primary objective in establishing the plantations was for commercial plantation forestry and logging purposes. The intent of the landscape plantings within the Crams Farm area is unknown although thought to be for visual and intrinsic value purposes.

Question	Result	Justification
3. Is the planted/translocated native vegetation individuals of a threatened species or other native species planted/translocated for the purpose of providing threatened species habitat under one of the following: a) A species recovery project b) Saving Our Species project c) Other types of government funded restoration project d) Condition of consent for a development approval that required those species to be planted or translocated for the purpose of providing threatened species habitat e) Legal obligation as part of a condition or ruling of court. This includes regulatory directed or ordered remedial plantings (e.g. Remediation Order for clearing without consent issued under the BC Act or the Native Vegetation Act) f) Ecological rehabilitation to re-establish a PCT or TEC that was, or is carried out under a mine operations plan, or g) Approved vegetation management plan (e.g. as required as part of a Controlled Activity Approval for works on waterfront land under the NSW Water Management Act 2000)?	ii. No ..... Go to 4.	No. The primary objective in establishing these plantations was for commercial plantation forestry and logging purposes. The planted native vegetation is assumed to be for visual and intrinsic value. To the best of our available knowledge the planting was not part of any restoration program or conservation action.
4. Was the planted native vegetation (including individuals of a threatened flora species) undertaken voluntarily for revegetation, environmental rehabilitation or restoration without a legal obligation to secure or provide for management of the native vegetation?	ii. No ..... Go to 5.	No. The primary objective in establishing these plantations was for commercial plantation forestry and logging purposes. There is no evidence to indicate that the planted native vegetation was established voluntarily for a revegetation, environmental rehabilitation or restoration without a legal obligation to secure or provide for management of the native vegetation?
5. Is the native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, horticultural or plantation forestry purposes? This includes examples such as: windbreaks in agricultural landscapes, roadside plantings (including street trees, median strips, roadside batters), landscaping in parks, gardens and sport fields/complexes, macadamia plantations or teatree farms?	i. Yes .... Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied).	Yes. The primary objective in establishing these plantations was for commercial plantation forestry and logging purposes. While the intent of the planted native vegetation remains unknown, it is assumed that the aesthetic value may be a primary purpose.

In accordance with D.2 streamlined assessment of the BAM (DPIE, 2020), suitability of the planted native vegetation for use by threatened species credit species must be assessed. If there is evidence that threatened species are utilising the planted native vegetation as habitat, the assessor must identify measures to mitigate and manage impacts to these species in accordance with Section 8.4 of the BAM (DPIE, 2020). An assessment of the habitat value of the planted native vegetation within the subject land is provided in Section 5.2.1.

4.4.4 Vegetation zone summary

The vegetation zones identified and assessed in the BAM-C are summarised in Table 4.13 and mapped on Figure 4.1.

Table 4.13 Vegetation zones

Vegetation zone ID	PCT ID	Condition	Area (ha)	Patch size class	No. plots required	No. plots completed	Plot IDs	Vegetation integrity (VI) score
827_high	827	High	72.13	>100 ha	5	6	Plot 3, 5, 12, 19, 23, 28	68.9
827_mod	827	Moderate	31.27	>100 ha	4	6	Plot 4, 10, 18, 26, 31, 33	60.5
827_burnt	827	Burnt	19.04	>100 ha	3	4	Plot 56_827_B, 57_827_B, 58_827_B, 59_827_B	92.3
827_low	827	Low	25.50	>100 ha	4	4	Plot 9, 11, 13, 55_827_L	56.1
827_planted	827	Planted	5.08	>100 ha	3	3	Plot 60_827_P, 61_827_P, 62_827_P	84.3
827_pasture	827	Pasture	64.06	>100 ha	5	5	Plot 27, 32, 64_827_G, 65_827_G, 66_827_G	6.2
827_derived_sedgeland	827	Derived sedgeland	4.58	>100 ha	2	2	Plot 53_827_D, 54_827_D	1.1
1073_high	1073	High	2.67	>100 ha	2	3	Plot 6, 70_1073_H, 71_1073_H	79.5
1302_high	1302	High	5.78	>100 ha	3	3	Plot 7, 17, 50_1302_H	63.7
1302_mod	1302	Moderate	2.99	>100 ha	2	3	Plot 24, 25, 51_1302_L	54.7

4.4.5 Threatened ecological communities

PCT 1302 is associated with two TECs listed under the BC Act:

- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion Endangered Ecological Community (EEC)
- Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC.

The first community, Lowland Rainforest on Floodplains, is described in the TBDC (DCCEEW, 2024a) as occupying riverine corridors and alluvial flats with rich, moist silts. The presence of floodplains is a key differentiator between the two EECs. The rainforest within the subject land occurs on moderate to steep sheltered slopes and slopes adjacent to watercourses, which do not constitute rich alluvial flats, therefore the second EEC listed is a more appropriate fit.

The Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC occurs within the subject land in areas mapped as PCT 1302, as shown on Figure 4.1. The occurrence within the subject land conforms to the Final Determination (NSW TSSC, 2011) on landscape and floristic points, as summarised in Table 4.14.

Table 4.14 Assessment of PCT 1302 against the Final Determination for Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC

Characteristic	Scientific determination	PCT 1302 within the subject land
Location	Occurs in the New South Wales North Coast and Sydney Basin bioregion.	The subject land occurs within the NSW North Coast bioregion.
Vegetation structure	In an undisturbed state, the TEC is a closed canopy forest characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes, give the canopy an irregular appearance (Floyd 1990).	Undisturbed occurrences of PCT 1302 within the subject land maintain a closed canopy and a high species richness. The three major strata: emergents, canopy and sub-canopy are present within the subject land. Occurrences of PCT 1302 that experience a higher level of disturbance possess a broken canopy.
Floristic composition	The scientific determination lists a 108 species characteristic of rainforest community occurring on floodplains.	A total of 68 species aligned with the characteristic species list were recorded with the subject land. This indicates a strong match for the EEC.

PCT 1302 also conforms to the equivalent Lowland Rainforest of Subtropical Australia Critically Endangered Ecological Community (CEEC) listed under the EPBC Act. Expanded discussion of this TEC is provided in Section 9.1.

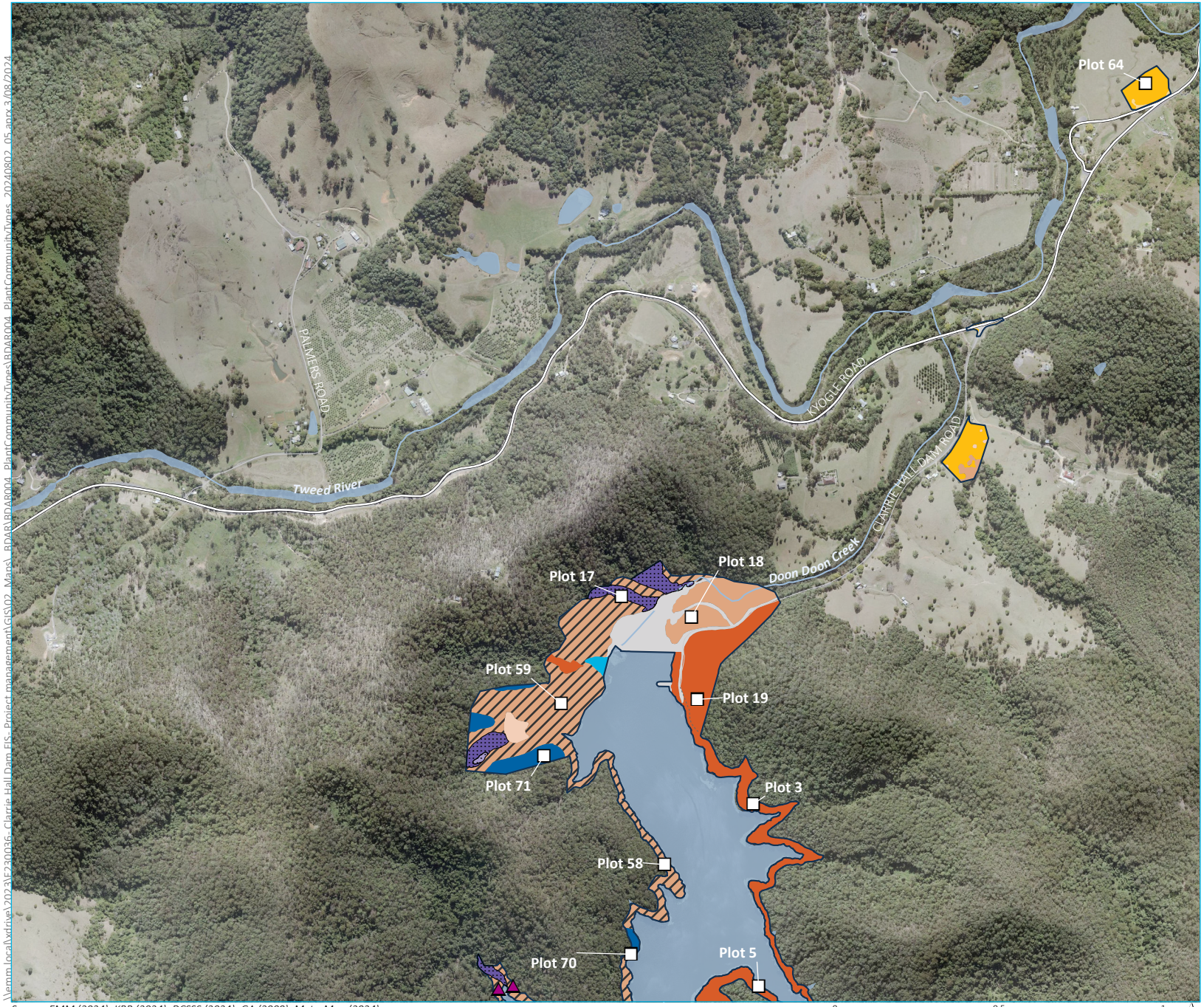
4.4.6 Vegetation within the Mount Jerusalem National Park revoked land

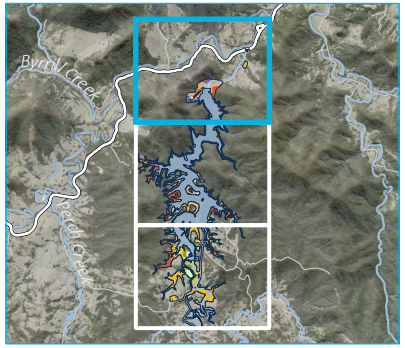
Table 4.15 provides a summary of the vegetation within the 1.91 ha of land that has been revoked from the Mount Jerusalem National Park. These areas of vegetation have been included in the vegetation zone areas quoted above.

Table 4.15 Vegetation within the Mount Jerusalem National Park revoked land

Vegetation zone ID	PCT ID	Condition	Area (ha)	Vegetation integrity (VI) score
827_high	827	High	0.18	68.9
827_low	827	Low	0.133	56.1
1302_high	1302	High	0.25	63.7

The vegetation within the revoked land is undifferentiated from the surrounding vegetation in the subject land and is consistent with the vegetation zones described in Table 4.5 to Table 4.7 above.





KEY

- Subject land
- Rapid vegetation assessment location
- BAM plot
- Threatened ecological community

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Pink Bloodwood- Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

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Plant community types
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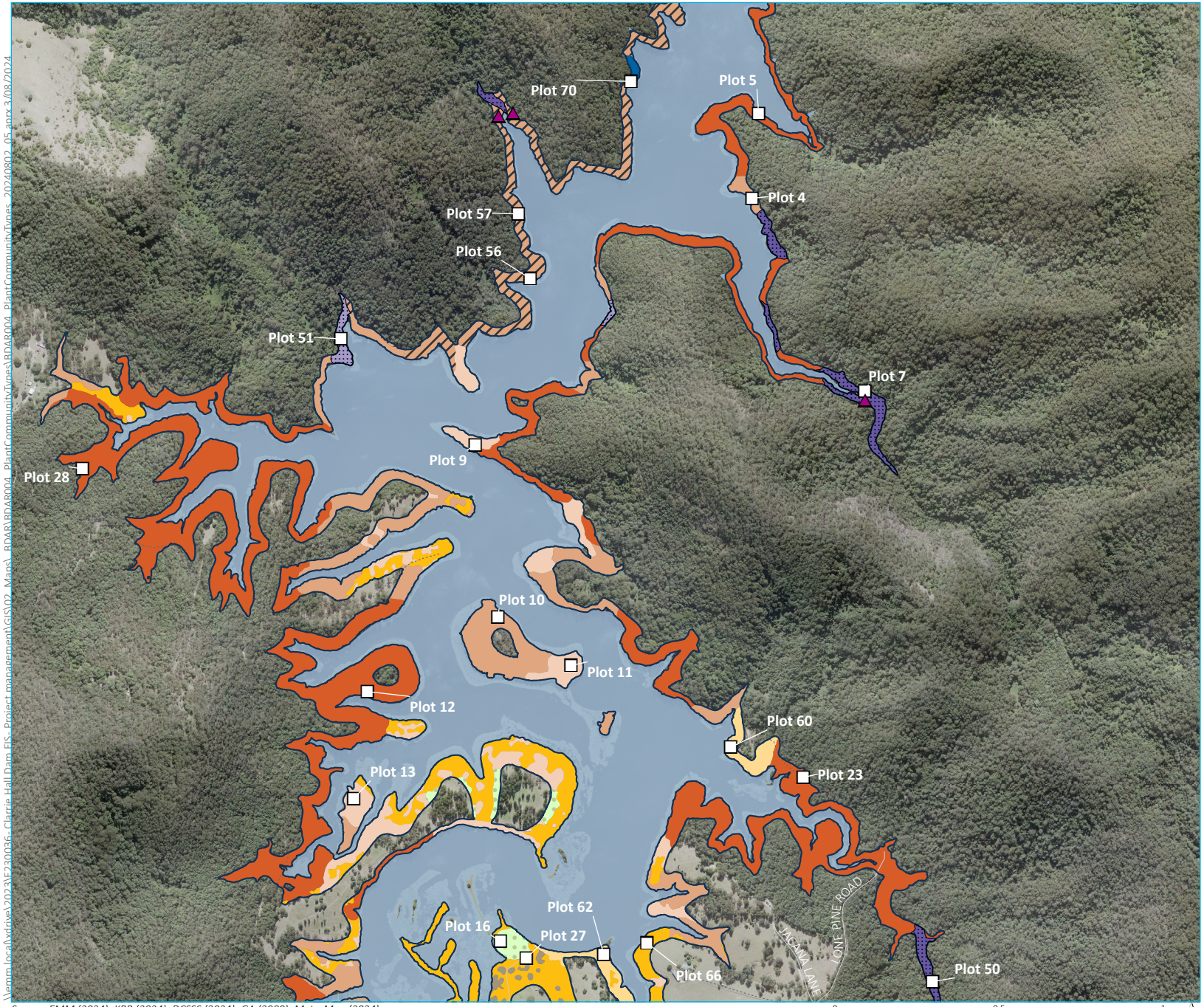
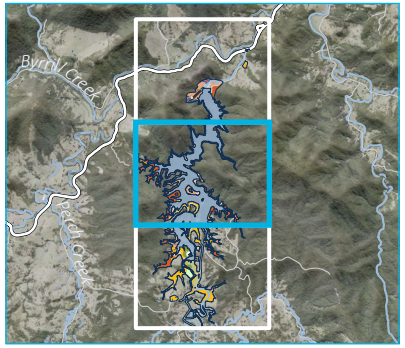
Figure 4.1

EMM
creating opportunities





KEY

- Subject land
- Rapid vegetation assessment location
- BAM plot
- Threatened ecological community

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Pink Bloodwood- Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion

- High

Other

- Hoop plantation
- Native planted vegetation

Existing environment

- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

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Plant community types
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Clarrie Hall Dam EIS
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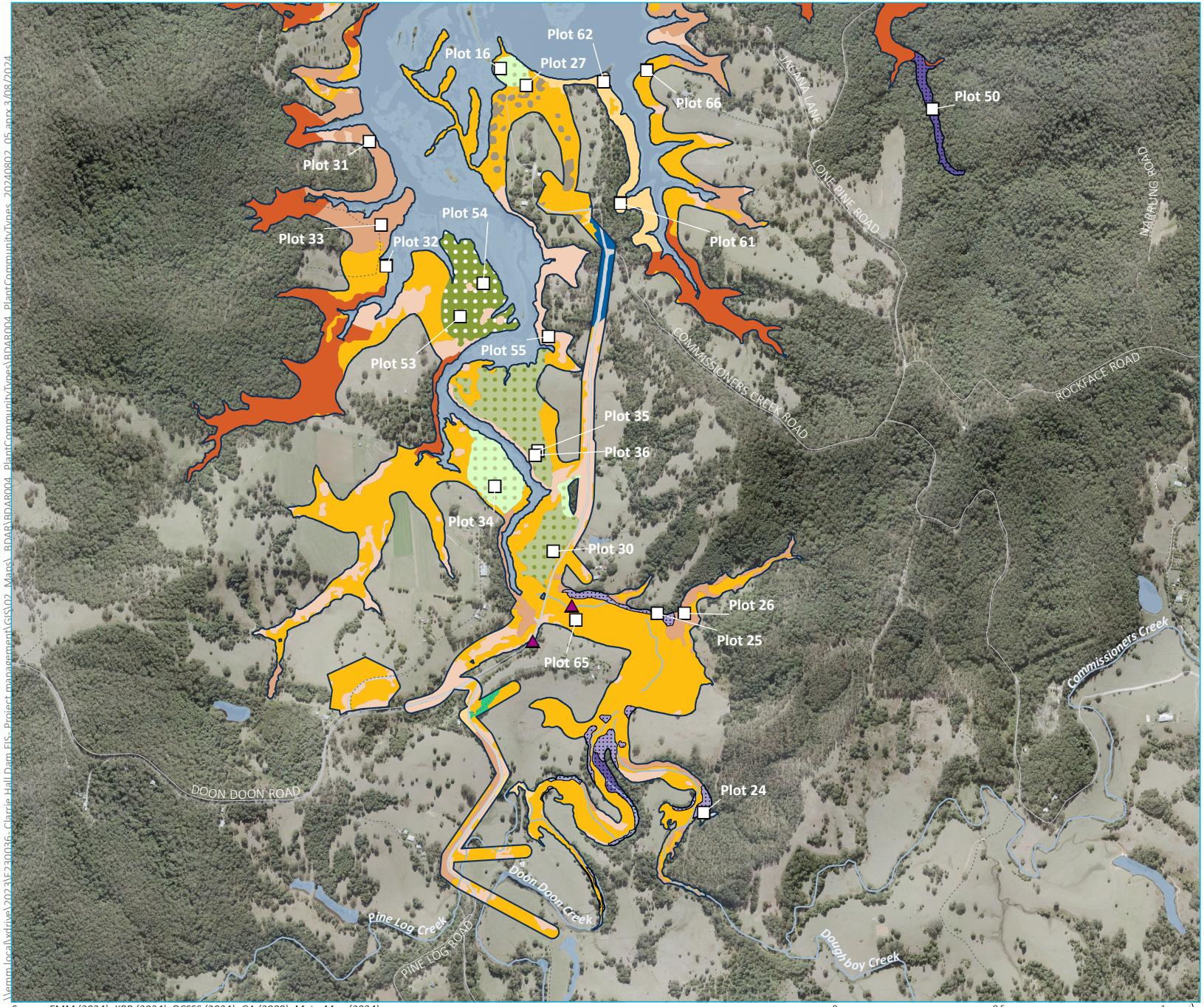
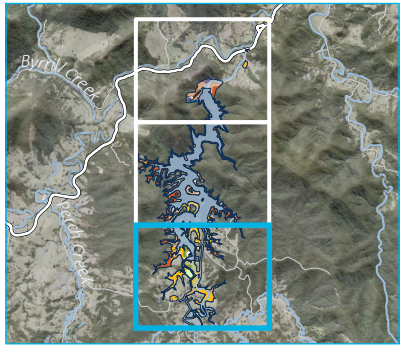
Figure 4.1

EMM
creating opportunities





KEY

- Subject land
- Rapid vegetation assessment location
- BAM plot
- Threatened ecological community

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Pink Bloodwood- Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Native planted vegetation
- Exotic trees
- Cleared

Existing environment

- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Plant community types
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EMM creating opportunities

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5 Threatened species

5.1 Threatened species assessment process

The presence of threatened species within the subject land was assessed according to Section 5.2 of the BAM (DPIE, 2020). The following steps were undertaken:

- Step 1: Identify the threatened species considered for assessment. This includes predicted species assessed for ecosystem credits and candidate species assessed for species credits. This step was completed based on review of the following data sources:
    - species predicted by the BAM-C (these are species that are associated with the PCTs recorded; the species distribution is within the IBRA subregion of the subject land; the subject land is within any specific geographic limitations for a species; and the subject land meets the species' requirements for vegetation class and patch size)
    - threatened species that have been previously recorded in the locality
    - species predicted to occur by the EPBC Act PMST (DCCEEW, 2023c).
- Step 2: Assess habitat constraints listed for each species in the TBDC based on field assessment of habitat constraints present and eliminate species that are vagrant in the IBRA subregion. This step results in a list of confirmed predicted species to be assessed for ecosystem credits (see Section 5.3, Table 5.1) and a list of confirmed candidate species credit species (see Section 5.4, Table 5.2).
- Step 3: Further assess habitat for candidate species credit species. Following a field assessment of the habitat present in the subject land, the likelihood of each threatened species occurring on the subject land is assessed, based on the quality of habitat and the presence of microhabitats required by each species. Species without suitable habitat do not require further assessment. See Section 5.4.2 for more details.
- Step 4: Determine the presence of candidate species through targeted surveys, assumption of presence, or expert reports. Survey methodology is provided in Section 5.4.3 and the results of these surveys are provided in Section 5.4.4.
- Step 5: Define a species polygon for threatened species present in the subject land (see Section 5.4.6).
- Step 6: Determine the habitat condition within the species polygon (for species assessed by area) or the count of individuals (for species assessed by count) (see Section 5.4.6).

5.2 Threatened species habitat values

The majority of the subject land consists of wet sclerophyll forest with patches of subtropical rainforest in gullies. Most areas of native vegetation are in moderate to good condition with low levels of weed invasion. However, owing to past and ongoing disturbance, exotic species are found throughout the subject land, inclusive of many HTW species. Exotic and HTW species are particularly prevalent towards the southern end of the subject land, where grassland is maintained for recreational and agricultural purposes, and are subject to continuing and frequent disturbance.

In the southern end of the subject land, much of the vegetation is highly modified with large areas of pasture and parklands that are maintained as grasslands through regular slashing and/ or grazing. These areas of vegetation provide little habitat value or refuge for fauna due to the lack of structural complexity. These areas are dominated by exotic grasses with a low diversity of native grasses also present. Occasional paddock trees and small remnant patches of forest regrowth are dispersed amongst the grassland habitat, providing rare refuges from the mostly treeless pasture.

The subject land and surrounding vegetation have historically been subjected to land clearing and forestry activities. Despite this past disturbance, much of the wet sclerophyll forest and subtropical rainforest is in good condition with a high diversity of native species. Weeds are mostly absent except for those areas subject to more prolonged or recent disturbance such as landslides, forestry tracks and areas which were entirely cleared. In these areas the exotic weed Lantana (*Lantana camara*) is particularly prevalent forming large thickets.

One of the most noticeable impacts of historical logging is the lack of old and large trees throughout the subject land, with a correspondingly lower abundance of hollow bearing trees, especially in the large sizes classes. This limits the carrying capacity of the subject land for hollow dependant fauna especially those dependant on large hollows such as threatened forest Owls and Cockatoos. Notwithstanding, some hollow bearing trees are present within the subject land and have the potential to provide habitat value for various hollow dependent species, such as bats, possums, gliders, owls, parrots, raptors and reptiles.

A portion of vegetation in the northwest of the subject land was burnt by a low intensity wildfire in December 2019, mostly affecting the midstorey and groundcover vegetation. The vegetation within this area is regenerating well and is likely to provide habitat value for a range of fauna species.

Several watercourses occur within the subject land, though most of these are of low Strahler stream order, with small catchments, steep banks and are composed of unconsolidated rock which is free draining. As such these watercourses are highly ephemeral, only flowing during and shortly after periods of rainfall. These habitats provide minimal breeding habitat for frogs, with the exception of the Pouched Frog (*Assa darlingtoni*) which require mesic areas rather than flowing or standing water. Two semi-permanent or permanent creeks exist in the subject land, flowing from east to west and terminating in the Dam. These provide high quality aquatic habitat and suitable breeding habitat for several amphibian species, including the threatened Giant Barred Frog (*Mixophyes iteratus*). Habitat features include surrounding intact native vegetation, largely permanent water sources and presence of several habitat features such as overhanging banks, pools, and riffle sections. The major watercourse within the subject land is Doon Doon Creek from which the Dam was created. Doon Doon Creek is a 5th order watercourse and is surrounded by a mosaic of remnant vegetation patches and cleared land including pasture. Despite this disturbance, it provides habitat for aquatic species and frogs.

Vegetation surrounding the existing Dam typically has an abrupt ecotone at the water's edge, and therefore lacks riparian vegetation. This is owing to the steep banks of the Dam and a consistent water level kept at or close to full supply level. There is little or no emergent vegetation, transitioning from open water with floating aquatic vegetation, directly into terrestrial vegetation, albeit with edge effects including increased light. In the south of the subject land the gradient is shallower, with a broader ecotone. These areas typically occur in predominantly cleared areas, consisting of a mix of native and exotic herbs, sedges and grasses dominating on land. The margins have a narrow band of rushes and reeds, providing suitable limited habitat for waders such as herons. Extensive areas of floating aquatic vegetation including the Cape Waterlilly (*Nymphaea capensis*) and Water Snowflake (*Nymphoides indica*) occur in the southern portion of the Dam, providing suitable habitat for the Comb-crested Jacana (*Irediparra gallinacea*). Owing to the consistent water level and topography of the Dam, shallow wetland habitat and mudflats are lacking in the subject land, limiting the potential habitat for small wetland birds and shorebirds.

5.2.1 Planted native vegetation

Due to its highly modified condition and the high abundance of exotic plant species in the ground layer, the planted native vegetation is only likely to be suitable as habitat for threatened species credit species that are associated with the "Highly disturbed areas with no or limited native vegetation" vegetation class. Furthermore, the planted vegetation is in poor condition with dieback of both the planted Hoop Pine and planted Dunn's White Gum (*Eucalyptus dunni*) and high levels of exotic weed groundcover. This dieback is likely, in part, due to flood sediments smothering the roots and trunks of the existing tree, causing excessive moisture and disease.

None of the candidate threatened species credit flora species for the Proposal are associated with the "Highly disturbed areas with no or limited native vegetation" vegetation class, and no threatened plant species were incidentally recorded within the Eucalyptus plantation or Hoop Pine plantation during surveys. There is no evidence that threatened species of plants are using the planted native vegetation.

Of the threatened animal species recorded or considered likely to occur in the subject land, the following species are the only ones that are associated with the "Highly disturbed areas with no or limited native vegetation" vegetation class:

- Regent Honeyeater (*Anthochaera phrygia*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Southern Myotis (*Myotis macropus*)
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*).

The Grey-headed Flying-fox (*Pteropus poliocephalus*) and Regent Honeyeater (*Anthochaera phrygia*) may forage on flowers in the canopy of the eucalyptus plantation seasonally. As Dunn's White Gum flowers in March (Benson & Hager, 1993) it is unlikely to provide an important spring or winter food source for the local Grey-headed Flying-fox population or any Regent Honeyeaters that may utilise the area, and it is unlikely to be important as habitat for either species.

Large Bent-winged Bats (*Miniopterus orianae oceanensis*) may forage within the plantations but, as predominantly cave-dwelling species, they are unlikely to roost in this habitat. The Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) are likely to forage intermittently in the plantation habitat. Given the low tree species diversity in the plantations they are unlikely to attract a particularly high diversity and abundance of insect prey for these insect-eating bats. The plantations are therefore unlikely to be important as foraging habitat for the species.

The Southern Myotis (*Myotis macropus*), Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) are unlikely to roost within the plantations owing to the lack of tree hollows and other suitable shelter.

Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) may forage in the plantations, however given that the species is more closely associated with drier and more open habitats, and that it has not been recorded on the subject land, it is unlikely to frequently utilise this habitat.

5.3 Ecosystem credit species

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (DPIE, 2020), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the subject land, based on the PCTs present and generated by the BAM-C is provided in Table 5.1. The potential for these species to occur within the subject land was assessed in accordance with Section 5.2.2 of the BAM (DPIE, 2020).

Table 5.1 Ecosystem species assessment

Scientific name	Common name	BC Act status	EPBC Act status	Sensitivity to gain	Habitat/geographic constraint	PCT associations	Justification for exclusion
Amaurornis moluccana	Pale-vented Bush-hen	Vulnerable	Not listed	High	Waterbodies, dense vegetation, within 300 m of or in shallows of streams or other natural or artificial wetlands	827, 1073, 1302	Not excluded
Anthochaera phrygia	Regent Honeyeater (Foraging)	Critically Endangered	Critically Endangered	High	N/A	827	Not excluded
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	Not listed	Moderate	N/A	827, 1073, 1302	Not excluded
Calyptorhynchus lathami lathami	Southern-eastern Glossy Black-Cockatoo (Foraging)	Vulnerable	Vulnerable	High	Presence of *Allocasuarina* and *Casuarina* species	827, 1073	Not excluded
Coracina lineata	Barred Cuckoo-shrike	Vulnerable	Not listed	Moderate	N/A	827, 1073, 1302	Not excluded
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Not listed	Moderate	N/A	827, 1073	Not excluded
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered	High	N/A	827, 1073, 1302	Not excluded
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	Not listed	High	N/A	827, 1073	Not excluded
Glossopsitta pusilla	Little Lorikeet	Vulnerable	Not listed	High	N/A	827, 1073	Not excluded
Hirundapus caudacutus	White-throated Needletail	Not listed	Vulnerable	High	N/A	827, 1073, 1302	Not excluded
Lophoictinia isura	Square-tailed Kite (Foraging)	Vulnerable	Not listed	Moderate	N/A	827, 1073	Not excluded
Macropus dorsalis	Black-striped Wallaby	Endangered	Not listed	High	West of Kygole	827, 1073, 1302	Excluded from assessment as the subject land is not located West of Kyogle.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Miniopterus australis	Little Bent-winged Bat (Foraging)	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded

Scientific name	Common name	BC Act status	EPBC Act status	Sensitivity to gain	Habitat/geographic constraint	PCT associations	Justification for exclusion
Miniopterus orianae oceanensis	Large Bent-winged Bat (Foraging)	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Ninox strenua	Powerful Owl (Foraging)	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Nyctimene robinsoni	Eastern Tube-nosed Bat	Vulnerable	Not listed	High	N/A	1073, 1302	Not excluded
Nyctophilus bifax	Eastern Long-eared Bat	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Ozimops lumsdenae	Northern Free-tailed Bat	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Petaurus australis	Yellow-bellied Glider	Vulnerable	Vulnerable	High	N/A	827, 1073	Not excluded
Phoniscus papuensis	Golden-tipped Bat	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Podargus ocellatus	Marbled Frogmouth	Vulnerable	Not listed	High	N/A	1073, 1302	Not excluded
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	Vulnerable	Not listed	High	N/A	827, 1073	Not excluded
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	Vulnerable	Vulnerable	High	N/A	827, 1073, 1302	Not excluded
Ptilinopus magnificus	Wompoo Fruit-Dove	Vulnerable	Not listed	Moderate	N/A	827, 1073, 1302	Not excluded
Ptilinopus regina	Rose-crowned Fruit-Dove	Vulnerable	Not listed	Moderate	N/A	827, 1073, 1302	Not excluded
Ptilinopus superbus	Superb Fruit-Dove	Vulnerable	Not listed	Moderate	N/A	827, 1073, 1302	Not excluded
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Syconycteris australis	Common Blossom-bat	Vulnerable	Not listed	High	N/A	827, 1302	Not excluded
Thylogale stigmatica	Red-legged Pademelon	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded
Tyto novaehollandiae	Masked Owl (Foraging)	Vulnerable	Not listed	High	N/A	827, 1073	Not excluded
Tyto tenebricosa	Sooty Owl (Foraging)	Vulnerable	Not listed	High	N/A	827, 1073, 1302	Not excluded

5.4 Species credit species

5.4.1 Candidate species assessment

In accordance with Step 3 (Section 5.2.3 of BAM (DPIE, 2020), a field assessment of habitat constraints and microhabitats was undertaken to determine the suitability of habitat within the subject land for:

- predicted species (ecosystem credit species associated with recorded PCTs, predicted by the BAM-C)
- candidate species (species credit species associated with specific geographic and landscape feature constraints)
- species predicted to occur by the EPBC Act PMST.

Candidate species predicted by the BAM-C are shown in Table 5.2. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded, in accordance with Steps 1 to 3 (Section 5.2.1 to 5.2.3) of the BAM (DPIE, 2020).

Table 5.2 Candidate species assessment

Step 1 – Identify threatened species for assessment (BAM section 5.2.1)						Steps 2 and 3 – Assessment of habitat constraints and vagrant species (BAM section 5.2.2)				Identify candidate species for further assessment	
Class	**Scientific name**	**Common name**	**BC Act listing**	**EPBC Act listing**	**Source**	**Habitat/geographic constraint**	**Habitat/geographic constraint present? (Step 2)**	**Microhabitats are present and habitat is not degraded? (Step 3)**	**Vagrant species?**	**Candidate species (yes/no) and rationale**	**Sensitivity to gain class**
Plant	*Acacia bakeri*	Marblewood	Vulnerable	Not listed	BAM-C	Within Mt Jerusalem National Park or within a 10 km buffer around this National Park	Yes	Yes	N/A	Yes – the subject land is within 10 km of the Mt Jerusalem National Park.	High Sensitivity to Gain
Plant	*Acalypha eremorum*	Acalypha	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Acronychia littoralis*	Scented Acronychia	Endangered	Endangered	BAM-C	Within 5km of coast	No	No	N/A	No – excluded as the subject land is not within 5 km of the coast.	High Sensitivity to Gain
Mammal	*Aepyprymnus rufescens*	Rufous Bettong	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Amyema plicatula*	Amyema plicatula	Endangered	Endangered	BAM-C	Epiphytes	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Angiopteris evecta*	Giant Fern	Endangered	Not listed	BAM-C	Waterbodies or within 50 m	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Antechinus arktos*	Black-tailed Antechinus	Endangered	Endangered	BAM-C	None	N/A	No	N/A	No – the species is only found in the areas of highest altitude and rainfall at the summit of the Tweed Volcano caldera of far south-east Queensland and north-east New South Wales (DCCEEW, 2024b). The subject land is not at sufficient altitude to support the species. Refer to Section 5.4.1i for further information).	High Sensitivity to Gain
Bird	*Anthochaera phrygia*	Regent Honeyeater (Breeding)	Critically Endangered	Critically Endangered	BAM-C	As per mapped areas	No	No	Yes	No – excluded from species credit assessment as the subject land is not within mapped areas.	High Sensitivity to Gain
Plant	*Antrophyum austroqueenslandicum*	Antrophyum austroqueenslandicum	Critically Endangered	Critically Endangered	EMM	None	N/A	Yes	N/A	Yes – the species has the potential to occur in rainforests within the Scenic Rim region. This species has no vegetation associations listed in BioNet and the BAM-C does not permit entry for this species, however this species been selected as a candidate species under the opinion of the lead botanist and is retained for further assessment.	Not listed in BioNet - presume High Sensitivity to Gain
Plant	*Archidendron hendersonii*	White Lace Flower	Vulnerable	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Arthraxon hispidus*	Hairy Jointgrass	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Arthropteris palisotii*	Lesser Creeping Fern	Endangered	Not Listed	EMM	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Amphibian	*Assa darlingtoni*	Pouched Frog	Vulnerable	Vulnerable	PMST	Leaf litter, fallen/ standing dead timber including logs, debris	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Atrichornis rufescens*	Rufous Scrub-bird	Vulnerable	Not listed	BAM-C	None	N/A	No	Yes	No – excluded as the species is now only found in high-rainfall areas above 600 m (DCCEEW, 2024b). Refer to Section 5.4.1i for further information.	High Sensitivity to Gain

Step 1 – Identify threatened species for assessment (BAM section 5.2.1)						Steps 2 and 3 – Assessment of habitat constraints and vagrant species (BAM section 5.2.2)				Identify candidate species for further assessment	
Class	**Scientific name**	**Common name**	**BC Act listing**	**EPBC Act listing**	**Source**	**Habitat/geographic constraint**	**Habitat/geographic constraint present? (Step 2)**	**Microhabitats are present and habitat is not degraded? (Step 3)**	**Vagrant species?**	**Candidate species (yes/no) and rationale**	**Sensitivity to gain class**
Plant	*Backhousia subargentea*	Giant Ironwood	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Baloghia marmorata*	Jointed Baloghia	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Belvisia mucronata*	Needle-leaf Fern	Endangered	Not listed	BAM-C	Cliffs, escarpments and boulders, epiphytes and lithophyte	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Bosistoa transversa*	Yellow Satinheart	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Brachyscome ascendens*	Border Ranges Daisy	Endangered	Not listed	BAM-C	Cliffs, basic and intermediate volcanics (not acid volcanic) or on cliff faces, rocky areas near the tops of cliffs or faces	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Bulbophyllum globuliforme*	Hoop Pine Orchid	Vulnerable	Vulnerable	BAM-C	Hoop pines	Yes	No	N/A	No – the subject land is not at sufficient altitude to support the species which is typically found between 300–600 m (DCCEEW, 2024b). Refer to Section 5.4.1i for further information.	High Sensitivity to Gain
Reptile	*Cacophis harriettae*	White-crowned Snake	Vulnerable	Not listed	BAM-C	Litter, rocky areas, surface rocks, fallen/standing dead timber including logs, or within 50m of fallen timber including logs	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	Vulnerable	Not listed	BAM-C	Living or dead tree with hollows greater than 15 cm diameter and greater than 8 m above ground.	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Carterornis leucotis*	White-eared Monarch	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Cassia marksiana*	Cassia marksiana	Endangered	Not listed	BAM-C	Within 20 km of Mount Nullum	Yes	Yes	N/A	Yes – the subject land is within 20 km of Mount Nullum.	High Sensitivity to Gain
Mammal	*Cercartetus nanus*	Eastern Pygmy-possum	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Chalinolobus dwyeri*	Large-eared Pied Bat	Vulnerable	Vulnerable	BAM-C	Cliffs, within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels	No	No	No	No – excluded based on lack of suitable breeding habitat within 2 km of the subject land.	Very High Sensitivity to Gain
Plant	*Clematis fawcettii*	Northern Clematis	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	Moderate Sensitivity to Gain
Plant	*Coatesia paniculata*	Axe-Breaker	Endangered	Not listed	BAM-C	East of Kyogle	Yes	Yes	N/A	Yes – the subject land is northeast of Kygole.	High Sensitivity to Gain
Reptile	*Coeranoscincus reticulatus*	Three-toed Snake-tooth Skink	Vulnerable	Vulnerable	BAM-C	Leaf and bark litter, fallen/standing dead timber including logs, timber and logs on the ground	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Corchorus cunninghamii*	Native Jute	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Corokia whiteana*	Corokia	Endangered	Vulnerable	BAM-C	North of Lismore	Yes	Yes	N/A	Yes – the subject land is located north of Lismore and the species has been previously recorded within the subject land.	High Sensitivity to Gain

Step 1 – Identify threatened species for assessment (BAM section 5.2.1)						Steps 2 and 3 – Assessment of habitat constraints and vagrant species (BAM section 5.2.2)				Identify candidate species for further assessment	
Class	**Scientific name**	**Common name**	**BC Act listing**	**EPBC Act listing**	**Source**	**Habitat/geographic constraint**	**Habitat/geographic constraint present? (Step 2)**	**Microhabitats are present and habitat is not degraded? (Step 3)**	**Vagrant species?**	**Candidate species (yes/no) and rationale**	**Sensitivity to gain class**
Plant	*Cryptocarya foetida*	Stinking Cryptocarya	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Potential Gain
Plant	*Cryptostylis hunteriana*	Leafless Tongue-orchid	Vulnerable	Vulnerable	PMST	None	N/A	No	N/A	No – excluded as the subject land is outside of the current known range and modelled range for the species (DCCEEW, 2024b). The species was only highlighted in the EPBC Act PMST, and there are no PCT associations.	Moderate Sensitivity to Gain
Plant	*Cupaniopsis serrata*	Smooth Tuckeroo	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Cyclopsitta diophthalma coxeni*	Coxen's Fig-Parrot	Critically Endangered	Endangered	BAM-C	None	N/A	Yes		Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Cynanchum elegans*	White-flowered Wax Plant	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Cyperus rupicola*	Cliff Sedge	Vulnerable	Not listed	BAM-C	Cliffs or within 50 m	N/A	Yes	N/A	Yes – while cliffs are absent from the subject land, rocky outcrops are present the species has been retained on a conservative basis.	High Sensitivity to Gain
Plant	*Cyperus semifertilis*	Missionary Nutgrass	Endangered	Vulnerable	BAM-C	Metasediment geology	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Dasyornis brachypterus*	Eastern Bristlebird	Endangered	Endangered	BAM-C	None	N/A	No	No	No – Microhabitats for the species are absent owing to the lack of tall and dense grassy understory. Refer to Section 5.4.1i for further information.	Moderate Sensitivity to Gain
Plant	*Davidsonia jerseyana*	Davidson's Plum	Endangered	Endangered	BAM-C	East of Tyalgum	Yes	Yes	N/A	Yes – the subject land is southeast of Tyalgum.	High Sensitivity to Gain
Plant	*Davidsonia johnsonii*	Smooth Davidson's Plum	Endangered	Endangered	BAM-C	East of Nimbin	Yes	Yes	N/A	Yes – the subject land is northeast of Nimbin.	Very High Sensitivity to Gain
Plant	*Dendrocnide moroides*	Gympie Stinger	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Desmodium acanthocladum* *Syn Pedleya acanthoclada*	Thorny Pea	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Diospyros mabacea*	Red-fruited Ebony	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Diploglottis campbellii*	Small-leaved Tamarind	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Doryanthes palmeri*	Giant Spear Lily	Vulnerable	Not listed	BAM-C	Cliffs, cliff tops, steep cliff faces or within 50 m, rocky areas, rocky outcrops or within 50 m	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Drynaria rigidula*	Basket Fern	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Eidothea hardeniana*	Nightcap Oak	Endangered	Critically Endangered	BAM-C	Rhyolite soils Nightcap National Park	No	No	N/A	No – the subject land is not within Nightcap National Park.	High Sensitivity to Gain

Step 1 – Identify threatened species for assessment (BAM section 5.2.1)						Steps 2 and 3 – Assessment of habitat constraints and vagrant species (BAM section 5.2.2)				Identify candidate species for further assessment	
Class	**Scientific name**	**Common name**	**BC Act listing**	**EPBC Act listing**	**Source**	**Habitat/geographic constraint**	**Habitat/geographic constraint present? (Step 2)**	**Microhabitats are present and habitat is not degraded? (Step 3)**	**Vagrant species?**	**Candidate species (yes/no) and rationale**	**Sensitivity to gain class**
Plant	*Elaeocarpus sedentarius*	Minyon Quandong	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Elaeocarpus williamsianus*	Hairy Quandong	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	Very High Sensitivity to Gain
Plant	*Endiandra floydii*	Crystal Creek Walnut	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Endiandra hayesii*	Rusty Rose Walnut	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Plant	*Endiandra muelleri subsp. bracteata*	Green-leaved Rose Walnut	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Bird	*Erythrotriorchis radiatus*	Red Goshawk	Endangered	Endangered	PMST	None	N/A	Yes	No	Yes – the subject land contains suitable habitat, though the species is not associated with any PCTs within the subject land. Literature for the species indicates the species is at the extreme southern limit of its range in northern NSW and it occurrence is limited to a single pair (DCCEEW, 2024a).	High Sensitivity to Gain
Plant	*Euphrasia bella*	Pretty Eyebright	Vulnerable	Vulnerable	BAM-C	Cliffs, rock outcrop and down-slope scree or within 20 m, basic and intermediate volcanic geology. North of Kyogle and above 400 m altitude	No	No	N/A	No – the subject land is below 400 m altitude.	High Sensitivity to Gain
Plant	*Floydia praealta*	Ball Nut	Vulnerable	Vulnerable	BAM-C	Within 45km of coast	Yes	Yes	N/A	Yes – the subject land is within 45 km of the coast.	High Sensitivity to Gain
Plant	*Fontainea australis*	Southern Fontainea	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Gossia fragrantissima*	Sweet Myrtle	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Grammitis stenophylla*	Narrow-leaf Finger Fern	Endangered	Not listed	EMM	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	Moderate Sensitivity to Gain
Plant	*Grevillea hilliana*	White Yiel Yiel	Endangered	Not listed	EMM	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Bird	*Haliaeetus leucogaster*	White-bellied Sea-eagle (Breeding)	Vulnerable	Not listed	EMM	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Yes	Yes	No	Yes – the subject land contains habitat previously known to be utilised by the species.	High Sensitivity to Gain
Plant	*Hibbertia hexandra*	Tree Guinea Flower	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain

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Plant	*Hicksbeachia pinnatifolia*	Red Boppel Nut	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Reptile	*Hoplocephalus bitorquatus*	Pale-headed Snake	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Reptile	*Hoplocephalus stephensii*	Stephens' Banded Snake	Vulnerable	Not listed	BAM-C	Hollow bearing trees, within 500 m of aboreal vine tangles, fallen/standing dead timber including logs, or within 500 m of this habitat	Yes	Yes	No	Yes – the subject land contains suitable habitat. A single Stephen's Banded Snake (*Hoplocephalus stephensii*) has been recorded by Tweed Shire Council approximately 1.5 km east of the subject land.	High Sensitivity to Gain
Plant	*Isoglossa eranthemoides*	Isoglossa	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Lepiderema pulchella*	Fine-leaved Tuckeroo	Vulnerable	Not listed	BAM-C	North of the southern arm of the Tweed River	No	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Plant	*Lindsaea brachypoda*	Short-footed Screw Fern	Endangered	Not listed	BAM-C	East of a line drawn north to south through Nimbim	Yes	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Amphibian	*Litoria brevipalmata*	Green-thighed Frog	Vulnerable	Not listed	BAM-C	Semi-permanent/ ephemeral wet areas, swamps, waterbodies	N/A	No	No	No – the subject land does not contain suitable ephemeral waterbodies. Refer to Section 5.4.1i for further information.	Moderate Sensitivity to Gain
Bird	*Lophoictinia isura*	Square-tailed Kite (Breeding)	Vulnerable	Not listed	BAM-C	Nest trees	N/A	Yes	No	Yes – the subject land contains suitable habitat.	Moderate Sensitivity to Gain
Plant	*Macadamia integrifolia*	Macadamia Nut	Not listed	Vulnerable	BAM-C	None	N/A	Yes	Yes	Yes – included as a conservative measure as the species is not known to occur naturally in NSW, however occurs in cultivation.	High Sensitivity to Gain
Plant	*Macadamia tetraphylla*	Rough-shelled Bush Nut	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Plant	*Marsdenia longiloba*	Slender Marsdenia	Endangered	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Plant	*Melicope vitiflora*	Coast Euodia	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Menura alberti*	Albert's Lyrebird	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Miniopterus australis*	Little Bent-winged Bat	Vulnerable	Not listed	BAM-C	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	N/A	No	No	No – excluded based on the absence of suitable breeding habitat within or within close proximity to the subject land.	Very High Sensitivity to Gain

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Mammal	*Miniopterus orianae oceanensis*	Large Bent-winged bat	Vulnerable	Not listed	BAM-C	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC – in cave;" observation type code "E nest-roost;" with numbers of individuals >500.	No	No	No	No – excluded based on the absence of suitable breeding habitat within or within close proximity to the subject land.	Very High Sensitivity to Gain
Amphibian	*Mixophyes fleayi*	Fleay's Barred Frog	Endangered	Endangered	BAM-C	Streams or within 750 m of waterbodies North of Kyogle	Yes	Yes	No	Yes – the subject land contains suitable habitat.	Very High Sensitivity to Gain
Amphibian	*Mixophyes iteratus*	Giant Barred Frog	Vulnerable	Vulnerable	BAM-C	Land within 50 m of semi-permanent and permanent drainages	N/A	Yes	No	Yes – the subject land contains suitable habitat.	Moderate Sensitivity to Gain
Mammal	*Myotis macropus*	Southern Myotis	Vulnerable	Not listed	BAM-C	Waterbodies with permanent pools/ stretches 3 m or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other waterbodies, on or within 200 m of the site	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Myrsine richmondensis*	Ripple-leaf Muttonwood	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Niemeyera whitei*	Rusty Plum, Plum Boxwood	Vulnerable	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Ninox strenua*	Powerful Owl (Breeding)	Vulnerable	Not listed	BAM-C	Living or dead trees with hollow greater than 20 cm diameter.	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Notamacropus parma*	Parma Wallaby	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Invertebrate	*Nurus atlas*	Atlas Rainforest Ground-beetle	Critically Endangered	Not listed	BAM-C	None	N/A	No	Yes	No – the species is generally found in "Big Scrub" remnants below 300 m altitude within a circle of about 15 km diameter to the east of Lismore (DCCEEW, 2024b). Refer to Section 5.4.1i for further information.	High Sensitivity to Gain
Invertebrate	*Nurus brevis*	Shorter Rainforest Ground-beetle	Vulnerable	Not listed	BAM-C	None	N/A	No	Yes	No – excluded as the subject land is outside of the current known range and modelled range for the species (DCCEEW, 2024b). Refer to Section 5.4.1i for further information.	High Sensitivity to Gain
Plant	*Oberonia complanata*	Yellow-flowered King of the Fairies	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Oberonia titania*	Red-flowered King of the Fairies	Vulnerable	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Ochrosia moorei*	Southern Ochrosia	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Owenia cepiodora*	Onion Cedar	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Ozothamnus vagans*	Wollumbin Dogwood	Endangered	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Peristeranthus hillii*	Brown Fairy-chain Orchid	Vulnerable	Not listed	BAM-C	Within 5 km of coast	No	No	N/A	No – the subject land is not within 5 km of the coast.	High Sensitivity to Gain

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Mammal	*Petauroides volans*	Southern Greater Glider	Endangered	Endangered	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Petaurus norfolcensis*	Squirrel Glider	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Phaius australis*	Southern Swamp Orchid	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Phascolarctos cinereus*	Koala	Endangered	Endangered	BAM-C	Presence of koala use trees – refer to Survey Comments in TBDC	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Amphibian	*Philoria kundagungan*	Mountain Frog	Endangered	Not listed	BAM-C	Semi-permanent/ephemeral wet areas, boggy headwaters of streams and soaks	Potential to occur	No	No	No – this species is restricted to elevations of 700 m ASL or greater. The subject land occurs at 100 m ASL and as such does not provide suitable habitat for the species. Refer to Section 5.4.1i for further information.	High Sensitivity to Gain
Amphibian	*Philoria loveridgei*	Loveridge's Frog	Endangered	Not listed	BAM-C	Bogs created from human-modification to natural flows, semi permanent/ephemeral wet areas, boggy headwaters of rainforest streams and soaks	Potential to occur	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Amphibian	*Philoria richmondensis*	Philoria richmondensis	Endangered	Endangered	BAM-C	Semi-permanent/ephemeral wet areas, boggy headwaters of streams, and soaks or within 1 km of bog North of Bruxner Highway	Potential to occur	No	No	No – this species is restricted to elevations of 400–800 m ASL or greater. The subject land occurs at 100 m ASL and as such does not provide suitable habitat for the species. Refer to Section 5.4.1i for further information.	High Sensitivity to Gain
Plant	*Phyllanthus microcladus*	Brush Sauropus	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	Moderate Sensitivity to Gain
Invertebrate	*Phyllodes imperialis southern subspecies*	Southern Pink Underwing Moth	Endangered	Endangered	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	Moderate Sensitivity to Gain
Mammal	*Planigale maculata*	Common Planigale	Vulnerable	Not listed	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Plectranthus nitidus*	Nightcap Plectranthus	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Pomaderris notata*	McPherson Range Pomaderris	Vulnerable	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Potorous tridactylus*	Long-nosed Potoroo	Vulnerable	Vulnerable	BAM-C	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest))	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Psilotum complanatum*	Flat Fork Fern	Endangered	Not listed	BAM-C	Epiphytes	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Mammal	*Pteropus poliocephalus*	Grey-headed Flying-fox (Breeding)	Vulnerable	Vulnerable	BAM-C	Breeding camps	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Randia moorei*	Spiny Gardenia	Endangered	Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain

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Plant	*Rhodamnia maideniana*	Smooth Scrub Turpentine	Critically Endangered	Not listed	PMST	None	N/A	Yes	N/A	Yes –This species has been included as a candidate species given that there the subject land contains suitable habitat (species is not associated with the PCTs in the subject land). The BAM-C does not allow entry for this species.	High Sensitivity to Gain
Plant	*Rhodamnia rubescens*	Scrub Turpentine	Critically Endangered	Critically Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat, and the species has been previously recorded within the subject land.	Very High Sensitivity to Gain
Plant	*Rhodomyrtus psidioides*	Native Guava	Critically Endangered	Critically Endangered	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Plant	*Rhynchosia acuminatissima*	Pointed Trefoil	Vulnerable	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Sarcochilus dilatatus*	nil	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Sarcochilus fitzgeraldii*	Ravine Orchid	Vulnerable	Vulnerable	PMST	Cliffs, exposed rockfaces and vertical moist cliffs, rocky areas/ exposed rockfaces and boulders	N/A	No	N/A	No – the subject land is not at sufficient altitude to support the species which is typically found between 500–900 m (DCCEEW, 2024b). Refer to Section 5.4.1i for further information.	High Sensitivity to Gain
Plant	*Sarcochilus hartmannii*	Waxy Sarcochilus, Blue Knob Orchid	Vulnerable	Vulnerable	PMST	Cliff faces or rock outcrops within 100 m	No	No	N/A	No – excluded as the species favours cliff faces on steep narrow ridges supporting eucalypt forest and clefts in volcanic rock from 500–1,000 m in altitude. The species was highlighted by the PMST, and there are no PCT associations.	High Sensitivity to Gain
Plant	*Sarcochilus weinthalii*	Blotched Sarcochilus	Vulnerable	Vulnerable	BAM-C	Epiphytes	N/A	No	N/A	No – the subject land is not at sufficient altitude to support the species which is typically found between 500–900 m (DCCEEW, 2024b). Refer to Section 5.4.1i for further information.	High Sensitivity to Gain
Plant	*Senna acclinis*	Rainforest Cassia	Endangered	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Sophora fraseri*	Brush Sophora	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Symplocos baeuerlenii*	Small-leaved Hazelwood	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Syzygium hodgkinsoniae*	Red Lilly Pilly	Vulnerable	Vulnerable	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain
Plant	*Syzygium moorei*	Durobby	Vulnerable	Vulnerable	BAM-C	Within 15 km of eastern boundary of Richmond – Tweed A Sub-region	No	Yes	N/A	Yes – the subject land contains suitable habitat and the species has been previously recorded within the subject land.	High Sensitivity to Gain

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Invertebrate	*Thersites mitchellae*	Mitchell's Rainforest Snail	Endangered	Critically Endangered	BAM-C	None	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Thesium australe*	Austral Toadflax, Toadflax	Vulnerable	Vulnerable	PMST	None	N/A	No	N/A	No – PCTs and habitat within the subject land do not align with the species requirements. The species was highlighted by the EPBC Act PMST, and there are no PCT associations.	High Sensitivity to Gain
Plant	*Tinospora tinosporoides*	Arrow-head Vine	Vulnerable	Not listed	BAM-C	None	N/A	Yes	N/A	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Turnix melanogaster*	Black-breasted Button-quail	Critically Endangered	Vulnerable	BAM-C	Deep leaf litter	N/A	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Tylophora woollsii (syn. Vincetoxicum woollsii)*	Cryptic Forest Twiner	Endangered	Endangered	PMST	None	N/A	Yes	N/A	Yes –the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Tyto novaehollandiae*	Masked Owl (Breeding)	Vulnerable	Not listed	BAM-C	Living or dead trees with hollows greater than 20 cm diameter	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Bird	*Tyto tenebricosa*	Sooty Owl (Breeding)	Vulnerable	Not listed	BAM-C	Caves or clifflines/ledges, living or dead trees with hollows greater than 20 cm diameter	Yes	Yes	No	Yes – the subject land contains suitable habitat.	High Sensitivity to Gain
Plant	*Uromyrtus australis*	Peach Myrtle	Endangered	Endangered	PMST	Rhyolite soils or metasediments Within 2 km of Whian Whian State Conservation Area, or the Goonengerry, Nightcap, or Mt Jerusalem National Parks	Yes	Yes	N/A	Yes – the subject land is within 2 km of Mount Jerusalem National Park.	High Sensitivity to Gain
Mammal	*Vespadelus troughtoni*	Eastern Cave Bat	Vulnerable	Not listed	BAM-C	Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds	No	No	No	No – excluded based on lack of suitable breeding habitat within 2 km of the subject land.	High Sensitivity to Gain
Plant	*Xylosma terrae-reginae*	Queensland Xylosma	Endangered	Not listed	BAM-C	Within 5 km of coast	No	No	N/A	No – the subject land is not within 5 km of the coast.	Very High Sensitivity to Gain
Plant	*Zieria adenodonta*	Wollumbin Zieria	Endangered	Not listed	BAM-C	Rocky areas, rocky slopes or within 50 m Mount Warning National Park	No	No	N/A	No – the subject land is not within Mount Warning National Park.	High Sensitivity to Gain

i Further assessment of species based on habitat and geographic constraints

The species discussed in this section have been excluded from requiring further assessment following field assessment of the habitat present in the subject land and consideration of geographic constraints listed in literature and/or BioNet. This approach was confirmed with the North East Branch of the BCD (Appendix B).

Several species considered below are associated with altitude. To provide context for these assessments the subject land is located within a valley of the Tweed caldera and occurs at relatively low altitude. The majority of the subject land is <77 m AHD with the highest portion of the construction footprint at approximately 140 m AHD.

a Black-tailed Antechinus (*Antechinus arktos*)

The Black-tailed Antechinus (*Antechinus arktos*) inhabits the areas of the highest altitude and rainfall along the summit of the Tweed Volcano caldera (DCCEEW, 2024b). The species has a limited distribution that appears to be contracting towards higher altitude habitats, with no recent records in lower altitude areas that the species was once known from (DCCEEW, 2024b). Black-tailed Antechinus inhabit cool, subtropical cloud forest and rainforest with notophyll vine and microphyll fern forests, and likely occur in association with cloud stripping plant species such as Flax Lily (*Helmholtzia glaberrima*) and Antarctic Beech (*Nothofagus moorei*) (DCCEEW, 2024b). Given the absence of suitable habitat within the subject land and the relatively low altitude the subject land does not provide suitable habitat for the Black-tailed Antechinus, and no further assessment is required.

b Rufous Scrub-bird (*Atrichornis rufescens*)

The Rufous Scrub-bird (*Atrichornis rufescens)* is a ground-dwelling bird inhabiting dense vegetation or ground cover such as woody debris or leaf litter (DCCEEW, 2024b). Two subspecies of Rufous Scrub-birds exist, the northern subspecies, *A. r. rufescens* and the southern subspecies, *A. r. ferrieri*. The northern subspecies occurs between the Mistake Range in southern Queensland (QLD) and the Gibraltar Range in northern NSW (DCCEEW, 2024b) (Newman, Stuart, & Hill, 2014), within which the subject land occurs.

The species was formerly known from altitudes below 600 m ASL in far northeastern NSW, however is now assumed to no longer inhabit these elevations following extensive clearing during European settlement (DCCEEW, 2024b). In recent years, the species is confined to areas of high altitude, generally only occurring between elevations of 600 – 1200 m ASL (DCCEEW, 2024b) (Newman, Stuart, & Hill, 2014) (Ferrier, 1984). At these high elevations, Rufous Scrub-birds inhabit high rainfall areas of subtropical, warm and cool temperate rainforests and wet sclerophyll forests (DCCEEW, 2024b) (Newman, Stuart, & Hill, 2014) (Ferrier, 1984). Considering the absence of suitable habitat within the subject land and the relatively low altitude the subject land does not provide suitable habitat for the Rufous Scrub-bird, and no further assessment is required.

c Hoop Pine Orchid (*Bulbophyllum globuliforme*)

Hoop Pine Orchids (*Bulbophyllum globuliforme*) are found almost exclusively in the McPherson Range, an easterly spur of the Great Dividing Range that occurs at the border of NSW and QLD (DCCEEW, 2024b) (Ecograph, 2004). The species is epiphytic, growing on the upper trunk and branches of Hoop Pines (*Araucaria cunninghamii*) in upland subtropical rainforests between elevations of 300 and 900 m ASL (DCCEEW, 2024b) (Copeland & Backhouse, 2022). The subject land contains Hoop Pine plantations however these are in substantially poor condition and the subject land is low in altitude. Therefore, the subject land does not provide suitable habitat for the species and no further assessment is required.

d Eastern Bristlebird (*Dasyornis brachypterus*)

The Eastern Bristlebird (*Dasyornis brachypterus*) has a limited distribution which has contracted into three geographically disjunct areas, including around the QLD and NSW border, central NSW and along the southern NSW and eastern Victorian border (DCCEEW, 2024b) (Commonwealth of Australia, 2022). The species appears to be highly dependent on large, contiguous areas of habitat containing tall, dense grass (Stone, Tasker, & Maron, 2018). There is a strong correlation between the persistence of the species in a habitat and the extent of the contiguous grassy habitat that is present (Stone, Tasker, & Maron, 2018). The subject land has a distinct lack of contiguous, tall, and dense grassy understoreys that would support the Eastern Bristlebird. Due to the absence of suitable microhabitats for the species, no further assessment is required.

e Green-thighed Frog (*Litoria brevipalmata*)

The Green-thighed Frog (*Litoria brevipalmata*) inhabits a range of vegetation types from rainforest to dry heath (DCCEEW, 2024b). In the southern extent of its range, the species exhibits a preference for moist forests, whereas in northern NSW into southern QLD, tends to extend into drier forests (DCCEEW, 2024b). According to the 'NSW Survey Guide for Threatened Frogs', breeding habitat for the Green-thighed Frog constitutes any semi-permanent or ephemeral waterbody that has a surface area greater than 25 metres squared (m^2), that is located within or adjacent to native vegetation (DPIE, NSW Survey Guide for Threatened Frogs, 2020). Habitat assessment at the subject land concluded that the topography was too steep to provide any areas which would support semi-permanent or ephemeral waterbodies with a surface area greater than 25 m^2, and as such does not contain suitable microhabitats to support this species. The southern area of the subject land includes some flatter terrain however these are predominantly cleared with no suitable habitat found for the species. No further assessment is required.

f Atlas Rainforest Beetle (*Nurus atlas*)

The Atlas Rainforest Beetle (*Nurus atlas*) is a flightless, ground dwelling beetle that is currently only known from the Alstonville Plateau, between Lismore and Ballina in northeast NSW (NSW TSSC, 2023). Subpopulations of the species are known from just 12 small and isolated patches of mature lowland rainforest on red krasnozem soils within 10 km of Alstonville (NSW TSSC, 2023). According to the Conservation Assessment for the species (NSW TSSC, 2023), the Atlas Rainforest Beetle does not inhabit areas that have experienced extensive past disturbance, occasional flood inundation or that contain rocky or steep terrain.

The subject land is located approximately 40 km northwest of Alstonville placing the subject land outside of the known distribution of the species. Additionally, the vegetation within the subject land has historically been subject to vegetation clearance and forestry activities, with more recent disturbance occurring as a result of the 2019 bushfire and the ongoing use of many areas of the Dam as public recreational areas. As such, the subject land does not provide suitable habitat for the species, nor does it occur within the known range, and no further assessment is required.

g Shorter Rainforest Ground-beetle (*Nurus brevis*)

BioNet states that the Shorter Rainforest Ground-beetle (*Nurus brevis*) is found in drier rainforest remnants on black soils from lowlands within Lismore city, as its easterly limit, and west to Mallanganee National Park and Cambridge Plateau on plateaus from 300 to 550 m. An isolated population, tentatively attributed to this species, has been discovered on a high open forest plateau with granite soils at above 1,000 m near Torrington, 100 km west of other populations of the species (DCCEEW, 2024a). The subject land is north of any known populations of this species and therefore the species requires no further assessment. This approach was supported during consultation with the North East Branch of the BCD (Appendix B).

h Mountain Frog (*Philoria kundagungan*) and *Philoria richmondensis*

The Mountain Frog (*Philoria kundagungan*) has a restricted geographical distribution between the Mistake Mountain range in southeast QLD to the Tooloom National Park in northern NSW. Known populations in NSW occur in Tooloom, Koreelah and Mount Clunie National Parks (DCCEEW, 2024b). The Mountain Frog is restricted to higher elevations throughout its range, inhabiting cool, moist montane habitats at altitudes of 700 m ASL or above (TSSC, 2021a) (Bolitho L. J., 2023).

Similarly, *Philoria richmondensis* has the most restricted range of the *Philoria* species and is only known from three populations (TSSC, 2021b) (Knowles, Mahony, Armstrong, & Donnellan, 2004). The species is endemic to the mid-high elevations of 400-800 m ASL at the Richmond Range, Toonumbar and Yabbra areas of NSW where it predominantly inhabits areas of old-growth subtropical rainforest (DCCEEW, 2024b) (TSSC, 2021b).

Both species are found in shallow burrows in mud or moss in or along the edges of headwaters of constantly flowing streams or permanent soaks in highland forest (Bolitho & Newell, 2022) (DCCEEW, 2024b).

The subject land is located east of the known ranges for both species, being approximately 79 km from the Tooloom National Park and 38 km from the Toonumbar National Park, the closest known populations of each respective species. The subject land also occurs at a much lower elevation than both species are restricted to and does not contain suitable microhabitats to support either species. Given this, no further assessment is required for either species. The related Loveridge's Frog (*Philora loveridgei*) has slightly broader habitat requirements and is known from slightly lower elevations than either *P. richmondensis* and *P. kundagungan,* and has been retained for further assessment.

i Ravine Orchid (*Sarcochilus fitzgeraldii*) and Blotched Sarcochilus (*Sarcochilus weinthalii*)

The Ravine Orchid (*Sarcochilus fitzgeraldii*) occurs from the Macleay River, north to Maleny in southeast QLD. The species grows on rocks and cliff faces in dense rainforest at altitudes between 500–900 m ASL (DCCEEW, 2024b) (Copeland & Backhouse, 2022). Similarly, the Blotched Sarcochilus (*Sarcochilus weinthalii*) occurs from the Richmond River in northeast NSW to south of Gympie in southeast QLD, and inhabits mid-high altitude rainforests between 300-900 m ASL (DCCEEW, 2024b) (Copeland & Backhouse, 2022). The mid to high altitude habitat required for this species is absent from the subject land, therefore no further assessment is required for the Ravine Orchid and the Blotched Sarcochilus.

5.4.2 Candidate species requiring further assessment

Candidate species for further assessment were identified in accordance with Step 1 to 2 (Section 5.2.1 to 5.2.2) of BAM (DPIE, 2020). A list of species requiring further assessment is provided in Table 5.3.

Table 5.3 Candidate species credit species requiring further assessment

Scientific name	Common name	BC Act	EPBC Act	Method to determine presence
Acacia bakeri	Marblewood	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Acalypha eremorum	Acalypha	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Aepyprymnus rufescens	Rufous Bettong	Vulnerable	Not listed	• Spotlighting • Terrestrial camera trapping
Amyema plicatula	Amyema plicatula	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects

Scientific name	Common name	BC Act	EPBC Act	Method to determine presence
Angiopteris evecta	Giant Fern	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Archidendron hendersonii	White Lace Flower	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Arthraxon hispidus	Hairy Jointgrass	Vulnerable	Vulnerable	• Adapted targeted flora large area method
Arthropteris palisotii	Lesser Creeping Fern	Endangered	Not Listed	• Adapted targeted flora large area method • Parallel transects
Assa darlingtoni	Pouched Frog	Vulnerable	Not listed	• Targeted searches • Watercourse transects • Habitat assessment
Backhousia subargentea	Giant Ironwood	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Baloghia marmorata	Jointed Baloghia	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Belvisia mucronata	Needle-leaf Fern	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Bosistoa transversa	Yellow Satinheart	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Brachyscome ascendens	Border Ranges Daisy	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Cacophis harriettae	White-crowned Snake	Vulnerable	Not listed	• Targeted diurnal searches • Pitfall trapping
Calyptorhynchus lathami	Glossy Black-Cockatoo (breeding)	Vulnerable	Not listed	• Habitat assessment • Frugivore bird surveys • Targeted transects
Carterornis leucotis	White-eared Monarch	Vulnerable	Not listed	• Diurnal bird area searches
Cassia marksiana	Cassia marksiana	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	Not listed	• Spotlighting • Arboreal camera trapping • Terrestrial camera trapping
Choricarpia subargentea	Giant Ironwood	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Clematis fawcettii	Northern Clematis	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Coatesia paniculata	Axe-Breaker	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	Vulnerable	Vulnerable	• Targeted diurnal searches • Pitfall trapping
Corchorus cunninghamii	Native Jute	Endangered	Endangered	• Adapted targeted flora large area method

Scientific name	Common name	BC Act	EPBC Act	Method to determine presence
Corokia whiteana	Corokia	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Cryptocarya foetida	Stinking Cryptocarya	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Cupaniopsis serrata	Smooth Tuckeroo	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	Critically Endangered	Endangered	• Diurnal bird area searches • Habitat area search • Targeted search
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Cyperus rupicola	Cliff Sedge	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Cyperus semifertilis	Missionary Nutgrass	Endangered	Vulnerable	• Adapted targeted flora large area method
Davidsonia jerseyana	Davidson's Plum	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Davidsonia johnsonii	Smooth Davidson's Plum	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Dendrocnide moroides	Gympie Stinger	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Desmodium acanthocladum	Thorny Pea	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Diospyros mabacea	Red-fruited Ebony	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Diploglottis campbellii	Small-leaved Tamarind	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Doryanthes palmeri	Giant Spear Lily	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Drynaria rigidula	Basket Fern	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Elaeocarpus sedentarius	Minyon Quandong	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Elaeocarpus williamsianus	Hairy Quandong	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Endiandra floydii	Crystal Creek Walnut	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects

Scientific name	Common name	BC Act	EPBC Act	Method to determine presence
Floydia praealta	Ball Nut	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Fontainea australis	Southern Fontainea	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Gossia fragrantissima	Sweet Myrtle	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	Not listed	• Adapted targeted flora large area method
Grevillea hilliana	White Yiel Yiel	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Haliaeetus leucogaster	White-bellied Sea-eagle (breeding)	Vulnerable	Not listed	• Habitat assessment
Hibbertia hexandra	Tree Guinea Flower	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Hicksbeachia pinnatifolia	Red Boppel Nut	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Hoplocephalus bitorquatus	Pale-headed Snake	Vulnerable	Not listed	• Spotlighting • Funnel trapping
Hoplocephalus stephensii	Stephens' Banded Snake	Vulnerable	Not listed	• Spotlighting • Funnel trapping
Isoglossa eranthemoides	Isoglossa	Endangered	Endangered	• Adapted targeted flora large area method
Lepiderema pulchella	Fine-leaved Tuckeroo	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Lindsaea brachypoda	Short-footed Screw Fern	Endangered	Not listed	• Adapted targeted flora large area method
Lophoictinia isura	Square-tailed Kite (breeding)	Vulnerable	Not listed	• Habitat assessment
Macadamia integrifolia	Macadamia Nut	Not listed	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Macropus parma	Parma Wallaby	Vulnerable	Not listed	• Spotlighting • Terrestrial camera trapping
Marsdenia longiloba	Slender Marsdenia	Endangered	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Melicope vitiflora	Coast Euodia	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Menura alberti	Albert's Lyrebird	Vulnerable	Not listed	• Winter diurnal bird area searches • Terrestrial camera trapping
Mixophyes fleayi	Fleay's Barred Frog	Endangered	Endangered	• Targeted searches • Watercourse transects

Scientific name	Common name	BC Act	EPBC Act	Method to determine presence
				• Habitat assessment
Mixophyes iteratus	Giant Barred Frog	Endangered	Endangered	• Targeted searches • Watercourse transects • Habitat assessment
Myotis macropus	Southern Myotis	Vulnerable	Not listed	• Acoustic detection • Harp trapping
Myrsine richmondensis	Ripple-leaf Muttonwood	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Niemeyera whitei	Rusty Plum, Plum Boxwood	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Ninox strenua	Powerful Owl	Vulnerable	Not listed	• Breeding habitat survey • Hollow-bearing tree assessment • Call playback and spotlighting
Oberonia complanata	Yellow-flowered King of the Fairies	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Oberonia titania	Red-flowered King of the Fairies	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Ochrosia moorei	Southern Ochrosia	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Owenia cepiodora	Onion Cedar	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Ozothamnus vagans	Wollumbin Dogwood	Endangered	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Petauroides volans	Southern Greater Glider	Endangered	Endangered	• Spotlighting • Arboreal camera trapping • Terrestrial camera trapping
Petaurus norfolcensis	Squirrel Glider	Vulnerable	Not listed	• Spotlighting • Arboreal camera trapping • Terrestrial camera trapping
Phaius australis	Southern Swamp Orchid	Endangered	Endangered	• Adapted targeted flora large area method
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable	• Spotlighting • Spot Assessment Technique • Arboreal camera trapping • Terrestrial camera trapping
Philoria loveridgei	Loveridge's Frog	Endangered	Not listed	• Targeted searches • Watercourse transects • Habitat assessment
Phyllanthus microcladus	Brush Sauropus	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects

Scientific name	Common name	BC Act	EPBC Act	Method to determine presence
Phyllodes imperialis southern subspecies	Southern Pink Underwing Moth	Endangered	Endangered	• Larval food plant survey
Planigale maculata	Common Planigale	Vulnerable	Not listed	• Spotlighting • Terrestrial camera trapping • Pitfall trapping
Plectranthus nitidus	Nightcap Plectranthus	Endangered	Endangered	• Adapted targeted flora large area method
Pomaderris notata	McPherson Range Pomaderris	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Potorous tridactylus	Long-nosed Potoroo	Vulnerable	Vulnerable	• Spotlighting • Terrestrial camera trapping • Cage trapping
Psilotum complanatum	Flat Fork Fern	Endangered	Not listed	• Adapted targeted flora large area method
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	• Daytime camp survey
Randia moorei	Spiny Gardenia	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Rhodamnia maideniana	Smooth Scrub Turpentine	Critically Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Rhodomyrtus psidioides	Native Guava	Critically Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Rhynchosia acuminatissima	Pointed Trefoil	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects
Sarcochilus dilatatus		Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Senna acclinis	Rainforest Cassia	Endangered	Not listed	• Adapted targeted flora large area method • Parallel transects
Sophora fraseri	Brush Sophora	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Symplocos baeuerlenii	Small-leaved Hazelwood	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Syzygium moorei	Durobby	Vulnerable	Vulnerable	• Adapted targeted flora large area method • Parallel transects
Thersites mitchellae	Mitchell's Rainforest Snail	Endangered	Critically Endangered	• Targeted habitat assessment
Tinospora tinosporoides	Arrow-head Vine	Vulnerable	Not listed	• Adapted targeted flora large area method • Parallel transects

Scientific name	Common name	BC Act	EPBC Act	Method to determine presence
Turnix melanogaster	Black-breasted Button-quail	Critically Endangered	Vulnerable	• Diurnal bird area searches • Terrestrial camera trapping
Tylophora woollsii (syn. Vincetoxicum woollsii)	nil	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects
Tyto novaehollandiae	Masked Owl	Vulnerable	Not listed	• Breeding habitat survey • Hollow-bearing tree assessment • Call playback and spotlighting
Tyto tenebricosa	Sooty Owl	Vulnerable	Not listed	• Breeding habitat survey • Hollow-bearing tree assessment • Call playback and spotlighting
Uromyrtus australis	Peach Myrtle	Endangered	Endangered	• Adapted targeted flora large area method • Parallel transects

5.4.3 Targeted survey methods

i Targeted flora surveys

Threatened flora survey were conducted within the subject land between November 2016 and February 2024. A summary of the survey effort and approach is provided below and in Table 5.4. Surveys were developed with consideration of NSW guidelines, including the NSW Guide to Surveying Threatened Plants (OEH, 2016) and the Surveying threatened plants and their habitats – NSW Survey Guide for the Biodiversity Assessment Method (DPIE, 2020).

Table 5.4 Summary of targeted flora survey effort

Technique	Target areas	Effort	Survey timing
Transects	Rainforest and wet sclerophyll forest in gullies (16 locations)	7 days (2 ecologists)	6–7 November 2016 13–16 November 2016 22 December 2016
Adapted large area method (first phase)	Entire subject land	9 days (4 ecologists)	26 October – 3 November 2020
Parallel transects	Entire subject land (except from discrete rainforest gullies as outlined in the first row of this table)	4.5 days (4 ecologists)	13–17 November 2023
		4.5 days (4 ecologists)	27 November – 1 December 2023
		4 days (4 ecologists) 0.5 days (3 ecologists)	11–15 December 2023
		4.5 days (2 ecologists)	22–26 January 2024
		3 days (4 ecologists) 1.5 days (3 ecologists)	12–16 February 2024
Combined effort		129 person days	

a Opportunistic survey during PCT mapping and plot surveys

During the mapping of vegetation and the survey of BAM plots, most of the heavily vegetated parts of the subject land, and much of the derived native grassland, were traversed on foot. Threatened species detectible year-round were searched for opportunistically during vegetation mapping and plots, which included identification of plants, particularly trees and shrubs for the purposes of PCT identification. BAM plots also provided opportunities for detection of threatened species, particularly ground layer species.

b Rainforest and wet sclerophyll gulleys

Targeted flora surveys were conducted in sixteen gullies by two observers, focusing upon rainforest and wet sclerophyll forest, considered likely to contain habitat for threatened flora (refer to Figure 5.1). Parallel transects were undertaken in accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016). Transect spacing was adjusted according to growth form. Surveys were conducted in November and December 2016 over a period of seven days.

c Large area method – first phase

An adapted version of the large area method (two-phase grid-based systematic survey approach) was applied to the subject land in accordance with the NSW Surveying threatened plants and their habitats guidelines (DPIE, 2020). The adapted methodology involved a survey vertex being applied every 100 m of suitable habitat within the subject land. Surrounding each survey vertex, a 20 m radius was searched for threatened species. If a threatened species was recorded, a systematic search was undertaken to each adjacent survey vertex to capture all occurrences of the species. A total of 442 survey vertices were conducted over a period of 9 days in October and November 2020.

d Large area method – second phase

In several discrete locations, predominantly rainforest gullies, survey effort was sufficient to gain accurate individual species counts. Given parallel transects had been conducted at appropriate spacing with subsequent fine searches undertaken once a threatened species had been located, no further survey effort was required in these areas as demonstrated by the density of survey tracks shown on Figure 5.1.

In contrast, the majority of the subject land was initially surveyed using an adapted first phase of the large area method (DPIE, 2020), which provided a record of the threatened species present in the subject land (Table 5.5).

Table 5.5 Threatened flora species recorded in the first phase of the large area method

Scientific name	Common name	Growth form	Area or count based species
Corokia whiteana	Corokia	Shrub	Count
Endiandra hayesii	Rusty Rose Walnut	Tree	Count
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Tree	Count
Grammitis stenophylla	Narrow-leaf Finger Fern	Fern and fern allies	Area
Lepiderema pulchella	Fine-leaved tuckeroo	Tree	Count
Macadamia tetraphylla	Bush Nut	Tree	Count
Marsdenia longiloba	Clear Milkvine	Vine	Area
Rhodamnia rubescens	Scrub Turpentine	Shrub	Count
Rhodomyrtus psidioides	Native Guava	Shrub	Area

Scientific name	Common name	Growth form	Area or count based species
Syzygium hodgkinsoniae	Red Lilly Pilly	Tree	Count
Syzygium moorei (planted)	Durobby	Tree	Count

A planted *Grevillea hilliana* was also recorded outside of the subject land. No individuals of this species were recorded within the subject land.

Five of the threatened species recorded during the first phase are 'area-based' species for the purposes of offsets. These require no further survey to establish their offset quantum given they are tied to habitat and vegetation zones, and not counts of individuals. 'Count-based' species require accurate counts of individuals to be established within the subject land. As such, it was deemed necessary to complete the second phase of the large area method.

Parallel transects were conducted, predominately targeting those species already recorded in 2016 and 2020. All of the count-based species recorded during the first phase (Table 5.5) were either shrubs or trees and therefore, transect spacing of 10 m within the dense vegetation was sufficient, as per the guidelines in Table 1 of the NSW Surveying threatened plants and their habitats guidelines (DPIE, 2020). When a threatened species was detected, a GPS location was recorded, and a search of the immediate area was undertaken at a finer scale to establish a total count.

Attempts were made to keep transects parallel, however in several areas, minor detours were required. This included dense patches of Lantana (*Lantana camara*) and extremely steep, rocky areas deemed unsafe to traverse. In most cases, sufficient coverage could still be achieved by getting as close as possible and using binoculars to confirm identification.

e Prescribed survey timing

Table 5.6 provides a summary of the specified survey timing and the PCT associations for each candidate flora species, with the survey effort displayed on Figure 5.1.

Table 5.6 Targeted flora survey timing

Scientific name	Common name	Specified survey months	Associated PCTs
Acacia bakeri	Marblewood	All year	827, 1073, 1302
Acalypha eremorum	Acalypha	September - February	827, 1073, 1302
Amyema plicatula	Amyema plicatula	All year	770, 1302
Angiopteris evecta	Giant Fern	All year	827, 1073, 1302
Antrophyum austroqueenslandicum	Antrophyum austroqueenslandicum	Not specified in BioNet. The species is detectable all year.	Not specified in BioNet. As the species is restricted to rainforests, the species has potential to occur in PCT 1302.
Archidendron hendersonii	White Lace Flower	All year	827, 1073, 1302
Arthraxon hispidus	Hairy Jointgrass	November - April	827, 1073, 1302
Arthropteris palisotii	Lesser Creeping Fern	All year	Not specified in BioNet. As the species is restricted to rainforests, the species has potential to occur in PCT 1302.

Scientific name	Common name	Specified survey months	Associated PCTs
Backhousia subargentea	Giant Ironwood	All year	Assumed to be associated with 827, 1073, 1302 on a conservative basis.
Baloghia marmorata	Jointed Baloghia	All year	827, 1073, 1302
Belvisia mucronata	Needle-leaf Fern	All year	827, 1073, 1302
Bosistoa transversa	Yellow Satinheart	All year	827, 1073, 1302
Cassia marksiana	Cassia marksiana	All year	827, 1073, 1302
Clematis fawcettii	Northern Clematis	All year	827, 1073, 1302
Coatesia paniculata	Axe-Breaker	All year	1302
Corchorus cunninghamii	Native Jute	All year	827, 1073, 1302
Corokia whiteana	Corokia	All year	1073, 1302
Cryptocarya foetida	Stinking Cryptocarya	All year	827, 1073, 1302
Cupaniopsis serrata	Smooth Tuckeroo	All year	827, 1073, 1302
Cynanchum elegans	White-flowered Wax Plant	All year	1302
Cyperus semifertilis	Missionary Nutgrass	November - February	1302
Davidsonia jerseyana	Davidson's Plum	All year	827, 1073, 1302
Davidsonia johnsonii	Smooth Davidson's Plum	All year	827, 1073, 1302
Dendrocnide moroides	Gympie Stinger	All year	1073, 1302
Desmodium acanthocladum	Thorny Pea	All year	1073, 1302
Diospyros mabacea	Red-fruited Ebony	All year	1073, 1302
Diploglottis campbellii	Small-leaved Tamarind	All year	1073, 1302
Drynaria rigidula	Basket Fern	All year	827, 1073, 1302
Elaeocarpus sedentarius	Minyon Quandong	All year	827, 1073, 1302
Elaeocarpus williamsianus	Hairy Quandong	All year	827, 1073, 1302
Endiandra floydii	Crystal Creek Walnut	All year	827, 1073, 1302
Endiandra hayesii	Rusty Rose Walnut	All year	827, 1073, 1302
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	All year	827, 1073, 1302
Fontainea australis	Southern Fontainea	All year	827, 1302
Gossia fragrantissima	Sweet Myrtle	All year	827, 1073, 1302
Grammitis stenophylla	Narrow-leaf Finger Fern	All year	Not associated with PCTs on the subject land. Species retained as a candidate species due to habitat being present and existing records located within the subject land.
Grevillea hilliana	White Yiel Yiel	All year	827, 1302

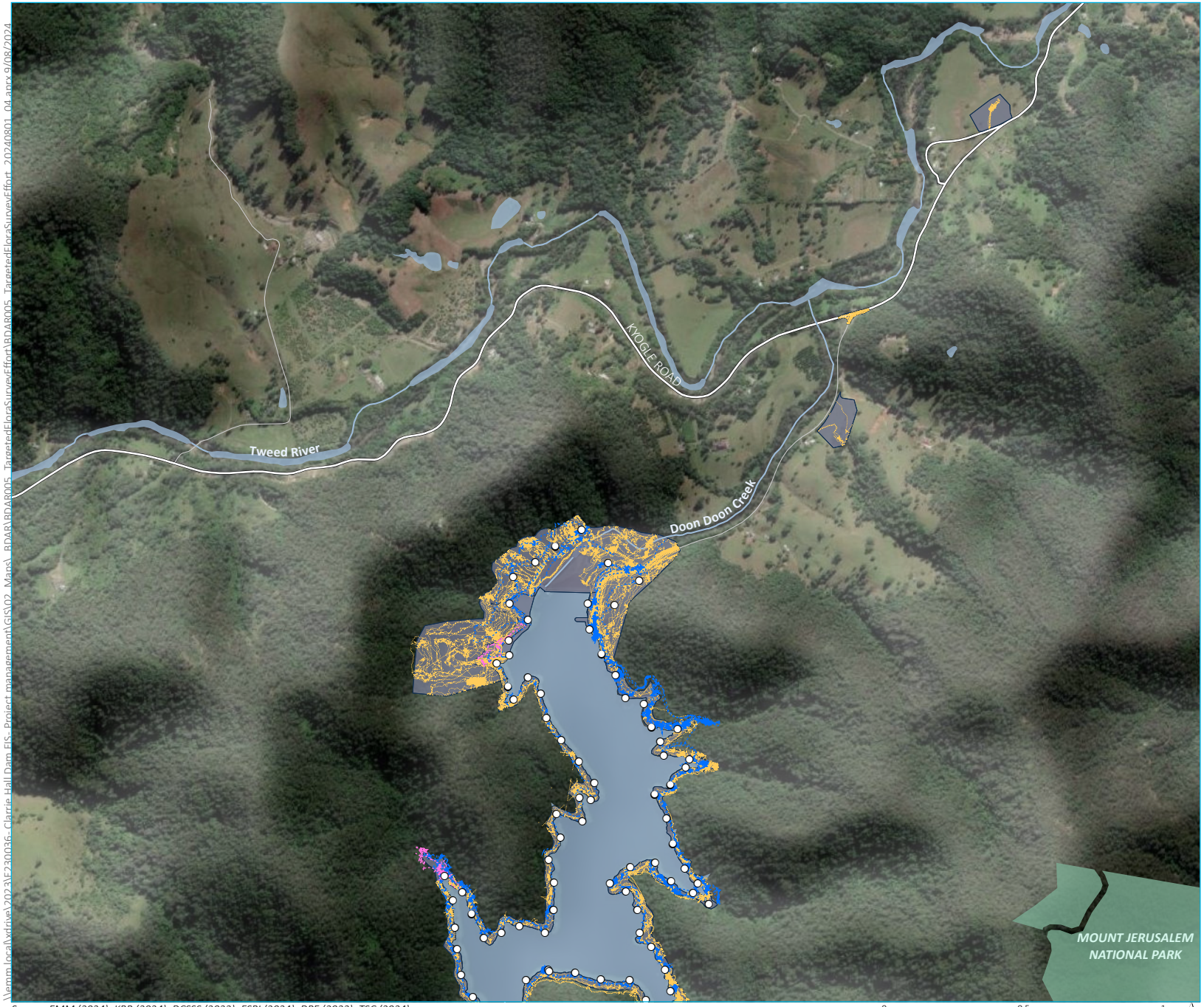
Scientific name	Common name	Specified survey months	Associated PCTs
Hibbertia hexandra	Tree Guinea Flower	All year	827, 1073
Hicksbeachia pinnatifolia	Red Boppel Nut	All year	827, 1073, 1302
Isoglossa eranthemoides	Isoglossa	September - November	1302
Lepiderema pulchella	Fine-leaved Tuckeroo	All year	827, 1302
Lindsaea brachypoda	Short-footed Screw Fern	All year	827, 1302
Macadamia integrifolia	Macadamia Nut	All year	Not associated with PCTs on the subject land. Species included due to the PMST and records existing within proximity to the subject land.
Macadamia tetraphylla	Rough-shelled Bush Nut	All year	827, 1073, 1302
Marsdenia longiloba	Slender Marsdenia	November - February	827, 1073, 1302
Melicope vitiflora	Coast Euodia	All year	1302
Myrsine richmondensis	Ripple-leaf Muttonwood	November - February	827, 1073, 1302
Niemeyera whitei	Rusty Plum, Plum Boxwood	All year	827, 1073, 1302
Oberonia complanata	Yellow-flowered King of the Fairies	All year	827, 1073, 1302
Oberonia titania	Red-flowered King of the Fairies	All year	827, 1073, 1302
Ochrosia moorei	Southern Ochrosia	All year	827, 1073, 1302
Owenia cepiodora	Onion Cedar	All year	827, 1073, 1302
Ozothamnus vagans	Wollumbin Dogwood	All year	1073, 1302
Phaius australis	Southern Swamp Orchid	September - October	827
Phyllanthus microcladus	Brush Sauropus	All year	1302
Plectranthus nitidus	Nightcap Plectranthus	All year	827, 1302
Pomaderris notata	McPherson Range Pomaderris	July - November	1302
Psilotum complanatum	Flat Fork Fern	February - December	1302
Randia moorei	Spiny Gardenia	All year	827, 1073, 1302
Rhodamnia maideniana	Smooth Scrub Turpentine	All year	827, 1073, 1302
Rhodamnia rubescens	Scrub Turpentine	All year	1073, 1302
Rhodomyrtus psidioides	Native Guava	All year	1073, 1302
Rhynchosia acuminatissima	Pointed Trefoil	September - February	827, 1073
Sarcochilus dilatatus	Brown Butterfly Orchid	December - March	1302
Senna acclinis	Rainforest Cassia	All year	827, 1073, 1302
Sophora fraseri	Brush Sophora	All year	827, 1073, 1302
Symplocos baeuerlenii	Small-leaved Hazelwood	All year	1302

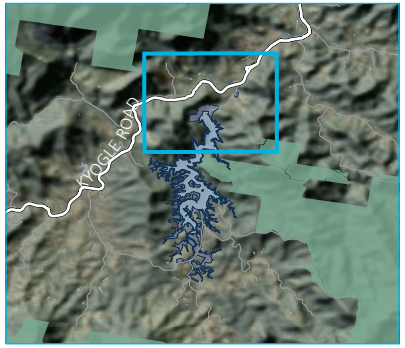
Scientific name	Common name	Specified survey months	Associated PCTs
Syzygium hodgkinsoniae	Red Lilly Pilly	All year	827, 1073, 1302
Syzygium moorei	Durobby	All year	827, 1073, 1302
Tinospora tinosporoides	Arrow-head Vine	All year	1302
Tylophora woollsii	Cryptic Forest Twiner	January - April	Not associated with PCTs on the subject land. Assumed to be associated with 827, 1073 and 1302 on a conservative basis.

f Identification

The flora surveys were undertaken within the specified survey months for the target species, increasing detectability and the ability to verify to species level. The Southern Swamp Orchid (*Phaius australis*) was surveyed for several days towards the end of the specified survey period of September to October, however the bulk of survey effort was within the November to January period. This will not impact detectability of the species given that the large terrestrial orchid has leaves that will persist over the summer months. Any orchid resembling the Southern Swamp Orchid (*Phaius australis*) was presumed to be the threatened species on a conservative basis.

In addition to using experienced field botanists, samples and photographs were also taken to assist with identification. Several samples were sent for confirmation at both the Queensland and NSW Herbarium. Advice was sought on identification of *Marsdenia longilobia* and *Tylophora* species given the similar vegetative characteristics. Identification characters and references for the various Endiandra species (*E. muelleri* subsp. *bracteata, Endiandra hayesii* and *E. pubens*) present on the subject land was also confirmed during the field surveys to ensure correct attribution of species.





KEY

Subject land

Flora Survey track

Rainforest and wet sclerophyll forest gulley

Tweed Shire Council (2016)

Large area- First phase

ELA (2020)

Survey vertex

Large area- Second phase

EMM (2023/2024)

Existing environment

Major road

Minor road

Named watercourse

Waterbody

NPWS reserve

Source: EMM (2024); KBR (2024); DCSSS (2023); ESRI (2024); DPE (2023); TSC (2024)

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Targeted flora survey effort

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Figure 5.1

EMM creating opportunities

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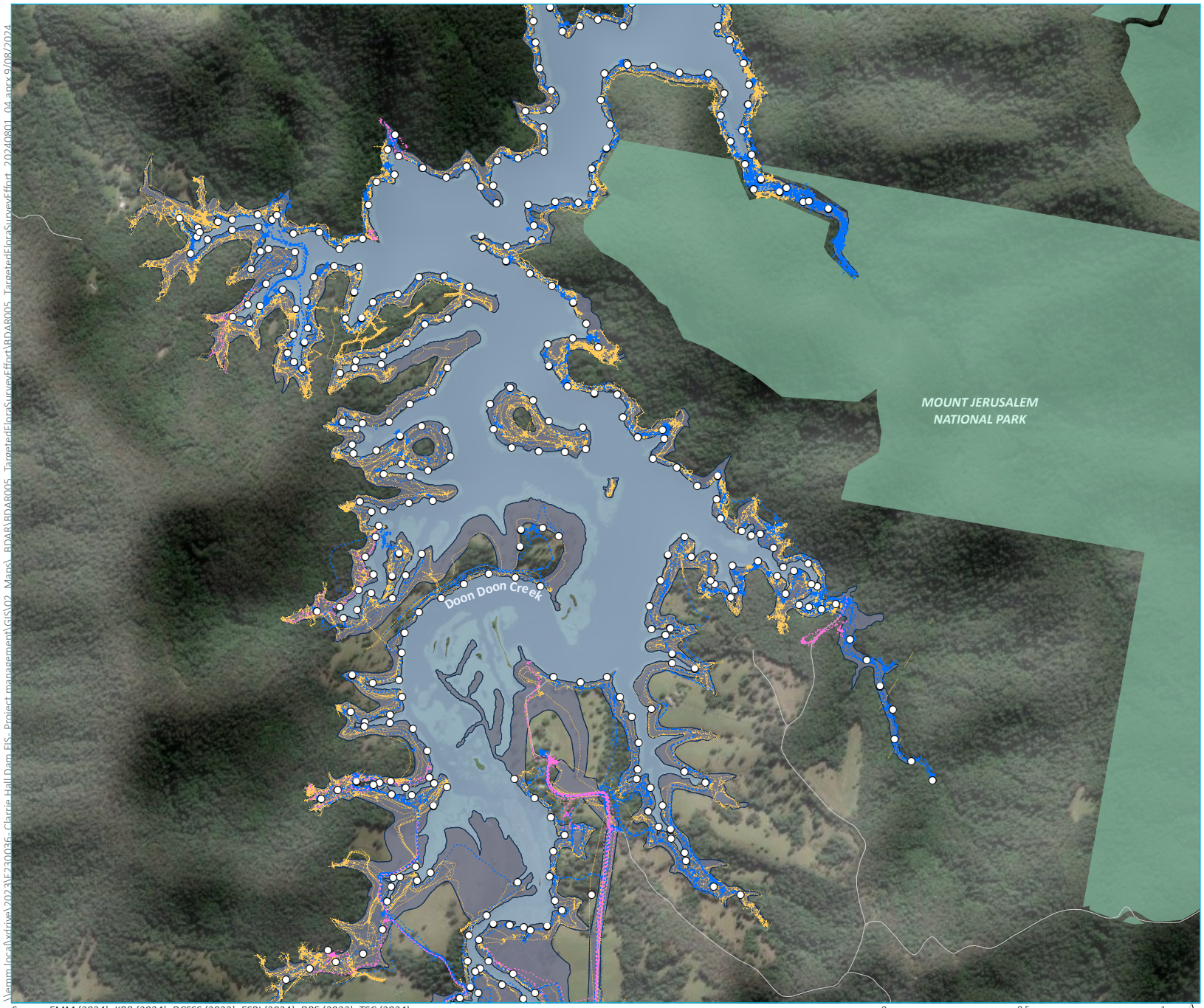

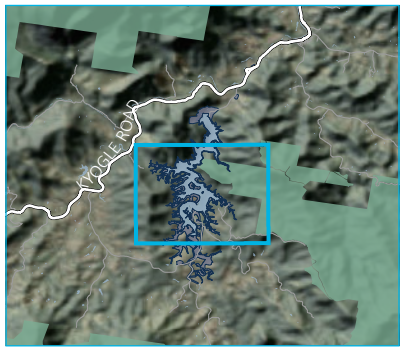

KEY

- Subject land
- Flora Survey track

Rainforest and wet sclerophyll forest gulley

- Tweed Shire Council (2016)

Large area- First phase

- ELA (2020)
- Survey vertex

Large area- Second phase

- EMM (2023/2024)

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody
- NPWS reserve

Source: EMM (2024); KBR (2024); DCSSS (2023); ESRI (2024); DPE (2023); TSC (2024)

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Targeted flora survey effort
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Figure 5.1

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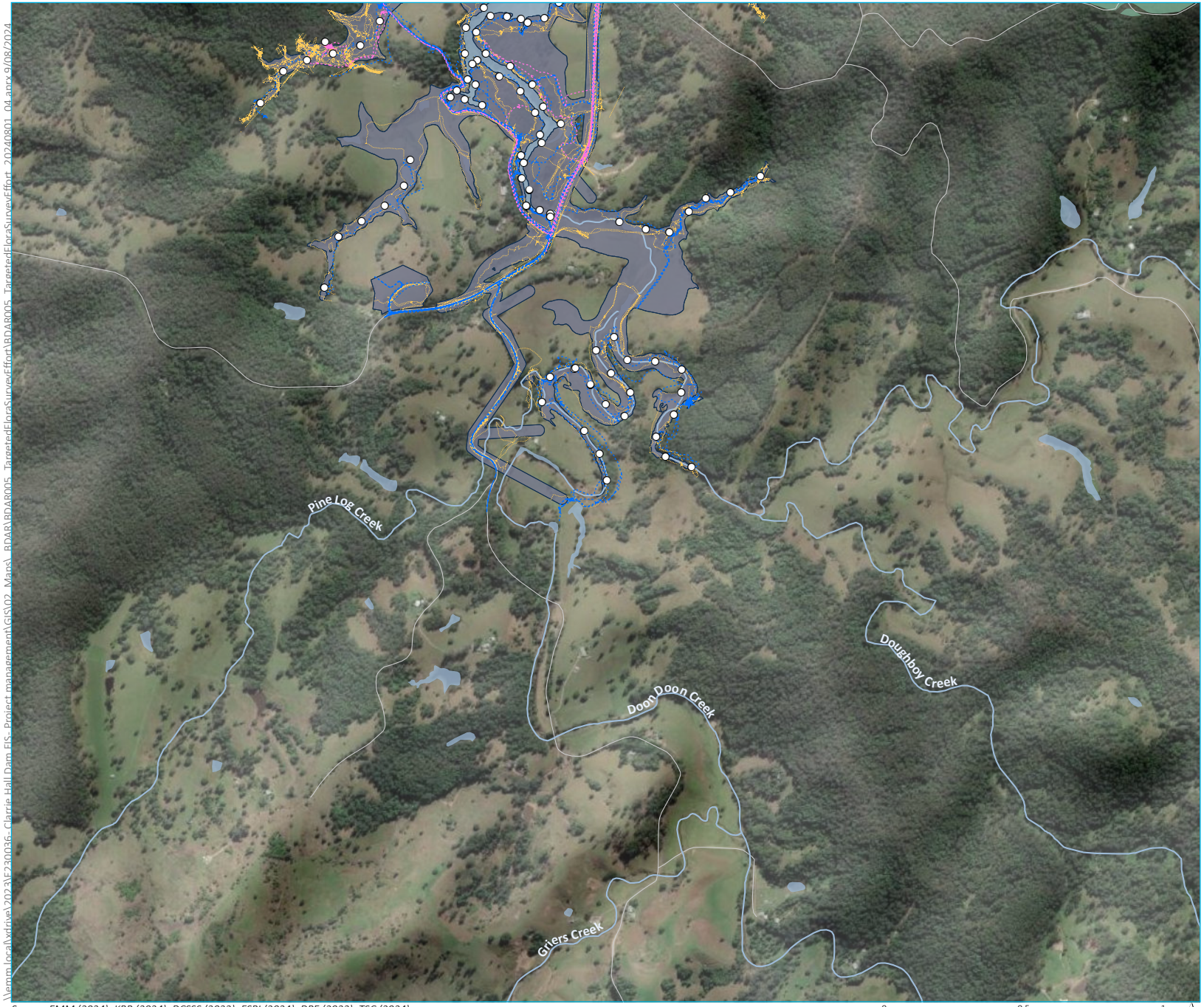

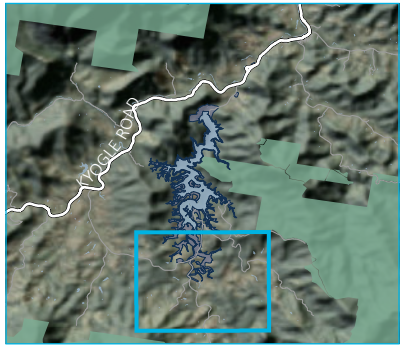

KEY

- Subject land

Flora Survey track

Rainforest and wet sclerophyll forest gulley
- Tweed Shire Council (2016)

Large area- First phase
- ELA (2020)
- Survey vertex

Large area- Second phase
- EMM (2023/2024)

Existing environment
- Major road
- Minor road
- Named watercourse
- Waterbody
- NPWS reserve

Source: EMM (2024); KBR (2024); DCSSS (2023); ESRI (2024); DPE (2023); TSC (2024)

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Targeted flora survey effort
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Figure 5.1

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ii Targeted fauna surveys

Targeted fauna surveys were undertaken between 2016 and 2024. Surveys have been conducted in accordance with various NSW and Commonwealth guidelines and are described in detail in the following sections.

Survey methods and effort were broadly developed based on vegetation stratification within the subject land. Stratification units and the area of each unit within the subject land is outlined in Table 5.7.

Table 5.7 Stratification units

Stratification unit/vegetation class	PCT Name	Vegetation formation	PCT impact area (ha)	Stratification unit area (ha)
North Coast Wet Sclerophyll Forests	827 Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast (including moderate, planted, burnt and high condition)	Wet Sclerophyll Forests (Shrubby sub-formation)	127.52	130.19
	1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion (high condition)	Wet Sclerophyll Forests (Shrubby sub-formation)	2.67	
Subtropical Rainforests	1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (moderate and high condition)	Rainforests	8.77	8.77
Total				**138.96**

a Summary of site based surveys

Threatened fauna surveys were undertaken by Tweed Shire Council between 21 November 2016 and 18 January 2017 aiming to detect a wide range of taxa as detailed in the *Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam* (Tweed Shire Council, 2017). The survey locations (Figure 5.2) were divided into core and ancillary sites with the range of techniques utilised at each of these locations summarised in Table 5.8.

Further detail on each of the survey methods conducted at these survey sites is provided in the relevant sections below for the target taxa.

Table 5.8 Fauna survey techniques utilised at each survey site

Method	Effort	Ancillary	Core
Diurnal bird survey (100 m x 200 m) 20 minutes repeated 3 times.	60 person minutes	✓	✓
Koala scat searches (100 m x 200 m)	30 trees	✓	✓
Camera trap (terrestrial) with universal and carnivore baits	16 nights	✓	✓
Reptile and amphibian searches 200 m x 100 m area. 30 minutes repeated 3 times 2 observers at core sites 1 observer at ancillary sites	180 minutes core 90 minutes ancillary	✓	✓
One Havahart® 80 cm cage trap (universal bait)	4 nights		✓

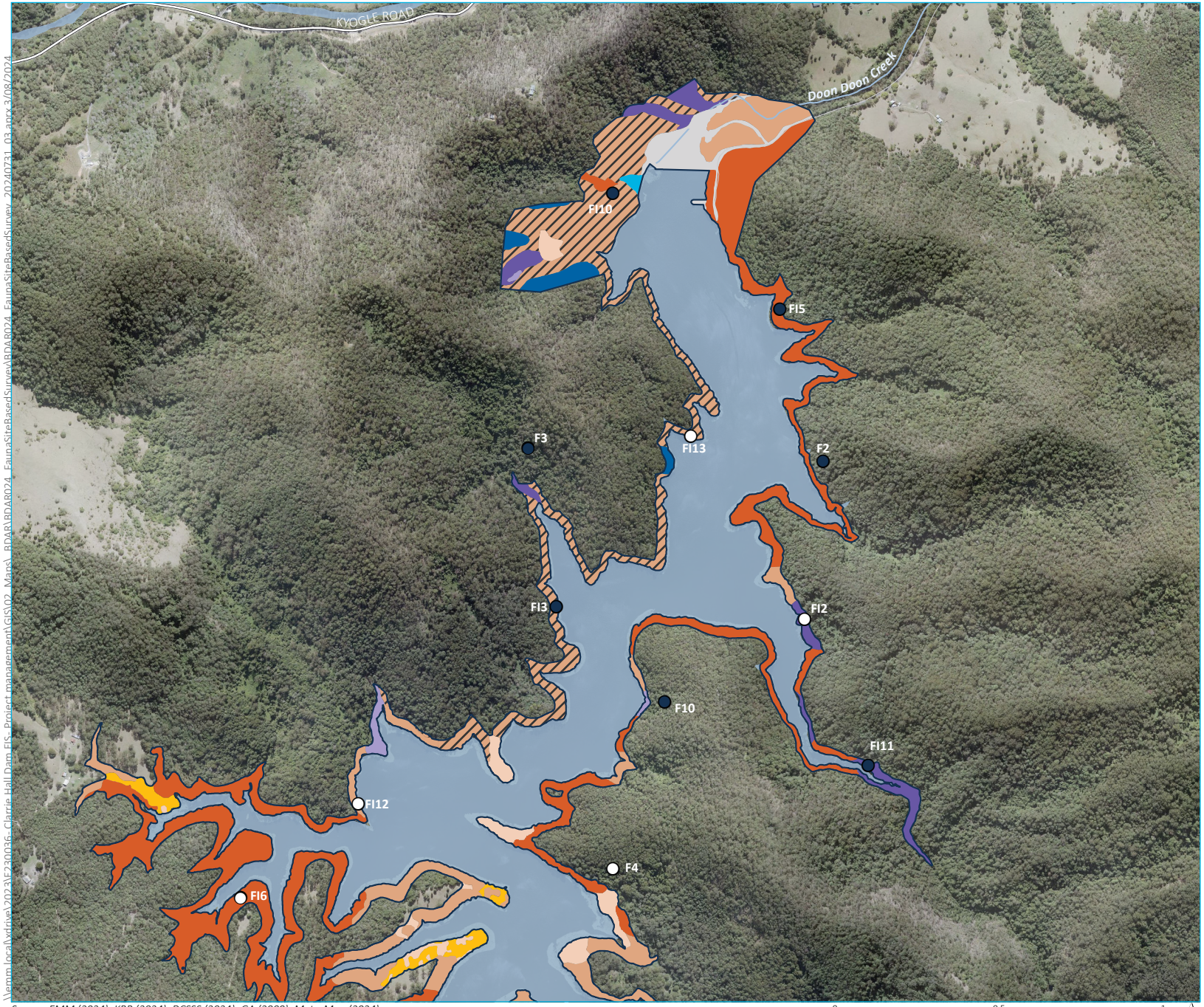
Method	Effort	Ancillary	Core
10 Elliot A traps – terrestrial (universal bait)	40 trap nights		✓
Five 20 L pitfall buckets with drift fence over four nights	20 trap nights		✓
Four funnel traps (associated with the drift fencing above)	16 nights		✓
Spotlighting, two people 200 m x 100 m area for 20 mins. Repeated 3 times	120 minutes		✓
Call play back prior to spotlighting	20 minutes		✓
Recording of tree hollows			✓

A total of 32 survey sites (Figure 5.2) were established within the subject land and in the surrounding area. For the purposes of the biodiversity assessment and quantification of fauna habitat effort, sites which are located within the subject land or within 100 m of the subject land have been included for stratification of fauna effort and are considered representative. Disjunct sites (>100 m) have been included within Figure 5.2 as they may assist in assessment of highly mobile species.

Table 5.9 provides a summary of the number of survey sites within each of the vegetation stratification units.

Table 5.9 Survey sites per stratification unit

Stratification unit	Ancillary site	Core site	Total
North Coast Wet Sclerophyll Forests (including moderate, burnt and high condition)	5	10	**15**
Subtropical Rainforests (high and moderate condition)	1	2	**3**
Pasture	2	4	**6**
Subtotal			**24**
Disjunct from the subject land (>100 m) and excluded from the assessment	5	3	**8**
Subtotal			**8**
Total			**32**



KEY

- Subject land

Fauna site based survey

Sites within and immediatly adjacent to the subject site
- Ancillary site
- Core site

Sites disjunct from the subject site and excluded from the assessment
- Ancillary site
- Core site

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast
- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion
- High
- Moderate

PCT 1073 | Pink Bloodwood- Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
- High

Other
- Cleared
- Water

Existing environment
- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

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Fauna site based surveys
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Figure 5.2

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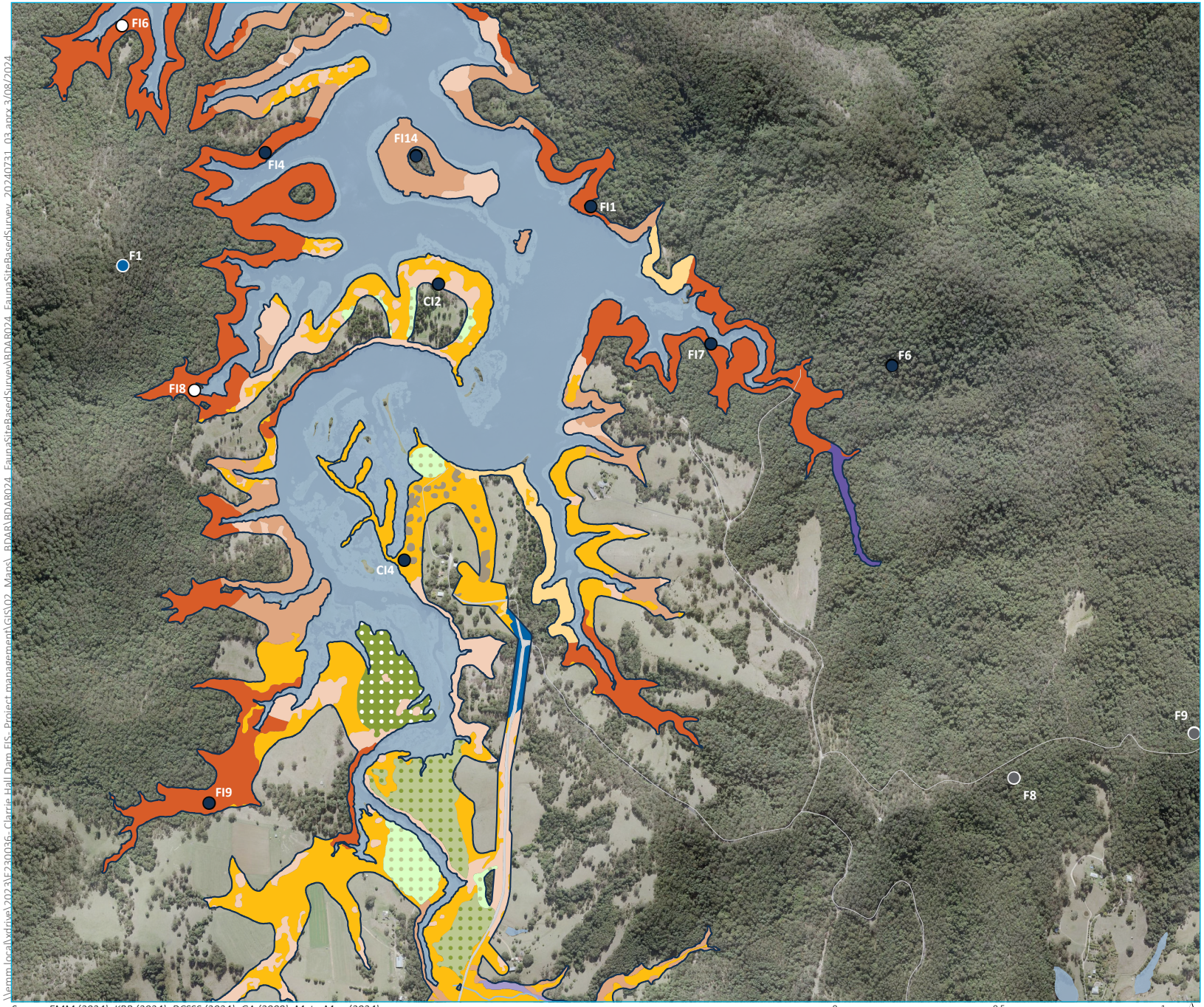

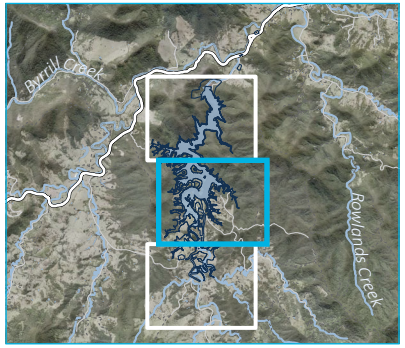

KEY

- Subject land

Fauna site based survey

Sites within and immediatly adjacent to the subject site
- Ancillary site
- Core site

Sites disjunct from the subject site and excluded from the assessment
- Ancillary site
- Core site

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast
- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion
- High
- Moderate

PCT 1073 | Pink Bloodwood- Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
- High

Other
- Eucalyptus plantation
- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

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Fauna site based surveys
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Figure 5.2

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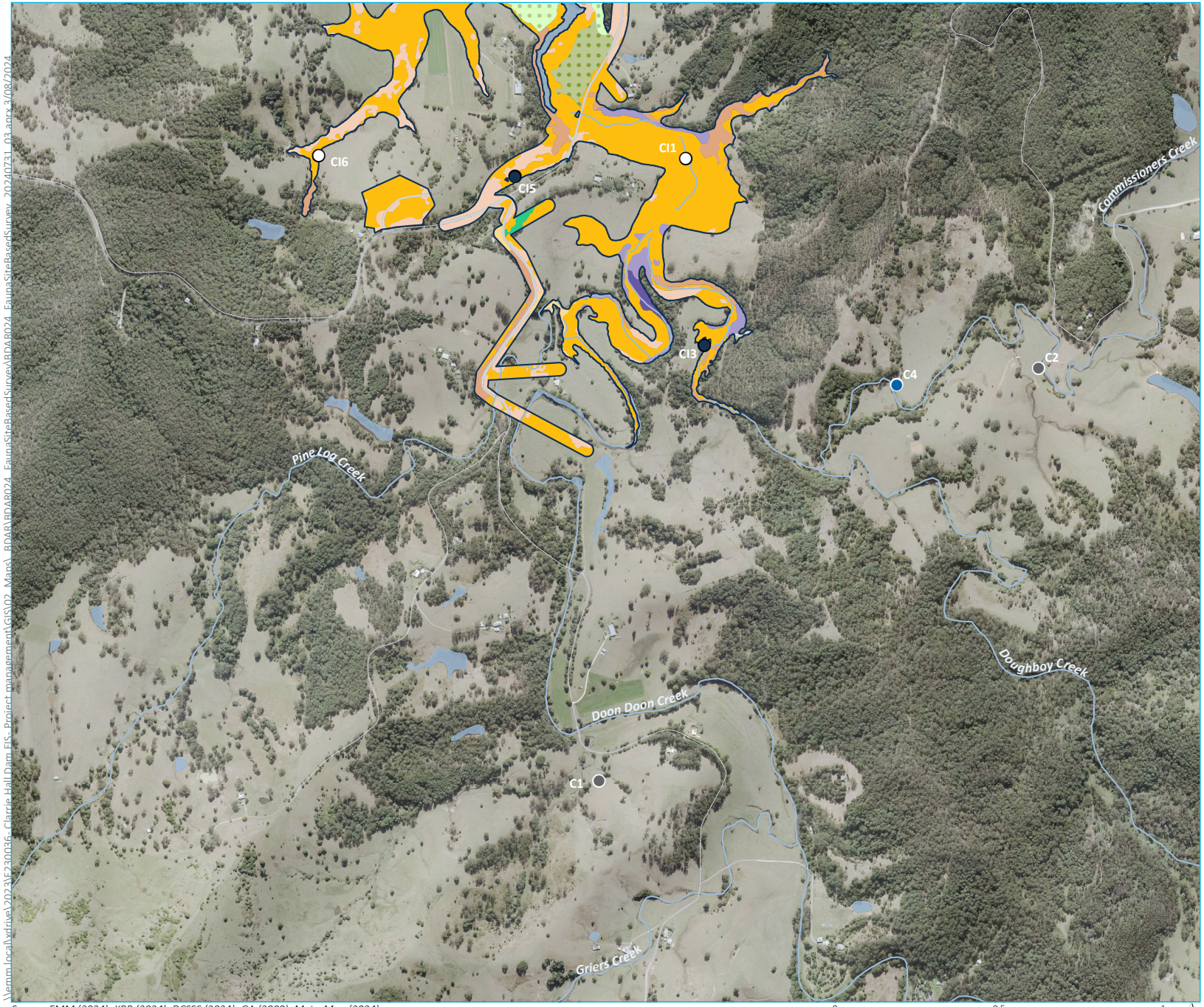

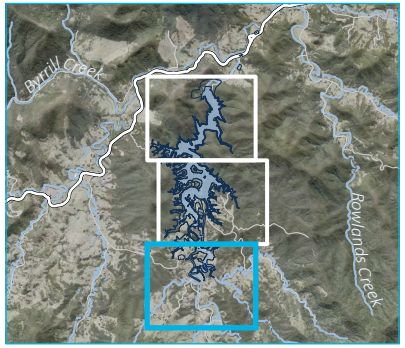

KEY

- Subject land

Fauna site based survey

Sites within and immediatly adjacent to the subject site
- Ancillary site
- Core site

Sites disjunct from the subject site and excluded from the assessment
- Ancillary site
- Core site

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast
- Moderate
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion
- High
- Moderate

Other
- Eucalyptus plantation
- Hoop plantation
- Exotic trees
- Cleared

Existing environment
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

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Fauna site based surveys
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Clarrie Hall Dam EIS
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Figure 5.2

EMM creating opportunities

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b Diurnal birds

Diurnal bird surveys were undertaken for the following species:

- Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*)
- White-eared Monarch (*Carterornis leucotis*)
- Coxen's Fig-Parrot (*Cyclopsitta diophthalma coxeni*)
- Red Goshawk (*Erythrotriorchis radiatus*)
- White-bellied Sea-eagle (*Haliaeetus leucogaster*)
- Little Eagle (*Hieraaetus morphnoides*)
- Square-tailed Kite (*Lophoictinia isura*)
- Albert's Lyrebird (*Menura alberti*)
- Black-breasted Button-quail (*Turnix melanogaster*).

Specific guidelines for the survey of threatened diurnal bird species are currently being developed by DPIE. In the interim, survey methods and survey effort have been developed in accordance with DEC (2004), DEWHA (2010) and TBDC (DCCEEW, 2024a) guidelines. Methods include a mix of area searches and transects to record bird activity, and habitat assessments involving targeted nest searches for the hollow nesting birds and birds of prey. Methods and survey effort are outlined in Table 5.10 and the survey locations are displayed on Figure 5.3.

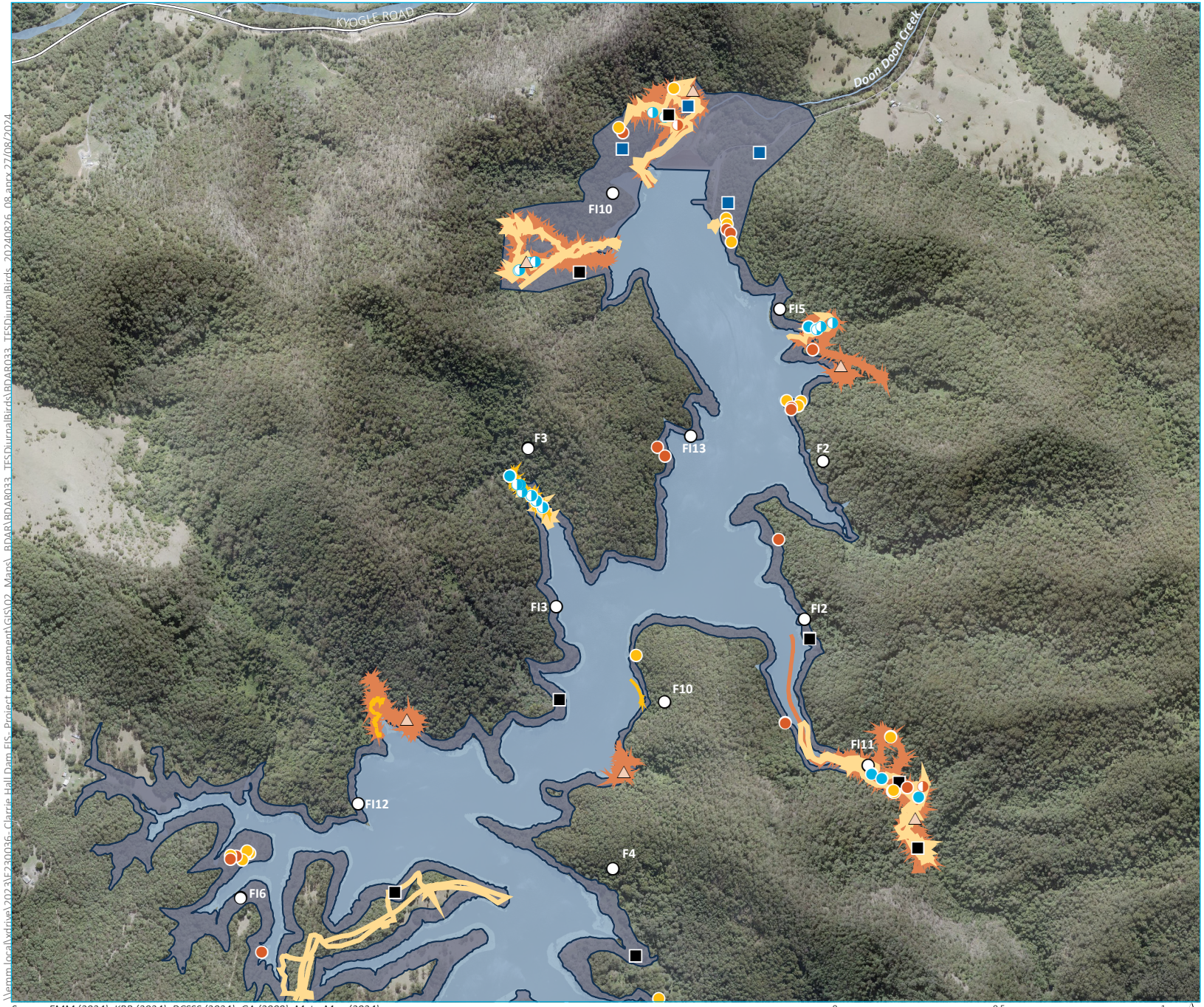
Table 5.10 Methods and survey effort – diurnal birds

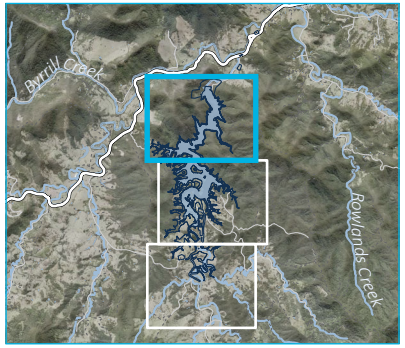
Target species	Survey method and guidelines	Survey effort
• White-eared Monarch • Coxen's Fig-Parrot • Black-breasted Button-quail • Albert's Lyrebird	**Diurnal bird area searches** The DEC (2004) draft guidelines have not resolved bird survey requirements and does not provide guidance on survey effort. The Commonwealth Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010) was reviewed and sympatric species survey efforts indicated a requirement for 8 hours of area searches to be undertaken over at least four days for sites less than 50 ha.	**Site based survey** Diurnal bird area searches were undertaken within a 200 m by 100 m area for a duration of 20 minutes at each of the core and ancillary sites (Figure 5.2). Techniques included looking for individuals or signs of presence and listening for calls of the species. The survey was repeated three times at each site on different days. Surveys were conducted between 21 November and 18 January 2017, between dawn and 10:30 am. Days with windy or rainy weather were avoided. **North Coast Wet Sclerophyll Forests** • 15 sites • 15 person hours **Subtropical Rainforests** • 3 sites • 3 person hours

Target species	Survey method and guidelines	Survey effort
• Albert's Lyrebird (targeted) • White-eared Monarch • Coxen's Fig-Parrot • Black-breasted Button-quail	**Winter diurnal bird area searches** Albert's Lyrebird requires survey during winter (July – August, TBDC (DCCEEW, 2024a)) when it is most detectable. In order to bolster survey effort for this species, additional surveys were conducted in August 2023. Eight locations were selected, preferentially selecting rainforest and more mesic wet sclerophyll forest gullies, likely to be optimal for the species. Surveys commenced shortly after dawn. A period of listening of five minutes (inclusive of 30 minutes survey effort) was undertaken on arrival for Albert's Lyrebird before commencing further visual and aural surveys where two observers looked for individuals and signs of presence and listened for calls of the species.	Observers conducted the area searches over five days between 6:00 am and 8:30 am in August 2023. Each of the eight sites were surveyed for thirty minutes with two observers. This was then repeated on a separate day. Total effort was 16 person hours.
Target species • Coxen's Fig-Parrot (target) **Incidental species targets** • White-eared Monarch • Black-breasted Button-quail	Specific surveys methods for Coxen's Fig Parrot exist under the Commonwealth Survey guidelines for Australia's threatened birds (DEWHA, 2010). The guidelines specify a two-stage process which has been implemented. **Stage 1 – Area searches** Area searches were conducted in which observers traversed suitable habitat and recorded the locations of fig trees and any other notable winter flowering or fruiting species suitable for Coxen's Fig Parrot. These are displayed in Figure 5.3. **Stage 2 – Targeted Searches** Targeted searches were undertaken in the areas in which fruiting fig trees were recorded. Observers positioned themselves nearby fig tree records and kept watch for individuals of the species, signs of presence and listened for calls of the species. Observers took records of all bird species found to utilise the trees. Surveys were completed during July and August 2023.	**Area searches** Area searches were undertaken over several days with effort totalling over 20 person hours. Any fig trees or other fruiting trees were recorded with GPS with any relevant details regarding habitat suitability taken to inform the subsequent survey. **Targeted searches** Two observers conducted three hours of targeted searches. Each observer focused on different aggregations of trees. This was repeated over four days. Approximately 24 person hours was conducted.
• Black-breasted Button-quail • Albert's Lyrebird.	**Terrestrial camera trapping** Detailed camera trapping survey effort is described for terrestrial mammals in Table 5.12.	**North Coast Wet Sclerophyll Forests** • 2016/2017: 15 sites, 240 trap nights • 2017: 3 sites, 48 trap nights • 2024: 15 sites, 225 trap nights • **Total:** 33 sites, 513 trap nights **Subtropical Rainforests** • 2016/2017: 3 sites, 48 trap nights • 2017:1 site, 16 trap nights • 2024: 13 sites, 195 trap nights • **Total:** 17 sites, 259 trap nights

Target species	Survey method and guidelines	Survey effort
• White-bellied Sea-eagle (breeding) • Square-tailed Kite (breeding) • Little Eagle (breeding)	**Raptor habitat assessment** For the raptor species, species credits are generated for the presence of breeding within the subject land. Breeding presence for each species as defined by the TBDC (DCCEEW, 2024a) consists of: • White-bellied Sea-eagle – Live, large, old trees within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines, and – The presence of a large stick nest within the tree canopy; or an adult observed with nest material, or adults observed duetting during the breeding period. • Square-tailed Kite – Live, large, old trees within suitable vegetation, and – Presence of a male and female; or a female observed with nesting material; or an individual on a large stick nest in the top half of the tree canopy. • Little Eagle – Live (occasionally dead), large, old trees within suitable vegetation, and – Presence of a male and female; or any adult observed with nesting material; or an individual on a large stick nest in the top half of the tree canopy; or pairs displaying breeding behaviour. Habitat assessment was conducted to identify the presence or absence of stick nests used for breeding. To conduct the habitat assessment, observers traversed the subject land scanning the canopy for large stick nests. The GPS location of the tree and details pertaining to the occupancy of the nest were recorded if a suitable nest was located.	No stratification units were defined for these species as breeding habitat is not strictly dependent on stratification unit, rather the presence of stick nests. The entire subject land was traversed identifying potential stick nests between 2016 and 2024 (albeit not continuously). Survey effort is cumulative between 2016 and 2024 and totals several months of person effort.
• Glossy Black-Cockatoo (breeding)	**Habitat assessment (2020)** Glossy Black-Cockatoo have been identified within the Subject Land during field surveys in 2016/2017 and 2020. This species is a dual credit species with species credits generated for breeding habitat only. As such, habitat assessment was undertaken across the subject land to identify and record all hollow bearing trees containing hollows with an entrance diameter of 100 mm or larger. For each tree containing suitable hollows, the species, diameter at breast height (DBH) and GPS location of the tree was recorded.	No stratification units were defined for this species as habitat is not dependent on stratification unit, rather the presence of suitable hollow bearing trees. This survey was conducted over a five-day period from 21–25 July 2020.

Target species	Survey method and guidelines	Survey effort
	Nesting survey (2020) Transects were undertaken by traversing the shoreline of the Dam via boat, with observers scanning the vegetation for individuals. Each HBT was inspected for evidence of breeding (such as lone males, begging birds, or an occupied hollow) for approximately ten minutes. Any other evidence of the species' occupation within the subject land (such as feeding individuals in *Allocasuarina/ Casuarina* species) was also recorded.	A total of 48 suitable hollow bearing trees recorded. Each suitable hollow bearing tree was assessed for evidence of breeding for approximately 10 minutes. This survey was conducted in conjunction with the hollow assessment, over a five-day period from 21–25 July 2020.
	Nesting hollow assessment for Glossy Black-Cockatoo (July/August 2023) It was deemed necessary to bolster the survey effort to determine if Glossy Black-Cockatoo were utilising the subject land for nesting. A total of 48 HBTs were identified as containing at a hollow of at least 10 cm in diameter. Each of the HBTs were visited during the day, assisted with binoculars to determine which are potential nest trees as defined in the TBDC (DCCEEW, 2024a). Potential nest trees contain hollows that are: 1. at least 8 m above the ground; and 2. in stems with a diameter of at least 30 cm; and 3. hollow diameter is at least 15 cm; and 4. stem angle is at least 45 degrees and may be near-vertical or vertical. During all surveys ecologists also recorded any signs of breeding, including begging birds of any age or sex or lone adult males identified during the breeding season (April to August).	Hollows were viewed during over a period of four days with two observers from 31 July to 3 August 2023.
	Dusk hollow watches (July/August 2023) Of the 48 HBTs identified as containing hollows greater than 10 cm diameter, 21 were considered as having potential to support nesting for the Glossy Black-Cockatoo. Each of the 21 hollows, or collection of hollows where they were visible simultaneously, were watched for a period of 30 minutes at dusk.	Approximately eight person hours of effort was undertaken over four nights between 31 July 2023 and 3 August 2023.





KEY

- Subject land

Diurnal bird searches and terrestrial camera trapping (site based) (2016/2017)

Sites within and immediatly adjacent to the subject site

- Ancillary and core

Camera trapping

- Terrestrial camera trapping (2024)
- Terrestrial camera trapping (2017)

Coxen's Fig Parrot (2023)

- Ficus coronata (Fruiting)
- Ficus coronata (Not fruiting)
- Ficus watkinsiana (Not fruiting)
- Coxen Fig Parrot area search
- Coxen Fig Parrot targeted search

Nesting hollow assessment for Glossy Black Cockatoo (2023)

- Suitable Glossy Black-Cockatoo Hollow
- Other Hollow-bearing Tree

Winter diurnal bird (2023)

- Winter Diurnal bird area search
- Winter Diurnal bird targeted search

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

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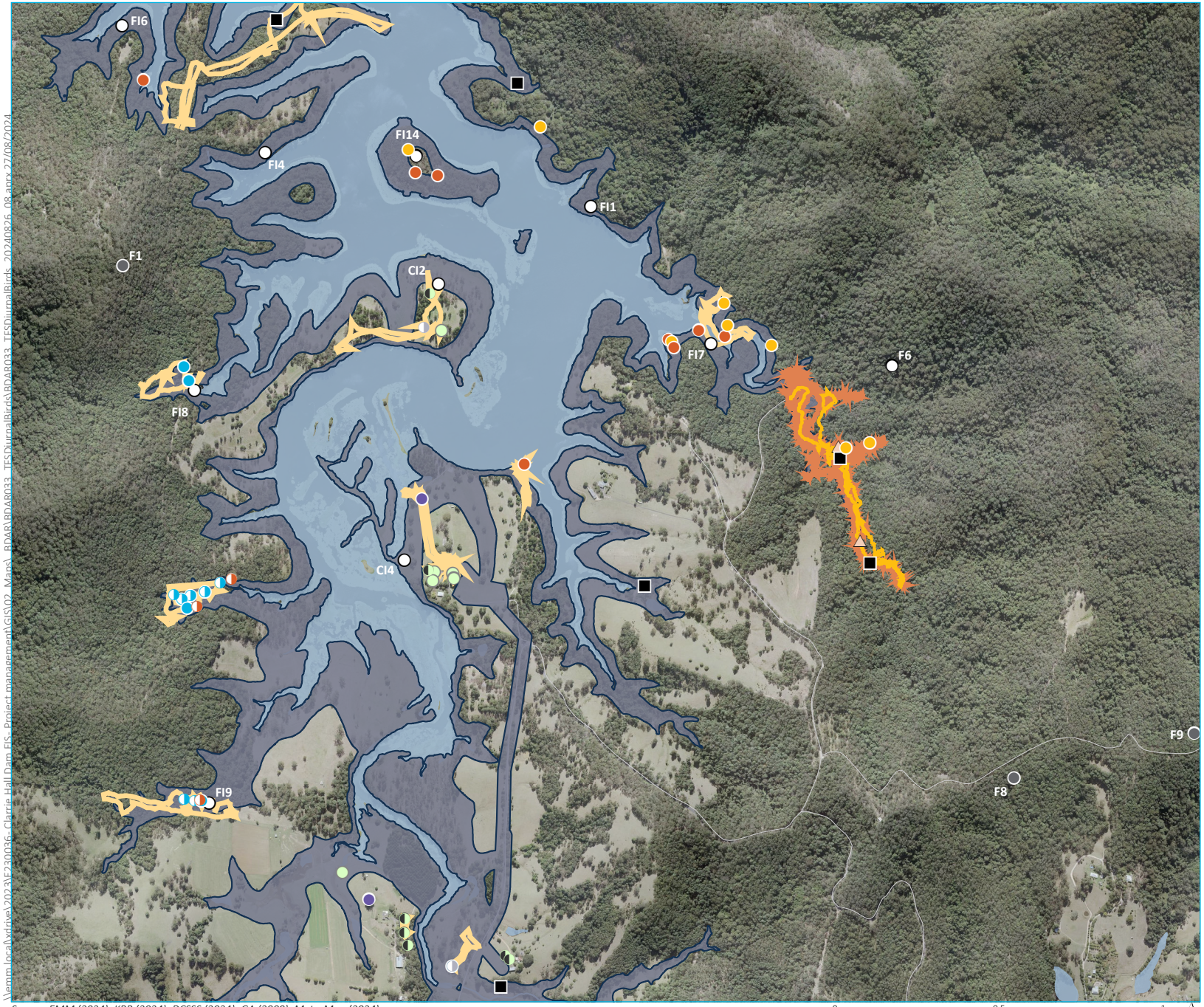
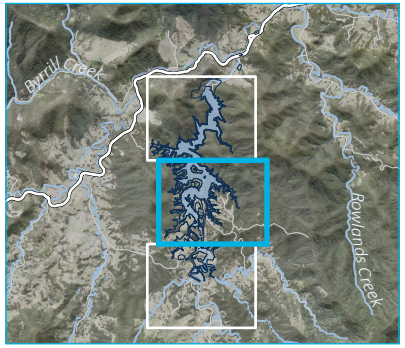
Targeted fauna surveys - Diurnal birds Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.3

EMM
creating opportunities





KEY

Subject land

Diurnal bird searches and terrestrial camera trapping (site based) (2016/2017)

Sites within and immediatly adjacent to the subject site

- Ancillary and core

Sites disjunct from the subject site and excluded from the assessment

- Ancillary and core site

Camera trapping

- Terrestrial camera trapping (2024)

Coxen's Fig Parrot (2023)

- Ficus coronata (Fruiting)
- Ficus coronata (Not fruiting)
- Ficus macrophylla (Fruiting)
- Ficus macrophylla (Not fruiting)
- Ficus rubinigosa (Fruiting)
- Ficus obliqua (Not fruiting)
- Ficus watkinsiana (Not fruiting)
- Coxen Fig Parrot area search
- Coxen Fig Parrot targeted search

Nesting hollow assessment for Glossy Black Cockatoo (2023)

- Suitable Glossy Black-Cockatoo Hollow
- Other Hollow-bearing Tree

Winter diurnal bird (2023)

- Winter Diurnal bird area search
- Winter Diurnal bird targeted search

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Targeted fauna surveys - Diurnal birds

Page 2 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.3

EMM creating opportunities

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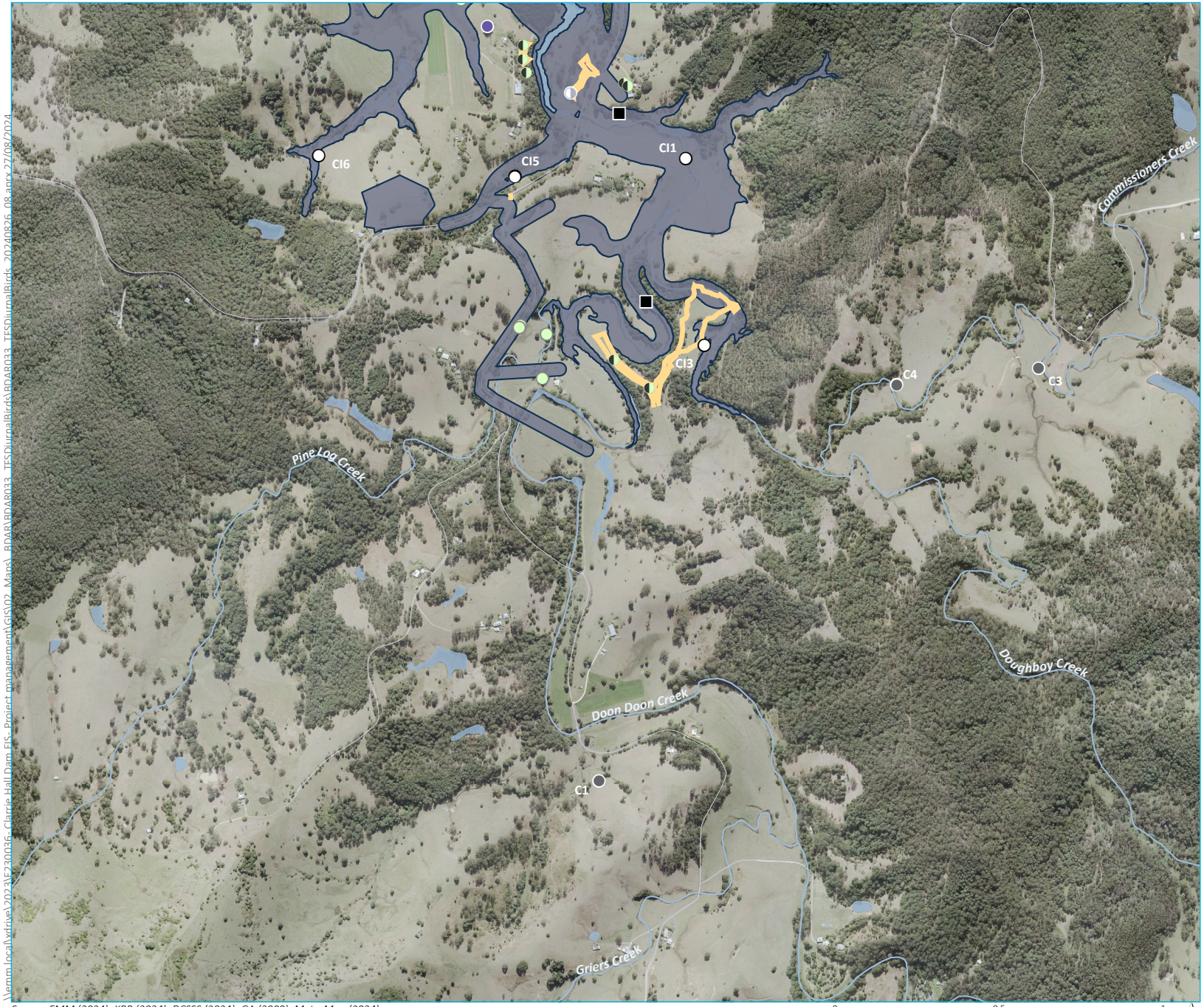

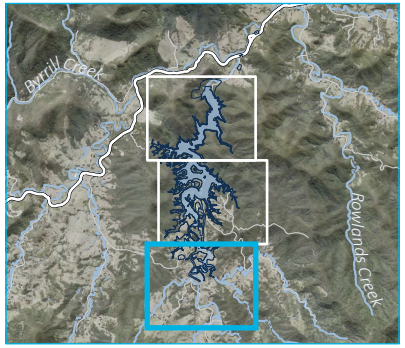

KEY

Subject land

Diurnal bird searches and terrestrial camera trapping (site based) (2016/2017)

Sites within and immediatly adjacent to the subject site

- Ancillary and core

Sites disjunct from the subject site and excluded from the assessment

- Ancillary and core site

Camera trapping

- Terrestrial camera trapping (2024)

Coxen's Fig Parrot (2023)

- Ficus coronata (Fruiting)
- Ficus macrophylla (Fruiting)
- Ficus macrophylla (Not fruiting)
- Ficus rubinigosa (Fruiting)
- Ficus obliqua (Not fruiting)
- Coxen Fig Parrot area search
- Coxen Fig Parrot targeted search

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

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Targeted fauna surveys - Diurnal birds

Clarrie Hall Dam EIS
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Figure 5.3

EMM creating opportunities

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c Nocturnal birds

Nocturnal bird surveys were undertaken for the following species:

- Powerful Owl (*Ninox strenua*)
- Barking Owl (*Ninox connivens*)
- Masked Owl (*Tyto novaehollandiae*)
- Sooty Owl (*Tyto tenebricosa*).

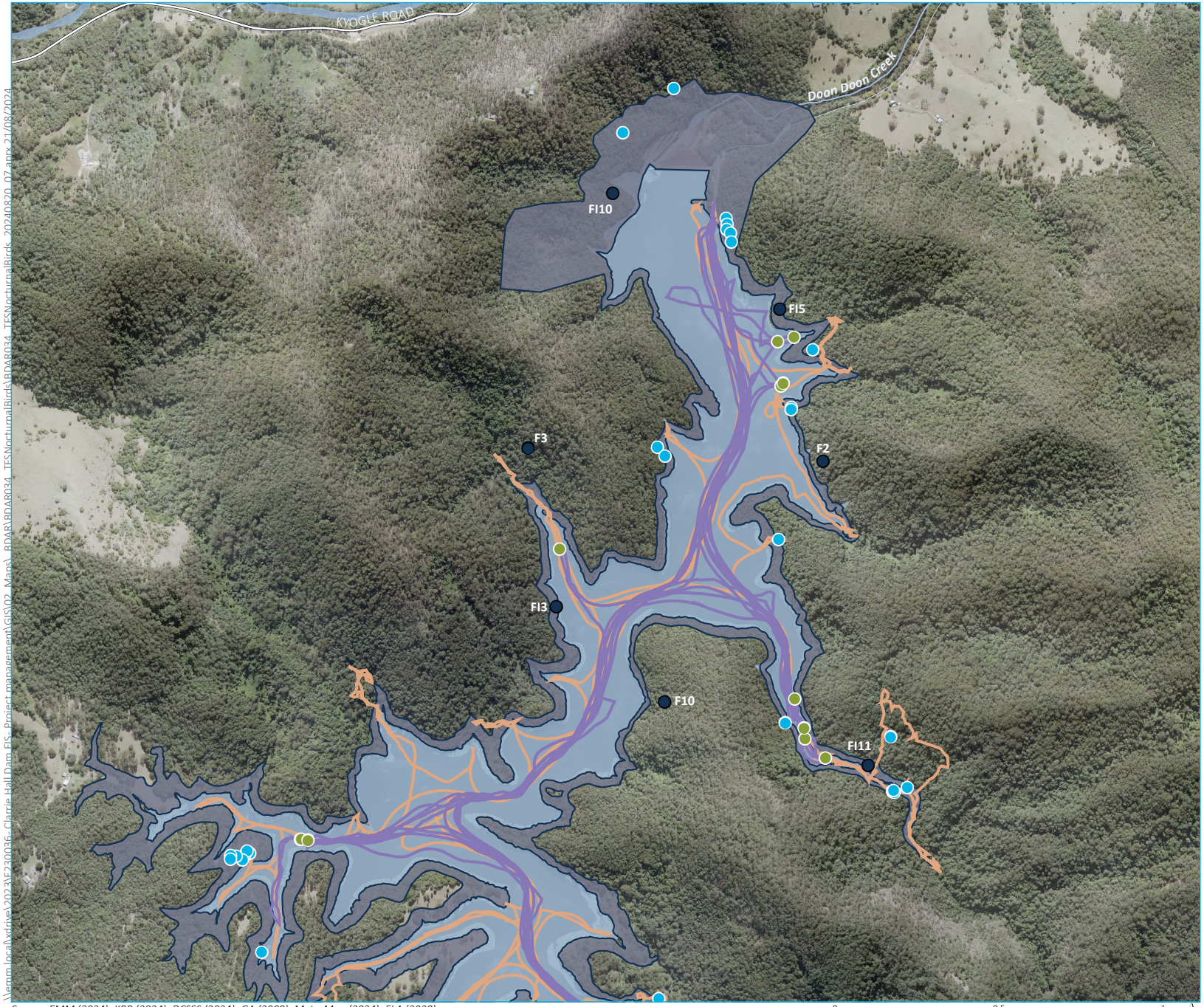
Nocturnal bird survey methods and survey effort was developed in accordance with the DEC guidelines (2004) and in consultation with BCD. This was prior to the publication of the new survey guidelines released in the TBDC in March 2024 (DCCEEW, 2024a). Notwithstanding, the results and species polygons will be interpreted and constructed in accordance with the new guidelines.

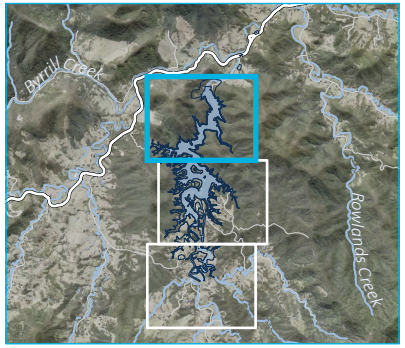
Methods and survey effort are outlined in Table 5.11 and the survey locations are displayed in Figure 5.4.

Table 5.11 Methods and survey effort – nocturnal birds

Target species	Survey method	Survey effort
All species	**Call playback and spotlighting – Core sites 2016/2017** Call playback and spotlighting surveys were undertaken at each core site, repeated over three non-consecutive nights. Calls of the candidate species were played for two minutes followed by two minutes of listening. Spotlighting was undertaken for a period of 20 minutes with two observers.	**North Coast Wet Sclerophyll Forests** • 10 sites • 20 person hours **Subtropical Rainforests** • 2 sites • 4 person hours
All species	**Breeding habitat survey - March 2020** Hollow-bearing trees with hollows greater than 100 mm in diameter were mapped. Where identified, the following information was collected for each potential breeding tree: • tree species • diameter at breast height (DBH) in cm • number and size class of hollows • GPS location • assessed for signs of use by owl species, including the presence of whitewash, pellets and feathers in the vicinity of the tree.	Surveys were conducted by two observers in March 2020. Four days of surveys conducted by two observers between 9–13 March 2020.
All species	**Call playback and spotlighting: 21 – 24 July 2020** Call playback was conducted at five sites (refer to Figure 5.4). Three of the sites were repeated over four nights, one site was repeated three times with one site surveyed once. The five sites were selected due to their close proximity to hollow bearing tree with potential to be used for breeding. At each call playback site, a 30 minute survey was undertaken, whereby contact calls for Masked Owl and Sooty Owl were played using a loudhailer. Powerful Owl and Barking Owl calls were also undertaken. Call payback involved playing the species call for a period of 2 minutes, followed by 5 minutes of silence. If recorded, the location and number of the target species was also noted. Call playback sites were prioritised in areas where hollow-bearing trees of suitable size were observed.	Four evenings of survey conducted between 21–24 July 2020. A total of 8 hours of call playback effort was conducted.

Target species	Survey method	Survey effort
	A spotlighting circumnavigation of the Dam shoreline was completed after call playback using a small open boat. The use of the boat provides a good line of sight, as well as ease of access throughout the inundation area.	





KEY

- Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Core site

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

- Core site

2020 survey

- Call playback site
- Potential owl hollow
- Diurnal survey
- Spotlighting track

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020)

0 0.5 1 km

GDA2020 MGA Zone 56

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Targeted fauna surveys-
Nocturnal birds
Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.4

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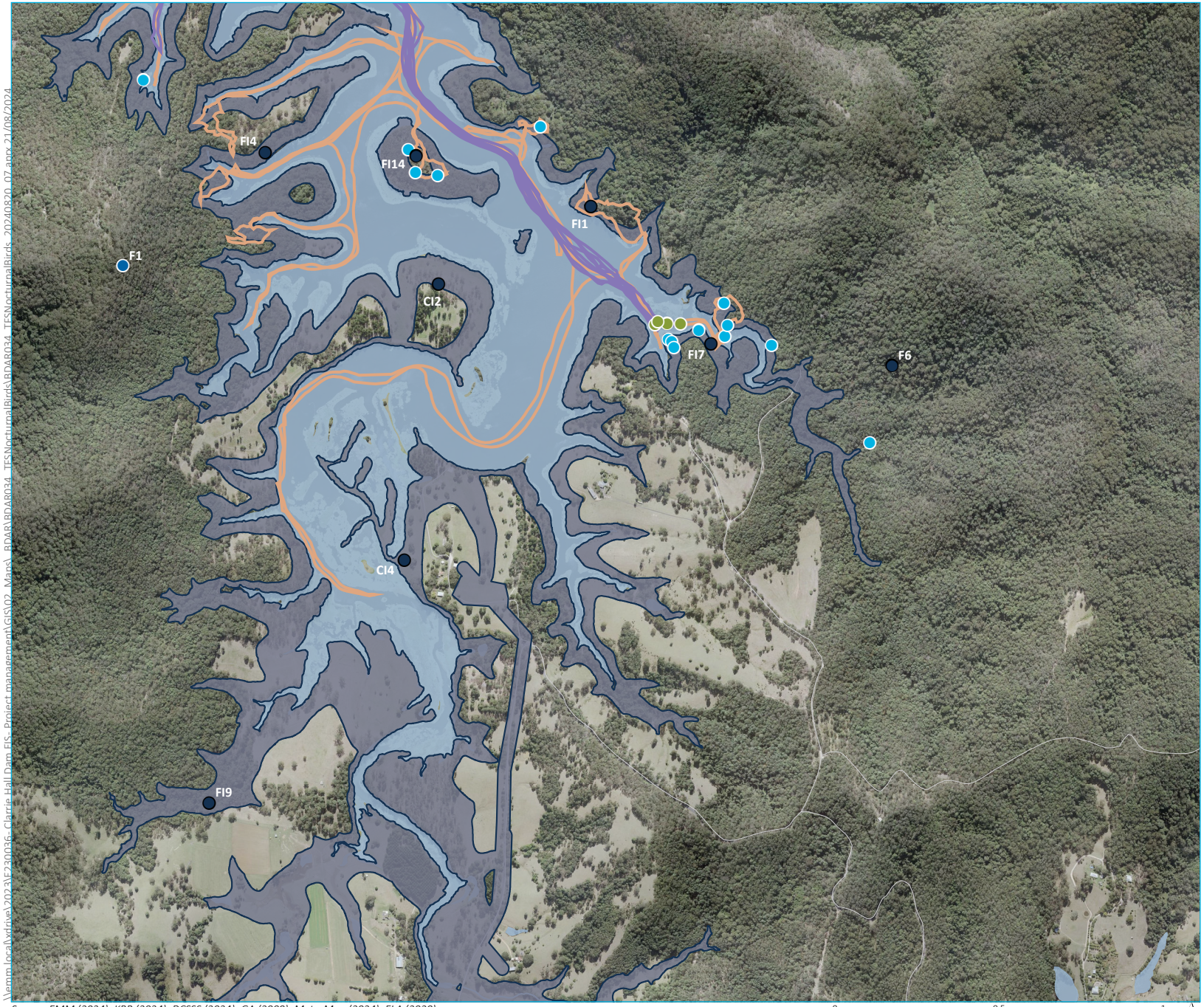
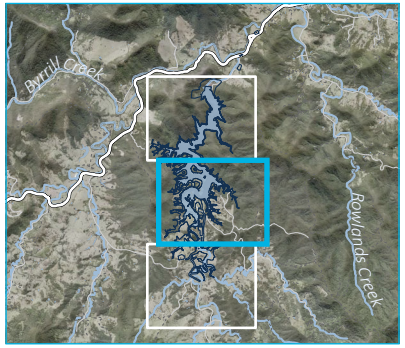
creating opportunities





KEY

- Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Core site

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

- Core site

2020 survey

- Call playback site
- Potential owl hollow
- Diurnal survey
- Spotlighting track

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Targeted fauna surveys-
Nocturnal birds
Page 2 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.4

EMM
creating opportunities

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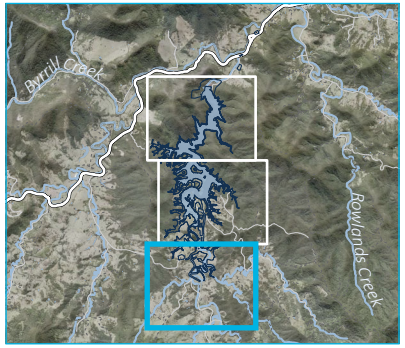

KEY

Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

Core site

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

Core site

2020 survey

Call playback site

Potential owl hollow

Diurnal survey

Spotlighting track

Existing environment

Major road

Minor road

Named watercourse

Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020)

0 0.5 1 km

GDA2020 MGA Zone 56

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Targeted fauna surveys- Nocturnal birds
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Figure 5.4

EMM creating opportunities

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d Terrestrial mammals

Terrestrial mammal surveys were undertaken for the following target species:

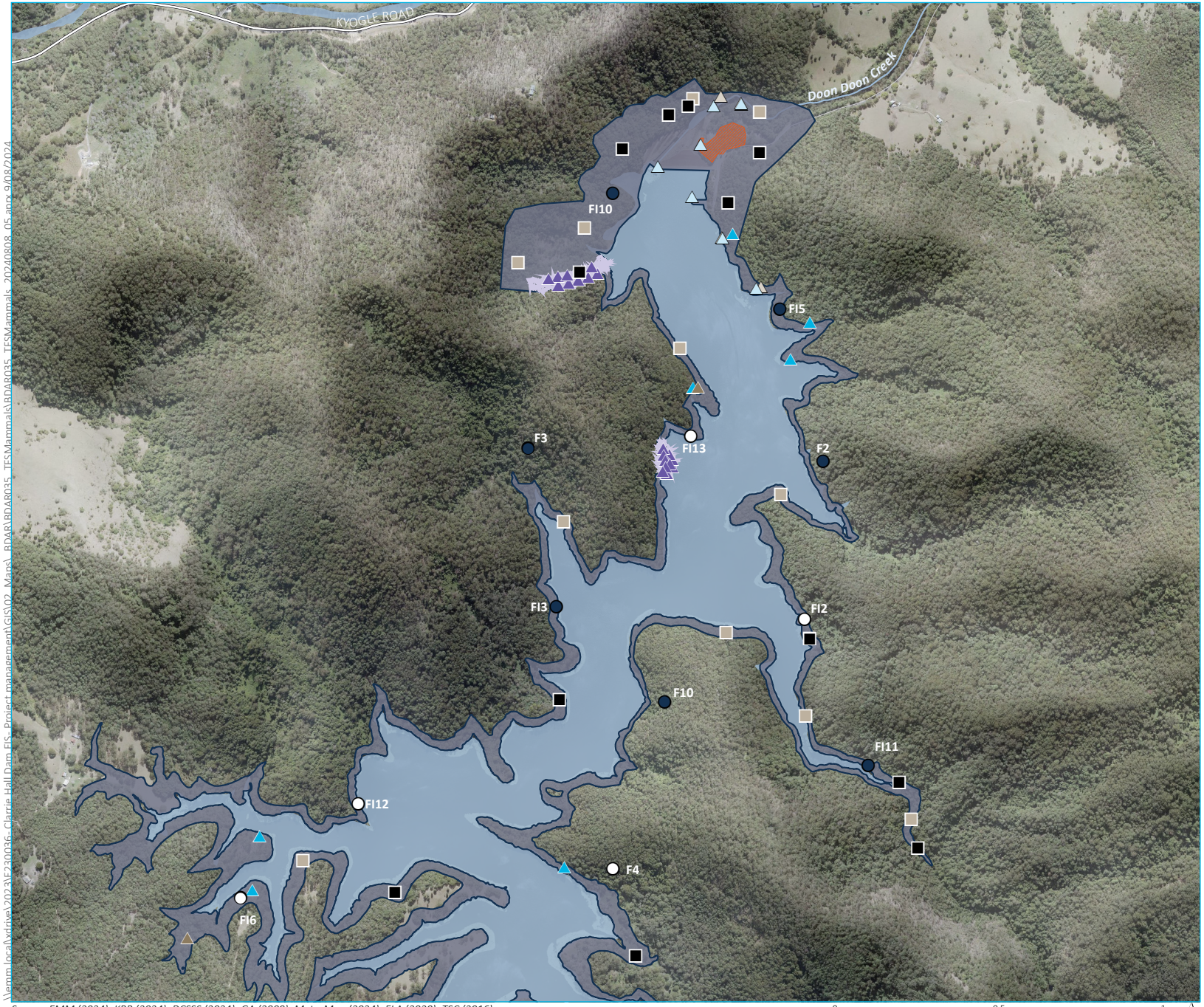
- Rufous Bettong (*Aepyprymnus rufescens*)
- Parma Wallaby (*Macropus parma*)
- Common Planigale (*Planigale maculata*)
- Long-nosed Potoroo (*Potorous tridactylus*).

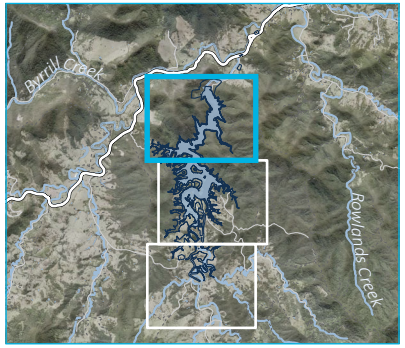
Methods and survey effort have been developed in accordance with DEC (2004), DSEWPaC (2011) and the relevant TBDC species profiles (DCCEEW, 2024a) and included a mix of terrestrial trapping and remote camera surveys. All surveys were completed as part of the site-based surveys as described in Section 5.4.3iia. Methods and survey effort are outlined in Table 5.12 and survey locations are displayed on Figure 5.5.

Table 5.12 Methods and survey effort – terrestrial mammals

Target species	Survey method	Survey effort
• Rufous Bettong • Parma Wallaby • Common Planigale • Long-nosed Potoroo	**Spotlighting (2016/2017)** Spotlighting was conducted in an area of 100 m x 200 m for 20 minutes at each core site (refer to Section 5.4.3iia), with two observers. A total of 12 sites were surveyed, each repeated 3 times on separate nights.	**North Coast Wet Sclerophyll Forests** • 10 sites • 20 person hours **Subtropical Rainforests** • 2 sites • 2 person hours
• Rufous Bettong • Parma Wallaby • Common Planigale • Long-nosed Potoroo	**Terrestrial camera trapping (2016/2017)** Motion detection baited camera traps were placed at each core and ancillary survey site and an additional four locations near the Dam wall (refer to Section 5.4.3iia). Each camera was deployed for 16 nights. Each camera trap was attached to a tree trunk at a height between 30 cm and 100 cm above the ground. Bait was placed 3–4 m in front of the line of sight of each camera. Bait targeting herbivorous species consisted of a mixture of peanut butter and oats and bait targeting carnivorous species consisted of a perforated tin of sardines. Cameras used were ScoutGuard® 560K 8-megapixel units. **Terrestrial camera trapping (2017)** An additional four cameras were installed at four locations in the construction and quarry areas close to the dam wall. Methods were the same as described above. **Terrestrial camera trapping (2024)** One ground camera trap (ScoutguardTM 560 k zero glow) was installed at 28 locations throughout the subject land. The camera was secured approximately 1–1.5 m above the ground and a bait station installed around 3–5 m away on freshly turned earth. Both the bait canister and earth received one large handful of peanut butter, honey and oats. A second bait application was applied after 7–8 days. Cameras were installed on 13–15 February and retrieved on 29 February and 1 March. This culminated in at least 15 nights of survey effort.	**North Coast Wet Sclerophyll Forests** • 2016/2017: 15 sites, 240 trap nights • 2017: 3 sites, 48 trap nights • 2024: 15 sites, 225 trap nights • **Total:** 33 sites, 513 trap nights **Subtropical Rainforests** • 2016/2017: 3 sites, 48 trap nights • 2017: 1 site, 16 trap nights • 2024: 13 sites, 195 trap nights • **Total:** 17 sites, 259 trap nights

Target species	Survey method	Survey effort
• Common Planigale	**Pitfall trapping (2016/2017)** Pitfall traps were set up in trap line configurations consisting of 5 buckets each. Each bucket had a capacity of 20 litres (L) and were spaced 4–5 m apart along a 40 cm high drift fence of polyethene. Each trap line was deployed for a total of four nights and was checked for captured fauna every morning and evening.	**North Coast Wet Sclerophyll Forests** • 10 sites • 200 trap nights **Subtropical Rainforests** • 2 sites • 40 trap nights
• Long-nosed Potoroo	**Cage trapping (2016/2017)** Cage trapping was undertaken at core sites in 2016/2017 (refer to Section 5.4.3iia). Havahart® traps (80 cm) were placed in areas suitable for Long-nosed Potoroo and other medium-sized terrestrial mammals, such as areas with dense vegetation cover and/or adjacent to a log. Each trap was placed on a 1 m^2 dirt pad that was created by removing vegetation and disturbing the exposed soil to conceal the wire base. Bait was placed inside each cage trap, consisting of a mixture of peanut butter, oats and honey and the trap was covered with a towel or hessian bag. Each cage trap was deployed for a total of four nights and was checked for captured fauna every morning and evening.	**North Coast Wet Sclerophyll Forests** • 10 sites • 48 trap nights **Subtropical Rainforests** • 2 sites • 8 trap nights
• Common Planigale (supplementary)	**Funnel trapping (2016/2017)** Funnel traps were deployed along a polyethene drift fence. Two traps were placed on opposing sides at one end of the drift fence, with another two traps placed in the same configuration at the other end of the drift fence. Each trap line was deployed for a total of four nights and was checked for captured fauna every morning and evening.	**North Coast Wet Sclerophyll Forests** • 10 sites • 40 trap nights **Subtropical Rainforests** • 2 sites • 32 trap nights
Common Planigale (supplementary)	**Elliot A Terrestrial Trapping (2016/2017)** Ten (10) Elliot A traps were spaced 20 m apart with a 3 cm bait ball (peanut butter, oats and honey). Four nights of trapping was completed at each core site.	**North Coast Wet Sclerophyll Forests** • 10 sites • 400 trap nights **Subtropical Rainforests** • 2 sites • 80 trap nights





KEY

- Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Ancillary site (koala scat search, terrestrial camera trapping)
- Core site (cage trapping, pitfall trapping, funnel trapping, terrestrial elliot A trapping, terrestrial camera trapping, spotlighting, koala scat search)
- Koala scat search area (2017)

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

- Ancillary site (koala scat search, terrestrial camera trapping)
- Core site (cage trapping, pitfall trapping, funnel trapping, terrestrial elliot A trapping, terrestrial camera trapping, spotlighting, koala scat search)

Camera trapping (2024)

- Terrestrial
- Arboreal

Bat survey

- Anabat (2016)
- Anabat (2020)
- Harp (2016)
- Harp (2020)

Trapping (2024)

- Arboreal Elliot
- Arboreal Elliot

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

0 0.5 1 km

GDA2020 MGA Zone 56

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Targeted fauna surveys- Mammals

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Biodiversity Development Assessment Report
Figure 5.5

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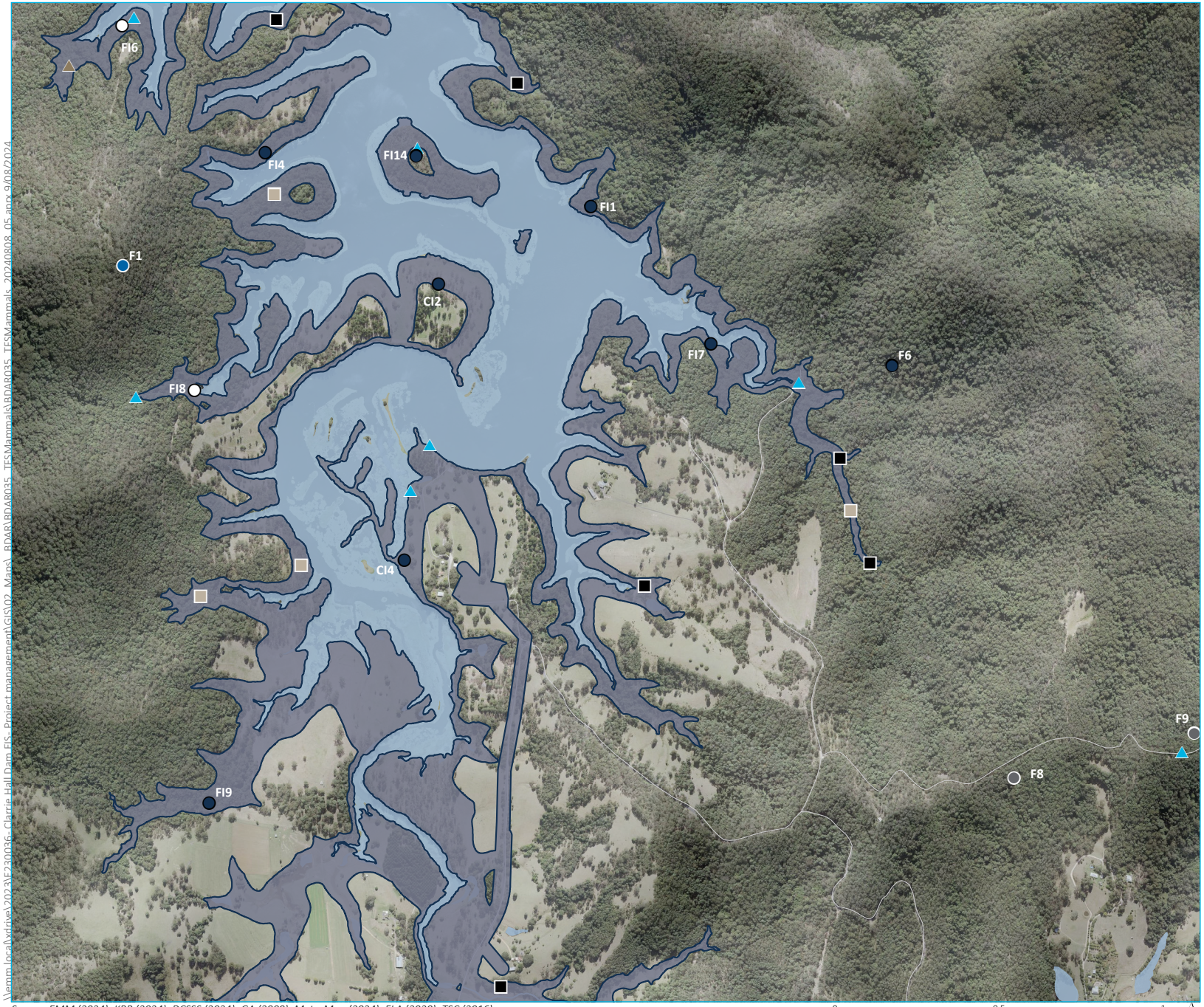
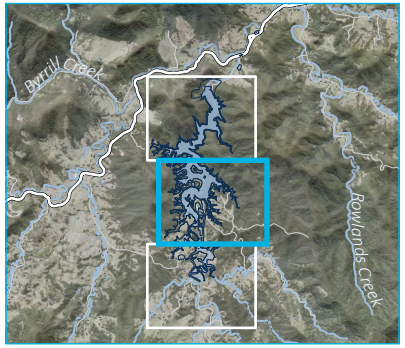
creating opportunities





KEY

Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Ancillary site (koala scat search, terrestrial camera trapping)
- Core site (cage trapping, pitfall trapping, funnel trapping, terrestrial elliot A trapping, terrestrial camera trapping, spotlighting, koala scat search)

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

- Ancillary site (koala scat search, terrestrial camera trapping)
- Core site (cage trapping, pitfall trapping, funnel trapping, terrestrial elliot A trapping, terrestrial camera trapping, spotlighting, koala scat search)

Camera trapping (2024)

- Terrestrial
- Arboreal

Bat survey

- Anabat (2016)
- Harp (2016)

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

0 0.5 1 km

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Targeted fauna surveys- Mammals
Page 2 of 3

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Figure 5.5

EMM creating opportunities

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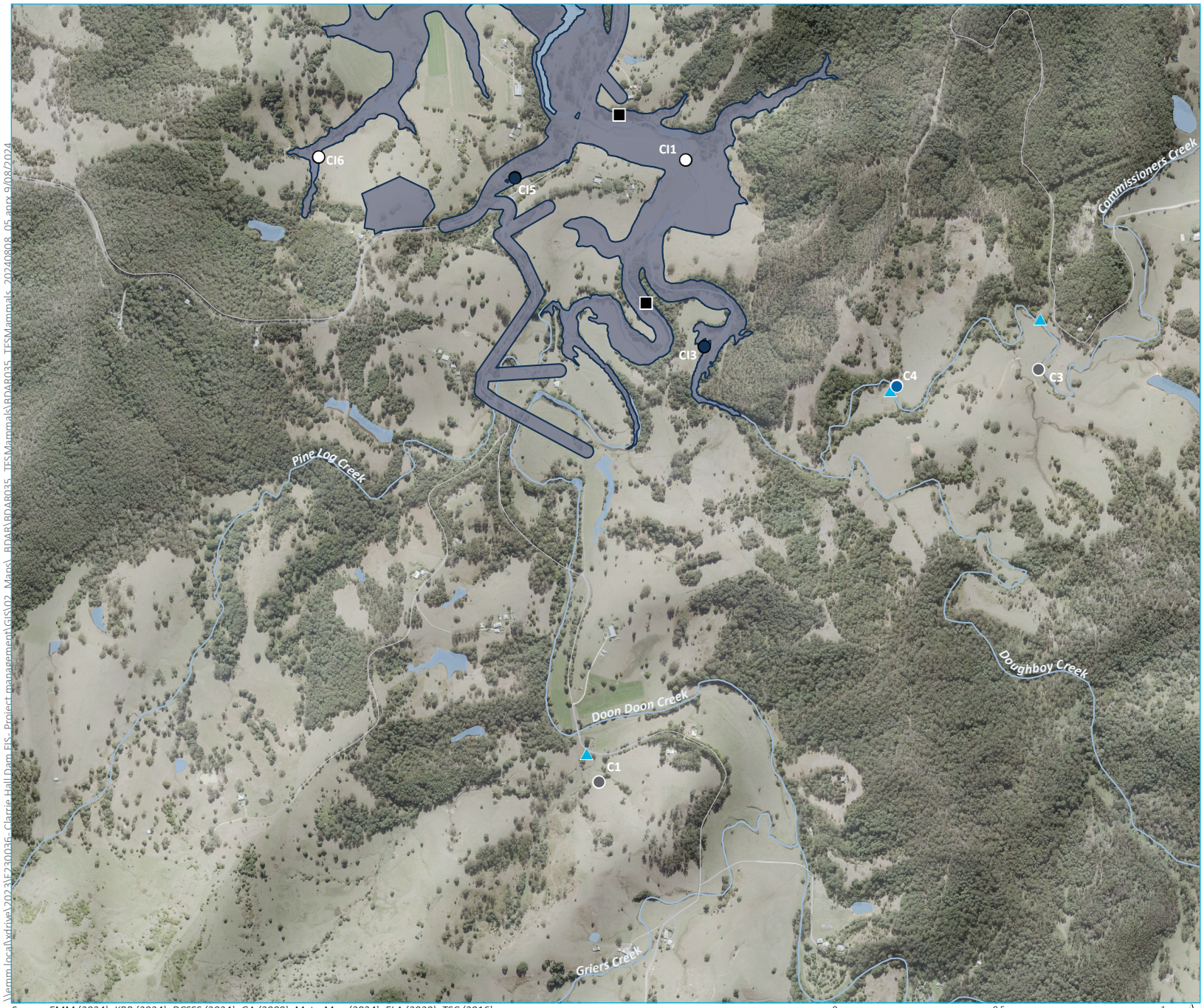

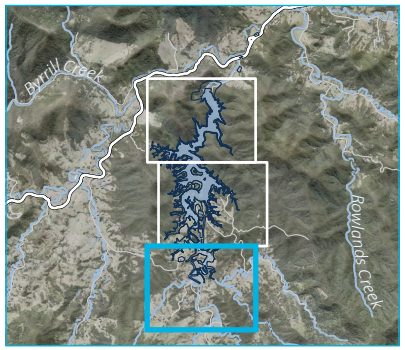

KEY

Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Ancillary site (koala scat search, terrestrial camera trapping)
- Core site (cage trapping, pitfall trapping, funnel trapping, terrestrial elliot A trapping, terrestrial camera trapping, spotlighting, koala scat search)

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

- Ancillary site (koala scat search, terrestrial camera trapping)
- Core site (cage trapping, pitfall trapping, funnel trapping, terrestrial elliot A trapping, terrestrial camera trapping, spotlighting, koala scat search)

Camera trapping (2024)

- Terrestrial
- Arboreal

Bat survey

- Anabat (2016)

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

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Targeted fauna surveys- Mammals
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Figure 5.5

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e Arboreal mammals

Arboreal mammal surveys were undertaken for the following species:

- Eastern Pygmy-possum (*Cercartetus nanus*)
- Southern Greater Glider (*Petauroides volans*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*).

Methods and survey effort have been developed in accordance with DEC (2004), DSEWPaC (2011a), the (DSE 2011) and Biolink (2011) for the Koala. Methods and survey effort is outlined in Table 5.13 and survey locations are displayed on Figure 5.5.

Table 5.13 Methods and survey effort – arboreal mammals

Target species	Survey method	Survey effort
• All species	**Spotlighting (2016/2017)** Spotlighting was conducted in an area of 100 m x 200 m for 20 minutes at each core site (refer to Section 5.4.3iia), with two observers. A total of 12 sites were surveyed, each repeated 3 times on separate nights.	**North Coast Wet Sclerophyll Forests** • 10 sites • 20 person hours **Subtropical Rainforests** • 2 sites • 4 person hours
• Koala	**Spot Assessment Technique** The Spot Assessment Technique (SAT) (Phillips & Callaghan, 2011) was used as a basis for the Koala scat search method. At each of the core and ancillary sites, a central tree was selected. A koala scat search was undertaken around the tree for two person minutes, encompassing a 1 m radius. A further 29 trees were then searched typically within the same 200 x 100 m search area as the spotlighting and bird searches. Sites were searched systematically, with a selection preference for tree species known to be used by Koala. In addition to the site based searches, scat searches were also undertaken downstream of the dam wall in the area shown on Figure 5.6.	**North Coast Wet Sclerophyll Forests** • 15 site based • 450 trees • One area search (2017) **Subtropical Rainforests** • 3 site based • 90 trees
• All species	**Arboreal camera trapping (2024)** Fifteen arboreal camera traps (ScoutguardTM 560 k zero glow) were installed, attaching the camera approximately 1.5 m above the ground and a bait station installed on an adjacent tree 2–3 m away. The bait canister was baited with peanut butter, honey and oats with extra peanut butter applied. A diluted honey solution (10% honey) was applied via a pump spray over the canister, above and below it to act as an additional attractant. A second bait application was applied after 7–8 days. Cameras were installed on 13–15 February and retrieved on 29 February – 1 March.	**North Coast Wet Sclerophyll Forests** • 10 sites/150 trap nights **Subtropical Rainforests** • 5 sites/75 camera trap nights

Target species	Survey method	Survey effort
• All species	**Terrestrial camera trapping (2016/2017 and 2024)** Terrestrial camera trapping was undertaken within the Subject Land as described in Table 5.12. Arboreal species such as the Eastern Pygmy Possum and Koala will often descend to the ground to investigate baits, therefore this can be considered as supplementary effort for arboreal species.	**North Coast Wet Sclerophyll Forests** • 2016/2017: 15 sites, 240 trap nights • 2017: 3 sites, 48 trap nights • 2024: 15 sites, 225 trap nights • **Total:** 33 sites, 513 trap nights **Subtropical Rainforests** • 2016/2017: 3 sites, 48 trap nights • 2017: 1 site, 16 trap nights • 2024: 13 sites, 195 trap nights • **Total:** 17 sites, 259 trap nights

f Bats

Bat surveys were undertaken for the following species:

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Eastern Cave Bat (*Vespadelus troughtonii*)
- Southern Myotis (*Myotis Macropus*) and
- Grey-headed Flying-fox (*Pteropus poliocephalus*).

Methods and survey effort have been developed in accordance with OEH (2018a), DEWHA (2010) and DPIE (2010). Methods and survey effort are outlined in Table 5.14 and survey locations are displayed on Figure 5.5.

Table 5.14 Methods and survey effort – bats

Target species	Survey method	Survey effort
• Large-eared Pied Bat • Little Bent-winged Bat • Large Bent-winged Bat • Eastern Cave Bat	**Breeding habitat assessment** Roost searches were undertaken in accordance with the following: • potential roost sites across the disturbance footprint (caves, scarps, cliffs, rock overhangs, disused mines, tunnels, bridges, culverts, old buildings, sheds) were searched for signs of use by microbats • searches included searching for signs of microbats (urine stains, droppings, remains, and bat fly casings) during the daytime • searches were done using handheld torches shined into cracks and crevices. Desktop habitat assessments were undertaken to identify potential breeding habitat for cave dwelling species within 2 km of the Subject Land as specified in the TBDC (DCCEEW, 2024a) for the Large-eared Pied Bat. This included consideration of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.	Features such as cliffs, rock areas, overhangs were inspected where access could be achieved safely on foot. One potential roost site was identified within the site: the Dam wall and associated cuttings and rock fill. This informed the placement of acoustic detection devices and harp traps. No other potential roost sites were detected.
• All candidate bat species (except Grey-headed Flying-Fox)	**Acoustic detection** November – January 2016 Anabats (SD1 and SD2 models) were deployed for 1–2 nights at 14 locations, within or adjacent to the Subject Land. Forested and cleared habitats were sampled. The placement of the detectors was determined by discerning areas likely used as flyways, with detectors also placed nearby to the Dam wall to determine whether this structure is utilised as a roost. November/December 2020 Six SongMeter Mini were deployed over four nights adjacent to and surrounding the Dam wall.	A minimum of 14 detector nights were conducted in 2016 with an additional 24 nights in 2020.

Target species	Survey method	Survey effort
• All candidate bat species (except Grey-headed Flying-Fox)	**Harp trapping** November – January 2016 Harp trapping was undertaken in three locations for 1–2 nights. November/December 2020 Four harp traps were used over four nights adjacent to and surrounding the Dam wall.	A minimum of 3 harp trapping nights were conducted in 2016 with an additional 16 nights in 2020.
• Grey-headed Flying-Fox	**Daytime camp survey** Field surveys at the subject land commenced in 2016 with field surveys continuing until early autumn 2024, albeit not continuously). During these surveys attention was paid to signs of any rooting bats. Coverage of the entire subject land was achieved on multiple occasions during other fauna survey vegetation mapping and flora surveys.	Survey effort is cumulative between 2016 and 2024 over multiple seasons.

g Amphibians

Amphibian (frog) surveys were undertaken for the following species:

- Pouched Frog (*Assa darlingtonia*)
- Fleay's Frog (*Mixophyes fleayi*)
- Giant Barred Frog (*Mixophyes iteratus*)
- Loveridge Frog (*Philoria loveridgei*).

Methods and survey effort have been developed in accordance with several guidelines including DECC (2009), DEWHA (2010) and DPIE (2020) and are outlined in Table 5.15 and survey locations are displayed on Figure 5.6.

Table 5.15 Methods and survey effort – amphibians

Target species	Survey method	Survey effort
• Pouched Frog • Fleay's Frog • Giant Barred Frog • Loveridge's Frog	**Targeted diurnal searches (2016/2017, site-based)** An area of 100 m x 200 m was searched over 30 minutes, with observers visually searching and areas of suitable habitat whilst lifting vegetative cover and raking through debris and the upper layer of soil searching for individuals. Suitable habitat that was targeted included leaf and bark litter, fallen timber and rocky areas. 18 locations were searched within the subject land, with each location repeated three times. Ancillary sites had a single observer whilst Core site had two observes (reflected in the survey effort)	**North Coast Wet Sclerophyll Forests** • 15 sites • 40 person hours **Subtropical Rainforests** • 3 sites • 7.5 person hours
• Giant Barred Frog (targeted) • Pouched Frog • Fleay's Frog • Loveridge's Frog	**Watercourse transects (2017)** Locations were selected based on habitat features likely to support Giant Barred Frog or where the species has been previously recorded. Surveys commenced at the locations of previous records with two observers moving downstream until no further frogs were detected. Observers then moved upstream until the stream either terminated or the observers were greater than 500 m from the subject land. Each observer surveyed up to 30 m from the stream edge. Call playback was occasionally used to illicit response from male frogs when locations could not be confirmed, or habitat appeared suitable, but no individuals were detected.	Two nights with two observers (15 and 16 February 2017).
• Giant Barred Frog (targeted) • Pouched Frog • Fleay's Frog • Loveridge's Frog	**Watercourse transects (2018 and 2020)** Surveys were completed along watercourses as described above. Survey included extension of transects outside of the subject site and repeated survey of locations where the Giant Barred Frog had been previously recorded.	Two nights with two observers, summer 2018 Two nights with two observers, summer 2020.

Target species	Survey method	Survey effort
• Pouched Frog • Fleay's Frog • Giant Barred Frog • Loveridge's Frog	**Habitat assessment (2020)** An assessment of microhabitats was undertaken at 39 locations across the subject land. Microhabitats were assessed for their functional habitat value for each candidate amphibian species. Microhabitats determined to be suitable for a candidate species were then included in targeted surveys. Data collected at these 39 locations was used to stratify the subject land into five habitat types for amphibians: 1. permanent drainages in remnant rainforest 2. complex ephemeral drainages 3. simple ephemeral drainage 4. forested dam fringe 5. permanent water with cleared land.	Two observers conducted habitat assessments over six days from 20–25 July 2020.
• Giant Barred Frog (targeted) • Pouched Frog • Fleay's Frog • Loveridge's Frog	**Targeted amphibian survey (2020)** Ten sites were selected to be representative of each of the five habitat types (listed above) and were surveyed following heavy rainfall. Where identified by call or observation, total number and type of all amphibian species were recorded. Surveys at each amphibian search site included a 20 minute audio-visual survey with two observers.	Surveys were completed over three nights from 12–14 January 2020. Each of the 10 sites were surveyed for 20 minutes with two observers. Sites were repeated twice on separate evenings.
• Pouched Frog • Fleay's Frog • Giant Barred Frog • Loveridge's Frog	**Habitat assessment (2023)** Additional diurnal habitat surveys were conducted at fourteen gullies to determine their potential to support each of the target species. Information collected included the bank characteristics, permeance of water present and surrounding vegetation type and observation of any frogs, spawn or tadpoles present.	Fourteen gullies were visited over a period of four days from 19–22 September 2023.
Considering the frog species recorded and the 2020 and 2023 habitat assessments it was determined that further targeted survey effort was required to establish the distribution of Loveridge's Frog and the Giant Barred Frog. Surveys were completed in accordance with the NSW Survey Guide for Threatened Frogs (DPIE 2020).		
• Giant-Barred Frog	**Targeted Giant Barred Frog survey (2023/2024)** Surveys were conducted downstream of the Dam wall along Doon Doon Creek and associated side channels. Initially the creek was surveyed up to its confluence with the Tweed River to determine any areas with suitable habitat characteristics for the species, including steam pool, overhanging backs and adjacent bankside forested habitat. Four areas of potential habitat were identified, constituting approximately 450 m in total length. Upstream of the Dam, habitat surveys identified five sections along Doon Doon creek with sup-optimal to good habitat for the species at which targeted survey should be undertaken. Potential habitat was sampled at 50 m intervals along the stream pools. At each point, five minutes of listening was initially conducted followed by two minutes of playback of *Mixophyes iteratus*, followed by two more minutes of listening. Visual searching and listening for frogs were conducted while moving between points within potential habitat.	**Doon Doon Creek – Upstream** Surveys were completed over four nights on 24 January and 1, 5, 6 February 2024 with two observers. Survey effort was approximately 17 person hours. **Doon Doon Creek -Downstream** A single night site visit was undertaken on 13 March 2024 for approximately two hours with two observers (four person hours. Three nights of surveys were undertaken with two observers, 24–26 March 2024. A fourth night was completed by one observer on 31 March 2024. Total person effort was 15.5 person hours.

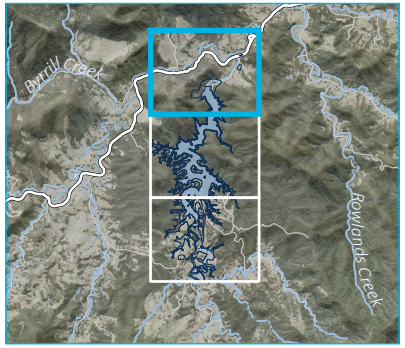
Target species	Survey method	Survey effort
	Supplementary effort was also achieved whilst travelling between sites either by canoe, owing to dense and weedy bank vegetation or on foot. A known reference site was checked on 1 and 2 February 2024 with the targeted species calling on both nights.	
Loveridge's Frog	**Targeted Survey for Loveridge's Frog (2023)** This species was recorded at a single location in 2016/2017 within an incised watercourse which holds semi-permanent water in rocky pools. A reference site in the Border Ranges National Park was surveyed on 21 November 2023. Survey commenced at 10:30 am for a period of one hour. The species was readily detected and were calling frequently. Potential habitat for this species is restricted to three sites with single watercourse and its associated tributaries which was surveyed on four sperate occasions on, 17 and 30 November and 1 and 7 December 2023. Surveys were conducted in warm (21 °C–21 °C) high humidity conditions (65%–92%) following a period of rainfall.	Three sites were surveyed, repeated on four occasions. Each site survey was approximately 30 minutes with two observers.

Table 5.16 Amphibian habitat assessment

Stream type	Habitat features	Threatened species potential	Photograph
Permanent drainages in subtropical rainforest and wet sclerophyll forest	Characterised by permanent flowing water. The creek bed is composed of a mixture of consolidated and unconsolidated rock, gravel and sandy sections, with pool and riffle sequences. Undercut banks are present in some sections. Aquatic submerged vegetation is largely absent. Adjacent terrestrial vegetation is typically diverse with abundant shelter including woody debris and deep leaf litter and loose rock. In limited areas, steeply incised consolidated bedrock provides permanently wet areas with moss which may provide suitable albeit suboptimal habitat for the Loveridge's' Frog.	• Pouched Frog (bankside vegetation) • Giant Barred Frog • Great Barred Frog • Loveridge's Frog (suboptimal)	

Stream type	Habitat features	Threatened species potential	Photograph
Complex and simple ephemeral drainages	Characterised by loose unconsolidated rock and sediment. Typically, steep and freely draining, flowing only during or after rainfall. Standing water in pools is typically fleeting limiting breeding habitat for frog species tied to aquatic habitat. Adjacent terrestrial vegetation is typically diverse with abundant shelter including woody debris and deep leaf litter and loose rock.	<u>Species with potential habitats:</u> • Pouched Frog <u>Unlikely:</u> • Giant Barred Frog • Loveridge's Frog • Great Barred Frog	

Stream type	Habitat features	Threatened species potential	Photograph
Forested dam fringe	Permanent open water with no discernible flow. Aquatic submerged, floating and emergent aquatic vegetation is present. The exotic Gambusia are present in large numbers, as are several native fish species which are likely to predate of frogs and tadpoles.	The Pouched Frog may occur in particularly high quality adjacent vegetation where it is associated with sheltered mesic gullies with deep leaf litter. Whilst the Dam is likely to provide habitat for several common frog species, no threatened species area considered likely to occur.	
Permanent water with cleared land	Permanent open water with no discernible flow and adjacent to cleared areas. Aquatic submerged, floating and emergent aquatic vegetation is present. The exotic Gambusia are present in large numbers, as are several native fish species which are likely to predate of frogs and tadpoles.	Whilst the Dam is likely to provide habitat for several common frog species, no threatened species area considered likely to occur.	



KEY

- Subject land

Sites within and immediatly adjacent to the subject site
- Targeted diurnal search 2016/2017 (two repeats)
- Targeted diurnal search 2016/2017 (one repeat)

Habitat assessment (2020)
- Survey point

Habitat mapping
- Complex drainage
- Simple drainage
- Forest
- Cleared land

Habitat assessment (2023)
- Assessment location

Targeted Giant Barred Frog Survey (2023/2024)
- Targeted survey- location point
- Targeted survey- stream section
- Field effort (walking or canoe)

Existing environment
- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

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Targeted fauna surveys- Amphibians

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Figure 5.6

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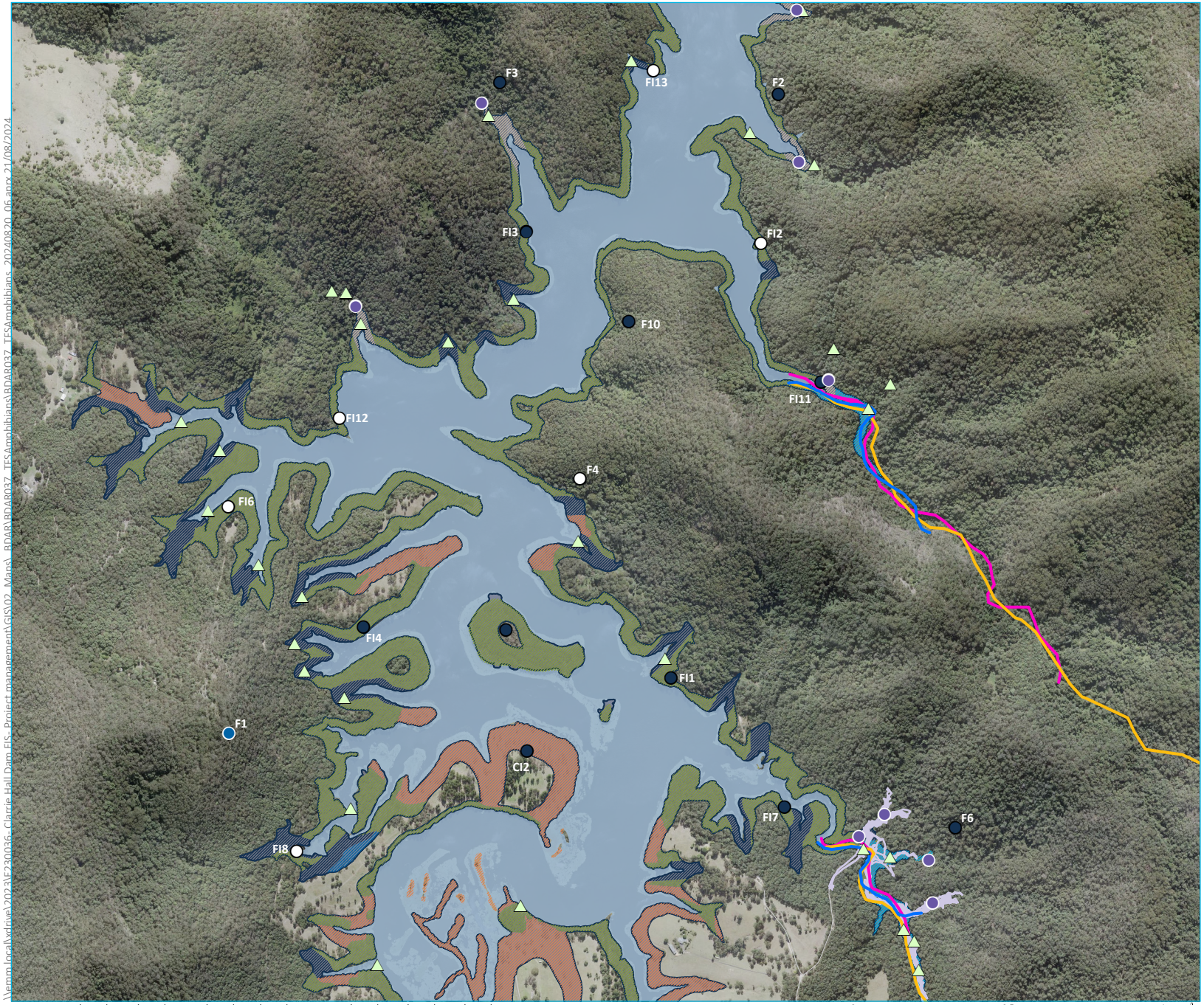

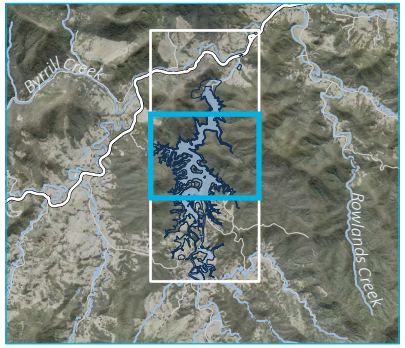

KEY

- Subject land

Sites within and immediatly adjacent to the subject site
- Targeted diurnal search 2016/2017 (two repeats)
- Targeted diurnal search 2016/2017 (one repeat)

Sites disjunct from the subject site and excluded from the assessment
- Targeted diurnal search 2016/2017 (one repeat)

Watercourse transect
- Survey track 2017
- Survey track 2018
- Survey track 2019

Habitat assessment (2020)
- Survey point

Habitat mapping
- Permenant drainage
- Complex drainage
- Simple drainage
- Forest
- Paddocks
- Cleared land

Habitat assessment (2023)
- Assessment location

Targeted Loveridge's Frog Survey (2023)
- Survey track

Existing environment
- Major road
- Minor road
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

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Targeted fauna surveys- Amphibians
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Figure 5.6

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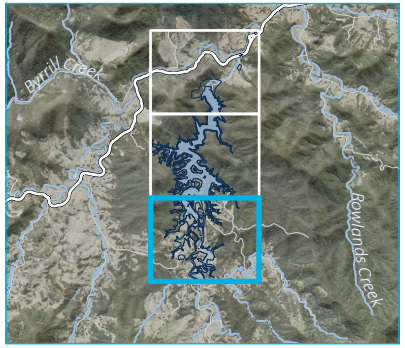

KEY

- Subject land

Sites within and immediatly adjacent to the subject site
- Targeted diurnal search 2016/2017 (two repeats)
- Targeted diurnal search 2016/2017 (one repeat)

Sites disjunct from the subject site and excluded from the assessment
- Targeted diurnal search 2016/2017 (two repeats)
- Targeted diurnal search 2016/2017 (one repeat)

Watercourse transect
- Survey track 2017
- Survey track 2018
- Survey track 2019

Habitat assessment (2020)
- Survey point

Habitat mapping
- Permenant drainage
- Simple drainage
- Forest
- Paddocks
- Cleared land

Habitat assessment (2023)
- Assessment location

Targeted Giant Barred Frog Survey (2023/2024)
- Targeted survey- location point
- Targeted survey- stream section
- Field effort (walking or canoe)

Targeted Loveridge's Frog Survey (2023)
- Survey track

Existing environment
- Major road
- Minor road
- Named watercourse
- Waterbody

Targeted fauna surveys- Amphibians
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Figure 5.6

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

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h Reptiles

Reptile surveys were undertaken for the following species:

- White-crowned Snake (*Cacophis harriettae*)
- Three-toed Snake-tooth Skink (*Coeranoscincus reticulatus*)
- Pale-headed Snake (*Hoplocephalus bitorquatus*)
- Stephens banded snake (*Hoplocephalus stephensii*).

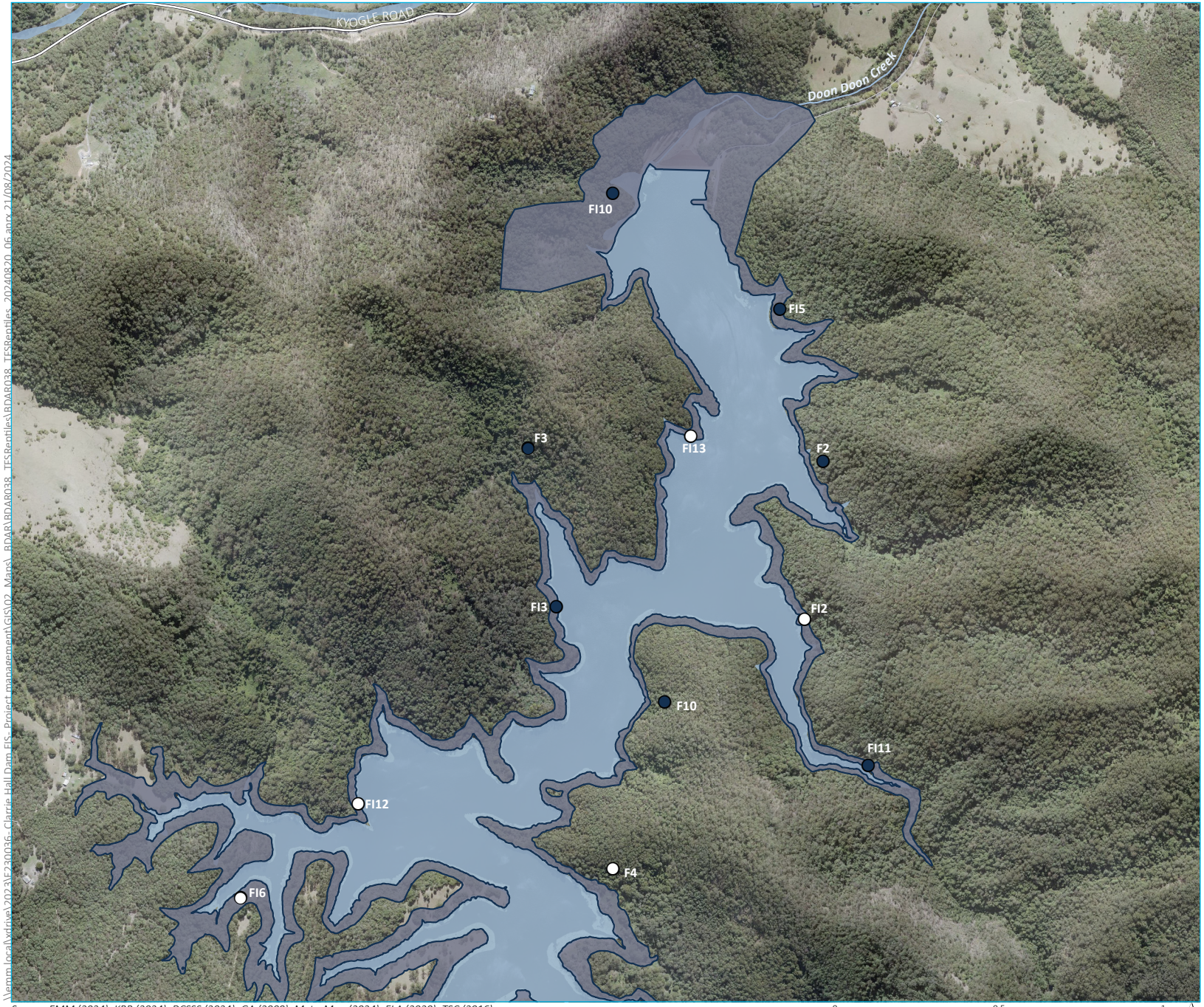
Reptile surveys were undertaken as part of the site-based surveys described in Section 5.4.3iia. Methods and survey effort is outlined in Table 5.17 and survey locations are displayed on Figure 5.7.

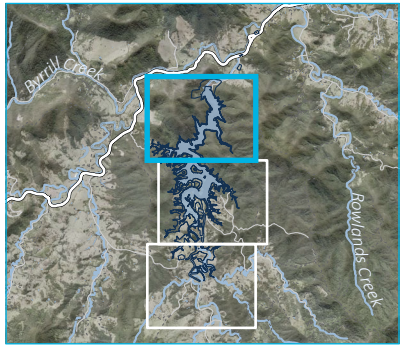
The reptile survey approach and effort has been developed in consultation with BCD and is considered adequate (Letter - DOC23/576802-7, BCD, 2023). Further detail on each of the survey methods conducted at these survey sites is provided in the relevant sections below for the target taxa.

Table 5.17 Methods and survey effort – reptiles

Target species	Survey method	Survey effort
• White-crowned Snake • Three-toed Snake-tooth Skink	**Targeted diurnal searches (2016/2017, site-based)** An area of 100 m x 200 m was searched over 30 minutes, with observers visually searching and areas of suitable habitat whilst lifting vegetative cover and raking through debris and the upper layer of soil searching for individuals. Suitable habitat that was targeted included leaf and bark litter, fallen timber and rocky areas. 18 locations were searched within the subject land, with each location repeated twice. Ancillary sites had a single observer whilst Core site had two observes (reflected in the survey effort).	**North Coast Wet Sclerophyll Forests** • 15 sites • 25 person hours **Subtropical Rainforests** • 3 sites • 7 person hours
• Pale-headed Snake • Stephens banded snake	**Spotlighting (2016/2017, site-based)** Spotlighting was conducted in an area of 100 m x 200 m for 20 minutes with two observers. A total of 12 sites were surveyed, each repeated 3 times on separate nights.	**North Coast Wet Sclerophyll Forests** • 10 sites • 20 person hours **Subtropical Rainforests** • 2 site • 4 person hours
• White-crowned Snake • Three-toed Snake-tooth Skink	**Pitfall trapping (2016/2017, site-based)** Pitfall traps were set up in trap line configurations consisting of 5 buckets each. Each bucket had a capacity of 20 litres (L) and were spaced 4–5 m apart along a 40 cm high drift fence of polyethene. Each trap line was deployed for a total of four nights and was checked for captured fauna every morning and evening.	**North Coast Wet Sclerophyll Forests** • 10 sites • 200 trap nights **Subtropical Rainforests** • 2 sites • 40 trap nights

Target species	Survey method	Survey effort
• Pale-headed Snake • Stephens banded snake	**Funnel trapping (2016/2017, site-based)** Funnel traps were deployed along a polyethene drift fence. Two traps were placed on opposing sides at one end of the drift fence, with another two traps placed in the same configuration at the other end of the drift fence. Each trap line was deployed for a total of four nights and was checked for captured fauna every morning and evening.	**North Coast Wet Sclerophyll Forests** • 10 sites • 40 trap nights **Subtropical Rainforests** • 2 sites • 32 trap nights





KEY

- Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Ancillary site (targeted diurnal searches, repeated twice with one observer)
- Core site (pitfall trapping, funnel trapping, spotlighting, targeted diurnal searches, repeated twice with two observers)

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

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Targeted fauna surveys- Reptiles
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Figure 5.7

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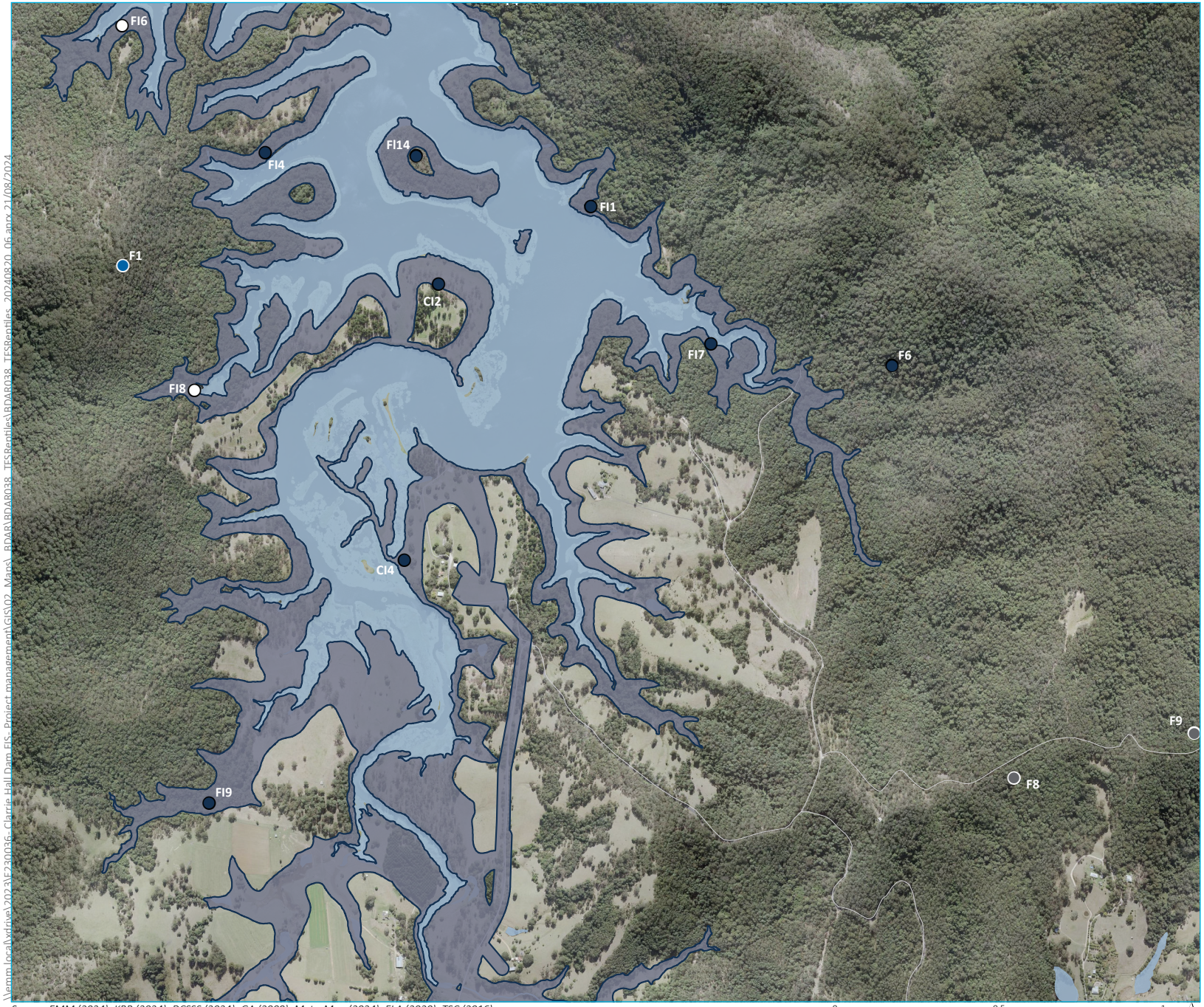

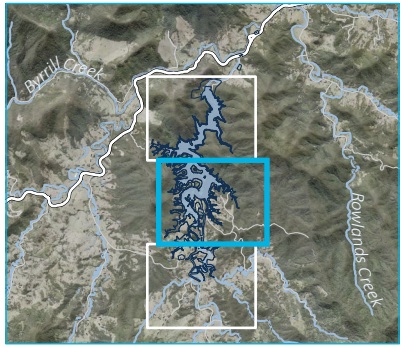

KEY

Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Ancillary site (targeted diurnal searches, repeated twice with one observer)
- Core site (pitfall trapping, funnel trapping, spotlighting, targeted diurnal searches, repeated twice with two observers)

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

- Ancillary site (targeted diurnal searches, repeated twice with one observer)
- Core site (pitfall trapping, funnel trapping, spotlighting, targeted diurnal searches, repeated twice with two observers)

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

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Targeted fauna surveys- Reptiles
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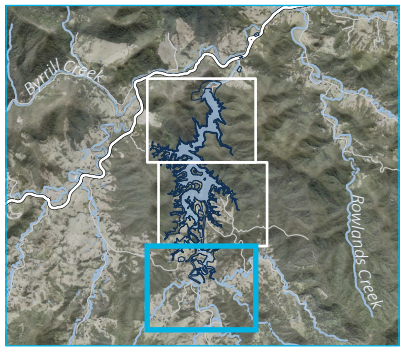
Figure 5.7

EMM
creating opportunities



KEY

Subject land

Sites within and immediatly adjacent to the subject site (2016/2017)

- Ancillary site (targeted diurnal searches, repeated twice with one observer)
- Core site (pitfall trapping, funnel trapping, spotlighting, targeted diurnal searches, repeated twice with two observers)

Sites disjunct from the subject site and excluded from the assessment (2016/2017)

- Ancillary site (targeted diurnal searches, repeated twice with one observer)
- Core site (pitfall trapping, funnel trapping, spotlighting, targeted diurnal searches, repeated twice with two observers)

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024); ELA (2020); TSC (2016)

0 0.5 1 km

GDA2020 MGA Zone 56

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Targeted fauna surveys- Reptiles
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Clarrie Hall Dam EIS
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Figure 5.7

EMM creating opportunities

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i Invertebrates

Surveys were undertaken for the following species:

- Mitchell's Rainforest Snail (*Thersites mitchellae*)
- Southern Pink Underwing Moth (*Phyllodes imperialis smithersi*).

Mitchell's Rainforest Snail was recorded incidentally during amphibian surveys in 2020 with photographs of the individual confirmed as the species by Dr John Stanisic, a registered Expert for this species.

Subsequent field studies were undertaken by consultants, Dr Stanisic and TSC to revisit the known location of the Mitchell's Rainforest Snail and investigate other areas of potential habitat within the subject land. Survey methods and effort are outlined in Table 5.18.

Dr Stanisic was engaged to author an expert report for the species on the basis of the site investigations and review of habitat present.

Table 5.18 Methods and survey effort – invertebrates

Target species	Survey method	Survey effort
Mitchell's Rainforest Snail	**Targeted habitat assessment** The area where the species was initially recorded was revisited and searched for any further individuals. Other areas within the subject land were then investigated, aiming to map habitat with suitable microhabitat preferences required by the species. For further method detail refer to the expert report (Appendix F).	At least four observers, including Dr John Stanisic (the registered species expert), conducted the survey on 6–7 April 2021.
Southern Pink Underwing Moth	**Larval food plant survey** This species is reliant on a rainforest vine *Caronia multisepalea* as a food source for the larvae, with the vine considered a suitable proxy for the species extent, confirmed by the BOS helpdesk which stated: *"Carronia Vines within the subject land are likely to be utilised by the adult moth, even if larvae is not detected. Therefore, all Carronia Vines identified provide suitable habitat for Southern Pink Underwing Moth* (Email dated 11 January 2024)". All locations of *Carronia multisepalea* within the subject land were recorded, incidentally and during targeted flora surveys (Figure 5.8)	Survey effort is described in Targeted Flora Survey, Section 5.4.3i.

5.4.4 Targeted survey results

i Targeted flora surveys

A total of 14 threatened flora species were recorded within the subject land. Of these, seven are considered candidates for SAII. Table 5.19 outlines the nine count-based threatened flora species and Table 5.20 outlines the five area-based threatened flora species recorded within the subject land.

Figure 5.8 shows all locations where threatened flora species were recorded within the subject land, noting that a point on the figure may have several individuals associated with it where high densities of a species were present. Figures (Figure 5.10 to Figure 5.23) are also provided for each individual threatened flora species, displaying the locations of records and the appropriate species polygon as defined in Section 5.4.6.

In addition to the threatened species recorded within the subject land, four threatened species were recorded outside of the subject land. Four of these species were recorded within landscape planting or gardens; Small-leaved Tamarind (*Diploglottis campbellii*), Durobby (*Syzygium moorei*), Macadamia Nut (*Macadamia tetraphylla*) and White Yiel Yiel (*Grevillea hilliana*). One species was naturally occurring: the epiphytic orchid, *Oberonia titiana*.

Table 5.19 Count based threatened flora species recorded in the subject land

Scientific name	Common name	BC Act Status	EPBC Act Status	SAII entity	PCT zone	Number of individuals
Corokia whiteana	Corokia	Endangered	Endangered	Yes	827_high	6
					1302_mod	6
					Total	**12**
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	No	1_827_high	7
					1302_high	36
					1302_mod	1
					827_mod	3
					827_burnt	3
					Total	**50**
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Endangered	Not listed	Yes	827_high	231
					1073_high	1
					1302_high	61
					1302_mod	29
					827_mod	51
					827_burnt	77
					827_low	3
					827_planted	4
					Total	**457**
Hicksbeachia pinnatifolia	Red Boppel Nut	Vulnerable	Vulnerable	No	827_planted	4
					Total	**4**

Scientific name	Common name	BC Act Status	EPBC Act Status	SAII entity	PCT zone		Number of individuals
Lepiderema pulchella	Fine-leaved Tuckeroo	Vulnerable	Not listed	Yes	827_low		5
					827_planted		10
						Total	**15**
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Vulnerable	No	827_high		1
					827_mod		6
					827_burnt		1
					827_low		3
					827_planted		1
						Total	**12**
Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Critically Endangered	Yes	827_high		406
					1073_high		2
					1302_high		10
					1302_mod		4
					827_mod		131
					827_burnt		47
					827_low		87
					827_planted		22
						Total	**709**
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	No	827_high		6
					1302_high		91
					827_burnt		8
						Total	**105**
Szygium moorei	Durobby	Vulnerable	Vulnerable	Yes	827_low		3
					827_planted		15
						Total	**18**

Table 5.20 Area based threatened flora species recorded in the subject land

Scientific name	Common name	BC Act Status	EPBC Act Status	SAII entity	PCT zone		Area of habitat (ha)
Desmodium acanthocladum	Thorny Pea	Vulnerable	Vulnerable	No	827_mod		3.30
						Total	3.30
Drynaria rigidula	Basket Fern	Endangered	Not listed	Yes	827_low		0.50
						Total	0.50
Grammitis stenophylla	Narrow leaf Finger Fern	Endangered	Not listed	No	827_high		12.75
					827_mod		0.93
					1302_high		1.31
						Total	**14.99**
Marsdenia longiloba	Slender Marsdenia	Endangered	Vulnerable	No	827_high		59.92
					827_mod		1.10
					827_burnt		12.54
					827_low		0.86
					1073_high		1.27
					1302_high		3.27
						Total	**78.96**
Rhodomyrtus psidioides	Native Guava	Critically Endangered	Critically Endangered	Yes	827_high		60.23
					827_mod		16.18
					827_burnt		15.25
					827_low		4.36
					827_planted		1.25
						Total	**97.26**

Several epiphytic orchids were recorded during the targeted flora surveys undertaken during 2023/2024. None of the orchids observed were in flower, and whilst they could be confidently identified to the *Sarcochilus* genus, species level identification was not possible. One such species was identified as a candidate species requiring assessment for the Proposal: the Brown Butterfly Orchid (*Sarcochilus dilatatus*). All *Sarcochilus* individuals identified within the subject land were within wet sclerophyll forest (PCT 827). As the Brown Butterfly Orchid (*Sarcochilus dilatatus*) is only associated with rainforest communities (DCCEEW, 2024a), it is considered unlikely that any of the *Sarcochilus* identified within the subject land are indeed the Brown Butterfly Orchid and rather one of several non-threatened species.

Photograph 5.1 *Sarcochilus* sp. identified within the development area (*Jason Searle 2023*)

Two species within the subject land, Scrub Turpentine (*Rhodamnia rubescens*) (Photograph 5.12) and Native Guava (*Rhodomyrtus psidioides)* (Photograph 5.13) were observed with Myrtle rust (*Puccinia psidii*). Myrtle rust is a fungal disease which infects plants in the *Myrtaceae* family and is considered the primary reason for rapid declines of Scrub Turpentine and Native Guava, contributing to the critically endangered listings of both species under both State and Commonwealth legislation.

Native Guava was prevalent in the central portion of the subject land, however most of the stems recorded were small, being less than 50 cm in height with many just 20 cm. Very few mature plants were observed in the subject land. It is anticipated that most of the small plants represent regeneration from rootstock rather than indicating seedling recruitment. The species was typically recorded in patches, with many small stems in high abundance, often in the order of several tens up to two hundred stems. It is difficult to determine the number of individual plants present without invasive methods to determine a common rootstock or genetic analysis. It is suspected that true individual counts are low with mature trees or shrubs existing prior to the introduction of Myrtle Rust. These are now absent with highly stressed but significant rootstock regenerating over a broad area.

Scrub Turpentine was found throughout the subject land with most of the individuals impacted by Myrtle Rust to varying degrees. Several smaller saplings were identified indicating some recruitment from seed, however a large number of individuals appeared to be stunted and in poor condition owing to Myrtle Rust infestation. Several small trees were observed in good condition.

Myrtle Rust was observed to be having a significant effect on the condition, reproduction, and mortality of both species, with Native Guava seemingly more affected. It is anticipated that the impact of Myrtle Rust is likely to be in a state of flux with the amount of dieback and mortality compared to regeneration according to environmental conditions including humidity, rainfall and season.

Photograph 5.2 Corokia (*Corokia whiteana*) (Jason Searle 2023)

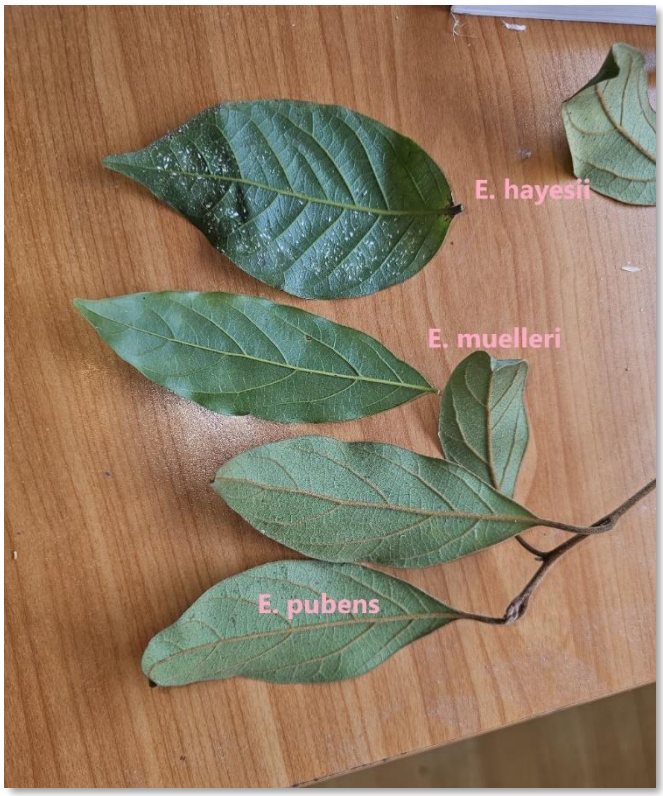
Photograph 5.3 Thorny Pea (*Desmodium acanthocladum*)

Photograph 5.4 **Basket Fern (*Drynaria rigidula*) and the non-threatened Fishbone Fern (*Nephrolepis cordifolia*)**

Photograph 5.5 **Rusty Rose Walnut (*Endiandra hayesii*) (Jason Searle)**

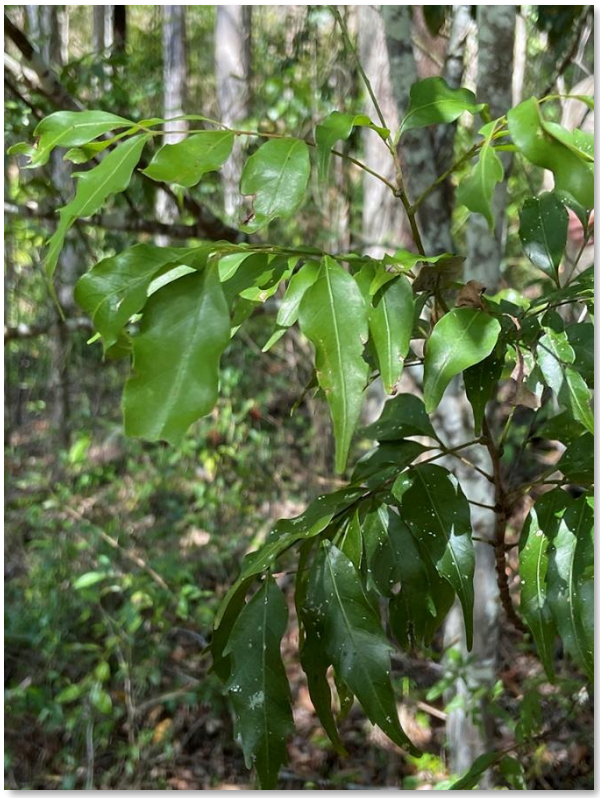
Photograph 5.6 Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) (Jason Searle 2023/2024)

Photograph 5.7 Comparison of *Endiandra* sp. on the subject land (Daniel Kelly 2023)



Photograph 5.8 Comparison of *Endiandra* sp. on the subject land (Daniel Kelly 2023)

Photograph 5.9 Narrow leaf Finger Fern (*Grammitis stenophylla*) (Jason Searle 2023)



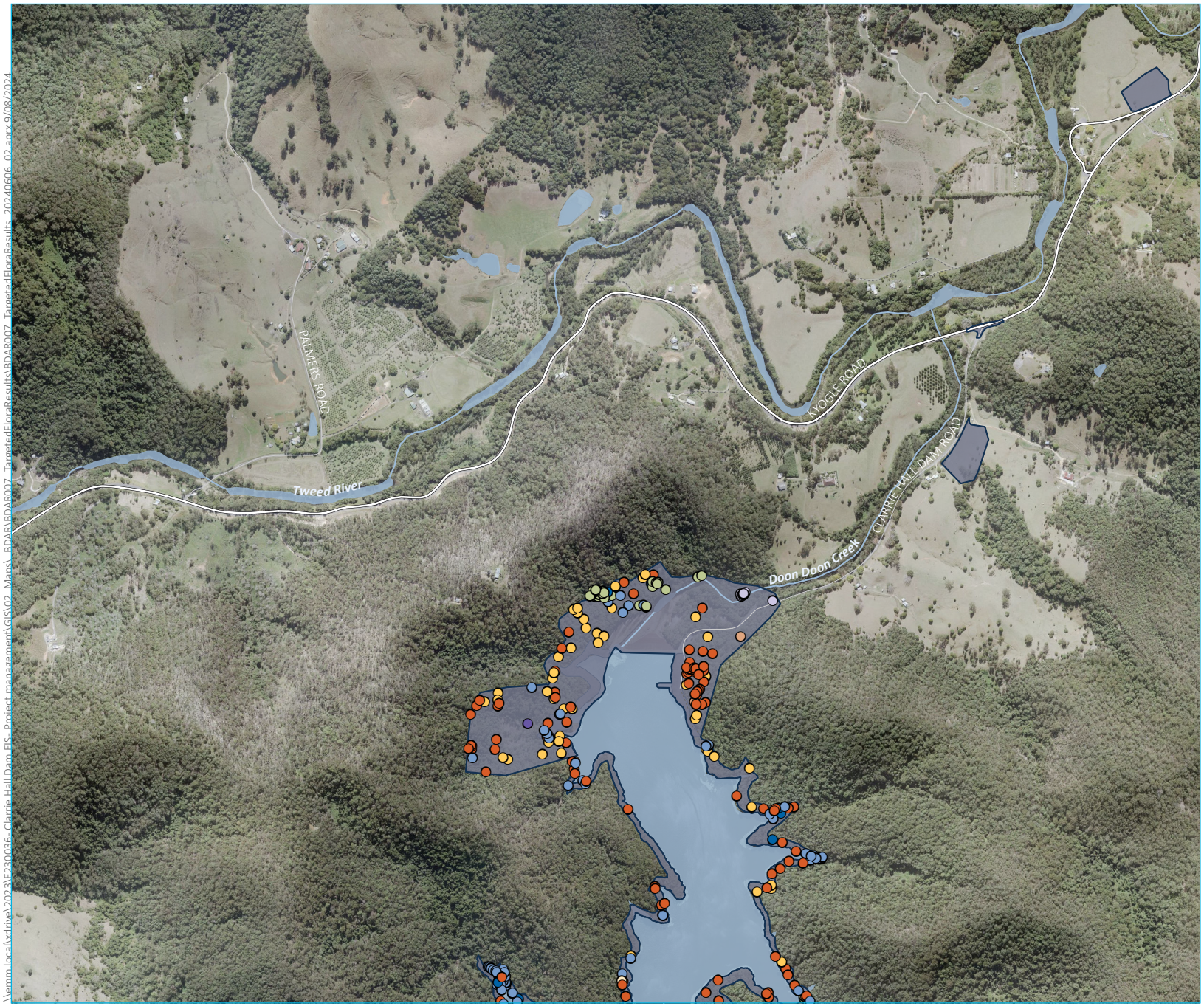
Photograph 5.10 Fine-leaved Tuckeroo (*Lepiderema pulchella*) (Jason Searle 2023)

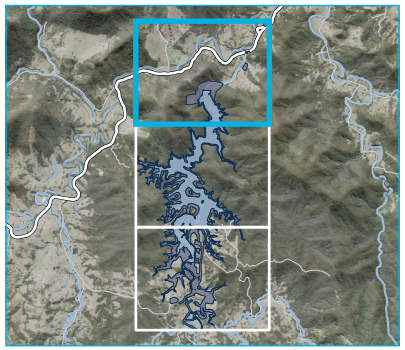
Photograph 5.11 Slender Marsdenia (*Marsdenia longiloba*) (Jason Searle 2023/2024)

Photograph 5.12 Scrub Turpentine (*Rhodamnia rubescens*) (Jason Searle 2023/2024)

Photograph 5.13 Native Guava (*Rhodomyrtus psidioides*) (Jason Searle 2023)

Photograph 5.14 Red Lilly Pilly (*Syzygium hodgkinsoniae*) (Jason Searle 2023)





KEY

Subject land

Threatened flora species

- *Desmodium acanthocladum*
- *Drynaria rigidula*
- *Endiandra hayesii*
- *Endiandra muelleri subsp. bracteata*
- *Macadamia tetraphylla*
- *Marsdenia longiloba*
- *Rhodamnia rubescens*
- *Rhodomyrtus psidioides*
- *Syzygium hodgkinsoniae*

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

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Targeted flora survey results
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Figure 5.8

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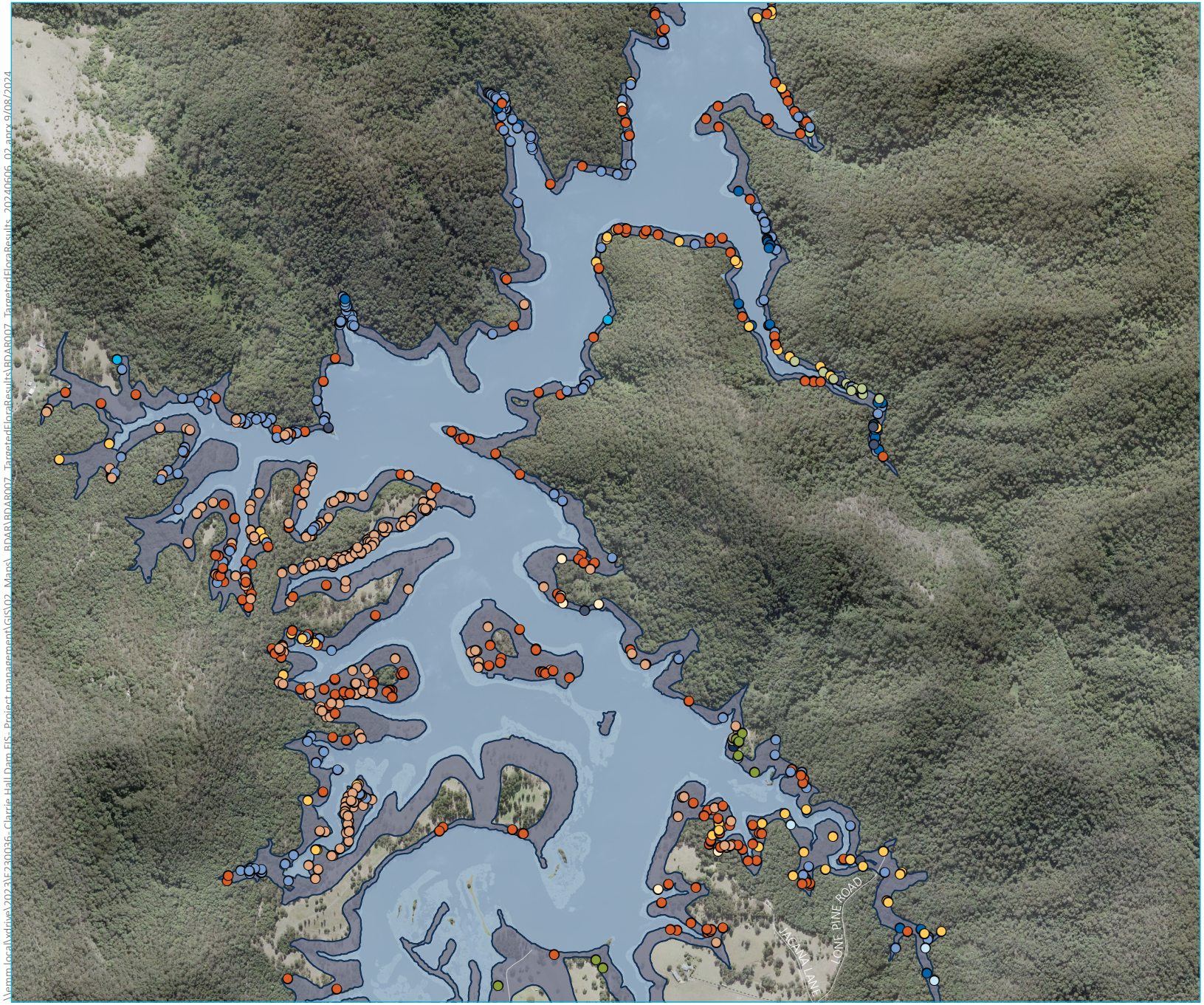
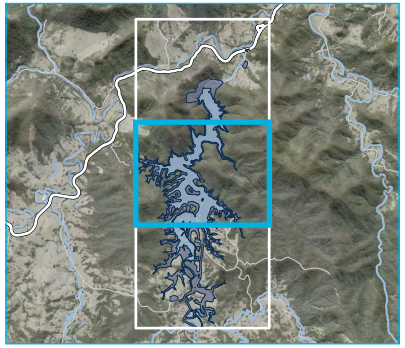
creating opportunities





KEY

Subject land

Threatened flora species

- *Carronia multisepalea*
- *Corokia whiteana*
- *Endiandra hayesii*
- *Endiandra muelleri subsp. bracteata*
- *Grammitis stenophylla*
- *Hicksbeachia pinnatifolia*
- *Lepiderema pulchella*
- *Macadamia tetraphylla*
- *Marsdenia longiloba*
- *Rhodamnia rubescens*
- *Rhodomyrtus psidioides*
- *Syzygium hodgkinsoniae*
- *Syzygium moorei*

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

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Targeted flora survey results
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Clarrie Hall Dam EIS
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EMM
creating opportunities

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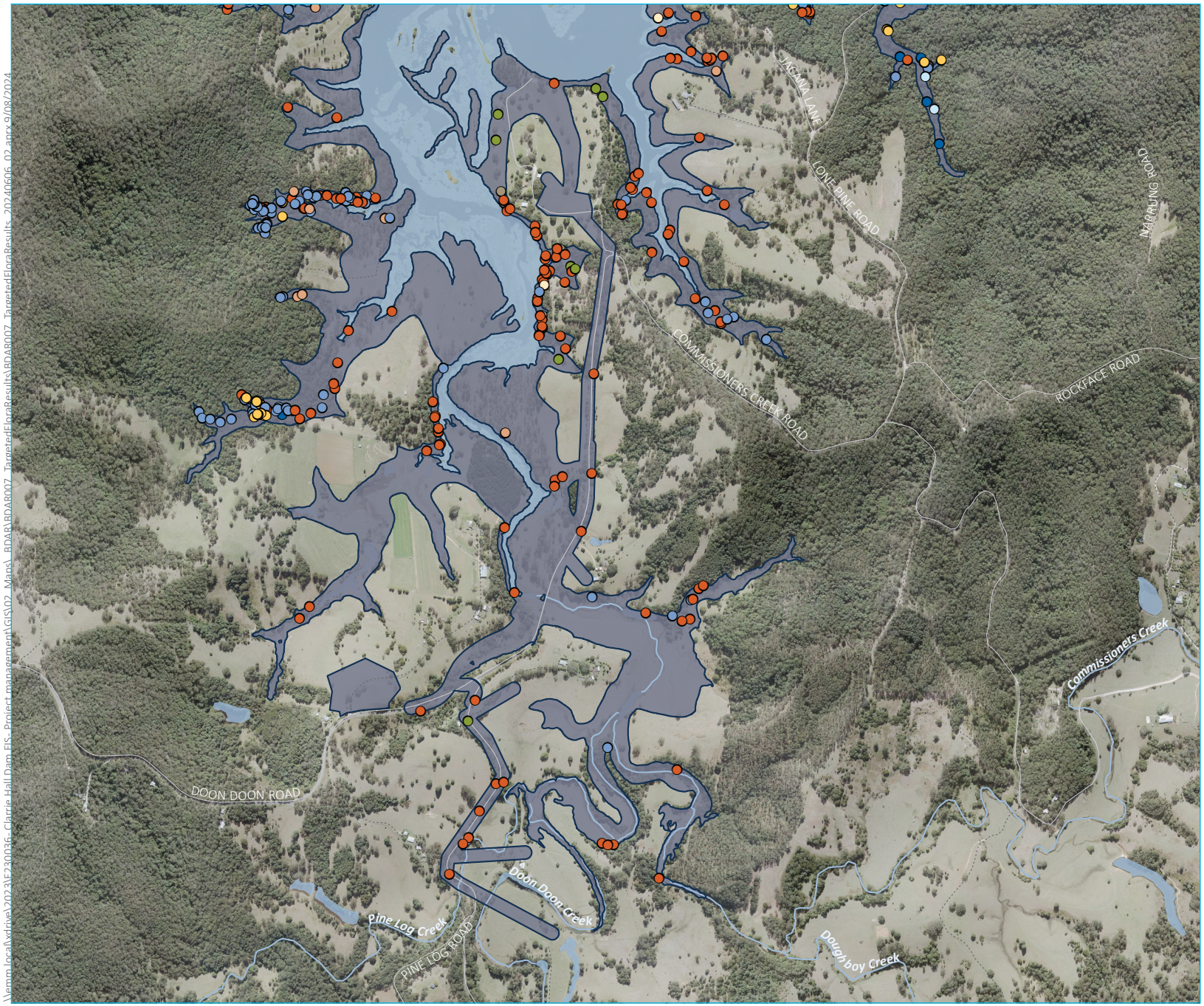

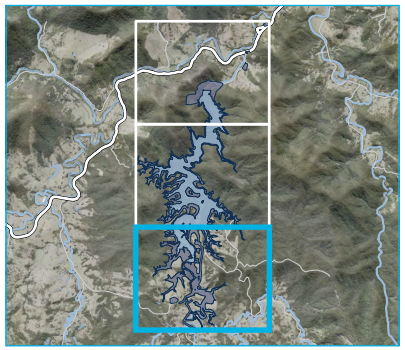

KEY

- Subject land

Threatened flora species

- *Corokia whiteana*
- *Endiandra hayesii*
- *Endiandra muelleri subsp. bracteata*
- *Grammitis stenophylla*
- *Lepiderema pulchella*
- *Macadamia tetraphylla*
- *Marsdenia longiloba*
- *Rhodamnia rubescens*
- *Rhodomyrtus psidioides*
- *Syzygium moorei*

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Targeted flora survey results
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Clarrie Hall Dam EIS
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Figure 5.8

EMM
creating opportunities

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ii Targeted fauna surveys

The results of targeted fauna surveys are detailed in the sections below and displayed on Figure 5.9.

a Diurnal birds

A total of twelve threatened diurnal bird species were recorded within the subject land or adjacent to the subject land. An overview of these species is provided in Table 5.21.

Table 5.21 Diurnal bird species recorded in the subject land

Scientific name	Common name	BC Act status	EPBC Act status	BAM (DPIE, 2020) credit type	Observation type and number of records
Amaurornis moluccana	Pale-vented Bush-hen	V	-	Ecosystem	• Incidental sightings detected the species at five locations in 2016/2017. Three sightings were within the subject land and two were within 50 m of the subject land.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Ecosystem (foraging) Species (breeding)	• Calls heard and individuals sighted at two locations within the subject land and one location outside of the subject land on 2016/2017. • Two individuals were detected feeding in the subject land in March 2020. • Two individuals were detected feeding in the subject land in July 2020. • No breeding was recorded.
Carterornis leucotis	White-eared Monarch	V	-	Species	• A total of two sightings were recorded within the subject land, with one additional record within 50 m of the subject land. • The records within the subject land constituted an incidental sighting at one location in 2020 within moderate condition PCT 827, with one individual recorded during 2023 targeted bird surveys in high condition PCT 1302.
Daphoenositta chrysoptera	Varied Sittella	V	-	Ecosystem	• One incidental sighting recorded five individuals within 50 m of the subject land.
Gallinago hardwickii	Latham's Snipe	-	V, Mi	Ecosystem	• One individual was recorded on a camera trap within the subject land. • One incidental sighting of a single individual was recorded within 50 m of the subject land.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Species (breeding)	• Nest surveys identified one stick nest utilised by two individuals in 2020. • Four additional sightings were recorded of the species within the subject land.

Scientific name	Common name	BC Act status	EPBC Act status	BAM (DPIE, 2020) credit type	Observation type and number of records
Irediparra gallinacea	Comb-crested Jacana	V	-	Ecosystem	• The species has been detected on 33 occasions between 2016 and 2020 within the subject land. • Of these sightings, 1 was located within the subject land and 32 were within 50 m of the subject land.
Ixobrychus flavicollis	Black Bittern	V	-	Ecosystem	• One incidental sighting of the species within 50 m of the subject land in 2020.
Menura alberti	Albert's Lyrebird	V	-	Species	• A terrestrial camera trap recorded one individual outside of the subject land in 2016/2017. • During targeted winter bird surveys in 2023, the species was recorded at several locations within high condition PCT 1302 and PCT 827.
Ptilinopus magnificus	Wompoo Fruit-Dove	V	-	Ecosystem	• The species was recorded on 12 occasions throughout the field surveys between 2016 and 2023. • Of these 12 sightings, 7 were located within the subject land and 5 were within 50 m of the subject land.
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	Ecosystem	• The species was recorded on five occasions throughout the field surveys between 2016 and 2023. Four were recorded within the subject land and one was recorded within 50 m of the subject land.
Ptilinopus superbus	Superb Fruit-Dove	V	-	Ecosystem	• The species was recorded on four occasions throughout the field surveys between 2016 and 2023. Two were recorded within the subject land and two were recorded within 50 m of the subject land.
Symposiachrus trivirgatus	Spectacled Monarch	-	Mi	Ecosystem	• The species was incidentally recorded on one occasion within the subject land.

Of the eleven species recorded, several species are ecosystem credit species and do not require further assessment. Impacts to these species will be offset accordingly through habitat surrogates. Four recorded species are species credit or dual credit species and require further consideration.

The Glossy Black-Cockatoo (*Calyptorhynchus lathami*) is a species credit species for the purposes of breeding habitat only. Targeted breeding surveys for Glossy Black-Cockatoo did not detect any evidence of breeding and no nest trees were recorded within the subject land. As such no further assessment is required and species credits will not be generated for this species. Ecosystems credits will be generated through habitat surrogates.

The White-eared Monarch (*Carterornis leucotis*) is a species credit species and was recorded on three occasions in rainforest (PCT 1302 high) and wet sclerophyll forest (PCT 827 mod). This species occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. They appear to prefer the ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads (DCCEEW, 2024a). Given the broad habitat requirements and high mobility of this

species, it is considered likely that the species would utilise much of the subject land. A species polygon is described in Section 5.4.6iii.

The White-bellied Sea-Eagle (*Haliaeetus leucogaster*) is a species credit species for the purposes of breeding habitat only. Targeted surveys for breeding habitat identified the presence of a stick nest in a dead tree with close proximity to the Dam edge. It was actively used in July 2020 (Photograph 5.15) by a pair of White-bellied Sea-Eagle. Inspection of the nest during surveys in January 2023 found the nest was unoccupied, however this is outside the typical breeding season (July to December, (DCCEEW, 2024a) and there is the potential for the nest to be used in the future. A species polygon will be generated in accordance with the TBDC (DCCEEW, 2024a), as described in Section 5.4.6iii.

Alberts Lyrebird (*Menura alberti*) is a species credit species and was recorded in rainforest PCT 1302 high and wet sclerophyll forest (PCT 827 mod). This species is associated with rainforests or wet sclerophyll forests, in the case of the latter, preferentially with a wet midstorey containing rainforest species. The species was most frequently recorded in sheltered gullies and slopes where preferred habitat characteristics were present, including deep, moist layer of leaf-litter, and fallen logs. There was also a relatively open ground cover. This species was only recorded on the eastern side of the dam where the sheltered gullies are longer and more expansive, with connectivity into Mount Jerusalem National Park. In contrast, the gullies on the western side of the dam have small catchments, with limited connectivity to areas of more optimal habitat. Where suitable habitat is present, it occurs in small and disparate patches, unlikely to be of sufficient size for a Lyrebird territory.

The findings in the subject site are supported by habitat description for NSW (Higgins et al, 2001), stating Albert's Lyrebird is only found in forests with a mesic understorey, either rainforest or wet sclerophyll forest, and then only the wettest examples of each of these forest types.

Photograph 5.15 White-bellied Sea-Eagle (*Haliaeetus leucogaster*) stick nest (ELA 2021)

b Nocturnal Birds

Two candidate nocturnal forest owl species, the Sooty Owl (*Tyto tenebricosa*) and the Masked Owl (*Tyto novaehollandiae*), were recorded within the subject land and adjacent to the subject land (Table 5.22).

As of 14 March 2024, both species are classed as species credit species, prior to this they were listed as dual credit species. Species credits will be generated for these species in accordance with the new TBDC guidelines (DCCEEW, 2024a) as detailed in Section 5.4.6.

The ecosystem credit species, Marbled Frogmouth (*Podargus ocellatus*) was also observed within the subject land and will generate ecosystem credits for suitable habitat.

Table 5.22 Candidate nocturnal bird species recorded in the subject land

Scientific name	Common name	BC Act status	EPBC Act status	BAM (DPIE, 2020) credit type	Observation method
Podargus ocellatus	Marbled Frogmouth	V	-	Ecosystem	• The species was detected incidentally throughout spotlighting for candidate fauna at 15 locations in 2016/2017. Six of the sightings were within the subject land and nine were within 50 m of the subject land.
Tyto novaehollandiae	Masked Owl	V	-	Species	• Spotlighting - the species was observed at two locations, one within the subject land and one within 50 m of the subject land in 2016/2017.
Tyto tenebricosa	Sooty Owl	V	-	Species	• Spotlighting and call playback- throughout these surveys; the species was heard calling or sighted on 17 between 2016 and 2020. Six of the observations were within the subject land and 11 were within 50 m of the subject land.

c Terrestrial mammals

No threatened terrestrial mammal species were recorded during surveys, and as such, no species offsets are required for terrestrial mammals.

The Long-nosed Potoroo (*Potorous tridactylus*) was recorded by a camera trap in 2016, approximately 330 m west of the subject land. The record was captured on a spur of a significant ridgeline, west of the subject land. The ridgeline habitats surrounding the subject land differ significantly from the habitat within the subject land. The forest structure is more open and is dryer than that of the subject land. The ground layer is typically denser with a higher coverage of grasses and grass trees (*Xanthorrhoea sp*) compared to the subject land.

Given the substantial camera trapping effort in the subject land with no records of the Long-nosed Potoroo, it is anticipated that the species prefers relatively open forest habitats along the ridgelines outside of the subject land, likely owing to increased shelter amongst the relatively dense ground cover. Given this, no species credits will be generated for the Long-nosed Potoroo.

d Arboreal mammals

One candidate arboreal mammal species, the Koala (*Phascolarctos cinereus*) was recorded within the subject land. The records are summarised in Table 5.23.

The species is considered to be widespread within the subject land with 31 records over the duration of the surveys. All vegetation zones, with the exception of pasture, sedgeland and cleared areas are considered habitat for the species. A species polygon for the Koala is described in Section 5.4.6.

Table 5.23 Candidate arboreal mammals recorded in the subject land

Scientific name	Common name	BC Act status	EPBC Act status	BAM (DPIE, 2020) credit type	Observation method
Phascolarctos cinereus	Koala	V	V	Species	• Koala were recorded via scats incidentally and during targeted scat searches during the site-based surveys. • Several Koala were observed directly. • Koala calls were heard during the duration of the Proposal. • One record during 2024 camera trapping on a ground- based camera trap. • In total 31 koala records were captured.

e Bats

Eleven threatened bat species were positively recorded within the subject land (Table 5.24), with one further species, *Nyctophilus bifax*, unable to be differentiated from other *Nyctophilus* species.

Table 5.24 Threatened bats recorded in the subject land

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Dual	Detected on one Songmeter in 2020.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Ecosystem	Detected by Anabat and harp trap capture in 2016.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	Ecosystem	This species was present at two Anabat sites in 2016.
Miniopterus australis	Little Bent-wing Bat	V	-	Dual	This species was widespread in 2016, recorded from 13 of the 16 Anabat locations. It was also recorded in 2020 by Songmeters.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Dual	This species was detected in six of the 16 Anabat sites, across multiple habitat types. It was also recorded by Songmeters in 2020.

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
Myotis macropus	Southern Myotis	V	-	Species	This species was recorded with confidence in four Anabat sites (2016) on multiple occasions and was captured in a harp trap downstream of the Dam wall in 2020.
Nyctimene robinsoni	Eastern Tube-nosed Bat	V	-	Ecosystem	Detected by vocalisations at two locations in rainforest and wet sclerophyll gullies in 2016. One record is within the subject land and one is located within 50 m of the subject land.
Nyctophilus bifax	Eastern long-eared bat	V	-	Ecosystem	Calls attributed to the *Nyctophilus* genus were recorded, however these cannot be confirmed to species level. Harp trapping recorded the non-threatened Gould's Long-eared Bat (*Nyctophilus gouldi*).
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Dual	No camps were present within the subject land. The species was observed foraging on four occasions during nocturnal surveys in 2016 and 2020. Two of these records are within the subject land and two are within 50 m of the subject land.
Saccolaimus flaviventris	Yellow-bellied sheath-tailed bat	V	-	Ecosystem	This species was detected rarely at one location in 2016.
Vespadelus troughtoni	Eastern cave bat	V	-	Species	The species was detected 72 times on the eastern most Anabat location, approximately 1 km from the subject land.

Five of the species (including *Nyctophilus bifax*) are ecosystem credits and hence no further consideration is required for offsetting purposes.

Of the dual credit and species credit species recorded, four can be broadly considered as cave roosting bat. These include:

- Large-eared Pied Bat
- Little Bent-wing Bat
- Large Bent-wing Bat
- Eastern Cave Bat.

Each of these species has a habitat constraint listed in the TBDC (DCCEEW, 2024a), which has been outlined in Table 5.2. Desktop surveys of potential habitat within 2 km of the subject land did not identify any potential breeding habitat for any for the cave roosting bats. Cliffs and extensive rock outcropping are present in the surrounding Wollombin, Nightcap and Mount Jerusalem National Parks, however, these features are located outside of the 2 km buffer.

Investigations within the subject land did not record any suitable rooting sites. The Dam wall and associated rock cuttings (refer to Photograph 5.16) and fill has a lack of cave-like structures or overhangs. No suitable fissures were found in the rock cuttings and the rock fill used on the downstream side of the Dam wall comprises tightly packed small rocks without sufficient void spaces present.

Photograph 5.16 Existing Clarrie Hall Dam wall and rock cuttings

Species polygons outlined in the TBDC (DCCEEW, 2024a) and NSW survey guidelines (OEH, 2018a) for each of the cave roosting species relate to the presence of breeding habitat. Given breeding habitat is absent from the subject land and the 2 km surrounding the subject land, no species credit offsets are required for these species.

The Grey-headed Flying Fox is a dual credit species with species credits generated for the presence of breeding camps. No breeding camps were identified within the subject land between 2016 and 2024. Given the absence of any camps within the subject land, no further assessment is required, and species credits will not be generated for this species. The species was observed foraging on multiple occasions within the subject land during nocturnal surveys in 2016 and 2020, and as such, the species will generate ecosystem credits and will be offset through habitat surrogates in accordance with the BAM (DPIE, 2020).

The Southern Myotis was recorded on multiple occasions and is likely to be widespread within the subject land. The species polygon for this species is described in Section 5.4.6.

f Amphibians

Three candidate amphibian species were recorded in the subject land. The records are summarised in Table 5.25.

Table 5.25 Candidate amphibians recorded in the subject land

Scientific name	Common name	BC Act status	EPBC Act status	BAM (DPIE, 2020) credit type	Observation method
Assa darlingtoni	Pouched Frog	V	-	Species	• Incidental sightings were made of the species throughout other targeted surveys. Three sightings were recorded within the subject land and five were recorded within 50 m of the subject land.
Mixophyes iteratus	Giant Barred Frog	E	E	Species	• Targeted habitat searches recorded the species on 55 occasions within 2 gullies. Of these records, 44 are within the subject land and 11 are within 50 m of the subject land. • The species was not recorded along Doon Doon Creek, below the Dam wall and is considered absent.
Philoria loveridgei	Loveridge's Frog	-	Not listed	Species	• Targeted habitat searches recorded one individual approximately 15 m outside of the subject land.

One candidate frog species, Fleay's Barred Frog (*Mixophyes fleayi*) was not recorded during targeted surveys. All potential habitat for the species was surveyed, with the related Giant Barred Frog and the Great Barred Frog (*Mixophyes fasciolatus*) (not threatened), recorded on multiple occasions. Fleay's Barred Frog is considered absent from the subject land.

Photograph 5.17 Giant Barred Frog recorded within the subject land (Greg Lollback 2024)

g Reptiles

No threatened reptiles were recorded within the subject land, and as such, no further assessment is required.

h Invertebrates

A single individual of Mitchell's Land Snail was recorded incidentally in 2021, adjacent to a watercourse in the east of the subject site. An additional individual was then recorded in the same continuous patch of habitat during subsequent targeted survey. In 2023, a further two empty shell of the species was subsequently detected in the same area. The low number of individuals and lack of abundant empty shells indicates a small population size. The species is anticipated to have a restricted distribution within the subject land, only occupying flat alluvium adjacent to creeks within rainforest areas. These areas have a dense mid stratum of Bangalow Palm and abundant leaf litter and woody debris.

An additional empty shell with holes was recorded on the west side of the subject site, in rocky habitat unsuitable for the species (Figure 5.35). Given the characteristic holes in the shell it is likely that the shell was brought into the subject site by a bird such as the Noisy Pitta (*Pitta versicolor*), with snail forming a major component of the Pitta's diet.

Further detail on the Mitchell's Land Snail and habitat preferences is provided in the expert report (Appendix F).

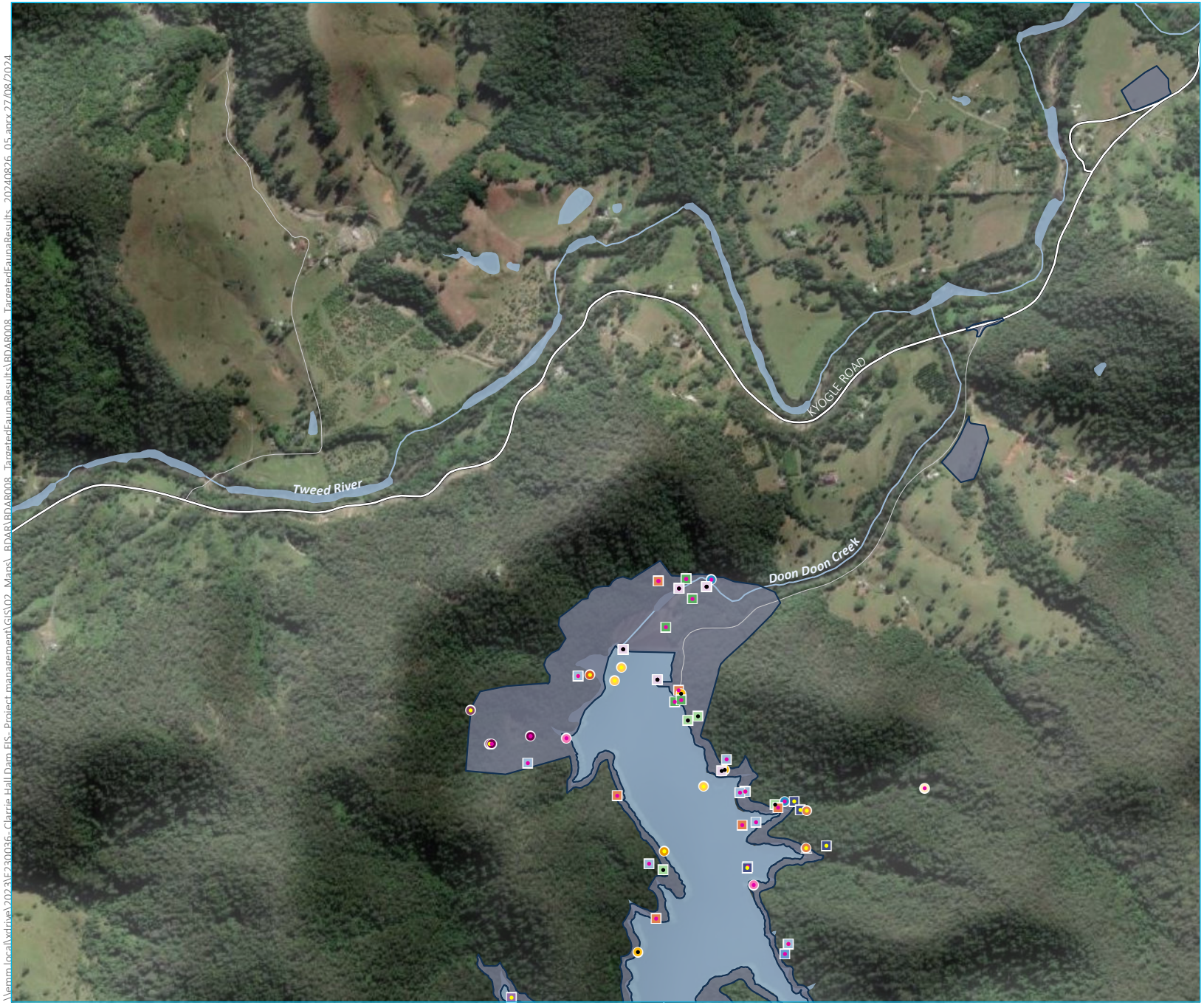
The Southern Pink Underwing Moth (*Phyllodes imperialis smithersi*) is reliant on a rainforest vine *Carronia multisepalea* as a food source for the larvae and requires low light conditions in rainforests for breeding. The species has not been recorded within the subject land, however the presence of *Carronia multisepalea* is considered a suitable proxy for the species extent (Figure 5.8). As such, the species is assumed present within the subject land. The species polygon is described in Section 5.4.6.

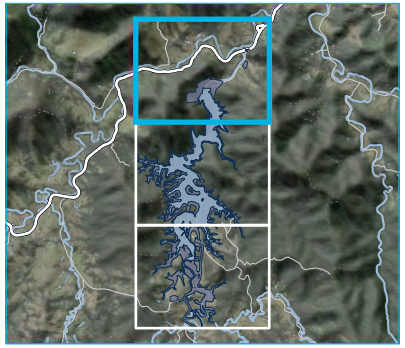
Table 5.26 Invertebrate species recorded in the subject land

Scientific name	Common name	BC Act status	EPBC Act status	BAM (DPIE, 2020) credit type	Observation method
Phyllodes imperialis smithersi	Southern Pink Underwing Moth	E	E	Species	• *Carronia multisepalea* was recorded at two locations within the subject land, refer to Figure 5.11. • No larvae or adult moths were observed, however targeted searches were not undertaken.
Thersites mitchellae	Mitchell's Rainforest Snail	V	-	Species	The following observations were • Incidental sightings recorded one live specimen and two empty shells. • Targeted surveys recorded one individual within the subject land. • An additional empty shell was recorded in habitat unsuitable for the species.

Photograph 5.18 Mitchell's Rainforest Snail recorded within the subject land (ELA 2021)

Photograph 5.19 Mitchell's Rainforest Snail recorded within the subject land (ELA 2021)





KEY

- Subject land

Threatened fauna species

Amphibians
- Pouched Frog

Bats
- Eastern Tube-nosed Bat
- Large Bent-wing Bat
- Large-eared Pied Bat
- Little Bent-wing Bat
- Southern Myotis

Diurnal birds
- Albert's Lyrebird
- Comb-crested Jacana
- Glossy Black-cockatoo
- Lathams Snipe
- Pale-vented Bush Hen
- Rose-crowned Fruit-dove
- White-bellied Sea-eagle
- Wompoo Fruit-dove
- White-eared Monarch

Nocturnal birds
- Marbled Frogmouth
- Masked Owl
- Sooty Owl

Mammal
- Koala
- Southern Pink Underwing Moth foodplant, *Carronia multisepalea*

EPBC Act listed migratory species
- Rufous Fantail

BAM (DPIE, 2020) credit type
- Dual
- Ecosystem
- Species

Existing environment
- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009); TSC (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Targeted fauna survey results
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Clarrie Hall Dam EIS
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Figure 5.9

EMM creating opportunities

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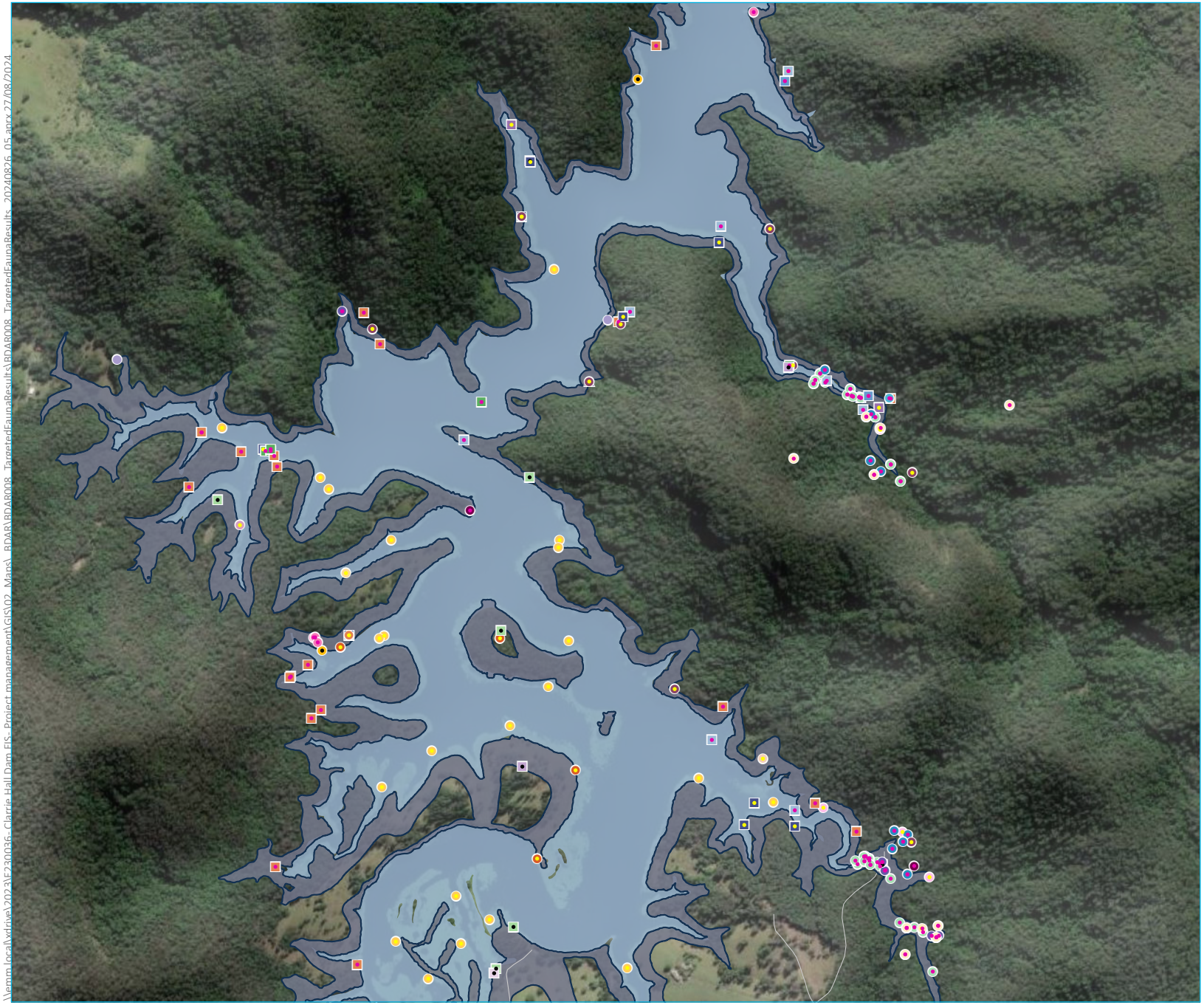

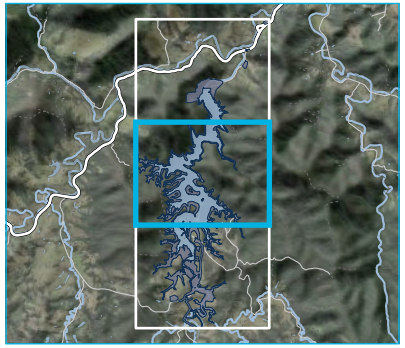

KEY

- Subject land

Threatened fauna species

Amphibians
- Giant Barred Frog
- Loveridge's Frog
- Pouched Frog

Bats
- Eastern Tube-nosed Bat
- Grey-headed Flying Fox
- Large Bent-wing Bat
- Little Bent-wing Bat
- Southern Myotis

Diurnal birds
- Albert's Lyrebird
- Black Bittern
- Comb-crested Jacana
- Glossy Black-cockatoo
- Pale-vented Bush Hen
- Rose-crowned Fruit-dove
- Spectacled Monarch
- Superb Fruit-dove
- Varied Sittella
- White-bellied Sea-eagle
- Wompoo Fruit-dove
- White-eared Monarch

Nocturnal birds
- Marbled Frogmouth
- Masked Owl
- Sooty Owl

Mammal
- Koala

Invertebrates
- Mitchell's Rainforest Snail
- Southern Pink Underwing Moth foodplant, *Carronia multisepalea*

EPBC Act listed migratory species
- Rufous Fantail

BAM (DPIE, 2020) credit type
- Dual
- Ecosystem
- Species

Existing environment
- Major road
- Minor road
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009); TSC (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Targeted fauna survey results
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Clarrie Hall Dam EIS
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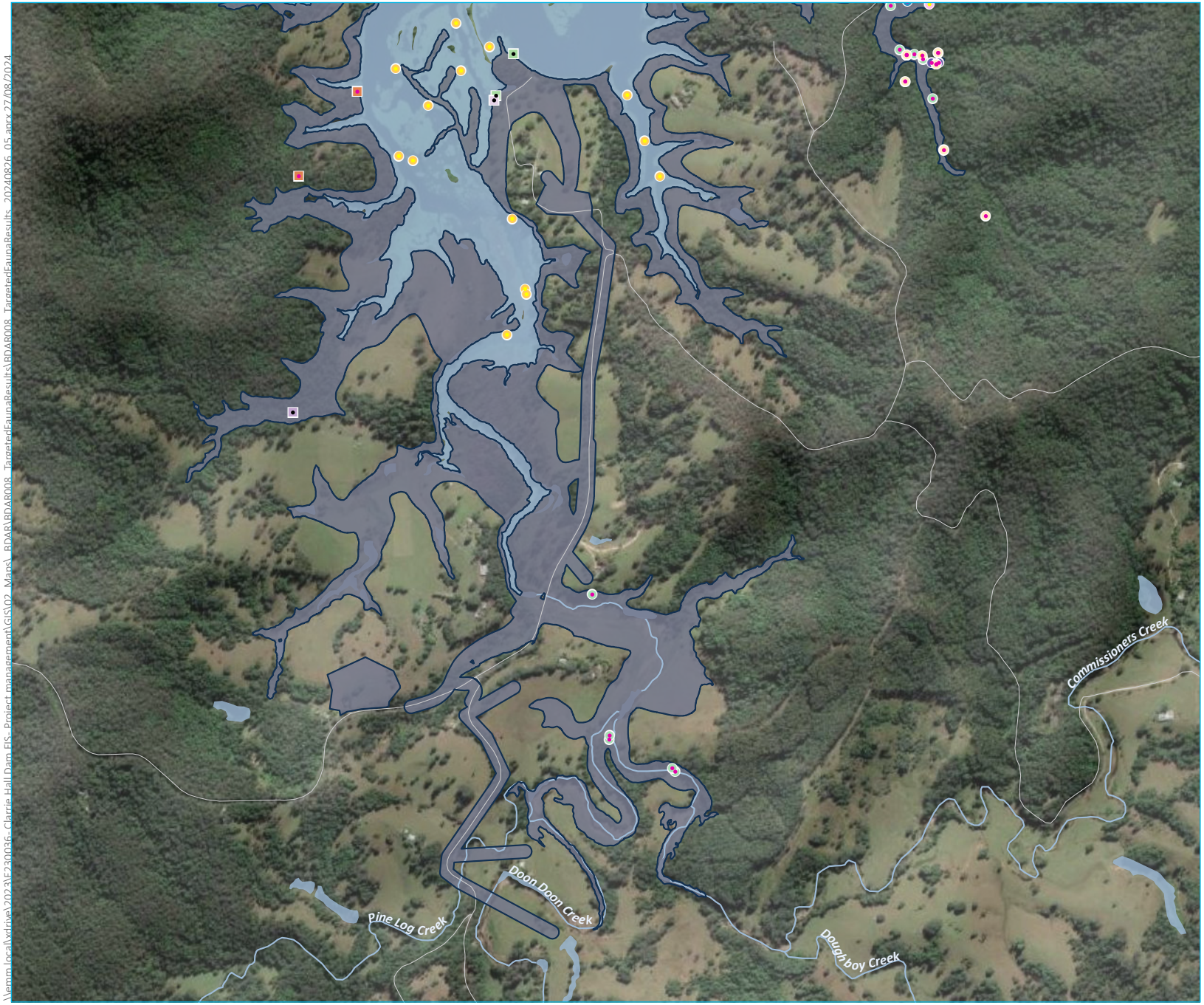
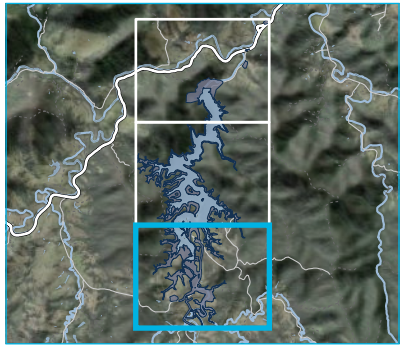
Figure 5.9

EMM
creating opportunities





KEY

Subject land

Threatened fauna species

Amphibians

- Giant Barred Frog
- Pouched Frog

Bats

- Grey-headed Flying Fox
- Large Bent-wing Bat
- Little Bent-wing Bat

Diurnal birds

- Albert's Lyrebird
- Comb-crested Jacana
- Superb Fruit-dove
- Wompoo Fruit-dove

Mammal

- Koala

Invertebrates

- Mitchell's Rainforest Snail
- Southern Pink Underwing Moth foodplant, *Carronia multisepalea*

EPBC Act listed migratory species

- Rufous Fantail

BAM (DPIE, 2020) credit type

- Dual
- Ecosystem
- Species

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Targeted fauna survey results
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Clarrie Hall Dam EIS
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Figure 5.9

EMM
creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009); TSC (2024)

0 0.5 1 km
GDA2020 MGA Zone 56
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5.4.5 Threatened species recorded within the Mount Jerusalem National Park revoked land

Table 5.27 provides a summary of the threatened species recorded within the 1.91 ha of land that has been revoked from the Mount Jerusalem National Park. These threatened species records have been included in the results above.

Table 5.27 Threatened species recorded within the Mount Jerusalem National Park revoked land

Scientific name	Common name	Number of individuals recorded
Endiandra hayesii	Rusty Rose Walnut	1 recorded within subject land 4 recorded outside subject land
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	1 recorded within subject land 1 recorded outside subject land
Grammitis stenophylla	Narrow-leaf Finger Fern	16 recorded outside subject land
Marsdenia longiloba	Slender Marsdenia	1 recorded within subject land 1 recorded outside subject land
Mixophyes iteratus	Giant Barred Frog	9 recorded within subject land
Rhodamnia rubescens	Scrub Turpentine	1 recorded within subject land

5.4.6 Species polygons

For species identified as present in Step 4, the following was undertaken:

- for plant species assessed by a count of individuals, as per the TBDC, targeted surveys were used to estimate the number of individuals and their location on the subject land and a species polygon was established by adding a 30 m buffer around the individuals or groups of individuals on the subject land, or
- for plant and animal species assessed by area of habitat, as per the TBDC, areas of vegetation zone(s) in which the species is predicted to occur based on habitat constraints and condition, which are contiguous with recorded locations, were used to define the species polygon, or
- in individual cases, the species polygon for areas of habitat was modified to represent areas in which microhabitats for the species are present and represent the most likely habitat for the species, or
- for animal species assessed by breeding habitat, a buffer was applied in accordance with the specific guidelines as per the TBDC.

Species polygons were developed for the calculation of species credit requirements based on the results of targeted surveys and the habitat present within and adjacent to the subject land. Detailed descriptions of the species polygons are provided in the following sections.

i Count based flora species

A species polygon for count-based flora species was created by making a 30 m buffer around all recorded locations and including all vegetation zones of PCTs associated with the species located within the buffer. Derived grassland and sedgeland areas of PCT 827 and other cleared areas of land were excluded from the species polygon as they do not provide habitat for the shrubs and trees recorded.

Descriptions of the species polygons for the count-based threatened flora species are provided in Table 5.28.

Table 5.28 Count based threatened flora species records and polygon descriptions

Scientific name	Common name	Habitat potential in the subject land	Species count and species polygon description
Corokia whiteana	Corokia	The species is associated with all PCTs within the subject land. Local occurrences of the species are restricted to the banks of a single flooded catchment in the west of the subject land. The species was recorded from two vegetation zones 827_high and 1302_high.	12 individuals were recorded within the subject land. Figure 5.10 shows the species polygon for this species.
Endiandra hayesii	Rusty Rose Walnut	This species was most frequently recorded in rainforest (PCT 1302_high) with a lower number of individuals found in wet sclerophyll forest (PCT 827, zones; mod, burnt, high).	50 individuals were recorded within the subject land. Figure 5.11 shows the species polygon for this species.
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	The species is associated with all PCTs within the subject land. This species was found throughout the development footprint within all PCTs and the majority of vegetation zones, excepting cleared and grassland areas.	457 individuals were recorded within the subject land. Figure 5.12 shows the species polygon for this species.
Hicksbeachia pinnatifolia	Red Boppel Nut	The species is associated with all PCTs within the subject land. This species was found within one vegetation zone; PCT 827_planted. It is likely that the species was originally planted in a mosaic of planted native species and remnant vegetation. The species was not recorded occurring naturally within the Subject Land.	4 individuals were recorded within the subject land. Figure 5.13 shows the species polygon for this species.
Lepiderema pulchella	Fine-leaved Tuckeroo	The species is associated with all PCTs within the subject land. This species was found within one PCT and two vegetation zones; PCT 827 planted and 827 low. It is likely that the species was originally planted in a mosaic of planted native species and remnant vegetation. The species was not recorded occurring naturally within the Subject Land.	15 individuals were recorded within the subject land. Figure 5.14 shows the species polygon for this species.
Macadamia tetraphylla	Rough-shelled Bush Nut	The species is associated with all PCTs within the subject land. This species was found within one PCT; 827 and five vegetation zones; low, mod, burnt, high and planted.	12 individuals were recorded within the subject land. Figure 5.15 shows the species polygon for this species.
Rhodamnia rubescens	Scrub Turpentine	The species is associated with PCT 1073 and 1302 in BioNet. Notably it is not associated with PCT 827. This species was widespread throughout the subject land including all vegetation zones of PCT 827 excepting grassland and sedgeland areas.	709 individuals were recorded within the subject land. Figure 5.16 shows the species polygon for this species. The species polygon includes areas of PCT 827. Despite the species not being associated with the PCT the species was prevalent within this vegetation community.

Scientific name	Common name	Habitat potential in the subject land	Species count and species polygon description
Syzygium hodgkinsoniae	Red Lilly Pilly	The species is associated with all PCTs within the subject land. The species was recorded within the northern half of the subject land, primarily within rainforest gullies and more sheltered patches of wet sclerophyll forest. The species was most prevalent in PCT 1302_high, also occurring in PCT 827_burnt and _high.	105 individuals were recorded within the subject land. Figure 5.17 shows the species polygon for this species.
Szygium mooreri	Durobby	The species is associated with all PCTs within the subject land. This species was recorded within planted native vegetation, PCT 827_planted and 827_low. Where species was planted within a mosaic of native remnant vegetation offset will be provided. Where the species is part of native planting, in an otherwise cleared area, the streamline assessment module applies, and no offsets are required. The species was not recorded occurring naturally within the Subject Land.	16 individuals were recorded within zones PCT 827_planted and 827_low and will be offset accordingly. 2 individuals were recorded within planted vegetation assessed under the streamline assessment module and do not require offsets. **Figure 5.18** shows the species polygon for this species.

ii Area based flora species

Species polygons for area-based flora species were created by including the contiguous vegetation zone within which each record of the species was located. A modified approach was taken to define the species polygon for Narrow leaf Finger Fern (*Grammitis stenophylla*) due to the species constrained microhabitat preferences.

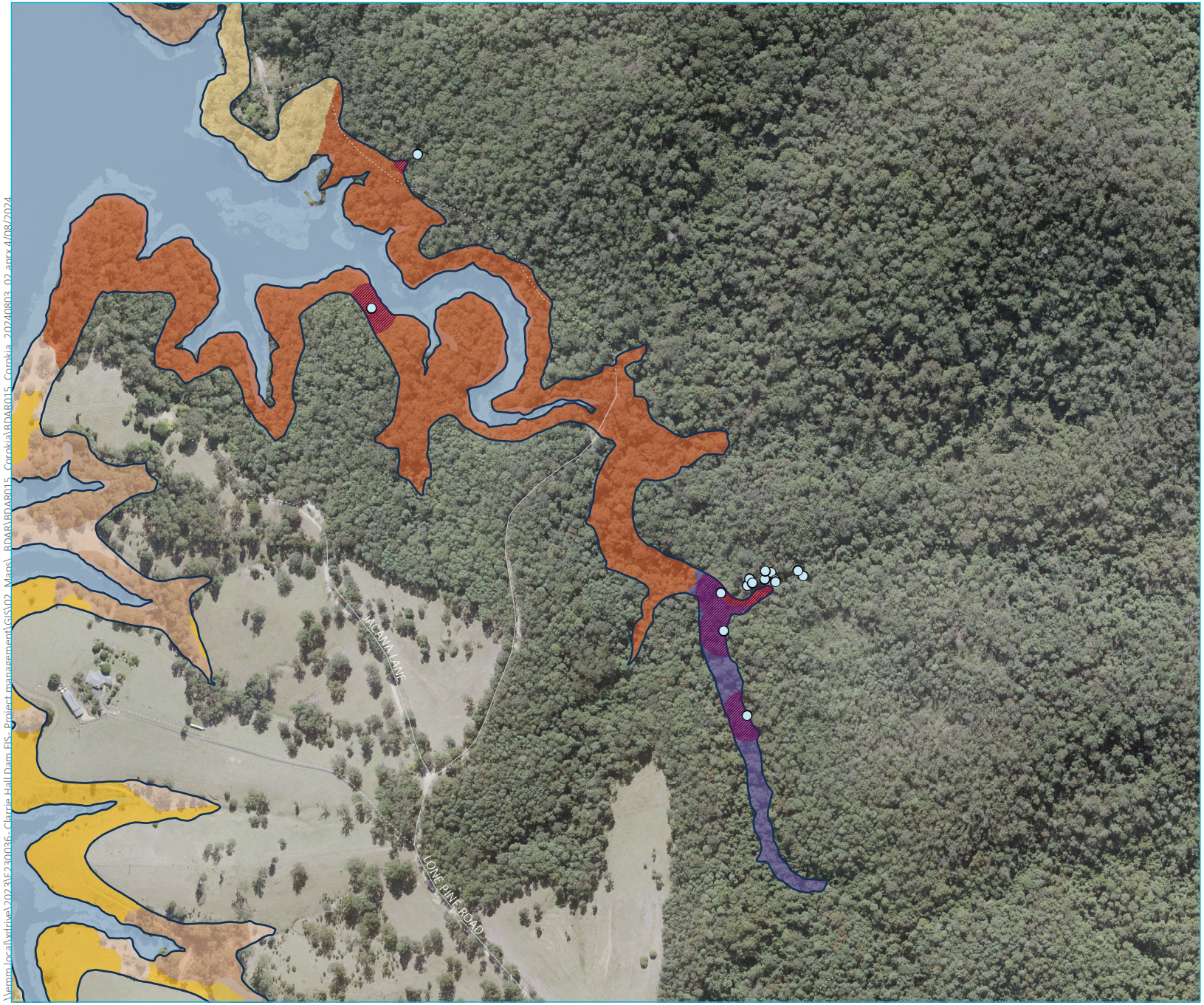
Descriptions of the species polygons for the area-based threatened flora species are provided in Table 5.29.

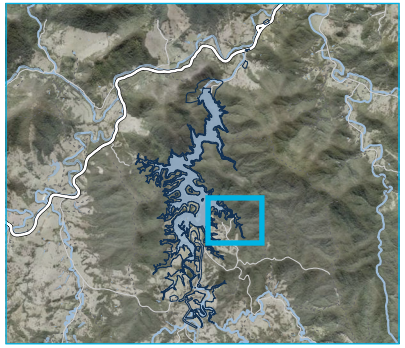
Table 5.29 Area based threatened flora species records and polygon descriptions

Scientific name	Common name	Habitat potential in the subject land	Species count and species polygon description
Desmodium acanthocladum	Thorny Pea	The species is associated with all PCTs within the subject land. The species is typically found alongside watercourses.	A total of 52 individuals were recorded, the majority of which were in a single patch adjacent to Doon Doon Creek, downstream of the existing Dam wall. A single individual was also identified adjacent to Clarrie Hall Dam Road. The species was recorded in PCT 827_mod which constitutes the species polygon of 2.21 ha (refer to Figure 5.19).

Scientific name	Common name	Habitat potential in the subject land	Species count and species polygon description
Drynaria rigidula	Basket Fern	The species is associated with all PCTs within the subject land. This species is relatively common in QLD, however, was presumed extinct in NSW until relatively recently. It is currently known from only 3 locations in N.S.W., although it is common in Queensland. Only one plant is known from each of the known locations in NSW (NSW final determination, 2021).	A total of five individuals were recorded within a regenerating area of the disused quarry at the northwest of the Dam. The species was recorded within a single patch of PCT 827_low which constitutes the species polygon of 0.50 ha (refer to Figure 5.20).
Grammitis stenophylla	Narrow leaf Finger Fern	The species is not associated with any PCTs within the subject land. This species has specific habitat requirements, found in moist areas of sclerophyll forest and rainforest, growing on rocks.	Six patches (containing a total of 91 individuals) of this species were recorded within the subject land, growing on rock outcrops, typically with moss and other fern species. The species was found with areas of PCT 827_mod, PCT 827_high and 1302_high. The species required specific habitat requirements and microhabitat features, including sheltered and mesic rocky outcrops. Within the subject land these features occur in discrete outcrops. The species is not associated with the PCTs on the subject land and the species polygon would be best represented by a buffer around the species records, encompassing the habitat features present. To create the species polygon a 30 m buffer has been added to each of the records. The area (ha) calculations include all areas in the subject land, with the exception of cleared area/water. Where the species record occurs outside of the disturbance area a 30 m buffer has been added on a conservative bases, with any overlap of the buffer and subject land also forming the species polygon. The species was recorded in PCT 827_mod, 827_high and PCT 1302_highwhich constitutes the species polygon of 1.03 ha (refer to Figure 5.21).
Marsdenia longiloba	Slender Marsdenia	The species is associated with all PCTs within the subject land. and has the potential to occur throughout.	The species was recorded throughout much of the subject land with the exception of the southernmost areas. A total of 228 individuals were recorded. It was present across multiple vegetation zones; PCT 827, zones low, burnt, mod, high; PCT 1302_high and PCT 1073_high. The species polygon is comprised of each continuous vegetation zone where one or more records are present. The species polygon totals 78.96 ha (refer to Figure 5.22).

Scientific name	Common name	Habitat potential in the subject land	Species count and species polygon description
Rhodomyrtus psidioides	Native Guava	The species is associated with PCT 1073 and PCT 1302. The species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines.	A total of 6,079 individuals of this species were recorded within the subject land. The species was recorded within all forested vegetation zones of PCT 827, despite not being associated with the vegetation community. The species polygon is comprised of each continuous vegetation zone where one or more records are present. The species polygon totals 95.53 ha (refer to Figure 5.23).





KEY

- Subject land
- Species polygon
- *Corokia whiteana*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Corokia (*Corokia whiteana*) records and species polygon (count based)

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Figure 5.10

EMM
creating opportunities

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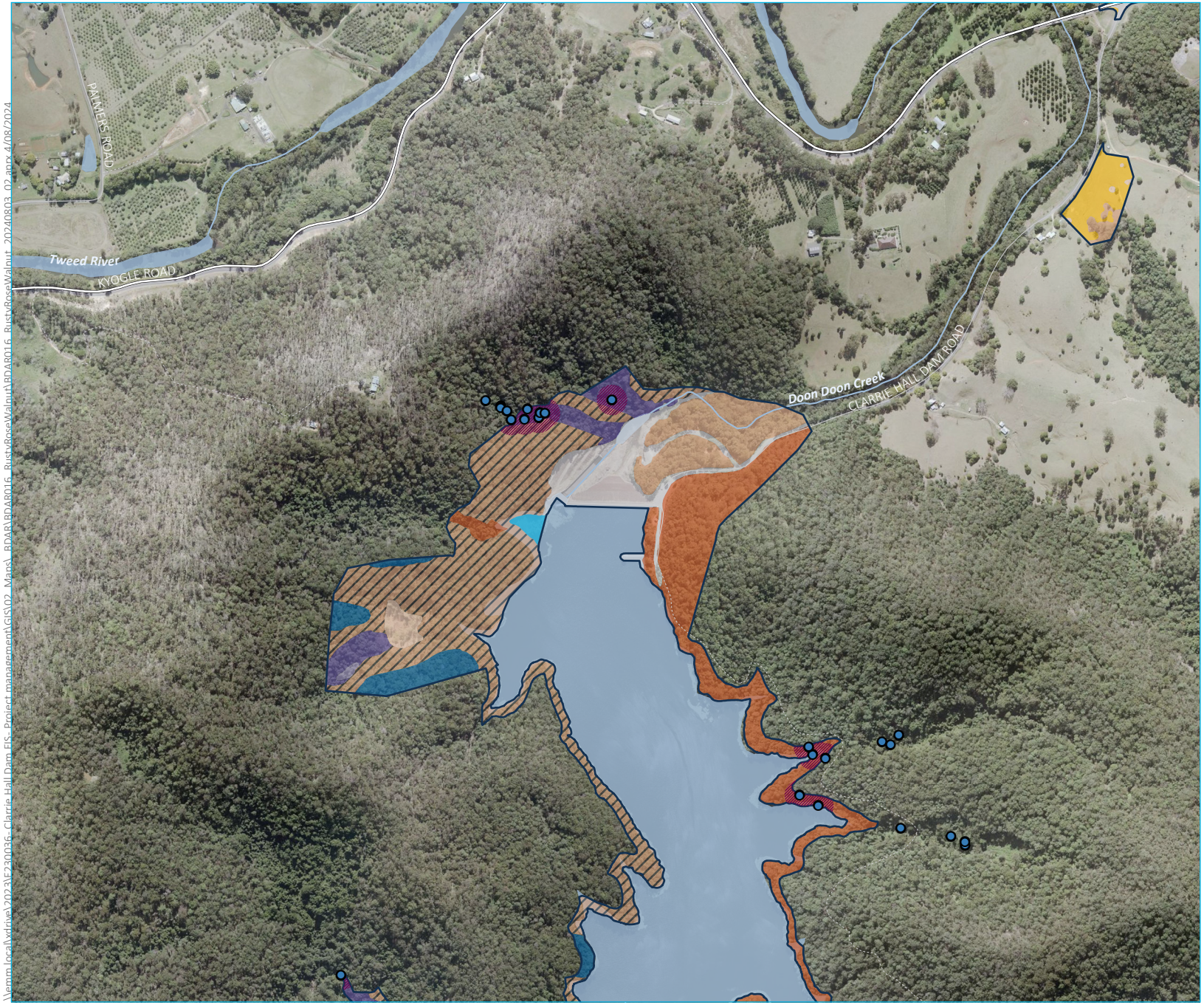

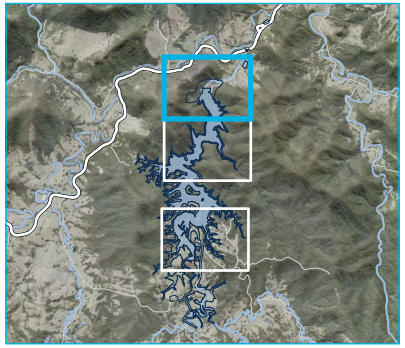

KEY

- Subject land
- Species polygon
- *Endiandra hayesii*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

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Rusty Rose Walnut (*Endiandra hayesii*) records and species polygon (count based) Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.11

EMM
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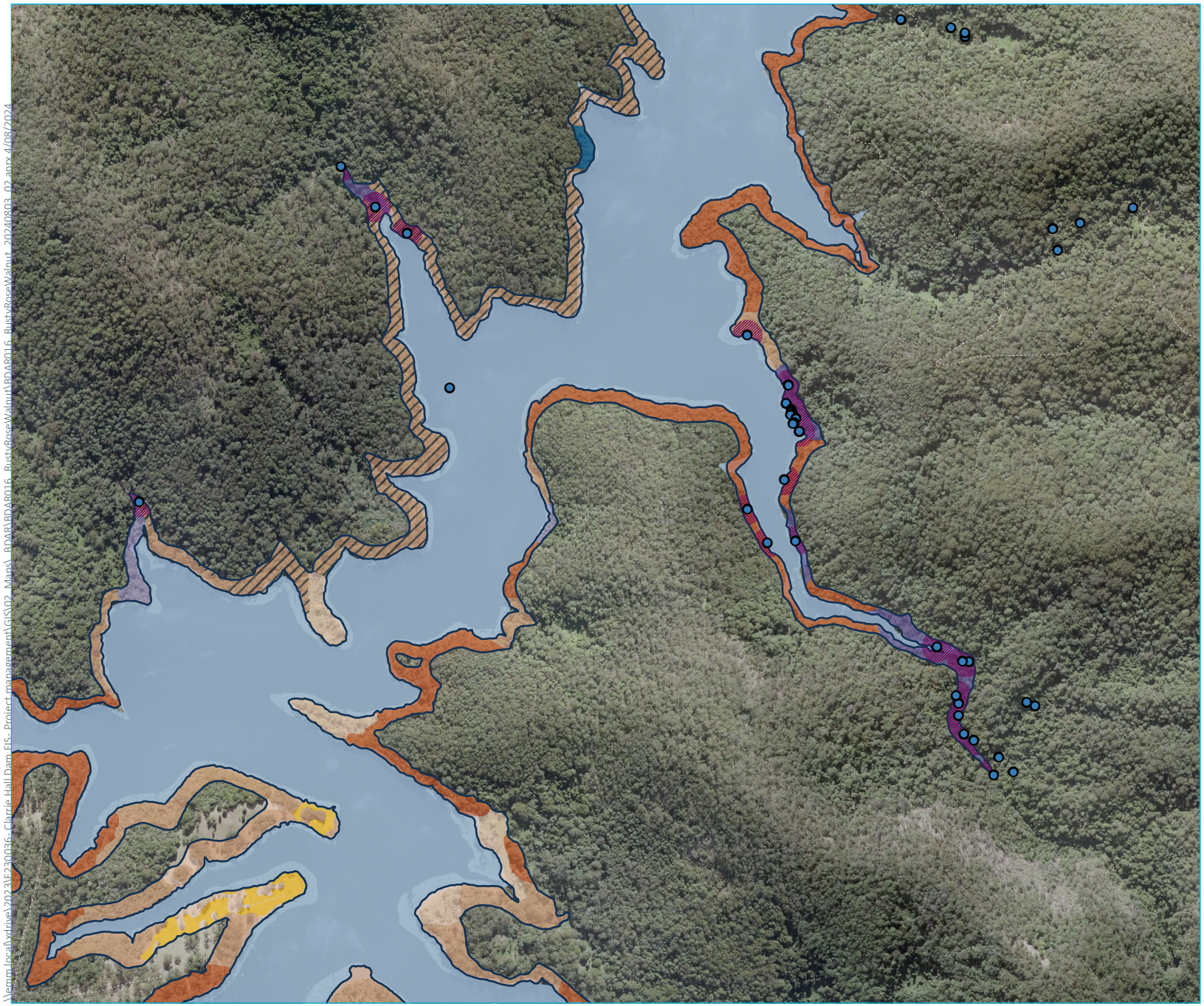

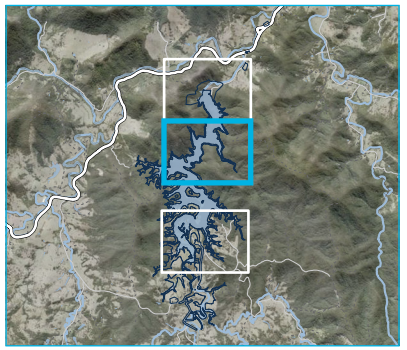

KEY

- Subject land
- Species polygon
- *Endiandra hayesii*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Rusty Rose Walnut (*Endiandra hayesii*) records and species polygon (count based) Page 2 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.11

EMM
creating opportunities

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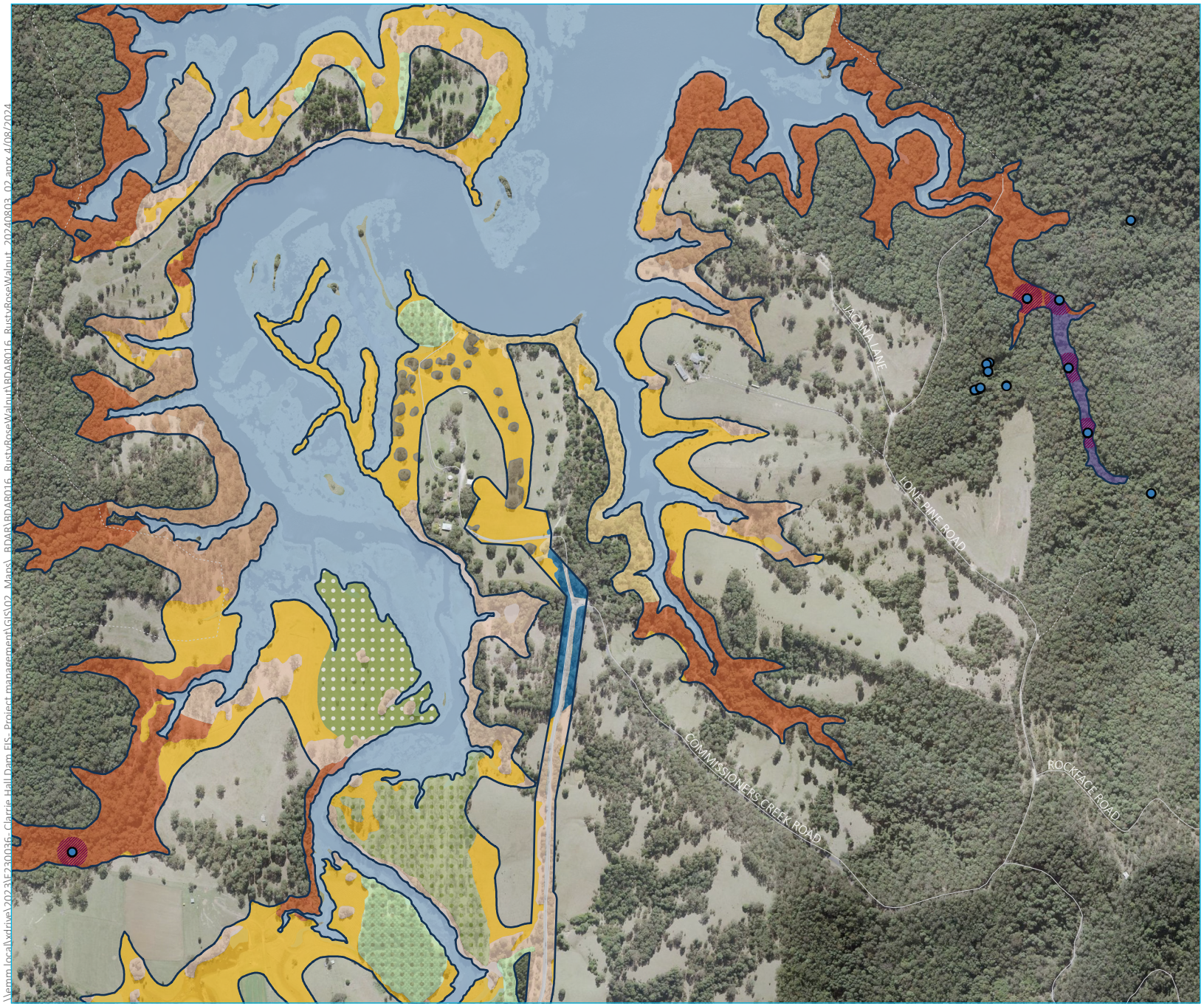

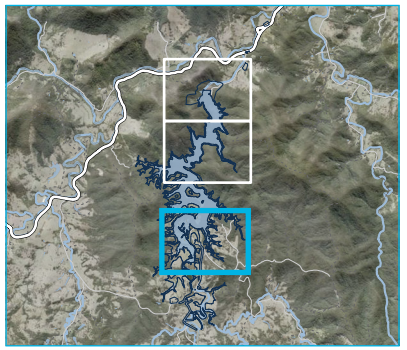

KEY

- Subject land
- Species polygon
- *Endiandra hayesii*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Rusty Rose Walnut (*Endiandra hayesii*) records and species polygon (count based) Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.11

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

EMM
creating opportunities

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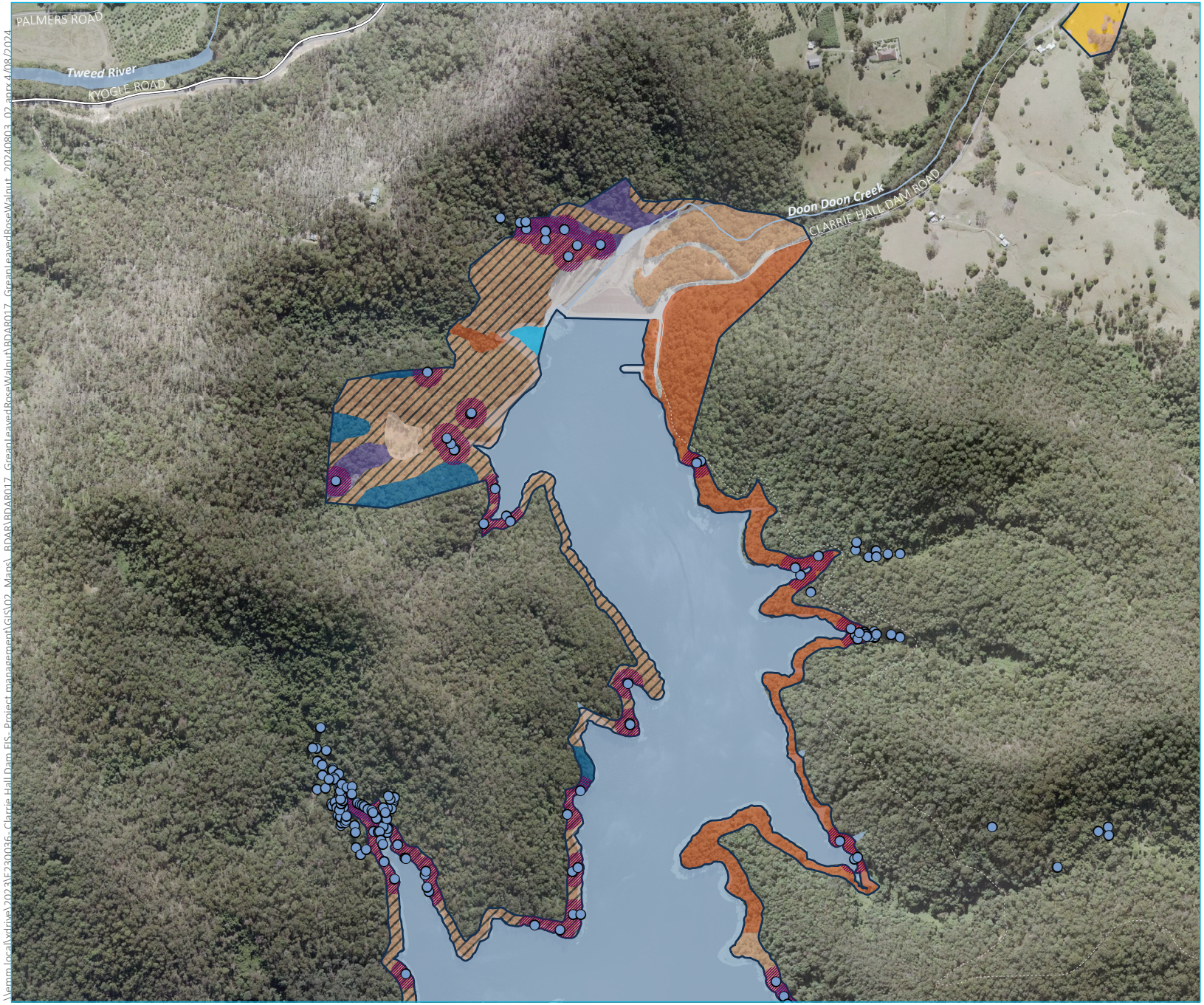

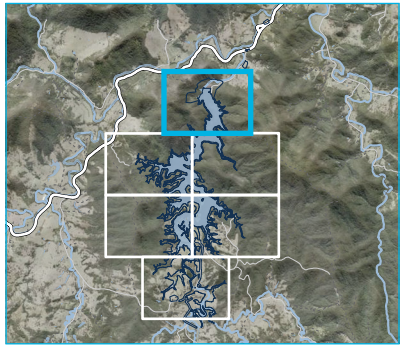

KEY

- Subject land
- Species polygon
- *Endiandra muelleri subsp. bracteata*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) records and species polygon (count based)

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Biodiversity Development Assessment Report
Figure 5.12

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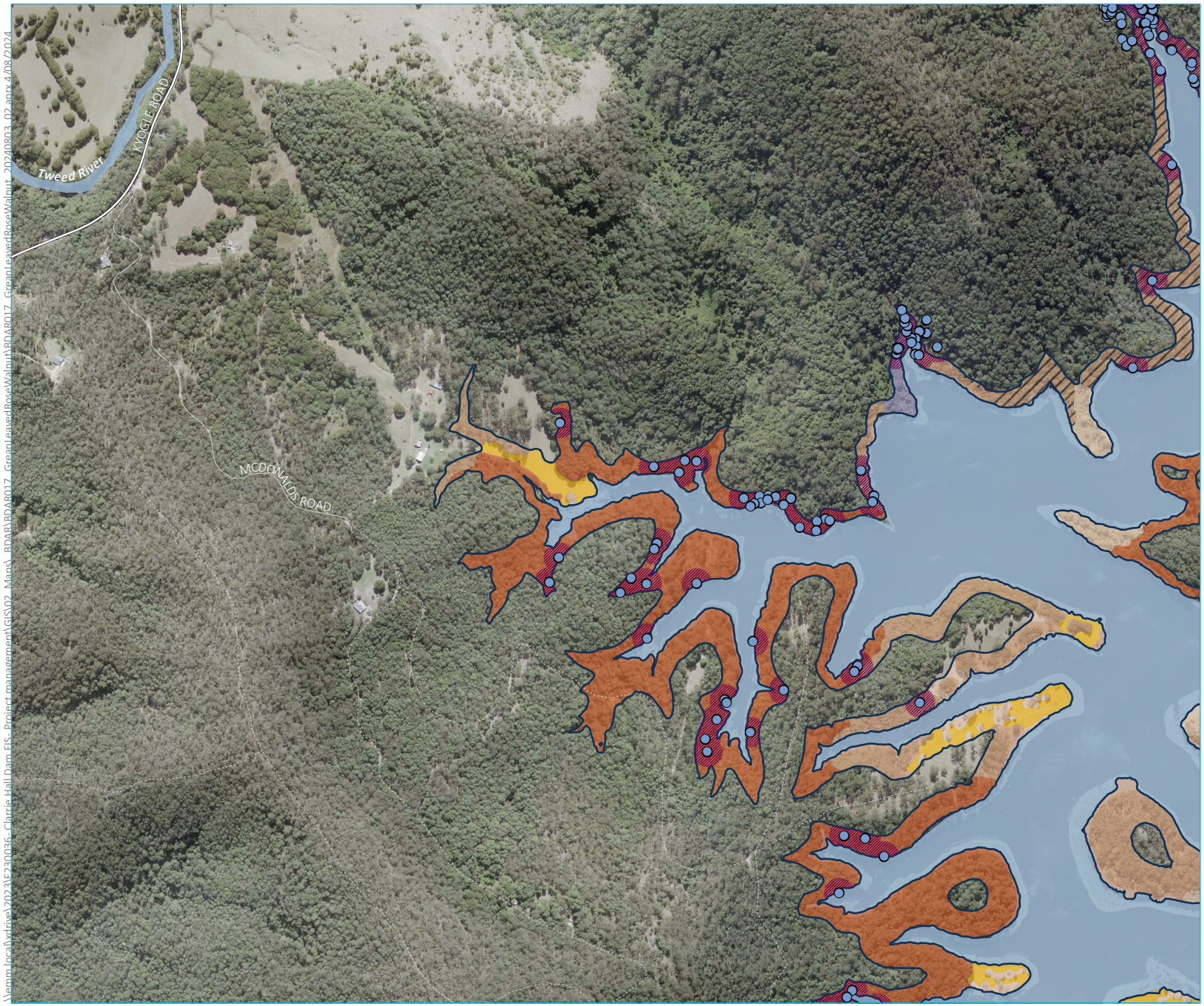

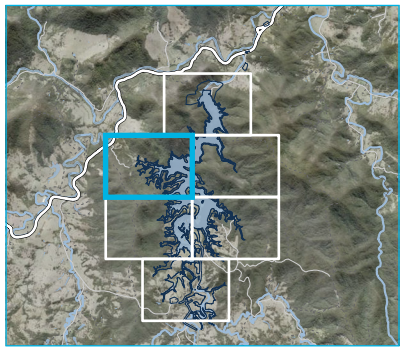

KEY

- Subject land
- Species polygon
- *Endiandra muelleri subsp. bracteata*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) records and species polygon (count based)

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.12

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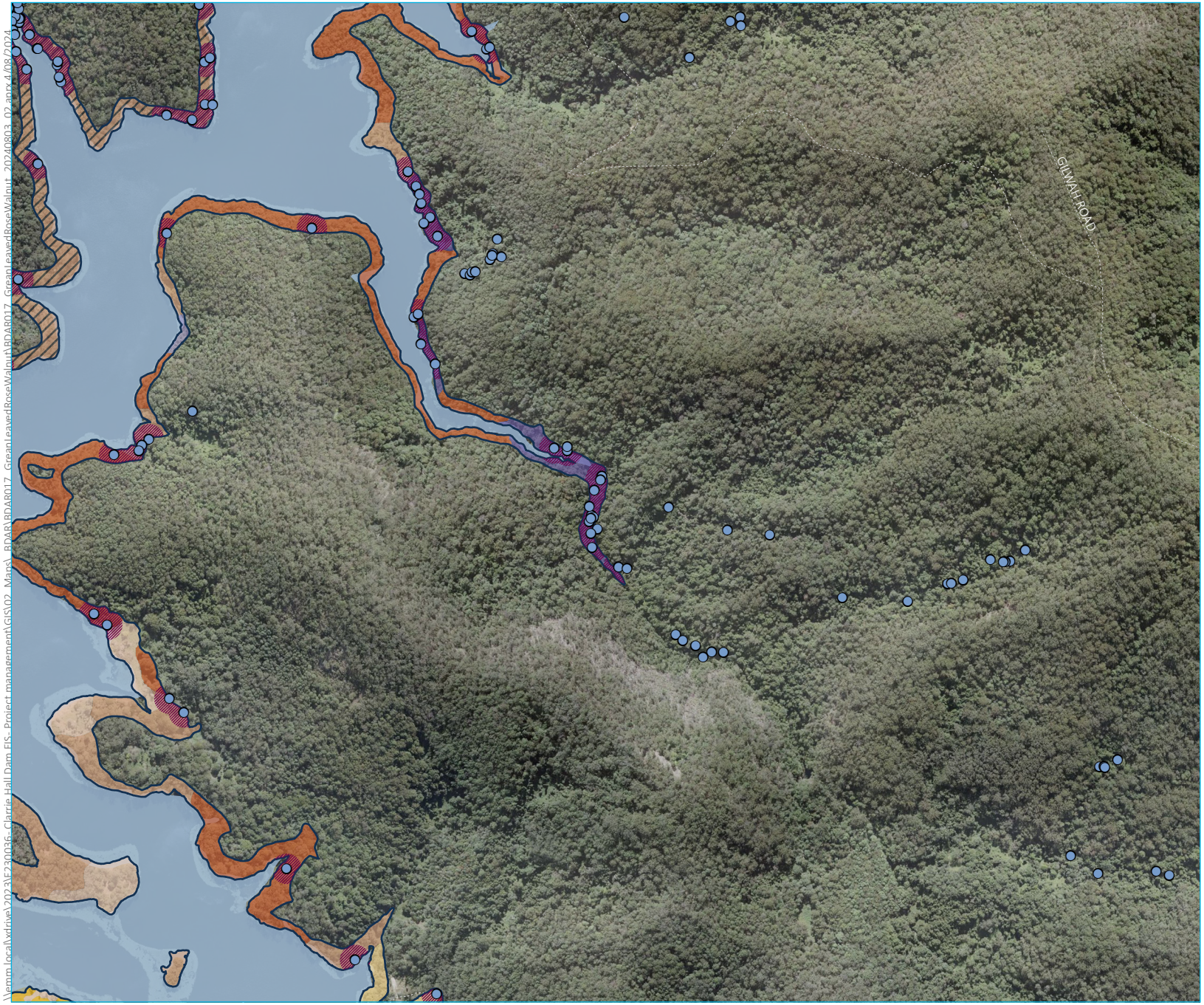

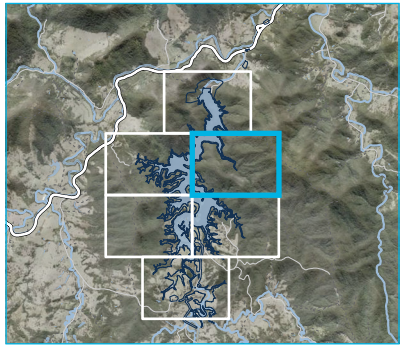

KEY

- Subject land
- Species polygon
- *Endiandra muelleri subsp. bracteata*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) records and species polygon (count based)

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.12

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

creating opportunities

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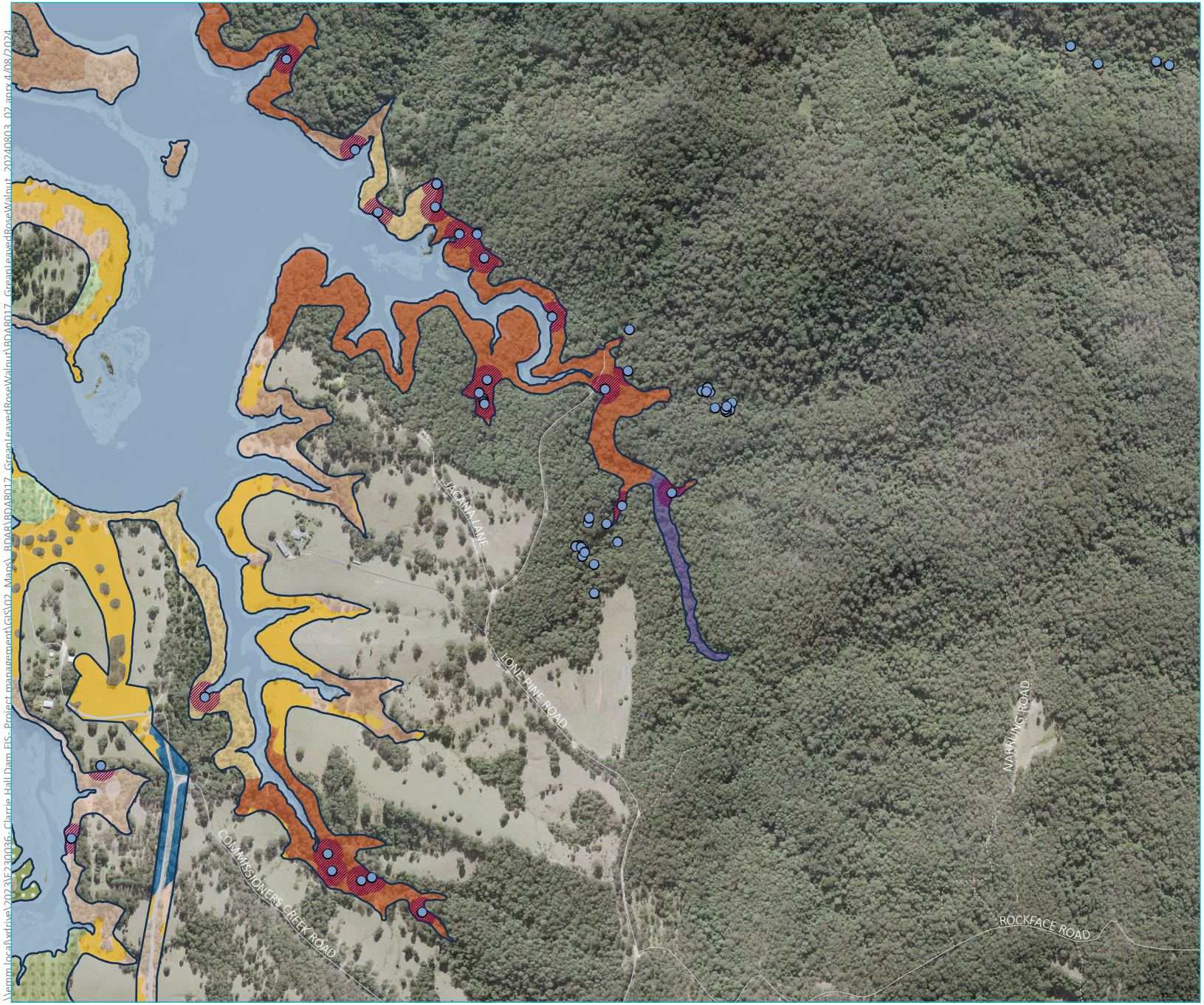

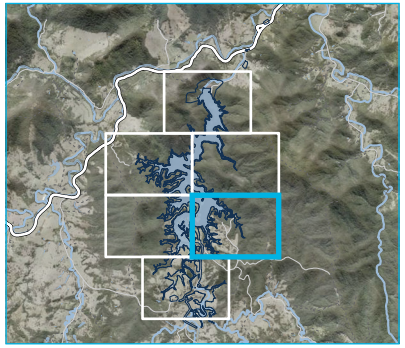

KEY

- Subject land
- Species polygon
- *Endiandra muelleri subsp. bracteata*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) records and species polygon (count based)

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Biodiversity Development Assessment Report
Figure 5.12

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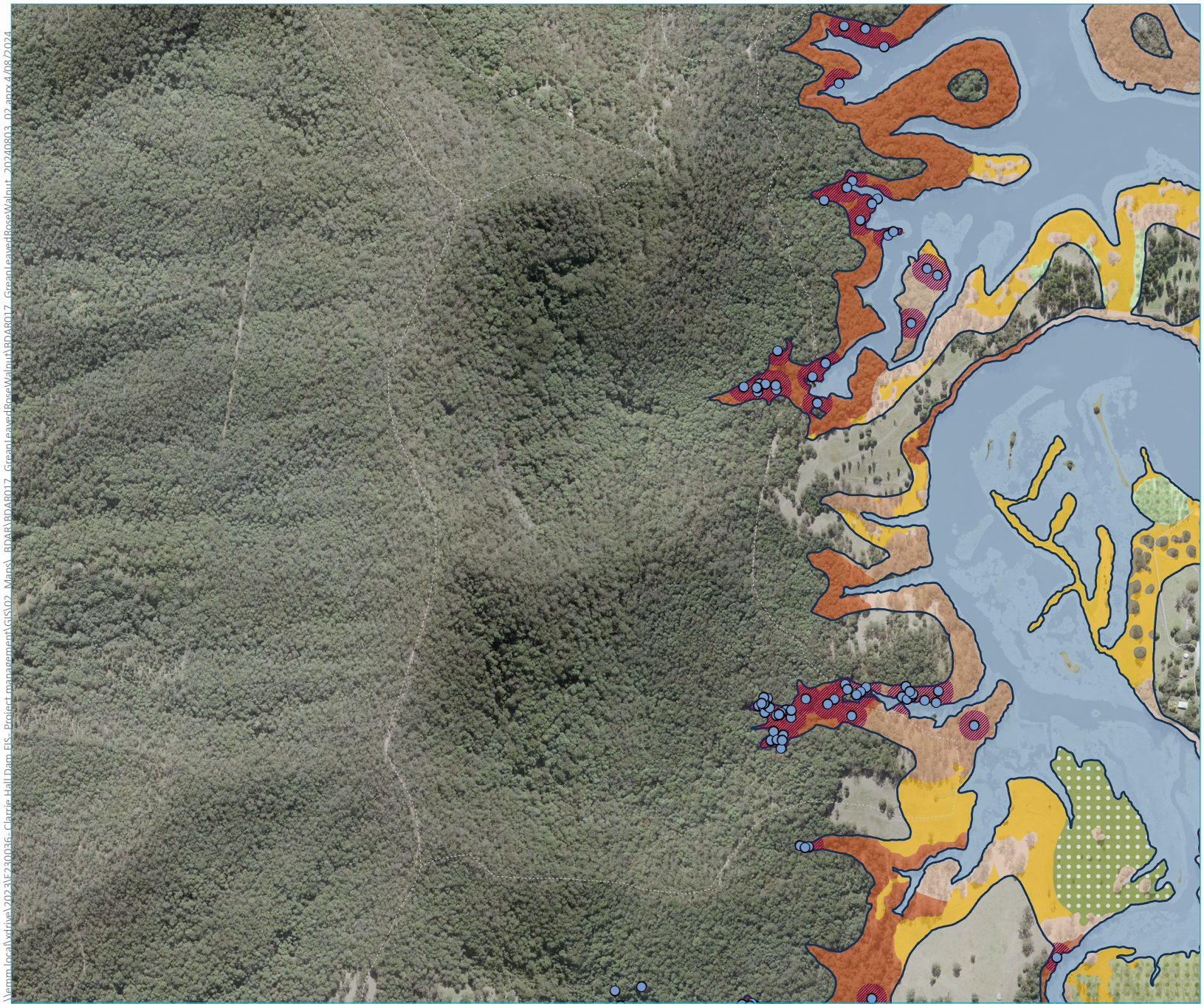

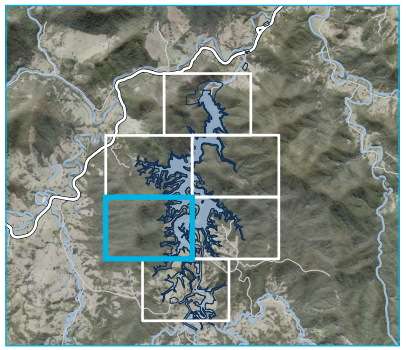

KEY

Subject land

Species polygon

Endiandra muelleri subsp. bracteata

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

High

Moderate

Low

Planted

Grassland

Derived sedgeland

Other

Eucalyptus plantation

Hoop plantation

Native planted vegetation

Cleared

Existing environment

Major road

Minor road

Vehicular track

Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

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Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) records and species polygon (count based)

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.12

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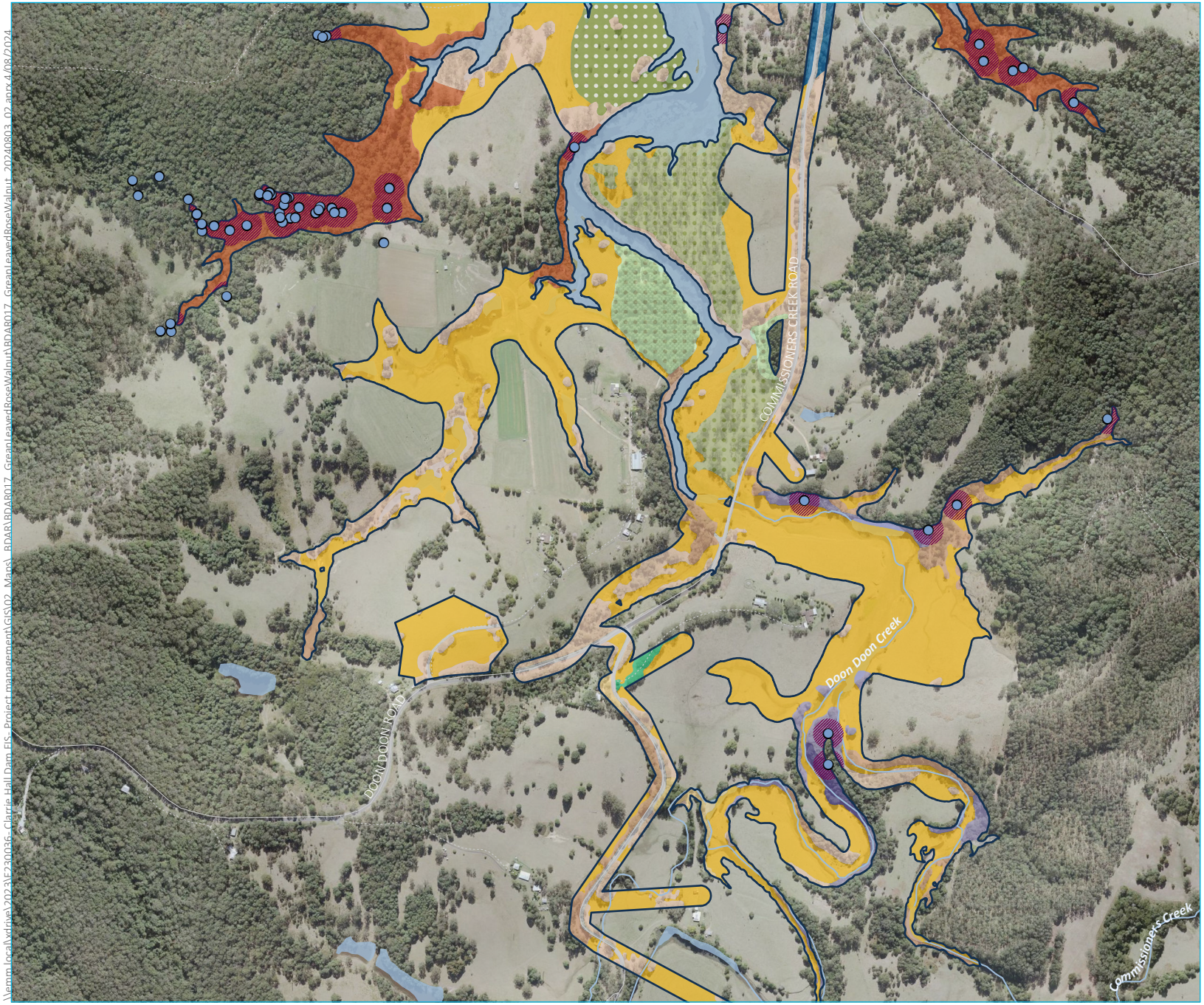

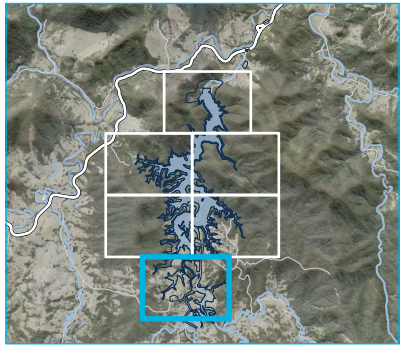

KEY

- Subject land
- Species polygon
- *Endiandra muelleri subsp. bracteata*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Exotic trees
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) records and species polygon (count based)
Page 6 of 6

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Biodiversity Development Assessment Report
Figure 5.12

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

creating opportunities

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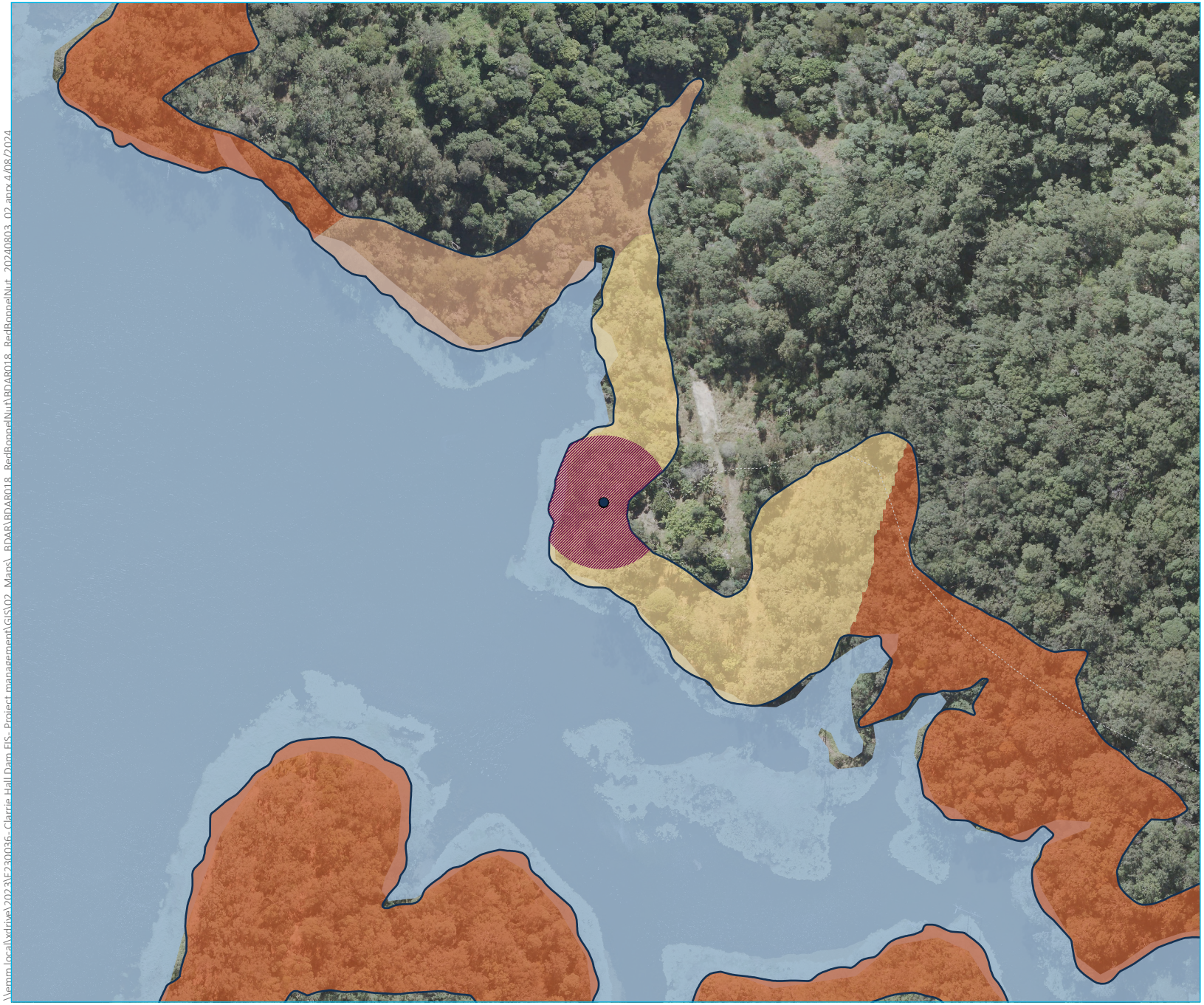

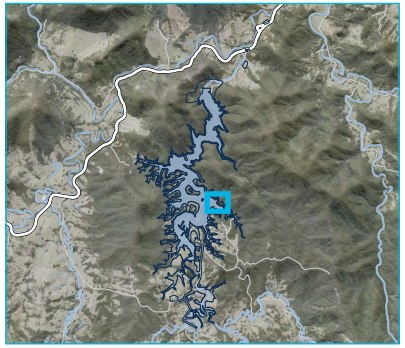

KEY

- Subject land
- Species polygon
- *Hicksbeachia pinnatifolia*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Planted

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

0 50 100 m

GDA2020 MGA Zone 56

N

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

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Red Boppel Nut (*Hicksbeachia pinnatifolia*) records and species polygon (count based)

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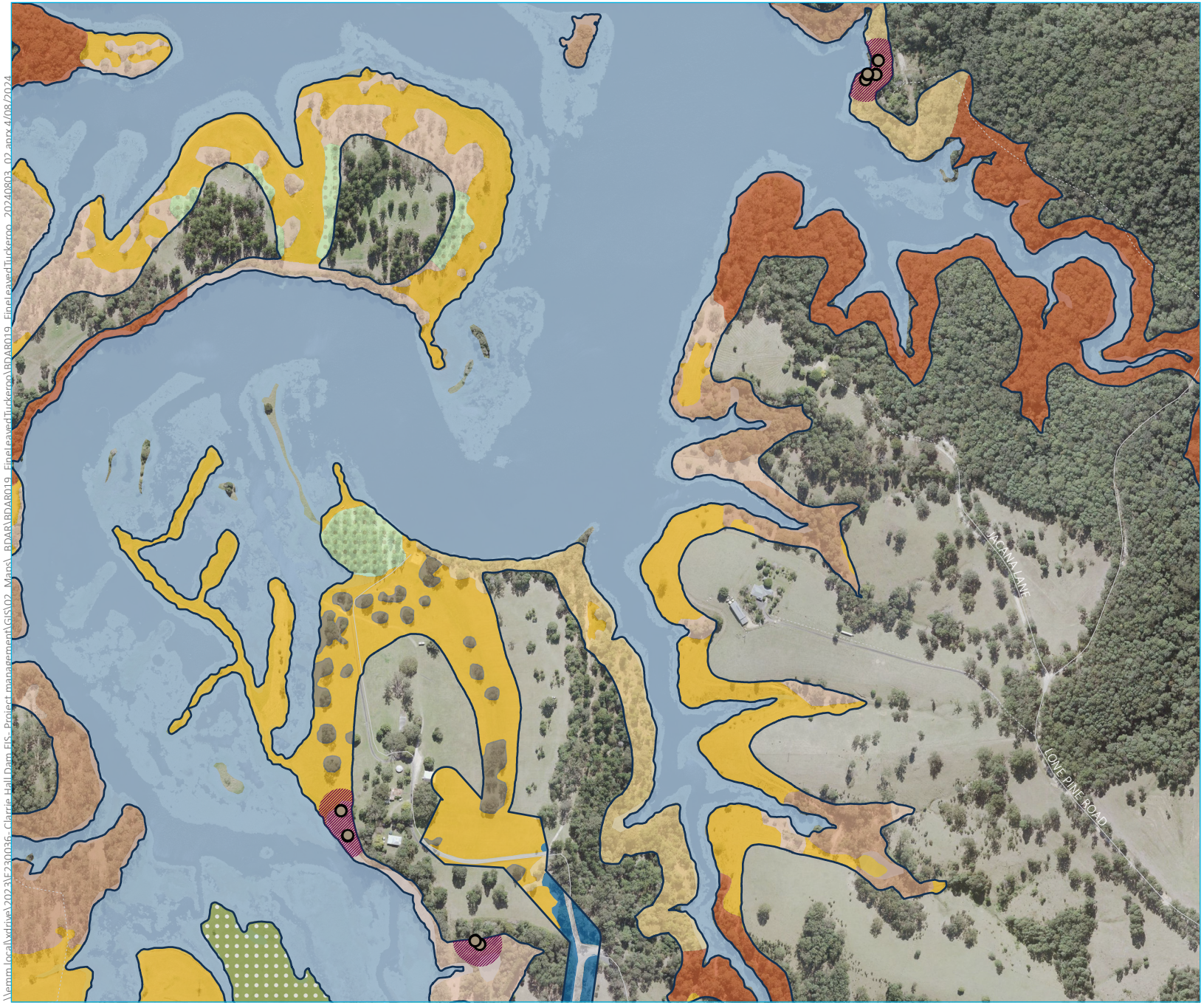
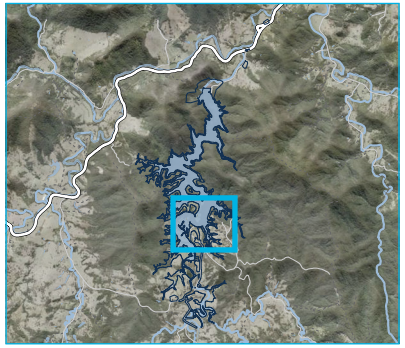
Biodiversity Development Assessment Report
Figure 5.13

EMM
creating opportunities





KEY

- Subject land
- Species polygon
- *Lepiderema pulchella*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Fine-leaved Tuckeroo (*Lepiderema pulchella*) records and species polygon (count based)

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Biodiversity Development Assessment Report
Figure 5.14

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

creating opportunities

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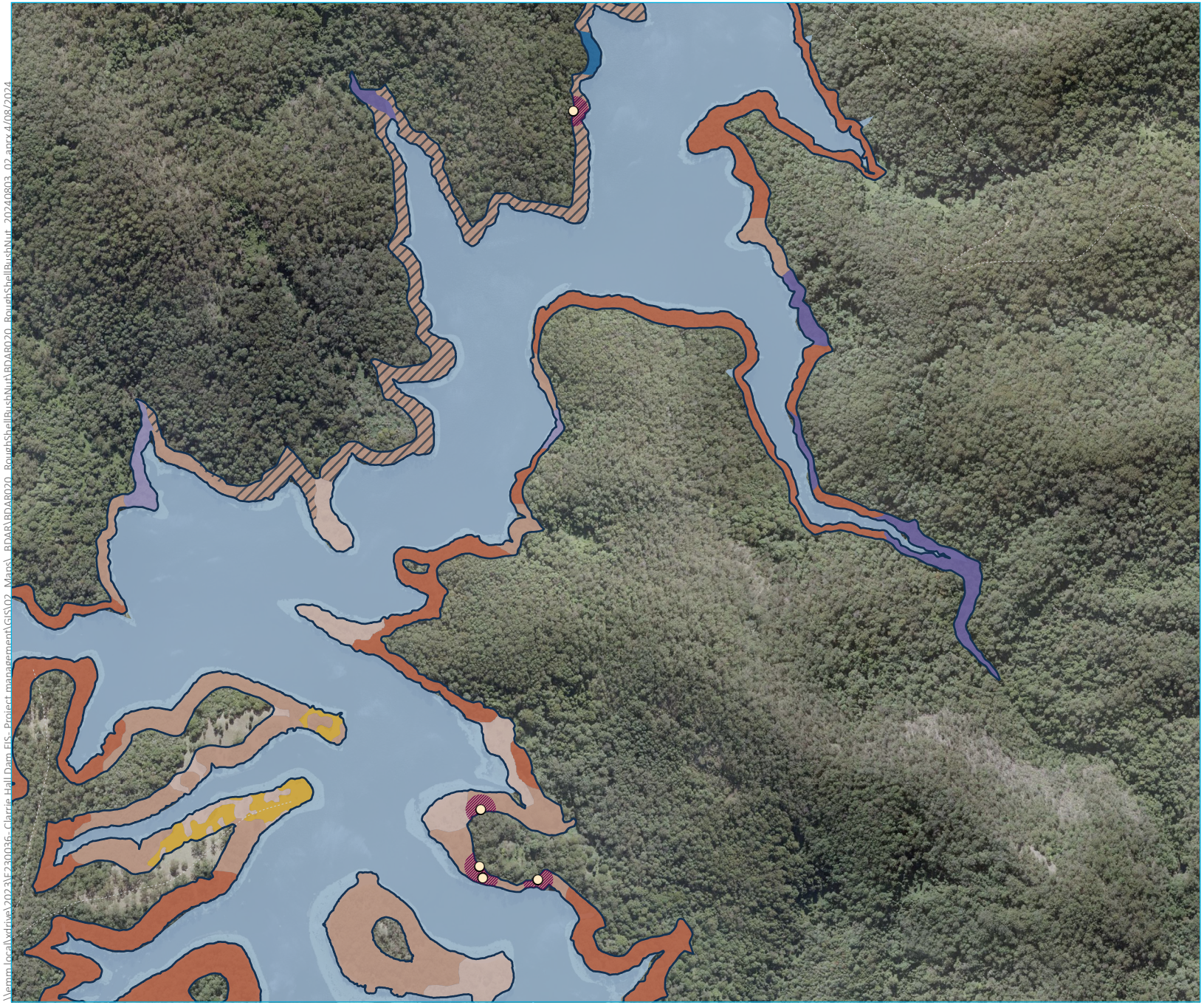

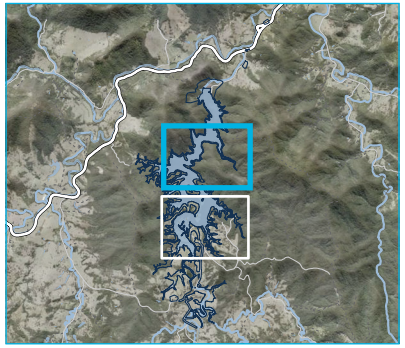

KEY

Subject land

Species polygon

Macadamia tetraphylla

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

High

Moderate

Burnt

Low

Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

High

Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

High

Existing environment

Major road

Minor road

Vehicular track

Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Rough-shelled Bush Nut (*Macadamia tetraphylla*) records and species polygon (count based) Page 1 of 2

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Biodiversity Development Assessment Report
Figure 5.15

EMM
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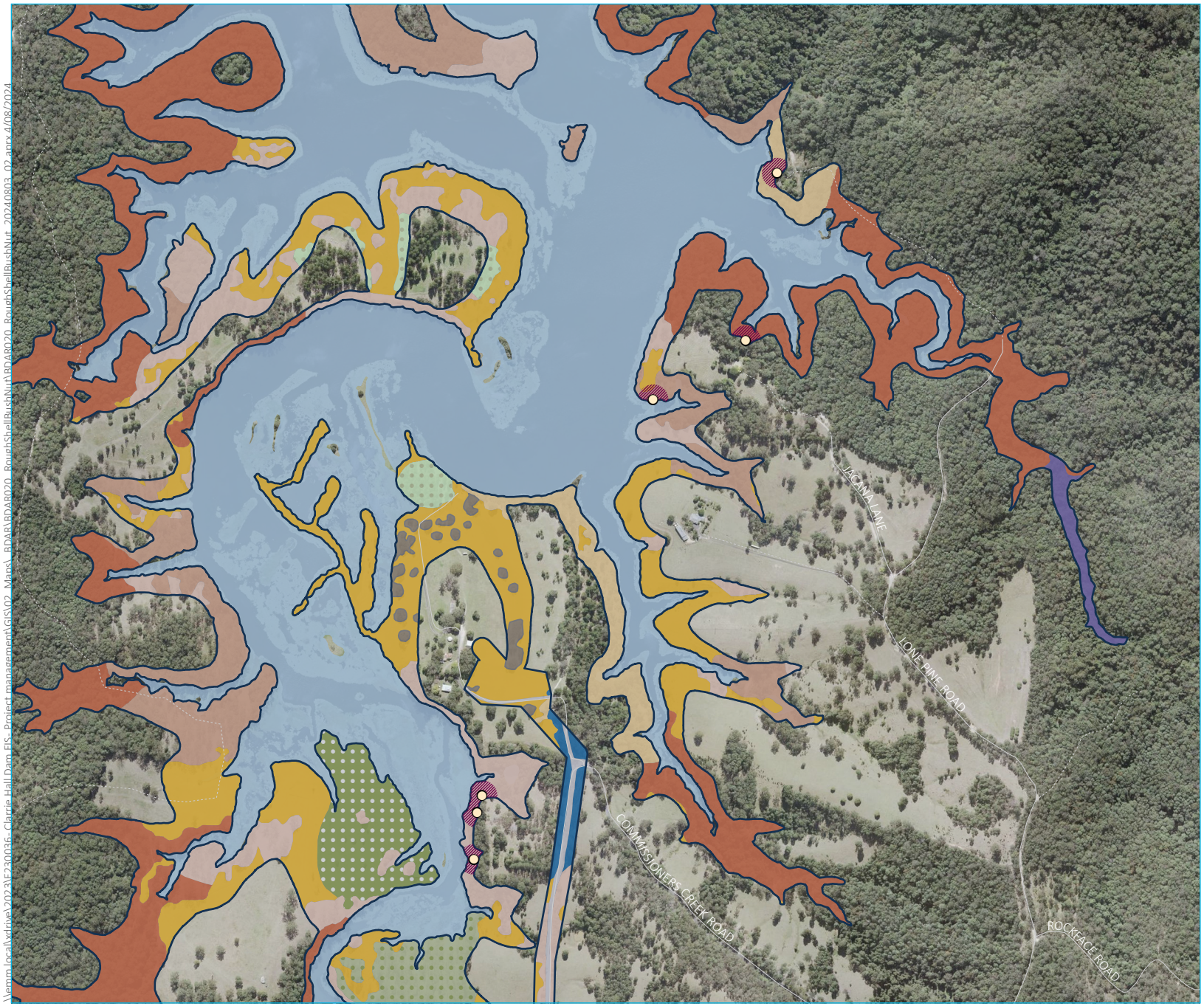
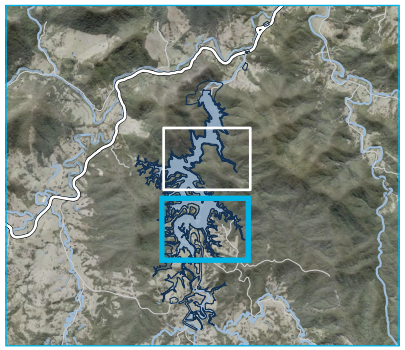




KEY

- Subject land
- Species polygon
- *Macadamia tetraphylla*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

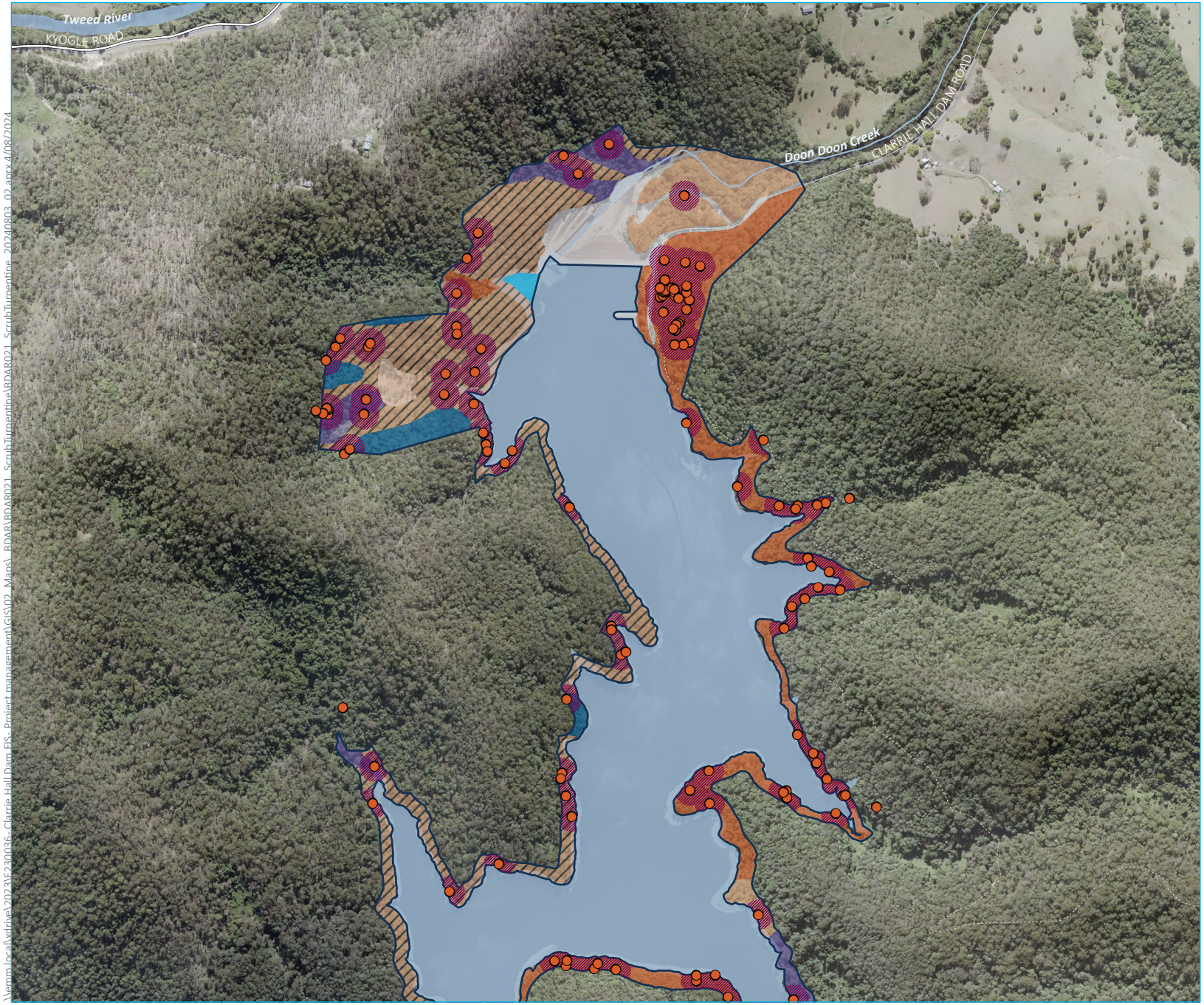
N

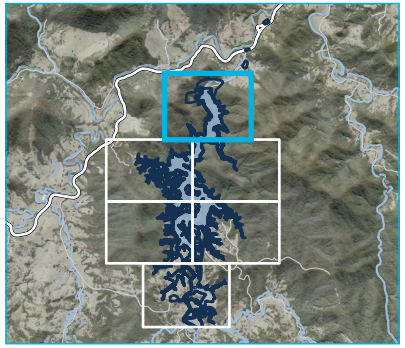
Rough-shelled Bush Nut (*Macadamia tetraphylla*) records and species polygon (count based) Page 2 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.15

EMM
creating opportunities

\\emm.local\xdrive\2023\E230036 - Clarrie Hall Dam EIS - Project management\GIS\02_Maps_BDAR\BDAR020_RoughShellBushNut\BDAR020_RoughShellBushNut_20240803_02.aprx 4/08/2024





KEY

Species polygon

Rhodamnia rubescens

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Scrub Turpentine (*Rhodamnia rubescens*) records and species polygon (count based) Page 1 of 6

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.16

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

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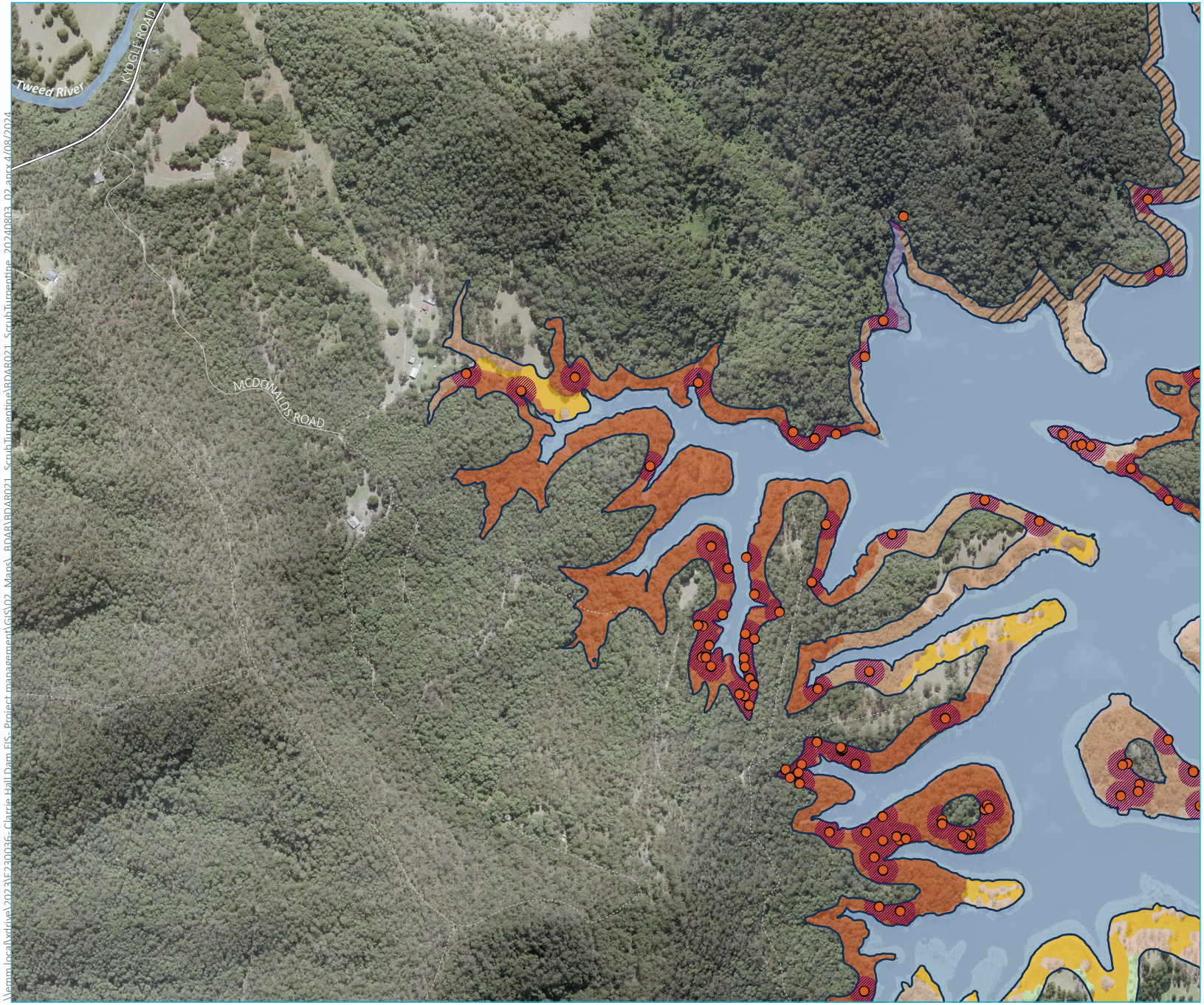

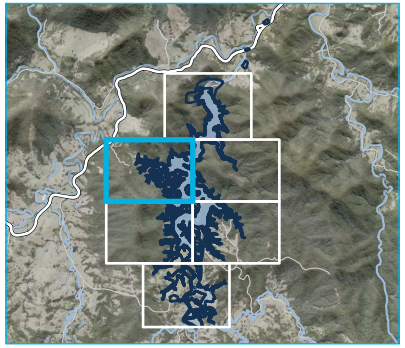

KEY

- Species polygon
- *Rhodamnia rubescens*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- Moderate

Other

- Hoop plantation

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

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Scrub Turpentine (*Rhodamnia rubescens*) records and species polygon (count based) Page 2 of 6

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.16

EMM
creating opportunities

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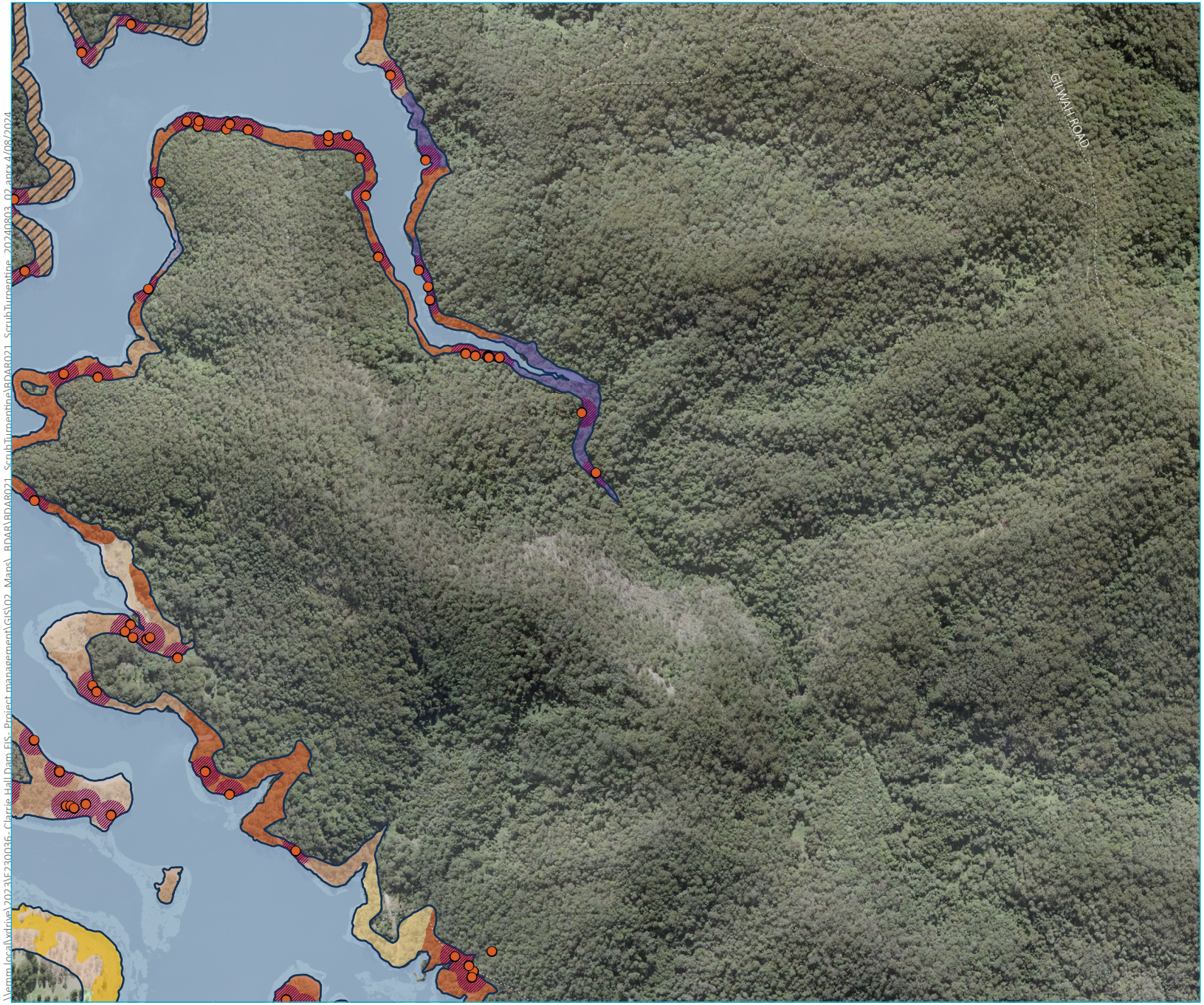

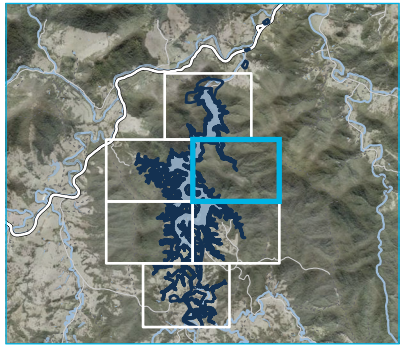

KEY

Species polygon

Rhodamnia rubescens

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

Other

- Hoop plantation

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

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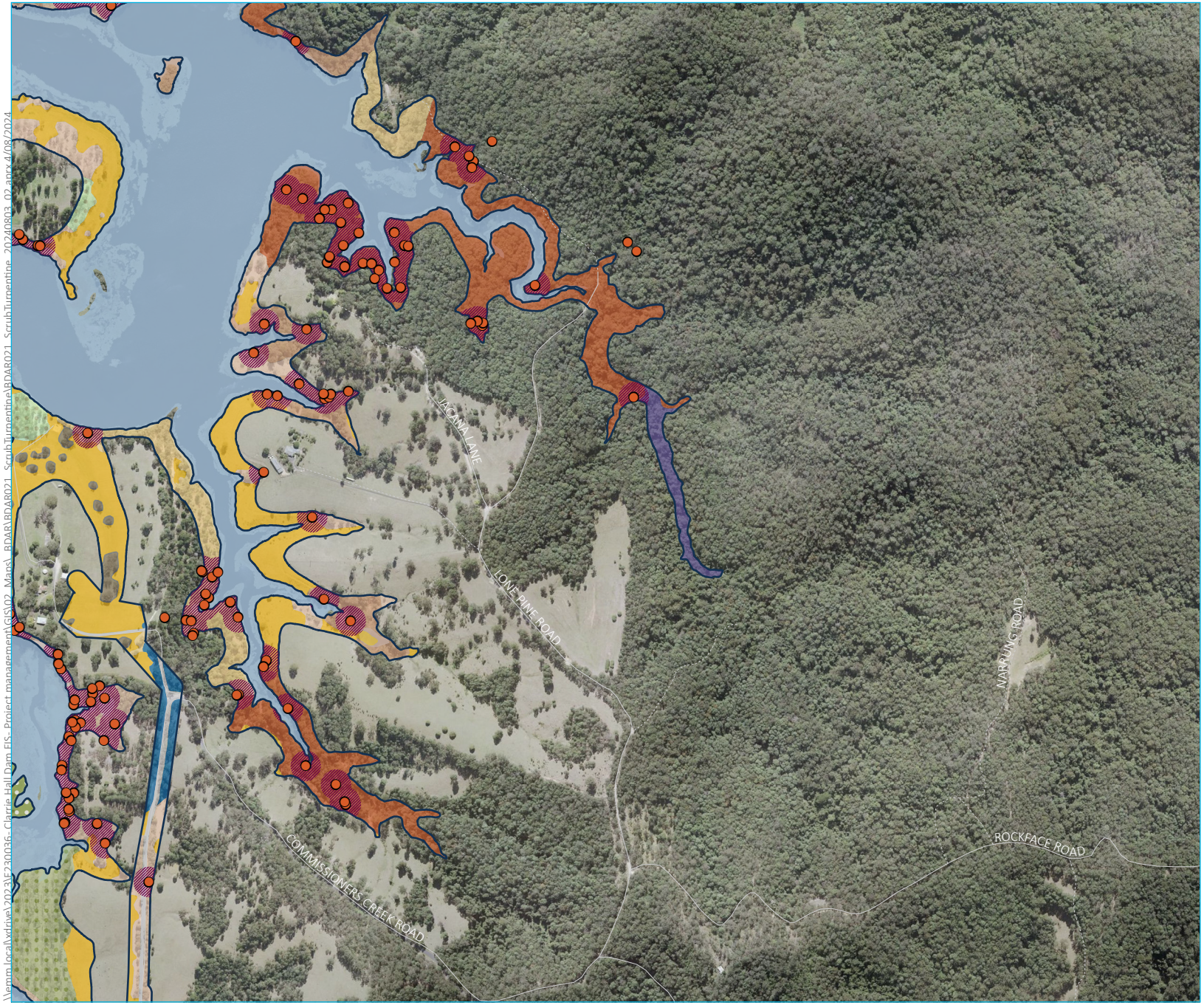
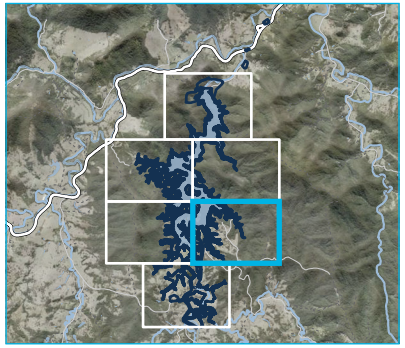
Scrub Turpentine (*Rhodamnia rubescens*) records and species polygon (count based) Page 3 of 6

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.16

EMM
creating opportunities





KEY

Species polygon

Rhodamnia rubescens

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

High

Moderate

Low

Planted

Grassland

Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

High

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

High

Other

Eucalyptus plantation

Hoop plantation

Native planted vegetation

Cleared

Existing environment

Major road

Minor road

Vehicular track

Waterbody

Scrub Turpentine (*Rhodamnia rubescens*) records and species polygon (count based) Page 4 of 6

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.16

EMM
creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56
N

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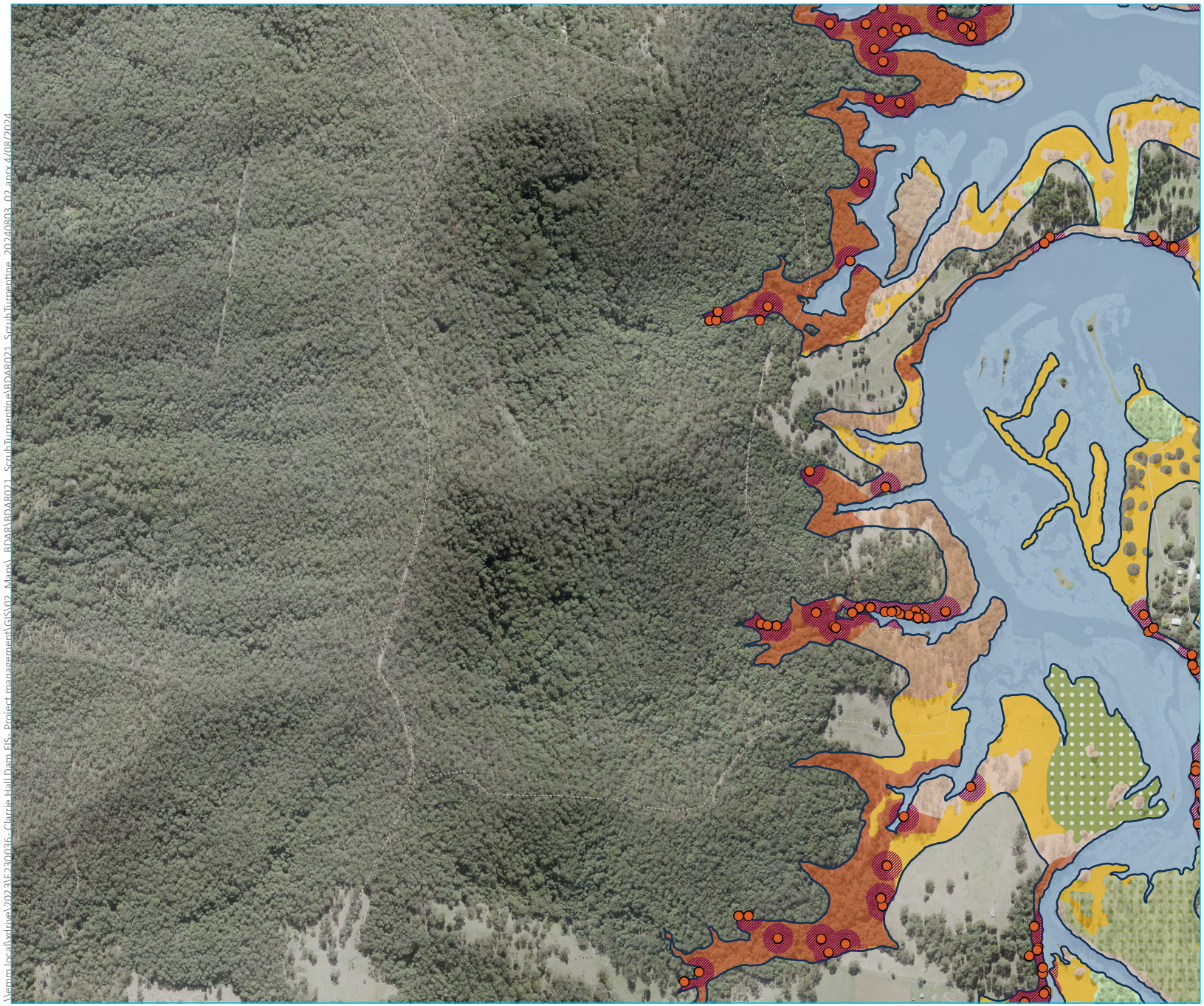

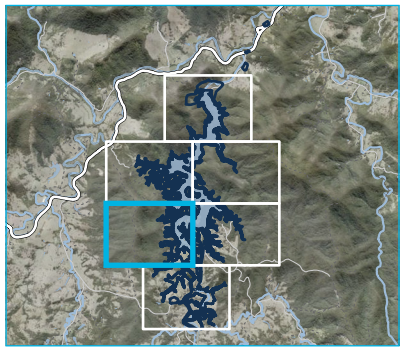

KEY

Species polygon

Rhodamnia rubescens

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

High

Moderate

Low

Planted

Grassland

Derived sedgeland

Other

Eucalyptus plantation

Hoop plantation

Native planted vegetation

Cleared

Existing environment

Major road

Minor road

Vehicular track

Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Scrub Turpentine (*Rhodamnia rubescens*) records and species polygon (count based) Page 5 of 6

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.16

EMM
creating opportunities

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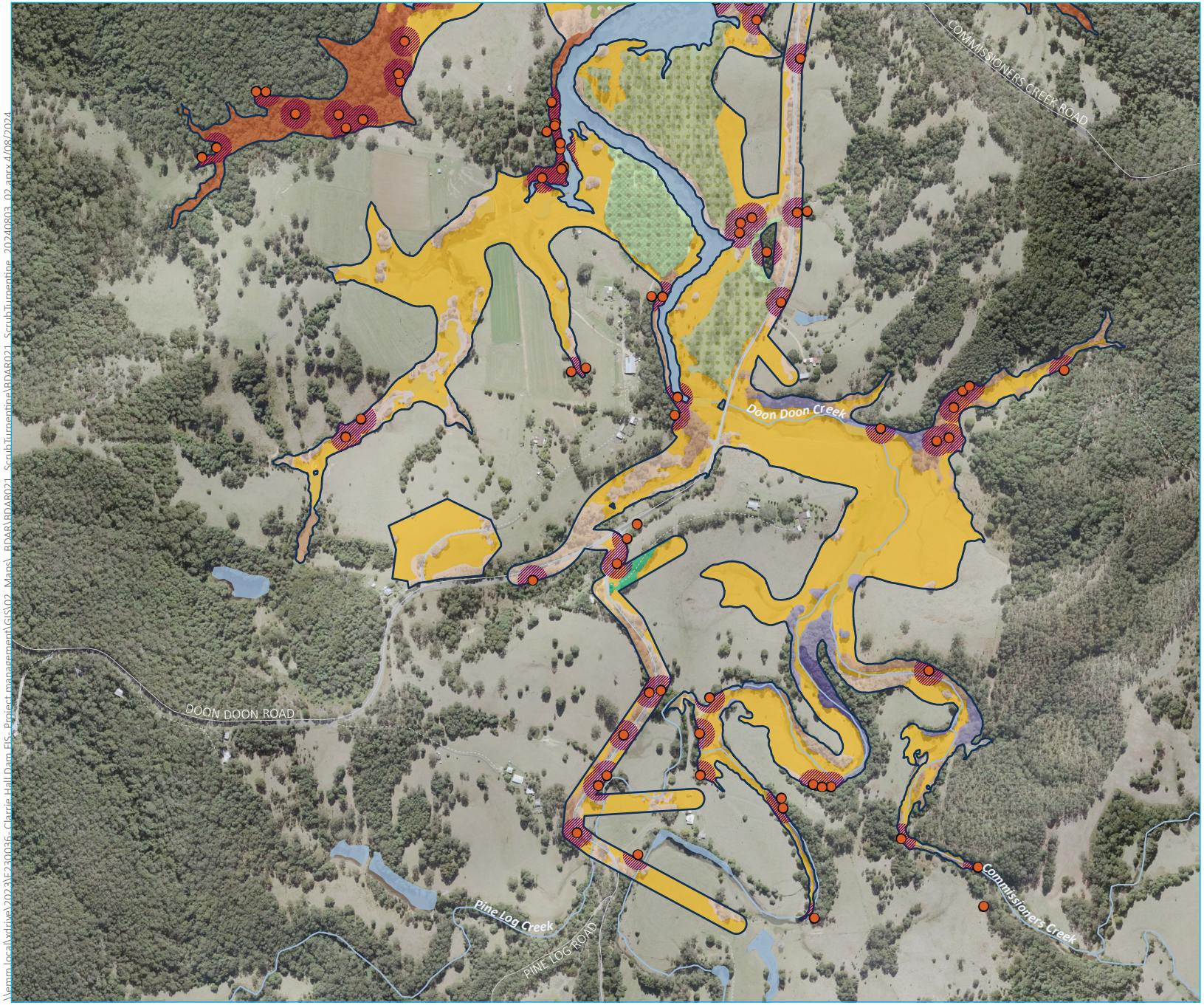

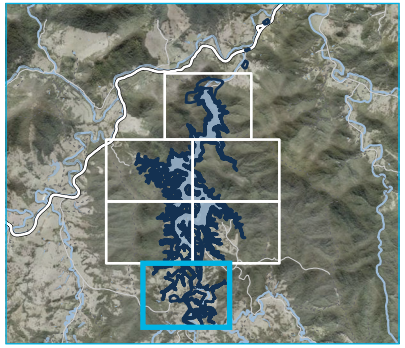

KEY

- Species polygon
- *Rhodamnia rubescens*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

Other

- Eucalyptus plantation
- Hoop plantation
- Exotic trees
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Scrub Turpentine (*Rhodamnia rubescens*) records and species polygon (count based) Page 6 of 6

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.16

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

creating opportunities

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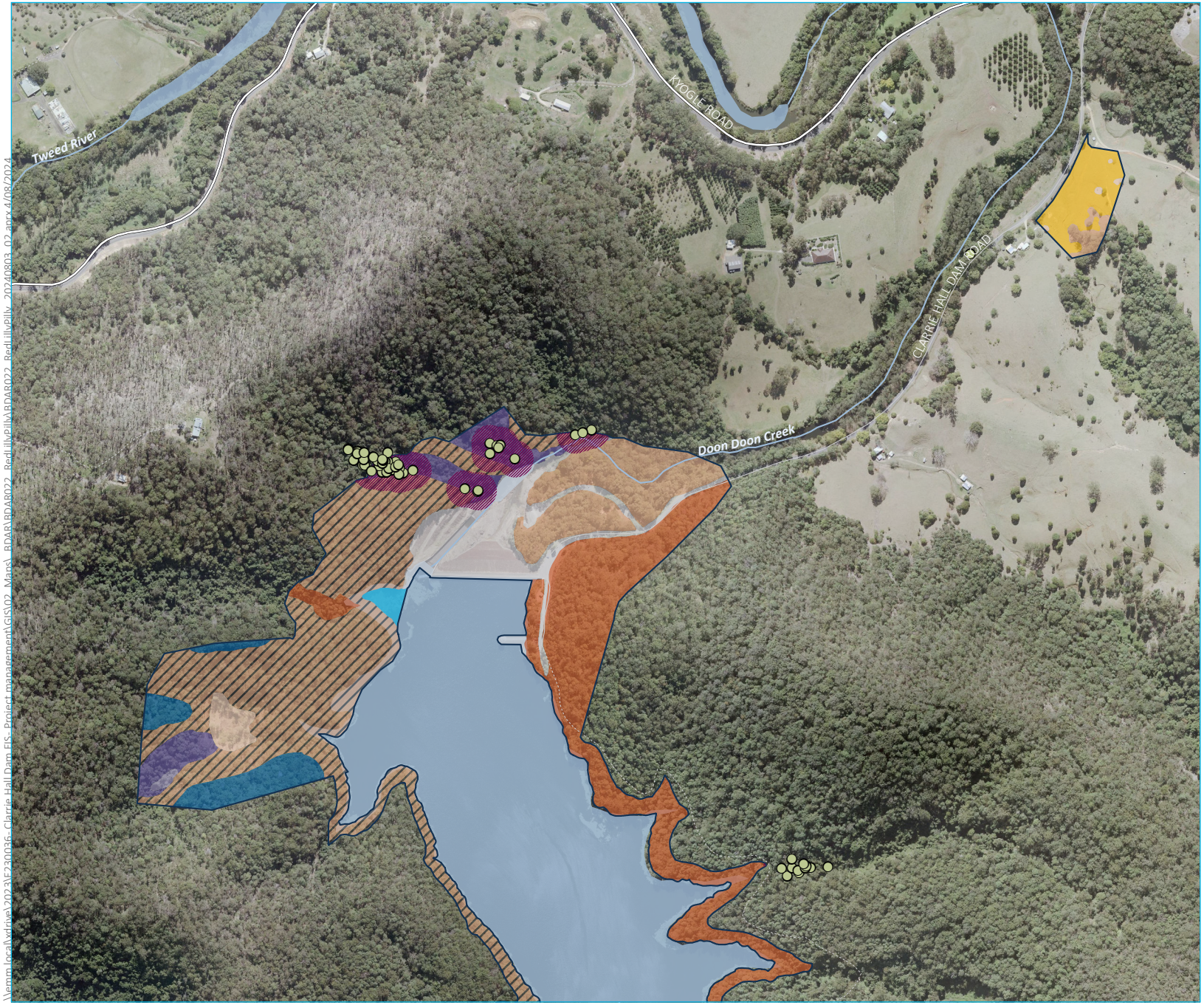

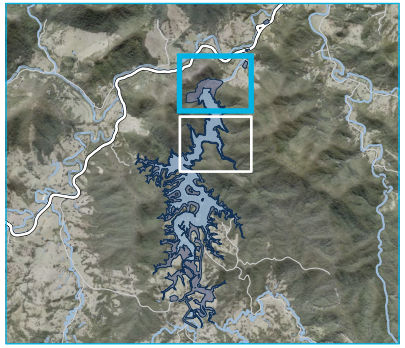

KEY

- Subject land
- Species polygon
- *Syzygium hodgkinsoniae*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Red Lilly Pilly (*Syzygium hodgkinsoniae*) records and species polygon (count based) Page 1 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.17

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

creating opportunities

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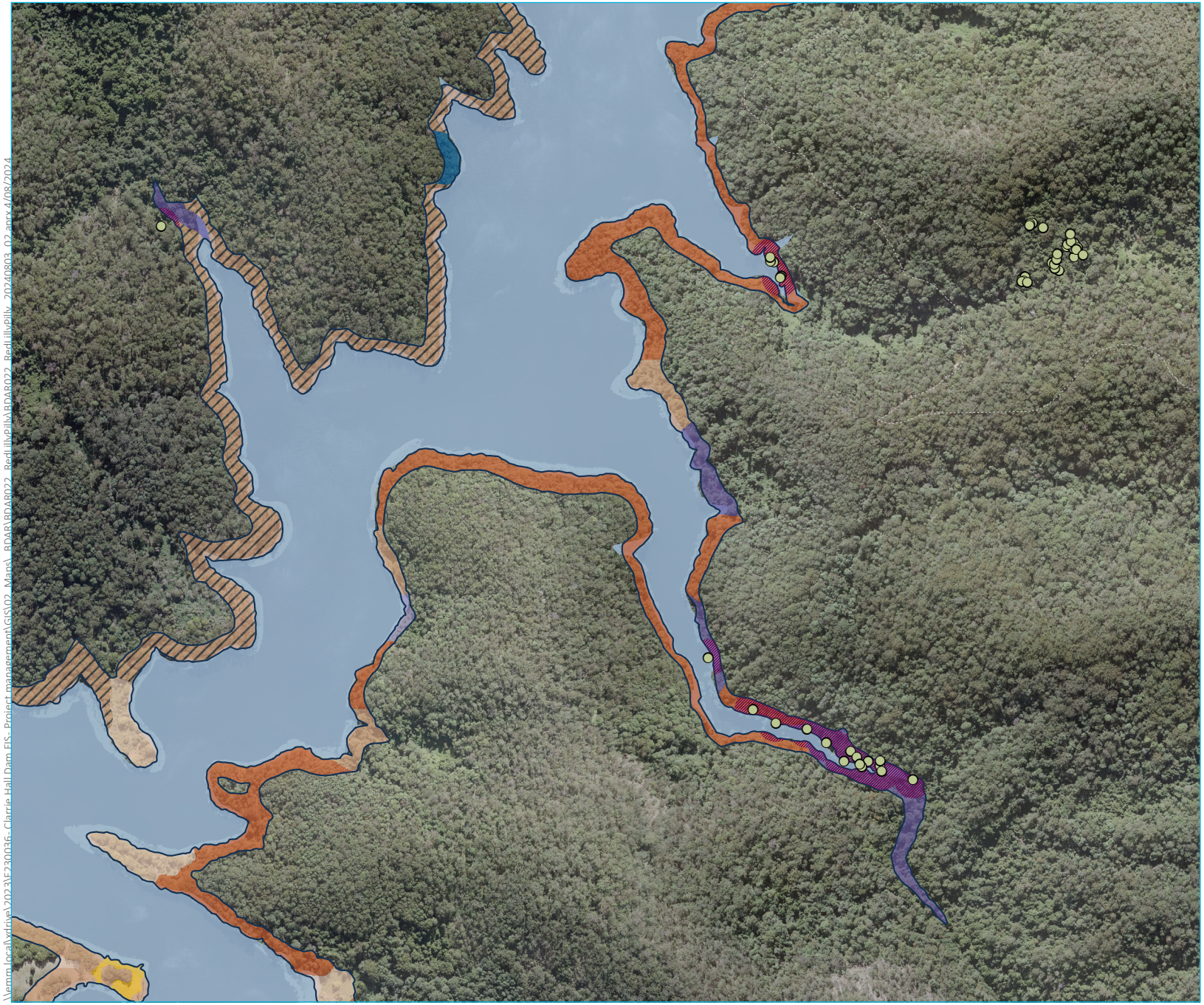

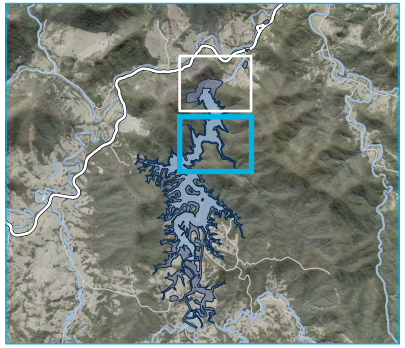

KEY

- Subject land
- Species polygon
- *Syzygium hodgkinsoniae*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Red Lilly Pilly (*Syzygium hodgkinsoniae*) records and species polygon (count based) Page 2 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.17

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

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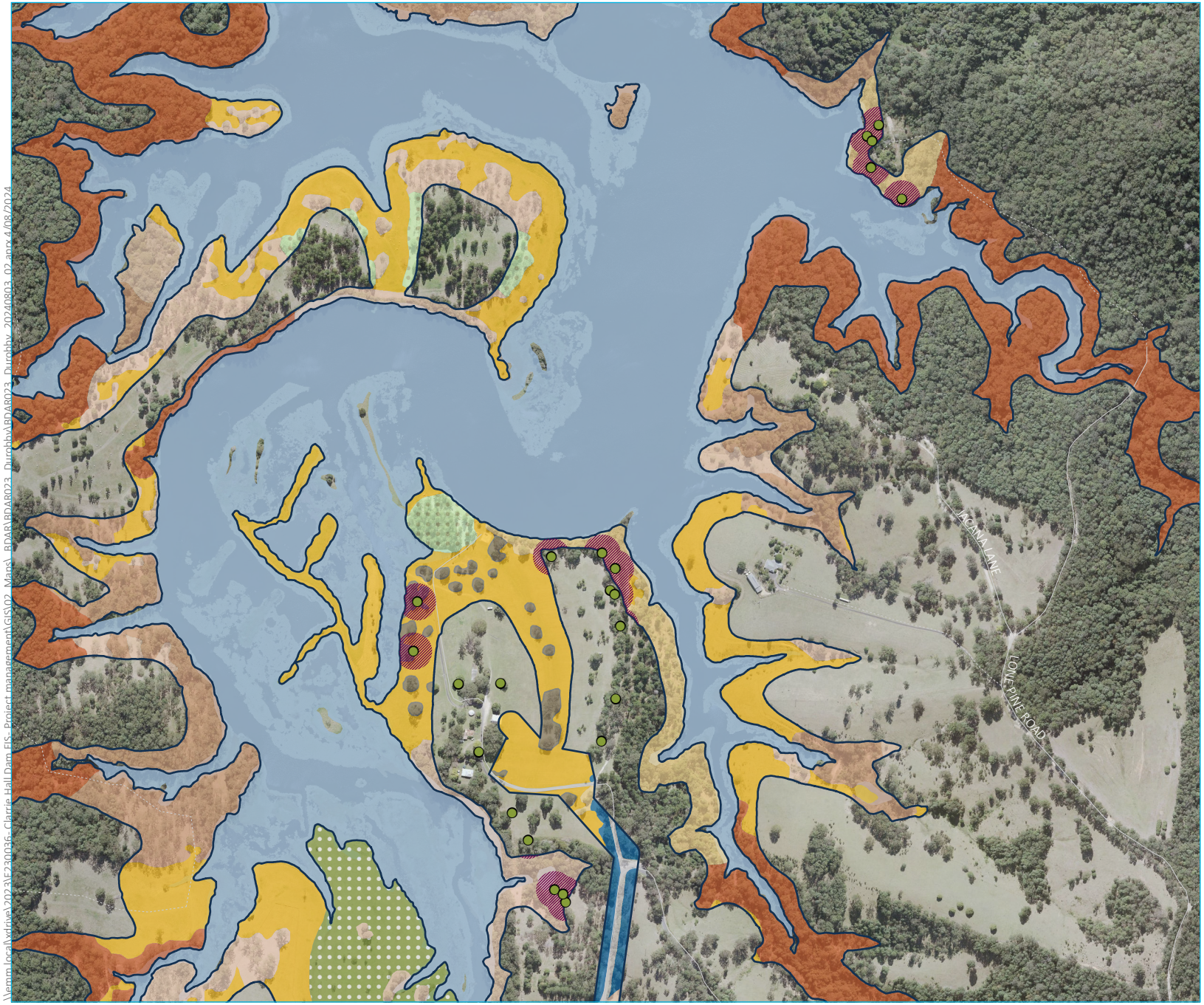

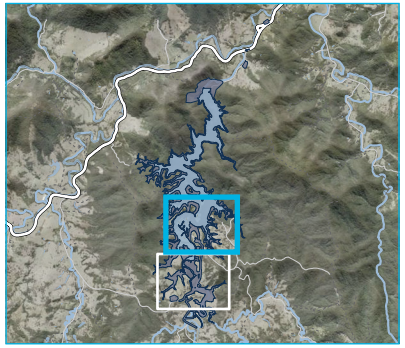

KEY

- Subject land
- Species polygon
- *Syzygium moorei*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Durobby (*Syzygium moorei*) records and species polygon (count based)
Page 1 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.18

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

creating opportunities

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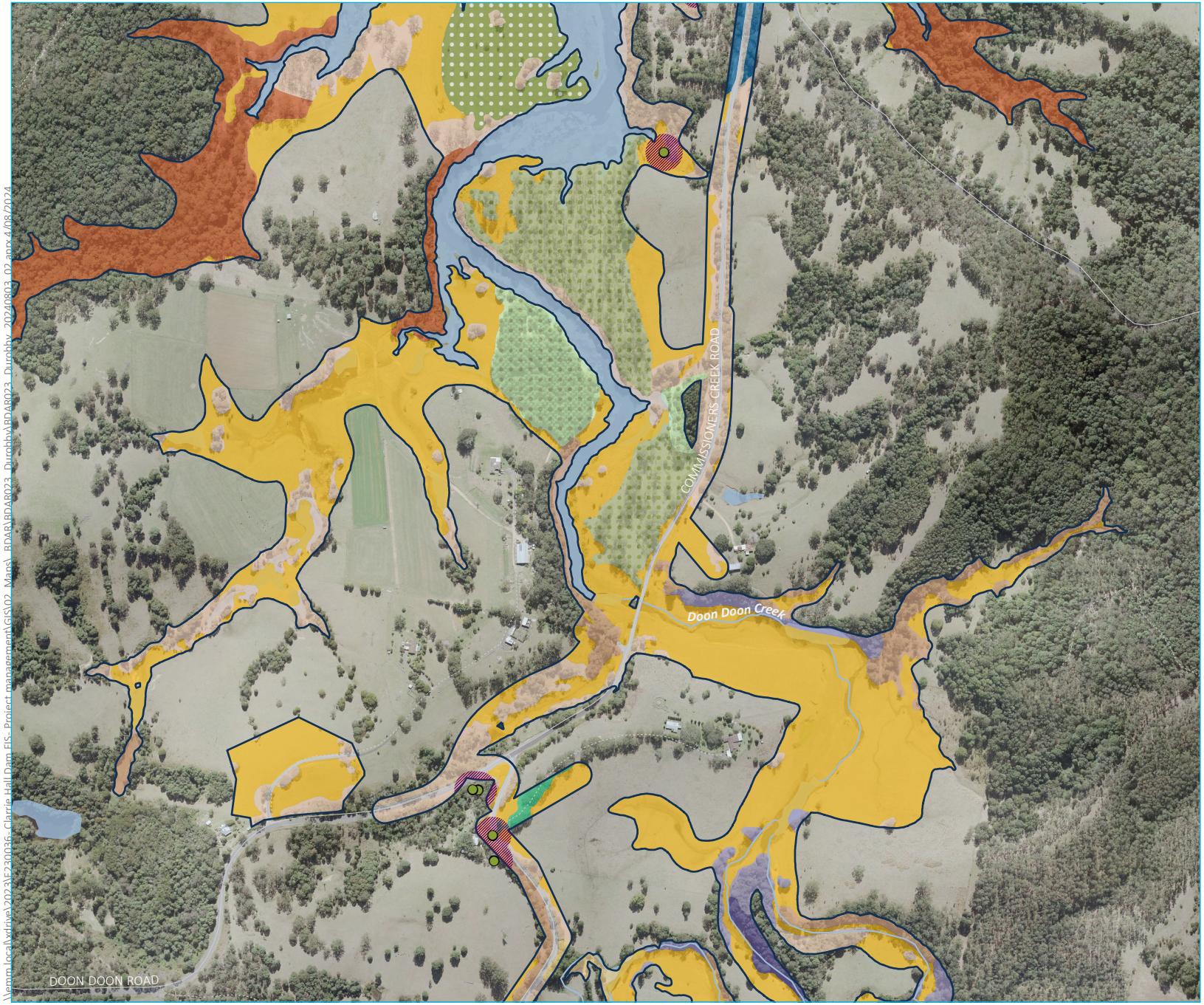

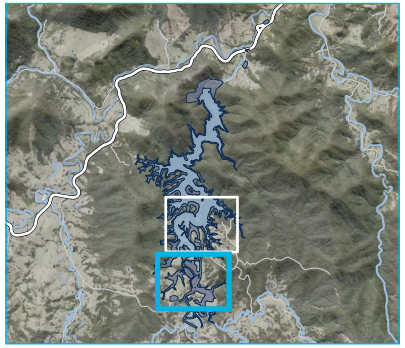

KEY

- Subject land
- Species polygon
- *Syzygium moorei*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Exotic trees
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Durobby (*Syzygium moorei*) records and species polygon (count based)
Page 2 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.18

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

creating opportunities

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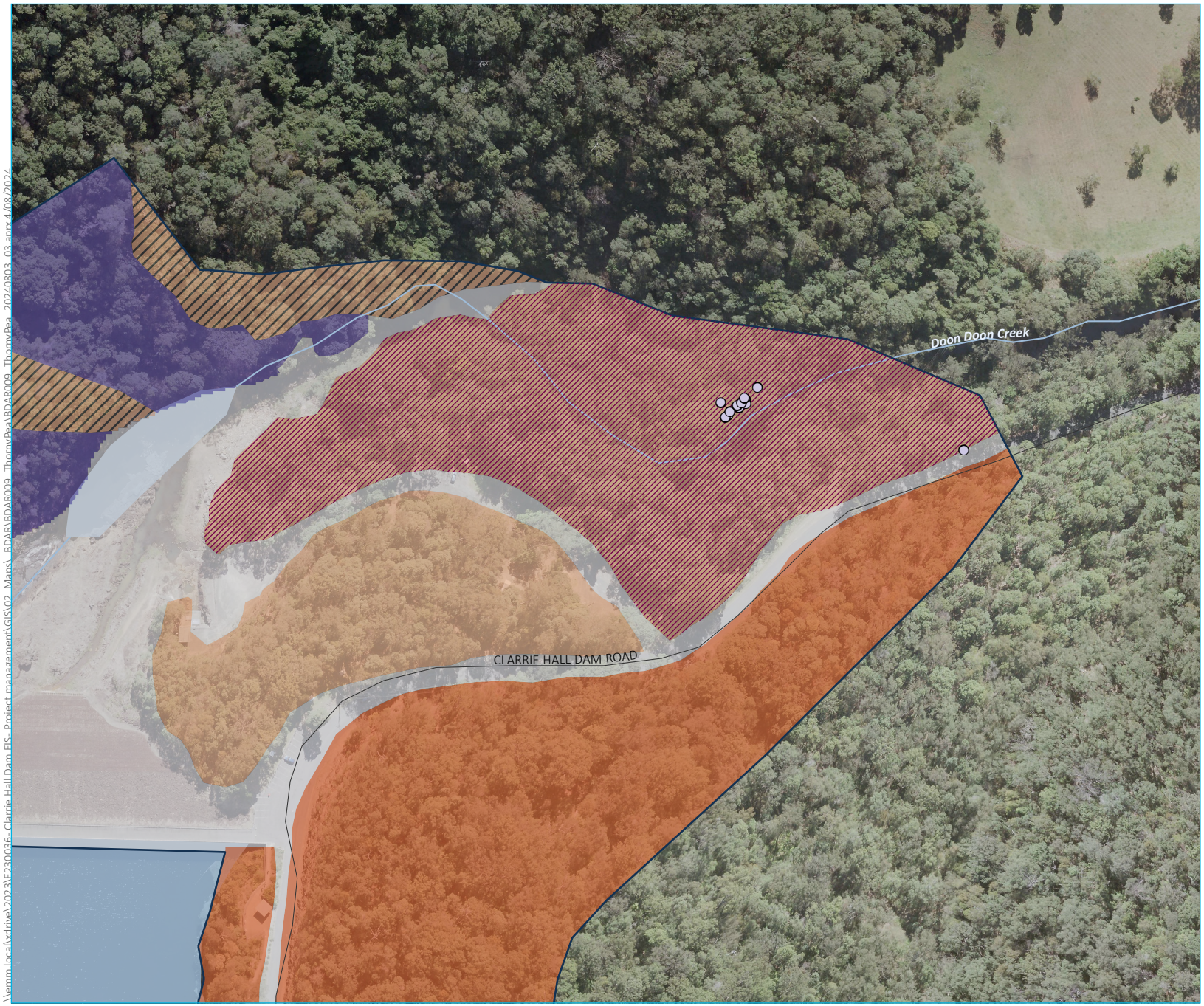

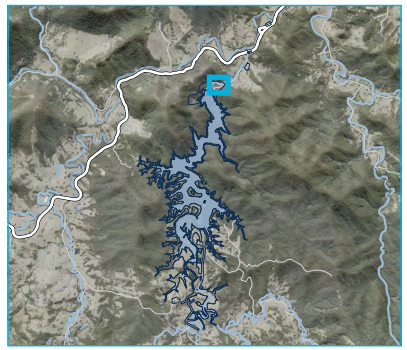

KEY

- Subject land
- Species polygon
- *Desmodium acanthocladum*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

Other

- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Thorny Pea (*Desmodium acanthocladum*) records and species polygon (area based)

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Biodiversity Development Assessment Report
Figure 5.19

EMM
creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 100 200 m
GDA2020 MGA Zone 56

N

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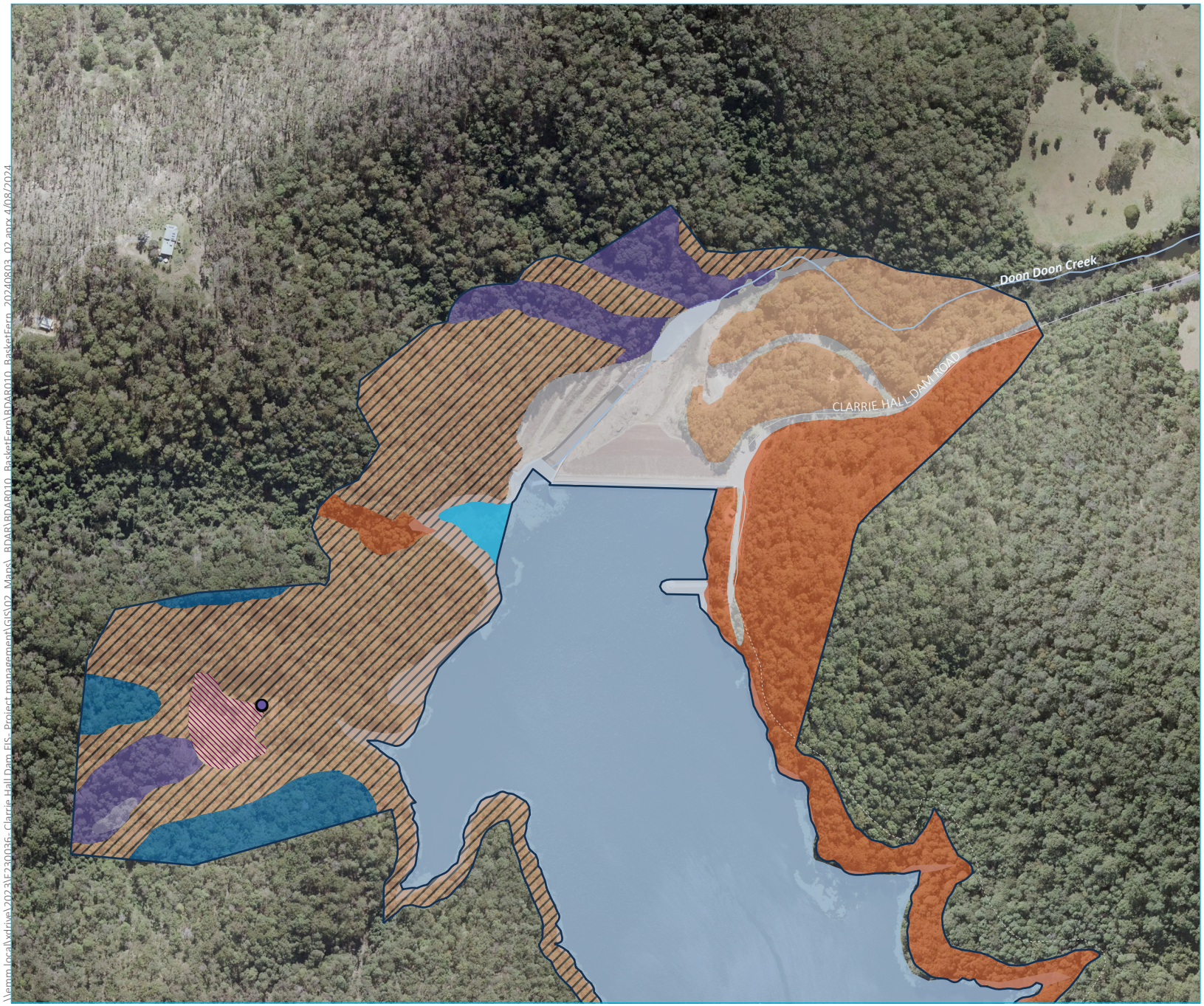

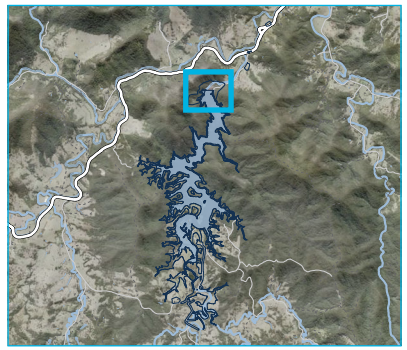

KEY

- Subject land
- Species polygon
- *Drynaria rigidula*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Basket Fern (*Drynaria rigidula*) records and species polygon (area based)

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.20

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 100 200 m
GDA2020 MGA Zone 56

N

creating opportunities

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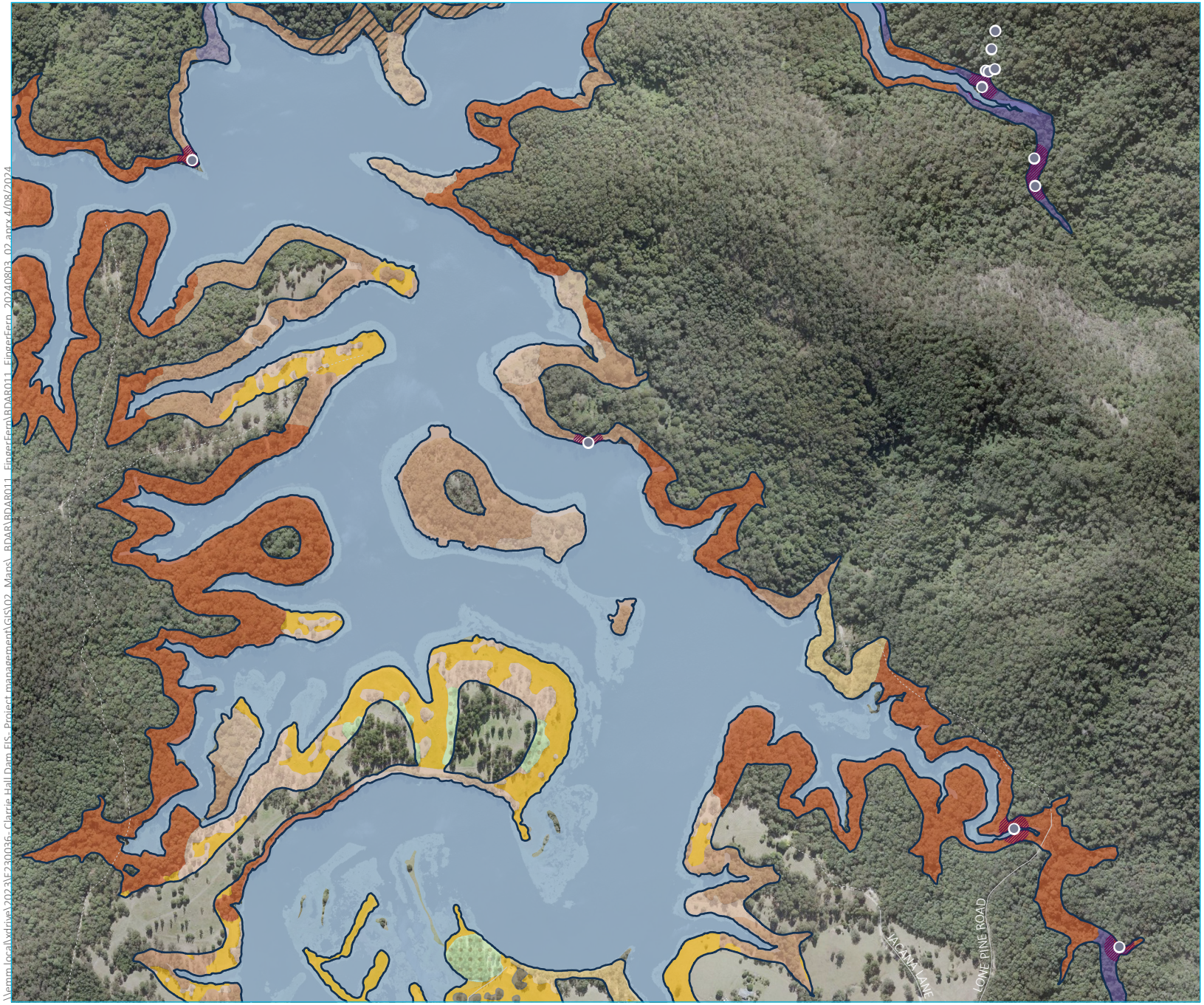

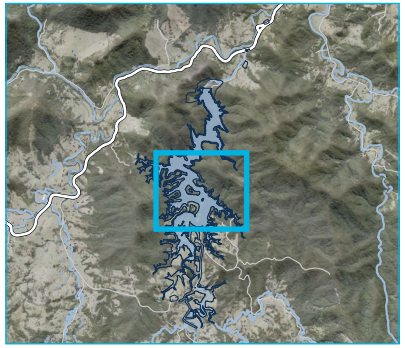

KEY

- Subject land
- Species polygon
- *Grammitis stenophylla*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Planted
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

Other

- Hoop plantation
- Native planted vegetation

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Narrow-leaf Finger Fern (*Grammitis stenophylla*) records and species polygon (area based)

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Biodiversity Development Assessment Report
Figure 5.21

EMM
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Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

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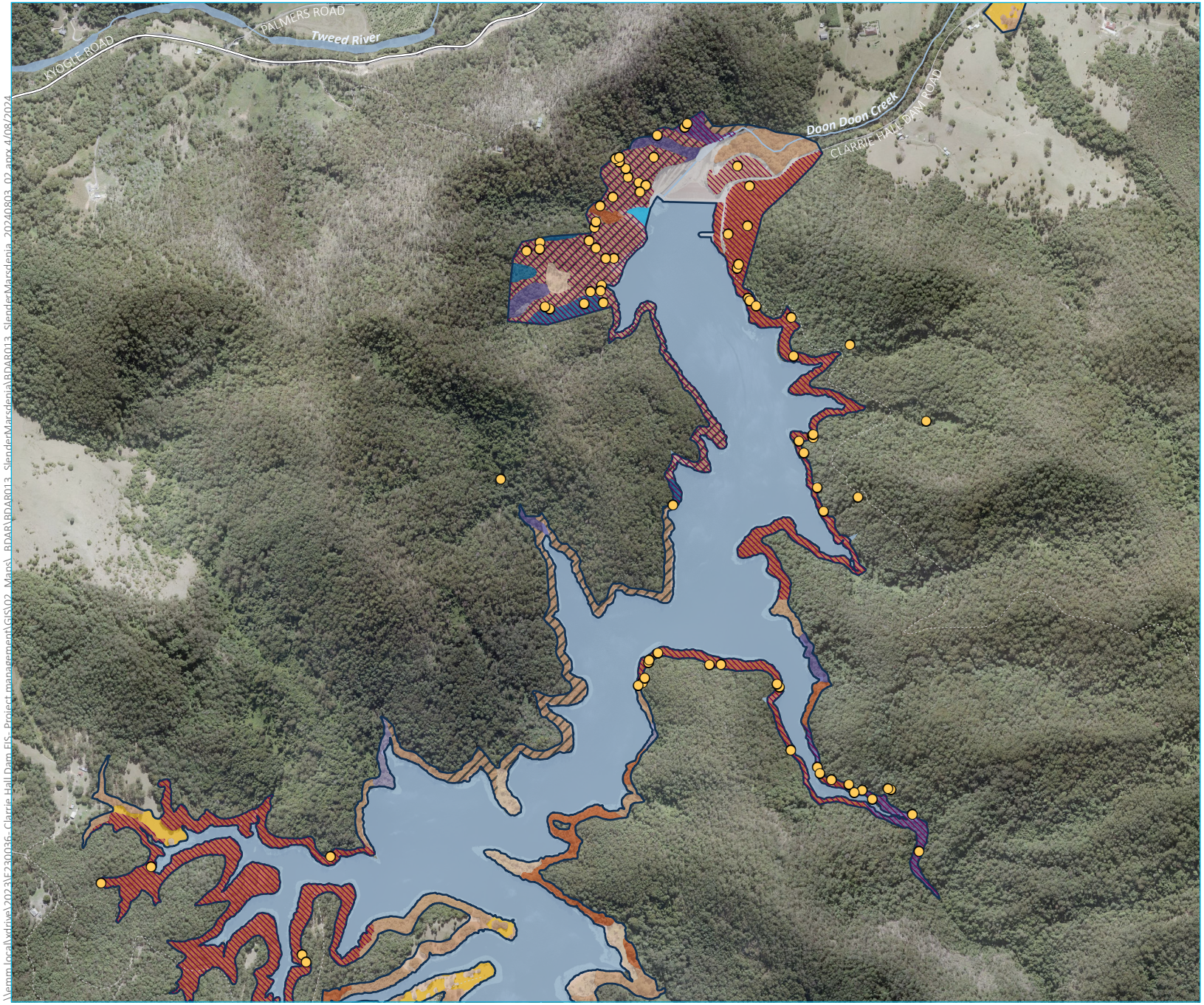

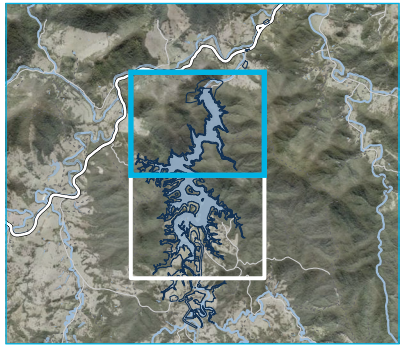

KEY

- Subject land
- Species polygon
- *Marsdenia longiloba*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Slender Marsdenia (*Marsdenia longiloba*) records and species polygon (area based) Page 1 of 2

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Biodiversity Development Assessment Report
Figure 5.22

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

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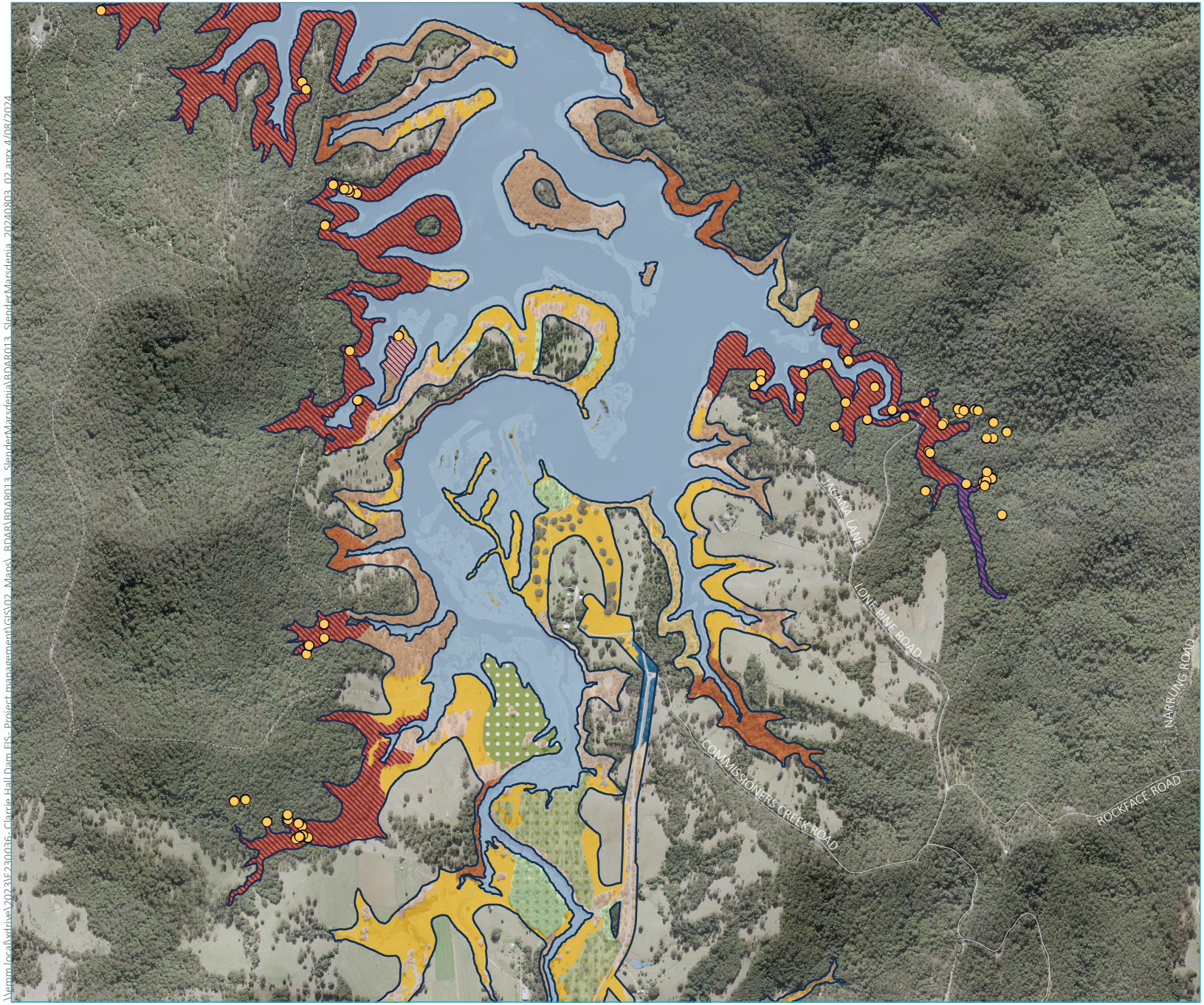

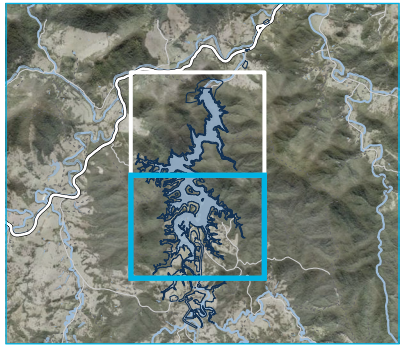

KEY

- Subject land
- Species polygon
- *Marsdenia longiloba*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Slender Marsdenia (*Marsdenia longiloba*) records and species polygon (area based) Page 2 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.22

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

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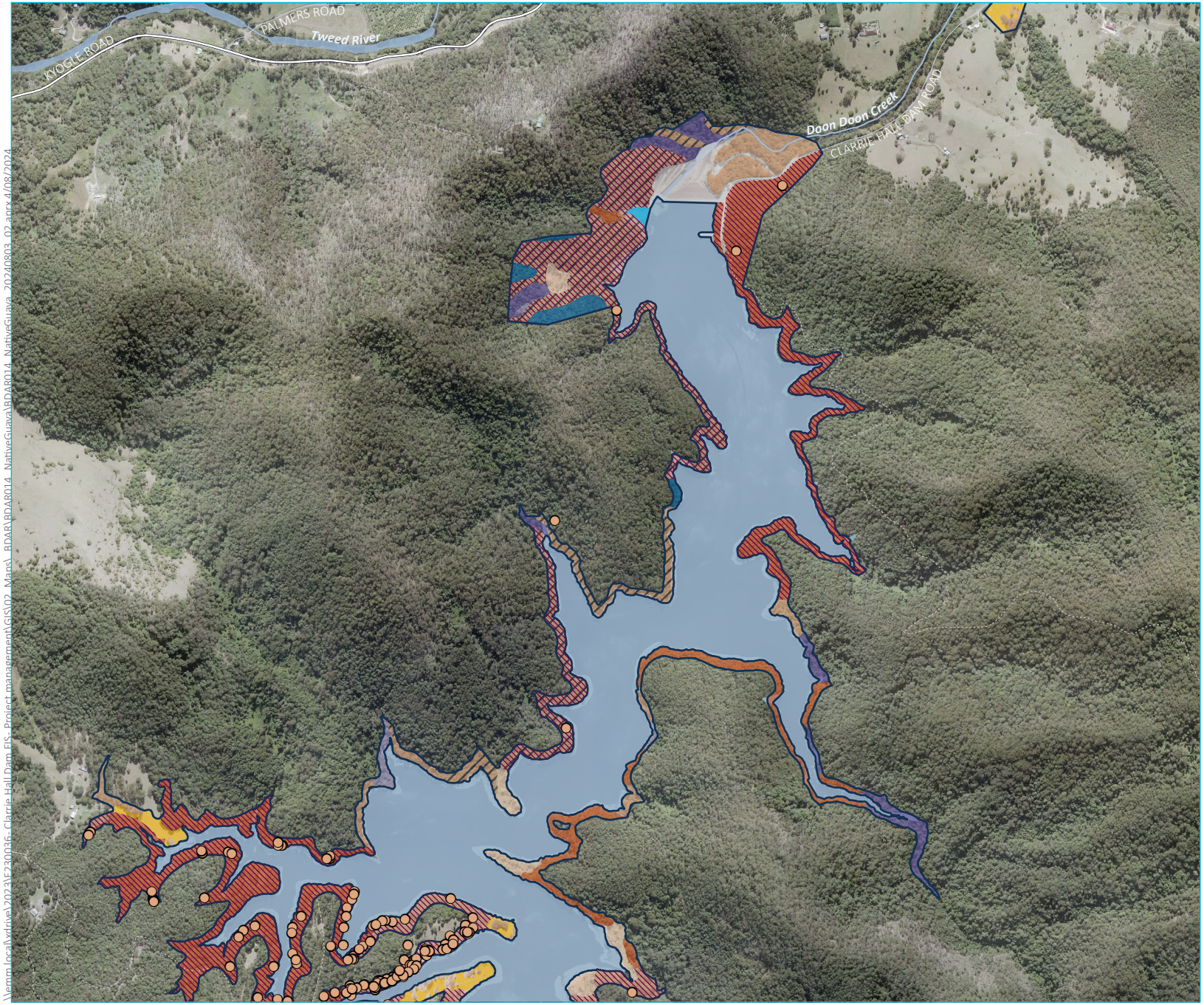

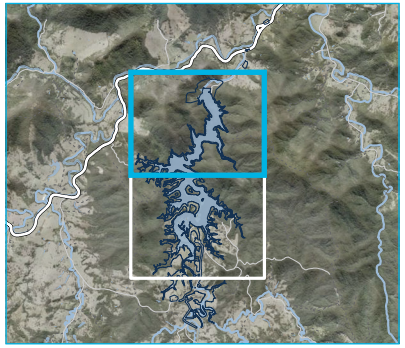

KEY

- Subject land
- Species polygon
- *Rhodomyrtus psidioides*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Burnt
- Low
- Grassland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High
- Moderate

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Cleared
- Water

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

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Native Guava (*Rhodomyrtus psidioides*) records and species polygon (area based) Page 1 of 2

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Figure 5.23

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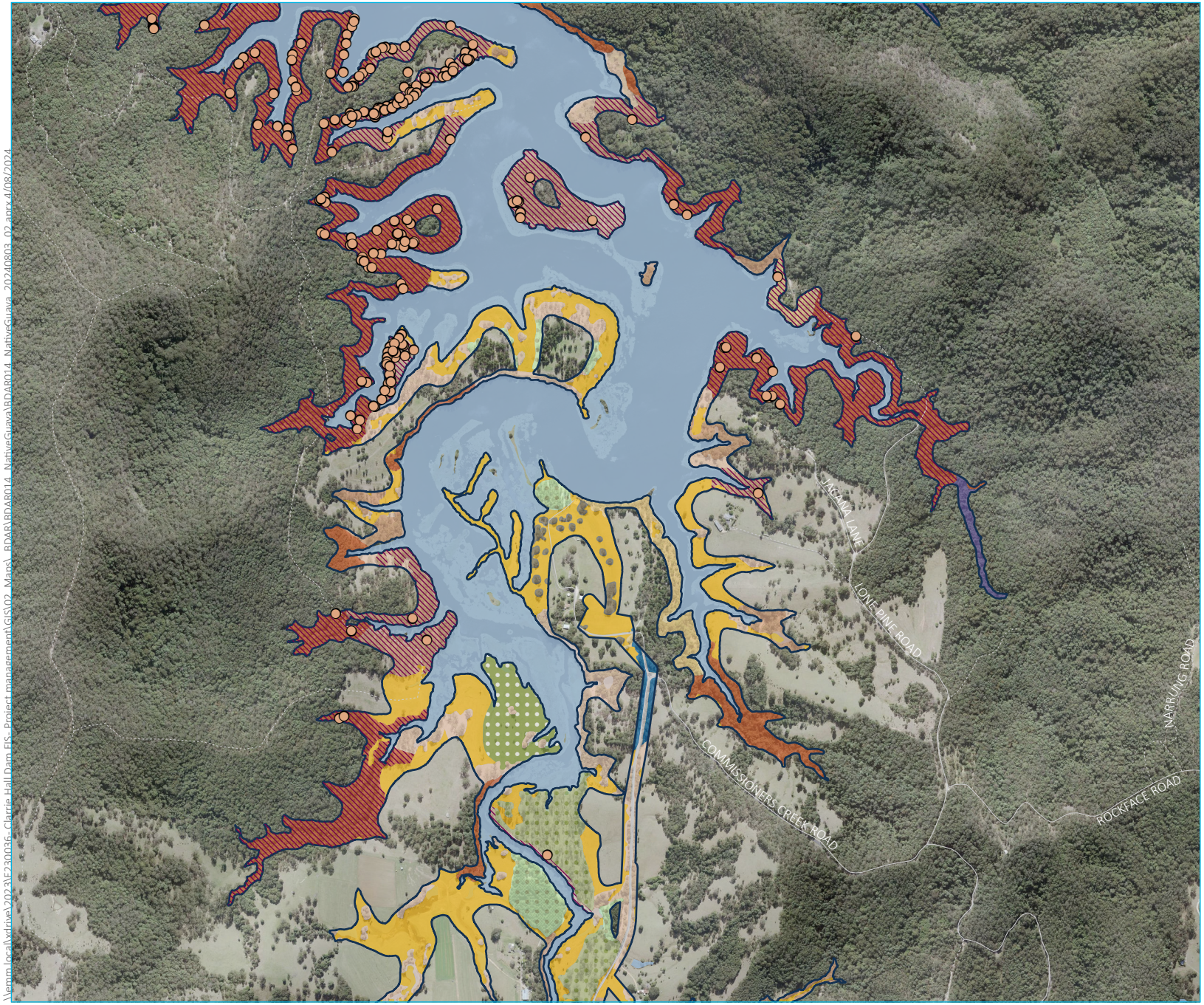

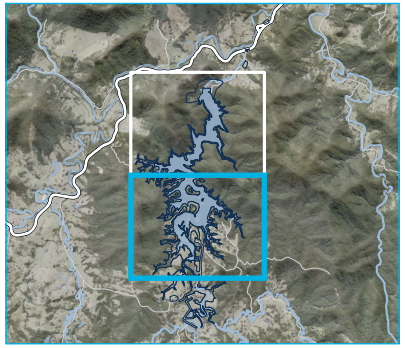

KEY

- Subject land
- Species polygon
- *Rhodomyrtus psidioides*

Plant community type

PCT 827 | Flooded Gum- Tallowwood- Brush Box moist open forest of the coastal ranges of the North Coast

- High
- Moderate
- Low
- Planted
- Grassland
- Derived sedgeland

PCT 1302 | White Booyong- Fig subtropical rainforest of the NSW North Coast Bioregion

- High

PCT 1073 | Wallum Banksia-Monotoca scoparia heath on coastal sands of the Central Coast and lower North Coast

- High

Other

- Eucalyptus plantation
- Hoop plantation
- Native planted vegetation
- Cleared

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

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Native Guava (*Rhodomyrtus psidioides*) records and species polygon (area based) Page 2 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.23

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iii Threatened fauna

Species polygons for threatened fauna identified within the subject land were developed in accordance with the BAM (DPIE, 2020) and the TBDC (DCCEEW, 2024a).

Table 5.30 Fauna species polygon description

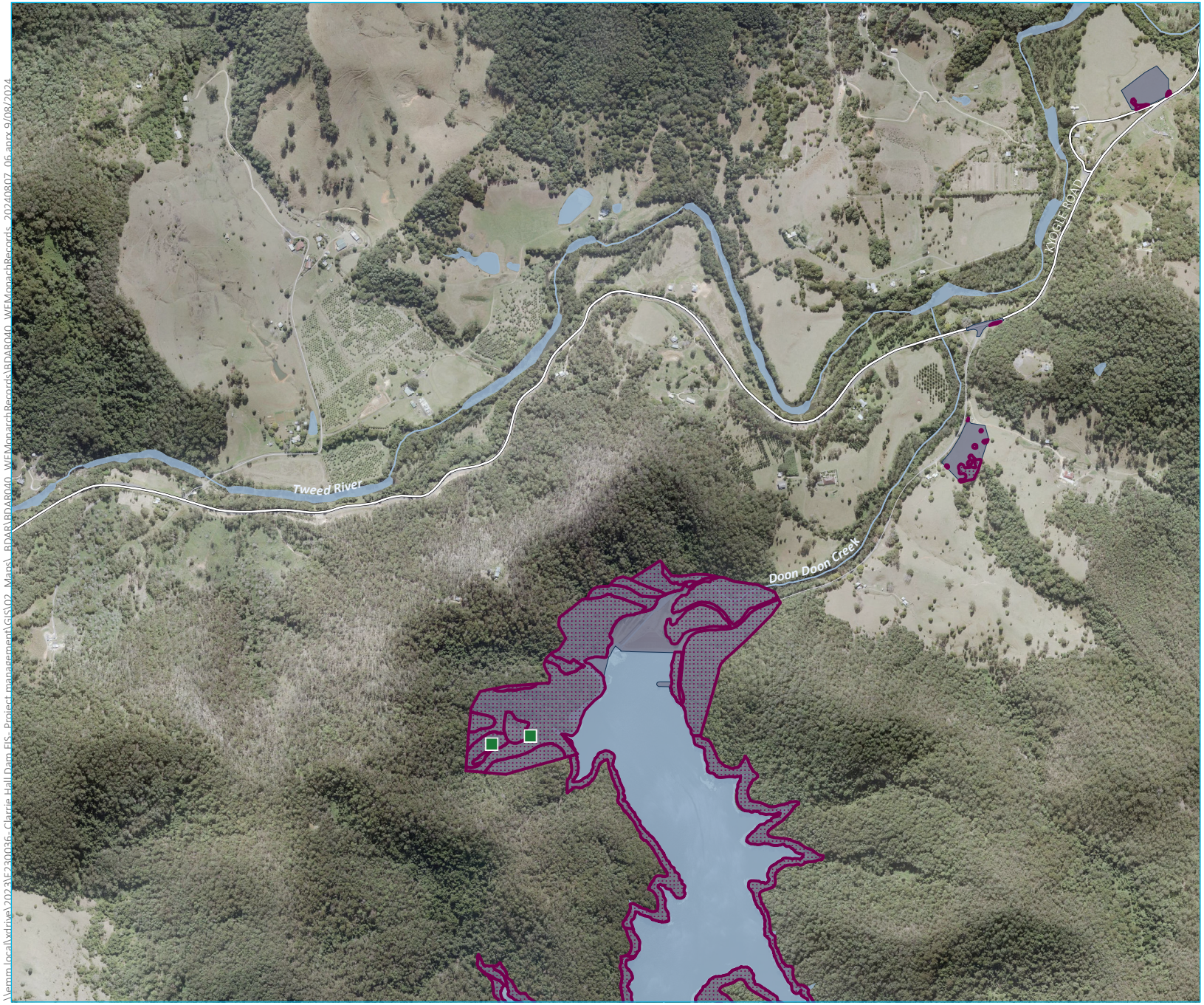
Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Carterornis leucotis	White-eared Monarch	This species was recorded on two occasions within the subject land in rainforest (PCT 1302 high) and wet sclerophyll forest (PCT 827 mod). This species occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. They appear to prefer the ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads (DCCEEW, 2024a). Given the broad habitat requirements and high mobility of this species it is considered likely to utilise much of the Subject Land.	No species polygon information is provided in the TBDC. A species polygon includes all areas of vegetation zones, 827_high, 827 mod, 827_burnt, 827 planted, 827 low 1073_high, 1302_high and 1302_mod. Figure 5.24 displays the species polygon comprising an area of 165.61 ha.
Menura alberti	Albert's Lyrebird	This species is associated with rainforests or wet sclerophyll forests. In the case of the latter, the species prefers a wet understory containing rainforest species. The species was recorded on several occasions in high condition PCT_1302 and PCT_827 with detection of the species focused within and around rainforest gullies, and the ecotone with adjacent wet sclerophyll forest. The species was not recorded on the western side of the Subject Land, despite survey effort being conducted at multiple locations. The species has a loud, frequent call during winter and is considered to have moderate detectability during the breeding season. The western side contains less favourable habitat, with steeper, drier gullies. Given the sub-optimal habitat and lack of detections, the species is considered absent from the western portion of the Subject Land.	No species polygon information is provided in the TBDC (DCCEEW, 2024a). The species polygon is comprised of the vegetation zones where the species was recorded, which includes PCT 827_high and PCT 1302_high. Other vegetation zones were lacking the microhabitat features required by the species. The species polygon includes those patches connected to areas where the species was recorded. In addition, adjacent areas of suitable habitat were included if they contained sheltered gullies and slopes with mesic vegetation and leaf litter. Areas excluded from the species polygon included more exposed and dryer patches of PCT 827_high without suitable habitat features for the species. Figure 5.25 displays the species polygon comprising an area of 14.49 ha.

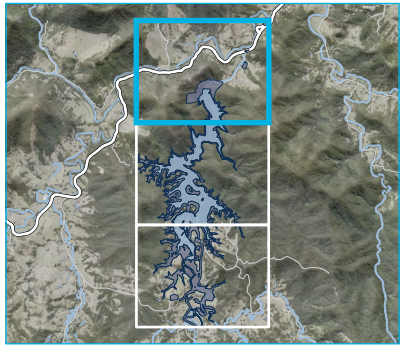
Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Haliaeetus leucogaster	White-bellied Sea-Eagle	A single nest has been recorded within the subject land. Breeding habitat for this species requires a buffer of 500 m (outside of urban and peri-urban areas). The remaining habitat within the Subject Land is considered foraging habitat. Foraging habitat is considered an ecosystem credit.	A circular polygon with a 500 m radius from the breeding site has been applied in accordance with the TBDC (DCCEEW, 2024a). All vegetation zones intersecting with the Subject Land and the 500 m buffer has been included with the species polygon. Figure 5.26 displays the species polygon comprising an area of 19.99 ha.
Tyto novaehollandiae	Masked Owl	The Masked Owl has been recorded on several occasions within the subject land and has the potential to utilise much of the subject land for foraging. No breeding locations have been recorded. One PCT, 827 is associated with the species.	Species polygon: The species polygon must be drawn to include all vegetation zones: 1. within 800 m (being the approximate home range) from the location of a detected owl, and 2. containing a living or dead tree with a hollow >20 cm diameter that occurs >4 m above the ground. Given the survey effort for owls was developed prior to recent survey guidance being published in the TBDC (DCCEEW, 2024a), the following species polygon approach has been developed on a conservative basis. Each patch of each vegetation zone containing hollows greater than 20 cm in diameter will form part of the species polygon regardless of whether it is within 800 m of a recorded individual. Figure 5.27 displays the species polygon comprising an area of 52.65 ha.
Tyto tenebricosa	Sooty Owl	The Sooty Owl was recorded within the subject land on multiple occasions and has the potential to utilise much of the subject land for foraging. No breeding locations have been recorded. All PCT within the subject land are associated with the species, however the species prefers more mesic areas especially wet sclerophyll and rainforest gullies.	In accordance with the TBDC (DCCEEW, 2024a), the species polygon for the Sooty Owl must contain all vegetation zones within 800 m of a record of the species, and all vegetation zones containing a living or dead tree with a hollow >20 cm diameter that occurs >4 m above the ground, or caves, or cliffs, or escarpments, or cliff lines/ledges. Given the survey effort for owls was developed prior to recent survey guidance being published in the TBDC the following species polygon approach has been developed on a conservative basis. Each patch of each vegetation zone containing hollows greater than 20 cm in diameter will form part of the species polygon regardless of whether it is within 800 m of a recorded individual. The subject land does not contain caves, cliffs, escarpments, cliff lines or ledges. Figure 5.28 displays the species polygon comprising an area of 52.65 ha.

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Phascolarctos cinereus	Koala	There are multiple records of Koala within the subject land. Koala habitat within the subject land is largely continuous and all forested vegetation zones contain Koala use trees for the North Coast as defined in Table 3 of the Koala (*Phascolarctos cinereus*). Biodiversity Assessment Method Survey Guide (DPE, 2022). The Koala is an area-based species. The species polygon has been developed in accordance with the BAM Koala survey guide (DPE, 2022).	Given the multiple records of Koala within the subject land and the largely continuous habitat, all forested vegetation zones are included within the species polygon with the exception of two small islands in the Dam, where Koala were absent, and the areas considered too small to support the species. Grassland and sedgeland areas are excluded due to the lack of wooded vegetation). Figure 5.29 displays the species polygon comprising an area of 160.87 ha.
Myotis macropus	Southern Myotis	Southern Myotis was recorded adjacent to the Dam and Doon Doon Creek. Southern Myotis is an area-based species. Potential habitat includes all associated PCTs within 200 m of medium to large waterbodies (i.e. a waterbody with pools/stretches of 3 m or wider) (DCCEEW, 2024a). All PCTs within the subject land are aligned with the species. Cleared areas such as pasture that have a vegetation integrity score below the threshold have been excluded from the species polygon.	The species polygon was created in accordance with the NSW guide for Species Credit threatened bats and their habitats (OEH, 2018a). The species polygon was created for all PCTs (above VIS threshold) within a 200 m buffer of the Dam, Doon Doon Creek and its tributaries with pools/stretches of 3 m or wider within the subject land. Figure 5.30 displays the species polygon comprising an area of 136.92 ha.
Assa darlingtoni	Pouched Frog	Potential habitat in the NSW Survey Guide (DPIE 2020) indicates montane areas (usually >600 m in altitude, however the species is known to occur at lower altitudes, to approximately 100 m). The subject land is below the typical extent for the species at approximately 70 m AHD. The guide also states that the species typically prefers areas of moisture such as deep leaf litter and rocky scree slopes. Eggs are laid under damp leaf litter, logs, rocks or anywhere on the forest floor. Records from the subject land show a strong correlation with the more mesic areas of the subject land, including rainforest areas (PCT 1302) and high quality patches of wet sclerophyll forest on sheltered gully slopes (PCT 827_high) The Pouched Frog is not associated with any of the PCTs within the subject land in the TBDC (DCCEEW, 2024a).	The species polygon was created in accordance with the NSW guide for Threatened Frogs (2020) which states the species polygon boundary should align with any suitable vegetation type linked directly to the record and a buffer incorporating the PCTs with which it is associated within a 50 m radius from the edge of the calling area. For the purposes of this species polygon, we have assumed that all rainforest (PCT 1302_high and 1302_mod) are suitable habitat, therefore forming part of the species polygon. The most sheltered and mesic areas of PCT 827_high have also been included. This was selected by buffering each of the watercourses within the subject land by 50 m and intersecting with the vegetation zone. Figure 5.31 displays the species polygon comprising an area of 32.16 ha.

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Mixophyes iteratus	Giant Barred Frog	Habitat includes two permanent unnamed watercourses within the west of the Subject Land. Suitable foraging habitat is continuous with intact rainforest bordering the watercourses. Shelter includes deep leaf litter and woody debris. Breeding habitat is optimal in several creek pools, with slow flowing water and overhanging banks. The species was also recorded in the upper reaches of Doon Doon Creek. These areas are disjunct with patches of suitable bankside vegetation, namely rainforest and wet sclerophyll forest interspersed with large areas of pasture which provides unsuitable foraging and shelter for the species. Breeding habitat is limited to slower flowing pool areas with overhanging banks and adjacent forest.	The species polygon was created in accordance with the NSW guide for Threatened Frogs (2020) which states the species polygon boundary should align with aquatic habitats linked directly to the record and a buffer, incorporating the PCTs with which the species is associated, of 50 metres radius from the top of bank. To construct the species polygon the bank of the watercourses with suitable habitat and records were buffered by a 50 m radius then intersected with the Subject Land and following vegetation zones; 827_high, 827_mod, 827_burnt, 827_low, 1302_high, 1302_mod. Figure 5.32 displays the species polygon comprising an area of 6.09 ha.
Philoria loveridgei	Loveridge's Frog	Loveridge's Frog was recorded once at a single location approximately 15 m outside of the subject land during surveys in 2016/2017. The habitat in which it was recorded and the elevation is atypical for the species. The species is considered absent from other areas of the subject land based on targeted survey and habitat searches. Subsequent survey in 2023 failed to detect the species. The species is not associated with any of the PCTs within the subject land.	The species polygon was created in accordance with the NSW survey guide for Threatened Frogs (DPIE, 2020). Given the single recorded outside of the subject land and the lack of suitable habitat inside the subject land, a buffer has been applied to the small pool where the individual was recorded. A buffer of 50 m was applied with all vegetation zones intersection with the buffer and subject land. Figure 5.33 displays the species polygon comprising an area of 0.16 ha.
Phyllodes imperialis smithersi	Southern Pink Underwing Moth	The BOS helpdesk provided the following advice in January 2024 (Appendix B): *"Carronia Vines identified provide suitable habitat for Southern Pink Underwing Moth and a buffer of 20 meters should be applied to all individual vines to generate the species polygon."*	A total of two *Corronia* vines were recorded within the subject land. A buffer of 20 m was applied to each of these locations which comprises the species polygon. Figure 5.34 displays the species polygon comprising an area of 0.10 ha.

Scientific name	Common name	Habitat potential in the disturbance footprint	Species polygon description
Thersites mitchellae	Mitchell's Rainforest Snail	This species is associated with lowland subtropical rainforest, especially those occurring in relatively flat areas. Several individuals have been recorded within a single area of continuous habitat within the subject land. In order to assist with definition of the habitat for the species and the development of the species polygon, an expert report has been prepared for the Proposal (Appendix F).	The species polygon is defined in the expert report and includes low lying areas of Bangalow Palm dominated lowland subtropical rainforest on mainly flat terrain. The species polygon has been increased in size slightly from the expert report to link small patches of adjacent habitat given there is likely a single population present rather than three small adjacent populations. The species polygon modification also takes into account more recent records. The species polygon does not include the western record of the species given it was an empty shell recorded in unsuitable habitat for the species. The shell was likely brought into the subject site by a Noisy Pitta or another bird species. Figure 5.35 displays the species polygon comprising an area of 2.20 ha.





KEY

- Subject land
- Species polygon
- White-eared Monarch species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

White-eared Monarch (*Carterornis leucotis*) records and species polygon
Page 1 of 3

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Figure 5.24

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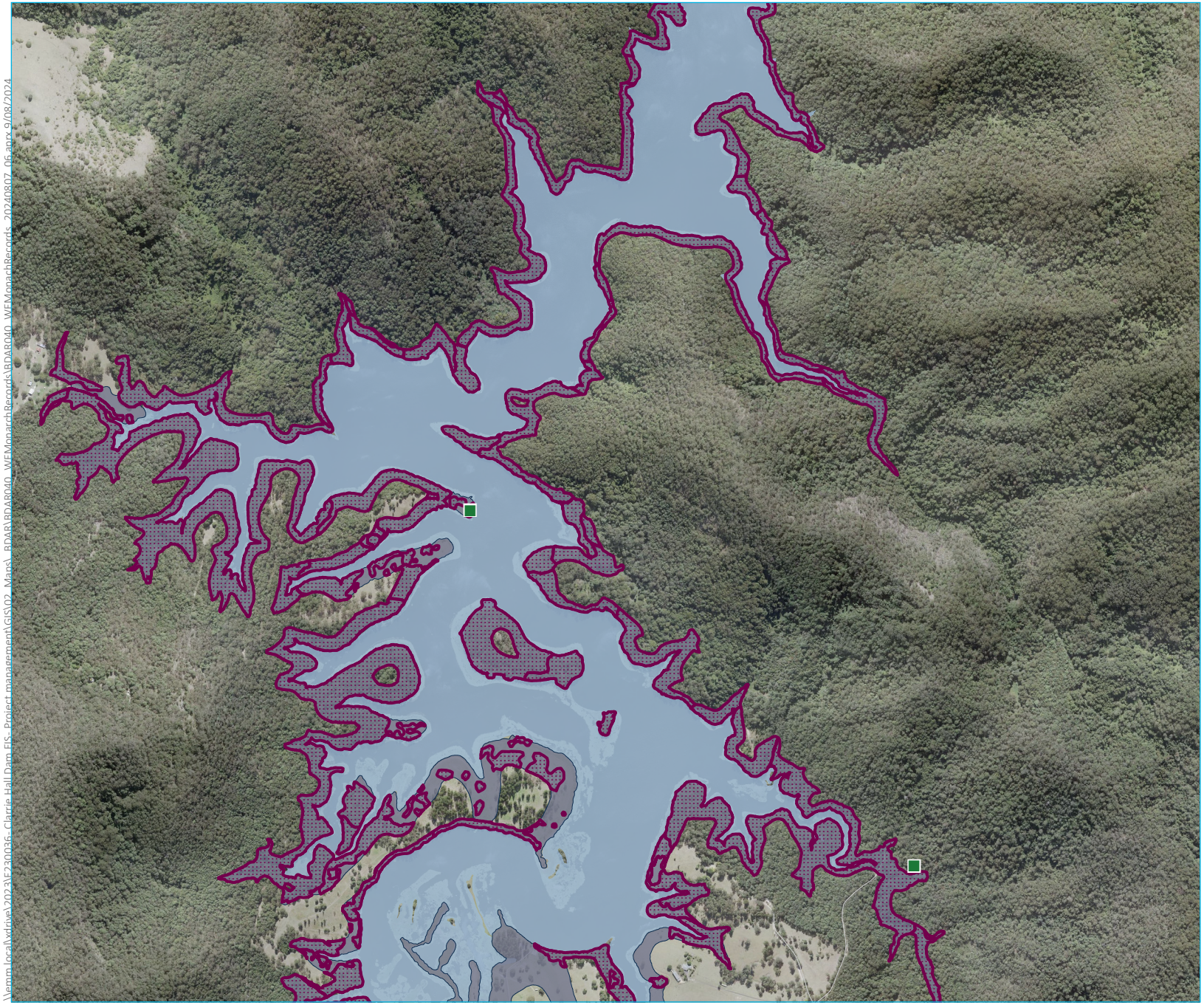

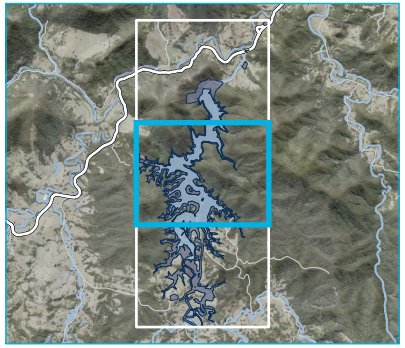

KEY

- Subject land
- Species polygon
- White-eared Monarch species record

Existing environment

- Major road
- Minor road
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

White-eared Monarch (*Carterornis leucotis*) records and species polygon

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Biodiversity Development Assessment Report
Figure 5.24

EMM
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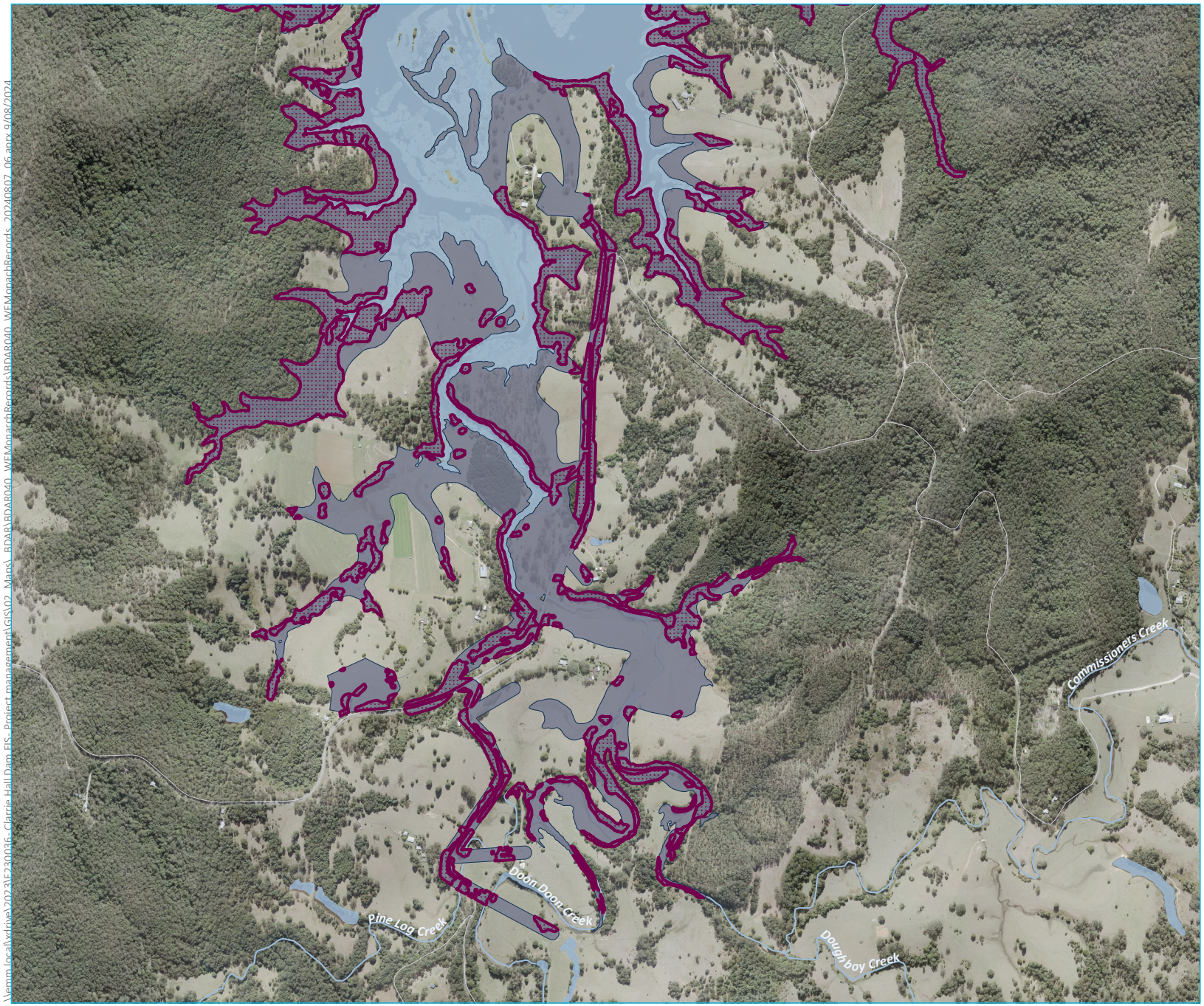

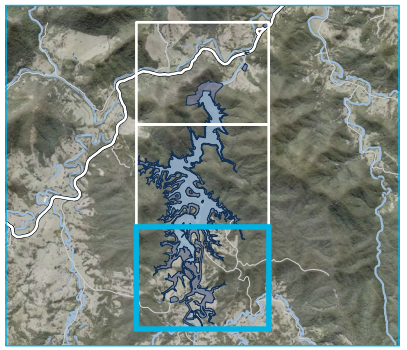

KEY

- Subject land
- Species polygon

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

White-eared Monarch (*Carterornis leucotis*) records and species polygon
Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.24

EMM
creating opportunities

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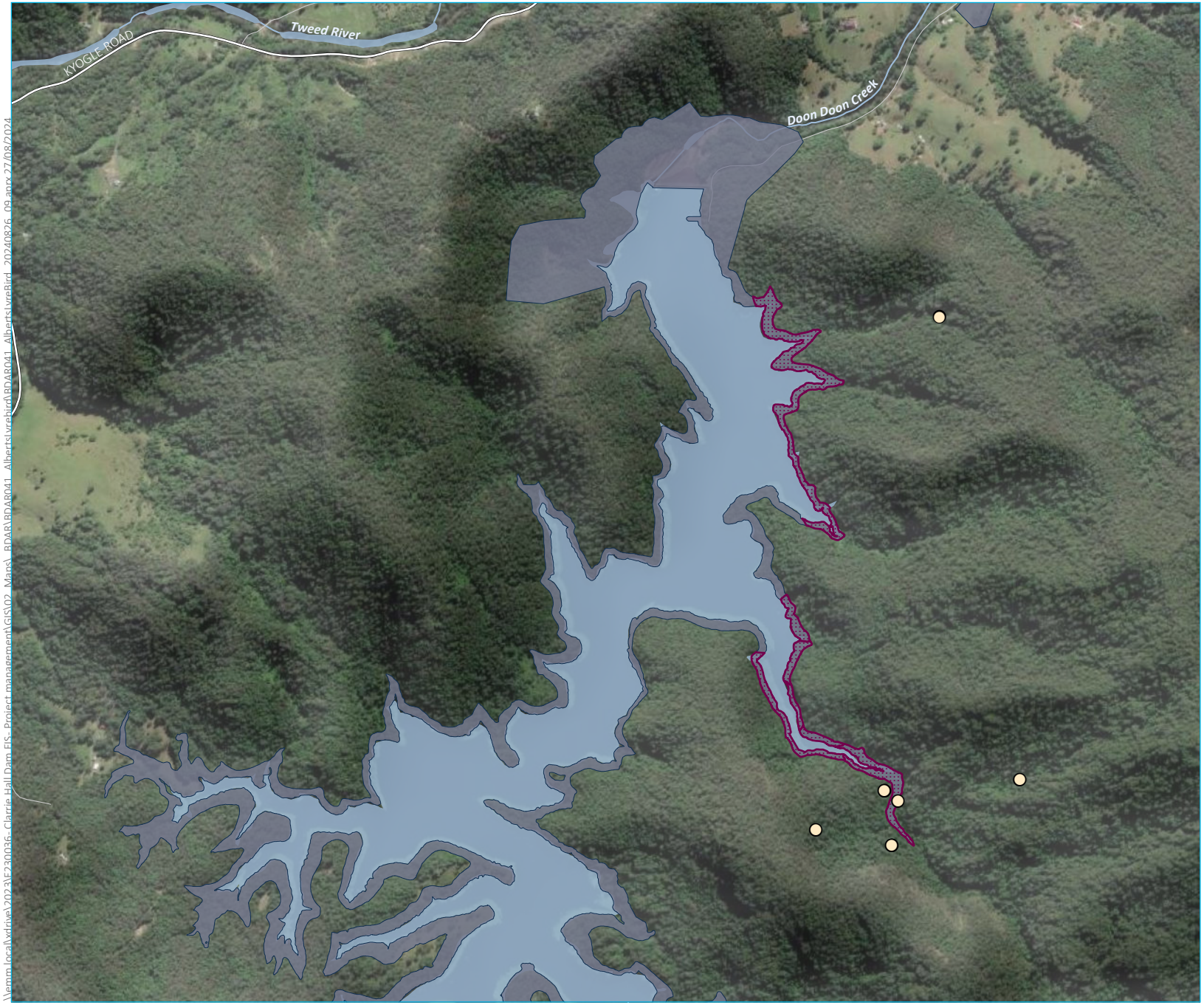

KEY

- Subject land
- Albert's Lyrebird species record
- Species polygon

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Albert's Lyrebird (*Menura alberti*) records and species polygon
Page 1 of 2

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.25

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009)

0 250 500 m
GDA2020 MGA Zone 56

N

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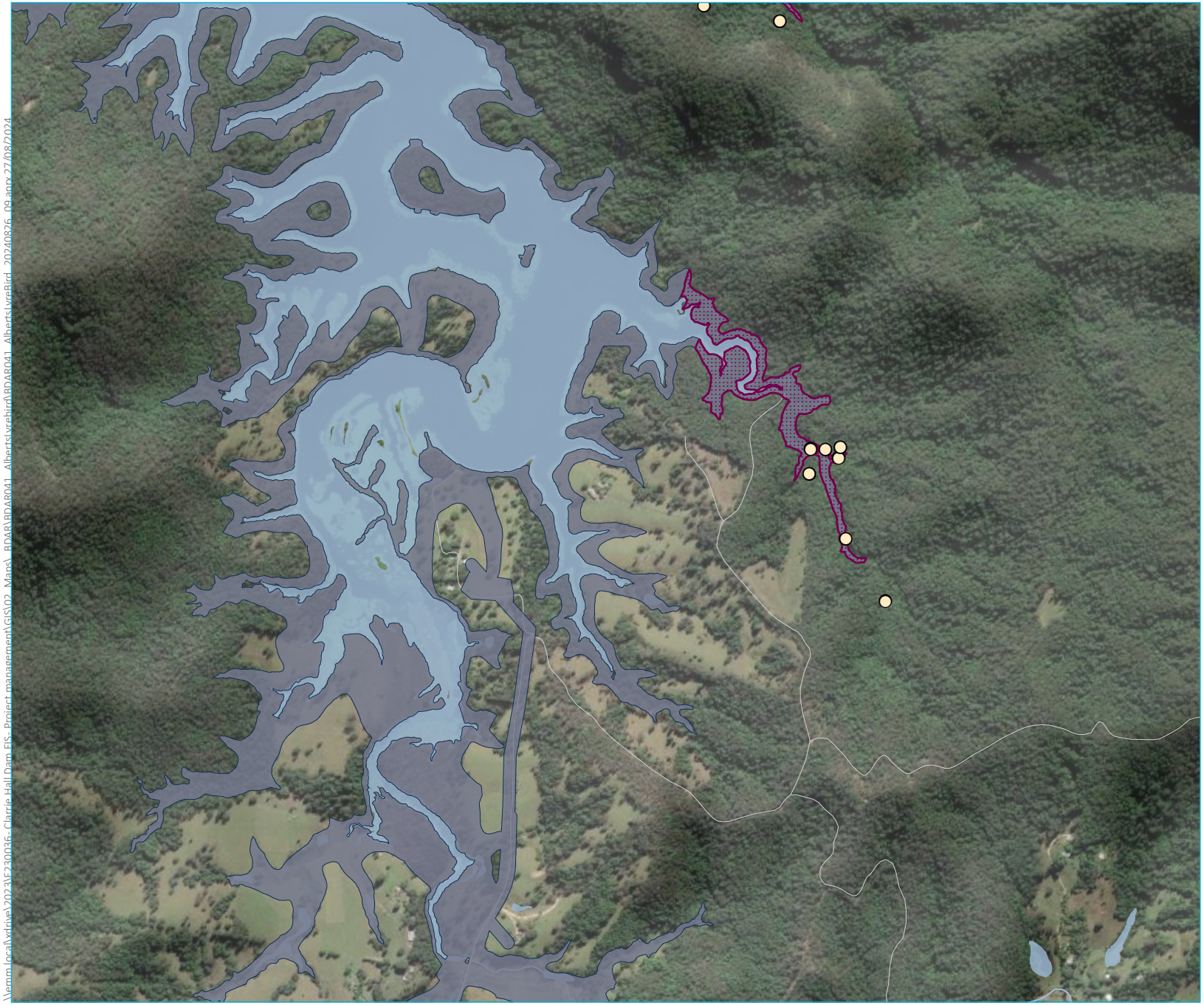

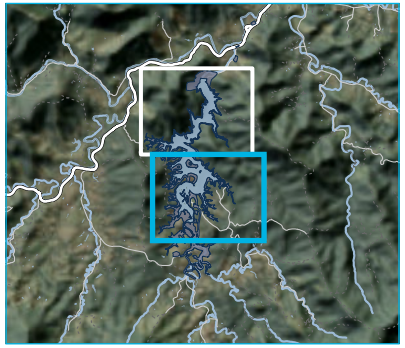

KEY

- Subject land
- Albert's Lyrebird species record
- Species polygon

Existing environment

- Minor road
- Named watercourse
- Waterbody

0 250 500 m

GDA2020 MGA Zone 56

N

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009)

Albert's Lyrebird (*Menura alberti*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.25

EMM
creating opportunities

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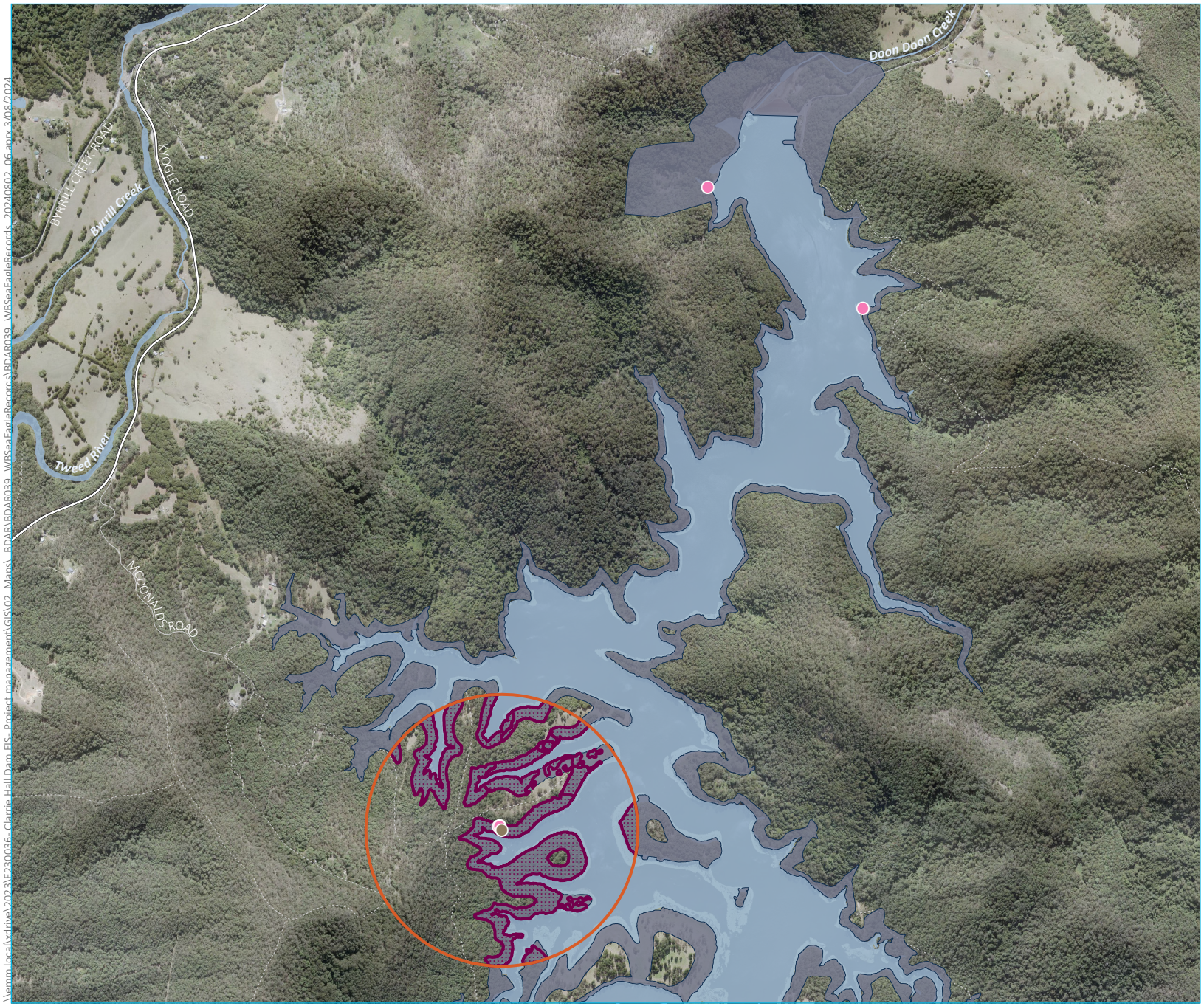

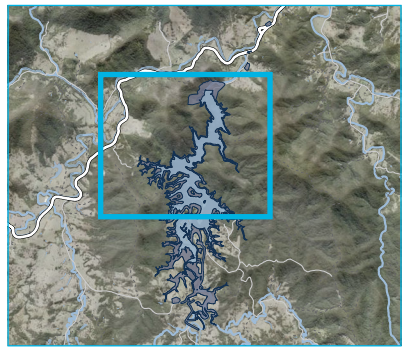

KEY

- Subject land
- Species polygon
- 200 m stick nest buffer

White-bellied sea eagle species record

- Ecological sighting
- Stick nest

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

White-bellied Sea Eagle (*Carterornis leucotis*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.26

EMM
creating opportunities

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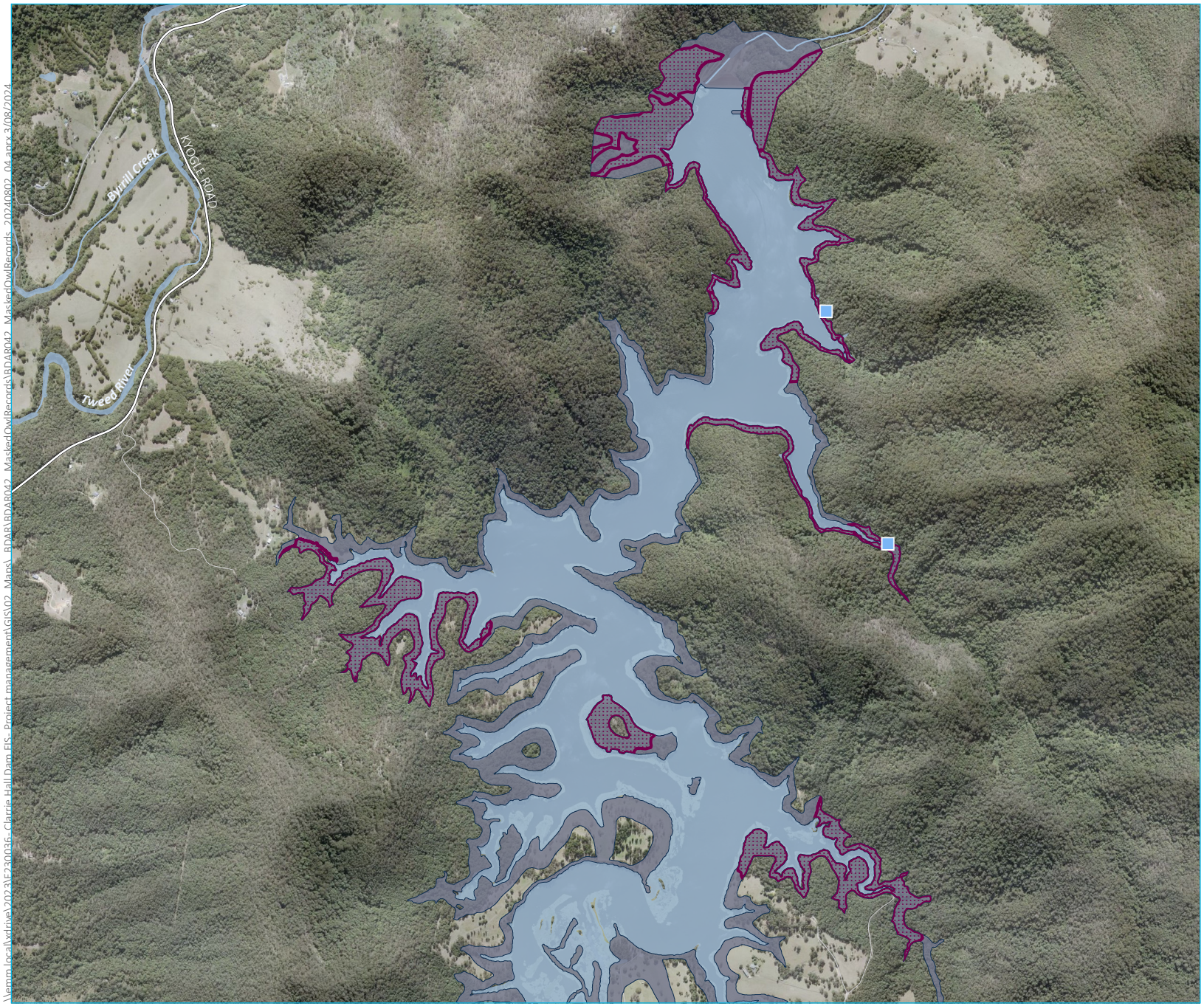

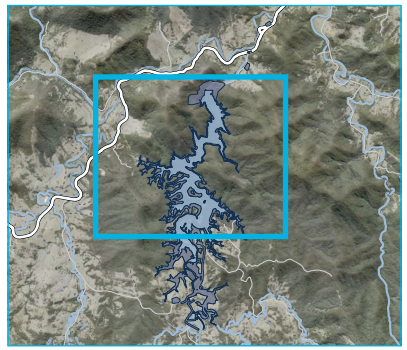

KEY

- Subject land
- Species polygon
- Masked Owl species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

Masked Owl (*Tyto novaehollandiae*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.27

EMM
creating opportunities

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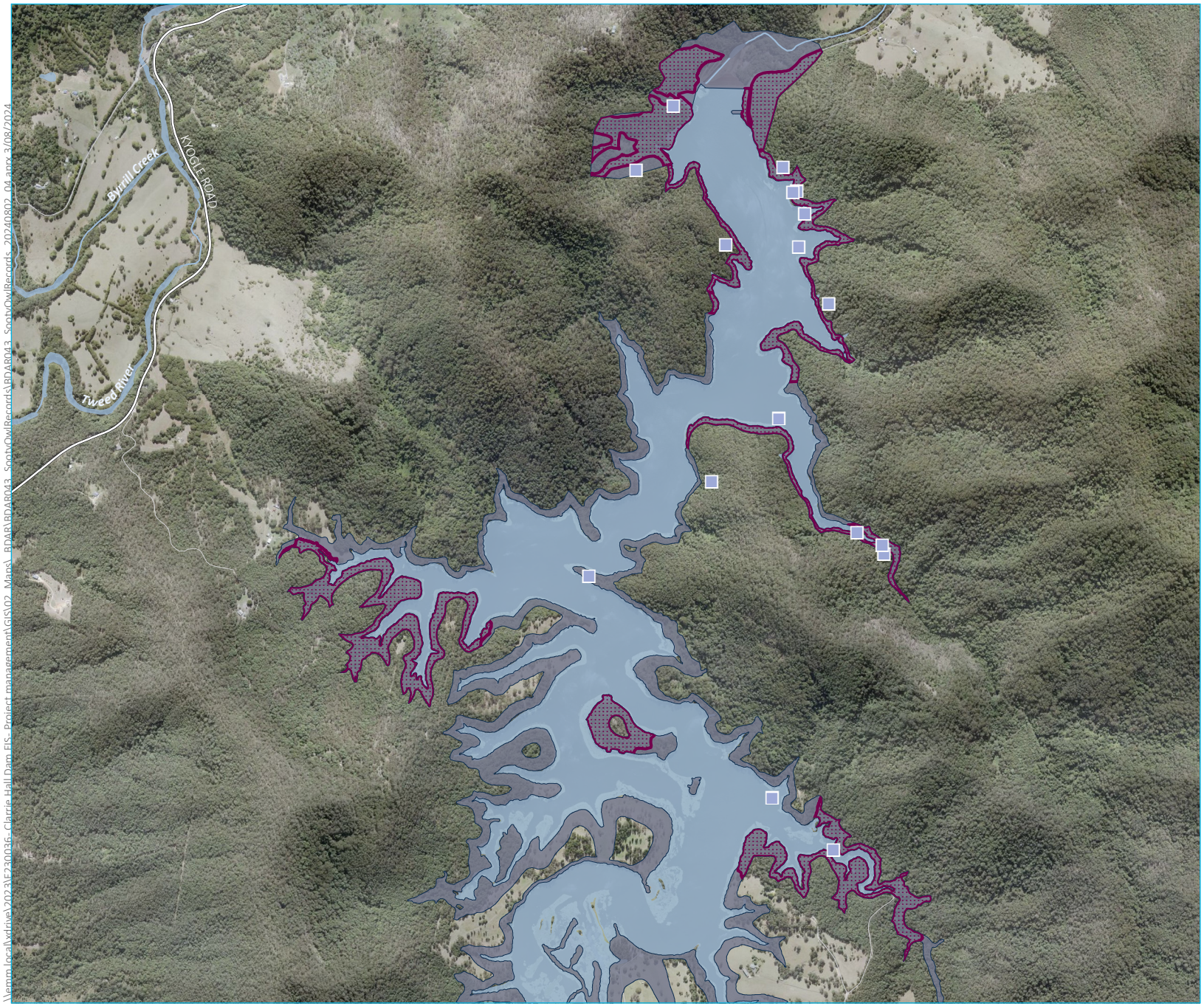

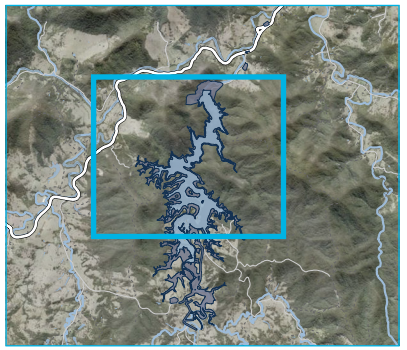

KEY

- Subject land
- Species polygon
- Sooty Owl species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Sooty Owl (*Tyto tenebricosa*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.28

EMM
creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024); GA (2009); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

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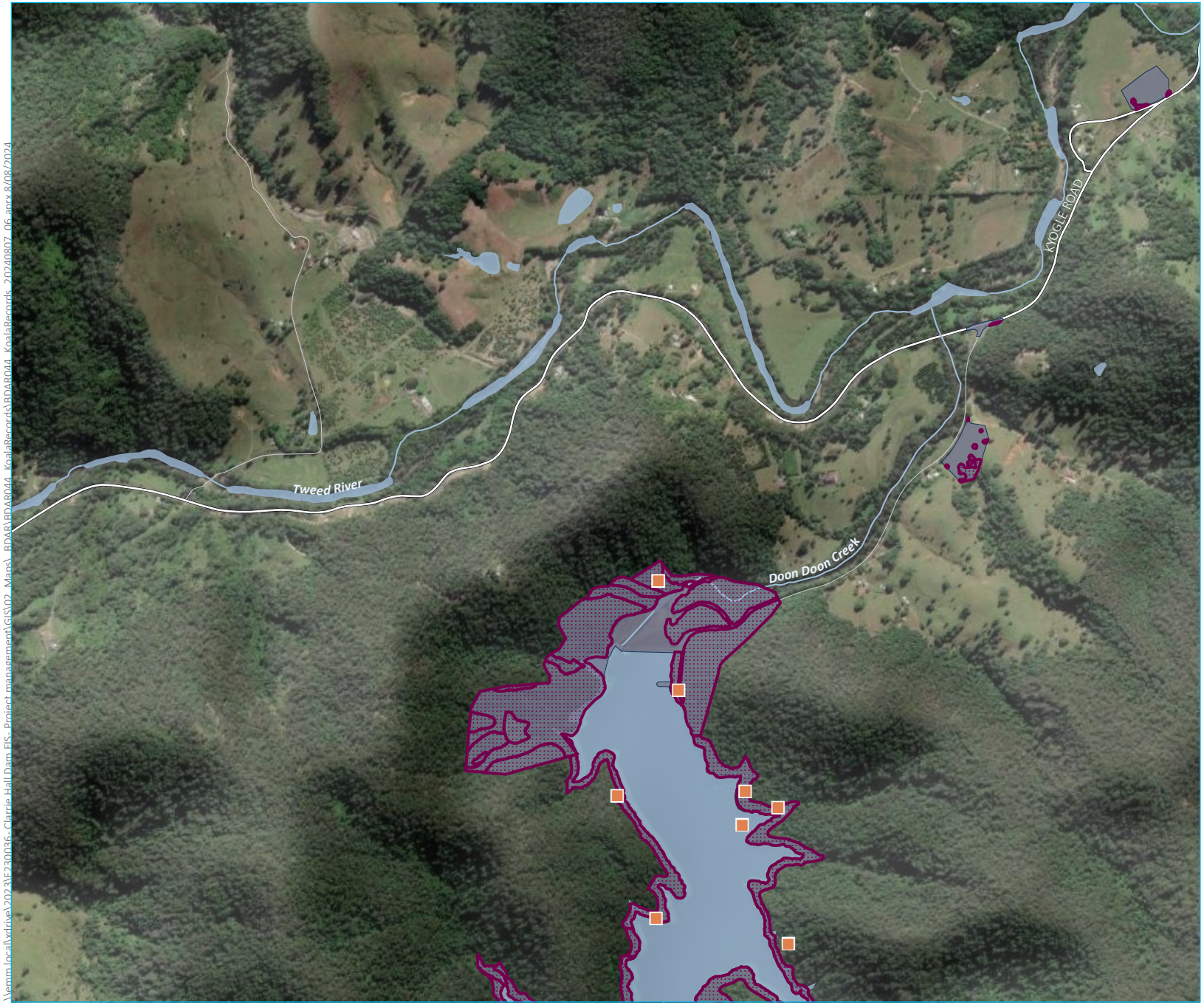

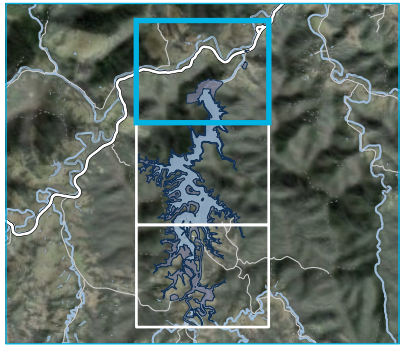

KEY

- Subject land
- Species polygon
- Koala species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

Koala (*Phascolarctos cinereus*) records and species polygon
Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.29

EMM
creating opportunities

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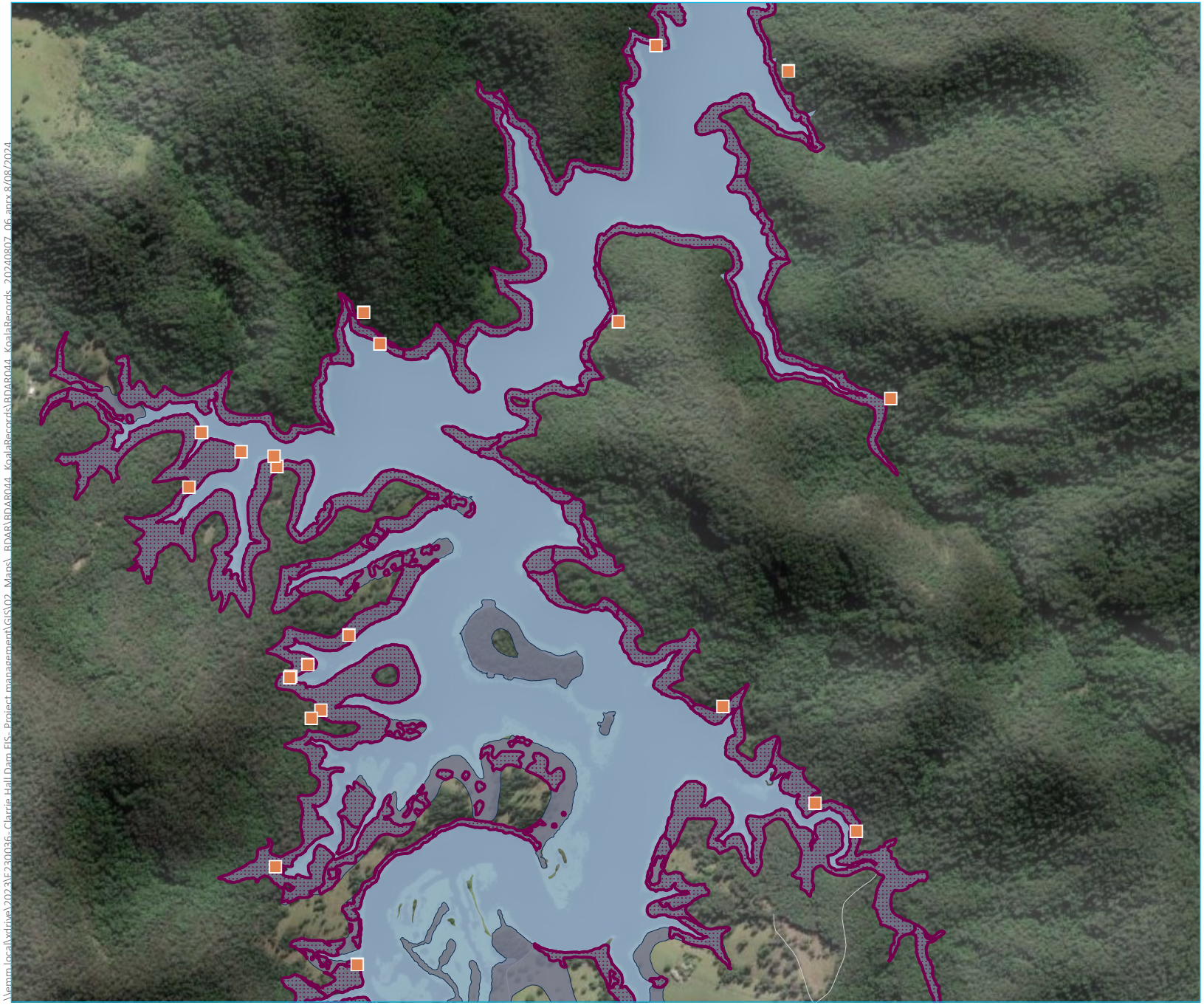

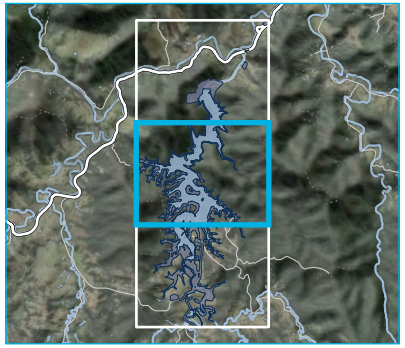

KEY

- Subject land
- Species polygon
- Koala species record

Existing environment

- Major road
- Minor road
- Waterbody

Koala (*Phascolarctos cinereus*) records and species polygon
Page 2 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.29

EMM
creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 250 500 m
GDA2020 MGA Zone 56
N

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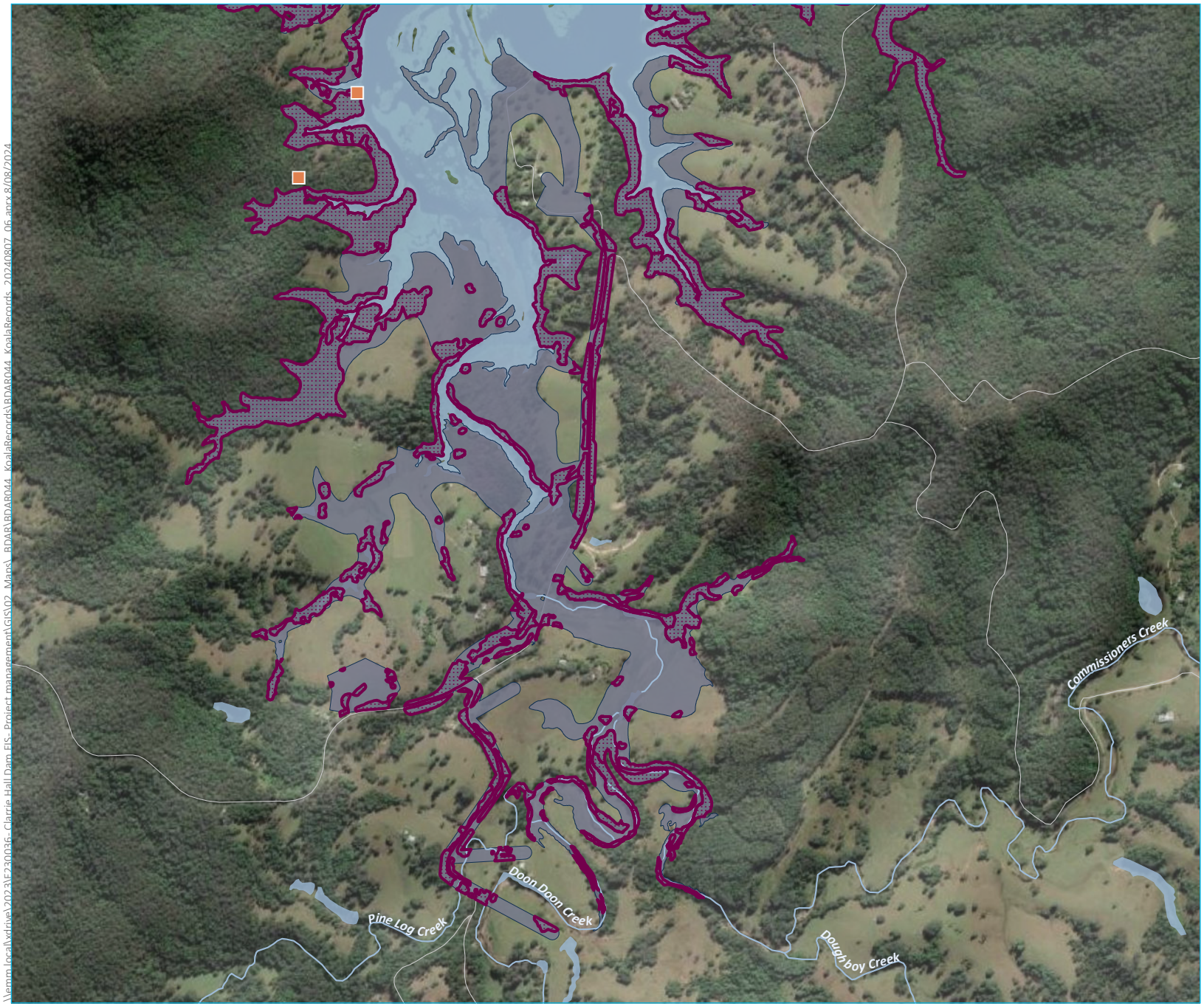

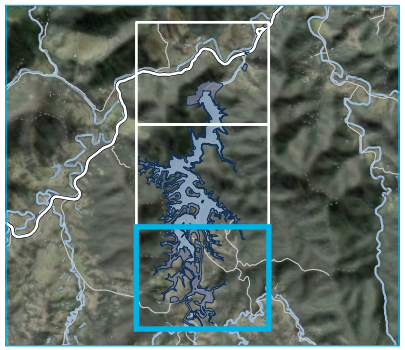

KEY

- Subject land
- Species polygon
- Koala species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

Koala (*Phascolarctos cinereus*) records and species polygon
Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.29

EMM creating opportunities

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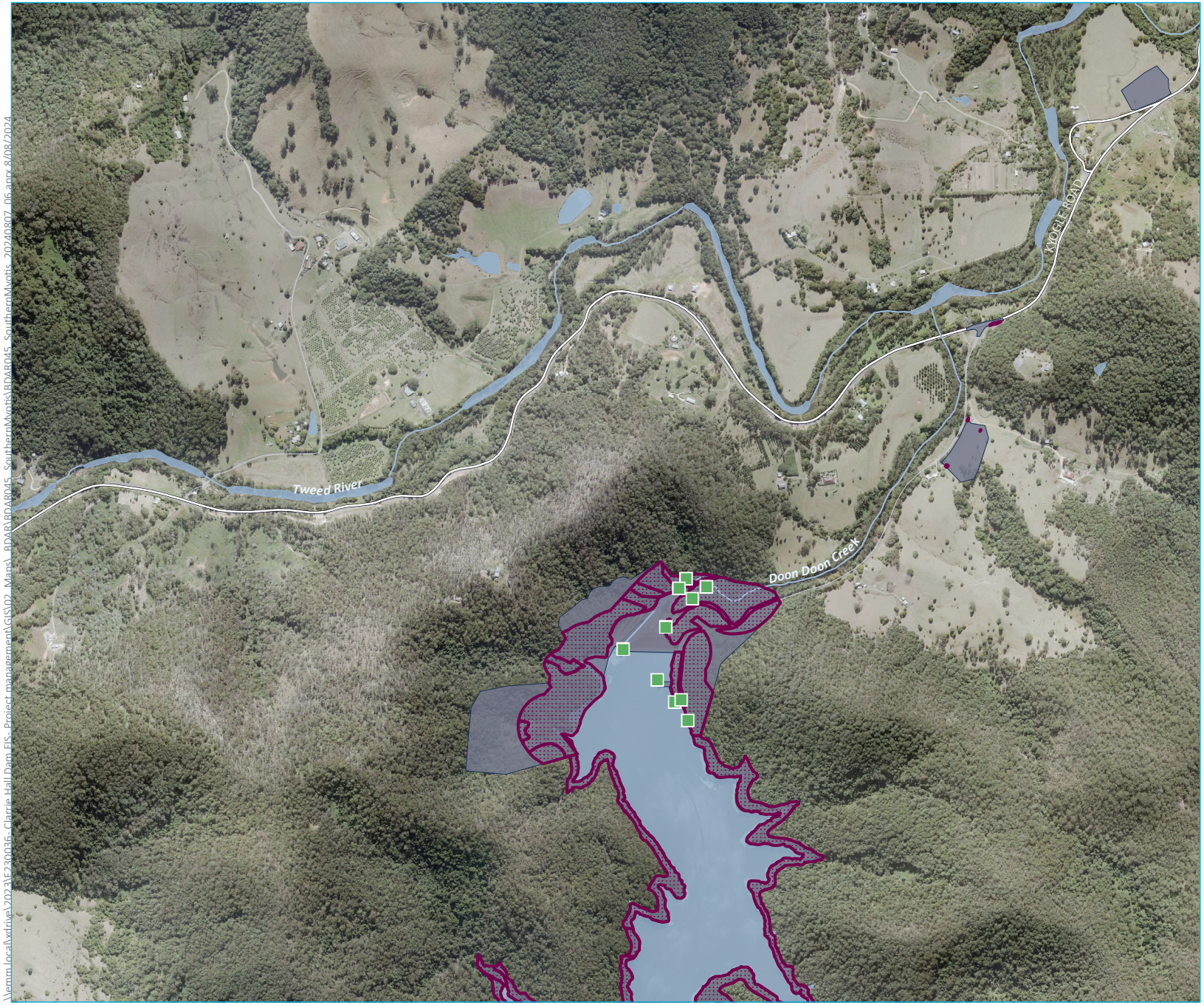

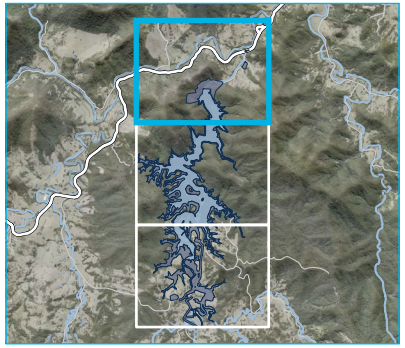

KEY

- Subject land
- Species polygon
- Southern Myotis species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Southern Myotis (*Myotis macropus*) records and species polygon
Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.30

EMM
creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56
N

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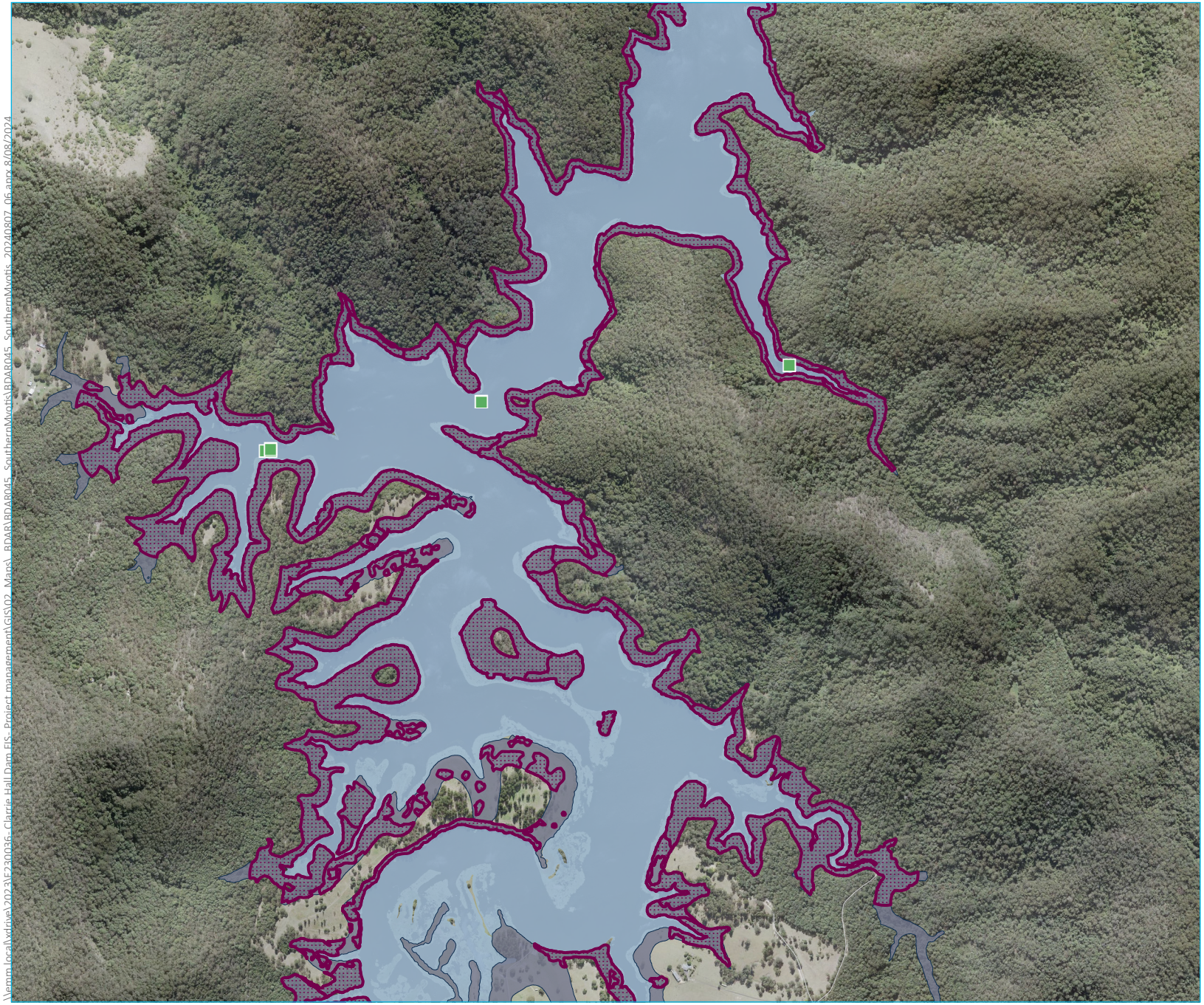

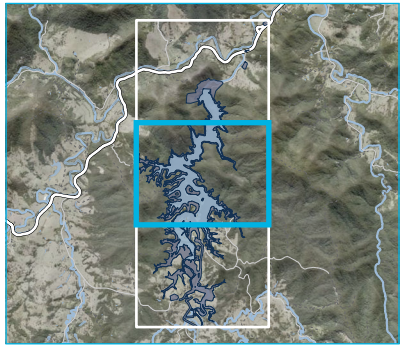

KEY

- Subject land
- Species polygon
- Southern Myotis species record

Existing environment

- Major road
- Minor road
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Southern Myotis (*Myotis macropus*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.30

EMM creating opportunities

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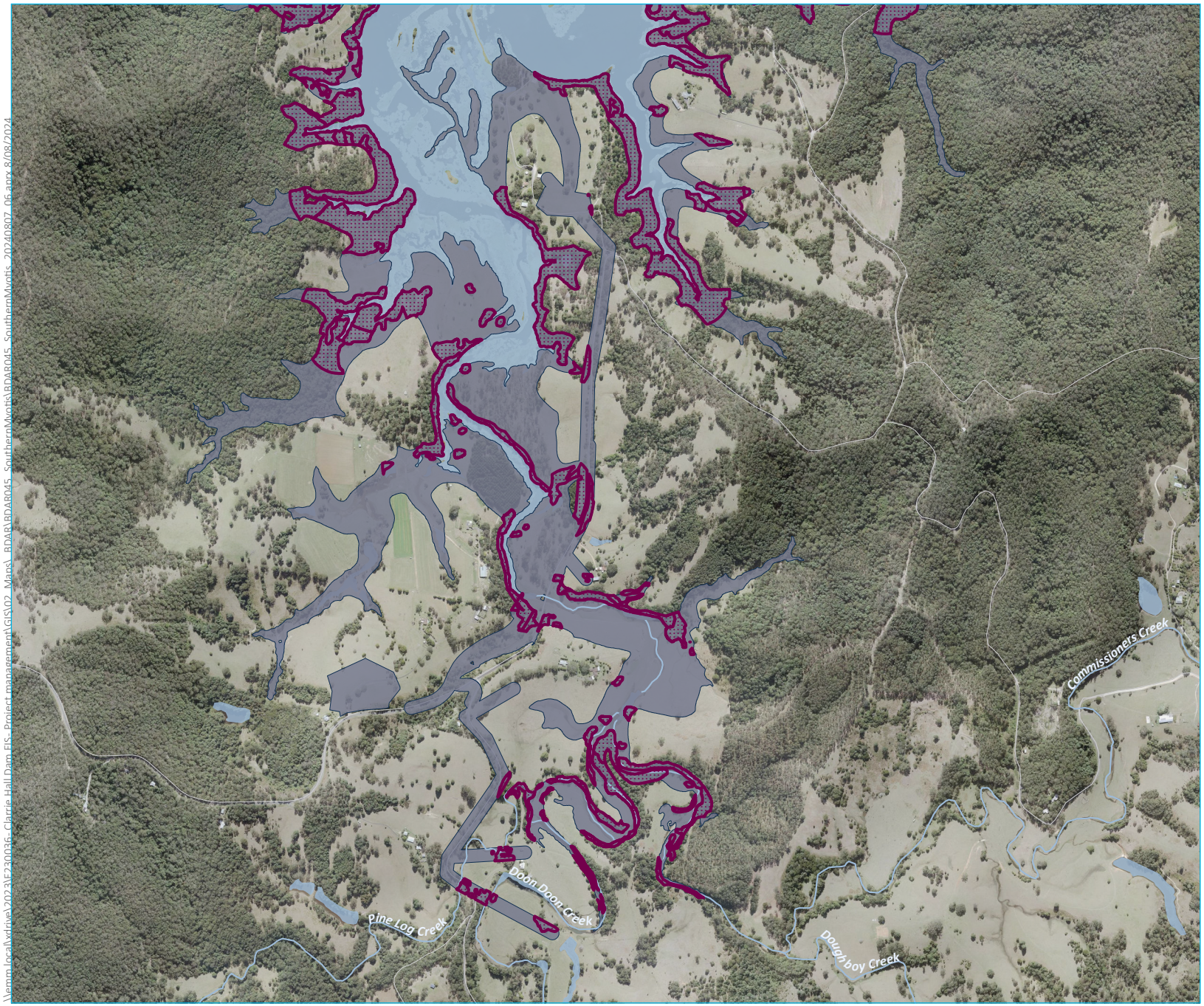

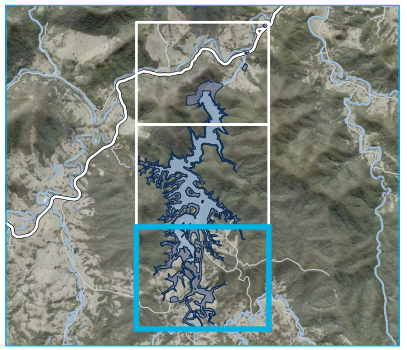

KEY

- Subject land
- Species polygon

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

Southern Myotis (*Myotis macropus*) records and species polygon
Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.30

EMM creating opportunities

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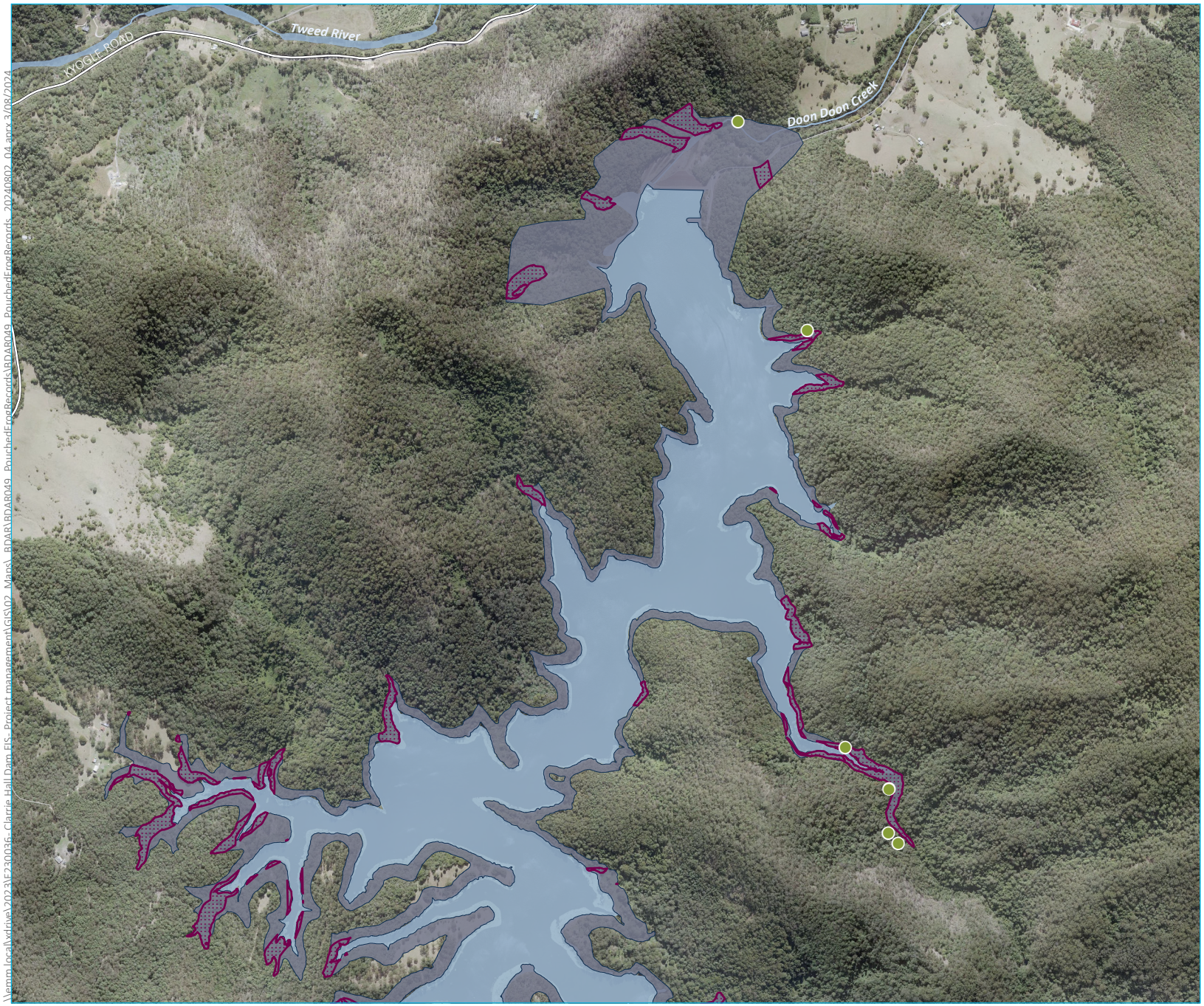

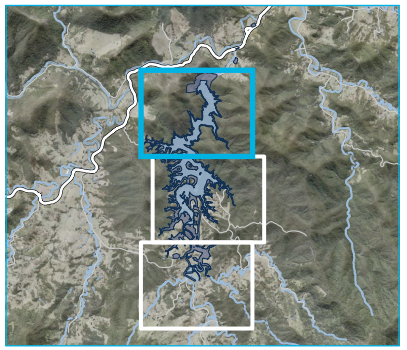

KEY

- Subject land
- Species polygon
- Pouched Frog species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

N

Pouched Front (*Assa darlingtoni*) records and species polygon

Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.31

EMM creating opportunities

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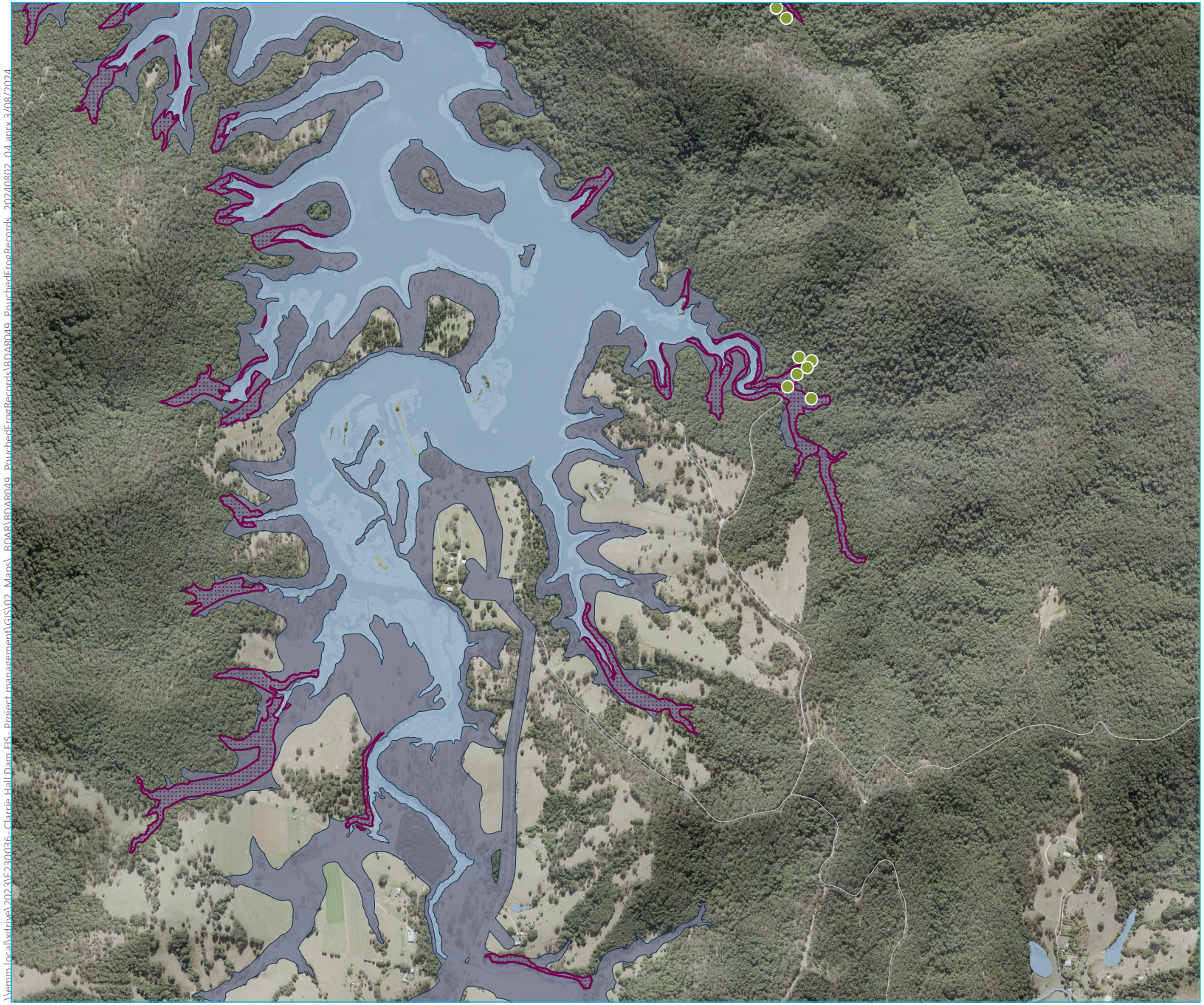

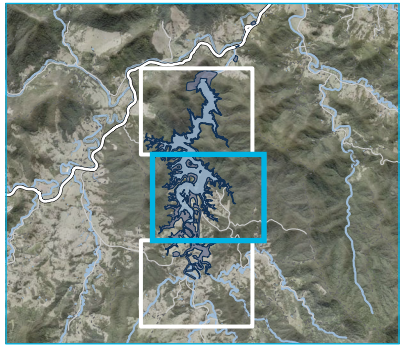

KEY

- Subject land
- Species polygon
- Pouched Frog species record

Existing environment

- Minor road
- Named watercourse
- Waterbody

0 250 500 m

GDA2020 MGA Zone 56

N

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

Pouched Front (*Assa darlingtoni*) records and species polygon
Page 2 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.31

EMM
creating opportunities

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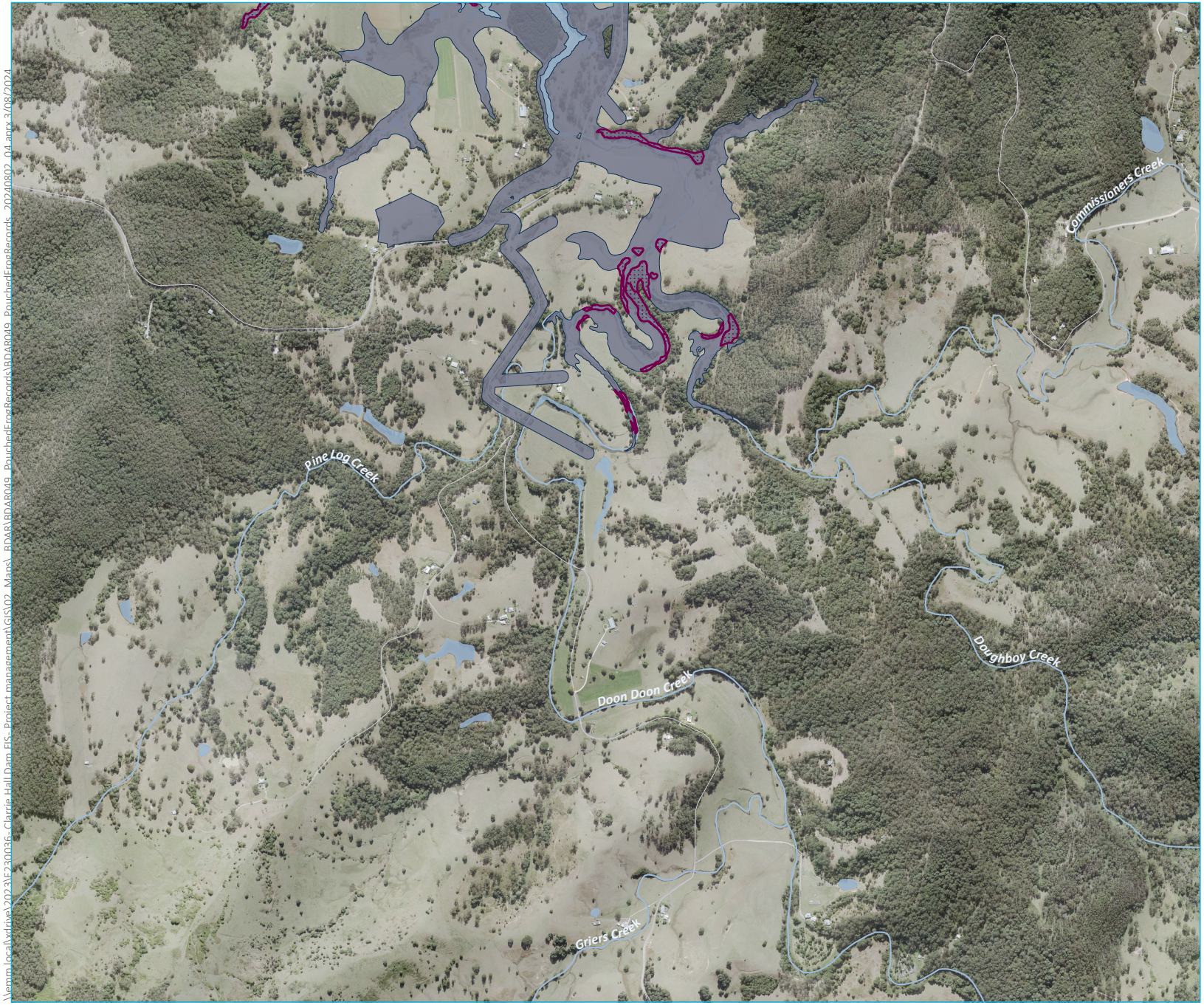
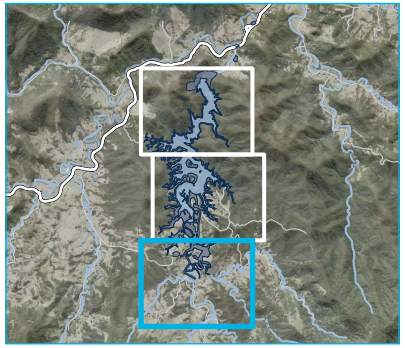




KEY

- Subject land
- Species polygon

Existing environment

- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m

GDA2020 MGA Zone 56

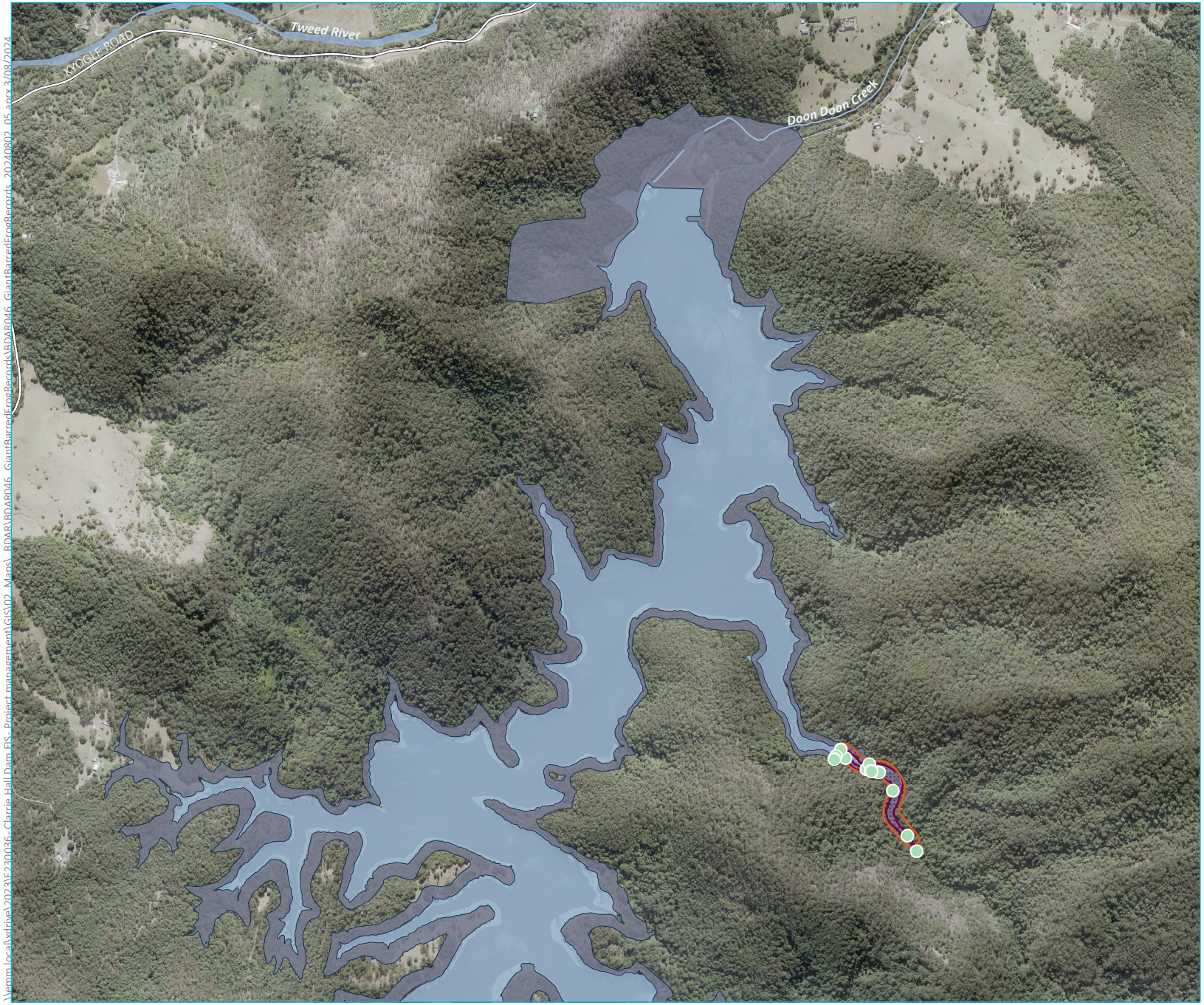
N

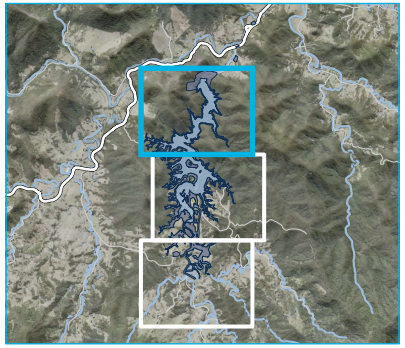
Pouched Front (*Assa darlingtoni*) records and species polygon
Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.31

EMM creating opportunities

\\emm.local\vdrive\2023\E230036_Clarrie Hall Dam EIS_Project management\GIS\02_Maps_BDAR\BDAR049_PouchedFrogRecords\BDAR049_PouchedFrogRecords_20240802_04.aprx 3/08/2024





KEY

- Subject land
- Species polygon
- 50 m buffer on watercourse
- Giant Barred Frog species record

Existing environment

- Major road
- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

Giant Barred Frog (*Mixophyes iteratus*) records and species polygon
Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.32

EMM
creating opportunities

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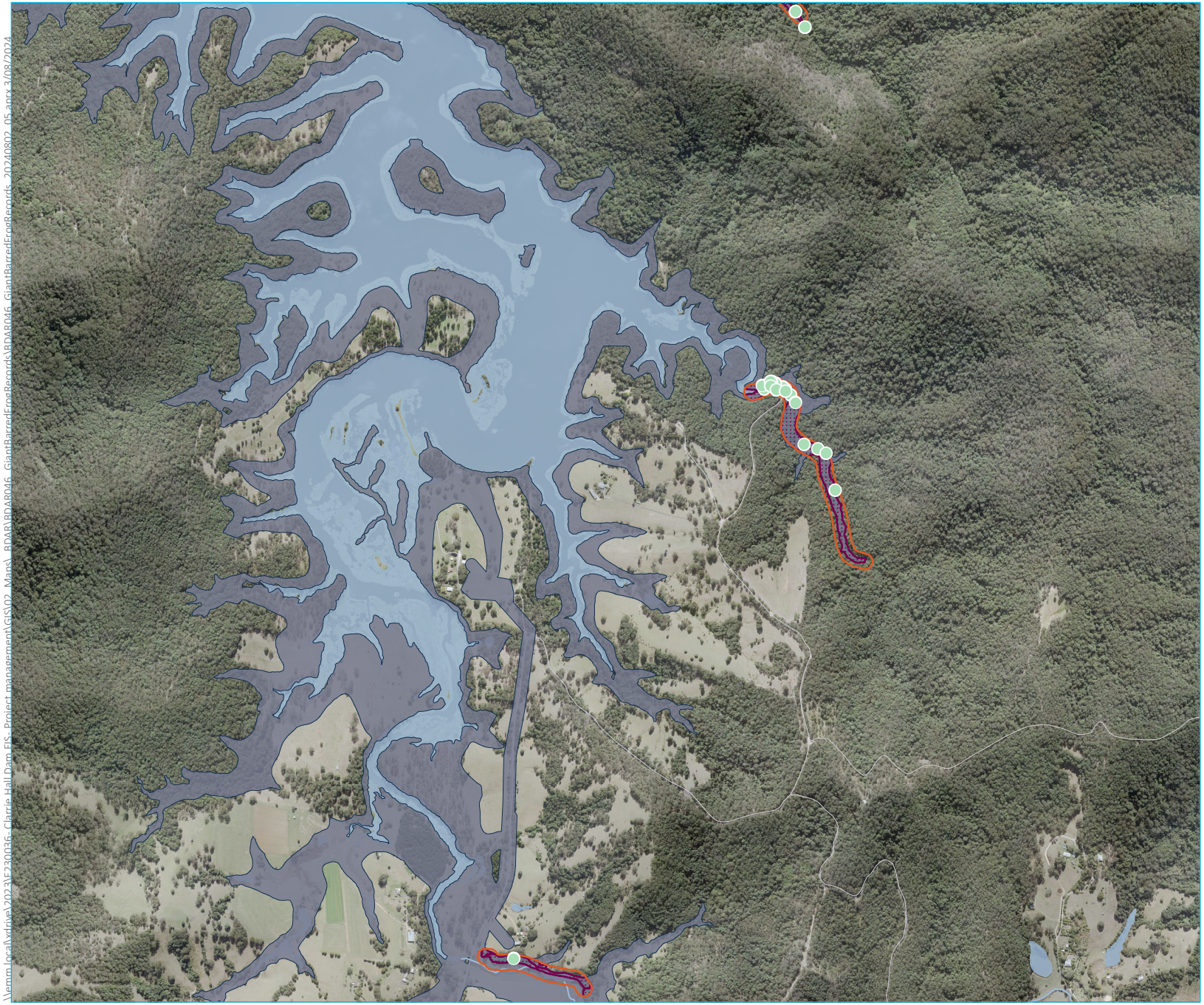

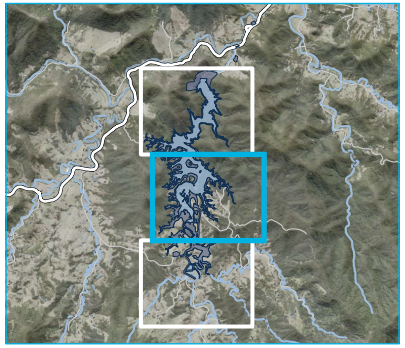

KEY

- Subject land
- Species polygon
- 50 m buffer on watercourse
- Giant Barred Frog species record

Existing environment

- Minor road
- Named watercourse
- Waterbody

0 250 500 m

GDA2020 MGA Zone 56

N

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

Giant Barred Frog (*Mixophyes iteratus*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.32

EMM
creating opportunities

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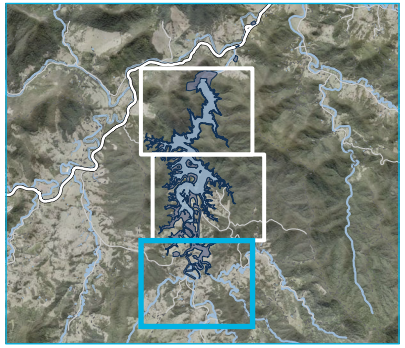

KEY

- Subject land
- Species polygon
- 50 m buffer on watercourse
- Giant Barred Frog species record

Existing environment

- Minor road
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

0 250 500 m
GDA2020 MGA Zone 56

N

Giant Barred Frog (*Mixophyes iteratus*) records and species polygon
Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.32

EMM
creating opportunities

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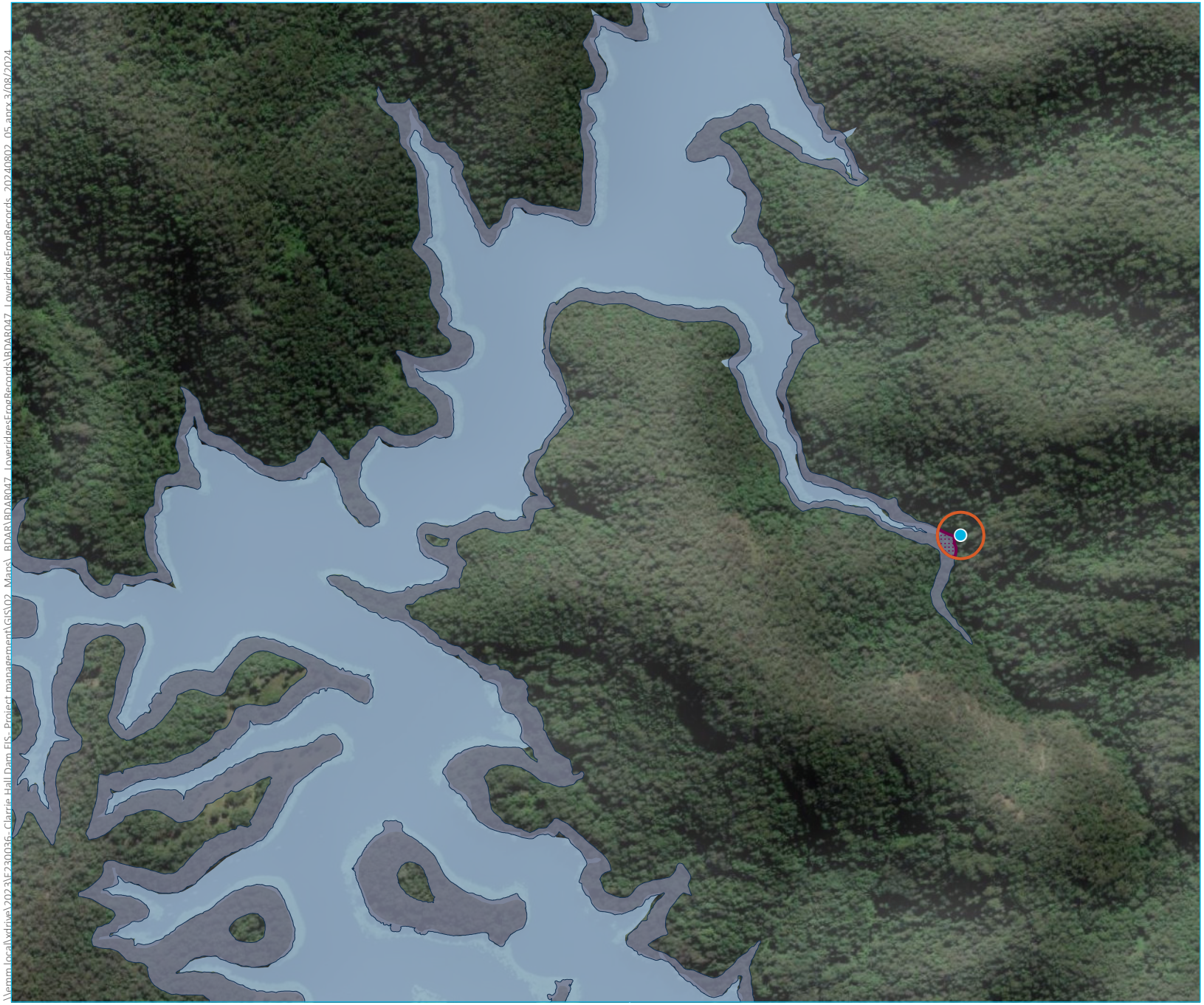

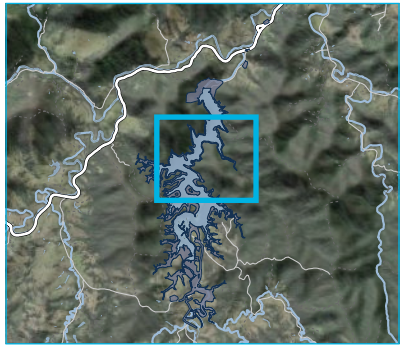

KEY

- Subject land
- Species polygon
- 20 m species record buffer
- Loveridge's Frog species record

Existing environment

- Major road
- Minor road
- Waterbody

Loveridge's Frog (*Philoria loveridgei*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.33

EMM creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

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GDA2020 MGA Zone 56

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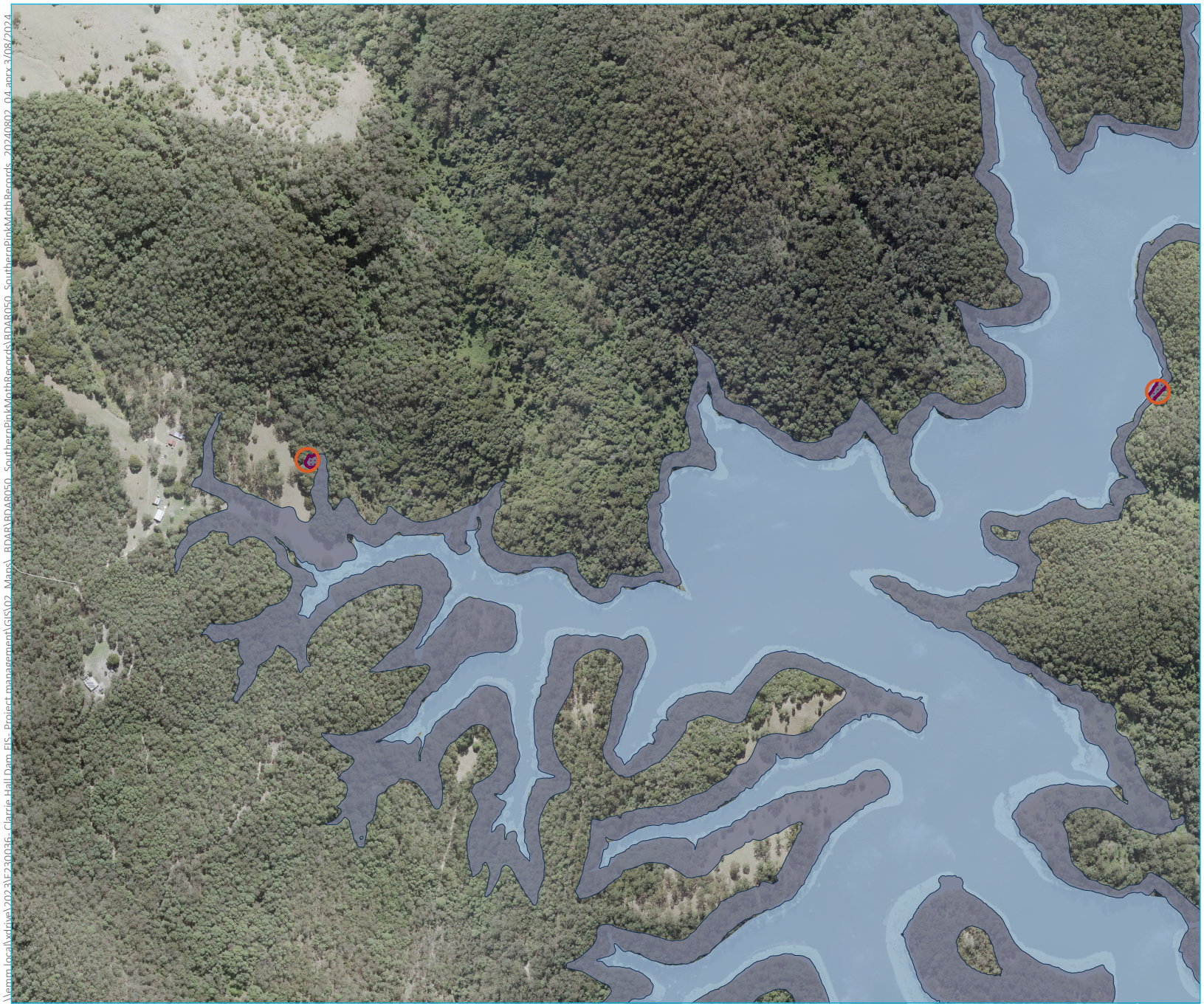

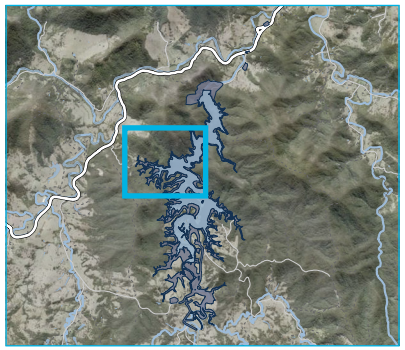

KEY

- Subject land
- Species polygon
- 20 m buffer of *Carronia Multisepalea*

Existing environment

- Major road
- Minor road
- Waterbody

Southern Pink Underwing Moth
(*Phyllodes imperialis smithersi*)
records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.34

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

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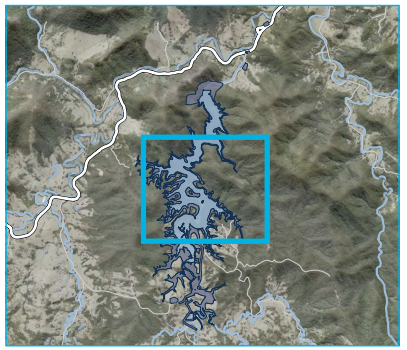

KEY

- Subject land
- Species polygon
- Mitchell's Rainforest Snail species record

Existing environment

- Major road
- Minor road
- Waterbody

0 250 500 m

GDA2020 MGA Zone 56

N

Source: EMM (2024); KBR (2024); DCSSS (2024); MetroMap (2024)

Mitchell's Rainforest Snail (*Thersites mitchellae*) records and species polygon

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 5.35

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6 Groundwater dependent ecosystems

The potential occurrence of groundwater dependant ecosystems (GDEs) within the subject land was assessed in EMM's Groundwater Impact Assessment (GIA) (EMM, 2024). There are no 'high priority' GDEs listed in the reviewed Water Sharing Plans (WSPs). The BoM GDE Atlas (BoM) indicates low potential of GDEs across the majority of the subject land, with three small patches of moderate potential GDE, mapped as Wet Bangalow Brushbox Forest, and Subtropical and Warm Temperate Rainforest. Field verification, outlined in Section 4.3.2 of this BDAR, found that these vegetation types do not differ substantially from other areas of the same vegetation types within the subject land, with no indication of groundwater utilisation in these areas. One vegetation type which is certainly a GDE, Wet Heath, is mapped in the south of the development area, however field survey found the area is dominated by wet sclerophyll forest, albeit disturbed and partially cleared and this vegetation is unlikely to be groundwater dependent.

It is unlikely that groundwater is essential to vegetation communities within the construction area. This is due to the regional high rainfall volumes, the typical depths to groundwater (which averages 17 mbgl in the fractured rock system), and the predominance of groundwater occurrence in fracture networks at depths typically not accessible by plant roots (EMM, 2024).

There may be some utilisation of groundwater by riparian vegetation upstream of the existing Dam where groundwater can be shallower in the alluvium (at approximately 4 mbgl), and is recharged by river flow and rainfall. The GIA found that these local systems are unconfined with high permeability but low storage owing to the typically narrow and thin extent of the Quaternary aged alluvial deposits, and high clay volumes. It is unlikely that these largely cleared areas, where native vegetation is limited to scatted trees and small patches of forest, contain GDEs.

Impacts to potential GDEs resulting from changes to groundwater levels and/or groundwater quality are unlikely to occur due to the Proposal. This is due to an absence of potential GDEs (both terrestrial and aquatic), likely owing to the regional high rainfall volumes, the typical depths to groundwater, and the predominance of groundwater occurrence in fracture networks. There may be some opportunistic use of groundwater from the shallow alluvium by riparian vegetation upstream of the existing Dam, however these areas are recharged by river flow and rainfall, and thus not solely groundwater dependent. These areas are also predominantly cleared.

The GIA found that the applied load from the higher water storage on the alluvial, porous and fractured rock groundwater sources has the potential to enhance recharge and cause the water pressure (or groundwater level) to rise, altering the local groundwater flow regime (hydraulic gradient and flow path) near the inundation area and Dam embankment, making groundwater more accessible to ecological communities.

7 Impact assessment

This chapter identifies the potential impacts of the Proposal on the biodiversity values identified within the subject land. Measures taken to avoid and minimise impacts are summarised and recommendations to mitigate and manage impacts are provided.

7.1 Avoidance and minimisation of impacts

The BAM requires that the strategies and actions taken to avoid or minimise impacts on biodiversity values during proposal planning of the Proposal are outlined, including efforts to minimise prescribed impacts (DPIE, 2020).

7.1.1 Water supply augmentation alternatives

A thorough assessment process was completed to identify and analyse suitable water supply augmentation options for the Tweed District. A range of technical studies were commissioned by Tweed Shire Council from 2007–2010 to identify suitable water supply augmentation options. These options were then investigated further from 2012–2015 to consider a wide range of relevant factors, including environmental, social and economic factors. A summary of the findings from these assessments is provided below.

i Dam raising options study (2007-2008)

A study commissioned by Tweed Shire Council investigated the optimum water level to which the FSL of the Dam could be raised, and the options for achieving this. Relevant factors considered for the alternative options were engineering, constructability, and social and environmental constraints.

The NSW Public Works Advisory (PWA) produced three reports: NSW PWA 2007a, 2007b and 2008. The study concluded that there were no engineering constraints impediment to raising the Dam and that raising it in a single rather than multiple stages, would be more economical. The study also established a knowledge base for further analysis of alternatives to this proposal.

ii Screening of alternatives (2009-2010)

A study by MHW (2009), which was commissioned by Tweed Shire Council, identified and screened feasible alternatives to augment the Tweed District water supply. Nine alternatives were identified: three dam options, two pipeline options, desalination, groundwater supply, direct water reuse and indirect water reuse. These options were analysed against 10 assessment criteria using a multi criteria analysis evaluation tool.

Following a coarse screen analysis of the nine alternatives identified by MHW (2009), MHW (2010) undertook a more detailed assessment of three shortlisted supply augmentation options (listed in order of analysis preference from highest to lowest):

- raising Clarrie Hall Dam
- staged links to South East Queensland (SEQ) Water via pipelines
- building a new small, large, and/or staged small to large dam at Byrrill Creek.

From 2009 to 2010, Tweed Shire Council undertook community consultation regarding these three primary options. Feedback was consolidated into a summary report prepared by the Community Working Group (Community Working Group, 2010). The Tweed Shire Water Supply Augmentation Community Working Group (CWG) was established to assist with the selection of a preferred option. The CWG identified the raising of the Clarrie Hall Dam as the preferred option given the legislative complexity of the SEQ pipeline option and the high conservation values of Byrrill Creek.

iii Council resolutions (2012–2015)

Based on the information collated for the three options above, Tweed Shire Council placed a 20-year moratorium on any dam proposal at Byrrill Creek from 2012.

Six options for an additional water source for the Tweed Shire Council LGA were considered by Tweed Shire Council in 2015:

- raise Clarrie Hall Dam
- build a small Byrrill Creek Dam
- build a small Byrrill Creek Dam then raise it at a later date
- build a large Byrrill Creek Dam
- link to SEQ Water
- link to Gold Coast City Council.

In December 2015, Tweed Shire Council resolved to adopt the raising of Clarrie Hall Dam as the preferred option for future water security and proceed with the planning approval and land acquisitions phase for the Proposal subject to Council continuing to undertake comprehensive investigations of Council's water supply-demand options. In October 2016, Council approved the commencement of a range of investigations at the Dam to further inform the Proposal team, Councillors and the community on the potential impacts of the Proposal, and to further guide decision making in relation to a preferred option. As a result of these studies, and on-going augmentation assessments, Council is progressing the preferred option to raise the Dam consistent with the 2015 resolution.

7.1.2 Avoidance and minimisation approach

Identification and analysis of options to augment the water supply for the Tweed District identified a dam as the optimal option, with a preference for raising the Dam. In implementing Council's resolution, the principles of avoidance and minimisation of environmental impacts have been used in the design of the proposal of raising the Dam.

i Location

The option of developing a secondary dam at Byrrill Creek, a fifth order waterway to the west of Kyogle Road, was the primary dam alternative to raising the Dam. The development of a new dam in a greenfield location in the region would introduce new and increased social, cultural and environmental impacts.

A new dam at Byrrill Creek would require the establishment of all new dam infrastructure and associated ancillary features, inclusive of a dam wall, spill way channel, access roads, operational facilities and the inundation of terrestrial vegetation, all of which combined are likely to require a much larger disturbance footprint than the proposal. A new dam at Byrrill Creek would create a barrier for some terrestrial species, potentially impeding connectivity, and the construction of a dam wall along Byrrill Creek would also likely impact aquatic connectivity through a significant modification of hydrology of this waterway. Other constraints include the significant Aboriginal cultural values of the Byrrill Creek area. Furthermore, this option would also require the revocation of National Parks owned land, as was required with the Proposal.

In contrast, the direct impacts to biodiversity values associated with the Dam raising Proposal are far less in extent and magnitude than that associated with flooding a new dam. Moreover, potential indirect impacts associated with raising the Dam are preexisting in the Doon Doon Catchment and have occurred since the construction of the existing Dam in the early 1980s. Hence, indirect impacts to aquatic and terrestrial connectivity associated with hydrology changes resulting from a raised Dam wall are considered negligible, particularly when compared to those of damming a new catchment.

ii Design

Measures have been taken to avoid biodiversity values within the construction footprint. This has been achieved by locating most of the Dam infrastructure at the northern end of the Dam, which is considerably disturbed by past construction activities. That is, the northern end of the Dam already contains areas of hardscaping for the current Dam infrastructure and will require less vegetation clearing to facilitate the new and upgraded infrastructure.

The location of ancillary infrastructure associated with the Dam has also been designed to minimise impacts to biodiversity values. The design of the Proposal has prioritised locating ancillary infrastructure associated with the Dam, such as workforce accommodation and road upgrades and realignments, within areas of cleared pasture where possible, with only narrow remnants or isolated patches of low condition wet sclerophyll forest present.

Due to the nature of the Proposal, avoidance of the biodiversity values within the operational footprint of the subject land is limited. As the Proposal proposes to increase the water supply yield of the current Dam, inundation of the surrounding land is required to achieve a greater FSL. As such, impacts to vegetation and fauna habitats located between the current and proposed future FSL cannot be avoided. Consideration was given, however, to minimising these impacts by adjusting the Dam height and FSL.

Hydrological models were examined to investigate whether an inflection point exists in the level of biodiversity impacts commensurate to the inundation level of the Dam. That is, models were run where the Dam height was varied in relation to potential biodiversity impacts. Flood modelling scenarios included Dam heights of 66 m AHD, 70 m AHD, 74 m AHD and 77 m AHD. The impact of inundation caused by these water levels was assessed for three vegetation types; lowland rainforest, wet sclerophyll forests and cleared land. The results indicated a linear increase in impacts to these vegetation types commensurate to the height of inundation. It was concluded that compared to the proposed increase of Dam wall to 70 m AHD, raising the Dam an additional 4 to 7 m would result in a 47% and 84% increase in biodiversity impacts to the vegetation communities, respectively. Hence, this exercise ensured the proposed increase of the Dam wall to 70 m AHD and no more would avoid biodiversity impacts where possible. Furthermore, the topography above a FSL of 70 m AHD presented design limitations. Above 70 m AHD, the upstream extents of the Dam would experience ‘break outs’ which would require the construction of saddle dams to contain the water (Public Works Advisory, 2018).

iii Construction

Early iterations of the Proposal design proposed to raise the Dam wall in stages. However, raising the wall in stages would result in multiple construction events, and hence, multiple occasions where the surrounding flora and fauna in adjacent retained vegetation would be disturbed. Raising the Dam wall in multiple events would also increase the financial obligation of Tweed Shire Council. To minimise the duration of disturbance to biodiversity values and reduce costs, the Proposal proposes to raise the Dam wall in one single event to limit the temporal impacts of construction.

7.1.3 Potential direct and indirect impacts

i Direct impacts

The direct impact of the Proposal on biodiversity values constitutes the loss of 246 ha of native vegetation, inclusive of 8.77 ha of a TEC and 13.00 ha of planted native vegetation, and the habitat values that this vegetation provides to some threatened species. Specifically, the Proposal will result in the loss of:

- 12 Corokia (*Corokia whiteana*) individuals, listed as Endangered under the BC Act and EPBC Act
- 50 Rusty Rose Walnut (*Endiandra hayesii*) individuals, listed as Vulnerable under the BC Act and EPBC Act
- 457 Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) individuals, listed as Endangered under the BC Act
- 4 Red Boppel Nut (*Hicksbeachia pinnatifolia*) individuals, listed as Vulnerable under the BC Act and EPBC Act
- 15 Fine-leaved Tuckeroo (*Lepiderema pulchella*) individuals, listed as Vulnerable under the BC Act
- 12 Rough-shelled Bush Nut (*Macadamia tetraphylla*) individuals, listed as Vulnerable under the BC Act and EPBC Act
- 709 Scrub Turpentine (*Rhodamnia rubescens*) individuals, listed as Critically Endangered under the BC and EPBC Act
- 105 Red Lilly Pilly (*Syzygium hodgkinsoniae*) individuals, listed as Vulnerable under the BC Act and EPBC Act
- 16 Durobby (*Szygium moorei*) individuals, listed as Vulnerable under the BC Act and EPBC Act
- 2.21 ha of habitat for Thorny Pea (*Desmodium acanthocladum*), listed as Vulnerable under the BC Act and EPBC Act
- 0.50 ha of habitat for Basket Fern (*Drynaria rigidula*), listed as Endangered under the BC Act
- 1.03 ha of habitat for Narrow-leaf Finger Fern (*Grammitis stenophylla*), listed as Endangered under the BC Act
- 78.96 ha of habitat for Slender Marsdenia (*Marsdenia longiloba*), listed as Endangered under the BC Act and Vulnerable under the EPBC Act
- 95.53 ha of habitat for Native Guava (*Rhodomyrtus psidioides*), listed as Critically Endangered under the BC and EPBC Act.

The Proposal will also lead to the loss and degradation of some threatened fauna species habitats, including hollow bearing trees, rocky areas, and creeks.

For area-based species the methods for calculation of habitat areas (species polygons) are provided in Section 5.4.6.

a Loss of native vegetation

A total area of 246 ha of native vegetation and planted native vegetation will be directly impacted as a result of inundation and clearing works. Following the construction of the Proposal, no further direct impacts to native vegetation are anticipated.

Table 7.1 outlines the areas of each vegetation zone that will be directly impacted by the Proposal.

Table 7.1 Vegetation zone and impact summary

PCT ID	PCT name	Vegetation zones	Extent in subject land (ha)
827	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	827_High	72.13
		827_Mod	31.27
		827_Burnt	19.04
		827_Low	25.50
		827_Planted	5.08
		827_Pasture	64.06
		827_Derived_sedgeland	4.58
		Total area of PCT	**221.66**
1073	Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	1073_High	2.67
		Total area of PCT	**2.67**
1302	White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	1302_High	5.78
		1302_Mod	2.99
		Total area of PCT	**8.77**
N/A	Eucalyptus plantation	N/A	7.34
N/A	Hoop Pine plantation	N/A	4.64
N/A	Planted native vegetation	N/A	1.02
		Total area of planted native vegetation	**13.00**
Total native vegetation			**246.11**

All vegetation zones of PCT 1302 totalling 8.77 ha represents the EPBC Act listed Lowland Rainforest of Subtropical Australia Critically Endangered Ecological Community (CEEC), and the BC Act listed, Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC.

A substantial amount (68.64 ha) of the impacted vegetation constitutes pasture or sedgeland in low condition, where the vegetation integrity offset in these areas is below the condition thresholds that require offsets (as per Section 9.2.1 of BAM (DPIE, 2020), and so will not require ecosystem offsets. A further 13.00 ha of planted native vegetation will also not require offsets. The remaining native vegetation in the disturbance footprint would generate an ecosystem credit offset requirement as described in Section 8.3. Impacts to habitat for species-credit species would also generate a species credit offset requirement as described in Section 8.3.

b Loss and degradation of native fauna habitat

The 246.11 ha of vegetation that will be directly lost also comprises habitat for native fauna. The threatened fauna habitat to be lost as a result of the Proposal constitutes:

- 165.61 ha of habitat for White-eared Monarch (*Carterornis leucotis*), listed as Vulnerable under the BC Act
- 19.99 ha of habitat and one nest tree for White-bellied Sea-Eagle (*Haliaeetus leucogaster*), listed as Vulnerable under the BC Act
- 14.49 ha of habitat for Albert's Lyrebird (*Menura alberti*), listed as Vulnerable under the BC Act
- 32.16 ha of habitat for Pouched Frog (*Assa darlingtoni*), listed as Vulnerable under the BC Act and the EPBC Act
- 6.09 ha of habitat for Giant Barred Frog (*Mixophyes iteratus*), listed as Vulnerable under the BC Act and EPBC Act
- 0.16 ha of habitat for Loveridge's Frog (*Philoria loveridgei*), listed as Endangered under the BC Act
- 136.92 ha of habitat for the Southern Myotis (*Myotis macropus*), listed as Vulnerable under the BC Act
- 160.87 ha of habitat for Koala (*Phascolarctos cinereus*), listed as Endangered under the BC Act and EPBC Act
- 0.10 ha of habitat for Southern Pink Underwing Moth (*Phyllodes imperialis smithersi*), listed as Endangered under the BC Act and EPBC Act
- 2.20 ha of habitat for Mitchell's Rainforest Snail (*Thersites mitchellae*), listed as Endangered under the BC Act and Critically Endangered under the EPBC Act
- 52.65 ha of habitat for Masked Owl (*Tyto novaehollandiae*), listed as Vulnerable under the BC Act
- 52.65 ha of habitat for Sooty Owl (*Tyto tenebricosa*), listed as Vulnerable under the BC Act
- 46 hollow bearing trees.

ii Indirect impacts

Section 8.2 of BAM (DPIE, 2020) requires the assessment of indirect impacts on native vegetation, threatened ecological communities and threatened species habitats.

The indirect impacts of biodiversity values that could occur as a result of the Proposal include:

- edge effects
- introduction and spread of weed species, resulting in degradation of retained native vegetation and habitat
- introduction and spread of fire ants
- temporary increase in noise, dust, vibration and artificial lighting levels associated with construction
- temporary inundation of retained native vegetation and habitats during extreme flood events

- temporary erosion and sedimentation impacts to the Dam and downstream receivers associated with construction
- minor increase in groundwater recharge in southern areas of the Dam.

More details on these potential indirect effects are provided below.

a Edge effects

Edge effects are zones of changed environmental conditions that occur along the edges of habitat fragments. These new environmental conditions along the edges can promote the growth of different plant species (including weeds), supress the growth of some native plant species, promote invasion of or change the behaviour by some native and introduced animals that specialise in such modified environments (Moenting & Morris, 2006). For instance, edge zones can be subject to higher levels of predation by introduced mammal and native bird predators, which changes the composition of the fauna community.

With regard to the potential edge effects associated with the Proposal, areas adjacent to the subject land were inspected during vegetation mapping, BAM plots and fauna surveys to determine the characteristics of vegetation and habitat present and their susceptibility to potential edge effects.

Most of the subject land has historically been logged throughout, so that logging tracks and cleared areas are still visible though often with substantial regrowth. However, apart from these cleared areas, the edge effect from this historical forestry is minimal. Apart from the removal of large trees by past forestry, most vegetation is intact and has little weed invasion.

Areas adjacent to the existing Dam, however, appear to be subject to a significant but highly stable 'edge' along the periphery of the Dam. This edge is typically narrow, to the point that a BAM plot would be too wide to fit in this area. Here, these edge effects appear to have led to a denser vegetation growth around the Dam edge than areas upslope, which also includes a high abundance of threatened species in these areas adjacent to the existing Dam. As such greater growth of vegetation adjacent to the Dam appears to have resulted predominately from a higher light exposure, and potentially availability to water in proximity to the root zone of the plants directly adjacent to the dam. Hence, it is possible that the Dam edge facilitates a higher abundance of vegetation growth than that which would occur in large patches of intact forest.

It is not expected that the Proposal will significantly change the spatial extent of the edge effects adjacent to the Dam, since the water level would simply move upslope. Hence, the edge environment associated with the Dam edge would also be expected to move upslope once water levels stabilise following raising of the Dam wall and subsequent filling of the Dam.

Apart from edge effects associated with dam water, there are areas of the construction footprint to the north of the Dam wall that have existing edge effects resulting from past construction activities associated with construction of the existing Dam. This is also true of the ancillary infrastructure that is proposed to support the Proposal. Whilst the construction areas and areas proposed for ancillary infrastructure have been located to largely occur within previously disturbed areas, including the quarry used for construction of the existing Dam, as well as areas of cleared pasture, the edge effects resulting from construction will likely increase the edge effects in these locations given the large size of the construction areas and their encroachment on relatively undisturbed areas of vegetation.

Within the southern half of the subject land, vegetation is patchy due to pastural land and other cleared areas. Vegetation associated with these areas is currently exposed to significant edge effects associated with agriculture including elevated areas of weed invasion. Transmission lines and road updates associated with the Proposal have the potential to increase edge effects further in the southern half of the subject land, however these impacts are anticipated to be minor given the highly fragmented and disturbed existing landscape.

b Weed introduction and spread

If inappropriately managed during the construction of the Proposal, vegetation may be exposed to weed dispersal via earthworks, soil movement and seed and propagule attachment to vehicles and machinery. As the subject land and surrounding vegetation contains high threat weeds and other exotic species, construction may spread or increase colonisation of weeds, particularly toward the edges of retained vegetation. Specifically, uncontrolled movement of vehicles, equipment, and personnel are all potential vectors in weed dispersal, particularly where unclean vehicles and equipment that have previously operated in areas well away from the subject land are used in construction. Moreover, many weed species thrive on ground disturbance and will rapidly colonise in areas disturbed by construction before native species can recolonise.

Where weeds are present along the edge of the existing Dam, in particular within sheltered areas such as gullies, there is the potential for these infestations to migrate upslope when the new footprint associated with the proposed FSL becomes inundated. In order to minimise the potential for these infestations to migrate upslope, the existing occurrences of weeds within the subject land should be controlled and/or removed prior to inundation.

Weed impacts will be mitigated during the construction and operational phases of the Proposal and will include measures such as weed removal, containment and disposal protocols (refer to Section 7.3).

c Introduction and spread of fire ants

The Proposal is located within the NSW Protection Zone for fire ants in accordance with the Biosecurity (Fire Ant) Emergency Order (No 8) 2024 made under the Biosecurity Act, and the transport of fire ant carriers into the NSW Protection Zone, inclusive of the subject land, has the potential to indirectly impact the surrounding environment through the introduction of fire ant infestations. The movement of vehicles, equipment, quarrying materials and organic materials such as vegetation and soil originating from a Fire Ant Infested Area has the potential to transport fire ants and facilitate the introduction and spread of fire ants within the subject land and the locality of the Proposal.

Mitigation and management measures (refer to Section 7.3) will be implemented throughout the construction of the Proposal, including restrictions on movements of vehicles, equipment and materials from and through fire ant infested areas, and wash down of vehicles.

d Disturbance of native flora and fauna in adjacent habitat

There may be temporary impacts from noise, vibration, dust and artificial lighting during construction of the Proposal. The impacts of noise, vibration, dust and artificial lighting are predicted to potentially impact areas adjacent to the Dam wall and quarry construction footprint of the Proposal. The areas surrounding the operational footprint of the Proposal, that are not in the vicinity of the construction footprint are not likely to be substantially affected by these indirect impacts as these areas will predominantly be subjected to inundation only, with only discrete areas of vegetation proposed to be removed through clearing works. Temporary disturbance to fauna in adjacent habitat may occur during clearing within the operational footprint.

Noise may adversely affect fauna by interfering with communication (for example, territorial bird song), masking the sound of predators and prey, causing avoidance reactions and displacement from habitat. Noise and vibration will be generated during the construction of the Proposal by plant, equipment and vehicles, and blasting associated with the adjacent quarry.

Increased dust from vegetation clearing, vehicle movements and quarry activities during construction has the potential to temporarily and locally impact flora and fauna values in the vicinity of the subject land. If inappropriately managed, excess generation of dust and subsequent deposition on leaves can impair plant photosynthesis and productivity (also resulting in reduced habitat quality for fauna) and impact on respiratory systems of fauna.

Whilst the quarry will not work into the night, selected construction works, such as concrete pouring, may be required to occur during the night due to engineering restrictions. Lighting required for construction work undertaken at night has the potential to spill into adjacent habitat and cause disturbance to fauna species during the construction of the Proposal.

During the construction of the Proposal, noise, vibration, dust and artificial lighting may lead some animals that are sensitive to disturbance to temporarily cease using habitat adjacent to the subject land or impair their normal activities. However, the short term nature of these construction related impacts is not expected to cause a significant impact on any species. Usage of these habitats is likely to return to the current levels following the completion of all construction works.

Additionally, the impacts of dust on surrounding vegetation are not predicted to be significant given that dust levels will be monitored and managed as required during operation of the quarry. That is, dust suppression will be implemented according to a management strategy that includes wetting down unsealed roads, dust sprays on the processing plant and reducing vehicle speeds.

e Erosion and sedimentation

If inappropriately managed, construction of the Proposal may lead to erosion and sedimentation that may affect water quality in the Dam and downstream receiving habitats. During construction, sediment may be mobilised and transported by surface water during rainfall events and discharge into the Dam, surrounding watercourses and drainage lines. If sediments are mobilised, this may reduce water quality in the Dam and downstream aquatic habitats in the Tweed River. That is, increased suspended sediments in waterways typically reduce light penetration into the water column, which can decrease dissolved oxygen levels through inhibiting photosynthesis of aquatic macrophytes and microalgae. Moreover, oxygen levels in the water column can be further reduced in the event of over nutrification of a waterway, whereby algae blooms and the following decay of this algae consumes oxygen.

Erosion and sediment control measures will be implemented during the construction of the Proposal. Strict controls will be put in place to ensure sediment does not runoff into the Dam, downstream extents of Doon Doon Creek, nor surrounding watercourses (refer to Section 7.3).

f Increase in groundwater recharge

Potential rises in groundwater levels are not expected to migrate beyond the FSL inundation area as the potentially highly transmissive alluvium is very localised and minor in extent, and the fractured and porous rock units have relatively low permeability (EMM, 2024). This statement is supported by observation of vegetation characteristics around the periphery of the existing Dam where species composition doesn't change significantly from directly adjacent to the Dam to tens of meters upslope. If groundwater recharge was a significant factor driving the vegetation type or condition in areas adjacent to the existing Dam, we would expect that species preferring more water would occur around the edge of the existing Dam. It is noted that vegetation is slightly denser within approximately 10-20 m of the Dam however this denser vegetation is likely result from higher light availability, but also may be due to a higher availability of other resources including living space and nutrient availability. Nevertheless, a greater density of vegetation adjacent to the Dam suggests proximity to the Dam does not appear to be detrimentally impacted by the Dam, including any potential changes to groundwater associated with the existing Dam. Hence, we can anticipate that a similar situation will result from the new FSL, given the water level (and apparent influence on groundwater) will simply shift the influence of the Dam on vegetation communities upslope.

g Indirect impacts to Mount Jerusalem National Park

Areas of the Mount Jerusalem National Park that have an interface with the subject land may experience some indirect impacts due to temporary inundation by flooding. However, no other indirect impacts as discussed in the 'Developments adjacent to National Parks and Wildlife Service lands' guideline (DPIE, 2020) are predicted for the Mount Jerusalem National Park as a result of the Proposal.

Areas of the Mount Jerusalem National Park that are located between the proposed FSL and the new PMF of the Dam may experience infrequent, temporary inundation for short periods during operation, during and following extreme rainfall events that may flood the Dam. These extreme flooding events are predicted to be highly infrequent, with the Dam levels remaining relatively stable most of the time, with the proposed Dam expected to be at FSL approximately 70% of the time (EMM Consulting, 2024). During such extreme flooding events, habitat between the FSL and PMF may become temporarily unsuitable for some threatened fauna species. As these flooding events are temporary in nature, the fauna species are likely to be able to return to these areas between flood events. Additionally, flora species adapted to riparian and floodplain environments, and so would typically grow adjacent to the Dam, are typically tolerant to temporary inundation (Howell & Benson, 2000). The impact of such inundation on the Mount Jerusalem National Park is therefore expected to be minor and temporary, as is currently true of the vegetation surrounding the existing Dam that remains relatively undisturbed from infrequent and short-term flooding. For further discussion of flooding impact refer to Section 7.2.2.

The Dam has the potential to enhance groundwater recharge however, based on current observations of vegetation adjacent to the existing Dam and the groundwater studies the impact of ground water recharge is likely to be negligible (see Section 7.1.3iif and the Groundwater Impact Assessment (EMM, 2024) and it is not expected that any changes in groundwater associated with raising the Dam wall would adversely affect any GDEs within the Mount Jerusalem National Park. That is, any increase in soil moisture resulting from modification of groundwater associated with raising the Dam wall should be tolerated by the wet sclerophyll and rainforest vegetation that is located adjacent to the Dam within the National Park.

Raising of the Dam wall should not threaten ecological connectivity of any flora and fauna (see Section 3.3).

Indirect impacts of weed introduction and spread, dust and artificial lighting from the construction of the Proposal are unlikely to affect the Mount Jerusalem National Park since the construction footprint of the Proposal is approximately 1.2 km from the nearest extent of Mount Jerusalem National Park, and approximately 1.5 km from the areas of Mount Jerusalem National Park revoked land. Erosion, sedimentation and stormwater runoff and wastewater associated with construction are also not expected to impact Mount Jerusalem National Park since the Dam and the subject land are downstream of the Mount Jerusalem National Park, and wastewater will be transported offsite. Moreover, access to the Dam will not be required through the National Park for construction or operation of the Proposal.

7.2 Prescribed impacts

An assessment of prescribed impacts is provided in Table 7.2.

Table 7.2 Prescribed impact assessment

Feature	Present	Description and location	Potential impact	Threatened species or community using or dependent on feature	Section of report where prescribed impact is addressed
Karst, caves, crevices, cliffs, rocks or other geological features of significance	☐ Yes / ☒ No	N/A	The subject land does not contain geologically significant features or rocky areas that represent habitat for threatened species or ecological communities.	N/A	N/A
Human-made structures	☒ Yes / ☐ No	Existing Dam infrastructure and associated ancillary infrastructure at the northern and southern ends of the Dam would be either upgraded or decommissioned.	The decommissioning or upgrading of existing human-made structures may result in the destruction or disturbance of habitat for fauna species that utilise artificial structures.	The existing structures within the subject land do not provide habitat for any threatened fauna. The existing Dam wall and associated infrastructure does not provide suitable habitat for roosting of threatened bat species given the lack of suitable void spaces.	N/A
Non-native vegetation	☒ Yes / ☐ No	Two vegetation zones 827_grassland (64.06 ha) and 827_derived_sedgeland (4.58 ha) were assigned a PCT to assess vegetation condition, despite being predominately exotic. These areas have been assessed throughout this report and found to have no habitat value for threatened flora or fauna. Native plantations within the subject land (13 ha), have been assessed under the streamlined assessment module (Section 0) with potential habitat for threatened species considered in Section 5.2.1. The native plantations are not likely to provide important habitat for any threatened flora or fauna species. A small patch of exotic trees occurs in the south of the subject land (0.24 ha) which is limited to two rows of planted exotic trees either side of a driveway. There is no midstorey present and groundcover is dominated by exotic grasses. The trees are not hollow bearing so has limited habitat value to any threatened species.	No impact is identified. The non-native vegetation has not been identified as habitat for any threatened species.	N/A	N/A

Feature	Present	Description and location	Potential impact	Threatened species or community using or dependent on feature	Section of report where prescribed impact is addressed
Habitat connectivity	☒ Yes / ☐ No	The subject land is highly connected to surrounding vegetation, with the region consisting of large areas of intact and mostly contiguous vegetation interspersed with farmland and cleared pastures. Local wildlife corridors run north-south along the western edge of the Dam, and northwest-southeast	Despite increases to the existing size of the Dam and the addition of the construction area, connectivity will be retained around the periphery of the Dam with a significant width of intact vegetation remaining. Access to the subject land will use existing roads, therefore not adversely impacting connectivity. In the south of subject land, the Proposal includes the construction of transmission lines, the raising of McCabes Bridge and realignment of Commissioners Creek Road. These Proposal elements will be constructed in predominantly cleared areas, with any remnant vegetation highly fragmented, as such the Proposal is not anticipated to alter habitat connectivity	No impact identified.	N/A
Waterbodies, water quality and hydrological processes	☒ Yes / ☐ No	Clarrie Hall Dam, Doon Doon Creek, Commissioners Creek, Pine Log Creek, and 92 unnamed watercourses. Areas of the Dam above full supply level for potential flood impacts.	Disturbance and alteration to flow regimes and water quality within these waterbodies. Potential increase of water table/groundwater. Alteration to hydrology downstream of the Dam wall. Changes to the flood regime upstream. Potential flooding.	• All threatened flora and fauna recorded. • Native vegetation. • Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC.	Refer to Section 7.2.2,Water bodies, water quality and hydrological processes
Wind farm development	☐ Yes / ☒ No	N/A	No wind farm is proposed as part of the Proposal.	N/A	N/A

Feature	Present	Description and location	Potential impact	Threatened species or community using or dependent on feature	Section of report where prescribed impact is addressed
Vehicle strikes on threatened fauna or animals that are part of a TEC	☐ Yes / ☒ No	During construction of the Proposal, there will be an increase in vehicle movement on existing internal access roads throughout the subject land.	An increase in traffic during Proposal construction will increase the risk of vehicular strikes on native fauna.	All threatened fauna species are susceptible to vehicle strike and may be impacted by the increase in traffic during construction.	Section 7.2.1 – Impacts on threatened species or fauna that are part of a TEC from vehicle strikes.

7.2.1 Impacts on threatened species or fauna that are part of a TEC from vehicle strikes.

There is the potential for an increased incidence of vehicle strikes upon fauna during the construction phase of the Proposal due to increased traffic volumes. Once construction is completed, the risk posed by vehicle strike to threatened fauna will return to current levels. Hence, the potential risk posed during operation is not beyond that at present.

Increased traffic expected during construction may result in increased mortality of native animals and will be minimised by the construction traffic driving rules in high-risk sections of road including speed limits (refer to Section 7.3. Construction vehicle movements will predominantly occur during daylight hours where fauna movements are typically lower, consequently reducing the risk of strike.

7.2.2 Waterbodies, water quality and hydrological processes

i Potential impact during construction and raising of the Dam to full supply level

During early stages of construction there will be no change to the existing spillway, and the flow regime will be unchanged. Construction of the new spillway will occur prior to decommissioning of the existing spillway. Following construction of the new spillway, the dam wall will be raised and the intake tower will be raised. During the dam wall raising the FSL will remain at the level of the existing spillway crest. The flow regime of water released over the existing spillway will remain unchanged during this stage. Once the Dam Wall is completed the existing spillway will be plugged and the new reservoir volume will begin to fill. Spillway discharges will cease until the reservoir reaches the new FSL. During this period, minimum flow releases will be maintained via the valve house The surface water assessment anticipates that it will take less than 1 year for the reservoir to fill to the new FSL and for the existing flow regime to be reinstated. Threatened flora submerged during the dam filling will be assumed to be a direct loss. It is anticipated that filling of the Dam will occur so slowly that all fauna species will be able to move upslope, avoiding loss of individuals.

ii Potential flood impacts above full supply level

a Flood modelling

Flood modelling has been completed for the Proposal as part of the EIS (Appendix F) with flooding expressed as being above the FSL of 70 m AHD. For the purposes of impact assessment, we will not use PMF as this defines the maximum extent of flood prone land. It is difficult to define a meaningful Annual Exceedance Probability (AEP) for the PMF, but it is commonly assumed to be of the order of 104 to 107 (once in 10,000 to 10,000,000 years). An event of this improbable magnitude is highly unlikely to eventual over the lifetime of the project and therefore it does not represent a realist flooding event.

In this assessment we instead refer to 0.2% AEP or once in 500 year event. The modelled flood extent for this is provide in Figure 7.1 and can be described as follows:

- an area of 166.55 ha (any areas overlapping with construction areas or ancillary impact areas of the subject site were removed)
- the maximum water level of approximately 73.8 m at 24 hours (3 m above FSL)
- a reduction to 2 m above FSL after 32 hours
- a reduction to 1 m above FSL after 32 hours.

b Assessment of flooding impacts

The current situation at the dam, is a predominantly full and overflowing reservoir, drawn down in drought. The average measured storage volume over the period 2008–2023 is around 16,000 ML, approximately 100% of the full design capacity. The effect of this consistent water level is evident during the terrestrial assessment with a well-defined and abrupt transition between aquatic habitat (i.e. the Dam waterbody) and terrestrial habitats. There are currently no observable impacts of flooding within the Dam despite this assessment occurring within and after several years of high rainfall during La Nina climatic oscillations. Threatened flora species were recorded in high abundances around the periphery of the Dam with particularly high concentrations of the Critically Endangered Native Guava and Scrub Turpentine. There is no evidence to suggest that flooding currently has any detrimental impact to threatened flora species. This is also the case for vegetation communities with an abrupt transition between wholly aquatic vegetation in the Dam and bankside terrestrial vegetation. The exception to this is within the southern areas of the Dam where the transition is more gradual owing to flatter topography rather than a periodic flood impacts.

Based upon the current lack of any observable flood impacts at the current FSL, it is anticipated that same scenario will occur once the dam raising is complete; plant communities, fauna habitats and threatened flora already established above FSL will remain intact with no discernible flooding impacts. This is likely due to any flooding being an occasional occurrence with relatively short inundation periods, evidenced by the flooding.

The majority of threatened fauna within the site are highly mobile and therefore any raising of the Dam water levels above FSL are consider temporary impacts with no mortality anticipated. In most case fauna will simply be able to move upslope away from the flood waters, given the relatively steep gradient and good connectivity of habitat. Given the large size of the dam relative to the catchment size and inflowing watercourse any flooding above FSL will happened slowly, allowing sufficient time for fauna to seek refuge upslope.

Fauna most vulnerable to flooding impact are anticipated to be the least mobile species and those preferring lower lying habitat adjacent to watercourses. The Critically Endangered Mitchell's Rainforest Snail is a riparian floodplain species recorded within very restricted habitat within the subject site, limited to alluvium adjacent to watercourses with sufficient shelter in the form of woody debris and leaf litter. Given the low lying nature of the preferred habitat and the slow movement of the species, the snail has the potential to be impacted by flooding. However, it's very persistence and preference for these habitats, indicate the ability to maintain their populations in flood prone areas. It anticipated that the snail seeks refugia during periods of heavy rainfall, moving upslope and also climbing trees to escape flood events (Parkyn 2014). Flooding of the dam above FSL will occur relatively slowly with low water velocity given the size of the dam water body. In contrast, the habitat in which Mitchell's Rainforest Snail was recorded (the alluvium along smaller watercourses) is likely to be subjected to relatively regular flooding with high velocity water directly related to heavy rain in the local and discrete catchment. The impact of these rainfall event of watercourse flooding is likely to be substantially in higher in magnitude and frequency than any flooding above the FSL.

iii Potential impacts downstream impacts of the Dam wall

Downstream of the Dam Wall, Doon Doon Creek is a regulated watercourse illustrating, perennial flow supported by dam releases with minimum flows of 4 ML/day supported by dam releases. Doon Doon Creek is incised into the landscape comprising sequences of pools and riffles. In addition to the water regulation, the watercourse is also impacted by historic clearance of vegetation, impacts from agriculture weed invasion and adjacent road building and earthworks. Immediately downstream of the Dam, up to around 200 m beyond the spillway, riparian vegetation has been highly modified as a result of disturbance associated with the construction and operation of the existing Dam.

The vegetation immediately adjacent to Doon Creek and impacted by high flow events include River Oak (*Casuarina cunninghamiana*) and to a lesser extent Water Gum (*Tristaniopsis laurina*). Exotic species are prevalent with Coral Tree (Cockspur Coral Tree (*Erythrina crista-galli*), Wild Tobacco Bush (*Solanum mauritianum*) and Camphor Laurel among the most notable. Herbaceous exotic species are also prevalent as groundcover. Areas of higher ground with less disturbance from floods, including alluvial terraces and slopes include both lowland rainforest and wet sclerophyll forest albeit with weed invasion.

a Modelled changes to downstream flows

Doon Doon Creek is not currently gauged, however estimates of streamflow as described in the proposals Surface water Assessment (EMM 2024) illustrate perennial flow supported by dam releases with minimum flows of 4 ML/day supported by dam releases occurring 50% of the time during summer and spring.

The long term flow modelling using palaeostochastic climate data detailed in the Surface Water Report (EMM 2024) suggest the following changes resulting from the proposal:

- mean managed releases from Clarrie Hall Dam would not materially change as a result of the Proposal
- high flows will be attenuated in the larger dam, resulting in:
    - a small reduction in flood peaks within Doon Doon Creek
    - frequency of spillway discharges of flows exceeding 100 ML/day is expected to increase
    - a small increase in duration of flood recession
- the frequency of minimum releases (4 ML/day) required to be released manually from the dam will increase from approximately 30% of the time to 40% of the time due to increased evaporation from the dam surface
- within 5 km downstream at Uki, most of the changes observable in Doon Doon Creek are negligible due to the contribution of the unregulated upstream reaches of the Tweed River runoff from additional catchment area and unaffected tributaries.

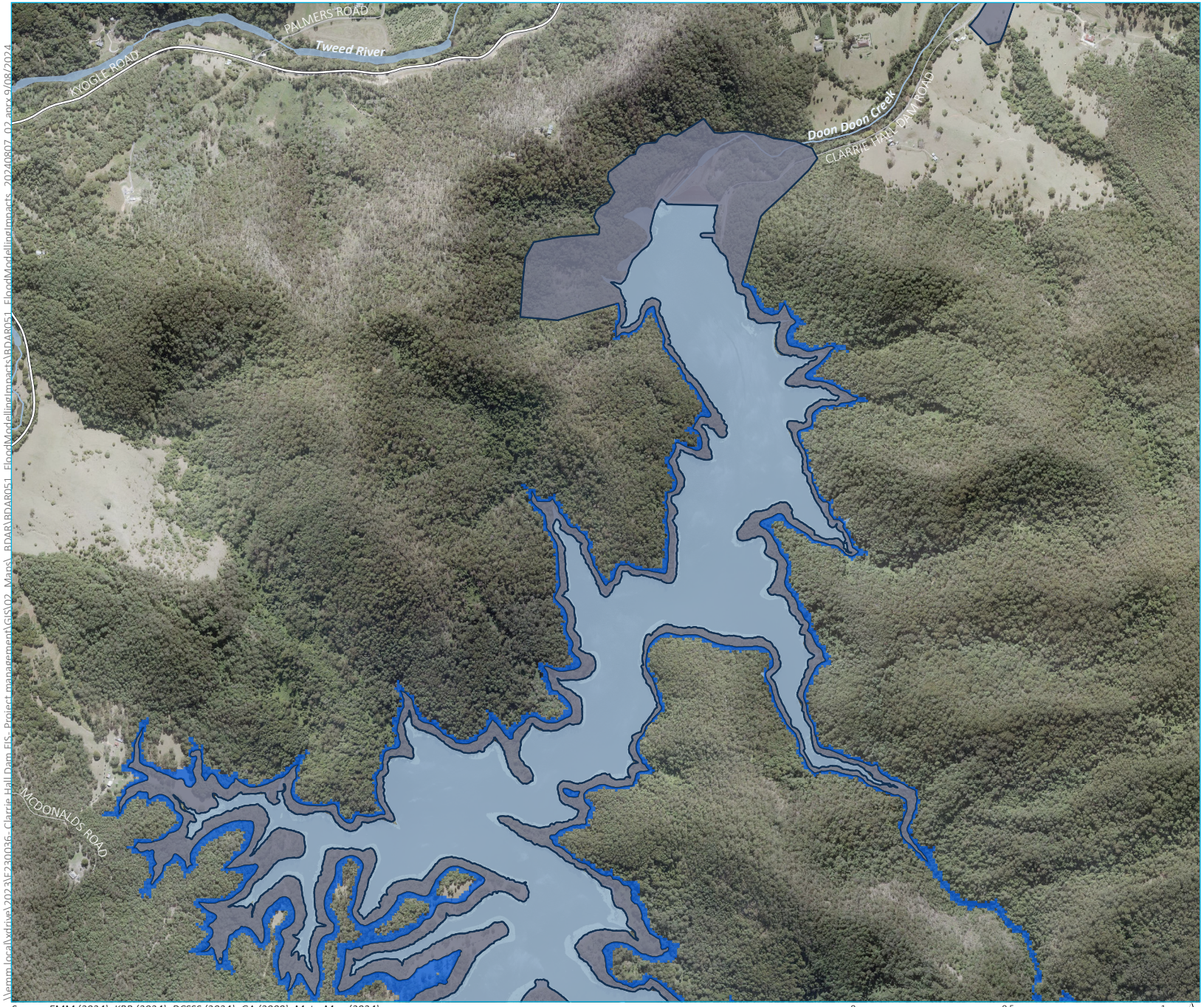
As a result of changes to flow regime there would be a decrease in sediment supply in Doon Doon Creek downstream from the dam following wall raising, promoting erosion of fine particles downstream. Diametrically, the decrease in peak discharges may promote sedimentation and a reduction in erosion. Taken together, these effects mean that the nature of any geomorphological change is difficult to predict, the extent to which one change neutralises the other remains unknown. The magnitude of each geomorphological effect is relatively small and as such, any change which does occur is expected to occur as slow adjustments over an extended period of time (Surface Water Report, EMM 2024).

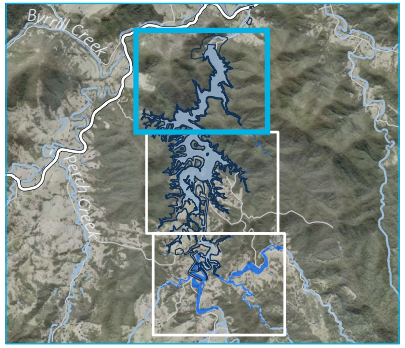
b Terrestrial biodiversity impacts

The reduction in the maximum peak flow during flood events as a result of the proposal, may promote a watercourse which is slightly less disturbed by extreme events, permitting persistence of some trees and other vegetation during extreme events, which would otherwise be removed by the water velocity. This extent to which this occurs is difficult to predict given the increased flood attenuation. Irrespective, the change is not anticipated to be of a significant magnitude to result in change of vegetation community and will relate only to the vegetation within the watercourse itself and immediately adjacent bankside vegetation.

The Proposal will result in fewer days where the spillway of the Dam overflows, despite this, flow will still be maintained by valve dam releases. The maintenance of surface flows will ensure that bankside vegetation reliant or facultatively using surface water will be largely unaffected by the proposal. Indeed it is likely that there is a net benefit for terrestrial biodiversity downstream of the Dam during drought periods where the raised Dam will be able to maintain greater water volumes to Doon Doon Creek for longer periods, the main intent of the Dam raising Project.

Given that the creek downstream of the Dam is already highly regulated, the anticipated changes to the hydrology are as a result of the project are considered comparatively minor and unlikely to have a detrimental impact to terrestrial biodiversity.





KEY

- Subject land
- Modelled flood extent 1:500

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Modelled flood extent above full supply level during 1:500 year flood
Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 7.1

EMM creating opportunities

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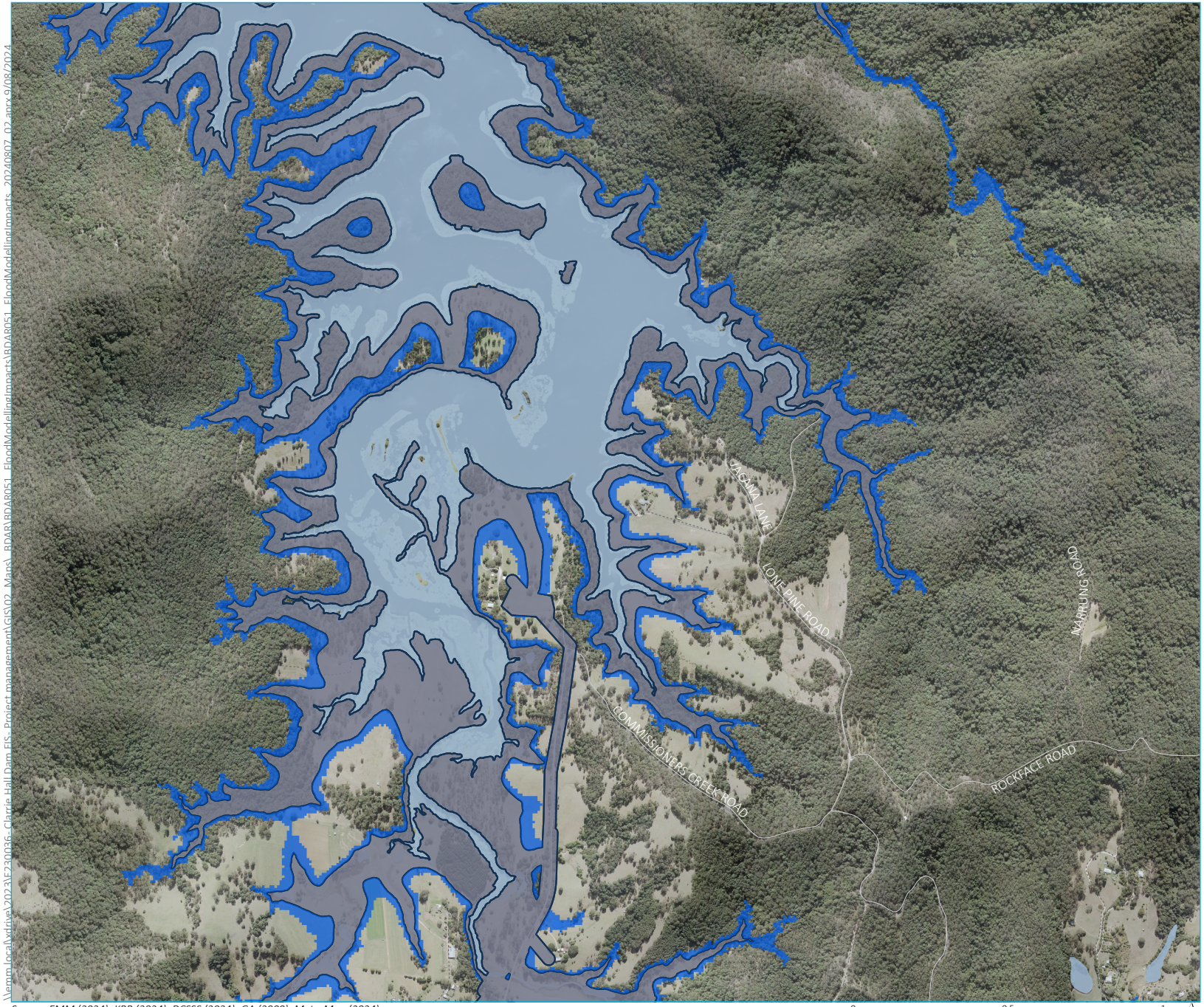

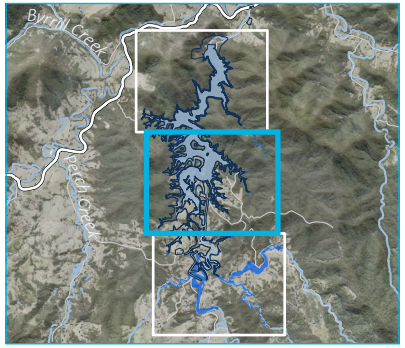

KEY

- Subject land
- Modelled flood extent 1:500

Existing environment

- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Modelled flood extent above full supply level during 1:500 year flood

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 7.1

EMM creating opportunities

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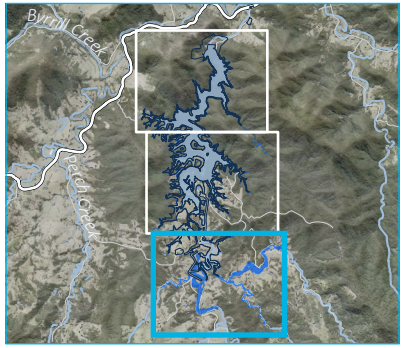

KEY

- Subject land
- Modelled flood extent 1:500

Existing environment

- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); GA (2009); MetroMap (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Modelled flood extent above full supply level during 1:500 year flood

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 7.1

EMM creating opportunities

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7.3 Mitigation and management

Measures proposed to mitigate and manage indirect, prescribed and uncertain impacts of the Proposal are outlined in Table 7.3.

Table 7.3 Mitigation and management measures

Impact	Mitigation method	Timing	Responsibility	Intended outcome
General[1]	A Site Plan will be included in a Construction Environmental Management Plan (CEMP) and/or an Operational Environmental Management Plan (OEMP) and will include (but is not limited to): • the extent of approved clearing and disturbance • any relevant sensitive areas • locations of approved stockpile and material laydown areas and site compounds. This Site Plan is to be placed in an accessible location to be viewed by all site personnel. Construction crew are to undertake an induction prior to commencement of work to inform them of sensitive biodiversity areas, including threatened species habitat and ecological communities. They are to be informed of the areas bound to work in, delineated no go areas and what to do in the case of an unexpected threatened species find.	Preconstruction	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat.
Fire[1]	Fire extinguishers accessible on site. Limits to some works undertaken during hot, dry and windy conditions, to reduce the risk of fire.	Construction Operation	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat.
Impacts to waterways, hydrological processes and native fauna utilising the habitat [1]	A Water Management Plan (WMP) will be established in consultation with DPE Water, the Environment Protection Authority (EPA) and Tweed Shire Council, and will include (but is not limited to): • a surface water monitoring program • spill management and response • water quality trigger levels • corrective actions and contingencies • reporting requirements. Responsibilities for all management actions will be detailed within the WMP.	Preconstruction Construction Operation	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat. Protection of the aquatic species and habitat within the Dam and downstream receivers.

Impact	Mitigation method	Timing	Responsibility	Intended outcome
Biosecurity and impacts to adjacent vegetation[1]	A Biodiversity Management Plan (BMP) will be implemented for retained vegetation and habitat adjacent to the subject land that includes (but is not limited to): • biosecurity protocols to control and manage weeds that may be exacerbated, spread or otherwise affected by the construction and operation of the Proposal • protocols to monitor the vegetation condition and habitat values of retained vegetation • provisions for corrective actions should a decline in vegetation or habitat condition be detected. The BMP will also include protocols to remove weeds within the subject land prior to inundation.	Preconstruction Construction Operation	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat.
Introduction and spread of fire ants[1]	As part of the BMP, biosecurity measures will be implemented in accordance with the Biosecurity (Fire Ant) Emergency Order (No 8) 2024 made under the Biosecurity Act to minimise the potential for introduction of fire ant infestations. These measures will include (but will not be limited to): • restrictions to the movement of vehicles, equipment and materials originating from Fire Ant Infested Areas or travelling through Fire Ant Movement Control Areas • washdown of vehicles prior to entering the subject land.	Pre-construction Construction	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat. Protection of the broader Tweed region.
Vehicle strike on fauna	A Construction Traffic Management Plan (CTMP) will be implemented to minimise the potential for animal strike during the construction phase, and will include (but is not limited to): • the location and design of approved roadways • speed limits • education to staff during induction about abiding by above driving rules to reduce fauna strike, including periods when vehicle strikes are more likely based on animal behaviour (e.g. sunrise and sunset).	Construction Operation	Contractor	Mitigate the risk of a prescribed impact (vehicle strike) on fauna species, inclusive of threatened species, during the construction of the Proposal.

Impact	Mitigation method	Timing	Responsibility	Intended outcome
Impacts to biodiversity, waterbodies and hydrological processes[1]	Sediment and erosion controls will be established as part of the CEMP, OEMP and/or WMP. These controls will include (but are not limited to): • installation of sediment fencing and traps in areas in which construction will be conducted in proximity to waterways or low-lying vegetation.	Preconstruction Construction	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat. Protection of the aquatic species and habitat within the Dam and downstream receivers.
Impacts to adjacent vegetation[1]	Dust suppression will be established as part of the CEMP or OEMP and will be implemented as required. Dust suppression methods may include (but are not limited to): • wetting down of unsealed roads and stockpiles • reducing vehicle speeds in adverse climatic conditions • use of dust sprays on crushing or screening plant at the quarry site.	Preconstruction Construction	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat.
Pathogen and disease introduction	Hygiene measures should be implemented as part of the CEMP to minimise the risk of pathogen and diseases spread on site (including Chytrid fungus), and should include procedures for equipment, footwear, and clothing. Ensure works vehicles are washed down prior to entering the works area.	Pre-construction Construction	Contractor	Minimise indirect impacts on adjacent riparian vegetation, downstream receivers and any native amphibians occurring in these habitats.
Fauna injury and removal of hollow bearing trees	Implementation of pre-clearing protocols to be conducted by a suitable qualified ecologist, including (but not limited to): • inspection of hollows, buildings and other artificial structures for fauna occupancy (to be conducted immediately prior to clearance activities) • removal of fauna individuals if found • relocation of fauna to suitable habitat in adjacent and similar vegetation outside of the subject land.	Preconstruction	Contractor Qualified ecologist	General protection measure for clearing of vegetation and habitat, inclusive of threatened species/ MNES habitat and plantations. Minimise injury/death of native fauna species, inclusive of threatened species.

Impact	Mitigation method	Timing	Responsibility	Intended outcome
Fauna injury and removal of hollow bearing trees	Implementation of clearing protocols, including (including but not limited to): • the presence of a suitably qualified ecologist throughout all clearing works • clearing to be conducted sequentially, moving outward, towards areas of retained vegetation to facilitate fauna refuge and prevent the creation of vegetation fragmentation • hollow bearing trees that are felled to be inspected once on the ground and if injured fauna are found, the individual is to be removed and taken to a veterinarian or wildlife clinic. Hollow bearing trees that are felled to be placed in proximity to retained vegetation and positioned with the hollows facing upward to allow fauna to escape overnight • if temperatures exceed 35°C, clearing works will be reassessed by a suitably qualified ecologist to evaluate whether works should be postponed for animal welfare.	Preconstruction Construction	Contractor Qualified ecologist	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat.
Loss of threatened fauna habitat	Logs of removed trees are to be installed within retained, adjacent vegetation to provide fauna habitat where practical.	Construction	Contractor	General protection measure for adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat. Protection of the aquatic species and habitat within the Dam and downstream receivers.
Loss of threatened flora species	Collection and replanting of seeds from threatened flora species and/or translocation of the individuals of threatened flora species within the subject land will be undertaken in adjacent vegetation.	Preconstruction	Contractor Qualified ecologist	Restoration and rehabilitation measure to maintain the local populations of threatened flora species.
Loss of Mitchell's Rainforest Snail	Where possible, individuals of the species within the subject land will be translocated to similar, adjacent vegetation to maintain the local population. As per the expert report, collecting of Rainforest Snail individuals for translocation would require a concentrated effort conducted over several nights in and around wet weather. Collection may also be conducted diurnally to supplement the nocturnal effort, by targeting known microhabitats (Parkyn 2014). Translocation would be to similar habitat/microhabitat within the Tweed River drainage.	Preconstruction	Contractor Qualified ecologist	Restoration and rehabilitation measure to maintain the local populations of the threatened Mitchell's Rainforest Snail.

Impact	Mitigation method	Timing	Responsibility	Intended outcome
Impacts to adjacent vegetation	Rehabilitation of the construction laydown areas following the completion of construction works if the area is not required for operational purposes. This will include the removal of any materials brought onto the site such as gravel and building materials.	Post-construction	Contractor	Minimisation of long-term impacts to adjacent vegetation and habitat, inclusive of threatened species/ MNES habitat.

1. Indicates measures proposed to mitigate and manage potential indirect, prescribed and uncertain impacts of the Proposal on the Mount Jerusalem National Park

7.4 Serious and irreversible impacts

In accordance with Section 9.1 of the BAM (DPIE, 2020), additional assessment is required for ecological communities and threatened species that are at risk of a serious and irreversible impact (SAII). An impact is to be regarded as SAII if it is likely to contribute significantly to the risk of a threatened species (including endangered populations) or an ecological community becoming extinct in accordance with the following four principles outlined in Clause 6.7 of the NSW BC Regulation:

- Principle 1: The impact will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.
- Principle 2: The impact will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.
- Principle 3: The impact is made on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.
- Principle 4: The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable.

Candidate SAII entities with regards to the Proposal are listed in Table 7.4 along with the relevant principles for the listing of the SAII entity, based on information from the TBDC. No assessment of any other threatened entities at risk of an SAII has been requested by the decision-maker in the SEARs for the Proposal.

7.4.1 Threatened ecological communities

Section 9.1.1 of the BAM (DPIE, 2020) requires additional impact assessment for threatened ecological communities that are also listed as candidate entities for SAII.

PCT 1302 within the subject land aligns with two TECs:

- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion EEC (BC Act)
- Lowland Rainforest of Subtropical Australia CEEC (EPBC Act).

Neither TEC is included in the current list of entities at risk of SAII and therefore no SAII assessment has been conducted for these TECs.

7.4.2 Threatened species

Section 9.1.2 of BAM (DPIE, 2020) requires additional impact assessment for threatened species that are also listed as candidate entities for SAII.

Based on targeted surveys, 13 candidate entities for SAII were recorded within the subject land and are summarised in Table 7.4 below. Actions to avoid and minimise impacts to these species have been discussed in Section 7.1 with mitigation and management measures outlined in Section 7.3.

Table 7.4 Candidate SAII species for the Proposal

Scientific name	Common name	Principle			
		1	2	3	4
Chalinolobus dwyeri	Large-eared Pied Bat (breeding)	☐	☐	☐	☒
Corokia whiteana	Corokia	☐	☒	☐	☐
Drynaria rigidula	Basket Fern	☐	☒	☒	☐
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	☒	☐	☐	☐
Lepiderema pulchella	Fine-leaved Tuckeroo	☐	☒	☐	☐
Miniopterus australis	Little Bent-wing Bat (breeding)	☐	☐	☐	☒
Miniopterus orianae oceanensis	Large Bent-winged Bat (breeding)	☐	☐	☐	☒
Rhodamnia rubescens	Scrub Turpentine	☒	☐	☐	☒
Rhodomyrtus psidioides	Native Guava	☒	☐	☐	☒
Syzygium moorei	Durobby	☒	☐	☐	☐
Thersites mitchellae	Mitchell's Rainforest Snail	☒	☐	☒	☐
Tyto tenebricosa	Sooty Owl	☐	☐	☐	☒
Vespadelus troughtoni	Eastern Cave Bat (breeding)	☐	☐	☐	☒

Of the candidate SAII entities recorded on the subject land, the microchiropteran bat species consisting of Large-eared Pied Bat (*Chalinolobus dwyeri*), Little Bent-wing Bat (*Miniopterus australis*), Large Bent-wing (*Miniopterus orianae oceanensis*) and Eastern Cave Bat (*Vespadelus troughtoni*), are considered as candidates for SAII for impacts on breeding habitat only. These species can be broadly considered as cave roosting bats, and targeted searches within the subject land did not record any suitable maternity roosts. The old quarry, Dam wall and associated rock cuttings (refer to Photograph 5.16) and fill have a lack of cave-like structures or overhangs. No suitable fissures were found in the rock cuttings and the rock fill used on the downstream side of the Dam wall which comprises tightly packed small rocks without sufficient void spaces present.

Desktop surveys of potential habitat within 2 km of the subject land did not identify any potential breeding habitat for any for the cave roosting bats. Cliffs and extensive rock outcropping are present in the surrounding Wollombin, Nightcap and Mount Jerusalem National Parks, however, these features are located outside of the 2 km buffer.

As these species are only candidates for SAII for impacts to breeding habitat, no SAII assessments have been undertaken for the microchiropteran bat species due to the lack of breeding habitat within and surrounding the subject land.

An SAII assessment has been prepared for the remaining candidate SAII entities recorded on the subject land. These assessments are provided in the sections below.

i Corokia

Table 7.5 and Table 7.6 below provide an assessment of the Proposal on the species. Figure 7.2 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.5 Current status - Corokia

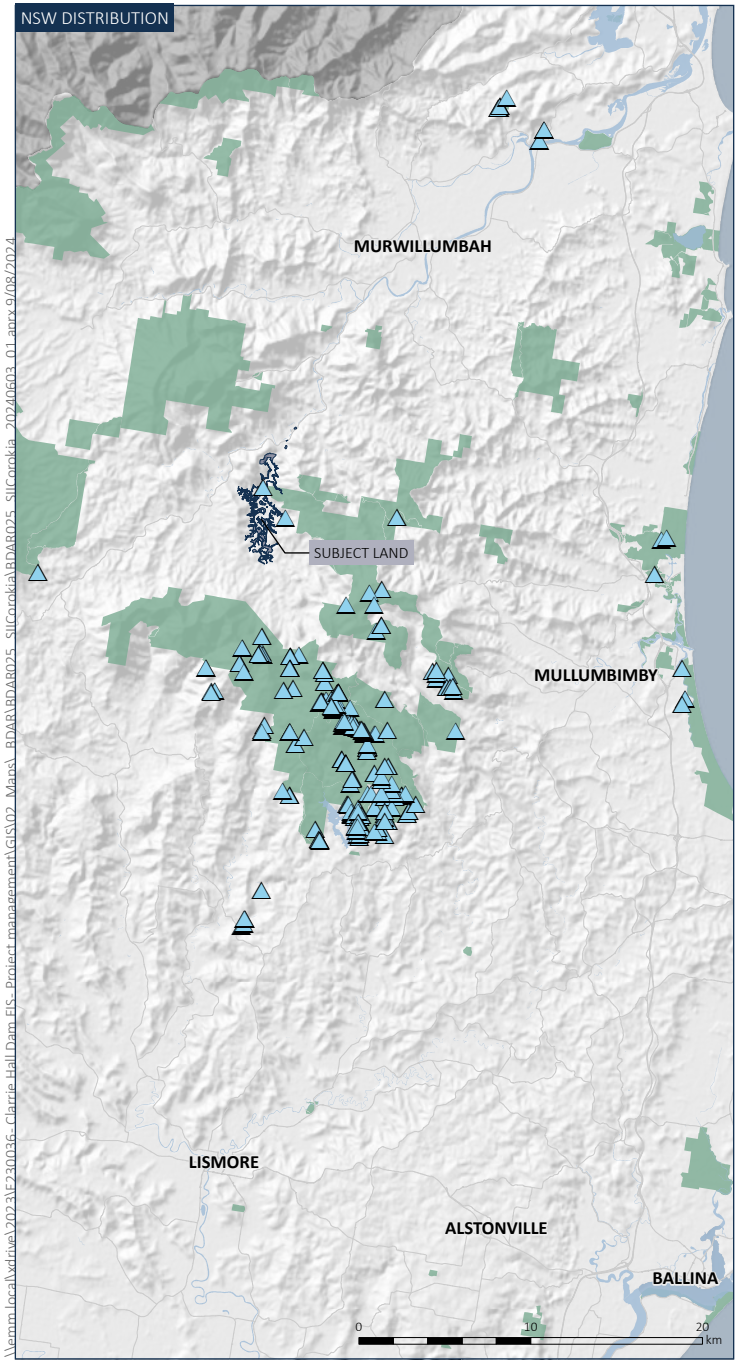
Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Not required as the species is not considered under Principle 1.	N/A	N/A
Evidence of small population size (Principle 2)			
Current population size in NSW	The current population size in NSW is estimated at less than 1,000 individuals from at least 6 subpopulations.	(NSW TSSC, 2023)	There is uncertainty as to the current population size. There is insufficient data to inform total population size.
Decline in species' population size in 3 years or one generation	It is expected that the species population size declined as a result of the 2019-2020 bushfires experienced in far north NSW. The bushfires overlapped with 8% of the species' modelled range, with 3% classed as high severity fire areas and 0.1% classed as very high severity fire areas.	(DCCEEW, 2022)	There is uncertainty as to the actual decline in the species population size.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	It is estimated that there is an average of eight mature individuals per subpopulation. The estimated percentage of mature individuals per subpopulation ranges from 0.6-20%.	(NSW TSSC, 2023) (DCCEEW, 2022)	There is uncertainty as to the current number of mature individuals in each subpopulation. There is no recent data on percentage of mature individuals in each subpopulation. The percentages provided have been calculated using data reported on in 1995.

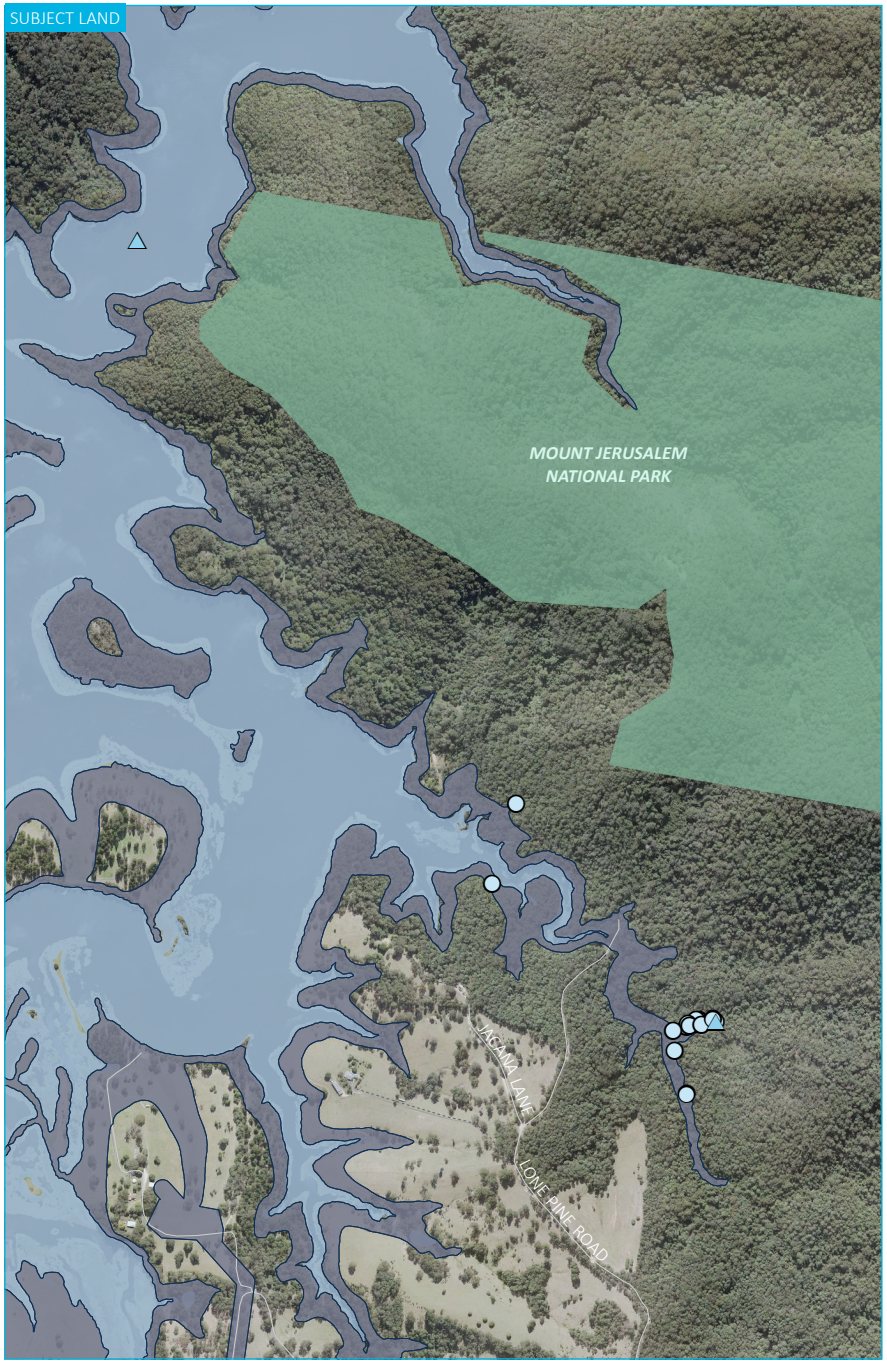
Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	The species extent of occurrence is estimated to be less than 5,798 km^2. The species is restricted to northeast NSW.	(NSW TSSC, 2023)	The extent of occurrence calculations utilised 40 years of records, many of which have not been resurveyed. As such, there is insufficient data to inform an accurate and current total extent of occurrence.
Area of occupancy (ha)	The species area of occupancy is 164 km^2. The species is restricted to northeast NSW.	(NSW TSSC, 2023)	The area of occupancy calculations utilised 40 years of records, many of which have not been resurveyed. As such, there is insufficient data to inform an accurate and current total area of occupancy.
Number of threat-defined locations	The BAM (DPIE, 2020) defines threat-defined locations as geographically or ecologically distinct areas in which a single threatening event may rapidly affect species occurrences. Where two or more subpopulations occur in an area that may be threatened by one such event, they are counted as a single location. Where a subpopulation covers an area larger than what a single event is likely to impact, this is counted as two or more locations. Using adverse fire regimes as the most serious plausible threat, the number of threat-defined locations for Corokia is five (NSW TSSC 2023).	(NSW TSSC, 2023) (DCCEEW, 2022)	There is insufficient data to accurately identify threat-defined locations.
Whether the species' population is likely to undergo extreme fluctuations	Due to the species restricted geographic distribution and specific habitat requirements, coupled with predictions for climate change and increased risk of fire, a continuing decline in the species' population has been predicted. However, it is unknown whether these fluctuations are considered extreme.	(NSW TSSC, 2023)	There is no data to inform whether the species' population is likely to undergo extreme fluctuations.
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	Not required as species is not considered under Principle 4.	N/A	N/A

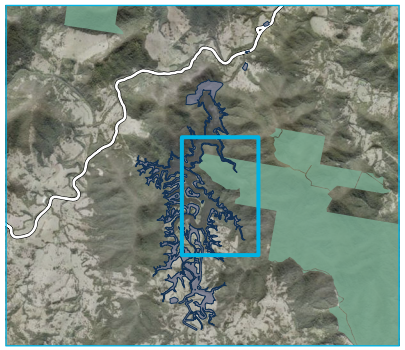
Table 7.6 Impact assessment - Corokia

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Within the subject land, 12 individuals of Corokia have been recorded. Nineteen individuals were also recorded adjacent to the subject land. While targeted survey for the Proposal focused on vegetation within the subject land, earlier surveys were conducted over a larger footprint and included areas of adjacent vegetation to the current subject land. Surveys in these adjacent areas were minor, and additional survey outside of the subject land would be required to ascertain the extent of the subpopulation, however it is considered likely additional records of Corokia would be observed.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey. It is considered that all records within the Proposal area are part of the same subpopulation, and likely to exchange genetic material.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	In accordance with a population size of 1,031 individuals, a total of 1.16% of the species population is present within the subject land.	(NSW TSSC, 2023)	The percentage is based upon a total population size of 1,031 individuals based on the individuals recorded within and adjacent to the subject land, in addition to the population size quoted in the listing advice. There is uncertainty as to the current population size outside of the subject land due to limited survey effort in these areas. There is insufficient data to inform total population size.
Number of individuals (mature and immature) to be impacted by the proposal	The Proposal will impact 12 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	In accordance with a population size of 1,031 individuals, a total of 1.16% of the species population is present within the subject land.	(NSW TSSC, 2023)	The percentage is based upon a total population size of 1,031 individuals based on the individuals recorded within and adjacent to the subject land, in addition to the population size quoted in the listing advice. There is uncertainty as to the current population size outside of the subject land due to limited survey effort in these areas. There is insufficient data to inform total population size.
Area of habitat to be impacted (ha) (for species measured by area only)	Corokia is measured by count.	N/A	N/A

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Area of the species' geographic range to be impacted by the proposal (ha)	10.80 ha of habitat for Corokia will be impacted by the Proposal. This area has been calculated in accordance with the method for determining the impact for area based flora species as specified in the TBDC and BAM (DPIE, 2020).	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 12 individuals of Corokia, however the Proposal is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.	(NSW TSSC, 2023)	The extent of occurrence and area of occupancy calculations utilised 40 years of records, many of which have not been resurveyed. As such, there is insufficient data to inform an accurate and current total extent of occurrence.
Individuals impacted	12 individuals will be impacted by the Proposal.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Viability of a fragmented population	Corokia occurs in isolated subpopulations, separated from other subpopulations by between 4–24 km of typically unsuitable habitat (agricultural or urban landscapes). The Proposal is unlikely to fragment the local population of Corokia. The areas in which the species was recorded within the subject land will not form islands as a result of the increased inundation, and therefore individuals will not become isolated from the broader population as a result of the Proposal.	(NSW TSSC, 2023)	Data is sufficient.
Additional assessment	Given that the Proposal will only result in an impact on 12 individuals of Corokia, no further SAII assessment has been undertaken for the species.	N/A	N/A







KEY

- Subject land

Corokia species record

- CHD project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody
- NPWS reserve

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); MetroMap (2024)

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Species records of Corokia (*Corokia whiteana*) in NSW

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 7.2

EMM
creating opportunities

ii Basket Fern (*Drynaria rigidula*)

Table 7.7 to Table 7.9 below provide an assessment of the Proposal on the species. Figure 7.3 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.7 Current status - Basket Fern

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Not required as species is not considered under Principle 1.	N/A	N/A
Evidence of small population size (Principle 2)			
Current population size in NSW	There is no current population estimate in NSW as of 2024. The most recent population estimate is from 1998 indicating a total of three individuals of the species from three separate locations. BioNet records indicate that the species has been recorded within NSW on 40 occasions.	(TSSC, 2021) (DCCEEW, 2024a)	Data is deficient. There is insufficient data to inform the current population size.
Decline in species' population size in 3 years or one generation	There is no data on whether the species' population size has or is likely to undergo a decline in three years or one generation.	(TSSC, 2021)	Data is deficient. There is no data on a decline in the species population in 3 years or one generation.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	As of 1998, the species was known from three locations, each with only one plant of the species. The current number or percentage of mature individuals in each subpopulation is unknown.	(TSSC, 2021)	Data is deficient. There is no recent data on the extent of occurrence for this species. The most current data on the count of individuals of the species is from 1998.
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	There is no data on the extent of occurrence of the species.	(TSSC, 2021)	Data is deficient. The most current data on the species is from 1998.
Area of occupancy (ha)	There is no data on the area of occupancy of the species.	(TSSC, 2021)	Data is deficient. The most current data on the species is from 1998.

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of threat-defined locations	There is no data on the number of threat-defined locations.	(TSSC, 2021)	Data is deficient. No threat-defined locations have been defined.
Whether the species' population is likely to undergo extreme fluctuations	There is no recent data on the species' population and no data on whether the species' population is likely to undergo extreme fluctuations.	(TSSC, 2021)	Data is deficient.
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	Not required as species is not considered under Principle 4.	N/A	N/A

b Impact assessment

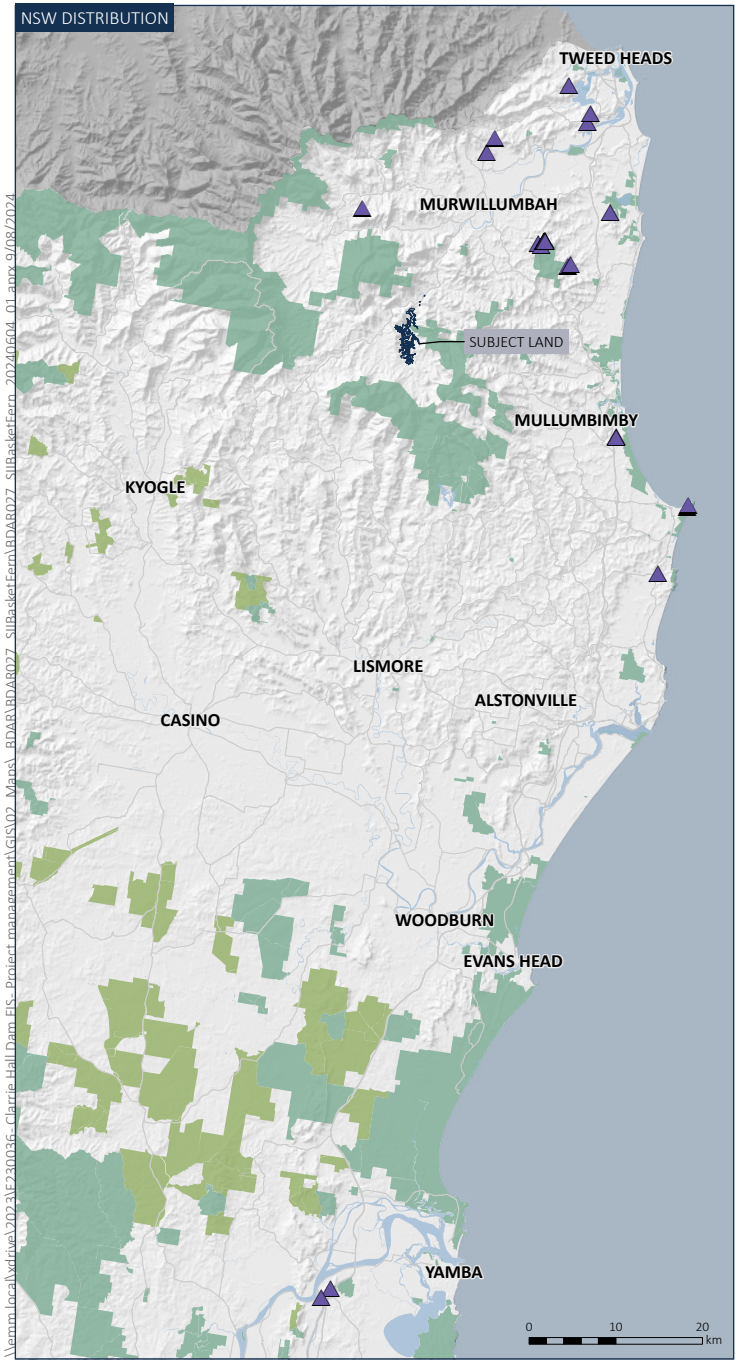
Table 7.8 Impact assessment - Basket Fern

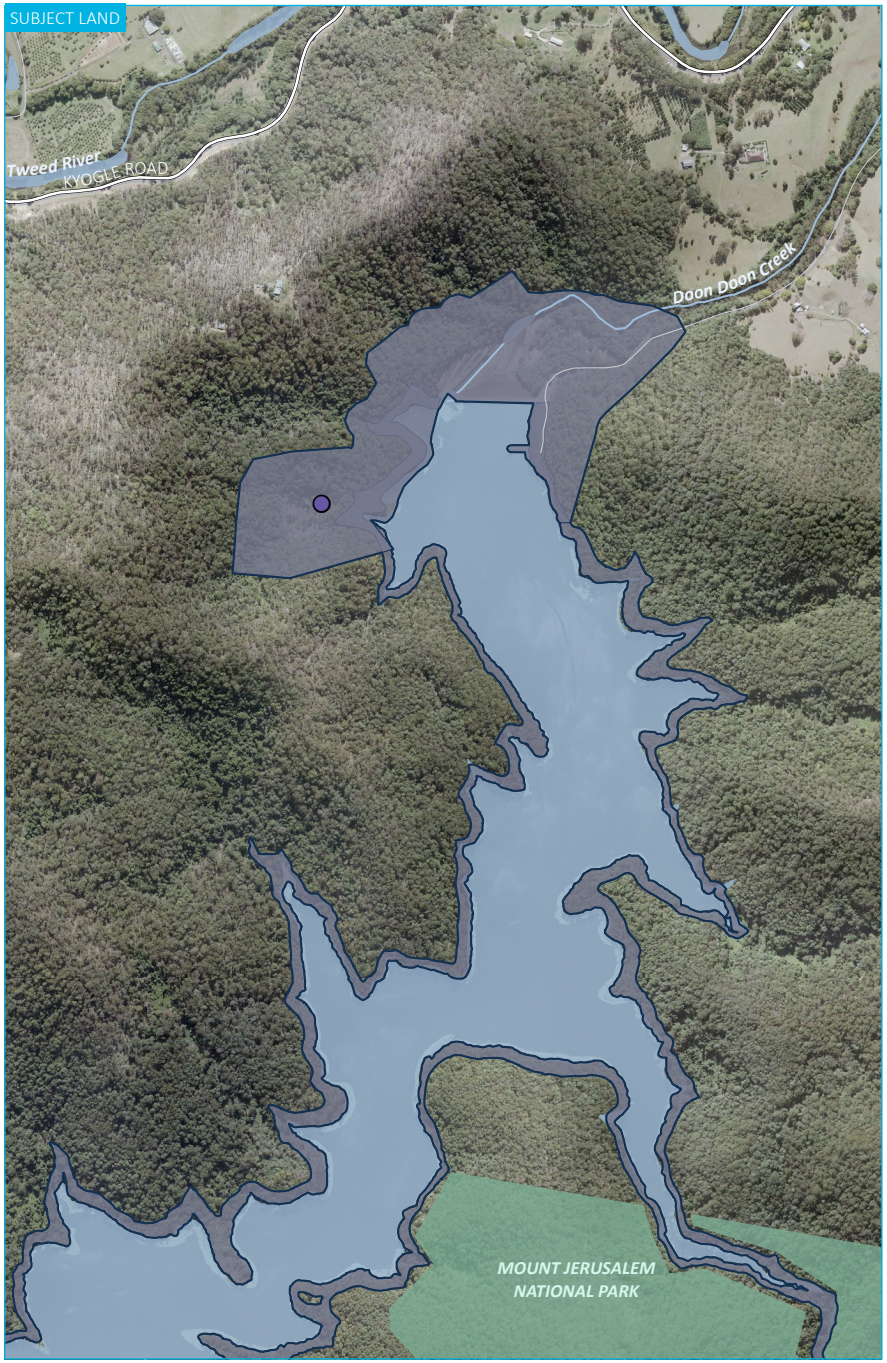
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Five individuals were recorded on the subject land and were restricted to a small area at the decommissioned quarry in the northwest of the subject land. Targeted surveys were largely contained within the subject land, with minor surveys in the adjacent vegetation. Additional survey outside of the subject land would be required to ascertain the extent of the subpopulation.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	The data on the population size for the species is deficient. The most recent data is from 1998 and indicated a population size of three individuals. BioNet records indicate that the species has been recorded within NSW on 40 occasions. The Proposal will impact five individuals. Given the lack of recent population data, a percentage cannot be calculated.	(TSSC, 2021) (DCCEEW, 2024a)	Data is deficient. There is no current data on the population size of the species in NSW.
Number of individuals (mature and immature) to be impacted by the proposal	The Proposal will impact five individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.

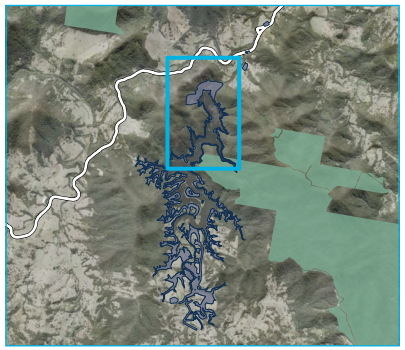
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	The data on the population size for the species is deficient. The most recent data is from 1998 and indicated a population size of three individuals. BioNet records indicate that the species has been recorded within NSW on 40 occasions. The Proposal will impact five individuals. Given the lack of recent population data, a percentage cannot be calculated.	(TSSC, 2021) (DCCEEW, 2024a)	Data is deficient. There is no current data on the population size of the species in NSW.
Area of habitat to be impacted (ha) (for species measured by area only)	The area of habitat for the Basket Fern to be impacted by the Proposal is 0.50 ha.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Area of the species' geographic range to be impacted by the proposal (ha)	As above.	EMM	As above
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 0.50 ha of habitat for Basket Fern, however the Proposal is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.	(TSSC, 2021)	Data is deficient. There is no current data on the area of the geographic range of the species.
Individuals impacted	The Proposal will impact five individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Viability of a fragmented population	There is no data on the viability of a fragmented population of the species. The most recent data is from 1998, in which the species was known from three locations, each containing only one individual of the species. Given the ability of the species to occur in isolation, it is assumed that the species is viable in fragmentation.	(TSSC, 2021)	Data is deficient. There is no data to determine the viability of a fragmented population of the species.
Additional assessment	Given that the Proposal will result in the loss of the entire known population of Basket Fern within proximity of the Dam, additional assessment has been considered in Table 7.9 below.	N/A	N/A

Table 7.9 Additional impact assessment – Basket Fern

Impact	Data/ information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII.	The records of Basket Fern are located within an old quarry within the construction area of the footprint. The quarry was selected to be reinstated as it is the only nearby source of suitable rhyolite within proximity of the Dam, and it was the quarry from which the materials for the existing Dam was sourced. Furthermore, due to its previous disturbance the quarry area consists of regrowth vegetation of lower quality than surrounding areas. Retaining this area containing the Basket Fern would require substantial redesign of the construction area and ancillary infrastructure and will require sourcing and transporting the rhyolite required to construct the Dam wall from outside of the locality which has the potential to introduce increased economic, social and environmental impacts.
The extent to which the impact exceeds any threshold for the potential entity.	The Proposal will result in the loss of five individuals of the Basket Fern and 0.50 ha of habitat for the species. No thresholds have been defined for the species.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal).	The Proposal will result in the loss of five individuals and 0.50 ha of habitat for the species, however it is considered likely that the local population of Basket fern is larger than has been indicated solely through records captured for the Proposal. Surveys in adjacent vegetation were minor, and additional survey outside of the subject land is required to ascertain the extent of the subpopulation. The removal of individuals of the species will result in an impact to the species ecology through the loss of the known local occurrence.
A description of the extent to which the local population will become fragmented.	The species was recorded in one location on the subject land and the Proposal will result in the loss of the entire known occurrence. As such, the Proposal is not predicted to fragment the local population into two or more populations.
The relationship of the local population to other populations.	The extent of the local population is unknown and given spores from this species are likely to be able to travel significant distances, the relationship between this group of individual plants and the wider context is also unknown. It is suspected that this population is likely to have limited exchange of genetic material with other known populations.
The measures proposed to contribute to the recovery of the species in the IBRA subregion.	Offsets for this species are proposed, however like-for-like offsets are not required as the species is not listed under the EPBC Act. Offsets can also occur outside of the IBRA subregion, therefore no measures contributing to the recovery of this species are proposed.







KEY

- Subject land

Basket Fern species record

- CHDR project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); MetroMap (2024)

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Species records of Basket Fern (*Drynaria rigidula*) in NSW

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Figure 7.3

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iii Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*)

Table 7.10 to Table 7.12 below provide an assessment of the Proposal on the species. Figure 7.4 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.10 Current status - Green-leaved Rose Walnut

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	There is no recent data on changes in the population size in NSW of the species. The most recent data is from 2004 indicating subpopulations in the Tweed and Byron regions were experiencing regeneration at the time. There is no data on the length of a generation for the species.	(DEC, 2004)	Data is deficient. There is no recent data on the population size of the species nor any data indicating changes in the population size in the past 10 years or three generations.
Evidence of small population size (Principle 2)			
Current population size in NSW	Not required as species is not considered under Principle 2.	N/A	N/A
Decline in species' population size in 3 years or one generation	As above.	N/A	N/A
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	As above.	N/A	N/A
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	Not required as species is not considered under Principle 3.	N/A	N/A
Area of occupancy (ha)	As above.	N/A	N/A
Number of threat-defined locations	As above.	N/A	N/A
Whether the species' population is likely to undergo extreme fluctuations	As above.	N/A	N/A

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	Not required as species is not considered under Principle 4.	N/A	N/A

b Impact assessment

Table 7.11 Impact assessment - Green-leaved Rose Walnut

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Within the subject land, 457 individuals of Green-leaved Rose Walnut were recorded. Outside of the subject land, the species was recorded 322 times in adjacent vegetation. Surveys in adjacent vegetation were minor, and additional survey outside of the subject land is required to ascertain the extent of the subpopulation, however it is considered likely additional records of Green-leaved Rose Walnut would be observed.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	There is no data on the current population size of the species in NSW. BioNet records indicate that the species has been recorded within NSW on 662 occasions. The Proposal will impact 457 individuals. Given the lack of recent population data, a percentage cannot be calculated.	(DEC, 2004) (DCCEEW, 2024a)	Data is deficient. There is no data on the current population size of the species in NSW.
Number of individuals (mature and immature) to be impacted by the proposal	The Proposal will impact 457 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	There is no data on the current population size of the species in NSW. BioNet records indicate that the species has been recorded within NSW on 662 occasions. Note that most of these records fail to state the number of individuals associated with each record. However, after conservatively assigning one individual per record where this information is lacking, the individuals recorded is at least 1,027. The Proposal will impact 457 individuals. Given the lack of recent population data, a percentage cannot be calculated.	(DEC, 2004) (DCCEEW, 2024a)	Data is deficient. There is no data on the current population size of the species in NSW.

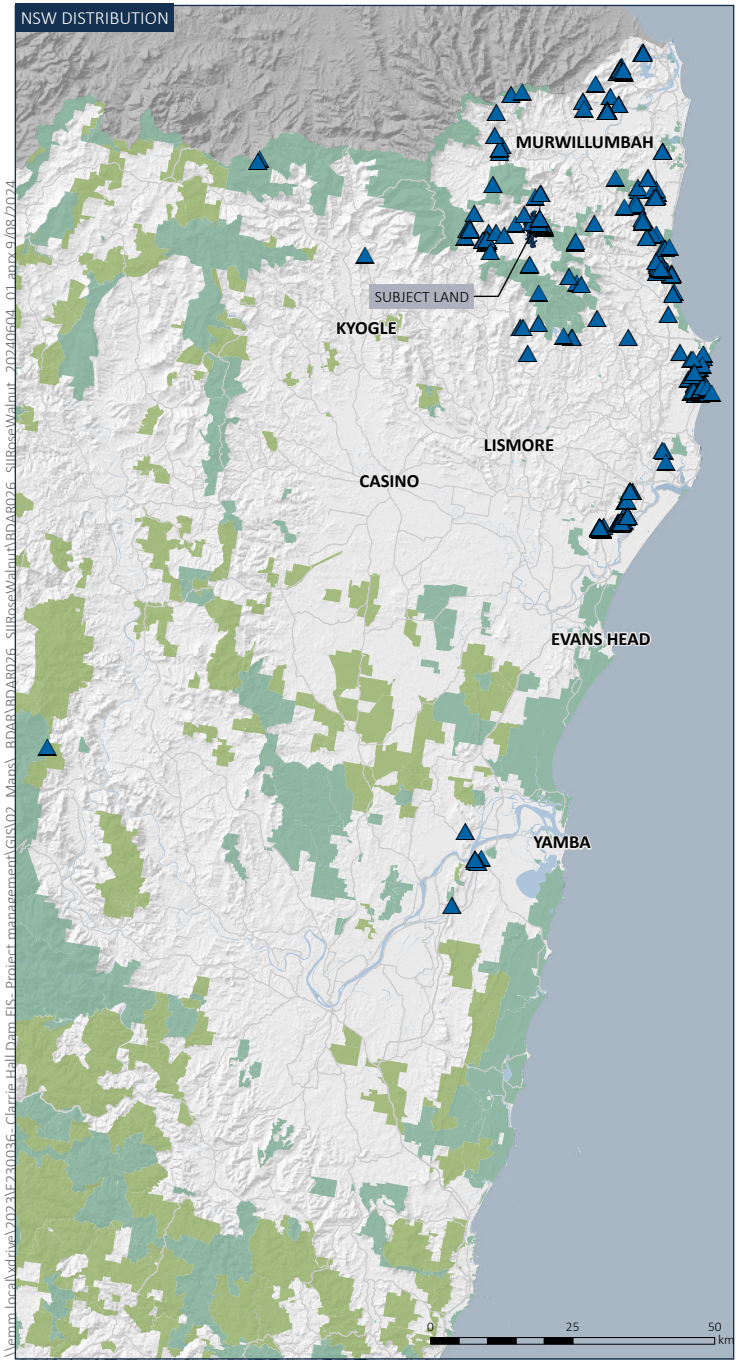
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Area of habitat to be impacted (ha) (for species measured by area only)	Green-leaved Rose Walnut is measured by count.	N/A	N/A
Area of the species' geographic range to be impacted by the proposal (ha)	110.24 ha of habitat for Green-leaved Rose Walnut will be impacted by the Proposal. This area has been calculated in accordance with the method for determining the impact for area based flora species as specified in the TBDC and BAM (DPIE, 2020).	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 457 individuals of Green-leaved Rose Walnut, which is likely to reduce the area of occupancy by 0.26% as defined by a 2 x 2 km grid as the complete loss of potential habitat from two individual grid cells will occur.	(DEC, 2004)	Data is deficient. There is no data on the current geographic range of the species in NSW.
Individuals impacted	The Proposal will impact 457 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Viability of a fragmented population	Habitat fragmentation is believed to be one of the primary causes of the prior decline in the species population. There is insufficient data as of 2024 to determine the viability of fragmented populations.	(DEC, 2004)	Data is deficient. The most recent data on the species' population and the impacts of fragmentation are from 2004. There is insufficient data to determine the viability of fragmented populations.
Additional assessment	Due to the high number of individuals to be impacted by the Proposal, additional assessment has been considered in Table 7.12 below.	N/A	N/A

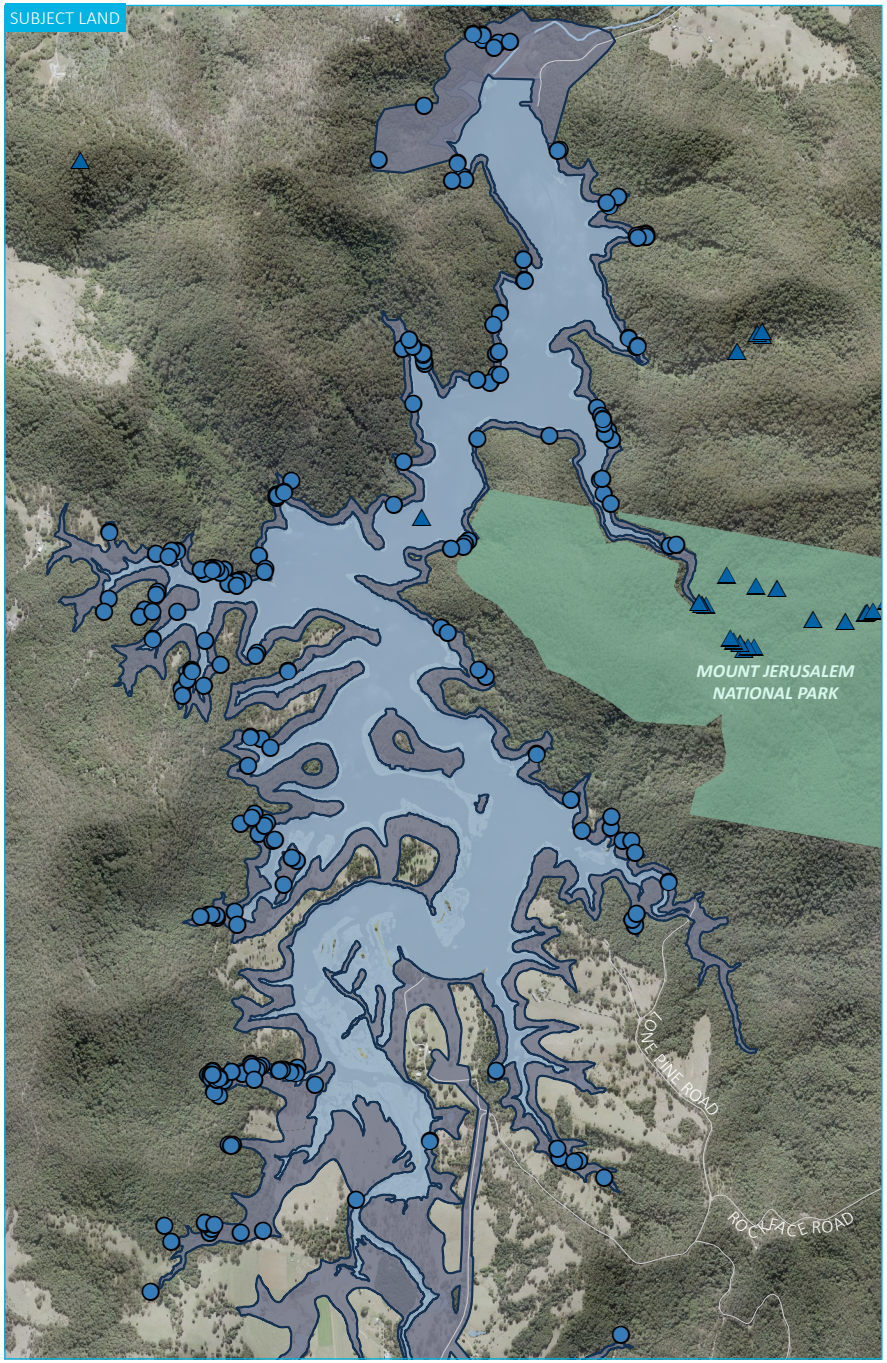
c Additional impact assessment

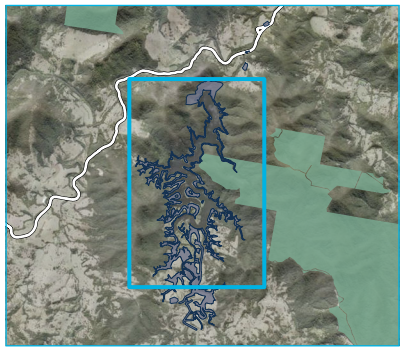
Table 7.12 Additional impact assessment - Green-leaved Rose Walnut

Impact	Data/ information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII.	The records of Green-leaved Rose Walnut are dispersed throughout the subject land and occur within the construction and operational footprints of the Proposal. Measures have been taken to avoid biodiversity values within the construction footprint, by locating the majority of the infrastructure at the northern end of the Dam. The northern end of the Dam already contains areas of hardscaping for the current Dam infrastructure and will require less vegetation clearing to facilitate the new and upgraded infrastructure. However, due to the nature of the Proposal, opportunities to avoid biodiversity values within the operational footprint of the subject land are limited. As the Proposal proposes to increase the water supply yield of the current Dam, inundation of the surrounding land is required to achieve a greater FSL. As such, impacts to the records of Green-leaved Rose Walnut located between the current and proposed future FSL cannot be avoided. Consideration was given, however, to minimising these impacts by adjusting the Dam height and FSL. Investigations were undertaken of the viability of alternate dam heights, including 74 m AHD and 77 m AHD. Flood modelling indicated that increasing the Dam to these heights would increase the biodiversity impacts by 47% and 84% respectively, in comparison to the proposed height of 70 m AHD.
The extent to which the impact exceeds any threshold for the potential entity.	The Proposal will result in the loss of 457 individuals of the Green-leaved Rose Walnut and 110.24 ha of habitat for the species. No thresholds have been defined for the species.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal).	As discussed above, in addition to the 457 individuals recorded in the subject land, 322 individuals of the Green-leaved Rose Walnut were recorded in adjacent vegetation to the subject land. Surveys in adjacent vegetation were minor, and additional survey outside of the subject land is required to ascertain the extent of the subpopulation, however it is considered likely additional records of Green-leaved Rose Walnut would occur. The Proposal will result in the loss of 457 individuals and 110.24 ha of habitat for the species, however it is considered likely that the local population of Green-leaved Rose Walnut is much larger than has been indicated solely through records captured for the Proposal. The removal of individuals of the species may result in a short-term impact to the species dispersal through a reduction in the local occurrence.
A description of the extent to which the local population will become fragmented.	The Proposal is not predicted to fragment the local population into two or more populations. The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population.
The relationship of the local population to other populations.	The population of Green-leaved Rose Walnut present within the subject land extends into the Mount Jerusalem National Park. This population is likely to have limited exchange of genetic material with other populations in the locality.

Impact	Data/ information
The measures proposed to contribute to the recovery of the species in the IBRA subregion.	Seeds of the threatened species to be impacted will be collected and propagated to plant in similar, adjacent vegetation to maintain the local population. Impacts to the species will be offset in accordance with the BOS (refer Section 8.3). Additionally, part of the survey effort conducted for the Proposal has contributed to the following recovery objective for the Green-leaved Rose Walnut: • to improve knowledge of distribution, regeneration and genetics.







KEY

- Subject land

Green-leaved Rose Walnut species record

- CHDR project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); MetroMap (2024)

Species records of Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*) in NSW

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Figure 7.4

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iv Fine-leaved Tuckeroo (*Lepiderema pulchella*)

Table 7.13 and Table 7.14 below provide an assessment of the Proposal on the species. Figure 7.5 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.13 Current status - Fine-leaved Tuckeroo

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Not required as species is not considered under Principle 1.	N/A	N/A
Evidence of small population size (Principle 2)			
Current population size in NSW	There is no current population estimate in NSW as of 2024.	(TSSC, 2021)	Data is deficient. There is insufficient data to inform the current population size.
Decline in species' population size in 3 years or one generation	There is no data to inform whether the species' population size has declined in three years or one generation.	(TSSC, 2021)	Data is deficient. There is no data on a decline in the species population in 3 years or one generation.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	There is no current population estimate in NSW as of 2024. As of 2001, it was estimated that the number of mature individuals in each subpopulation was fewer than 20 individuals. BioNet records indicate that the species has been recorded within NSW on 1,251 occasions.	(TSSC, 2021) (DCCEEW, 2024a)	Data is deficient. There is insufficient data to inform the current number of mature individuals or to determine if the species is likely to undergo extreme fluctuations.
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	There is no data on the extent of occurrence of the species.	(TSSC, 2021)	Data is deficient. The most current data on the species is from 2001.
Area of occupancy (ha)	There is no data on the area of occupancy of the species.	(TSSC, 2021)	Data is deficient. The most current data on the species is from 2001.
Number of threat-defined locations	There is no data on the number of threat-defined locations.	(TSSC, 2021)	Data is deficient.

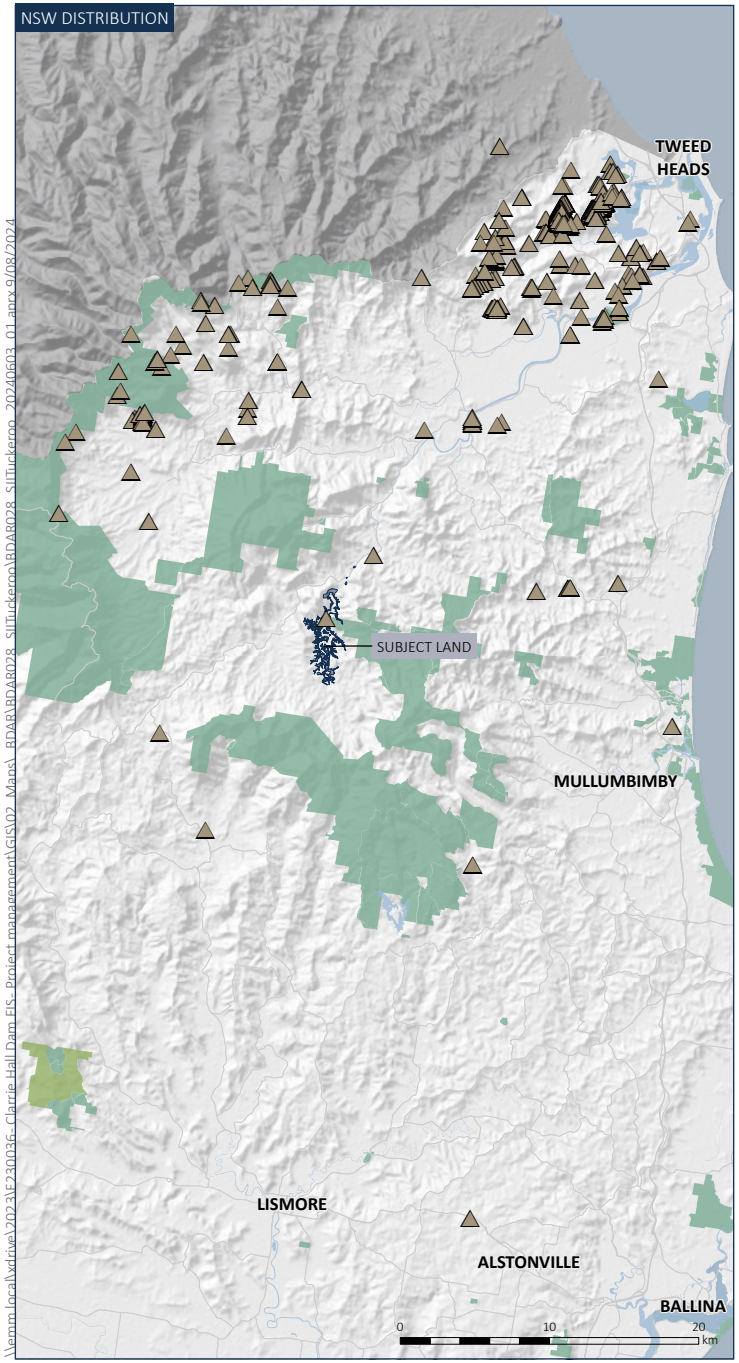
Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Whether the species' population is likely to undergo extreme fluctuations	There is no recent data on the species' population and no data on whether the species' population is likely to undergo extreme fluctuations.	(TSSC, 2021)	Data is deficient.
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	Not required as species is not considered under Principle 4.	N/A	N/A

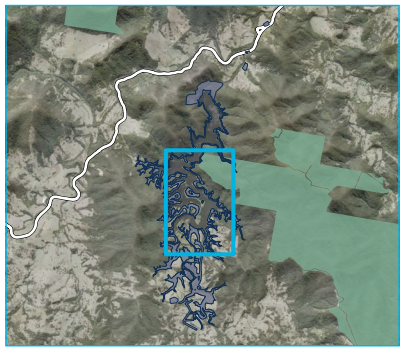
b Impact assessment

Table 7.14 Impact assessment - Fine-leaved Tuckeroo

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Within the subject land, 15 individuals of Fine-leaved Tuckeroo were recorded. No individuals were recorded outside of the subject land during the limited survey effort in adjacent vegetation. Additional survey outside of the subject land is required to ascertain the extent of the subpopulation. The Fine-leaved Tuckeroo is a commonly planted species, and it is likely that the occurrences within the subject land are historical garden and/or landscape plantings or have derived from planted specimens due to the discrete locations it has been recorded.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	There is no data on the current population size of the species in NSW. As of 2001, it was estimated that the number of mature individuals in each subpopulation was fewer than 20 individuals. BioNet records indicate that the species has been recorded within NSW on 1,251 occasions. The Proposal will impact 15 individuals. Given the lack of recent population data, a percentage cannot be calculated.	(TSSC, 2021) (DCCEEW, 2024a)	Data is deficient. There is no data on the current population size of the species in NSW.
Number of individuals (mature and immature) to be impacted by the proposal	The Proposal will impact 15 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	There is no data on the current population size of the species in NSW. As of 2001, it was estimated that the number of mature individuals in each subpopulation was fewer than 20 individuals. BioNet records indicate that the species has been recorded within NSW on 1,251 occasions. The Proposal will impact 15 individuals. Given the lack of recent population data, a percentage cannot be calculated.	(TSSC, 2021) (DCCEEW, 2024a)	Data is deficient. There is no data on the current population size of the species in NSW.
Area of habitat to be impacted (ha) (for species measured by area only)	Fine-leaved Tuckeroo is measured by count.	N/A	N/A
Area of the species' geographic range to be impacted by the proposal (ha)	3.77 ha of habitat for the Fine-leaved Tuckeroo will be impacted by the Proposal. This area has been calculated in accordance with the method for determining the impact for area based flora species as specified in the TBDC and BAM (DPIE, 2020).	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 15 individuals of Fine-leaved Tuckeroo, however the Proposal is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.	(TSSC, 2021)	Data is deficient. There is no data on the current geographic range of the species in NSW.
Individuals impacted	The Proposal will impact 15 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Viability of a fragmented population	There is no data on the viability of a fragmented population of the species.	(TSSC, 2021)	Data is deficient. There is no data on the viability of a fragmented population of the species.
Additional assessment	Given that the Proposal will only result in an impact on 15 individuals of Fine-leaved Tuckeroo, no further SAII assessment has been undertaken for the species.	N/A	N/A





KEY

- Subject land

Fine-leaved tuckeroo species record

- CHDR project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody
- NPWS reserve
- State forest

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); MetroMap (2024)

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Species records of Fine-leaved Tuckeroo (*Lepiderema pulchella*) in NSW

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Figure 7.5

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v Scrub Turpentine (*Rhodamnia rubescens*)

Table 7.15 to Table 7.17 below provide an assessment of the Proposal on the species. Figure 7.6 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.15 Current status - Scrub Turpentine

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Calculations based on documented rates of mortality of the species across its range, have predicted a quantitative estimate of decline of 96-99% of the population over three generations. This calculation is based on a generation time of 30–40 years.	(TSSC, 2020)	Data reported on for the Conservation Advice (TSSC, 2020) for the species was collected prior to the 2019-2020 bushfires. There is no recent data on the change in population.
Evidence of small population size (Principle 2)			
Current population size in NSW	Not required as species is not considered under Principle 2.	N/A	N/A
Decline in species' population size in 3 years or one generation	As above.	N/A	N/A
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	As above.	N/A	N/A
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	Not required as species is not considered under Principle 3.	N/A	N/A
Area of occupancy (ha)	As above.	N/A	N/A
Number of threat-defined locations	As above.	N/A	N/A
Whether the species' population is likely to undergo extreme fluctuations	As above.	N/A	N/A

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	The species is considered highly to extremely susceptible to infection by Myrtle Rust (*Austropuccinia psidii*), an exotic, pathogenic fungi. For smaller, high value occurrences of the species, monthly application of fungicides is feasible. However, no effective widespread management control is currently available in Australia to protect or treat Scrub Turpentine populations from infection.	(TSSC, 2020)	There is insufficient data on the response of the species to management at stewardship sites.

b Impact assessment

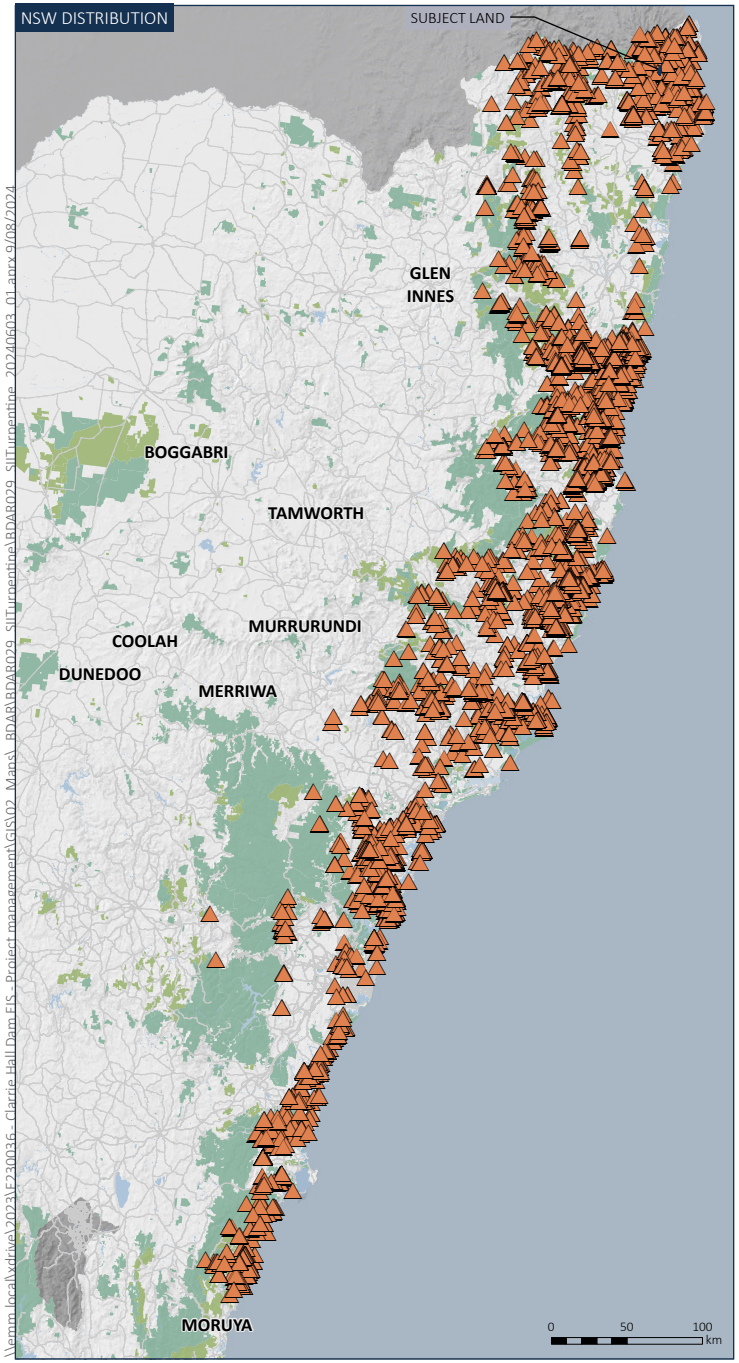
Table 7.16 Impact assessment - Scrub Turpentine

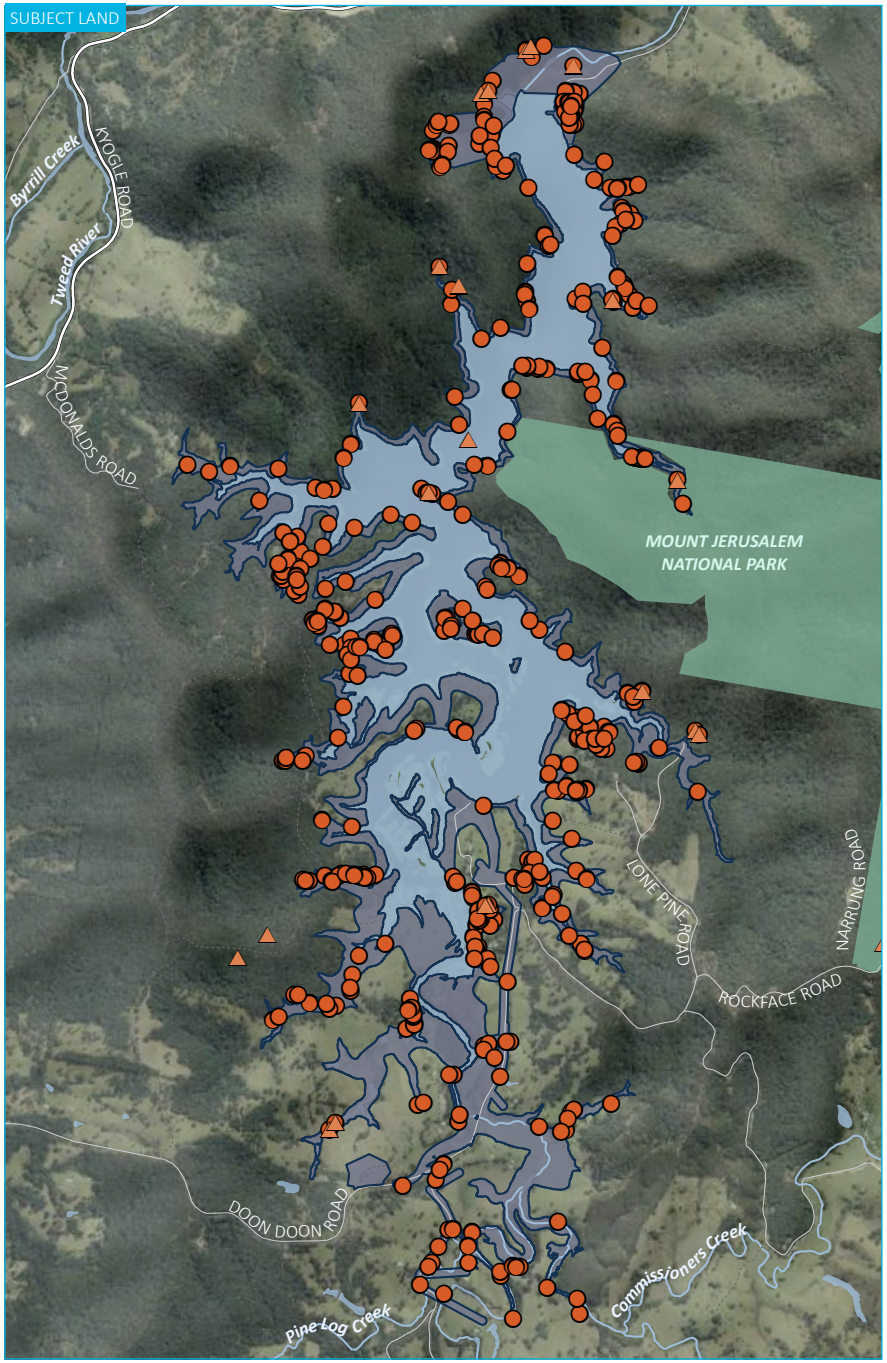
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Within the subject land, 709 individuals of Scrub Turpentine were recorded. Outside of the subject land, the species was recorded 105 times in adjacent vegetation. Surveys in adjacent vegetation were minor, and additional survey outside of the subject land is required to ascertain the extent of the subpopulation, however it is considered likely additional records of Scrub Turpentine would be observed.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	The number of individuals of Scrub Turpentine in NSW is currently unknown. It is expected that the species has a large population (not <10,000 individuals overall). Based on a population size of 10,000, the number of individuals recorded within the subject land constitutes 7.1% of the total population.	(TSSC, 2020)	There is insufficient data prior to 2010 to determine a formal estimate of the total population size in NSW.
Number of individuals (mature and immature) to be impacted by the proposal	The Proposal will impact 709 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	Based on a population size of 10,000, the number of individuals recorded within the subject land constitutes 7.1% of the total population.	(TSSC, 2020)	There is insufficient data prior to 2010 to determine a formal estimate of the total population size in NSW.

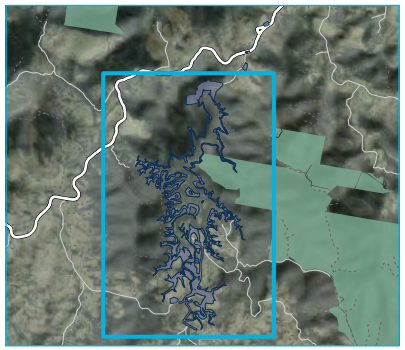
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Area of habitat to be impacted (ha) (for species measured by area only)	Scrub Turpentine is measured by count.	N/A	N/A
Area of the species' geographic range to be impacted by the proposal (ha)	127.96 ha of habitat for the Scrub Turpentine will be impacted by the Proposal. This area has been calculated in accordance with the method for determining the impact for area based flora species as specified in the TBDC and BAM (DPIE, 2020).	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 709 individuals of Scrub Turpentine, which is likely to reduce the area of occupancy by 0.04% as defined by a 2 x 2 km grid as the complete loss of potential habitat from two individual grid cells will occur.	(TSSC, 2020)	There is insufficient data prior to 2010 to determine a formal estimate of the total population size in NSW.
Individuals impacted	709 individuals will be impacted by the Proposal.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Viability of a fragmented population	Fragmentation of populations is considered to potentially contribute to the species decline. As such, fragmented populations may not be considered viable.	(TSSC, 2020)	There is insufficient data as to whether the species is viable in fragmented population.
Additional assessment	Whilst the species is considered relatively 'common' in NSW, additional assessment has been undertaken for the species on a conservative basis due to the relatively high number of individuals to be impacted within the subject land. Table 7.17 below details this additional assessment.	N/A	N/A

Table 7.17 Additional impact assessment - Scrub Turpentine

Impact	Data/ information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII.	The records of Scrub Turpentine are dispersed throughout the subject land and occur within the construction and operational footprints of the Proposal. Measures have been taken to avoid biodiversity values within the construction footprint, by locating the majority of the infrastructure at the northern end of the Dam. The northern end of the Dam already contains areas of hardscaping for the current Dam infrastructure and will require less vegetation clearing to facilitate the new and upgraded infrastructure. However, due to the nature of the Proposal, opportunities to avoid biodiversity values within the operational footprint of the subject land are limited. As the Proposal proposes to increase the water supply yield of the current Dam, inundation of the surrounding land is required to achieve a greater FSL. As such, impacts to the records of Scrub Turpentine located between the current and proposed future FSL cannot be avoided. Consideration was given, however, to minimising these impacts by adjusting the Dam height and FSL. Investigations were undertaken of the viability of alternate dam heights, including 74 m AHD and 77 m AHD. Flood modelling indicated that increasing the Dam to these heights would increase the biodiversity impacts by 47% and 84% respectively, in comparison to the proposed height of 70 m AHD.
The extent to which the impact exceeds any threshold for the potential entity.	The Proposal will result in the loss of 709 individuals of the Scrub Turpentine and 127.96 ha of habitat for the species. No thresholds have been defined for the species.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal).	The Proposal will result in the loss of 709 individuals and 127.96 ha of habitat for the species, however it is considered likely that the local population of Scrub Turpentine is much larger than has been indicated solely through records captured for the Proposal. Surveys in adjacent vegetation were minor, and additional survey outside of the subject land is required to ascertain the extent of the subpopulation. Within adjacent vegetation, 105 individuals were recorded, however it is considered likely additional records of Scrub Turpentine would be observed with further survey effort outside of the subject land. The removal of individuals of the species may result in a short-term impact to the species dispersal through a reduction in the local occurrence.
A description of the extent to which the local population will become fragmented.	The Proposal is not predicted to fragment the local population into two or more populations. The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population.
The relationship of the local population to other populations.	The population with the subject land and surrounding vegetation is likely to be a disjunct population, geographically isolated from other populations in the locality. This population is likely to have limited exchange of genetic material with other populations.
The measures proposed to contribute to the recovery of the species in the IBRA subregion.	Impacts to the species will be offset in accordance with the BOS, however offsets do not have to be located in the same IBRA subregion.







KEY

- Subject land

Scrub Turpentine species record

- CHDR project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); Sixmaps (2024)

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Species records of Scrub Turpentine (*Rhodamnia rubescens*) in NSW

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Figure 7.6

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vi Native Guava (*Rhodomyrtus psidioides*)

Table 7.18 to Table 7.20 below provide an assessment of the Proposal on the species. Figure 7.7 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.18 Current status - Native Guava

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Calculations based on documented rates of mortality of the species across its range, have predicted a quantitative estimate of decline of 99% of the population over three generations. This calculation is based on a generation time of 20 years.	(TSSC, 2020)	Data reported on for the Conservation Advice (TSSC, 2020) for the species was collected prior to the 2019-2020 bushfires. There is no recent data on the change in population.
Evidence of small population size (Principle 2)			
Current population size in NSW	Not required as species is not considered under Principle 2.	N/A	N/A
Decline in species' population size in 3 years or one generation	As above	N/A	N/A
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	As above	N/A	N/A
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	Not required as species is not considered under Principle 3.	N/A	N/A
Area of occupancy (ha)	As above	N/A	N/A
Number of threat-defined locations	As above	N/A	N/A
Whether the species' population is likely to undergo extreme fluctuations	As above	N/A	N/A
Response to management (Principle 4)			

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Unlikely to respond to management at a stewardship site	The species is considered highly to extremely susceptible to infection by Myrtle Rust (*Austropuccinia psidii*), an exotic, pathogenic fungi. For smaller, high value occurrences of the species, monthly application of fungicides is feasible. However, no effective widespread management control is currently available in Australia to protect or treat Native Guava populations from infection.	(TSSC, 2020)	There is insufficient data on the response of the species to management at stewardship sites.

b Impact assessment

Table 7.19 Impact assessment - Native Guava

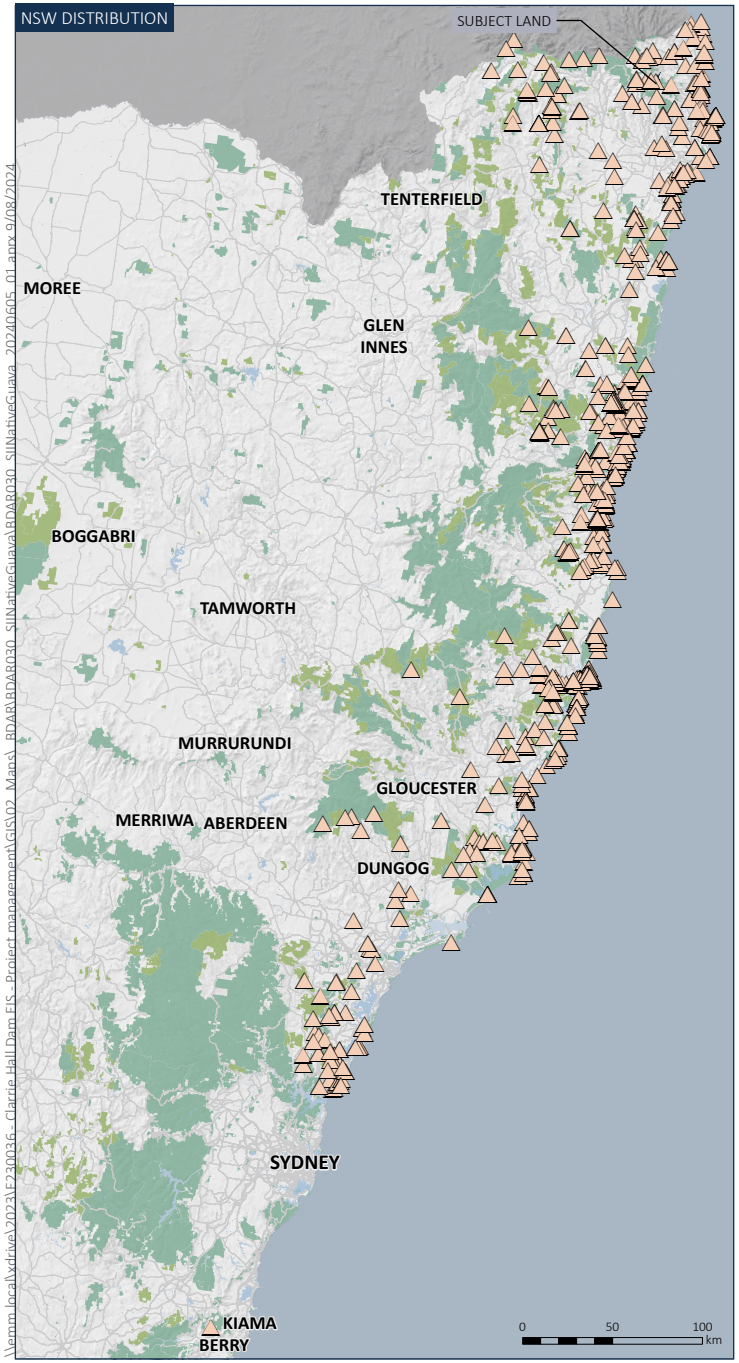
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Within the subject land, 6,079 stems of Native Guava were estimated. Many of these are likely to be suckers from a much small number of plants therefore the number of individuals is likely to be much lower and cannot be determined without invasive techniques or genetic studies. In several areas it was possible that over 100 stems were from a single rootstock. For the purposes of this assessment we will assume that there are 10 stems (or root suckers) per individual which equates to 608 individuals. This is still likely to be highly conservative as it was estimated over 100 stems were attributed to a single rootstock. Outside of the subject land, the species was recorded at 107 locations in adjacent vegetation. Surveys in adjacent vegetation were minor compared to the subject land, and additional survey outside of the subject land is required to ascertain the extent of the subpopulation, however it is considered likely additional records of Native Guava would be observed.	EMM	Survey effort is sufficient, and the subject land has undergone thorough targeted survey. This is an area based species for the purposes of calculation of offset quantum, however stem counts were also undertaken. These stem counts significantly overestimate the number of individuals present.

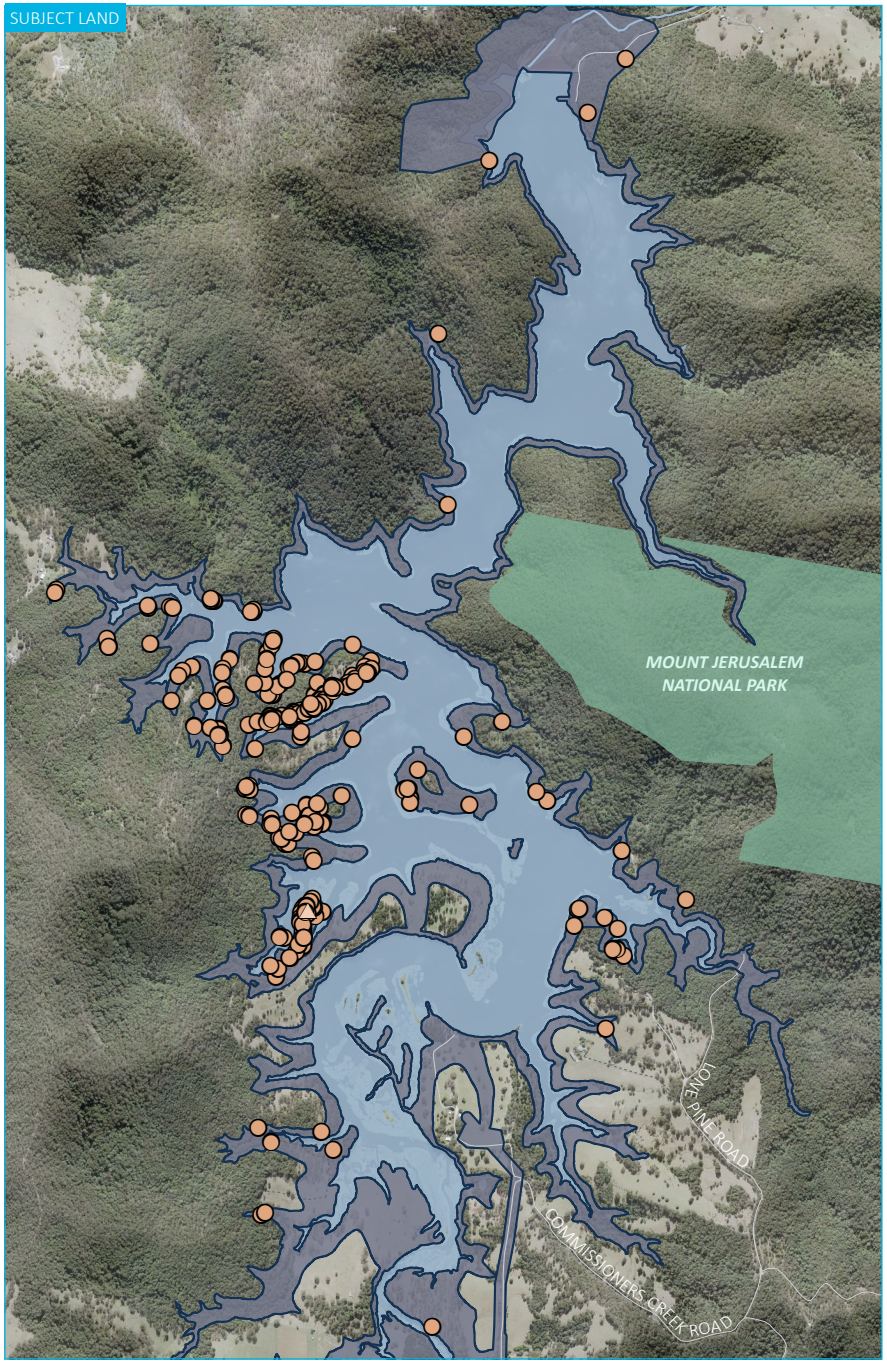
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	The total population of Native Guava is unknown. It is suspected that the total number of mature individuals is greater than 100,000. The number of individuals of Native Guava within the subject land remains unknown given that multiple stems are likely from a common rootstock. If we assume that 10 stems exist per rootstock then 0.61% of the total NSW population is likely to be present at the subject land. The individuals are immature seedlings or suckers and are unlikely to reach maturity given their observed susceptibility to Myrtle Rust.	(TSSC, 2020)	The percentage is based upon a total population size of 100,000 individuals. There is uncertainty as to the current population size. There is insufficient data to inform total population size. The number of individuals of Native Guava within the subject land remains unknown given that multiple stems are likely from a common rootstock.
Number of individuals (mature and immature) to be impacted by the proposal	The Proposal will impact 6,079 roots suckers and an unknown number of individuals. For the purposes of this assessment, we will assume that there are 10 stems (or root suckers) per individual which equates to 608 individuals. All stems recorded within the subject land are immature and are infected with Myrtle Rust. As such, the individuals are unlikely to reach reproductive maturity if left unimpacted by the Proposal.	EMM	The subject land has undergone thorough targeted survey, however the number of individuals of Native Guava within the subject land remains unknown given that multiple stems are likely from a common rootstock.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	Using the rational outlined above an estimated 0.61% of the total NSW population is likely to be present at the subject land and will be impacted by the proposal. All individuals recorded within the subject land are immature and infected with Myrtle Rust. As such, the individuals are unlikely to reach reproductive maturity if left unimpacted by the Proposal.	(TSSC, 2020)	The percentage is based upon a total population size of 100,000 individuals. There is uncertainty as to the current population size. There is insufficient data to inform total population size. The number of individuals of Native Guava within the subject land remains unknown given that multiple stems are likely from a common rootstock
Area of habitat to be impacted (ha) (for species measured by area only)	95.53 ha of habitat will be impacted by the Proposal.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Area of the species' geographic range to be impacted by the proposal (ha)	95.53 ha of habitat will be impacted by the Proposal.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.

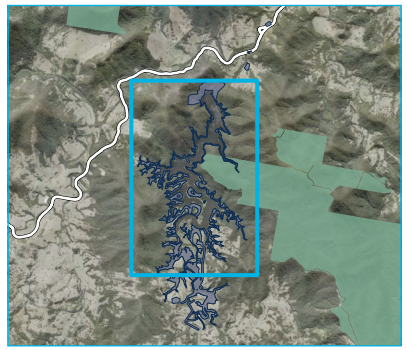
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 6,079 stems of Native Guava, which is likely to reduce the area of occupancy by 0.15% as defined by a 2 x 2 km grid as the complete loss of potential habitat from one individual grid cell will occur.	(TSSC, 2020)	There is insufficient data to determine the actual area of occupancy or extent of occurrence of the species.
Individuals impacted	The Proposal will impact and unknown number of individuals with 6,079 stems removed. For the purposes of this assessment, we will assume that there are 10 stems (or root suckers) per individual which equates to 608 individuals. This is still likely to be highly conservative as it was estimated over 100 stems were attributed to a single rootstock in some cases.	EMM	The subject land has undergone thorough targeted survey. This is an area based species for the purposes of calculation of offset quantum, however stem counts were also undertaken. These stem counts significantly overestimate the number of individuals present.
Viability of a fragmented population	Fragmentation of populations is considered to potentially contribute to the species decline. As such, fragmented populations may not be considered viable.	(TSSC, 2020)	There is insufficient data as to whether the species is viable in fragmented population.
Additional assessment	Due to the high number of individuals to be impacted by the Proposal, additional assessment has been considered in Table 7.20 below.	N/A	N/A

Table 7.20 Additional impact assessment – Native Guava

Impact	Data/ information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII	The majority records of Native Guava within the subject land are located on the western and southern areas of the Dam. The majority of the infrastructure is situated at the northern end of the Dam, largely avoiding impact. However, due to the nature of the Proposal, opportunities to avoid biodiversity values within the operational footprint of the subject land are limited. As the Proposal proposes to increase the water supply yield of the current Dam, inundation of the surrounding land is required to achieve a greater FSL. The majority of the records of Native Guava within the subject land are located within this area of inundation. As such, impacts to the records of Native Guava located between the current and proposed future FSL cannot be avoided. Consideration was given, however, to minimising these impacts by adjusting the Dam height and FSL. Investigations were undertaken of the viability of alternate dam heights, including 74 m AHD and 77 m AHD. Flood modelling indicated that increasing the Dam to these heights would increase the biodiversity impacts by 47% and 84% respectively, in comparison to the proposed height of 70 m AHD.
The extent to which the impact exceeds any threshold for the potential entity	No thresholds have been defined for the species. The Proposal will result in the loss of 95.53 ha of habitat for the species and an estimated 6,079 stems. For the purposes of this assessment, we will assume that there are 10 stems (or root suckers) per individual which equates to 608 individuals. This is still likely to be highly conservative as it was estimated over 100 stems were attributed to a single rootstock.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal)	The Proposal will result in the loss 95.53 ha of habitat for the species; however it is considered likely that the local population of Native Guava is larger than has been indicated solely through records captured for the Proposal. Surveys in adjacent vegetation were minor, and additional survey outside of the subject land is required to ascertain the extent of the subpopulation. Within adjacent vegetation, 107 were recorded, however it is considered likely additional records of Native Guava would be observed with further survey effort outside of the subject land. All individuals of Native Guava recorded within the subject land are immature and infected by Myrtle Rust. As such, the individuals are unlikely to reach reproductive maturity due to the infection and are unlikely to set fruit and contribute to the species dispersal. Therefore, the Proposal is unlikely to have an impact on the ecology of the local population of Native Guava.
A description of the extent to which the local population will become fragmented	The Proposal is not predicted to fragment the local population into two or more populations. The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population.
The relationship of the local population to other populations	The population with the subject land and surrounding vegetation is likely to be a disjunct population, geographically isolated from other populations in the locality. This population is likely to have limited exchange of genetic material with other populations.
The measures proposed to contribute to the recovery of the species in the IBRA subregion	Impacts to the species will be offset in accordance with the BOS, however offsets do not have to be located in the same IBRA subregion. No measures have been proposed to contribute to the recovery of the species in the IBRA subregion.







KEY

- Subject land

Native Guava species record

- CHDR project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); MetroMap (2024)

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Species records of Native Guava (*Rhodomyrtus psidioides*) in NSW

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 7.7

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vii Durobby (*Syzygium moorei*)

Table 7.21 and Table 7.22 below provide an assessment of the Proposal on the species. Figure 7.8 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.21 Current status - Durobby

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	There is no data to inform a change in the population size of the species in the past 10 years or three generations.	(DEWHA, 2008)	Data is deficient. There is insufficient data to inform changes in the population size of the species.
Evidence of small population size (Principle 2)			
Current population size in NSW	There is no current population estimate in NSW as of 2024. The most recent population estimates are from 2008 indicating 115 occurrences of the species from the Byron Bay and Tweed LGAs. BioNet records indicate that the species has been recorded within NSW on 783 occasions.	(DEWHA, 2008) (DCCEEW, 2024a)	There is insufficient data to inform the current population size. The latest report on the population size is from 2008.
Decline in species' population size in 3 years or one generation	There is no data on a decline in the species population in 3 years or one generation.	(DEWHA, 2008)	There is no data on a decline in the species population in 3 years or one generation.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	The current number or percentage of mature individuals in each subpopulation is unknown.	(DEWHA, 2008)	There is no recent data on the full extent of occurrence for this species. The most current data on the count of individuals for this species is from 2008.
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	There is no recent data on the extent of occurrence for this species. In 2008, the species was known from the Byron Bay and Tweed LGAs, and from Nicholls Scrub and Upper Tallebudgera Creek in QLD.	(DEWHA, 2008)	There is no recent data on the full extent of occurrence for this species. The most current data is from 2008.

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Area of occupancy (ha)	There is no recent data on the area of occupancy for this species. In 2008, the species was known from the Byron Bay and Tweed LGAs, and from Nicholls Scrub and Upper Tallebudgera Creek in QLD.	(DEWHA, 2008)	There is no recent data on the full area of occupancy for this species. The most current data is from 2008.
Number of threat-defined locations	The Durobby is known to occur from a small number of localities due to its limited distribution. However, there is no current information on the number of threat-defined locations.	(DEWHA, 2008)	There is no data on the number of threat-defined locations for the species.
Whether the species' population is likely to undergo extreme fluctuations	The species is susceptible to stream bank erosion, fire, and coastal storms. There is no report of previous fluctuations in the population, and it is uncertain whether a fluctuation in the population would be considered as extreme.	(DEWHA, 2008)	There is no data on whether the species' population is likely to undergo extreme fluctuations.
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	Not required as species is not considered under Principle 4.	N/A	N/A

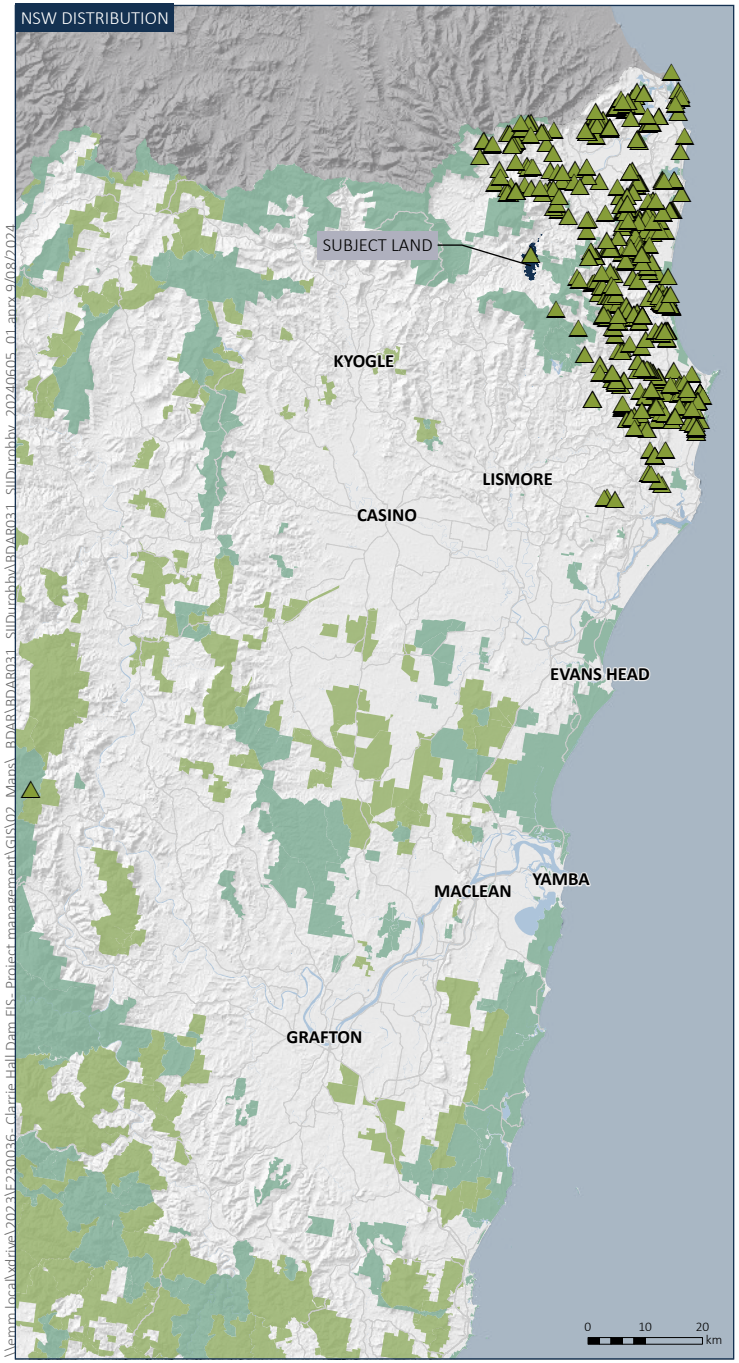
b Impact assessment

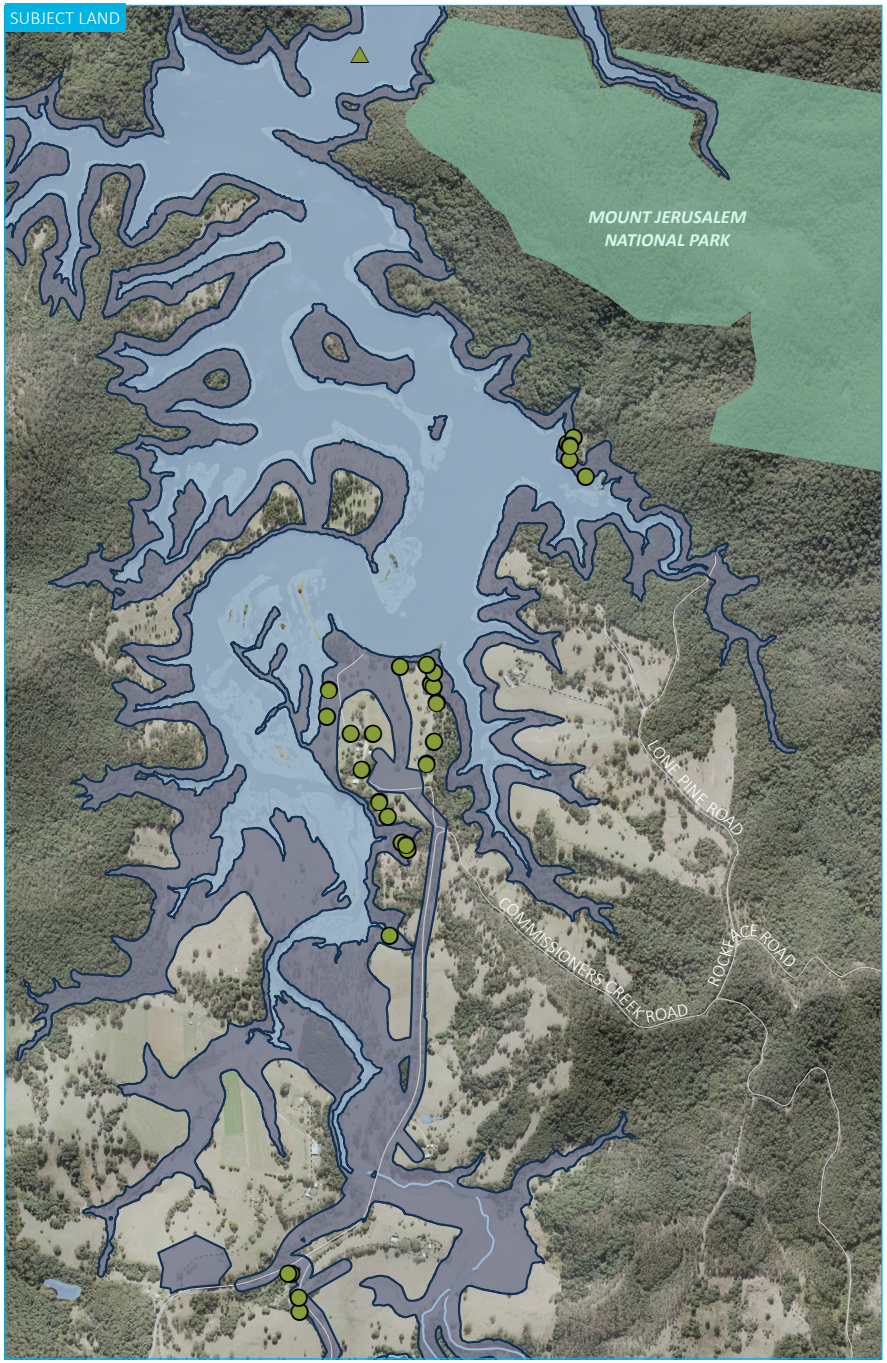
Table 7.22 Impact assessment - Durobby

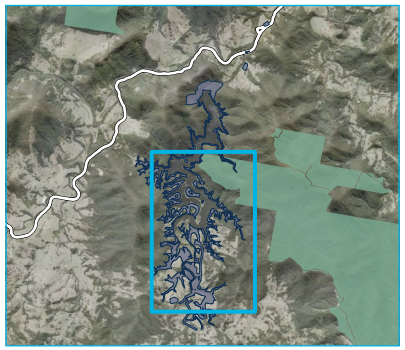
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Within the subject land, 18 individuals of Durobby were recorded. Of these 18 records, 2 were recorded within planted native vegetation that has been assessed in accordance with the streamlined assessment module of the BAM (DPIE, 2020). Outside of the subject land, the species was recorded 15 times in adjacent vegetation. Durobby is a commonly planted species, and all individuals recorded within the subject land and adjacent to the subject land are likely to have been planted or have self seeded from planted specimens. It is unlikely that the species occurs naturally within the immediate vicinity of the Subject Land with the species more commonly occurring on the lower floodplain of the Tweed catchment.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	The latest report on the population size of the species is from 2008. The current total population of Durobby is unknown. BioNet records indicate that the species has been recorded within NSW on 783 occasions. The Proposal will involve the loss of 18 individuals. Given the lack of recent population data, a percentage cannot be calculated.	(DEWHA, 2008) (DCCEEW, 2024a)	There is no recent data on the population size of the species.
Number of individuals (mature and immature) to be impacted by the proposal	The Proposal will involve the loss of 18 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	The latest report on the population size of the species is from 2008. The current total population of Durobby is unknown. BioNet records indicate that the species has been recorded within NSW on 783 occasions. The Proposal will involve the loss of 18 individuals. Given the lack of recent population data, a percentage cannot be calculated.	(DEWHA, 2008) (DCCEEW, 2024a)	There is no recent data on the population size of the species.
Area of habitat to be impacted (ha) (for species measured by area only)	Durobby is measured by count.	N/A	N/A
Area of the species' geographic range to be impacted by the proposal (ha)	7.41 ha of habitat for Durobby will be impacted by the Proposal. This area has been calculated in accordance with the method for determining the impact for area based flora species as specified in the TBDC and BAM (DPIE, 2020).	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 18 individuals of Durobby, however the Proposal is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.	(DEWHA, 2008)	There is insufficient data to determine the area of occupancy or extent of occurrence of the species.
Individuals impacted	The Proposal will involve the loss of 18 individuals.	EMM	Data is sufficient. The subject land has undergone thorough targeted survey.

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Viability of a fragmented population	Many individuals of the species occur as isolated paddock trees. Whilst the species can survive in isolation, there are limited opportunities for natural regeneration.	(DEWHA, 2008)	There is insufficient data as to whether the species is viable in fragmented population.
Additional assessment	Given that the Proposal will only result in a loss of 18 individuals of Durobby, no further SAII assessment has been undertaken for the species.	N/A	N/A







KEY

- Subject land

Durobby species record

- CHDR project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); MetroMap (2024)

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Species records of Durobby (*Syzygium moorei*) in NSW

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Figure 7.8

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viii Mitchell's Rainforest Snail (*Thersites mitchellae*)

Table 7.23 to Table 7.25 below provide an assessment of the Proposal on the species. Figure 7.9 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.23 Current status - Mitchell's Rainforest Snail

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Records have indicated that the species was once common within its range and has since undergone a decline. However, there is no data to support a change in population in the past 10 years or 3 generations.	(TSSC, 2016)	Data is deficient. There is currently no data to indicate a change in population in the past 10 years or 3 generations.
Evidence of small population size (Principle 2)			
Current population size in NSW	Not required as species is not considered under Principle 2.	N/A	N/A
Decline in species' population size in 3 years or one generation	As above	N/A	N/A
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	As above	N/A	N/A
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	The extent of occurrence is estimated to be less than 400 km^2.	(TSSC, 2002)	Data is deficient. The latest estimate for the extent of occurrence for the species was from 2002.
Area of occupancy (ha)	The area of occupancy is estimated to be less than 5 km^2.	(TSSC, 2002) (TSSC, 2016)	Data is deficient. The latest estimate for the extent of occurrence for the species was from 2016.
Number of threat-defined locations	There is no data on the number of threat-defined locations.	(TSSC, 2002) (TSSC, 2016)	Data is deficient. No threat-defined locations have been defined.

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Whether the species' population is likely to undergo extreme fluctuations	There is no recent data on the species' population and no data on whether the species' population is likely to undergo extreme fluctuations.	(TSSC, 2002) (TSSC, 2016)	Data is deficient.
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	Not required as species is not considered under Principle 4.	N/A	N/A

b Impact assessment

Table 7.24 Impact assessment - Mitchell's Rainforest Snail

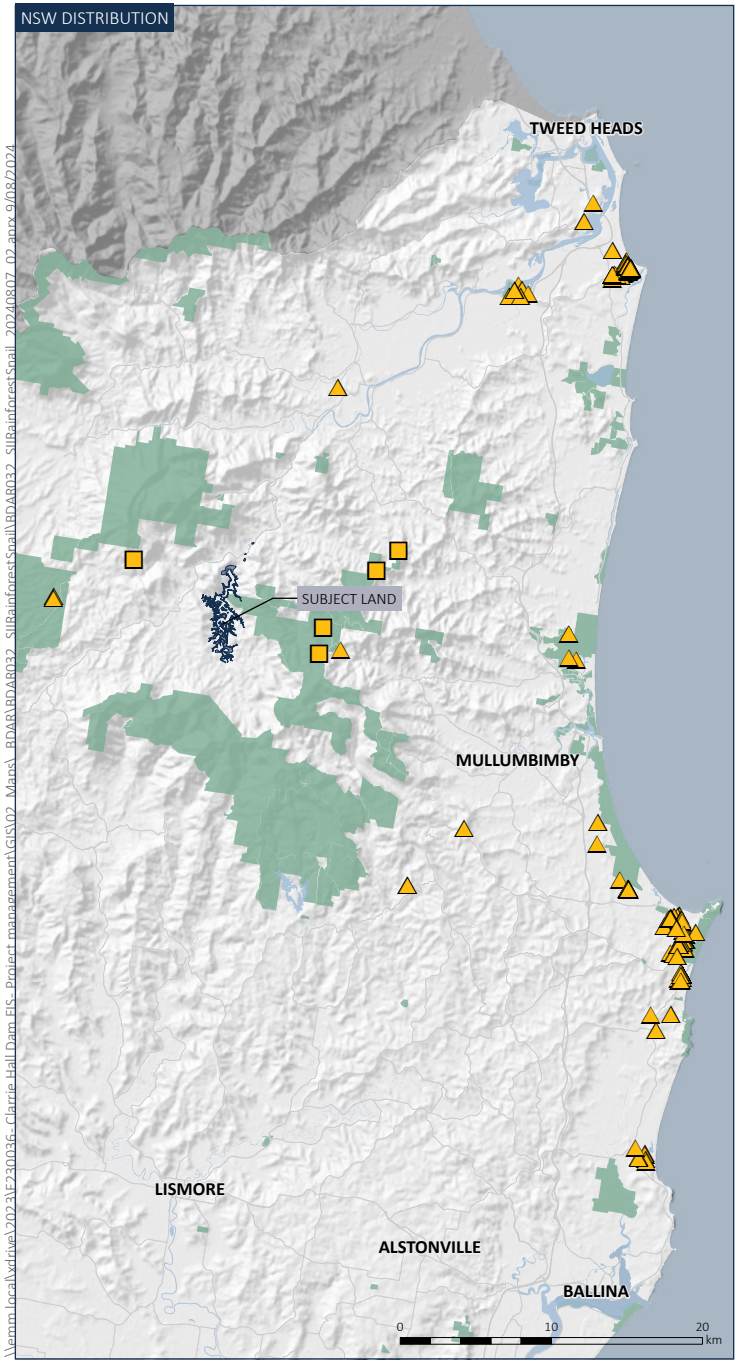
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Within the subject land, four individuals of the species were recorded, consisting of two live individuals and two empty shell. One of the live individuals was identified as a sub-adult, which may indicate that this population is a breeding population. An additional empty shell was recorded in the subject site but was brought into the area by a predatory bird. In accordance with the expert report prepared for the species (Appendix F). In terms of the size of the population, the expert report states "*it is impossible to put a hard number on the population of mature individuals, but a ballpark estimate would be less, and maybe very much less, than 100 individuals*."	EMM (Stanisic, 2021)	Data is deficient. Additional survey is required to determine the actual size of the population in and adjacent to the subject land.

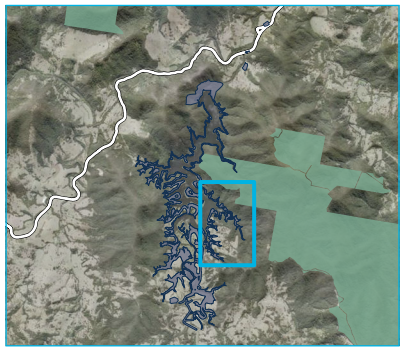
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	The size of the population in NSW has not been reported. As of 2011, the total population of the species across its range was estimated to be up to 500 individuals (TSSC, 2016) . A thesis completed by Jonathan Parkyn (2014) studied a population of the species within the Byron Shire and estimated this subpopulation to contain 500 individuals itself. Parkyn (2014) has since proposed a revised total population estimate of approximately 5,000 mature individuals of the Mitchell's Rainforest Snail. Three individuals were recorded within the subject land. Based on these records and identified habitat the expert report stated that "*it is impossible to put a hard number on the population of mature individuals, but a ballpark estimate would be less, and maybe very much less, than 100 individuals*." Moreover, surveys in adjacent areas was not undertaken as part of the Expert Report, so the extent of the population and its associated habitat cannot be accurately estimated. Hence, it is difficult to accurately estimate the percentage of total NSW population present.	(TSSC, 2016) (Parkyn, 2014)	Data is deficient. There is insufficient data with conflicting estimates to determine the total population of the species in NSW.
Number of individuals (mature and immature) to be impacted by the proposal	The expert report stated that the proposal may impact the population, which size has been described as "*it is impossible to put a hard number on the population of mature individuals, but a ballpark estimate would be less, and maybe very much less, than 100 individuals*." However, the expert report also states that "*translocation would significantly reduce the impact of the dam raising on Rainforest Snail and also and benefit the continued existence of Rainforest Snail in the Tweed River drainage*." Mitigation requirements to translocate Mitchell's Rainforest Snail are detailed in Table 7.3.	EMM	Data is deficient. Survey is unlikely to be able to ascertain the total number of individuals present within the subject land.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	Two live individuals were recorded within the subject land, with one of these a sub-adult which indicates it is a breeding population. However, based on these records and identified habitat, the expert report stated that "*it is impossible to put a hard number on the population of mature individuals, but a ballpark estimate would be less, and maybe very much less, than 100 individuals*." Hence, it is difficult to accurately estimate the percentage of total NSW population to be impacted.	(TSSC, 2016)	Data is deficient. There is insufficient data to determine the total population of the species in NSW.

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Area of habitat to be impacted (ha) (for species measured by area only)	As defined in the expert report for the species, the area of habitat for the Mitchell's Rainforest Snail to be impact by the Proposal is 0.82 ha. Note that the species polygon was previously three separate units, which were joined in this BDAR to take a more conservative approach to quantify habitat for this species. The revised species polygon is 2.20 ha.	EMM (Stanisic, 2021)	Data is sufficient. The area of habitat to be impacted has been adequately assessed by the species expert.
Area of the species' geographic range to be impacted by the proposal (ha)	2.20 ha of habitat will be impacted by the Proposal.	EMM	Data is sufficient. The area of habitat to be impacted has been adequately assessed by the species expert.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 2.20 ha of habitat for Mitchell's Rainforest Snail, which is likely to reduce the area of occupancy by 0.21% as defined by a 2 x 2 km grid as the complete loss of potential habitat from one individual grid cell will occur.	(TSSC, 2016)	There is insufficient data to determine the actual area of occupancy or extent of occurrence of the species.
Individuals impacted	The Proposal will impact two live individuals. However, the expert report describes the number of individuals to be impacted as "*it is impossible to put a hard number on the population of mature individuals, but a ballpark estimate would be less, and maybe very much less, than 100 individuals*." Hence, it is difficult to accurately estimate the number of individuals to be impacted. Nevertheless, the expert report states that "*Clarrie Hall Dam project must minimise the impact on population discovered within the inundation footprint. This can best be achieved by translocating as many of the individuals considered at risk which will have a continuing benefit for Rainforest Snail in the Tweed River drainage*."	EMM	Data is insufficient. Survey is unlikely to be able to ascertain the total number of individuals present within the subject land.
Viability of a fragmented population	The viability of a fragmented populations is uncertain. However, as a land snail, areas that are permanently inundated could fragment a population if mitigation (i.e. translocation) is not undertaken.	(TSSC, 2016)	There is insufficient data to inform the viability of fragmented populations.
Additional assessment	Due to the population on the subject land likely to be a new breeding population, additional assessment has been considered in Table 7.25 below.	N/A	N/A

Table 7.25 Additional impact assessment - Mitchell's Rainforest Snail

Impact	Data/ information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII	Mitchell's Rainforest Snail was located in the operational footprint of the Proposal where inundation will occur. Due to the nature of the Proposal, opportunities to avoid biodiversity values within the operational footprint of the subject land are limited. As the Proposal proposes to increase the water supply yield of the current Dam, inundation of the surrounding land is required to achieve a greater FSL. As such, impacts to the records of Mitchell's Rainforest Snail located between the current and proposed future FSL cannot be avoided. Consideration was given, however, to minimising these impacts by adjusting the Dam height and FSL. Investigations were undertaken of the viability of alternate dam heights, including 74 m AHD and 77 m AHD. Flood modelling indicated that increasing the Dam to these heights would increase the biodiversity impacts by 47% and 84% respectively, in comparison to the proposed height of 70 m AHD.
The extent to which the impact exceeds any threshold for the potential entity	The Proposal will result in the loss of two known live individuals of the Mitchell's Rainforest Snail, however the full extent of the population is *"impossible to put a hard number on the population of mature individuals, but a ballpark estimate would be less, and maybe very much less, than 100 individuals"* according the expert report prepared for the species. The proposal will remove 2.20 ha of habitat for the species. Additional individuals of the species are likely to be present within the subject land than were identified through survey. No thresholds have been defined for the species.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal)	As indicated by the presence of a sub-adult individual, the Mitchell's Rainforest Snail population within the subject land is likely to be a breeding population (Stanisic, 2021). As such, the inundation of 2.20 ha of habitat for the species may adversely impact breeding habitat as well as foraging habitat for the local population. Being a slow-moving invertebrate, without mitigation methods, individuals located within the subject land during inundation will be unable to disperse to alternate locations.
A description of the extent to which the local population will become fragmented	The live individuals of the Mitchell's Rainforest Snail were recorded within a gully at the southeastern end of the Dam. The increase in the capacity of the Dam will result in the water level within this gully extending further upstream, potentially fragmenting the terrestrial vegetation on either side of the gully for less mobile fauna species such as the Mitchell's Rainforest Snail. It is proposed that individuals within the known area of habitat be translocated to an area of similar habitat in the locality to maintain the local population. As such, with this mitigation measure in place, it is unlikely that the Proposal will fragment the population.
The relationship of the local population to other populations	Mitchell's Rainforest Snail is restricted to northeastern NSW, where small populations occur in remnant areas of suitable vegetation (TSSC, 2016). As the species has low mobility and occurs as distinct populations, it is likely that there is a limited relationship between individual populations of the species. Historically this species was known to predominantly occurs on coastal plains. Studies by Parkyn (2014) found several additional populations occurring up to 600 m elevation, providing suitable riparian habitat is present. Several of these additional records are within Mount Jerusalem National Park which is adjacent and connected to the subject site.
The measures proposed to contribute to the recovery of the species in the IBRA subregion	Where possible, individuals of the species within the subject land will be translocated to similar, adjacent vegetation to maintain the local population (see Table 7.3). Impacts to the species will be offset in accordance with the BOS (refer Section 8.3).





KEY

- Subject land

Mitchell's Rainforest Snail species record

- CHDR project record
- Bionet record
- Parkyn 2014 record

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody
- NPWS reserve

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); MetroMap (2024)

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Species records of Mitchell's Rainforest Snail (*Thersites mitchellae*) in NSW

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Figure 7.9

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ix Sooty Owl (*Tyto tenebricosa*)

Table 7.26 to Table 7.28 below provide an assessment of the Proposal on the species. Figure 7.10 displays the records of the species both within the subject land, and within NSW as a whole.

a Current status

Table 7.26 Current status - Sooty Owl

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	Not required as species is not considered under Principle 1.	N/A	N/A
Evidence of small population size (Principle 2)			
Current population size in NSW	Not required as species is not considered under Principle 2.	N/A	N/A
Decline in species' population size in 3 years or one generation	As above.	N/A	N/A
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	As above.	N/A	N/A
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	The species total extent of occurrence (EOO) is estimated to be 230,000 km^2. In NSW the EOO is estimated to be greater than 115,000 km^2.	(NSW Scientic Committee, 2008)	Data is deficient. The latest estimate for the extent of occurrence for the species was from 2008.
Area of occupancy (ha)	The species total area of occupancy (AOO) is estimated to be 50,000 km^2. In NSW the AOO is estimated to be greater than 25,000 km^2.	(NSW Scientic Committee, 2008)	Data is deficient. The latest estimate for the area of occupancy for the species was from 2008.

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of threat-defined locations	There is no data on the number of threat-defined locations. The BAM (DPIE, 2020) defines threat-defined locations as geographically or ecologically distinct areas in which a single threatening event may rapidly affect species occurrences. Where two or more subpopulations occur in an area that may be threatened by one such event, they are counted as a single location. Where a subpopulation covers an area larger than what a single event is likely to impact, this is counted as two or more locations.	(NSW Scientic Committee, 2008)	Data is deficient. No threat-defined locations have been defined.
Whether the species' population is likely to undergo extreme fluctuations	There is no evidence of extreme fluctuations in the population size or habitat for Sooty Owl.	(NSW Scientic Committee, 2008)	Data is deficient.
Response to management (Principle 4)			
Unlikely to respond to management at a stewardship site	There is no evidence that the species is unlikely to respond to management at a stewardship site. The species inhabits sheltered gullies of subtropical and warm temperate rainforest and moist eucalypt forest. The species roosts in a variety of features such as hollows, dense vegetation and rock overhangs, and relies on hollows for nesting and breeding. The species prefers large blocks of forest, typically greater than 200 ha. Stewardship sites lacking the hollows of sufficient size for the species breeding will not respond to management, given the time taken for such hollows to develop. Foraging resources in contrast would have a response to management, if prey species result in increased abundances.	(NSW Scientic Committee, 2008)	There is insufficient data on the response of the species to management at stewardship sites.

Table 7.27 Impact assessment - Sooty Owl

Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of individuals (mature and immature) present in the subpopulation on the subject land	Targeted surveys recorded Sooty Owl on 17 occasions within and surrounding the subject land. Six of the observations were within the subject land and 11 were within 50 m of the subject land. Due to the mobile nature of the species, it cannot be ascertained if the same individuals were recorded multiple times, nor whether the subpopulation in the area is larger than could be determined through targeted survey.	EMM	Data is sufficient. Subject land was surveyed with presence of species determined in accordance with recommended survey guidelines.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	It is estimated that the Sooty Owl has a minimum population size of 2,000 pairs or breeding individuals, or at least 10,000 mature individuals. The estimate does not include immature individuals; therefore, the overall population is likely to be larger. Based on an overall population size of 10,000 mature individuals or Sooty Owl, the Proposal will impact upon 0.17% of the total NSW population.	(DEC NSW, 2006)	Data is deficient. The latest estimate for the population size is from 2006.
Number of individuals (mature and immature) to be impacted by the proposal	The species was recorded 6 times within the subject land, with an additional 11 records within 50 m of the subject land. Due to the mobile nature of the species, it cannot be ascertained if the same individuals were recorded multiple times, nor whether the subpopulation in the area is larger than could be determined through targeted survey.	EMM	Data is sufficient. Subject land was surveyed with presence of species determined in accordance with recommended survey guidelines.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	Resident breeding pairs of Sooty Owls defend exclusive nesting territories within larger, defended home ranges of 400-3 000 ha, depending on habitat quality and prey densities. Using a highly conservative estimate of 4 pairs within the subject land and an overall population size of 10,000 mature individuals or Sooty Owl, the Proposal would impact upon 0.08% of the total NSW population.	(DEC NSW, 2006) (NSW Scientic Committee, 2008)	Data is deficient. The latest estimate for the population size is from 2006.
Area of habitat to be impacted (ha) (for species measured by area only)	The Proposal will impact on 52.65 ha of habitat for the Sooty Owl.	EMM	Data is sufficient. Subject land was surveyed with presence of species determined in accordance with recommended survey guidelines.

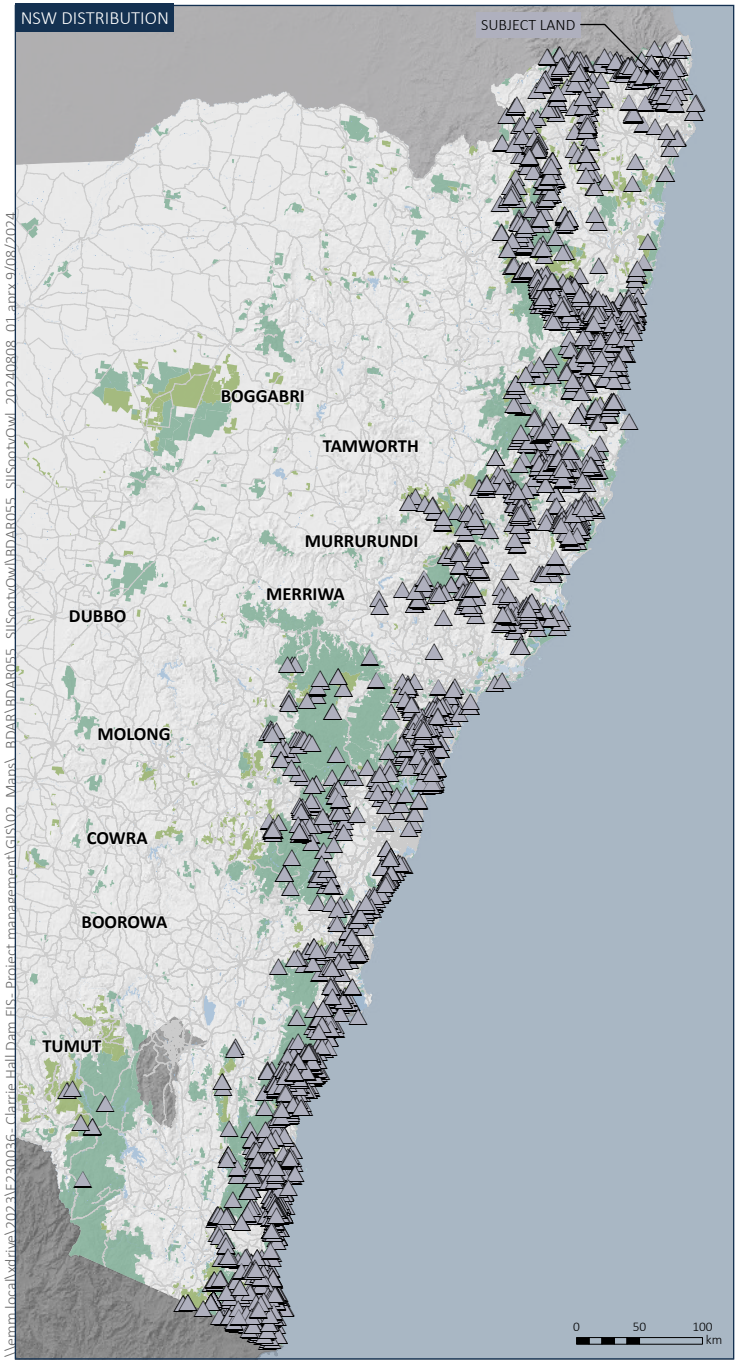
Impact	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Area of the species' geographic range to be impacted by the proposal (ha)	The Proposal will impact on 52.65 ha of habitat for the Sooty Owl.	EMM	Data is sufficient. Subject land was surveyed with presence of species determined in accordance with recommended survey guidelines.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	The IUCN recommends standardisation of estimates of area of occupancy by applying a 2 x 2 km grid to occurrence data, a method which is adopted in assessment of conservation status under the EPBC Act (TSSC, 2015). The Proposal will result in the loss of 52.65 ha of habitat for Sooty Owl, however the Proposal is unlikely to reduce the area of occupancy as defined by a 2 x 2 km grid as the complete loss of potential habitat from any individual grid cell is unlikely to occur.		
Individuals impacted	Targeted surveys recorded Sooty Owl on 17 occasions within and surrounding the subject land. Six of the observations were within the subject land and 11 were within 50 m of the subject land.	EMM	Data is sufficient. Subject land was surveyed with presence of species determined in accordance with recommended survey guidelines.
Viability of a fragmented population	There is little evidence of the effect of fragmentation on the Sooty Owl. The species exhibits a preference for large blocks of forest, typically greater than 200 ha, avoiding small patches and strips. The species is highly mobile however, dispersing up to 50 km across cleared landscapes and is therefore unlikely to become fragmented by the Proposal.	(DEC NSW, 2006)	Data is deficient. The latest estimate for the population size is from 2006.
Additional assessment	Additional assessment has been undertaken for the Sooty Owl.	N/A	N/A

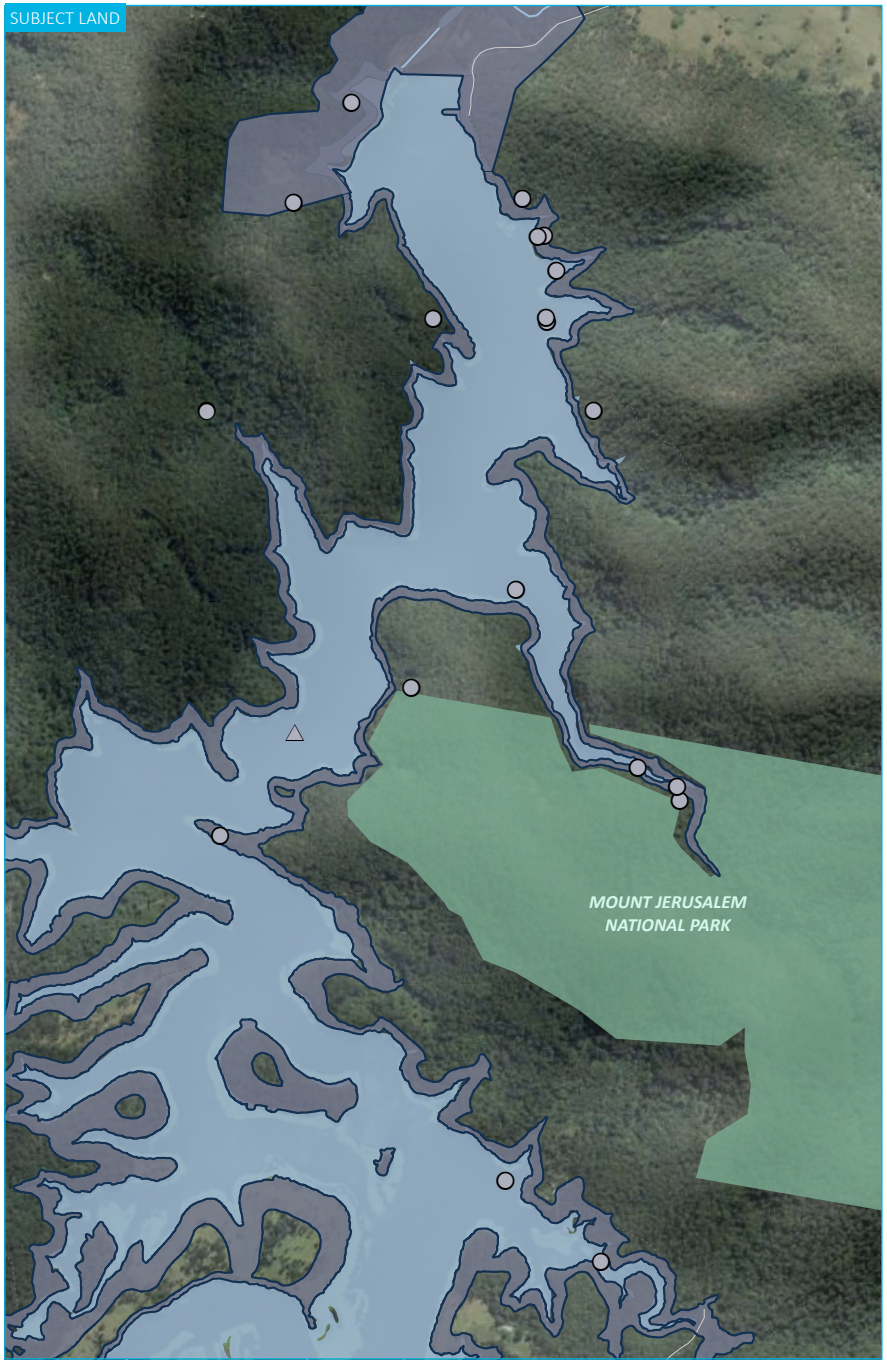
c Additional impact assessment

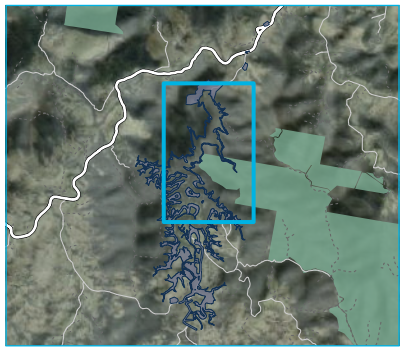
Table 7.28 Additional impact assessment - Sooty Owl

Impact	Data/ information
Actions and measures taken to avoid direct and indirect impact on the potential entity for SAII	The records of Sooty Owl are dispersed throughout the subject land and occur within the construction and operational footprints of the Proposal. Measures have been taken to implement avoidance of biodiversity values within the construction footprint, by locating the majority of the infrastructure at the northern end of the Dam. The northern end of the Dam already contains areas of hardscaping for the current Dam infrastructure and will require less vegetation clearing to facilitate the new and upgraded infrastructure. However, due to the nature of the Proposal, opportunities for avoidance of the biodiversity values within the operational footprint of the subject land are limited. As the Proposal proposes to increase the water supply yield of the current Dam, inundation of the surrounding land is required to achieve a greater FSL. As such, impacts to the records of Sooty Owl located between the current and proposed future FSL cannot be avoided. Consideration was given, however, to minimising these impacts by adjusting the Dam height and FSL. Investigations were undertaken of the viability of alternate dam heights, including 74 m AHD and 77 m AHD. Flood modelling indicated that increasing the Dam to these heights would increase the biodiversity impacts by 47% and 84% respectively, in comparison to the proposed height of 70 m AHD.
The extent to which the impact exceeds any threshold for the potential entity	No thresholds have been defined for the species. Targeted surveys recorded Sooty Owl on 17 occasions within and surrounding the subject land. Six of the observations were within the subject land and 11 were within 50 m of the subject land. The species polygon for the Sooty Owl constitutes 52.65 ha of suitable habitat which will be impacted by the Proposal.
The likely impact on the ecology of the local population (breeding/ foraging and dispersal)	The species inhabits sheltered gullies of subtropical and warm temperate rainforest and moist eucalypt forest. The species roosts in a variety of features such as hollows, dense vegetation and rock overhangs, and relies on hollows for nesting and breeding. The species prefers large blocks of forest, typically greater than 200 ha. The Proposal will involve the loss of 225.36 ha of wet sclerophyll forest and 8.77 ha of subtropical rainforest known to support foraging and roosting habitat for the Sooty Owl. Subtropical rainforest typically occurs within discrete gullies within the subject land and extends upstream into the adjacent vegetation. According to the SVTM, extensive areas of wet sclerophyll forest and discrete patches and larger tracts of rainforest occur within 10 km of the subject land (DCCEEW, 2022). The Proposal will also involve the loss of 48 hollow bearing trees, however targeted surveys did not detect breeding. As such, the Proposal is likely to have an impact on the local population of Sooty Owl, however it is unlikely to be substantial as the population will be able to utilise the similar habitat surrounding the subject land.
A description of the extent to which the local population will become fragmented	The Proposal will involve an outward expansion of the Dam footprint as a result of the increase in the capacity of the reservoir. Records of the of Sooty Owl are dispersed throughout the subject land, on both sides of the reservoir. The species is highly mobile however, dispersing up to 50 km across cleared landscapes and is therefore unlikely to become fragmented by the Proposal.
The relationship of the local population to other populations	The species has been recorded 160 times in the locality of the subject land (DCCEEW, 2024a). The majority of these records are within the surrounding and highly vegetated Nightcap, Mebbin and Wollumbin National Parks. Due to the high mobility of the species, it is likely that the individuals observed within the subject land would interact with the surrounding populations.

Impact	Data/ information
The measures proposed to contribute to the recovery of the species in the IBRA subregion	Impacts to the species will be offset in accordance with the BOS (refer Section 8.3).







KEY

- Subject land

Sooty Owl species record

- CHD project record
- Bionet record

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

INSET KEY

- Major road

Source: EMM (2024); KBR (2024); DCSSS (2024); OEH (2024); GA (2009); Sixmaps (2024)

\\emm.local\xdrive\2023\E230036 - Clarrie Hall Dam EIS - Project management\GIS\02_Maps_BDAR\BDAR055_SIISootyOwl\BDAR055_SIISootyOwl_20240808_01.aprx 9/08/2024

Species records of Sooty Owl (*Tyto tenebricosa*) in NSW

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 7.10

EMM
creating opportunities

8 Impact summary

8.1 Impacts not requiring offset

In accordance with Section 9.2.1 of BAM (DPIE, 2020), impacts on vegetation zones and threatened species habitat do not require offsets where:

- a vegetation zone representative of a critically endangered or endangered ecological community has a vegetation integrity score less than 15, and/or
- a vegetation zone representative of a vulnerable ecological community and/or threatened species habitat has a vegetation integrity score less than 17, and/or
- a vegetation zone that is not listed has a vegetation integrity score less than 20.

In addition, areas not requiring assessment in accordance with Section 9.3 of the BAM (DPIE, 2020) include:

- existing roads
- cleared and highly disturbed land
- exotic vegetation
- planted native vegetation
- watercourses.

Table 8.1 provides a summary of the vegetation zones that do not trigger the above thresholds and therefore do not require ecosystem credits. This includes exotic vegetation, vegetation below the vegetation integrity threshold and planted native vegetation.

Table 8.1 Summary of impacts not requiring offsets – native vegetation

Vegetation zone	PCT ID	Condition	Area (ha)	Change in vegetation integrity score
827_derived_sedgeland	827	Derived sedgeland	4.58	-1.1
827_pasture	827	Pasture	64.06	-6.2
Hoop_plantation	N/A	Hoop Pine plantation	4.64	N/A
Euc_plantation	N/A	Eucalyptus plantation	7.34	N/A
Planted native vegetation	N/A	N/A	1.02	N/A
Exotic trees	N/A	Exotic	0.24	N/A

8.2 Impacts requiring offset

This section provides an assessment of the impacts requiring offsetting in accordance with Section 9.2 of BAM (DPIE, 2020).

8.2.1 Impacts to native vegetation

Impacts to native vegetation requiring offsets include:

- direct impacts to 221.66 ha of PCT 827 - Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast
- direct impacts to 2.67 ha of PCT 1073 - Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
- direct impacts to 8.77 ha of PCT 1302 - White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion.

A summary of ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, is provided in Table 8.2. Credit reports are provided in Appendix G.

Table 8.2 Summary of impacts requiring offset – ecosystem credits

Vegetation zone ID	PCT	Condition	Impact area (ha)	Current VI score	Future VI score	Change in VI score	Biodiversity risk weighting	Ecosystem credits required
PCT 827 Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast								
827_High	827	High	72.13	68.9	0	-68.9	1.75	2,173
827_Mod	827	Moderate	31.27	60.5	0	-60.5	1.75	827
827_Burnt	827	Burnt	19.04	92.3	0	-92.3	1.75	769
827_Low	827	Low	25.50	56.1	0	-56.1	1.75	626
827_Planted	827	Planted	5.08	84.3	0	-84.3	1.75	187
Subtotal								**4,582**
PCT 1073 Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion								
1073_High	1073	High	2.67	79.5	0	-79.5	1.5	80
Subtotal								**80**
PCT 1302 White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion								
1302_High	1302	High	5.78	63.7	0	-63.7	2.5	230
1302_Mod	1302	Moderate	2.99	54.7	0	-54.7	2.5	102
Subtotal								**332**
Total number of ecosystem credits required								**4,994**

8.2.2 Impacts to threatened species

A summary of the species credits required for all vegetation zones occupied by threatened species is provided in Table 8.3. Credit reports are provided in Appendix G.

Table 8.3 Summary of impacts requiring offsets – species credits

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
Pouched Frog (*Assa darlingtoni*)							
827_High	23.4	68.9	0	-68.9	2	False	805
1302_High	5.8	63.7	0	-63.7	2	False	184
1302_Mod	3.0	54.7	0	-54.7	2	False	82
Subtotal							**1,071**
White-eared Monarch (*Carterornis leucotis*)							
827_Burnt	19.0	92.3	0	-92.3	2	False	879
827_High	72.1	68.9	0	-68.9	2	False	2,483
827_Low	25.5	56.1	0	-56.1	2	False	715
827_Mod	31.3	60.5	0	-60.5	2	False	945
827_Planted	5.1	84.3	0	-84.3	2	False	214
1073_High	2.7	79.5	0	-79.5	2	False	106
1302_High	5.8	63.7	0	-63.7	2	False	184
1302_Mod	3.0	54.7	0	-54.7	2	False	82
Subtotal							**5,608**
Corokia (*Corokia whiteana*)							
827_High	6	N/A	0	N/A	3	True	18
1302_High	6	N/A	0	N/A	3	True	18
Subtotal							**36**

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
Thorny Pea (*Desmodium acanthocladum*)							
827_Mod	2.2	60.5	0	-60.5	2	False	67
Subtotal							**67**
Basket Fern (*Drynaria rigidula*)							
827_Low	0.5	56.1	0	-56.1	3	True	21
Subtotal							**21**
Rusty Rose Walnut (*Endiandra hayesii*)							
827_Burnt	3	N/A	0	N/A	2	False	6
827_High	7	N/A	0	N/A	2	False	14
827_Mod	3	N/A	0	N/A	2	False	6
1302_High	36	N/A	0	N/A	2	False	72
1302_Mod	1	N/A	0	N/A	2	False	2
Subtotal							**100**
Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*)							
827_Burnt	77	N/A	0	N/A	3	True	231
827_High	231	N/A	0	N/A	3	True	693
827_Low	3	N/A	0	N/A	3	True	9
827_Mod	51	N/A	0	N/A	3	True	153
827_Planted	4	N/A	0	N/A	3	True	12
1073_High	1	N/A	0	N/A	3	True	3
1302_High	61	N/A	0	N/A	3	True	183
1302_Mod	29	N/A	0	N/A	3	True	87

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
Subtotal							**1,371**
Narrow leaf Finger Fern (*Grammitis stenophylla*)							
827_High	0.34	68.9	0	-68.9	2	False	12
827_Mod	0.12	60.5	0	-60.5	2	False	4
1302_High	0.57	63.7	0	-63.7	2	False	18
Subtotal							**34**
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)							
827_High	14.4	68.9	0	-68.9	2	False	494
827_Low	1.3	56.1	0	-56.1	2	False	36
827_Mod	4.4	60.5	0	-60.5	2	False	132
Subtotal							**662**
Red Boppel Nut (*Hicksbeachia pinnatifolia*)							
927_Planted	4	N/A	0	N/A	2	False	8
Subtotal							**8**
Fine-leaved Tuckeroo (*Lepiderema pulchella*)							
827_Low	5	N/A	0	N/A	3	True	15
827_Planted	10	N/A	0	N/A	3	True	30
Subtotal							**45**
Rough-shelled Bush Nut (*Macadamia tetraphylla*)							
827_Burnt	1	N/A	0	N/A	2	False	2
827_High	1	N/A	0	N/A	2	False	2
827_Low	3	N/A	0	N/A	2	False	6

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
827_Mod	6	N/A	0	N/A	2	False	12
827_Planted	1	N/A	0	N/A	2	False	2
Subtotal							**24**
Slender Marsdenia (*Marsdenia longiloba*)							
827_Burnt	12.5	92.3	0	-92.3	2	False	579
827_High	59.9	68.9	0	-68.9	2	False	2,063
827_Low	0.86	56.1	0	-56.1	2	False	24
827_Mod	1.1	60.5	0	-60.5	2	False	33
1073_High	1.3	79.5	0	-79.5	2	False	50
1302_High	3.3	63.7	0	-63.7	2	False	104
Subtotal							**2,853**
Albert's Lyrebird (*Menura alberti*)							
827_High	11.5	68.9	0	-68.9	2	False	396
1302_High	3.0	63.7	0	-63.7	2	False	95
Subtotal							**491**
Giant Barred Frog (*Mixophyes iteratus*)							
827_High	1.7	68.9	0	-68.9	2	False	60
827_Low	0.27	56.1	0	-56.1	2	False	8
827_Mod	0.66	60.5	0	-60.5	2	False	20
1302_High	2.2	63.7	0	-63.7	2	False	70
1302_Mod	1.2	54.7	0	-54.7	2	False	33
Subtotal							**191**

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
Southern Myotis (*Myotis macropus*)							
827_Burnt	15.5	92.3	0	-92.3	2	False	714
827_High	61.9	68.9	0	-68.9	2	False	2,132
827_Low	19.0	56.1	0	-56.1	2	False	533
827_Mod	27.8	60.5	0	-60.5	2	False	842
827_Planted	4.8	84.3	0	-84.3	2	False	214
1073_High	0.66	79.5	0	-79.5	2	False	26
1302_High	3.7	63.7	0	-63.7	2	False	117
1302_Mod	2.9	54.7	0	-54.7	2	False	80
Subtotal							**4,642**
Koala (*Phascolarctos cinereus*)							
827_Burnt	19.0	92.3	0	-92.3	2	False	879
827_High	72.1	68.9	0	-68.9	2	False	2,483
827_Low	24.5	56.1	0	-56.1	2	False	687
827_Mod	27.6	60.5	0	-60.5	2	False	833
827_Planted	5.1	84.3	0	-84.3	2	False	214
1073_High	2.7	79.5	0	-79.5	2	False	106
1302_High	5.8	63.7	0	-63.7	2	False	184
1302_Mod	3.0	54.7	0	-54.7	2	False	82
Subtotal							**5,468**
Loveridge's Frog (*Philoria loveridgei*)							
1302_High	0.16	63.7	0	-63.7	2	False	5

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
Subtotal							**5**
Southern Pink Underwing Moth (*Phyllodes imperialis smithersi*)							
827_High	0.04	68.9	0	-68.9	2	False	1
1302_Mod	0.05	54.7	0	-54.7	2	False	1
Subtotal							**2**
Scrub Turpentine (*Rhodamnia rubescens*)							
827_Burnt	47	N/A	0	N/A	3	True	141
827_High	406	N/A	0	N/A	3	True	1,218
827_Low	87	N/A	0	N/A	3	True	261
827_Mod	131	N/A	0	N/A	3	True	393
827_Planted	22	N/A	0	N/A	3	True	66
1073_High	2	N/A	0	N/A	3	True	6
1302_High	10	N/A	0	N/A	3	True	30
1302_Mod	4	N/A	0	N/A	3	True	12
Subtotal							**2,127**
Native Guava (*Rhodomyrtus psidioides*)							
827_Burnt	15.3	92.3	0	-92.3	3	True	1,056
827_High	60.2	68.9	0	-68.9	3	True	3,110
827_Low	4.47	56.1	0	-56.1	3	True	111
827_Mod	16.2	60.5	0	-60.5	3	True	734
827_Planted	1.3	84.3	0	-84.3	3	True	79
Subtotal							**5,090**

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
Red Lilly Pilly (*Syzygium hodgkinsoniae*)							
827_Burnt	8	N/A	0	N/A	2	False	16
827_High	6	N/A	0	N/A	2	False	12
1302_High	91	N/A	0	N/A	2	False	182
Subtotal							**210**
Durobby (*Szygium moorei*)							
827_Low	2	N/A	0	N/A	3	True	6
827_Planted	14	N/A	0	N/A	3	True	42
Subtotal							**48**
Mitchell's Rainforest Snail (*Thersites mitchellae*)							
827_High	2.0	68.9	0	-68.9	3	True	103
1302_High	0.21	63.7	0	-63.7	3	True	10
Subtotal							**113**
Masked Owl (*Tyto novaehollandiae*)							
827_Burnt	12.1	92.3	0	-92.3	2	False	560
827_High	35.5	68.9	0	-68.9	2	False	1,222
827_Mod	3.5	60.5	0	-60.5	2	False	106
1073_High	0.21	79.5	0	-79.5	2	False	8
1302_High	1.3	63.7	0	-63.7	2	False	42
Subtotal							**1,938**
Sooty Owl (*Tyto tenebricosa*)							
827_Burnt	12.1	92.3	0	-92.3	3	True	840

Vegetation zone ID	Impact area (ha)/ individual (HL)	Current habitat condition score	Future habitat condition score	Change in habitat condition score	Biodiversity risk weighting	Candidate SAII	Species credits required
827_High	35.5	68.9	0	-68.9	3	True	1,833
827_Mod	3.5	60.5	0	-60.5	3	True	159
1073_High	0.21	79.5	0	-79.5	3	True	13
1302_High	1.3	63.7	0	-63.7	3	True	63
Subtotal							**2,908**
Total number of species credits required							**35,133**

8.3 Biodiversity offset strategy

8.3.1 Offset requirements

Impacts and offset requirements for the Proposal are outlined above. The Proposal will result in the loss and clearing of 233 ha of native vegetation of varying condition and habitat for threatened species.

A consolidated summary of the credit requirements and like-for-like credit offset requirements for ecosystem credit classes is provided in Table 8.4 with offset requirements for species credits provided in Table 8.5.

Table 8.4 Summary of offsets requirements for the Proposal and like-for-like credit options/

PCT Name/Species	Offset trading group	Credits
827 Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	North Coast Wet Sclerophyll Forests; >=50% and <70% Including PCTs: 661, 686, 694, 827, 1217, 1237, 1244, 1285, 1504, 841, 1843, 1915, 3067, 3073, 3078, 3088, 3102, 3136, 3145, 3147, 3171, 3177.	4,582
1073 Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	North Coast Wet Sclerophyll Forests - <50% cleared group Including PCTs: 487, 613, 661, 684, 686, 692, 693, 694, 695, 699, 747, 748, 752, 812, 826, 827, 1073, 1208, 1217, 1222, 237, 244, 1245, 1257, 1259, 1260, 1261, 1265, 1266, 1282, 1284, 1285, 1504, 1561, 1562, 1563, 1566, 1567, 1568, 1569, 1572, 1573, 1575, 1579, 1841, 1843, 915, 3058, 3060, 3067, 3073, 3078, 3084, 3087, 3088, 102, 3125, 3136, 3137, 3138, 3139, 3140, 3141, 3142, 145, 3147, 3148, 3149, 3150, 3153, 3154, 3156, 3157, 158, 3160, 3161, 3162, 3163, 3164, 3165, 3166, 3168, 169, 3171, 3172, 3173, 3174, 3176, 3177, 3178, 3180, 4043, 4115.	80
1302 White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	Lowland Rainforest of Subtropical Australia Including PCTs: 669, 670, 845, 886, 887, 1068, 1106, 1201, 1275, 1302, 2068, 3001, 3002, 3003, 3004, 3005, 3006, 3007, 3009, 3010, 3011, 3012, 3015, 3016, 3017, 3019, 3021, 3022, 3026, 3032, 3035, 3061, 3064, 3065, 3066, 3070, 3076, 3083, 3089, 3100, 3104, 3109, 3121, 3148, 3149, 3165, 4031, 4105, 4107, 4110	332
Total		**4,994**

Table 8.5 Summary of species credit offset requirements

Species	Offset trading group	Credits
Assa darlingtoni	Pouched Frog	1,071
Carterornis leucotis	The White-eared Monarch	5,608
Corokia whiteana	Corokia	36
Desmodium acanthocladum	Thorny Pea	67
Drynaria rigidula	Basket Fern	21
Endiandra hayesii	Rusty Rose Walnut	100
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	1,371
Grammitis stenophylla	Narrow leaf Finger Fern	34
Haliaeetus leucogaster	White-bellied Sea-Eagle	662

Species	Offset trading group	Credits
Hicksbeachia pinnatifolia	Red Boppel Nut	8
Lepiderema pulchella	Fine-leaved Tuckeroo	45
Macadamia tetraphylla	Rough-shelled Bush Nut	24
Marsdenia longiloba	Slender Marsdenia	2,853
Menura alberti	Albert's Lyrebird	491
Mixophyes iteratus	Giant Barred Frog	191
Myotis macropus	Southern Myotis	4,642
Phascolarctos cinereus	Koala	5,468
Philoria loveridgei	Loveridge's Frog	5
Phyllodes imperialis smithersi	Southern Pink Underwing Moth	2
Rhodamnia rubescens	Scrub Turpentine	2,127
Rhodomyrtus psidioides	Native Guava	5,090
Syzygium hodgkinsoniae	Red Lilly Pilly	210
Szygium mooreri	Durobby	48
Thersites mitchellae	Mitchell's Rainforest Snail	113
Tyto novaehollandiae	Masked Owl	1,938
Tyto tenebricosa	Sooty Owl	2,908
Total		**35,133**

8.3.2 Staging of offsets

Typically, offset liabilities need to be met before construction commences; however, Section 7.14 of the BC Act allows for the staged retirement of credits in line with the stages of development and Tweed Shire Council will be seeking to separate offsets for two stages as outlined in Table 8.6 and Figure 8.1.

Table 8.6 Proposed timing and offsetting approach

Component	Impact	Offset timing
Stage 1: • Dam wall infrastructure • Ancillary works – both construction and operational	Direct loss of vegetation and threatened species	Retirement of biodiversity credits prior to construction and/or clearing works commencing on Stage 1.
Stage 2: • The flooding of the raised Dam up to operation full supply level	Direct loss of vegetation and threatened species	Retirement of biodiversity credits prior to construction and/or clearing works commencing on Stage 2.

As the BAM-C for the Proposal combines all impact areas for the Proposal (i.e. the calculator has not been split into two stages), the following equations (as per Section 9.2 of the BAM) have been manually calculated to determine the split of credits by stage:

- *Equation 1: Determine the number of ecosystem credits required for the impact on vegetation that is a TEC, contain threatened species habitat, or is any other PCT* (refer to)
- *Equation 2: Determine the number of fauna species credits or flora species credits required for the impact of development, activity, clearing or biodiversity certification* (refer to).

Equation 1 Determine the number of ecosystem credits required for the impact on vegetation that is a TEC, contains threatened species habitat, or is any other PCT

$$\text{Ecosystem credits required for each vegetation zone} = \sum_{i=1}^{n} (\Delta\text{VI Loss} \times BRW\ x\ area)\ x\ 0.25$$

where:

i = the ith vegetation zone on land directly impacted by the proposal

ΔVI Loss = the change (loss) in the vegetation integrity score of a vegetation zone at the development site as determined by Equation 27

BRW = means the biodiversity risk weighting applied to the vegetation zone. The biodiversity risk weighting for a TEC or a PCT containing threatened species habitat is based on the sensitivity to loss class of the TEC/PCT and the highest sensitivity to gain class of the predicted threatened species. For a PCT or TEC not associated with threatened species habitat, the sensitivity to loss class for the PCT or TEC is used with the low sensitivity gain class

area = the area in hectares of the vegetation zone

Plate 8.1 Equation 1, section 9.2 of the BAM (DPIE 2020)

Equation 2 Determine the number of fauna species credits or flora species credits required for the impact of development, activity, clearing or biodiversity certification

$$\text{Number of fauna or flora species credits required} = [\sum_{n=i}(HC_i\ x\ HL_i)]\ x\ BRW\ x\ 0.25$$

where:

HC_i = the condition of fauna or flora habitat within each vegetation zone (or portion thereof) which occurs within the ith species polygon

HL_i = the area of habitat within each vegetation zone (or portion thereof) which occurs within the ith species polygon for the development site or biodiversity certification proposal, prepared in accordance with Box 2

HC_i x HL_i is summed for each vegetation zone (or portion thereof) which occurs within the ith species polygon

BRW = the biodiversity risk weighting for the species as set out in the TBDC

Plate 8.2 Equation 2, section 9.2 of the BAM (DPIE 2020)

A summary of the number of credits generated for each stage is provided in Table 8.7.

Table 8.7 Summary of ecosystem and species credits generated by each stage

Stage 1	Number of Credits
Ecosystem species credits	995
Species credits	6,800
Total	**7,795**
Stage 2	**Number of Credits**
Ecosystem species credits	3,999
Species credits	28,333
Total	**32,332**

A detailed overview of the manual calculations is provided in Table 8.8 and Table 8.9.

Due to rounding errors in the manual calculations, where the manual calculations did not meet the credit requirement generated in the BAM-C for a species credit species, the manual calculation was increased until the credit requirement was equal to that of the BAM-C. In instances where the manual calculation exceeded the credit requirement generated in the BAM-C for a species credit, the manual calculation was reduced until the credited requirement was equal to that of the BAM-C. Analysis was completed to ensure the adjustments to credits were completed within the vegetation zone that the rounding error was made.

The manual calculations will be submitted to the BCD upon lodgement of the BAM-C for the Proposal.

Table 8.8 Ecosystem credits generated by each stage

PCT	Vegetation zones	Area (ha)	Change in VI score	BRW	Credits (manual)
Stage 1					
827	827_high	4.60	68.9	1.75	139
	827_mod	4.64	60.5	1.75	123
	827_burnt	10.47	92.3	1.75	423
	827_low	5.63	56.1	1.75	138
	827_planted	0.39	84.3	1.75	14
1073	1073_high	2.46	79.5	1.5	73
1302	1302_high	2.07	63.7	2.5	82
	1302_mod	0.07	54.7	2.5	3
Total					**995**
Stage 2					
827	827_high	67.53	68.9	1.75	2,035
	827_mod	26.63	60.5	1.75	704
	827_burnt	8.57	92.3	1.75	346

PCT	Vegetation zones	Area (ha)	Change in VI score	BRW	Credits (manual)
	827_low	19.88	56.1	1.75	488
	827_planted	4.69	84.3	1.75	173
1073	1073_high	0.21	79.5	1.5	6
1302	1302_high	3.71	63.7	2.5	148
	1302_mod	2.91	54.7	2.5	100
Total					**3,999**

Table 8.9 Species credits generated by each stage

Species	Vegetation zones	Area (ha)	Change in HC (VI score) or number of individuals	BRW	Credits (manual)
Stage 1					
Pouched Frog (*Assa darlingtonia*)	827_high	0.58	68.9	2	20
	1302_high	2.07	63.7	2	66
	1302_mod	0.07	54.7	2	2
Subtotal					**88**
The White-eared Monarch (*Carterornis leucotis*)	827_high	4.60	68.9	2	158
	1073_high	2.46	79.5	2	98
	1302_high	2.07	63.7	2	66
	1302_mod	0.07	54.7	2	2
	827_mod	4.64	60.5	2	140
	827_burnt	10.47	92.3	2	483
	827_low	5.63	56.1	2	158
	827_planted	0.39	84.3	2	16
Subtotal					**1,122**
Thorny Pea (*Desmodium acanthocladum*)	827_mod	2.21	60.5	2	67
Subtotal					**67**
Basket Fern (*Drynaria rigidula*)	827_low	0.50	56.1	3	21
Subtotal					**21**
Rusty Rose Walnut (*Endiandra hayesii*)	1302_high	0.49	10	2	20
Subtotal					**20**

Species	Vegetation zones	Area (ha)	Change in HC (VI score) or number of individuals	BRW	Credits (manual)
Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*)	1073_high	0.06	1	3	3
	1302_high	0.81	10	3	30
	827_burnt	0.05	16	3	48
Subtotal					**81**
Slender Marsdenia (*Marsdenia longiloba*)	827_high	4.29	68.9	2	148
	1073_high	1.06	79.5	2	42
	1302_high	0.73	63.7	2	23
	827_mod	1.10	60.5	2	33
	827_burnt	10.16	92.3	2	469
Subtotal					**715**
Southern Myotis (*Myotis macropus*)	827_high	3.49	68.9	2	120
	1073_high	0.44	79.5	2	18
	1302_high	0.99	63.7	2	32
	827_mod	3.50	60.5	2	106
	827_burnt	6.88	92.3	2	318
	827_low	1.54	56.1	2	43
	827_planted	0.08	84.3	2	3
Subtotal					**639**
Koala (*Phascolarctos cinereus*)	827_high	4.60	68.9	2	158
	1073_high	2.46	79.5	2	98
	1302_high	2.07	63.7	2	66
	1302_mod	0.07	54.7	2	2
	827_mod	4.64	60.5	2	140
	827_burnt	10.47	92.3	2	483
	827_low	5.63	56.1	2	158
	827_planted	0.39	84.3	2	16
Subtotal					**1,122**
Scrub Turpentine (*Rhodamnia rubescens*)	827_high	2.15	71	3	213
	1073_high	0.16	2	3	6
	1302_high	0.92	5	3	15
	827_mod	0.00	9	3	27
	827_burnt	0.64	25	3	75

Species	Vegetation zones	Area (ha)	Change in HC (VI score) or number of individuals	BRW	Credits (manual)
	827_low	3.46	8	3	24
	827_planted	1.00	2	3	6
Subtotal					**336**
Native Guava (*Rhodomyrtus psidioides*)	827_high	4.29	68.9	3	222
	827_burnt	9.74	92.3	3	675[1]
Subtotal					**896**
Red Lilly Pilly (*Syzygium hodgkinsoniae*)	1302_high	1.00	72	2	144
	827_burnt	0.03	8	2	16
Subtotal					**160**
Durobby (*Syzygium moorei*)	827_planted	0.01	2	3	6
Subtotal					**6**
Masked Owl (*Tyto novaehollandiae*)	827_high	4.29	68.9	2	148
	827_burnt	9.74	92.3	2	450[1]
Subtotal					**598**
Sooty Owl (*Tyto tenebricosa*)	827_high	4.29	68.9	3	222
	827_burnt	9.74	92.3	3	676[1]
Subtotal					**898**
Stage 2					
Pouched Frog (*Assa darlingtonia*)	827_high	22.78	68.9	2	785
	1302_high	3.71	63.7	2	118
	1302_mod	2.91	54.7	2	80
Subtotal					**983**
The White-eared Monarch (*Carterornis leucotis*)	827_high	67.53	68.9	2	2,324[2]
	1073_high	0.21	79.5	2	8
	1302_high	3.71	63.7	2	118
	1302_mod	2.91	54.7	2	80
	827_mod	26.63	60.5	2	804[2]
	827_burnt	8.57	92.3	2	396
	827_low	19.88	56.1	2	558
	827_planted	4.69	84.3	2	198
Subtotal					**4,486**

Species	Vegetation zones	Area (ha)	Change in HC (VI score) or number of individuals	BRW	Credits (manual)
Corokia (*Corokia whiteana*)	827_high	0.23	6	3	18
	1302_high	0.43	6	3	18
Subtotal					**36**
Rusty Rose Walnut (*Endiandra hayesii*)	827_high	1.38	7	2	14
	1302_high	1.79	26	2	52
	1302_mod	0.06	1	2	2
	827_mod	0.17	3	2	6
	827_burnt	0.33	3	2	6
Subtotal					**80**
Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteata*)	827_high	14.96	231	3	693
	1302_high	1.94	51	3	153
	1302_mod	0.76	29	3	87
	827_mod	2.83	51	3	153
	827_burnt	2.96	61	3	183
	827_low	0.70	3	3	9
	827_planted	0.60	4	3	12
Subtotal					**1,290**
Narrow leaf Finger Fern (*Grammitis stenophylla*)	827_high	0.34	68.9	2	13[1]
	1302_high	0.57	63.7	2	18
	827_mod	0.12	60.5	2	4
Subtotal					**34**
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	827_high	14.34	68.9	2	494
	827_mod	4.36	60.5	2	132
	827_low	1.28	56.1	2	36
Subtotal					**662**
Red Boppel Nut (*Hicksbeachia pinnatifolia*)	827_planted	0.22	4	2	8
Subtotal					**8**
Fine-leaved Tuckeroo (*Lepiderema pulchella*)	827_low	0.41	5	3	15
	827_planted	0.30	10	3	30
Subtotal					**45**

Species	Vegetation zones	Area (ha)	Change in HC (VI score) or number of individuals	BRW	Credits (manual)
Rough-shelled Bush Nut (*Macadamia tetraphylla*)	827_high	0.12	1	2	2
	827_mod	0.64	6	2	12
	827_burnt	0.14	1	2	2
	827_low	0.42	3	2	6
	827_planted	0.18	1	2	2
Subtotal					**24**
Slender Marsdenia (*Marsdenia longiloba*)	827_high	55.63	68.9	2	1,915[2]
	1073_high	0.21	79.5	2	7[2]
	1302_high	2.54	63.7	2	81
	827_burnt	2.38	92.3	2	110
	827_low	0.86	56.1	2	24
Subtotal					**2,138**
Albert's Lyrebird (*Menura alberti*)	827_high	11.49	68.9	2	396
	1302_high	2.99	63.7	2	95
Subtotal					**491**
Giant Barred Frog (*Mixophyes iteratus*)	827_high	1.74	68.9	2	60
	1302_high	2.21	63.7	2	70
	1302_mod	1.21	54.7	2	33
	827_mod	0.66	60.5	2	20
	827_low	0.27	56.1	2	8
Subtotal					**191**
Southern Myotis (*Myotis macropus*)	827_high	58.39	68.9	2	2,010[2]
	1073_high	0.21	79.5	2	8
	1302_high	2.68	63.7	2	85
	1302_mod	2.91	54.7	2	80
	827_mod	24.33	60.5	2	736
	827_burnt	8.57	92.3	2	396
	827_low	17.45	56.1	2	489
	827_planted	4.69	84.3	2	198
Subtotal					**4,003**
	827_high	67.53	68.9	2	2,324[2]
	1073_high	0.21	79.5	2	8

Species	Vegetation zones	Area (ha)	Change in HC (VI score) or number of individuals	BRW	Credits (manual)
Koala (*Phascolarctos cinereus*)	1302_high	3.71	63.7	2	118
	1302_mod	2.91	54.7	2	80
	827_mod	22.90	60.5	2	694[1]
	827_burnt	8.57	92.3	2	396
	827_low	18.87	56.1	2	529
	827_planted	4.69	84.3	2	198
Subtotal					**4,347**
Loveridge's Frog (*Philoria loveridgei*)	1302_high	0.16	63.7	2	5
Subtotal					**5**
Southern Pink Underwing Moth (*Phyllodes imperialis smithersi*)	827_high	0.04	68.9	2	1
	1302_mod	0.05	54.7	2	1
Subtotal					**2**
Scrub Turpentine (*Rhodamnia rubescens*)	827_high	21.27	335	3	1,005
	1302_high	0.67	5	3	15
	1302_mod	0.27	4	3	12
	827_mod	6.55	122	3	366
	827_burnt	2.09	22	3	66
	827_low	4.59	79	3	237
	827_planted	1.23	20	3	60
Subtotal					**1,761**
Native Guava (*Rhodomyrtus psidioides*)	827_high	55.94	68.9	3	2,888[2]
	827_mod	16.18	60.5	3	734
	827_burnt	5.51	92.3	3	381
	827_low	2.63	56.1	3	111
	827_planted	1.25	84.3	3	79
Subtotal					**4,193**
Red Lilly Pilly (*Syzygium hodgkinsoniae*)	827_high	0.50	6	2	12
	1302_high	0.89	19	2	38
Subtotal					**50**

Species	Vegetation zones	Area (ha)	Change in HC (VI score) or number of individuals	BRW	Credits (manual)
Durobby (*Syzygium moorei*)	827_low	0.43	2	3	6
	827_planted	1.25	12	3	36
Subtotal					**42**
Mitchell's Rainforest Snail (*Thersites mitchellae*)	827_high	1.99	68.9	3	103
	1302_high	0.21	63.7	3	10
Subtotal					**113**
Masked Owl (*Tyto novaehollandiae*)	827_high	31.17	68.9	2	1,074
	1073_high	0.21	79.5	2	8
	1302_high	1.31	63.7	2	42
	827_mod	3.50	60.5	2	106
	827_burnt	2.38	92.3	2	110
Subtotal					**1,340**
Sooty Owl (*Tyto tenebricosa*)	827_high	31.17	68.9	3	1,611
	1073_high	0.21	79.5	3	13
	1302_high	1.31	63.7	3	63
	827_mod	3.50	60.5	3	159
	827_burnt	2.38	92.3	3	165
Subtotal					**2,010**

1. Credits have been manually added to match BAM-C, due to rounding errors in manual calculationsPrepared By Position

2. Credits have been manually removed to match BAM-C, due to rounding errors in manual calculationsPrepared By Position

8.4 Objectives of the biodiversity offset strategy

The objectives of the biodiversity offset strategy are to:

- meet the requirements of the NSW Biodiversity Offset Scheme (BOS), noting that under the EPBC Act, the NSW BAM and the BOS is endorsed by the Commonwealth for state significant Proposals under the NSW Assessment Bilateral Agreement
- maximise the benefits to biodiversity values through the offset program
- identify offsets that have additional social, economic and/or environmental co-benefits, particularly for the local environment
- minimise costs to the Proposal.

8.5 Options under the Biodiversity Offsets Scheme

Under the NSW Biodiversity Offsets Scheme, several pathways are available to the proponent to meet the offset obligation arising from the Proposal. These pathways are shown in Plate 8.3. Funding of a biodiversity conservation action is only available for a limited set of species and communities, as set out in the *Ancillary rules: Biodiversity conservation actions* (OEH, 2017); none of these species occur. The Proposal is not a State Significant Development (SSD) mining Proposal and thus ecological rehabilitation is not available. This means that offsets will need to be provided via retirement of like-for-like credits or payment into the Biodiversity Conservation Fund (BCF).

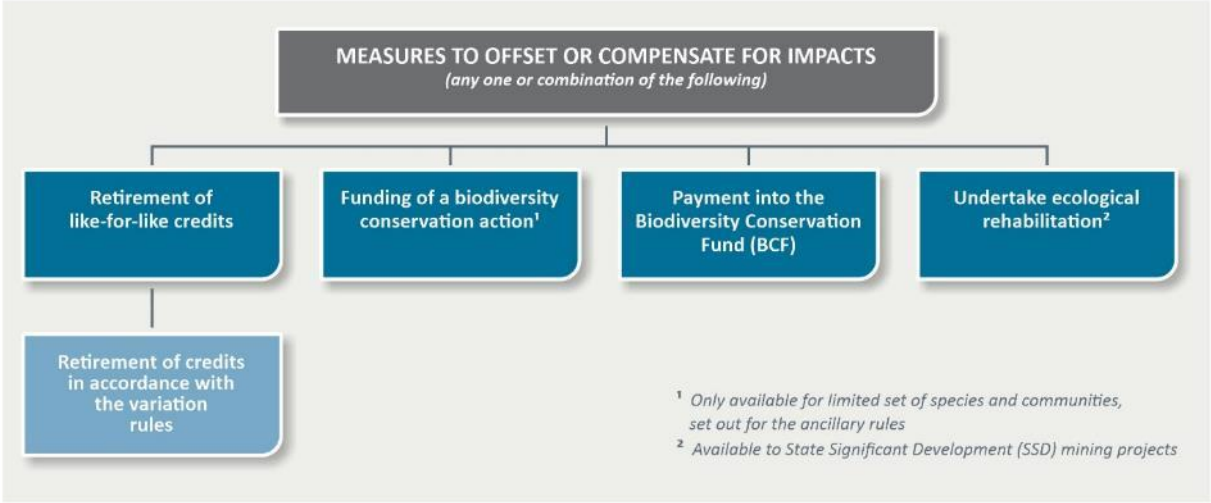


Plate 8.3 NSW Biodiversity Offset Scheme offset options

The various options available to meet the offset requirements of the Proposal are discussed below.

8.5.1 Like-for-like credits

i Credits available on the market

Like-for-like credits may be purchased from the credits market and used to retire all or a portion of the credit liability for the Proposal. Like for like requirements for ecosystem credits area shown in Table 8.4. To meet the like for like credit requirements the ecosystem credits must:

- contain hollow bearing trees
- occur in the Scenic Rim, Burringbar-Conondale Ranges, Clarence Lowlands and Woodenbong IBRA subregion or any IBRA subregion that is within 100 km of the outer edge of the impacted site.

ii Proponent driven offsets

Tweed Shire Council have options to use Council owned land surrounding the disturbance footprint to offset the impacts of the Proposal. This approach would have several benefits:

- use of surrounding land is likely to meet the needs of the Proposal by providing the right types of credits. PCTs and species impacted by the Proposal are likely to occur within the land immediately adjacent to the site
- this approach has the additional benefit of adding to a broader area of land protected in perpetuity for conservation, which may add to the extent of the adjacent National Park

- this approach would provide a local socio-economic benefit for the Proposal.

High level preliminary assessment of indicative PCTs within the Council owned lands indicate there is potentially suitable land to generate at least the required ecosystem credits. Further detailed assessment of this land is required to more accurately estimate the potential credit yields for ecosystem credits.

Assessments will also be required to determine which the amount and type of species credits which can be generated. This may require a combination of targeted surveys, consideration of existing records, habitat mapping and expert reports.

Should the credit yields prove sufficient, the proponent may propose to develop a Biodiversity Stewardship Agreement over this land to offset some, or if possible, all of the impacts arising from the Proposal. The proponent will also investigate the potential to transfer ownership of Council owned land to National Parks, rather than setting up stewardship sites. Council has been consulting with the NSW NPWS regarding compensation of land revoked from Mount Jerusalem National Park and the transfer of land as part of the biodiversity offset strategy.

8.5.2 Credits under the variation rules

Following reasonable steps to obtain like-for-like credits the proponent may seek to retire credits under the variation rules. However, variation rules cannot be used where there are impacts on a listed threatened species or ecological community, or its habitat, by a proposed action that is a controlled action under the EPBC Act. The Proposal has been designated as a controlled action, and therefore variation rules cannot be utilised for impacts on entities listed under the EPBC Act.

Where applicable, the variation rules allow broader trading:

- for ecosystem credits:
  - they represent the same vegetation formation
  - they are in the same or a higher offset trading group
  - they represent a location that is in:
    - the same Interim Biogeographic Regionalisation of Australia region as the impacted site, or
    - a subregion that is within 100 kilometres of the outer edge of the impacted site
  - if the impacted habitat contains hollow bearing trees—they represent vegetation that contains hollow bearing trees or artificial hollows.
- for species credits:
  - if the impacted species is a plant—they represent a plant
  - if the impacted species is an animal—they represent an animal
  - they represent a species that has the same or a higher category of listing under the BC Act as a threatened species
  - they represent a location that is in:
    - the same Interim Biogeographic Regionalisation of Australia region as the impacted site, or

- a subregion that is within 100 kilometres of the outer edge of the impacted site.

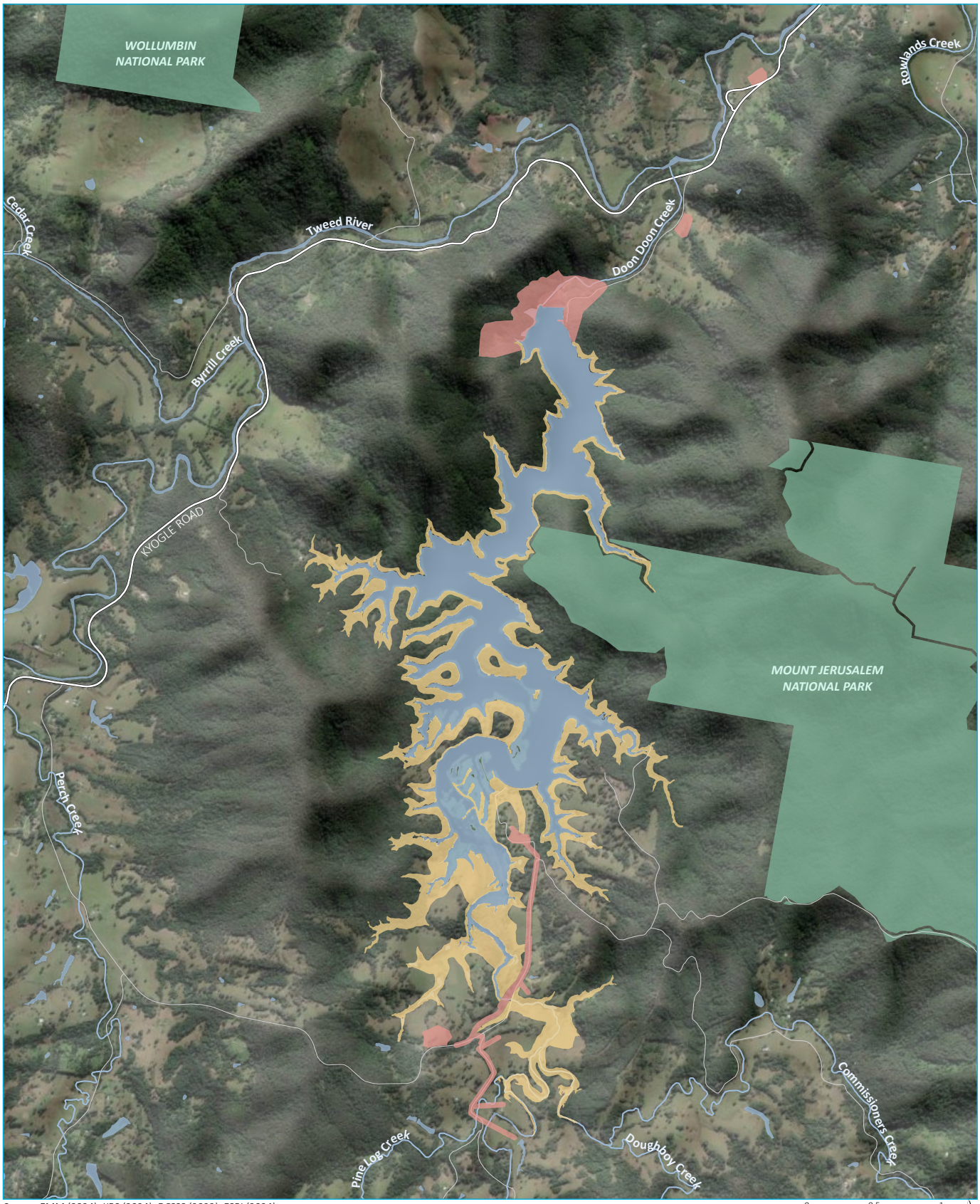
A review of public registers indicates that currently there are no suitable ecosystem or species credits available under the variation rules. The proponent will continue to investigate these options.

8.6 Biodiversity Offset Package

Prior to any development being carried out that would impact on biodiversity values, a detailed Biodiversity Offset Package will be prepared that is consistent with this Biodiversity Offset Strategy. The Biodiversity Offset Package will include:

- details of the specific biodiversity offset measures to be implemented and delivered in accordance with the EIS and this Biodiversity Offset Strategy, including the proposed location for the retirement of like-for-like credits from existing and proponent driven offset sites and certainty that this can be achieved
- the estimated cost which would be required to be paid into the BCF if the relevant proponent driven offset measure is not implemented and delivered (as calculated in accordance with Division 6 of *the BC Act* and the biodiversity offsets payment calculator)
- the timing and responsibilities for the implementation and delivery of the measures required in the Package.

The Biodiversity Offset Strategy outlined herein, and the detailed Biodiversity Package to be developed post-approval, will provide certainty that the residual impacts of the Proposal can be adequately offset.



Source: EMM (2024); KBS (2024); DCSSS (2023); ESRI (2024)

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KEY

Offset stage

- Stage 1 (Construction disturbance, Workforce accommodation, Concrete batching, McCabes bridge realignment, Powerlines, Haul road option 1 & 2, Office locations, Quarry site, Spillway impact area)
- Stage 2 (inundation area)

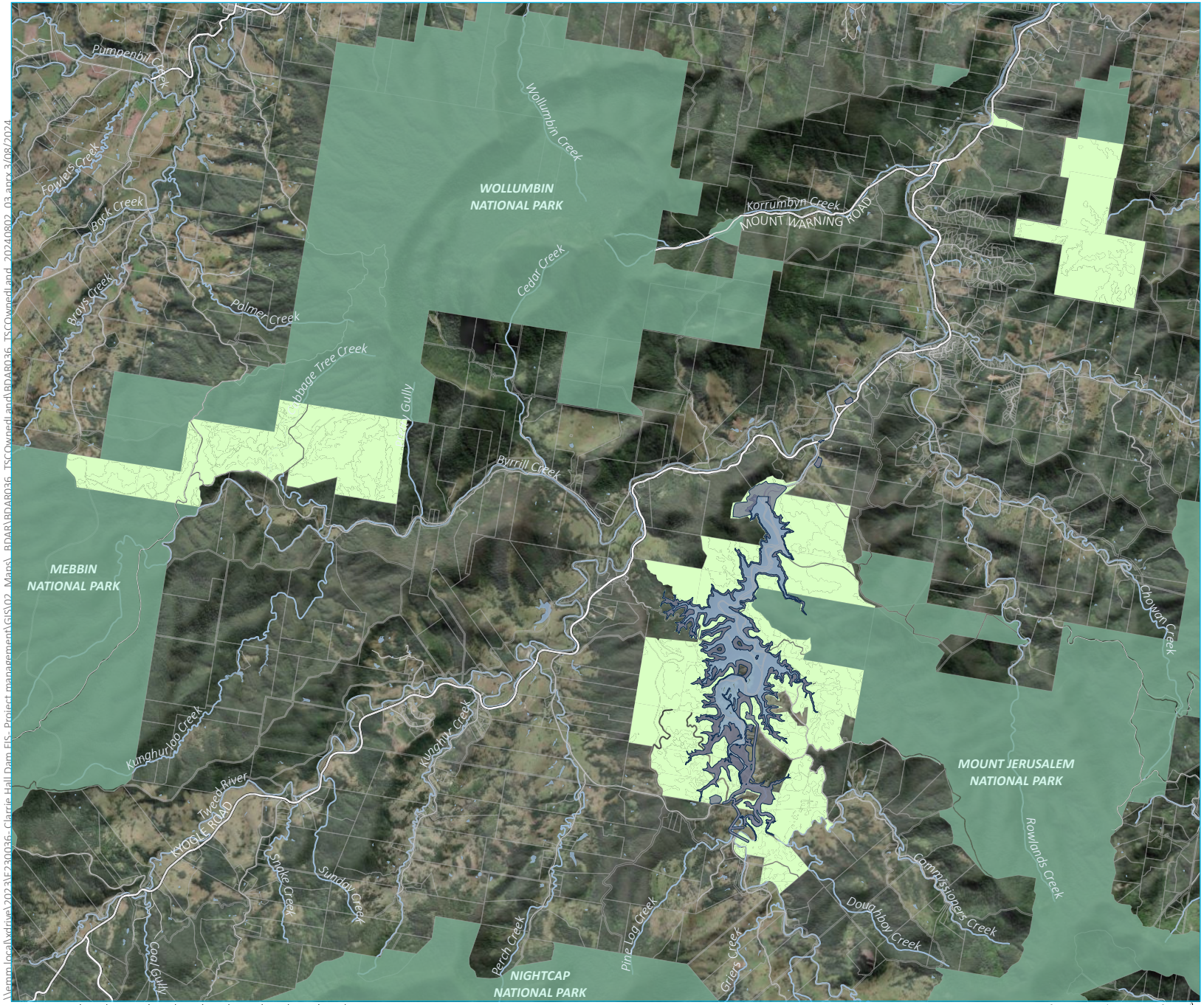
Existing environment

- Major road
- Minor road
- Named watercourse
- NPWS reserve

Staged offset approach

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 8.1

EMM
creating opportunities



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Source: EMM (2024); DCSSS (2024); GA (2009); ESRI (2024); TSC (2023)

Tweed Shire Council owned land for potential Biodiversity Stewardship Agreement

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 8.2

EMM
creating opportunities

9 Assessment of other relevant biodiversity legislation

9.1 Environmental Protection and Biodiversity Conservation Act 1999

This chapter provides an assessment of the potential impact of the proposed development to species and communities listed under the EPBC Act, known as Matters of National Environmental Significance (MNES).

9.1.1 Likelihood of occurrence assessment

A desktop assessment was completed to determine a list of MNES with potential to occur on the subject land, as outlined in Step 1 of Section 5.1. As well as species and communities generated by the PMST (DCCEEW, 2023c), EPBC listed entities have been added based on existing species records from the region, and associations with the PCTs recorded within the subject land.

A likelihood of occurrence assessment was conducted for all entities with potential to occur on the subject land. Aquatic species predicted by the PMST (DCCEEW, 2023c) were excluded from the assessment, as these entities are addressed in the Aquatic Ecology Assessment (Austral Research and Consulting, 2024). All entities were assessed against the criteria outlined in Table 9.1. The full assessment is provided in Appendix H.

Table 9.1 Likelihood of occurrence criteria

Likelihood	Description	Further assessment required?
Negligible	The potential for the species to occur is considered so unlikely as to not be worth considering.	No
Low	Based on data collected during field investigations it was concluded that the species was unlikely to occur on the subject land or use habitat in the subject land. A species may utilise the subject land on rare occasions. Species is considered vagrant in the bioregion and is thus considered unlikely to occur in the subject land.	No
Moderate	The species is known to occur in the bioregion and the subject land provides some habitat value for the species. Habitat values are somewhat degraded and considered suboptimal.	Yes
High	The species is known to occur in the bioregion and the subject land supports optimal habitat features for the species.	Yes
Known	The species has been recorded on the subject land during current surveys. The species has been recorded on the subject land previously and there has not been any change in habitat values since this time.	Yes

i Threatened ecological communities

Five TECs listed under the EPBC Act were predicted to occur within the subject land by the PMST (DCCEEW, 2023c), NSW BioNet (DCCEEW, 2024a) and the BAM-C. A likelihood of occurrence assessment for these communities is provided in Appendix H.

One EPBC Act listed TEC has been identified to occur on the subject land:

- Lowland Rainforest of Subtropical Australia (Critically Endangered).

This TEC occurs within the subject land in the areas identified as PCT 1302 and is mapped on Figure 4.1. An assessment of PCT 1302 against the Conservation (DSEWPaC, 2011) (TSSC, 2011) and Listing Advice (TSSC, 2011) for the Lowland Rainforest of Subtropical Australia TEC is provided in Table 9.2.

Table 9.2 Assessment of PCT 1302 against the Conservation and Listing Advice for Lowland Rainforest of Subtropical Australia CEEC

Characteristic	Conservation and Listing Advice (DSEWPaC, 2011) (TSSC, 2011) (TSSC, 2011)	PCT 1302 within the subject land
Location	The CEEC occurs in the South East Queensland and NSW North Coast IBRA bioregions. The CEEC primarily occurs from Maryborough, QLD to the Clarence River, NSW. The CEEC is also located in isolated areas between the Clarence River and Hunter River, such as the Bellinger and Hastings valleys.	Occurs between Maryborough QLD and Clarence River NSW, and the subject land occurs within the South East Queensland IBRA bioregion.
Elevation	The CEEC mostly occurs at or below 300 m ASL. On north-facing slopes, the CEEC can be found at elevations greater than 300 m ASL.	Occurs below 300 m ASL in lowland gullies (approximately 70 m to 140 m).
Soils	The CEEC occurs on soils derived from basalt and alluvial, or enriched rhyolitic soils. This includes sands and old or elevated alluvial soils, and floodplain alluvial.	Occurs on soil derived from volcanic rocks (basalt) and some alluvial sediments.
Rainfall	The CEEC typically occurs in areas that receive greater than 1,300 mm of rainfall annually.	Occurs in a region that receives an average of between 2,000-3,000 mm of rain annually (BoM, 2024).
Structure	The structure of the ecological community is typically a tall (20–30 m) closed forest, often with multiple canopy layers.	Tall closed forest with canopy emergent, canopy and mid-story species present.
Diversity	Patches of the ecological community typically have high species richness (at least 30 woody species)	A very high diversity of woody species are present in the subject land.
Coastal influence	The ecological community is typically more than 2 km inland from the coast.	The subject land is approximately 25 km from the coast.
Condition	The occurrence must meet the condition thresholds inclusive of patch type and size, canopy cover, species richness and percent of total native vegetation cover.	Aligns with Patch Type A. Though historical logging has occurred, there is a persistence of some mature trees. Each patch to be impacted is greater than 1 ha in size, has a canopy cover of greater than 70%, contains greater than 40 native woody species and the overall composition within each patch is greater than 70% native. PCT 1302 within the subject land meets the thresholds for the CEEC listed under the EPBC Act.

ii Threatened species

A total of 91 species listed under the EPBC Act were predicted to occur within the subject land by the PMST (DCCEEW, 2023c), NSW BioNet (DCCEEW, 2024a) and the BAM-C. A likelihood of occurrence assessment for these species is provided in Appendix H.

Twenty of the species predicted to occur were determined to have a moderate or higher likelihood of occurrence within the subject land. These species have been assessed further in Section 9.1.2 below.

iii Migratory species

Eighteen species listed as migratory under the EPBC Act were predicted to occur within the subject land by the PMST (DCCEEW, 2023c), NSW BioNet (DCCEEW, 2024a) and the BAM-C. A likelihood of occurrence assessment for these species is provided in Appendix H.

Five of the species predicted to occur were determined to have a moderate or higher likelihood of occurrence within the subject land. Two of these migratory species are also listed as threatened species under the EPBC Act and have therefore also been assessed as threatened species. These species have been assessed further in Section 9.1.2 below.

9.1.2 Impact assessments for MNES

Species and communities that are listed as MNES and likely to be impacted by the Proposal are addressed in more detail in the following sections. Potential impacts to each MNES entity have been assessed according to the requirements of the SEARs and the residual impacts (after the implementation of the avoidance and mitigation measures outlined in the previous section) have been assessed in accordance with the *Matters of National Environmental Significance – Significance Impact Guidelines 1.1* (DoE, 2013) to determine if the Proposal is likely to have a 'significant impact' on MNES.

The impact significance assessments for each MNES known to occur or deemed likely to occur on the subject land, are provided in the following sections. Table 9.3 provides a summary of the outcomes of the impact assessments.

Table 9.3 Outcomes of impact significance assessments for MNES likely to occur on the subject land

Scientific name	Common name	EPBC Status[1]	Likelihood of occurrence	Outcome of significant impact assessment
Lowland Rainforest of Subtropical Australia	Lowland Rainforest of Subtropical Australia	CE	Known	Likely
Assa darlingtoni	Pouched Frog	V	Known	Possible
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V	Known	Possible
Chalinolobus dwyeri	Large-eared Pied Bat	E	Known	Unlikely
Corokia whiteana	Corokia	E	Known	Likely
Desmodium acanthocladum	Thorny Pea	V	Known	Likely
Endiandra hayesii	Rusty Rose Walnut	V	Known	Unlikely
Gallinago hardwickii	Latham's Snipe	V, Mi	Known	Unlikely
Hicksbeachia pinnatifolia	Red Boppel Nut	V	Known	Unlikely
Hirundapus caudacutus	White-throated Needletail	V, Mi	High	Unlikely
Macadamia tetraphylla	Rough-shelled Bush-nut	V	Known	Unlikely
Marsdenia longiloba	Slender Marsdenia	V	Known	Likely
Mixophyes iteratus	Giant Barred Frog	V	Known	Likely
Monarcha melanopsis	Black-faced Monarch	Mi	Moderate	Unlikely

Scientific name	Common name	EPBC Status[1]	Likelihood of occurrence	Outcome of significant impact assessment
Phascolarctos cinereus	Koala	E	Known	Likely
Phyllodes imperialis southern subspecies	Southern Pink Underwing Moth	E	Known	Unlikely
Pteropus poliocephalus	Grey-headed Flying-fox	V	Known	Possible
Rhipidura rufifrons	Rufous Fantail	Mi	Moderate	Unlikely
Rhodamnia rubescens	Scrub Turpentine	CE	Known	Likely
Rhodomyrtus psidioides	Native Guava	CE	Known	Likely
Symposiachrus trivirgatus	Spectacled Monarch	Mi	Moderate	Unlikely
Syzygium hodgkinsoniae	Red Lilly Pilly	V	Known	Likely
Syzygium moorei	Durobby	V	Known	Unlikely
Thersites mitchellae	Mitchell's Rainforest Snail	CE	Known	Likely

1. V = vulnerable, E = endangered, CE = critically endangered, Mi = migratory

i Threatened ecological communities

a Lowland Rainforest of Subtropical Australia

Table 9.4 Significant impact assessment – Lowland Rainforest of Subtropical Australia (Critically Endangered)

Significant impact	Assessment
Would the action reduce the extent of an ecological community?	The Lowland Rainforest of Subtropical Australia critically endangered ecological community (CEEC) is represented within the subject land by 8.77 ha of PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion. The TBDC (DCCEEW, 2024a) indicates that 11 decommissioned legacy PCTs and 40 Eastern NSW PCTs are associated with the EPBC Act listed CEEC. The SVTM (DCCEEW, 2022) indicates that 40,792 ha of PCTs conforming to the CEEC are within 10 km of the subject land. The Proposal will involve the loss of 8.77 ha of the CEEC which represents approximately 0.02% of all PCTs associated with the CEEC within the locality. The Proposal will likely reduce the extent of the CEEC.
Would the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?	Despite increases to the existing size of the Dam and the addition of the construction area, connectivity will be retained around the periphery of Dam with a significant width of intact vegetation remaining. All rainforest areas outside of the subject land will retain connectivity to other areas of continuous forested vegetation. Access to the subject land will use existing roads, therefore not adversely impacting connectivity.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of an ecological community?	In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of an ecological community refers to areas necessary: • for the long-term maintenance of the ecological community (including the maintenance of species essential to the survival of the ecological community, such as pollinators) • for the recovery of the ecological community (DoE, 2013). The Conservation Advice (DSEWPaC, 2011) and the Listing Advice (TSSC, 2011) for the CEEC do not define critical habitat for the community. The 8.77 ha of the CEEC within the subject land is likely to contribute to the long-term maintenance of the ecological community within the locality, however given that the Proposal will result in the loss of 0.02% of the CEEC within the locality, it is unlikely that this relatively small extent of CEEC is critical to the survival of the ecological community across its entire range. As such, the Proposal is unlikely to adversely affect habitat critical to the survival of the ecological community.
Would the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?	The Proposal involves increasing the capacity of the Dam and the construction of associated ancillary infrastructure. Once the inundation of the subject land has been completed, the Dam will remain as a relatively stable reservoir, only experiencing fluctuations above the FSL during extreme flooding events. Surface water drainage that influences the retained areas of the CEEC outside of the subject land will be unimpacted by the Proposal. All disturbance associated with the Proposal is located from the current FSL of the Dam outward, and all extents of the CEEC within this disturbance area (8.77 ha) will be completely removed, with no residual impacts predicted. Given this, the Proposal will involve the direct loss of 8.77 ha of the CEEC, however, it is unlikely to modify or destroy abiotic factors necessary for the survival of the adjacent extents of the CEEC outside of the subject land.
Would the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?	The Proposal will not involve flora harvesting activities such as those associated with agriculture and horticulture, firewood collection, or seed harvesting for re-vegetation Proposals. The Proposal will also not involve regular burning activities that may shift the species composition towards a more fire-tolerant assemblage or increase the susceptibility of important canopy species. The Proposal will involve the direct loss of 8.77 ha of the CEEC; however, it is unlikely to substantially change the species composition of the CEEC outside of the subject land.
Would the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.	The Listing Advice (TSSC, 2011) for the CEEC lists a number of invasive weed species and feral animals that are harmful to the CEEC. Invasive weed species of note described in the Listing Advice (TSSC, 2011) include Camphor Laurel (*Cinnamomum camphora*), Tobacco Bush (*Solanum mauritianum*), Madeira Vine (*Anredera cordifolia*), Morning Glory (*Ipomoea* spp.), Wandering Jew (*Tradescantia fluminensis*), Climbing Asparagus (*Asparagus plumosus*), Ochna (*Ochna serrulata*) and Small-leaved Privet (*Ligustrum sinense*). All of these species are already prevalent within the subject land and surrounding vegetation. The Listing Advice (TSSC, 2011) also describes feral animals harmful to the CEEC, including Cane Toad (*Bufo marinus*), Red Fox (*Vulpes vulpes*), Black Rat (*Rattus rattus*) and Wild Dog (*Canus familiaris*), all of which have been recorded within the subject land. With the implementation of the mitigation and management measures proposed (refer Section 7.3) it is unlikely that the Proposal would facilitate further species invasions. Mitigation and management measures will also be put in place to manage the risk of pollutants entering the environment (Section 7.3). The Proposal will also not impact upstream surface water regimes that adjacent extents of the CEEC to the subject land may depend upon. As such, the Proposal is unlikely to substantially reduce the quality or integrity of the occurrences of the CEEC outside of the subject land.

Significant impact	Assessment
Would the action interfere with the recovery of an ecological community?	No recovery plans have been prepared for the CEEC. The Conservation Advice (DSEWPaC, 2011) for the CEEC lists a number of priority actions to support the recovery of the ecological community, including: • protect and conserve remaining areas of the ecological community. The Proposal will involve the direct loss of 8.77 ha of the CEEC which detracts from the priority action listed above. Given this, the Proposal is likely to interfere with the recovery of the ecological community.
Conclusion	Based on the above assessment, it is considered likely that the Proposal will have a significant impact on the Lowland Rainforest of Subtropical Australia CEEC.

ii Threatened species

a Pouched Frog (*Assa darlingtoni*)

Table 9.5 Significant impact assessment - Pouched Frog (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Conservation Advice (DCCEEW, 2023a) for the Pouched Frog defines six important populations of the species. These populations are genetically distinct and are largely defined through the geographic region in which they inhabit. Important populations for the Pouched Frog have been defined as those occurring within the following geographic regions: • Connondale/ Blackall Ranges (QLD) • D'Aguilar Range (QLD) • McPherson Range (QLD/NSW) • Mount Barney/Mount Nothofagus (QLD/NSW) • Gibraltar Range (NSW) • Dorrigo Plateau (NSW) (DCCEEW, 2023a). The subject land is not located within the distinct geographic regions listed as containing important populations. The population within the subject land is not at or near the limit of the species' range and is unlikely to be large enough or distinct enough to be important for breeding, dispersal or maintaining genetic diversity. Any individuals of the species occurring within the subject land would not be part of an important population. Given this, the Proposal is unlikely to lead to a long-term decrease in the size of an important population of the Pouched Frog.
Would the action reduce the area of occupancy of an important population?	It is unlikely that an important population of the species inhabits the subject land. Hence, it is unlikely that the removal of 32.16 ha of habitat would reduce the area of occupancy of an important population of the species.
Would the action fragment an existing important population into two or more populations?	It is unlikely that an important population of the species inhabits the subject land. Hence, it is unlikely that an important population of the species would be fragmented. The expansion of the Dam footprint is also unlikely to increase fragmentation of any populations already separated by the existing reservoir. As such, it is unlikely that the removal of 32.16 ha of habitat would fragment an existing important population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat (DCCEEW, 2022) for the Pouched Frog. Habitat critical to the survival of the Pouched Frog has been defined in the Conservation Advice (DCCEEW, 2023a) as "closed forest communities (>90% canopy cover), with an established layer of damp leaf litter". The Pouched Frog is restricted to closed forest communities, generally at elevations above 800 m (DCCEEW, 2023a). The mapped habitat within the subject land are patches of mesic closed forest with damp litter and therefore can be considered critical habitat for the species
Would the action disrupt the breeding cycle of an important population?	It is unlikely that an important population of the species inhabits the subject land. Hence, it is unlikely that the removal of 32.16 ha of habitat on the subject land would disrupt the breeding cycle of an important population of Pouched Frog.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will reduce the area of a specific habitat required by the Pouched Frog by 32.16 ha. The loss of habitat will likely lead to decline in the species within the locality.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Conservation Advice (DCCEEW, 2023a) for the Pouched Frog lists invasive weeds as a threat to the habitat of the species. As the species inhabits areas of established leaf litter, the introduction of weeds has the potential to alter the composition of the understorey (DCCEEW, 2023a). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further weed invasions will be established as a result of the Proposal.
Would the action introduce disease that may cause the species to decline?	The amphibian chytrid fungus *Batrachochytrium dendrobatidis* (Bd), is known to cause the infectious disease Chytridiomycosis (Chytrid) in amphibian species (DCCEEW, 2023a). The Pouched Frog has been documented to be highly susceptible to the disease in laboratory conditions, however no individuals tested from the wild have been recorded with the disease (DCCEEW, 2023a). Chytrid is found throughout NSW and it is unlikely that the subject land has avoided the pathogen. Notwithstanding mitigation and management measures are proposed (refer Section 7.3) to prevent the spread of novel pathogens.
Would the action interfere with the recovery of the species?	The Conservation Advice (DCCEEW, 2023a) for the Pouched Frog provides one primary conservation objective: • to ensure that there is no further decline in the distribution of the Pouched Frog, and that the population size is stable or increasing with existing habitat being protected and maintained (DCCEEW, 2023a). The Proposal will remove 32.16 ha of known habitat for the Pouched Frog. The removal of this habitat will detract from the conservation objective listed for the Pouched Frog.
Conclusion	It is considered possible that the Proposal will have a significant impact on the Pouched Frog, given that suitable habitat for the species is being removed.

b South-eastern Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami)*

Table 9.6 Significant impact assessment - South-eastern Glossy Black-Cockatoo (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	The South-eastern Glossy Black-Cockatoo occurs as a single population north from Mitchell, Queensland through eastern New South Wales to East Gippsland, with more scattered occurrences inland as far west as the NSW Riverina (DCCEEW, 2022). While birds in the Riverina were previously considered an isolated population, they are now considered connected to the main population (Cameron, Castley, Teixiera, Menkhorst, & Garnett, 2021). An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Conservation Advice (DCCEEW, 2022) for South-eastern Glossy Black-Cockatoo does not define an important population for this species. Within the locality of the subject land, the South-eastern Glossy Black-Cockatoo has been recorded on 71 occasions (DCCEEW, 2024a). During surveys for the Proposal, the species was recorded foraging on the subject land on 6 occasions between 2016 and 2024. Surveys targeting suitable potential breeding hollows confirmed no breeding within the subject land. The Proposal will result in the removal of 162.49 ha of foraging habitat for the South-eastern Glossy Black-Cockatoo, in the form of vegetation zones containing *Allocasuarina* and *Casuarina* species. It is likely that the removal of these potential foraging resources is a small extent of a regional selection of foraging sites. That is, within the southeast Queensland region (nearby to the subject land) Glossy Black-Cockatoo are often considered to be seasonal in several locations, which suggests the birds are moving around the region in response to resource availability or breeding requirements (Stock & Wild, 2005). Moreover, some Glossy Black-Cockatoo have been recorded making daily, round-trip flights of up to 30 km to forage (Pepper, 1996) (Garnett, Pedler, & Crowley, 1999) (Mooney & Pedler, 2005).This provides additional evidence that the subject land provides only a small component of a vast extent of habitat resources in the local area. Looking more broadly at potential food resources for the local Glossy Black-Cockatoo population, the SVTM (DCCEEW, 2022) indicates that considerable extents of vegetation surrounding the subject land and in the broader locality contains comparable native vegetation with *Allocasuarina* and *Casuarina* species. The subject land is not at or near the limit of the species range, and the species has been recorded on 71 occasions within the locality of the subject land (DCCEEW, 2024a). Due to the proximity of suitable habitat in the locality of the subject land, with comparable native vegetation, it is considered unlikely that the foraging resources within the subject land are necessary for maintaining genetic diversity, dispersal, breeding or roosting for the species. Given the above, it is considered unlikely that the subject land supports an important population of the species, and the removal of foraging habitat is unlikely to lead to the long-term decrease in the size of an important population of South-eastern Glossy Black-Cockatoo.
Would the action reduce the area of occupancy of an important population?	As important populations have not been defined for the South-eastern Glossy Black-Cockatoo (DCCEEW, 2022) and the subject land is considered unlikely to contain an important population (important habitat), it is considered unlikely that the Proposal would reduce the area of occupancy of an important population of the species.
Would the action fragment an existing important population into two or more populations?	Important populations have not been defined for the South-eastern Glossy Black-Cockatoo (DCCEEW, 2022) and the subject land is considered unlikely to contain an important population (important habitat). The species is highly mobile and is unlikely to be fragmented by the outward expansion of the Dam footprint. As such, it is unlikely that the Proposal would fragment an existing important population of South-eastern Glossy Black-Cockatoo into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the species has been defined in the Conservation Advice (DCCEEW, 2022), and refers to areas that are necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DCCEEW, 2022). The South-eastern Glossy Black-Cockatoo is known to forage in the subject land, though have been observed infrequently. Within the subject land, suitable foraging habitat is largely limited to *Allocasuarina torulosa* trees which are scattered through most vegetation zones. Whilst all the vegetation zones containing *Allocasuarina torulosa* constitute a combined 162.49 ha, the foraging resources are considered suboptimal with *Allocasuarina torulosa* trees sparsely distributed. Targeted surveys confirmed that the species does not breed within the subject land. Based on the SVTM (DCCEEW, 2022), vegetation surrounding the subject land and in the broader locality contains comparable native vegetation with *Allocasuarina* and *Casuarina* species. The subject land is not at or near the limit of the species range, and the species has been recorded on 71 occasions within the locality of the subject land (DCCEEW, 2024a). Due to the proximity of suitable habitat in the locality of the subject land, with comparable native vegetation, it is considered unlikely that the foraging resources within the subject land are critical to the survival of the species.
Would the action disrupt the breeding cycle of an important population?	Important populations have not been defined for the South-eastern Glossy Black-Cockatoo (DCCEEW, 2022) and the subject land is considered unlikely to contain an important population. Targeted surveys have confirmed no breeding within the subject land. Given this, it is considered unlikely that the Proposal will disrupt the breeding cycle of an important population of South-eastern Glossy Black-Cockatoo.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will remove 162.49 ha of potential suboptimal foraging habitat for the South-eastern Glossy Black-Cockatoo. Within the locality of the subject land, large tracts of suitable vegetation occur comprising *Allocasuarina* and *Casuarina* trees. Given the proximity of suitable habitat in the locality, it is considered unlikely that the species is solely reliant on the foraging resources within the subject land. As such, it is unlikely that the removal of foraging habitat within the subject land will remove or modify habitat to the extent that the species is likely to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Conservation Advice (DCCEEW, 2022) lists invasive weeds as a minor threat to the habitat of the South-eastern Glossy Black-Cockatoo. Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further weed invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	Psittacine beak and feather disease (PBFD) is a potentially fatal disease caused by psittacine circovirus, typically transferring between adults, nestlings, and contaminated nest hollows (DCCEEW, 2022). Given that the disease transfers via contact with diseased individuals or contaminated nest hollows, the Proposal is unlikely to introduce disease that may cause the species to decline. A decrease in nesting hollows coupled with intensified competition may increase the likelihood of disease transmission in the future (DCCEEW, 2022). The Proposal will result in the removal of 48 hollow bearing trees. However, no hollow bearing trees on the subject land were observed to be utilised by the species. Hence, it is not expected that the removal of these hollow bearing trees would contribute to nest tree competition and disease transmission.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	The Conservation Advice for the South-eastern Glossy Black-Cockatoo (DCCEEW, 2022) provides the following primary conservation outcomes for the species: • protect, enhance extent and quality of habitat across the subspecies' range • address critical knowledge gaps of the subspecies' ecological needs to guide and refine management strategies • enhance community awareness and stewardship of the conservation of the subspecies (DCCEEW, 2022). The Proposal will result in the removal of 162.49 ha of potential suboptimal foraging habitat for the species, which interferes with the conservation outcomes listed above regarding the species' habitat and will possibly interfere with the recovery of the species.
Conclusion	Based on the above assessment, it is considered possible that the Proposal will have a significant impact on the South-eastern Glossy Black-Cockatoo. Whilst foraging habitat is considered sub-optimal given the low density of feed trees, the area of the impact is relatively high.

c Large-eared Pied Bat (*Chalinolobus dwyeri*)

Table 9.7 Significant impact assessment - Large-eared Pied Bat (Endangered)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of a population?	Important populations of the Large-eared Pied Bat are outlined in the National Recovery Plan for the species (DERM, 2011). These include large populations that would exist in areas of sandstone escarpments in the Queensland range of the species distribution, and populations at the northern known limit of the species range in Shoalwater Bay. The subject land is not located within these areas, and as such a population occurring within the locality of the subject land would not be considered an important population. The largest known populations of the Large-eared Pied Bat within NSW occur in areas dominated by sandstone escarpments in the Sydney Basin and northwest slopes (DERM, 2011). The species breeds in arch caves with dome roofs with indentations, and roosts diurnally in disused mine shafts, caves, overhangs, and abandoned Fairy Martin (*Hirundo ariel*) nests (DERM, 2011). Modelling of distribution suggests that the Large-eared Pied Bat requires a combination of appropriate roosting and foraging habitat. It is usually found in areas with cliffs, escarpments, or rocky outcrops for roosting (typically sandstone but also rhyolite), although the presence of suitable caves, overhangs and cracks is likely more important than the precise geology (DCCEEW, 2023b). This roosting habitat is in close association with foraging habitat, and the species has been recorded foraging in fertile (relative to surrounding landscape) valleys and plains, as well as areas with moderately tall to taller trees in woodland along water courses and upper slopes and crests of ranges (DCCEEW, 2023b). Foraging excursions from a roost typically extend up to 2.5 km (Williams & Thomson, 2018). The Large-eared Pied Bat was recorded within the subject land via acoustic detection. Within the locality of the subject land, the species was recorded five times (DCCEEW, 2024b). Desktop surveys of potential habitat within 2 km of the subject land did not identify any potential breeding habitat for the species. Cliffs and extensive rock outcropping are present in the surrounding Wollombin, Nightcap and Mount Jerusalem National Parks, however, these features are greater than 2 km from the subject land, as per the buffer applied to the habitat assessments in accordance with the TBDC (DCCEEW, 2024a). Investigations within the subject land did not record any roosting sites. Based on the SVTM (DCCEEW, 2022), vegetation surrounding the subject land and in the broader locality contains large extents of comparable native vegetation. Given the large extent of at least comparable foraging opportunities for the Large-eared Pied Bat in close proximity of the subject land, it is considered unlikely that the loss of potential foraging habitat would lead to a long-term decrease in the size of a population of the Large-eared Pied Bat.

Significant impact	Assessment
Would the action reduce the area of occupancy of the species?	The Large-eared Pied Bat was recorded within the subject land via acoustic detection. Investigations within the subject land did not record any maternity or roosting sites. The subject land contains suitable foraging habitat only for the species which will be removed as part of the Proposal. Therefore, the Proposal may reduce the area of occupancy of the Large-eared Pied Bat.
Would the action fragment an existing population into two or more populations?	The subject land contains suitable foraging habitat only for the species. Almost all records of Large-eared Pied Bat have been documented within a few kilometres of cliff lines or rocky terrain (DERM, 2011), indicating the species travels up to 2.5 km from roost to the edge of a preferred foraging area (Williams & Thomson, 2018). The species is known to forage in a wide range of vegetation types, inclusive of "dry and wet sclerophyll forest, grassy woodland, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country" (DERM, 2011) and references therein. Given the high mobility of the species, it is considered unlikely that the Proposal will fragment an existing population into two or more populations.
Would the action adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the Large-eared Pied Bat is defined in the National Recovery Plan for the species (DERM, 2011). Critical habitat includes any maternity roosts, sandstone cliffs and fertile wooded valley habitat in close proximity to one another, and rainforest and moist eucalypt forest on other geological substrates at high elevation (DERM, 2011). Surveys within the subject land did not identify suitable roost habitat, nor were any maternity roosts observed. The subject land contains fertile wooded valley habitat and is located approximately 2.5 km from the nearest cliff line, located to the southeast of the subject land within Mount Jerusalem National Park. However, the cliff lines within the national park are not sandstone and rather consist of basaltic and felsic rocks. Moreover, if the nearest cliff line was the location of a maternity roost, the subject land would likely be on the edge of the foraging range for this species (Williams & Thomson, 2018). Additionally, the subject land does not occur at high elevation, with the maximum elevation approximately 100 m ASL. As such, the habitat within the subject land is unlikely to be critical to the survival of the species and the removal of foraging habitat within the subject land is unlikely to adversely affect an extent of habitat that is critical to the survival of the Large-eared Pied Bat.
Would the action disrupt the breeding cycle of a population?	The number of known breeding sites for the Large-eared Pied Bat is limited, with the species exhibiting specific preference for arch caves with dome roofs and indentations (DERM, 2011). The subject land is located approximately 2.5 km from the nearest cliff line, located in the Mount Jerusalem National Park. This habitat may provide suitable roosting habitat for the Large-eared Pied Bat. The Large-eared Pied Bat, however, is not likely to breed in the subject land due to the absence of outcrops, cliffs, disused mine shafts, or caves. The subject land provides only foraging habitat for the species. Given the foraging range of the species (as discussed above) and the proximity of comparable suitable foraging habitat to the subject land in the locality, it is considered unlikely that the Large-eared Pied Bat would be solely reliant on the resources within the subject land. Given this, the removal of foraging habitat within the subject is considered unlikely to disrupt the breeding cycle of the Large-eared Pied Bat.
Would the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The subject land does not contain suitable breeding or roosting habitat for the Large-eared Pied Bat. Within the subject land, foraging habitat only will be removed. Given the foraging range of the species (as discussed above) and the proximity of comparable suitable foraging habitat to the subject land in the locality, it is considered unlikely that the removal of foraging habitat within the subject land will impact the availability of habitat to the extent that the Large-eared Pied Bat is likely to decline.

Significant impact	Assessment
Would the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	The National Recovery Plan for the species (DERM 2011) suggests that invasive species such as goats, cats, foxes and rats may disturb and predate on Large-eared Pied Bats while roosting. Invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. Given that these invasive species are already established in the subject land and broader locality, it is unlikely that any further species invasions will be facilitated by the Proposal.
Would the action introduce disease that may cause the species to decline?	Currently, there are no known diseases associated with the Large-eared Pied Bat within Australia. White nose syndrome (WNS) is a potential threat to the Large-eared Pied Bat. The disease has not yet been detected in Australia but is a threat to cave-dwelling bats in other parts of the world and could have a significant impact on this species if it is introduced (DCCEEW, 2023b). The primary vector of WNS is recreational cavers and bushwalkers spreading diseases when moving between cave systems, rather than development activities (DCCEEW, 2023b). Because there is no maternity or roosting habitat (caves) within or near the subject land and the nature of the Proposal, the Proposal is unlikely to aid in the introduction of WNS.
Would the action interfere with the recovery of the species?	The recovery plan prepared for Large-eared Pied Bat notes several conservation and management actions (DERM, 2011). Of the listed actions, one is relevant to the Proposal: • conserve known roosts and associated foraging habitats and management of threats where possible. The subject land does not contain suitable breeding or roosting habitat for the Large-eared Pied Bat, and no roosts were identified during surveys. Within the subject land, foraging habitat only will be removed. That is, there are no known roosts within the locality of the subject land, and the habitat within the subject land is unlikely to be critical to the survival of the species. The Proposal is also not expected to increase threats for this species, including introducing disease or invasive fauna. Given this, it is considered unlikely that the Proposal will interfere with the recovery of the species.
Conclusion	Based on the above assessment, it is considered unlikely that the Proposal will have a significant impact on the Large-eared Pied Bat.

d Corokia (*Corokia whiteana*)

Table 9.8 Significant impact assessment - Corokia (Endangered)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of a population?	Corokia has a restricted range within northeast NSW and the species occurs as sparsely distributed individuals or clusters of individuals across this range (DCCEEW, 2022). A total of 12 individuals of Corokia were recorded within the subject land during targeted surveys. During these surveys, 19 individuals of Corokia were recorded outside of the subject land in adjacent vegetation. Note that surveys outside of the subject land were limited, and likely did not capture the full extent of the subpopulation of Corokia. Regardless, the loss of 38% of the known subpopulation of the species has the potential to lead to a long-term decrease in the size of the local population.
Would the action reduce the area of occupancy of the species?	The Proposal will result in the loss of 12 individuals of Corokia. Given the presence of 19 Corokia recorded outside of the subject land and presence of large tracts of habitat surrounding the subject land the Proposal is unlikely to reduce the area of occupancy.
Would the action fragment an existing population into two or more populations?	The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population. The species was recorded along the eastern bank of the Dam and will remain connected to the large tracts of vegetation adjacent to the subject land. Given this, it is unlikely that the Proposal will fragment an existing population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013) defines habitat critical to the survival of a species as areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The Conservation Advice (DCCEEW, 2022) for Corokia defines habitat critical to the survival of the species as: • rainforest, wet sclerophyll forest, and open moist eucalypt forest, even if the species is not currently occupying the area • remnant habitat that the species is currently occupying or occupied in the past. The habitat in which the species was recorded within the subject land comprises wet sclerophyll forest and rainforest, and as such would constitute habitat critical to the survival of the species. Given this, the loss of 12 individuals (and 10.80 ha of wet sclerophyll forest and rainforest in which the species was recorded) as a result of the Proposal is likely to adversely affect habitat critical to the survival of Corokia.
Would the action disrupt the breeding cycle of a population?	The Proposal will involve the loss of 12 individuals of the species. The species was recorded an additional 19 times outside of the subject land in adjacent vegetation. Note that surveys outside of the subject land were limited, and likely did not capture the full extent of the subpopulation of Corokia. Regardless, the loss of 38% of the known subpopulation of the species has the potential to disrupt the breeding cycle of the subpopulation.
Would the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will involve the loss of 12 individuals of the species and 10.80 ha of habitat that is likely to be critical to the survival of the species. The species was recorded an additional 19 times outside of the subject land in adjacent vegetation. Note that surveys outside of the subject land were limited, and likely did not capture the full extent of the sub population of Corokia. The Proposal is likely to remove habitat to the extent that the subpopulation will decline, however the implications of this habitat removal in relation to the entire population of Corokia is unknown.
Would the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	Invasive weeds have been identified as harmful to Corokia (DCCEEW, 2022). Species of note listed in the Conservation Advice include Camphor Laurel (*Cinnamomum camphora*), Large-leaved Privet (*Ligustrum lucidum*), Small-leaved Privet (*Ligustrum sinense*), Lantana (*Lantana camara*), and Grounsel (*Baccharis halimifolia*) (DCCEEW, 2022), all of which are already prevalent within the subject land and surrounding vegetation. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further weed invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to impact Corokia. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause Corokia to decline.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	No Recovery Plan has been developed for the Corokia. The Conservation Advice (DCCEEW, 2022) for the species lists multiple conservation and recovery actions to support the recovery of the species. The following is a subset of these actions, targeting actions relevant to the Proposal: • mitigate future damage to individuals, and suitable habitat • manage sites to prevent the introduction of invasive weeds • continue to collect and manage seed from extant subpopulations to store within the Australian Seedbank Partnership. The remainder of the recovery actions relate to research and species awareness. Mitigation and management measures have been proposed (refer Section 7.3) to control the spread of weeds by the Proposal, and the collection of seeds from threatened species within the subject land has been proposed as conservation measure. The Proposal will involve the loss of 12 individuals of Corokia and may detract from one of the recovery actions, however the Proposal will assist in the recovery of the species through collection of seeds for replanting and store in a seedbank.
Conclusion	Based on the above assessment, the Proposal is likely to have a significant impact on Corokia.

e Thorny Pea (*Desmodium acanthocladum*)

Table 9.9 Significant impact assessment - Thorny Pea (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The Approved Conservation Advice (DEWHA, 2008) for Thorny Pea does not define an important population for the species. Thorny Pea species distribution is confined to north-east NSW, primarily occurring in the Lismore area. Species records extend as far west as Casino, east to Byron Bay, south to Grafton and north to the Queensland/NSW border (DEWHA, 2008) (DCCEEW, 2024a). For the purposes of this assessment, an important population is considered to be: • important either for reproduction or dispersal • necessary for maintaining genetic diversity, and/or • near the limit of the species range. A total of 52 individuals of the species were recorded within the subject land, occupying a species polygon of 3.30 ha along the riparian zone of Doon Doon Creek, a tributary of the Tweed River. Thorny Pea is locally common and species records occur at 20 locations within approximately 5 km of the subject land, primarily located along the riparian zone of the Tweed River and its tributaries. Additional records are located along the Oxley River, approximately 10 km to the north of the subject land (DCCEEW, 2024a). This cluster of records is geographically distinct from the majority of other species records, which focus around the Lismore area. Hence, the population in which individuals within the subject land below are likely to be a separate population. This population is also near the limit of the species range, as it is within approximately 10 km of its northern extent (DCCEEW, 2022). The geographic separation of this population, its location near the limit of the species range and its spatial distribution along rivers and tributaries in an area with a high number of waterways, indicates it may have a high genetic diversity. That is, it is likely to be genetically diverse from the larger, southern population. As such, this population is likely to be necessary to maintain genetic diversity within the species. Therefore, the population that Thorny Pea individuals within the subject land belong to is likely to be important for the species. The action will impact 3.30 ha of known habitat for this important population, which includes the loss of 52 individuals. The SVTM indicates that 199.89 ha of Eastern Riverine Forests along the Tweed River and its tributaries are within 5 km of the subject land (DCCEEW, 2022). Various species records indicate that this is suitable habitat, contiguous with habitat identified within the subject land. The area of suitable habitat within the subject land, 3.30 ha, represents 1.65% of the contiguous suitable habitat within 5 km of the subject land. While contiguous, most of this riverine habitat is surrounded by cleared farmland or urban land. At least 364 individuals of this species have been recorded in the locality, inclusive of those recorded within the subject land. Some records do not provide species counts; most that do, estimate that the number of individuals recorded is a minimum (DCCEEW, 2024a). Hence, it is likely that the number of individuals in the population is much higher than 364. Based on the available data, however, the loss of 52 individuals is a significant proportion, 14.29%, of the recorded population. Hence, the Proposal could possibly lead to a long-term decrease in the size of an important population.
Would the action reduce the area of occupancy of an important population?	Based on the available data, the loss of 52 individuals within the subject land constitutes a loss of 14.29% of the recorded population in the locality. As such, the Proposal could possibly lead to a reduction in the area of occupancy of an important population.

Significant impact	Assessment
Would the action fragment an existing important population into two or more populations?	The Approved Conservation Advice (DEWHA, 2008) for Thorny Pea does not define an important population for the species, however, it is considered likely that the subject land supports a portion of an important population for the species. The portion of an important population to be impacted within the subject land is likely to located at an extremity of contiguous habitat for the population, near the base of the Dam wall. It is likely that the existing reservoir already fragments the population. The expansion of the Dam footprint is unlikely to increase fragmentation of any populations already separated by the existing reservoir. As such, it is unlikely that the action would fragment an existing important population into two or more populations.
Would the action adversely affect habitat critical to the survival of a species?	No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for the Thorny Pea. Habitat critical to the survival of the Thorny Pea has not been defined in the conservation advice, however, habitat for the species has been described as mainly occurring along rivers in dry rainforest and on the fringes of riverine subtropical rainforest on basalt-derived soils at low elevations (DEWHA, 2008). The action will impact 3.30 ha of habitat for what is considered likely to be an important population. The area of habitat to be impacted constitutes 1.65% of contiguous habitat along the Tweed River and its tributaries within 5 km of the subject land. This riverine habitat for an important population is likely to be critical to the survival of the species. The action will adversely affect habitat critical to the survival of the species, however, due to the small area of impact, it is unlikely to have a significant affect.
Would the action disrupt the breeding cycle of an important population?	The Approved Conservation Advice (DEWHA, 2008) for Thorny Pea does not define an important population for the species, however, it is considered likely that the subject land supports a portion of an important population for the species. Specific breeding cycle information for the species is unavailable, however, it is likely that seed pod dispersal is via epizoochory; similar to that of other *Desmodium* species, a dense covering of hooked hairs on seed pods that facilitate their dispersal by passing animals (DPIPWE, 2012). The existing reservoir is likely to impede the movement of pollinators and the operation of seed dispersal. The action is unlikely to create an additional barrier to species dispersal. The loss of 52 individuals, indicatively 14.29% of the population, will likely disrupt local recruitment, at least in the short term. Therefore, the action is likely to disrupt the breeding cycle of an important population of the species.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The action will reduce the area of habitat available to the Thorny Pea by 3.30 ha and cause the loss of 52 individuals. The area of habitat to be impacted is relatively small, however, the number of individuals to be lost is potentially significant for the local population. Large areas of contiguous habitat along the Tweed River and its tributaries may provide an opportunity for the local population to recover, however, considerable clearing surrounding most of this habitat may limit recovery potential. At least in the short-term, the loss of 52 individuals will lead to a decline in an important population for the species. Therefore, the action will remove habitat to the extent that the species is likely to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Approved Conservation Advice (DEWHA, 2008) for the Thorny Pea lists invasive weeds as a threat to the species, particularly *Asparagus sp*. and *Lantana sp*. Owing to past and ongoing disturbance, a high abundance of invasive weed species, inclusive of Lantana are already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further weed invasions will be established as a result of the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases identified which pose a specific threat to the Thorny Pea (DEWHA, 2008). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Thorny Pea to decline.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	No Recovery Plan has been prepared for the Thorny Pea. The Conservation Advice (DEWHA, 2008) for the species lists multiple recovery and threat abatement actions to support the recovery of the species. The following is a subset of these actions, targeting actions relevant to the Proposal: • monitor known populations to identify key threats • minimise adverse impacts from land use at known sites • protect habitat areas that are at risk of disturbance by activities such as clearing of habitat and making or upgrading roads through appropriate measures such as fencing • rehabilitate habitat areas, particularly lowland floodplain rainforest • identify, remove, and prevent introduction of weeds in the local area, which could become a threat to the species, using appropriate methods • control invasive weeds in habitat areas, particularly *Lantana sp*, *Senna sp*, Camphor Laurel (*Cinnamomum camphora*) and introduced vines such as *Asparagus sp*. • prevent grazing pressure at known sites on private property or on leased crown land through exclusion fencing. The loss of 52 individuals of Thorny Pea and the removal of 3.30 ha of habitat for an important population will interfere with the recovery of the species.
Conclusion	Based on the above assessment, the Proposal is likely to have a significant impact on the Thorny Pea.

f Rusty Rose Walnut (*Endiandra hayesii*)

Table 9.10 Significant impact assessment - Rusty Rose Walnut (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. The Approved Conservation Advice (DEWHA, 2008) for Rusty Rose Walnut does not define an important population for the species. The species distribution is restricted to northern NSW and southern Queensland. Some species records are scattered near coastal locations however the majority are clustered in the Border Ranges and Nightcap Ranges area (DEWHA, 2008). The species is known from 16 reserved estates in Queensland and NSW (DCCEEW, 2022). For the purposes of this assessment, an important population is considered to be: • important either for reproduction or dispersal • necessary for maintaining genetic diversity, and/or • near the limit of the species range. Within the subject land, 50 individuals of Rusty Rose Walnut were recorded across 39.82 ha of suitable habitat. The species was also recorded within vegetation adjacent to the subject land. Surveys outside of the subject land were limited; additional species records are likely to occur. The species was predominately recorded in rainforest patches, with some records in wet sclerophyll forest. The SVTM indicates that approximately 26,855 ha of potentially suitable habitat, consisting of 12 PCTs associated with the species (DCCEEW, 2022), are within a 10 km buffer of the subject land (DCCEEW, 2022). Database searches indicate that the species has been recorded in 46 locations within an approximate 10 km radius of the subject land constituting the vast majority of total records for the species (DCCEEW, 2024a). NSW DCCEEW (2024a) species records align with the Approved Conservation Advice; species records are significantly higher in surrounding areas such as Nightcap National Park, Border Ranges, Wollumbin National Park and Mooball National Park. A large number of individual or small clusters of records are also spread outside of these locations within a 35 km radius of the subject land. Given the abundance, higher density and spread of records beyond the local vicinity of the subject land, it is unlikely that the population to be impacted is important for reproduction, dispersal or necessary to maintain genetic diversity for the species. Additionally, the subject land is not near the limit of the species range. As such, it is unlikely that the Rusty Rose Walnut population recorded within the subject land is an important population of the species.
Would the action reduce the area of occupancy of an important population?	It is unlikely that an important population of the species is found in the subject land. Hence, it is unlikely that the removal of 39.82 ha of potentially suitable habitat and the loss of 50 individuals would reduce the area of occupancy of an important population of the species.
Would the action fragment an existing important population into two or more populations?	As it is unlikely that an important population of the species is found in the subject land, it is unlikely that an important population of the species would be fragmented. The expansion of the Dam footprint is also unlikely to increase fragmentation of any populations already separated by the existing reservoir. As such, it is unlikely that the removal of 39.82 ha of potentially suitable habitat and the loss of 50 individuals would fragment an existing important population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for the Rusty Rose Walnut. Habitat critical to the survival of the Rusty Rose Walnut has not been defined in the conservation advice, however, habitat for the species is described as occurring on poorer soils derived from sedimentary, metamorphic, or acid volcanic rocks. Vegetation includes subtropical and warm temperate rainforests, and Brush Box (*Lophostemon confertus*) forests, including regrowth and highly modified forms of these habitats. The altitude varies from near sea level to 800 m (DEWHA, 2008). The Proposal will remove 39.82 ha of potentially suitable habitat for the species and result in the loss of 50 individuals unlikely to be part of an important population for the species. Approximately 26,855 ha of potentially suitable habitat occurs within a 10 km buffer of the subject land. The species is known from 16 reserved estates in Queensland and NSW, most of which are within 35 km of the subject land. It is unlikely that the action will adversely affect habitat critical to the survival of the species.
Would the action disrupt the breeding cycle of an important population?	It is unlikely that an important population of the species is found in the subject land. Hence, it is unlikely that the removal of 39.82 ha of potentially suitable habitat and the loss of 50 individuals on the subject land would disrupt the breeding cycle of an important population of Rusty Rose Walnut.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will reduce the area of habitat available to the Rusty Rose Walnut by 39.82 ha, which will lead to a small decline in the species within the locality. However, the loss of this habitat is not expected to occur to the extent that the species is likely to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Approved Conservation Advice (DEWHA, 2008) for the Rusty Rose Walnut lists invasive weeds as a threat to the species, particularly Lantana *(Lantana camara)* and Camphor Laurel (*Cinnamomum camphora*). Owing to past and ongoing disturbance, a high abundance of invasive weed species, inclusive of Lantana are already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further weed invasions will be established as a result of the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases identified which pose a specific threat to the Rusty Rose Walnut (DEC, 2004) (DEWHA, 2008). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Rusty Rose Walnut to decline.
Would the action interfere with the recovery of the species?	No Commonwealth Recovery Plan has been prepared for the Rose Nut Walnut. The Conservation Advice (DEWHA, 2008) for the species lists multiple recovery and threat abatement actions to support the recovery of the species. The following is a subset of these actions, targeting actions relevant to the Proposal: • Control access routes to suitably constrain public access to known sites on public land. • Suitably control and manage access on private land. • Minimise adverse impacts from land use at known sites. • Identify, remove, and prevent introduction of weeds in the local area, which could become a threat to Rusty Rose Walnut, using appropriate methods. The Proposal will involve the loss of 50 individuals of Rose Nut Walnut and may detract from some of these recovery actions, however the Proposal is unlikely to substantially interfere with the recovery of the species.
Conclusion	Based on the above assessment, the Proposal will unlikely have a significant impact on the Rose Nut Walnut.

g Latham's Snipe (*Gallinago hardwickii*)

The Latham's Snipe (*Gallinago hardwickii*) is listed as vulnerable and migratory under the EPBC Act. As such, two significant impact assessments have been undertaken for the species in accordance with the significant impact criteria for vulnerable species (Table 9.11) and migratory species (Table 9.24) (DoE, 2013).

Table 9.11 Significant impact assessment - Latham's Snipe (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	The Conservation Advice (DCCEEW, 2024) for Latham's Snipe does not define an important population for the species. The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013) identifies an important population of a species as a population that is necessary for the long-term survival and recovery of the species. This may constitute important populations identified in recovery plans and/or populations that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Latham's Snipe breeds exclusively in Japan and Russia, and only migrates to Australia during the non-breeding season (DCCEEW, 2024). In Australia, Latham's Snipe disperses across the east coast, with records ranging from Cape York to Tasmania (DCCEEW, 2024). The species is highly mobile during the non-breeding season in Australia and likely moves in response to rainfall and availability of food (DCCEEW, 2024). DoE (2015) defines important habitat for the Latham's Snipe as areas that have previously been identified as internationally important for the species, or areas that support at least 18 individuals of the species. Since only a single individual of Latham's Snipe was incidentally recorded on the subject land on one occasion, it is not considered that the subject land provides important habitat for this species. The subject land is also not at or near the limit of the species' range and is unlikely to support an important population of the species. Given this, it is unlikely that the Proposal will lead to a long-term decrease in the size of an important population of Latham's Snipe.
Would the action reduce the area of occupancy of an important population?	Important populations have not been defined for Latham's Snipe (DCCEEW, 2024), and the subject land is considered unlikely to support an important population. Given this, it is unlikely that the Proposal will reduce the area of occupancy of an important population of Latham's Snipe.
Would the action fragment an existing important population into two or more populations?	Due to the migratory nature of the species, the Latham's Snipe is highly mobile and travels extensive distances over fragmented habitat. The subject land is considered unlikely to support an important population of Latham's Snipe. Given this, it is unlikely that the Proposal will fragment an existing important population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The Conservation Advice (DCCEEW, 2024) for Latham's Snipe defines habitat critical to the survival of the species in terms of nationally and internationally important habitat. Habitat is considered as internationally important if it supports more than 1% of the population (300 individuals), and habitat is considered nationally important if it has previously been identified as internationally important for the species, or if it supports at least 18 individuals of the species (DCCEEW, 2024). One individual of Latham's Snipe was recorded within the subject land, with an additional individual incidentally recorded 50 m outside of the subject land. Due to the low number of individuals observed between 2016 and 2024, the subject land does not meet the threshold for nationally or internationally important habitat, and therefore critical habitat, for Latham's Snipe. Given this, it is unlikely that the Proposal will adversely affect habitat critical to the survival of Latham's Snipe.
Would the action disrupt the breeding cycle of an important population?	The Latham's Snipe breeds exclusively in Japan and Russia, and only migrates to Australia during the non-breeding season (DCCEEW, 2024). The subject land is considered unlikely to support an important population of the species and is unlikely to contain habitat critical to the survival of the species. Given this, it is considered unlikely that the Proposal will disrupt the breeding cycle of an important population of Latham's Snipe.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Due to the migratory nature of the species, the Latham's Snipe is highly mobile and travels extensive distances over fragmented habitat. In Australia, Latham's Snipe disperses across the east coast during the non-breeding season, with records ranging from Cape York to Tasmania (DCCEEW, 2024). The species is highly mobile during the non-breeding season in Australia and likely moves in response to rainfall and availability of food (DCCEEW, 2024). Given this, it is unlikely that the Proposal will impact habitat to the extent that the Latham's Snipe is likely to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Conservation Advice (DCCEEW, 2024) for Latham's Snipe identifies fox and cats as harmful to the species through predation. Broad-leaved Tea-tree (*Melaleuca viridiflora*) is also listed as a threat to Latham's Snipe through invasion of grassland habitat on the Cape York Peninsula (DCCEEW, 2024). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to impact the Latham's Snipe. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Latham's Snipe to decline.
Would the action interfere with the recovery of the species?	No Recovery Plan or Listing Advice has been created for Latham's Snipe. The Proposal is unlikely to affect critical habitat or an important population of the species and is unlikely to otherwise interfere substantially with the recovery of the species.
Conclusion	Based on the above assessment, it is considered unlikely that the Proposal will have a significant impact on the Latham's Snipe.

h Red Boppel Nut (*Hicksbeachia pinnatifolia*)

Table 9.12 Significant impact assessment - Red Boppel Nut (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013) identifies an important population of a species as a population that is necessary for the long-term survival and recovery of the species. This may constitute important populations identified in recovery plans and/or populations that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Conservation Advice (DEWHA, 2008) and the Listing Advice (TSSC, 2012) for the Red Boppel Nut do not define important populations for the species. During targeted surveys for the Proposal, four individuals of the Red Boppel Nut were recorded within one continuous patch of PCT 827 in the subject land. The vegetation within which the species was recorded is categorised as planted, as described in Table 4.5. This patch of vegetation contains planted flora species and garden escapees from historical residential properties in the adjacent land holdings. Targeted surveys did not record the species elsewhere in the subject land. Within the locality of the subject land, the species has previously been recorded 138 times (DCCEEW, 2024a). The actual size of the population is expected to be much larger, and the species is known to be locally noticeable in northern NSW, in particular within and surrounding Nightcap National Park to the south of the subject land (TSSC, 2012). The subject land is not located at or near the limit of the species' range, and the small number of individuals located in the subject land are unlikely to be unnecessary for maintaining genetic diversity. As such, the population within the subject land is not considered to be an important population, and the Proposal is therefore unlikely to decrease the size of an important population of Red Boppel Nut.
Would the action reduce the area of occupancy of an important population?	As important populations have not been defined for the Red Boppel Nut and the subject land is considered unlikely to contain an important population, it is unlikely that the Proposal will reduce the area of occupancy of an important population of Red Boppel Nut.
Would the action fragment an existing important population into two or more populations?	Important populations have not been defined for the Red Boppel Nut and the subject land is considered unlikely to contain an important population. Four individuals of the species were recorded in a single patch of vegetation. Targeted surveys did not record the species elsewhere in the subject land. As such, it is unlikely that the Proposal would fragment an existing important population of Red Boppel Nut into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the Red Boppel Nut has not been defined in the Conservation Advice (DEWHA, 2008) nor Listing Advice (TSSC, 2012), and no habitat for the species has been listed on the Register of Critical Habitat under the EPBC Act (DCCEEW, 2022). In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The Red Boppel Nut is 'locally noticeable' in the locality of the subject land (TSSC, 2012), and the occurrence of the four individuals of the species within the subject land is unlikely to be a key source population for breeding or dispersal. The patch of vegetation the species was recorded within occurs in a modified condition with an abundance of planted flora species and garden escapees. The subject land is not located at or near the limit of the species' range, and the small number of individuals located in the subject land are unlikely to be unnecessary for maintaining genetic diversity. As such, the habitat within the single patch of PCT 827 in a planted condition is unlikely to be habitat critical to the survival of the species, and the Proposal is therefore unlikely to adversely affect habitat critical to the survival of the Red Boppel Nut.
Would the action disrupt the breeding cycle of an important population?	As important populations have not been defined for the Red Boppel Nut and the subject land is considered unlikely to contain an important population, it is unlikely that the Proposal will disrupt the breeding cycle of an important population.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Four individuals of the Red Boppel Nut were recorded in a single location within the subject land. Targeted surveys did not record the species elsewhere in the subject land. Within the locality of the subject land, the species has previously been recorded 138 times (DCCEEW, 2024a). The actual size of the population is expected to be much larger, and the species is known to be locally noticeable in northern NSW, in particular within and surrounding Nightcap National Park to the south of the subject land. As such, the loss of four individuals of the species is unlikely to impact the availability of habitat to the extent that the Red Boppel Nut is likely to significantly decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Invasive weed species have been listed as threats to the Red Boppel Nut through competition and contribution to fuel load (TSSC, 2012) (DEWHA, 2008). Species of note include Lantana (*Lantana camara*) and Camphor Laurel (*Cinnamomum camphora*) (TSSC, 2012) (DEWHA, 2008), two weeds that are abundant throughout the subject land and surrounding vegetation. Owing to the abundance of invasive species already present within the subject land, it is unlikely that any further weed invasions will be established by the Proposal with the implementation of the mitigation and management measures proposed (refer Section 7.3).
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Red Boppel Nut. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Red Boppel Nut to decline.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	The Conservation Advice (DEWHA, 2008) for the Red Boppel Nut lists multiple recovery and threat abatement actions that can be done to support the recovery of the species. The following is a subset of the recovery actions, targeting actions relevant to the Proposal: • undertake appropriate seed collection and storage for NSW Seedbank, and develop collection program of one provenance of Monkey Nut in collaboration with Botanic Gardens Trust and North Coast Regional Botanic Gardens • investigate options for linking, enhancing or establishing additional populations. The Proposal will involve the loss of four individuals of the Red Boppel Nut and will detract from the latter recovery action listed above. Mitigation measures proposed for the Proposal include the collection of seeds from threatened flora species where possible. With the implementation of this measure, the seeds may be stored for inclusion in state and national seed banks, contributing to this recovery action for the species. Given the above, the Proposal will interfere with one of the recovery actions for the Red Boppel Nut, however, will also provide an opportunity to contribute to seed collection and the potential establishment of additional populations.
Conclusion	Based on the above assessment, it is considered unlikely that the Proposal will have a significant impact on the Red Boppel Nut.

i White-throated Needletail (*Hirundapus caudacutus*)

The White-throated Needletail (*Hirundapus caudacutus*) is listed as vulnerable and migratory under the EPBC Act. As such, two impact significance assessments have been undertaken for the species in accordance with the significant impact criteria for vulnerable species (Table 9.13) and migratory species (Table 9.25) (DoE, 2013).

Table 9.13 Significant impact assessment - White-throated Needletail (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	The Conservation Advice (TSSC, 2019) for the White-throated Needletail does not define an important population of the species. The White-throated Needletail breeds in the Northern Hemisphere and migrates to Australia in the non-breeding season. During the non-breeding season, the species is widespread in eastern and southeastern Australia and is mostly aerial (TSSC, 2019). The species is most commonly recorded flying over wooded areas including open forest and rainforest and is known to roost in dense vegetation or hollows (TSSC, 2019). Once the White-throated Needletail enters Australia in the north, the species continues south until reaching the southern extent of its range in Victoria and Tasmania (TSSC, 2019). The species has not been recorded within the subject land; however, the species may fly over the subject land during migration and may forage or roost in areas of wet sclerophyll forest and rainforest. Due to the typically aerial nature of the species and its widespread nature along the entire east coast of Australia, it is considered unlikely that the subject land supports an important population of the species. Given this, the Proposal is unlikely to lead to a long-term decrease in the size of an important population of the White-throated Needletail.
Would the action reduce the area of occupancy of an important population?	Important populations have not been defined for the White-throated Needletail (TSSC, 2019), the species has not been recorded in the subject land, and the subject land is considered unlikely to support an important population. Given this, it is unlikely that the removal of potential foraging habitat would reduce the area of occupancy of an important population of the species
Would the action fragment an existing important population into two or more populations?	The subject land is considered unlikely to support an important population of the White-throated Needletail. Due to the migratory nature of the species, the White-throated Needletail is highly mobile and travels extensive distances over fragmented habitat. Given this, it is unlikely that the Proposal will fragment an existing important population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the White-throated Needletail has not been defined in the Conservation Advice (TSSC, 2019). In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The White-throated Needletail is a migratory species that breeds exclusively in the northern hemisphere but has a widespread distribution in eastern and southeastern Australia during the non-breeding season (TSSC, 2019). The species is almost exclusively aerial in Australia, flying over most types of habitats, and is also known to roost in dense vegetation or hollows (TSSC, 2019). The subject land contains potential foraging and roosting habitat for the species, in the form of wet sclerophyll forest and rainforest. Based on the SVTM (DCCEEW, 2022), large extents of vegetation surrounding the subject land and in the broader locality contains comparable native vegetation. Given the proximity of suitable habitat in the locality of the subject land with comparable vegetation, and the fact that the species was not recorded during surveys between 2016 and 2024, it is considered unlikely that the habitat within the subject land is critical to the survival of the species. As such, the Proposal is considered unlikely to adversely affect habitat critical to the survival of the White-throated Needletail.
Would the action disrupt the breeding cycle of an important population?	The White-throated Needletail does not breed in Australia (TSSC, 2019). The species migrates to Australia during the non-breeding season, where the species is widespread in the eastern and southeastern regions (TSSC, 2019). Given this, it is considered unlikely that the Proposal will disrupt the breeding cycle of an important population of White-throated Needletail.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The White-throated Needletail has not been recorded within the subject land. The Proposal will remove potential foraging and roosting habitat for the species. The species is widespread in eastern and southeastern Australia during the non-breeding season, and is highly mobile, travelling extensive distances over fragmented habitat (TSSC, 2019). Given the above, the removal of potential habitat within the subject land is considered unlikely to decrease or modify the available habitat such that the White-throated Needletail is likely to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Invasive species that are harmful to the White-throated Needletail have not been described (TSSC, 2019). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to impact the White-throated Needletail. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the White-throated Needletail to decline.
Would the action interfere with the recovery of the species?	No Recovery Plan or Listing Advice has been created for the White-throated Needletail. The Proposal is unlikely to affect critical habitat or otherwise interfere substantially with the recovery of the species.

Significant impact	Assessment
Conclusion	Based on the above assessment, it is considered unlikely that the Proposal will have a significant impact on the White-throated Needletail.

j Rough-shelled Bush-nut (*Macadamia tetraphylla*)

Table 9.14 Significant impact assessment - Rough-shelled Bush-nut (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013) identifies an important population of a species as a population that is necessary for the long-term survival and recovery of the species. This may constitute important populations identified in recovery plans and/or populations that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Recovery Plan (DCCEEW, 2023) for the Rough-shelled Bush-nut provides a list of known populations of the species and prioritises each population based on population size, proximity to other populations and occurrence in remnant vegetation. The population recorded on the subject land is not identified within this list. Twelve individuals of Rough-shelled Bush-nut were recorded throughout the subject land. Within the locality of the subject land, the species has been recorded on 74 occasions (DCCEEW, 2024a). The subject land is not located at or near the limit of the species' range, and the small number of individuals located in the subject land are unlikely to be unnecessary for maintaining genetic diversity. As such, the population that includes individuals within the subject land is not considered to be an important population. Hence, the Proposal is unlikely to decrease the size of an important population of Rough-shelled Bush-nut.
Would the action reduce the area of occupancy of an important population?	As the population of Rough-shelled Bush-nut within the subject land is not considered to be an important population, it is unlikely that the Proposal will reduce the area of occupancy of an important population of the species.
Would the action fragment an existing important population into two or more populations?	The population of Rough-shelled Bush-nut within the subject land is not considered to be an important population, and the Proposal is unlikely to create a barrier to the movement of pollinators or the operation of seed dispersal mechanisms of relevance to the species. Therefore, it is unlikely that the Proposal will fragment an existing population into two or more populations.
Would the action adversely affect habitat critical to the survival of a species?	The Recovery Plan (DCCEEW, 2023) for the Rough-shelled Bush-nut lists seven NSW vegetation classes that the species occurs in, inclusive of North Coast Wet Sclerophyll Forest. The species was recorded within PCT 827 on the subject land, a vegetation community that is classed as North Coast Wet Sclerophyll Forest. As such, the Proposal is likely to adversely affect an extent of habitat that is critical to the survival of the Rough-shelled Bush-nut.
Would the action disrupt the breeding cycle of an important population?	The population of Rough-shelled Bush-nut within the subject land is not considered to be an important population, and the Proposal is unlikely to create a barrier to the movement of pollinators or the operation of seed dispersal mechanisms of relevance to the species. Therefore, the Proposal is unlikely to disrupt the breeding cycle of an important population of Rough-shelled Bush-nut.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will involve the loss of 12 individuals of Rough-shelled Bush-nut within the subject land. This will directly decrease the area of habitat for the species within the subject land. However, within the locality and directly adjacent to the subject land there are large tracts of similar vegetation that provide comparable habitat value for the species. Given this, it is unlikely that the proposed removal of habitat within the subject land will be to the extent that the species is likely to decline.

Significant impact	Assessment
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Invasive weed species have been listed as a threat to the Rough-shelled Bush-nut and other Macadamia species (DCCEEW, 2023). Species of note include Lantana (*Lantana camara*) and Madeira Vine (*Anredera cordifolia*), two weeds that have been recorded throughout the subject land and surrounding vegetation. Feral pigs are also listed as a threat to Macadamia species (DCCEEW, 2023). Feral pigs are suggested to predate on the species, damage trees and potentially facilitate the spread of *Phytophthora cinnamomi* (DCCEEW, 2023). Owing to the abundance of invasive species already present within the subject land, it is unlikely that any further invasions will be established by the Proposal with the implementation of the mitigation and management measures proposed (refer Section 7.3).
Would the action introduce disease that may cause the species to decline?	*Phytophthora cinnamomi* is a disease known to impact Macadamia species by inducing stem tree death through root rot and stem canker (DCCEEW, 2023). Other potential threats that have been identified in orchards of Macadamia species are blossom blight, husk spot and trunk canker, however research is required to identify the impact of these diseases on wild populations (DCCEEW, 2023). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Rough-shelled Bush-nut to decline.
Would the action interfere with the recovery of the species?	The Recovery Plan (DCCEEW, 2023) for the Rough-shelled Bush-nut identifies five recovery and management objectives: • continue to identify and evaluate the extent and quality of Macadamia species populations and their habitat • reduce and manage the major threatening processes affecting Macadamia species and their habitat • increase knowledge of Macadamia species and their ecology to affect their conservation and management • improve awareness and understanding of Macadamia species, especially their conservation management requirements and major threats • manage, monitor and evaluate the National recovery Plan for Macadamia species (DCCEEW, 2023). The Proposal will involve the loss of 12 individuals of Rough-shelled Bush-nut and the associated loss of habitat for the species. The loss of individuals and reduced availability of habitat are listed as threats to the species (DCCEEW, 2023), therefore the Proposal is likely to interfere with the recovery of the Rough-shelled Bush-nut.
Conclusion	Based on the above assessment, the Proposal is unlikely to have a significant impact on Rough-shelled Bush-nut.

k Slender Marsdenia (*Marsdenia longiloba*)

Table 9.15 Significant impact assessment - Slender Marsdenia (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013) identifies an important population of a species as a population that is necessary for the long-term survival and recovery of the species. This may constitute important populations identified in recovery plans and/or populations that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Conservation Advice (DEWHA, 2008) for Slender Marsdenia does not define an important population of the species. A total of 228 individuals of Slender Marsdenia were recorded on the subject land during targeted surveys. The only records of the species within the locality of the Dam are located within the subject land (DCCEEW, 2024a). As such, the population within the subject land is likely to be an important population. The Proposal will result in the loss of 78.96 ha of known habitat for the Slender Marsdenia, which is likely to lead to a long-term decrease in the size of an important population of the species.
Would the action reduce the area of occupancy of an important population?	The only records of the species within the locality of the Dam are located within the subject land (DCCEEW, 2024a). Whilst the species is likely to be widespread in the area surrounding the subject land, there are no records to support this assumption. Based on current knowledge the population within the subject land is considered likely to be an important population. The Proposal will result in the loss of 78.96 ha of habitat for Slender Marsdenia, therefore the Proposal may reduce the area occupancy of an important population.
Would the action fragment an existing important population into two or more populations?	The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population. The Proposal is also unlikely to create a barrier to the movement of pollinators or the operation of seed dispersal mechanisms of relevance to the species. Given this, it is unlikely that the Proposal will fragment an existing important population into two or more populations.
Would the action adversely affect habitat critical to the survival of a species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013) defines habitat critical to the survival of a species as areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The Conservation Advice (DEWHA, 2008) for Slender Marsdenia does not define habitat critical to the survival of the species. Due to the considerable number of individuals and large area of habitat for each species within the subject land, it is likely that the habitat within the subject land is necessary for breeding and dispersal, and therefore, is critical to the survival of these species. Given this, the Proposal is likely to adversely affect habitat critical to the survival of Slender Marsdenia.
Would the action disrupt the breeding cycle of an important population?	The habitat within the subject land is likely to be critical to the survival of Slender Marsdenia and the population inhabiting the subject land is likely to an important population. Therefore, the Proposal is likely to disrupt the breeding cycle of an important population of the species.

Significant impact	Assessment
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will involve the loss of 222 individuals of the species and 78.96 ha of habitat that is likely to be critical to the survival of the species. Given the extent of critical habitat to be removed, the Proposal is likely to decrease the availability of habitat to the extent that the species is likely to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Conservation Advice (DEWHA, 2008) for Slender Marsdenia lists invasive weeds, in particular Lantana (*Lantana camara*) and cattle as harmful to the species. Owing to past and ongoing disturbance, a high abundance of invasive weed species, inclusive of Lantana are already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Slender Marsdenia. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Slender Marsdenia to decline.
Would the action interfere with the recovery of the species?	No Recovery Plan has been prepared for the Slender Marsdenia. The Conservation Advice (DEWHA, 2008) for the species lists multiple recovery and threat abatement actions to support the recovery of the species. The following is a subset of these actions, targeting actions relevant to the Proposal: • monitor known populations to identify key threats • minimise adverse impacts from land use at known sites • identify, remove, and prevent introduction of weeds in the local area, which could become a threat to the species, using appropriate methods • undertake appropriate seed collection and storage for NSW Seedbank. The loss of 228 individuals of Slender Marsdenia and the loss of 78.96 ha of habitat is likely to interfere with the recovery of the species.
Conclusion	Based on the above assessment, it is considered likely that the Proposal will have a significant impact on Slender Marsdenia.

I Giant Barred Frog (*Mixophyes iteratus*)

Table 9.16 Significant impact assessment - Giant Barred Frog (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	An important population of a species is a population that is necessary for the long-term survival and recovery of the species (DoE, 2013). This may constitute important populations identified in recovery plans and/or populations that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Conservation Advice (TSSC, 2021) and the Recovery Plan (Hines, H.B. and the South-east Queensland Threatened Frogs Recovery Team, 2002) for the Giant Barred Frog do not define important populations of the species. For the purposes of this assessment, habitat important for the species has been used to determine the presence of an important population. Important habitat for a threatened species is considered to include habitat known to be occupied by the species that is: • important for either breeding or dispersal • necessary for maintaining genetic diversity, and/or • near the limit of the species' range. The Giant Barred Frog was recorded along four streams within the subject land. Within the locality of the subject land, the species has been recorded on 83 occasions, with five of these records occurring within 2 km of the subject land (DCCEEW, 2024a). The subject land is not located at or near the limit of the species' range. During targeted surveys, adults and sub-adults of the species were observed within the streams, indicating the presence of breeding within these populations. Given this, the habitat within the subject land is known to support breeding for the Giant Barred Frog, and these populations may be considered important. Adult individuals of the species were also recorded upstream of the inundation level. As such, the Proposal will not remove the entirety of this breeding habitat for Giant Barred Frog and the populations are likely to persist upstream of the inundation area. Nonetheless, as the subject land has the potential to support an important population of the Giant Barred Frog, the Proposal may lead to a long-term decrease in the size of an important population of this species.
Would the action reduce the area of occupancy of an important population?	During targeted surveys, adults and sub-adults of the species were observed within both streams, indicating the presence of breeding within these populations. Given this, the habitat within the subject land is known to support breeding for the Giant Barred Frog, and these populations may be considered important. The Proposal will result in the inundation of 6.09 ha of known habitat for the Giant Barred Frog which may lead to a reduction in the area of occupancy of the species.
Would the action fragment an existing important population into two or more populations?	The known populations of Giant Barred Frog within the subject land occur within disjunct streams in the southeastern extent of the subject land and are separated from one another by a tract of forested vegetation greater than 500 m in width. The Giant Barred Frog is known to travel up to 150 m from aquatic habitat (TSSC, 2021). Given the distance between the streams and populations is greater than the known home range of the species, the populations are likely fragmented from one another. Given the above, the Proposal is unlikely to further fragment the known populations of the Giant Barred Frog.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	The Recovery Plan (Hines, H.B. and the South-east Queensland Threatened Frogs Recovery Team, 2002) listed for the Giant Barred Frog only identifies habitat critical to the survival of the species within the southeastern Queensland region. This habitat broadly consists of permanent freshwater streams at elevations of 0 m to 700 m ASL, and narrow remnants of riparian rainforest along streams and their major tributaries (Hines, H.B. and the South-east Queensland Threatened Frogs Recovery Team, 2002). In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The populations within the subject land were observed to contain sub-adult individuals, indicating the presence of breeding. Given that the subject land contains habitat known to support breeding of the Giant Barred Frog, the Proposal is likely to adversely affect an extent of habitat critical to the survival of the species.
Would the action disrupt the breeding cycle of an important population?	The populations within the subject land were observed to contain sub-adult individuals, indicating the presence of breeding. The populations of Giant Barred Frog within the subject land may be considered important, and the inundation of the known breeding habitat for the species is likely to disrupt the breeding cycle of the population of Giant Barred Frog.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The species has been recorded along four streams within the subject land and in riparian habitat adjacent to the subject land. The Proposal will result in the inundation of known habitat for the Giant Barred Frog and will decrease the availability of habitat by 6.09 ha. The populations of Giant Barred Frog were found to inhabit the areas of riparian habitat directly adjacent to the subject land. As such, it is likely that this retained habitat should continue to support the species upstream of the Proposal. Whilst the Proposal will decrease the availability of habitat for the Giant Barred Frog, it is not considered to be of an extent that is likely to cause the species to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Conservation Advice (TSSC, 2021) for the Giant Barred Frog lists feral pigs, domestic stock, feral cats, Freshwater Yabby, predatory fish species and invasive weeds as threats to the species through predation and habitat degradation. A number of invasive fauna species are known to inhabit the subject land and surrounding vegetation, inclusive of cattle, wild dogs and foxes. Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further invasive species will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	The Giant Barred Frog is susceptible to Chytridiomycosis, an infectious disease caused by the fungal pathogen *Batrachochytrium dendrobatidis* (Bd) (TSSC, 2021). The Giant Barred Frog is particularly susceptible and has been documented to carry chronic infections of Bd (TSSC, 2021). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the species to decline.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	The Recovery Plan for stream frogs (Hines, H.B. and the South-east Queensland Threatened Frogs Recovery Team, 2002) lists five recovery actions, constituting: • manage the recovery process • monitor populations • gain information required for management • protect populations and manage habitat • provide education and information. The Proposal will remove 6.09 ha of known habitat for the Giant Barred Frog which will detract from the recovery of the species.
Conclusion	Based on the above assessment, it is likely that the Proposal will have a significant impact on the Giant Barred Frog.

m Koala (*Phascolarctos cinereus*)

Table 9.17 Significant impact assessment - Koala (Endangered)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of a population?	The Koala was recorded 35 times within the subject land between 2016 and 2024. Records were obtained via several survey methods, including scat searches, camera trapping and spotlighting searches where individuals were observed or heard calling. The subject land is located in the North Coast Koala monitoring region (KMR) as defined in the Koala Habitat Information Base Technical Guide (DPIE, 2019). The majority of forested vegetation zones within the subject land contain Koala use trees for the North Coast as listed in Table 3 of the Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE, 2022). Given the multiple records of Koala and the largely continuous habitat, the Koala has been associated with all forested vegetation zones within the subject land (grassland and sedgeland areas are excluded due to the lack of wooded vegetation). This equates to 160.87 ha of suitable habitat for the Koala within the subject land. The removal and inundation of 160.87 ha of habitat to facilitate the Proposal will not directly lead to a decrease in the size of the Koala population, given the mitigation and management measures proposed for pre-clearance (refer to Section 7.3). However, the Proposal will reduce the extent of habitat available to the species in the locality and therefore has the potential to lead to a decrease in the population by reducing habitat resources to support the life cycle of this species. It is possible the Proposal could lead to a potential decrease in the local population.
Would the action reduce the area of occupancy of the species?	The Proposal will reduce the area of habitat available to the Koala by 160.87 ha, which is likely to reduce the area of occupancy of the species.
Would the action fragment an existing population into two or more populations?	The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population. With the preclearance measures proposed in Section 7.3, the Proposal is considered unlikely to create any additional barriers to movement for mobile fauna species and is therefore unlikely to fragment an existing population of Koala into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	No critical habitat for the Koala has been listed on the Register of Critical Habitat (DCCEEW, 2022). The Conservation Advice (DAWE, 2022a) for the Koala defines habitat critical to the survival of a species as 'the areas that a species relies on to avoid or halt decline and promote recovery of the species'. Key factors in identifying habitat critical to the Koala have been identified in the National Recovery Plan for the Koala (DAWE, 2022b) and include: a) whether the habitat is used during periods of stress (examples flood, drought or fire) b) whether the habitat is used to meet essential life cycle requirements (e.g. foraging, breeding, social behaviour, dispersal) c) the extent to which the habitat is used by important populations d) whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development e) whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements f) whether the habitat is necessary to ensure the long-term future of the species through reintroduction or re-colonisation g) any other way in which habitat may be critical to the survival of a listed threatened species (EPBC Act) (DAWE, 2022b). The Koala is known to utilise the habitat within the subject land, with regular sightings indicating the species has persisted between 2016 and 2024. This suggests that the local population of koala use at least some of the subject land to regularly meet essential life cycle requirements. Given this, the habitat within the subject land can be considered critical to the survival of the species in the locality.
Would the action disrupt the breeding cycle of a population?	The removal of 160.87 ha of habitat critical to the survival of the Koala will likely disrupt the breeding cycle of the local population. Additionally, during targeted surveys for the Proposal, Koalas were heard calling which may indicate the presence of breeding individuals within the subject land or in the vicinity of the subject land. Given this, the Proposal may disrupt the breeding cycle of the local population of the Koala.
Would the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will reduce the area of habitat available to the Koala by 160.87 ha, which may lead to a decline in the species within the locality. However, it is considered unlikely that the loss of this extent of habitat by the Proposal is likely to lead to the decline of the species, given a large extent of adjoining, comparable habitat, including large extents of connective vegetation being protected by National Parks.
Would the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	The National Recovery Plan (DAWE, 2022b) cites attacks from dogs as a direct threat to the Koala. Wild dogs have been observed within the subject land. As these feral species are already established within the subject land and the broader locality, it is unlikely that any further species invasions will be facilitated by the Proposal.
Would the action introduce disease that may cause the species to decline?	Koalas carry and are susceptible to multiple diseases, including Chlamydia (*Chlamydia pecorum*), Koala retrovirus, Koala herpesvirus, Trypanosomes and *Sarcoptes scabeii* (DAWE, 2022b). The Proposal is unlikely to introduce the above diseases nor any other pathogens harmful to the Koala to the locality. Biosecurity measures will be included in management plans for the Proposal to prevent the spread of disease.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	The National Recovery Plan (DAWE, 2022b) lists the following overarching objectives for the species' recovery: • The area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased. • The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased. • Metapopulation processes are maintained or improved. • Partners, communities and individuals have a greater role and capability in listed Koala monitoring, conservation, and management. The removal of 160.87 ha of habitat for the species may interfere with the first two if the Proposal is to result in a decline in the local population of the Koala.
Conclusion	Based on the above assessment, it is considered likely that the Proposal will have a significant impact on the Koala.

n Southern Pink Underwing Moth (*Phyllodes imperialis* southern subspecies)

Table 9.18 Significant impact assessment - Southern Pink Underwing Moth (Endangered)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of a population?	The Southern Pink Underwing Moth occurs in association with the larval food plant *Carronia multisepalea* (TSSC, 2002) (DEWHA, 2008). The presence of the Southern Pink Underwing Moth has been assumed at two locations within the subject land due to the observation of two *Carronia multisepalea* plants. No Southern Pink Underwing Moth larvae or moths were recorded on or around the *C. multisepalea* plants, nor elsewhere within the subject land, however targeted survey was not undertaken. Note that although only two *C. multisepalea* plants were found in the subject land, PlantNet describes this species as "widespread in subtropical rainforest north of Dorrigo" (Royal Botanic Gardens and Domain Trust, n.d.). Hence, these two individuals are likely to be more extensively found nearby the subject land. The Southern Pink Underwing Moth has a limited distribution and is only known from five locations in QLD and NSW. Only one of these locations has been confirmed as breeding habitat (TSSC, 2002) (DEWHA, 2008). Within the locality of the subject land, the Southern Pink Underwing Moth has been recorded on 12 occasions (DCCEEW, 2024a). Although there is a chance of the species occurring within the subject land, the loss of only two individuals of the larval food plant *Carronia multisepalea* is considered unlikely to lead to the long-term decrease in the size of the population of Southern Pink Underwing Moth.
Would the action reduce the area of occupancy of the species?	The presence of the Southern Pink Underwing Moth has been assumed at two locations within the subject land due to the observation of two *Carronia multisepalea* plants. No Southern Pink Underwing Moth larvae or moths were recorded on or around the *C. multisepalea* plants, nor elsewhere within the subject land, however targeted survey was not undertaken. Although there is a chance of the species occurring within the subject land, the loss of only two individuals of the larval food plant *Carronia multisepalea* is considered unlikely to reduce the area of occupancy of the species.
Would the action fragment an existing population into two or more populations?	No Southern Pink Underwing Moth were recorded within the subject land, however, two *Carronia multisepalea* plants were recorded in a single location. The Proposal will involve the complete loss of these two plants and will not fragment the areas of known habitat for the Southern Pink Underwing Moth. No other *Carronia multisepalea* plants were recorded elsewhere in the subject land and no moths or larvae of the Southern Pink Underwing Moth were recorded opportunistically in the subject land. Given this, it is unlikely that the Proposal will fragment an existing population of Southern Pink Underwing Moth into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	The Conservation Advice (TSSC, 2002) for the Southern Pink Underwing Moth does not define important populations for the species. In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The Southern Pink Underwing Moth occurs in association with the larval food plant *Carronia multisepalea* (TSSC, 2002) (DEWHA, 2008). *Carronia multisepalea* is utilised by the species for both foraging and breeding, and therefore, the presence of two *Carronia multisepalea* plants is likely to constitute a very small extent of resources that may be considered critical habitat for the Southern Pink Underwing Moth. Based on the very small extent of loss of two *Carronia multisepalea* plants, combined with a lack of observations of this species in the subject land, it is considered unlikely to adversely affect habitat critical to the survival of the Southern Pink Underwing Moth.
Would the action disrupt the breeding cycle of a population?	As discussed above, the Southern Pink Underwing Moth uses *Carronia multisepalea* plants for breeding, likely relying on the darkness provided by the collapsed form of the vine (TSSC, 2002) (DEWHA, 2008). The Proposal will involve the loss of two *Carronia multisepalea* plants. Based on this very small loss of resources, and lack of observations of this species in the subject land, the Proposal is therefore unlikely to disrupt the breeding cycle of a population of Southern Pink Underwing Moth.
Would the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will involve the loss of only two *Carronia multisepalea* plants from one location within the subject land. Although this habitat within the subject land may be considered critical to the survival of the Southern Pink Underwing Moth, the loss of such a small extent of this habitat is not likely to lead to the species to decline.
Would the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	Invasive species that are harmful to the Southern Pink Underwing Moth have not been described (TSSC, 2002) (DEWHA, 2008). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	No diseases have been identified as harmful to the Southern Pink Underwing Moth (TSSC, 2002) (DEWHA, 2008). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Southern Pink Underwing Moth to decline.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	No recovery plan has been prepared for the Southern Pink Underwing Moth. The Conservation Advice (TSSC, 2002) provides regional and local priority actions to support the recovery of the species. The following are a subset of these priority actions, targeting those relevant to the Proposal: • manage threats to areas of vegetation that contain populations/ occurrences/ remnants of the Southern Pink Underwing Moth • ensure infrastructure or development activities in areas where the Southern Pink Underwing Moth occurs do not adversely impact on known populations • protect populations through the development of conservation agreements and/or covenants including breeding and foraging sites on private land (TSSC, 2002). The Southern Pink Underwing Moth has not been recorded within the subject land but has been assumed present at two discrete locations where a potential host plant *Carronia multisepalea* plants was located within the subject land. The Proposal will result in the inundation of these two plants, however given C. *multisepalea* is considered to be widespread in subtropical rainforest in the region, this is not expected to interfere with the recovery of this moth species.
Conclusion	Based on the above assessment, it is unlikely that the Proposal will have a significant impact on the Southern Pink Underwing Moth.

o Grey-headed Flying-fox (*Pteropus poliocephalus*)

Table 9.19 Significant impact assessment - Grey-headed Flying-fox (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	The National Recovery Plan for the species (DAWE, 2021) does not define an important population for the species. For the purposes of this assessment, habitat important to the species has been used to assess whether or not an impact on an 'important population' is likely. Within the locality of the subject land, the Grey-headed Flying-fox has been recorded on 222 occasions (DCCEEW, 2024b). During surveys for the Proposal, the species was incidentally recorded foraging on the subject land on four occasions in 2016 and 2020. No evidence of breeding camps was observed in the subject land during surveys. The Grey-headed Flying-fox is considered to form a single population, with animals distributing widely across Australia between roosting and breeding sites (DAWE, 2021). Critical habitat for the Grey-headed Flying-fox has been defined in the National Recovery Plan (DAWE, 2021), and consists of winter and spring flowering vegetation communities. Of the important feed species listed in the National Recovery Plan (DAWE, 2021), the following have been recorded on the subject land: • Swamp Mahogany (*Eucalyptus robusta*) • Silky Oak (*Grevillea robusta*). The National Recovery Plan (DAWE, 2021) also lists vegetation communities containing native foraging species within 20 km of a nationally important camp as critical habitat for the Grey-headed Flying-fox. Two nationally important camps are located approximately 12 km from the subject land, one located in Bray Park to the north, and one located near Nimbin to the south of the subject land (DCCEEW, 2024). As the subject land contains important feed species, is located within 20 km of two nationally important camps, and the Grey-headed Flying-fox has been observed at least intermittently foraging on the subject land, the foraging habitat within the subject land is important to the survival of the species, and the population that forages within the subject land is likely of importance. In accordance with the SVTM (DCCEEW, 2022), vegetation surrounding the subject land and in the broader locality contains comparable extents of native vegetation with winter and spring flowering species. Furthermore, the Grey-headed Flying-fox is known to travel large distances to forage, with recorded instances indicating a distance of up to 148 km (DAWE, 2021). However, foraging distances are typically up to 50 km (Tidemann and Nelson 2004). Due to the lack of breeding camp and proximity of the subject land to a large extent of suitable foraging habitat, coupled with the high foraging range of the species, it is considered unlikely that the removal of 62.87 ha of foraging habitat would lead to a long-term decrease in the size of an important population of Grey-headed Flying-fox.
Would the action reduce the area of occupancy of an important population?	As the subject land is known to provide foraging resources for the Grey-headed Flying-fox, and the resources within the subject land are likely to be important to the species, the removal of 62.87 ha of foraging habitat may slightly reduce the area of occupancy of an important population of Grey-headed Flying-fox.
Would the action fragment an existing important population into two or more populations?	The Grey-headed Flying-fox forms a single national population, with animals distributing widely across Australia between roosting and breeding sites (DAWE, 2021) Owing to this wide dispersal, the mobility of this species and its ability to traverse large areas of highly modified landscapes, the Proposal is unlikely to fragment an existing important population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	As discussed above, critical habitat for the Grey-headed Flying-fox has been defined in the National Recovery Plan (DAWE, 2021), and consists of winter and spring flowering vegetation communities. Of the important feed species listed in the National Recovery Plan (DAWE, 2021), the following have been recorded on the subject land: • Swamp Mahogany (*Eucalyptus robusta*) • Silky Oak (*Grevillea robusta*). The National Recovery Plan (DAWE, 2021) also lists vegetation communities containing native foraging species within 20 km of a nationally important camp as critical habitat for the Grey-headed Flying-fox. Two nationally important camps are located approximately 12 km from the subject land, one located in Bray Park to the north, and one located near Nimbin to the south of the subject land (DCCEEW, 2024). As the subject land contains important feed species, is located within 20 km of two nationally important camps, and the Grey-headed Flying-fox has been observed foraging on the subject land, the habitat within the subject land is considered critical to the survival of the species. Given this, the removal of 62.87 ha of foraging habitat in the subject land may adversely affect habitat critical to the survival of the Grey-headed Flying-fox.
Would the action disrupt the breeding cycle of an important population?	The subject land does not contain breeding or roosting camps of the Grey-headed Flying-fox. However, the species is known to forage on the subject land. Two nationally important camps are located approximately 12 km from the subject land, one located in Bray Park to the north, and one located near Nimbin to the south of the subject land (DCCEEW, 2024). An additional camp is located in Uki, approximately 3 km northeast of the subject land, however this camp is not considered nationally important (DCCEEW, 2024). As discussed above, the vegetation in the locality of the subject land is comparable in nature and extent, with similar winter and spring flowering species. Due to the proximity of suitable habitat in the locality of the subject land, it is considered unlikely that the local Grey-headed Flying-fox population would be solely reliant on the foraging habitat provided within the subject land. Given this, it is considered unlikely that the removal of 62.87 ha of foraging habitat will substantially disrupt the breeding cycle of an important population of the Grey-headed Flying-fox, as the surrounding vegetation will continue to provide foraging resources to support the species.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will involve the removal of 62.87 ha of foraging habitat for the Grey-headed Flying-fox. The subject land does not contain breeding or roosting camps of the species. As discussed above, the vegetation in the locality of the subject land is comparable in nature and extent, with similar vegetation containing winter and spring flowering species. Due to the proximity of suitable habitat in the locality of the subject land, it is considered unlikely that the removal of foraging habitat within the subject land will decrease the availability of habitat to the extent that the species is likely to decline significantly.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Invasive species that are harmful to the Grey-headed Flying-fox have not been described (DAWE, 2021). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	The National Recovery Plan (DAWE, 2021) for the Grey-headed Flying-fox does not identify any diseases likely to impact the health of the species. All discussion about disease in the recovery plan concerns risk of disease transmission from bats to humans. The Proposal is unlikely to introduce disease that may cause the Grey-headed Flying-fox to decline.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	The National Recovery Plan (DAWE, 2021) for the Grey-headed Flying-fox provides nine recovery objectives. The following is a subset of these objectives, targeting objectives relevant to the Proposal: • identify, protect and increase native foraging habitat that is critical to the survival of the species • reduce the impact to the species of electrocution on power lines, and entanglement in netting and on barbed wire (DAWE, 2021). The Proposal will result in the removal of 62.87 ha of known foraging habitat that is considered as habitat critical to the survival of the species. Additionally, the Proposal will involve the relocation of existing power and telecommunication utilities. Minimising collision and electrocution hazards to animals will be considered in the design of the overhead powerline, including the spacing and configuration of conductors. The resulting design is unlikely to pose a significant electrocution risk to Grey-headed Flying-foxes. Given this, the Proposal is likely to detract from the recovery objectives for the species listed above, however is not considered to interfere significantly.
Conclusion	Based on the above assessment, it is possible that the Proposal will have a significant impact on the Grey-headed Flying-fox.

p Scrub Turpentine (*Rhodamnia rubescens*) and Native Guava (*Rhodomyrtus psidioides*)

Scrub Turpentine (*Rhodamnia rubescens*) and Native Guava (*Rhodomyrtus psidioides*) have been grouped together for this assessment due to the similarity in the vegetation types and microhabitats they inhabit, as well as their susceptibility to infection by Myrtle Rust (*Austropuccinia psidii*).

Table 9.20 Significant impact assessment - Scrub Turpentine and Native Guava (Critically Endangered)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of a population?	Targeted surveys for the Proposal determined the presence of both Scrub Turpentine (*Rhodamnia rubescens*) and Native Guava (*Rhodomyrtus psidioides*) within the subject land. The Proposal will result in the inundation and loss of 709 individuals of Scrub Turpentine and 97.26 ha of habitat for the Native Guava. Both species have wide distributions and are relatively abundant across their range. Estimates of population size indicate that the population of Scrub Turpentine is larger than 10,000 and the population of Native Guava is larger than 20,000 mature plants (TSSC, 2020a) (TSSC, 2020b). The populations of Scrub Turpentine and Native Guava within the subject land are infected with Myrtle Rust (*Austropuccinia psidii*), a disease known to infect these species. Without the impact of the Proposal, the populations of Scrub Turpentine and Native Guava are likely to decline due to prevalence of Myrtle Rust. Nonetheless, the significant number of individuals and large area of habitat that will be impacted by the Proposal is likely to lead to a long-term decline in the size of the populations of Scrub Turpentine and Native Guava.
Would the action reduce the area of occupancy of the species?	As required by the SAII assessment, the reduction in area of occupancy (AOO) for Scrub Turpentine and Native Guava has been calculated based on 2 km grid cells (refer Section 7.4.2). The Proposal will result in a decrease in the area of occupancy by 0.04% for Scrub Turpentine and 0.15% for Native Guava.
Would the action fragment an existing population into two or more populations?	The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population. The Proposal is also unlikely to create a barrier to the movement of pollinators or the operation of seed dispersal mechanisms of relevance to the species. Given this, it is unlikely that the Proposal will fragment an existing important population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	The Conservation Advice for Scrub Turpentine (TSSC, 2020a) and Native Guava (TSSC, 2020b) do not define habitat critical to the survival of the species'. In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). Due to the significant number of individuals and large area of habitat for each species within the subject land, it is likely that the habitat within the subject land is necessary for breeding and dispersal, if assuming these species are still capable of reproducing given the impact of Myrtle Rust. Therefore, habitat in the subject land to be impacted by the Proposal could be considered critical to the survival of these species.
Would the action disrupt the breeding cycle of a population?	All individuals of Native Guava recorded within the subject land are immature and infected by Myrtle Rust. The population of Scrub Turpentine was also significantly impacted by Myrtle Rust, with the majority of specimens recorded exhibiting signs of the disease. As such, the individuals of these species are unlikely to reach reproductive maturity due to the infection and are unlikely to set fruit and contribute to the species dispersal. Given this, the Proposal is unlikely to disrupt the breeding cycle of the populations of Scrub Turpentine and Native Guava, as the populations are unlikely to be viable for reproduction.
Would the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The inundation of 127.96 ha of habitat for Scrub Turpentine and 97.26 ha of habitat for Native Guava is likely to decrease the availability of habitat to the extent that each species is likely to decline.
Would the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	Invasive flora and fauna species that are harmful to Scrub Turpentine and Native Guava are not described in the relevant Conservation Advice for each species (TSSC, 2020a) (TSSC, 2020b). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	Myrtle Rust (*Austropuccinia psidii*) is an infectious disease known to affect Scrub Turpentine and Native Guava (TSSC, 2020a) (TSSC, 2020b). Myrtle Rust was evident in the populations of both species within the subject land (refer to Photograph 5.12 and Photograph 5.13). Given that Myrtle Rust is already prevalent in the local population of each species, the Proposal is unlikely to introduce disease that may cause the species to decline.
Would the action interfere with the recovery of the species?	No Recovery Plans for Scrub Turpentine and Native Guava have been prepared as the implementation of priority actions and mitigations measures against key threats for the species is considered sufficient (DCCEEW, 2022). The Conservation Advice for each species lists a set of conservation and management actions derived from key threat (TSSC, 2020a) (TSSC, 2020b). The following is a subset of these actions, targeted those that are relevant to the Proposal: • develop hygiene protocols to minimise spread of Myrtle Rust • weed controls measures at known sites must ensure adequate hygiene protocols to minimise spread of Myrtle Rust (TSSC, 2020a) (TSSC, 2020b). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will interfere with the recovery of the species.

Significant impact	Assessment
Conclusion	Based on the above assessment, it is considered likely that the Proposal will have a significant impact on both Scrub Turpentine and Native Guava.

q Red Lilly Pilly (*Syzygium hodgkinsoniae*)

Table 9.21 Significant impact assessment - Red Lilly Pilly (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery (DoE, 2013). This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Conservation Advice for the Red Lilly Pilly (DEWHA, 2008) does not define important populations for the species. Within the subject land, 105 individuals of Red Lilly Pilly were recorded. Within adjacent vegetation to the subject land, the species was recorded an additional 168 times during targeted surveys. Surveys outside of the subject land were limited, and additional individuals of the species are likely to occur. The species was mostly observed along drainage lines towards the north of the Dam. Database searches within the locality of the subject land indicate that the species has been recorded 110 times (DCCEEW, 2024a). Given the abundance of the species within and adjacent to the subject land (in comparison to the known occurrences in the locality), it is likely that this habitat is important for the population of Red Lilly Pilly. Therefore, since the Proposal will involve the loss of 105 individuals of Red Lilly Pilly and associated habitat of this species, this may lead to a long-term decrease in the size of an important population of this species.
Would the action reduce the area of occupancy of an important population?	Given the abundance of the species within and adjacent to the subject land (in comparison to the known occurrences in the locality), it is likely that this habitat is important for the population of Red Lilly Pilly. The Proposal will involve the loss of 105 individuals of Red Lilly Pilly and associated habitat of this species, which may lead to a reduction in the area of occupancy of an important population.
Would the action fragment an existing important population into two or more populations?	The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population. The Proposal is also unlikely to create a barrier to the movement of pollinators or the operation of seed dispersal mechanisms of relevance to the species. Given this, it is unlikely that the Proposal will fragment an existing important population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the Red Lilly Pilly has not been defined in the Conservation Advice (DEWHA, 2008). In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). Given the abundance of Red Lilly Pilly recorded within and adjacent to the subject land (in comparison to the known occurrences in the locality), it is likely that the habitat within the subject land is necessary for the long-term maintenance of the species in the locality. Therefore, habitat in the subject land is considered critical to the survival of the species. As such, the Proposal is likely to adversely affect habitat critical to the survival of the Red Lilly Pilly.
Would the action disrupt the breeding cycle of an important population?	A total of 273 individuals of Red Lilly Pilly were recorded during surveys for the Proposal, consisting of 105 individuals inside and 168 recorded outside of the subject land. Whilst it is likely that the species occurrence surrounding the subject land is larger than was observed during the surveys, the loss of 105 individuals of this population of Red Lilly Pilly is likely to disrupt the breeding cycle of an important population.
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will involve the loss of 105 individuals of Red Lilly Pilly. An additional known 168 individuals of the species will be retained in adjacent vegetation surrounding the subject land. Whilst it is likely that the species occurrence surrounding the subject land is larger than was observed during the surveys, the loss of 105 individuals of this population may lead to a small decline in the species occurrence.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Invasive weeds have been identified as harmful to the Red Lilly Pilly (DEWHA, 2008). Species of note listed in the Conservation Advice include Camphor Laurel (*Cinnamomum camphora*), Lantana (*Lantana camara*), Small-leaved Privet (*Ligustrum sinense*) and exotic grasses (DEWHA, 2008), all of which have already been recorded throughout the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further weed invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Red Lilly Pilly. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Red Lilly Pilly to decline.
Would the action interfere with the recovery of the species?	No Recovery Plan has been developed for the Red Lilly Pilly. The Conservation Advice (DEWHA, 2008) for the species lists multiple regional and local recovery and threat abatement actions to support the recovery of the species. The following is a subset of these actions, targeting actions relevant to the Proposal: • monitor known populations to identify key threats • control access routes to suitably constrain public access to known sites on public land • ensure road widening and maintenance activities (or other infrastructure or development activities involving substrate or vegetation disturbance) in areas where the species occurs do not adversely impact on known populations • identify and remove weeds in the local area, which could become a threat to the • develop, initiate and encourage management regimes on public lands (and private property) that minimise physical damage the trees and their habitat, and provide opportunity for the species to regenerate (DEWHA, 2008). The loss of 105 individuals of the Red Lilly Pilly will likely interfere with the recovery actions for the species.

Significant impact	Assessment
Conclusion	Based on the above assessment, it is considered likely that the Proposal will have a significant impact on Red Lilly Pilly.

r Durobby (*Syzygium moorei*)

Table 9.22 Significant impact assessment - Durobby (Vulnerable)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery (DoE, 2013). This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range (DoE, 2013). The Conservation Advice for Durobby (DEWHA, 2008) does not define an important population for the species. Within the subject land, 18 individuals of Durobby were recorded. All individuals of the species recorded within the subject land were observed within isolated patches of landscape planting and have either been planted and/or have derived from planted specimens. Whilst these occurrences are isolated from the broader population of Durobby, the population within the subject land appears to be not naturally occurring and exists within a modified landscape. Given this, it is unlikely that the specimens observed within the subject land are key sources for dispersal or maintaining genetic diversity. As such, the population within the subject land is considered unlikely to be an important population and the Proposal is therefore unlikely to lead to a long-term decrease in the size of an important population of Durobby.
Would the action reduce the area of occupancy of an important population?	As it is unlikely that an important population of Durobby is found on the subject land, it is unlikely that the loss of 18 individuals of the species would reduce the area of occupancy of an important population of the species.
Would the action fragment an existing important population into two or more populations?	As it is unlikely that an important population of Durobby is found in the subject land, it is unlikely that an important population of the species would be fragmented. The Proposal involves an outward expansion of the Dam footprint, which is not considered to sever connectivity to surrounding areas of habitat nor the exchange of genetic material within the population. The Proposal is also unlikely to create a barrier to the movement of pollinators or the operation of seed dispersal mechanisms of relevance to the species. Given this, it is unlikely that the Proposal will fragment an existing important population into two or more populations.
Would the action adversely affect habitat critical to the survival of a species?	No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat for Durobby. Habitat critical to the survival of the Durobby has not been defined in the Conservation Advice, however, habitat for the species has been described as sheltered, fertile soils in lowland riverine and gully rainforests, typically subtropical rainforests (DEWHA, 2008). All individuals of Durobby recorded within the subject land appear to be planted and/or have derived from planted specimens and were recorded within PCT 827 Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast. PCT 827 is categorised as wet sclerophyll forest, and all individuals of Durobby were recorded in the planted and low condition zones of this PCT. As such, the habitat in which the species was recorded within the subject land is not likely to be critical to the survival of the species. Given this, the Proposal is unlikely to adversely affect habitat critical to the survival of Durobby.
Would the action disrupt the breeding cycle of an important population?	As it is unlikely that an important population of Durobby is found on the subject land, it is unlikely that the loss of 18 individuals of the species would disrupt the breeding cycle of an important population of the species.

Significant impact	Assessment
Would the action modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will involve the loss of 18 individuals. The species is typically associated with rainforest, however, was recorded within the subject land in areas of wet sclerophyll forest. The habitat within which the species was recorded constitutes patches of PCT 827 planted and low condition zones, totalling 7.41 ha. All individuals of Durobby recorded within the subject land appear to be planted and/or have derived from planted specimens. The population within the subject land is not naturally occurring and exists within a modified landscape. As such, the loss of 7.41 ha of modified and low condition wet sclerophyll forest in which the species was recorded is unlikely to decrease the availability of habitat to the extent that the species is likely to decline.
Would the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Conservation Advice (DEWHA, 2008) for Durobby lists invasive weeds and browsing/ grazing by feral animals as a threat to the species. Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established as a result of the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases identified which pose a specific threat to Durobby (DEWHA, 2008). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Durobby to decline.
Would the action interfere with the recovery of the species?	The Border Ranges Rainforest Biodiversity Management Plan – NSW and Queensland (DECCW NSW, 2010) lists multiple objectives to support the recovery of the species. The following is a subset of these objectives, targeting objectives relevant to the Proposal: • protect rainforest related vegetation and species from clearing • protect rainforest and related vegetation from fragmentation, modification and degradation • protect rainforest and related vegetation from the impact of weeds • protect rainforest from fire and to promote the implementation of appropriate fire regimes in related vegetation • protect rainforest and related vegetation from grazing and trampling by livestock • minimise the impacts of human interference • control and minimise impacts of introduced pathogens and diseases • maintain the viability and evolutionary potential of rainforest and related populations, species and communities. The loss of 18 individuals of Durobby will interfere with the recovery objectives for the species.
Conclusion	Based on the above assessment, the Proposal is unlikely to have a significant impact on Durobby.

s Mitchell's Rainforest Snail (*Thersites mitchellae*)

Table 9.23 Significant impact assessment - Mitchell's Rainforest Snail (Critically Endangered)

Significant impact	Assessment
Would the action lead to a long-term decrease in the size of a population?	Three individuals of the Mitchell's Rainforest Snail have been recorded within the subject land. Two individuals were incidentally recorded on separate occasions during surveys for other species, including one live individual and one shell. During targeted searches for the Mitchell's Rainforest Snail undertaken in the presence of Dr John Stansic, a registered expert for the species, an additional live individual was recorded within the subject land. The targeted searches were conducted to inform an expert report for the Proposal, prepared by Dr Stanisic, provided in Appendix F. The live individuals of the Mitchell's Rainforest Snail were recorded within a continuous area of lowland subtropical rainforest in PCT 1302 White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion. The area of habitat for the species to be impacted by the Proposal has been defined in the expert report for the species, and covers a total area of 2.20 ha, constituting the continuous patch of PCT 1302 within which it was recorded. As discussed in the expert report, only the one population of Mitchell's Rainforest Snail is likely to occur within the subject land, and individuals recorded on the subject land form part of this population. As such, the inundation of 2.20 ha of known habitat for the species is likely to lead to a long-term decrease in the size of the population. Nevertheless, as directed by the expert report (Appendix F, the impact of the Proposal will be mitigated to some extent through translocating individuals to retained nearby habitat prior to construction (see Section 7.3).
Would the action reduce the area of occupancy of the species?	The Proposal will result in the loss of 2.20 ha of habitat for Mitchell's Rainforest Snail, which is likely to reduce the area of occupancy for the species 0.21% as defined by a 2 x 2 km grid cells. The species requires specific habitat characteristics which are uncommon. Removal of any habitat will permanently reduce the occupancy of the species.
Would the action fragment an existing population into two or more populations?	The live individuals of the Mitchell's Rainforest Snail were recorded within a gully at the southeastern end of the Dam. The proposed increase in the capacity of the Dam will result in the water level within this gully extending further upstream, potentially fragmenting the terrestrial vegetation on either side of the gully for less mobile fauna species such as the Mitchell's Rainforest Snail. Given that there is a single population of Mitchell's Rainforest Snail within the subject land, the Proposal has the potential to fragment an existing population into two or more populations.

Significant impact	Assessment
Would the action adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of the Mitchell's Rainforest Snail was previously listed on the Register of Critical Habitat (the Register) (DCCEEW, 2022) as Stotts Island Nature Reserve, located approximately 33 km north of the subject land in the Tweed River. As of 5 June 2024, Stotts Island Nature Reserve is no longer listed on the Register, and no other areas of habitat are listed on the Register for Mitchell's Rainforest Snail. As no specific habitat is currently defined, in accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), habitat critical to the survival of a species refers to areas necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long-term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community (DoE, 2013). The subject land contains 2.20 ha of known habitat for the Mitchell's Rainforest Snail. The population within the subject land has been identified as a breeding population, indicated by the presence of a subadult individual (refer to the expert report in Appendix F). As such, the habitat within the subject land is considered critical to the survival of the Mitchell's Rainforest Snail. Given this, the Proposal is considered likely to adversely affect habitat critical to the survival of the Mitchell's Rainforest Snail. Nevertheless, as directed by the expert report (Appendix F), the impact of the Proposal will be mitigated to some extent through translocating individuals to retained nearby habitat prior to construction (see Section 7.3).
Would the action disrupt the breeding cycle of a population?	As outlined in the expert report (Appendix F), the population of Mitchell's Rainforest Snail within the subject land has been identified as a breeding population. The Proposal will involve the inundation of 2.20 ha of known habitat for the Mitchell's Rainforest Snail, and as such, the Proposal is likely to disrupt the breeding cycle of the population.
Would the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Proposal will reduce the area of habitat available to the Mitchell's Rainforest Snail by 2.20 ha, which may lead to a decline in the species within the locality. Given the rarity of this snail, with less than 500 individuals estimated in the wild (TSSC, 2016), it is considered that the Proposal would remove habitat to the extent that the species is likely to decline. Nevertheless, as directed by the expert report (Appendix F), the impact of the Proposal will be mitigated to some extent through translocating individuals to retained nearby habitat prior to construction (see Section 7.3).
Would the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?	The Conservation Advice (TSSC, 2016) lists invasive weeds as a threat to the habitat of the Mitchell's Rainforest Snail. Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further weed invasions will be established by the Proposal.
Would the action introduce disease that may cause the species to decline?	There are no diseases known to affect the Mitchell's Rainforest Snail. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that the Proposal will introduce disease that may cause the Mitchell's Rainforest Snail to decline.

Significant impact	Assessment
Would the action interfere with the recovery of the species?	The Recovery Plan (NSW NPWS, 2001) for the Mitchell's Rainforest Snail provides five recovery objectives. Of the listed actions, one is relevant to the Proposal: • to improve the protection and management of other populations of Mitchell's Rainforest Snail and remaining areas of habitat (NSW NPWS, 2001). The Proposal will involve the inundation of 2.20 ha of known habitat for the Mitchell's Rainforest Snail and will likely adversely affect the known population within this habitat. Given this, the Proposal is likely to interfere with the recovery objectives of the species. Nevertheless, as directed by the expert report (Appendix F), the impact of the Proposal will be mitigated to some extent through translocating individuals to retained nearby habitat prior to construction (see Section 7.3).
Conclusion	Based on the above assessment, it is considered likely that the Proposal will have a significant impact on the Mitchell's Rainforest Snail.

iii Migratory species

a Latham's Snipe (*Gallinago hardwickii*)

Table 9.24 Significant impact assessment - Latham's Snipe (Migratory)

Significant impact	Assessment
Would the action substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), defines important habitat for a migratory species as: • habitat utilised by a by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or • habitat that is of critical importance to the species at particular life-cycle stages, and/or • habitat utilised by a migratory species which is at the limit of the species range, and/or • habitat within an area where the species is declining. The Conservation Advice (DCCEEW, 2024) for Latham's Snipe defines important habitat for the species in terms of national and international considerations. Habitat is considered as internationally important if it supports more than 1% of the population (300 individuals), and habitat is considered nationally important if it has previously been identified as internationally important for the species, or if it supports at least 18 individuals of the species (DCCEEW, 2024). A single individual of Latham's Snipe was incidentally recorded on the subject land on one occasion. Due to the low number of individuals observed between 2016 and 2024, the subject land does not meet the threshold for nationally or internationally important habitat, and therefore critical habitat, for Latham's Snipe. Given this, it is unlikely that the Proposal will substantially impact important habitat for Latham's Snipe.
Would the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	The Conservation Advice (DCCEEW, 2024) for Latham's Snipe identifies fox and cats as harmful to the species through predation. Broad-leaved Tea-tree (*Melaleuca viridiflora*) is also listed as a threat to Latham's Snipe through invasion of grassland habitat on the Cape York Peninsula (DCCEEW, 2024). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.

Significant impact	Assessment
Would the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	The Conservation Advice (DCCEEW, 2024) for Latham's Snipe defines an ecologically significant proportion of the population of the species in terms of national and international considerations. Habitat is considered as internationally important if it supports more than 1% of the population (300 individuals), and habitat is considered nationally important if it has previously been identified as internationally important for the species, or if it supports at least 18 individuals of the species (DCCEEW, 2024). Hence, given only one individual has been recorded within the subject land, it does not appear to support an ecologically significant proportion of a migratory species. A single individual of Latham's Snipe was incidentally recorded on the subject land on one occasion. Therefore, the subject land is unlikely to support an ecologically significant proportion of the Latham's Snipe. Moreover, Latham's Snipe breeds exclusively in Japan and Russia, and only migrates to Australia during the non-breeding season (DCCEEW, 2024). Hence, the Proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the species.
Conclusion	Based on the above assessment, it is considered unlikely that the Proposal will have a significant impact on the Latham's Snipe.

b White-throated Needletail (*Hirundapus caudacutus*)

Table 9.25 Significant impact assessment - White-throated Needletail (Migratory)

Significant impact	Assessment
Would the action substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	In accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), an area of important habitat for a migratory species constitutes: • habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or • habitat that is of critical importance to the species at particular life-cycle stages, and/or • habitat utilised by a migratory species which is at the limit of the species range, and/or • habitat within an area where the species is declining (DoE, 2013). The draft referral guidelines (DoE, 2015) for migratory birds defines important habitat for the White-throated Needletail as non-breeding habitat. As described in the Conservation Advice (TSSC, 2019) for the White-throated Needletail, the species is mostly aerial and is widespread in eastern and southeastern Australia. The species is known to fly over most types of habitats and is known to roost in dense vegetation or hollows (TSSC, 2019). The subject land contains potential foraging and roosting habitat for the species, in the form of wet sclerophyll forest and rainforest. Given the proximity of large extents suitable habitat in the locality of the subject land with comparable vegetation, it is considered unlikely that the Proposal will substantially impact an area of important habitat for the White-throated Needletail.
Would the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	As discussed above, invasive species that are harmful to the White-throated Needletail have not been described (TSSC, 2019). Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species, including wild dogs, foxes and rats, have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.

Significant impact	Assessment
Would the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	The White-throated Needletail does not breed in Australia (TSSC, 2019). The species migrates to Australia during the non-breeding season, where the species is widespread in the eastern and southeastern regions (TSSC, 2019). The subject land contains potential foraging and roosting habitat for the species, in the form of wet sclerophyll forest and rainforest. Due to the widespread distribution of the species and the fact that the species was not recorded during surveys between 2016 and 2024, it is considered unlikely that the subject land supports an ecologically significant proportion of the population of White-throated Needletail. Given this, it is unlikely that the Proposal will seriously disrupt the lifecycle of an ecologically significant proportion of the population of White-throated Needletail.
Conclusion	Based on the above assessment, it is considered unlikely that the Proposal will have a significant impact on the White-throated Needletail.

c Black-faced Monarch (*Monarcha melanopsis*) and Spectacled Monarch (*Symposiachrus trivirgatus*)

Table 9.26 Significant impact assessment - Black-faced Monarch and Spectacled Monarch (Migratory)

Significant impact	Assessment
Would the action substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), defines important habitat for a migratory species as: • habitat utilised by a by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or • habitat that is of critical importance to the species at particular life-cycle stages, and/or • habitat utilised by a migratory species which is at the limit of the species range, and/or • habitat within an area where the species is declining (DoE, 2013). The draft referral guidelines (DoE, 2015) for migratory birds defines important habitat for the Black-faced Monarch and Spectacled Monarch. This habitat is summarised below: • Black-faced Monarch: rainforest and wet sclerophyll forest, particularly sheltered gullies and slopes with a dense understorey of ferns and/or shrubs, and • Spectacled Monarch: dense rainforest, wet sclerophyll or moist forest vegetation, and occasionally other dense vegetation such as mangroves, drier forest and woodlands (DoE, 2015). The vegetation within the subject land constitutes rainforest and wet sclerophyll forest of varying density and condition class. All vegetation zones excluding pasture and derived sedgeland have the potential to provide habitat for the Black-faced Monarch and Spectacled Monarch. No Black-faced Monarch or Spectacled Monarch were recorded on the subject land during any surveys between 2016 and 2024. Potential habitat occurs in the form of PCTs 827, 1073 and 1302, however due to the absence of records of Black-faced Monarch or Spectacled Monarch, it is unlikely that the habitat within the subject land constitutes important habitat for these species. Given this, the Proposal is unlikely to substantially impact an area of important habitat for the Black-faced Monarch or Spectacled Monarch.
Would the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	The draft referral guidelines (DoE, 2015) for migratory birds lists the Black Rat (*Rattus rattus*) and invasive vines of riparian habitat such as Rubber Vine (*Cryptostegia grandiflora*) as harmful to the Black-faced Monarch and Spectacled Monarch. Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species including the Black Rat have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.

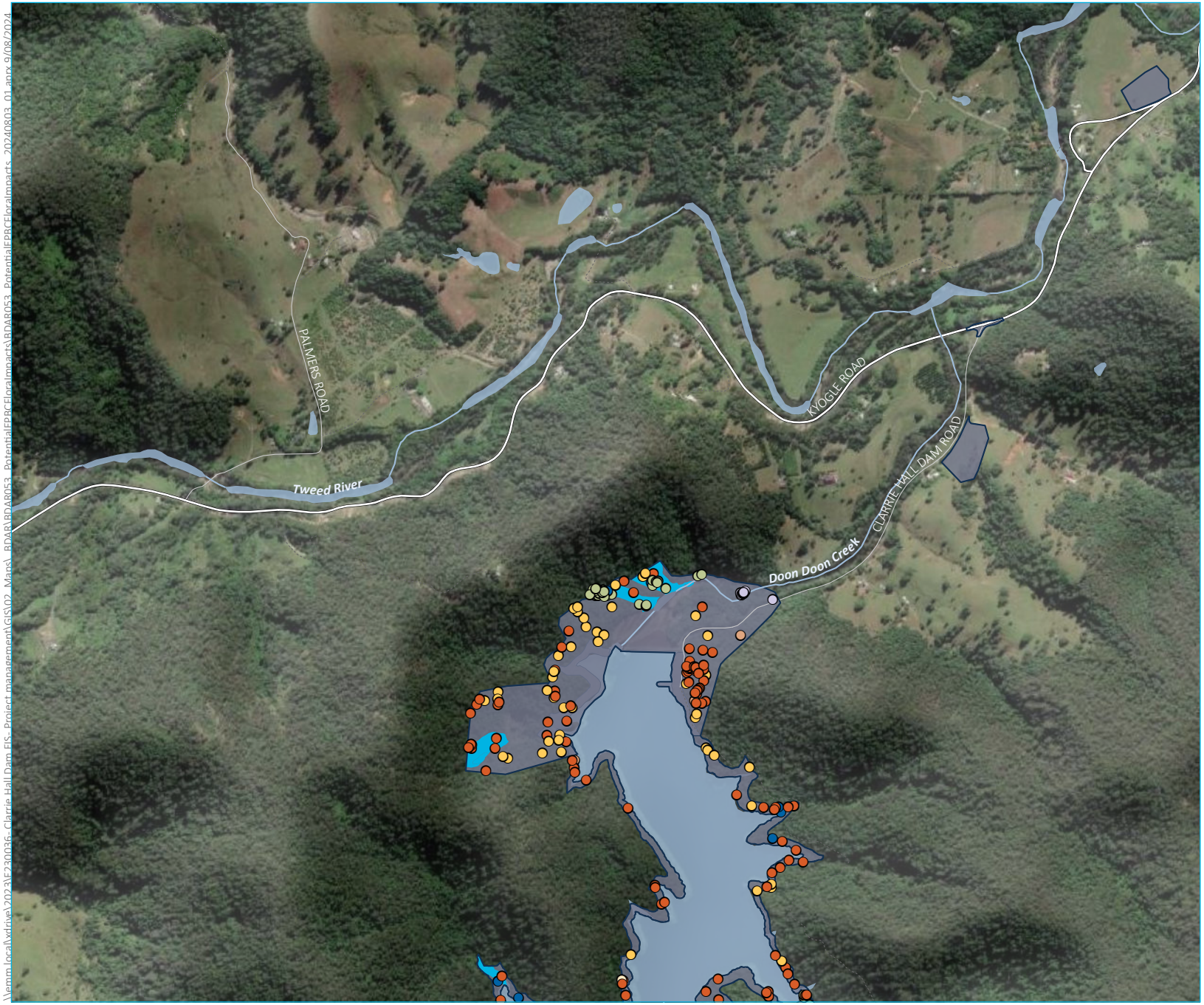
Significant impact	Assessment
Would the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	The draft referral guidelines (DoE, 2015) for migratory birds defines ecologically significant proportions of the populations of Black-faced Monarch, Rufous Fantail and Spectacled Monarch based on international (1% of the population) and national (0.1% of the population) considerations: • Black-faced Monarch: 1% constitutes 4,600 individuals and 0.1% constitutes 460 individuals • Spectacled Monarch: 1% constitutes 4,100 individuals and 0.1% constitutes 410 individuals. The Black-faced Monarch and Spectacled Monarch have not been recorded within the subject land, nor in the locality of the subject land (DCCEEW, 2024a). As such, it is unlikely that the subject land support an ecologically significant proportion of the populations of these species. Given this, it is unlikely that the Proposal will seriously disrupt the lifecycle of an ecologically important proportion of Black-faced Monarch and Spectacled Monarch.
Conclusion	Based on the above assessment, it is considered unlikely that the Proposal will have a significant impact on the Black-faced Monarch and Spectacled Monarch.

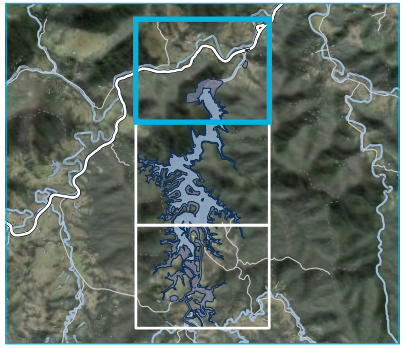
d Rufous Fantail (*Rhipidura rufifrons*)

Table 9.27 Significant impact assessment - Rufous Fantail (Migratory)

Significant impact	Assessment
Would the action substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	The 'Matters of National Environmental Significance Significant impact guidelines 1.1' (DoE, 2013), defines important habitat for a migratory species as: • habitat utilised by a by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or • habitat that is of critical importance to the species at particular life-cycle stages, and/or • habitat utilised by a migratory species which is at the limit of the species range, and/or • habitat within an area where the species is declining (DoE, 2013),. The draft referral guidelines (DoE, 2015) for migratory birds defines important habitat for the Rufous Fantail as moist, dense habitats such as mangroves, rainforest, riparian forests and thickets, and wet eucalypt forest with a dense understorey. Dry eucalypt woodlands and forests and Brigalow shrublands are used during passage (DoE, 2015). The vegetation within the subject land constitutes rainforest and wet sclerophyll forest of varying density and condition class. All vegetation zones excluding pasture and derived sedgeland have the potential to provide habitat for the Rufous Fantail. The Rufous Fantail has been recorded within the subject land on two occasions between 2016 and 2024 and is likely to only occasionally utilise the habitat within the subject land. The Proposal will result in the loss of 8.77 ha of rainforest and 156.74 ha of wet sclerophyll forest (pasture and derived sedgeland vegetation zones excluded due to lack of wooded vegetation). Large tracts of wet sclerophyll forest and subtropical rainforest are located within the 10 km locality of the subject land, including within the surrounding Nightcap, Mebbin and Wollumbin National Parks. As the species has been recorded a low amount of times, it is unlikely that the habitat within the subject land constitutes important habitat for the species as is intended by the significant impact guidelines (DoE, 2013),. Given this, the Proposal is unlikely to substantially impact an area of important habitat for the Rufous Fantail.

Significant impact	Assessment
Would the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	The draft referral guidelines (DoE, 2015) for migratory birds lists the Black Rat (*Rattus rattus*) and invasive vines of riparian habitat such as Rubber Vine (*Cryptostegia grandiflora*) as harmful to the Rufous Fantail. Owing to past and ongoing disturbance, a high abundance of invasive weed species is already established within the subject land and surrounding vegetation. Of the 107 introduced species recorded within the subject land, 23 are considered high-threat weeds for the purpose of application of the BAM (DPIE, 2020). Additionally, invasive fauna species including the Black Rat have been observed within the subject land. With the mitigation and management measures proposed (refer Section 7.3), it is unlikely that any further species invasions will be established by the Proposal.
Would the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	The draft referral guidelines (DoE, 2015) for migratory birds defines ecologically significant proportions of the populations of the Rufous Fantail and Spectacled Monarch based on international (1% of the population) and national (0.1% of the population) considerations: • 1% constitutes 11,600 individuals • 0.1% constitutes 1,100 individuals. Within the subject land, the Rufous Fantail has been recorded on two occasions. Within the locality of the subject land, the Rufous Fantail has not previously been recorded. The number of total records within and in the locality of the subject land does not meet the threshold for an ecologically significant proportion of the population of Rufous Fantail. Given this, it is unlikely that the Proposal will seriously disrupt the lifecycle of an ecologically important proportion of Rufous Fantail.
Conclusion	Based on the above assessment, it is unlikely that the Proposal will have a significant impact on the Rufous Fantail.





KEY

Subject land

EPBC Act listed threatened flora species and ecological communities | EPBC status

- *Desmodium acanthocladum* | V
- *Endiandra hayesii* | V
- *Macadamia tetraphylla* | V
- *Marsdenia longiloba* | V
- *Rhodamnia rubescens* | CE
- *Rhodomyrtus psidioides* | CE
- *Syzygium hodgkinsoniae* | V

Lowland Rainforest of subtropical Australia | CE

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Potential direct impacts to EPBC Act listed threatened ecological communities and threatened flora species

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 9.1

EMM
creating opportunities

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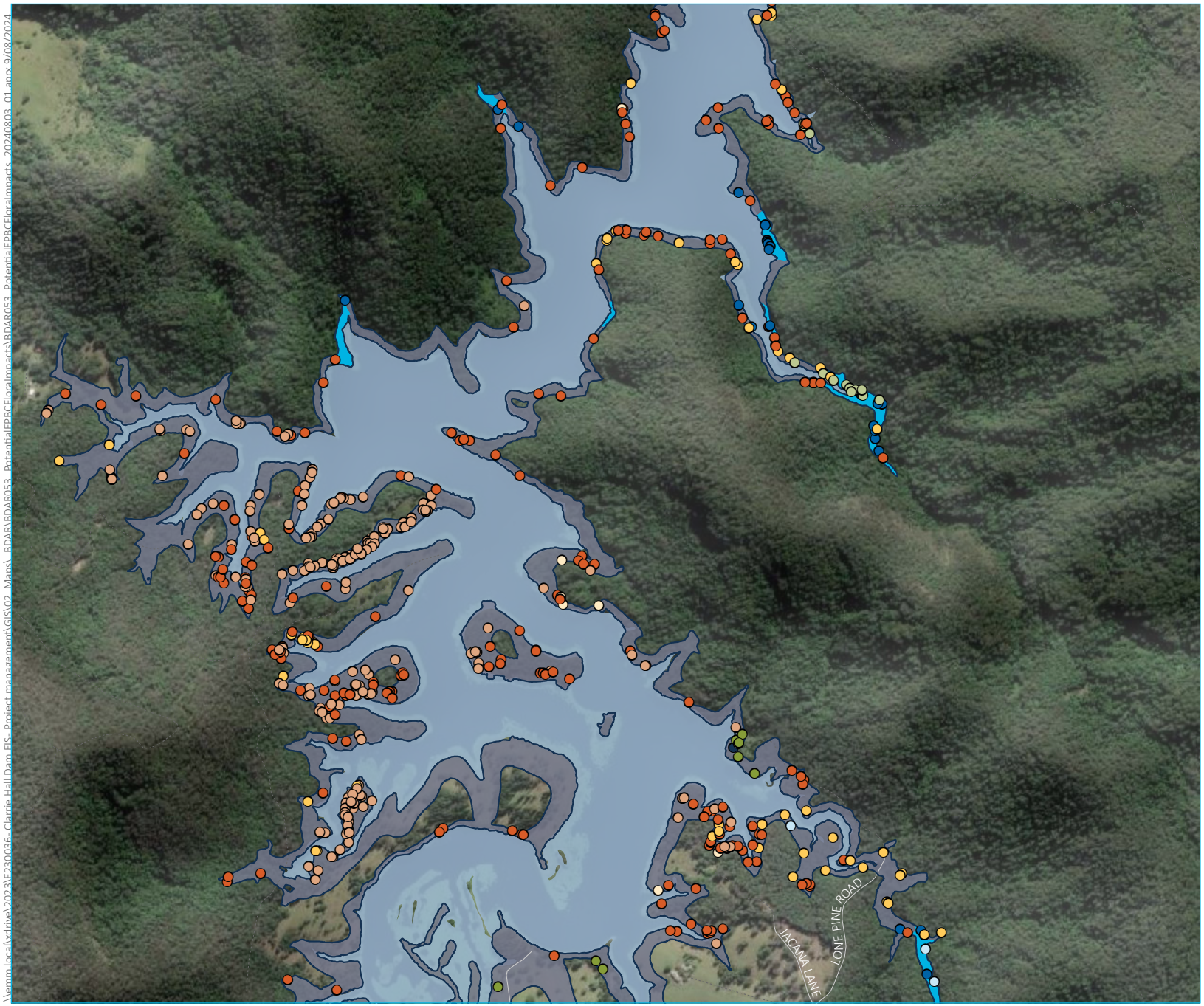

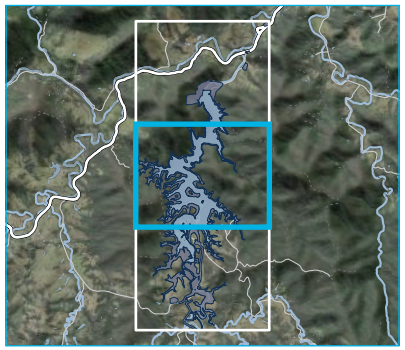

KEY

Subject land

EPBC Act listed threatened flora species and ecological communities | EPBC status

- *Corokia whiteana* | E
- *Endiandra hayesii* | V
- *Hicksbeachia pinnatifolia* | V
- *Macadamia tetraphylla* | V
- *Marsdenia longiloba* | V
- *Rhodamnia rubescens* | CE
- *Rhodomyrtus psidioides* | CE
- *Syzygium hodgkinsoniae* | V
- *Syzygium moorei* | V
- Lowland Rainforest of subtropical Australia | CE

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Potential direct impacts to EPBC Act listed threatened ecological communities and threatened flora species

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Figure 9.1

EMM creating opportunities

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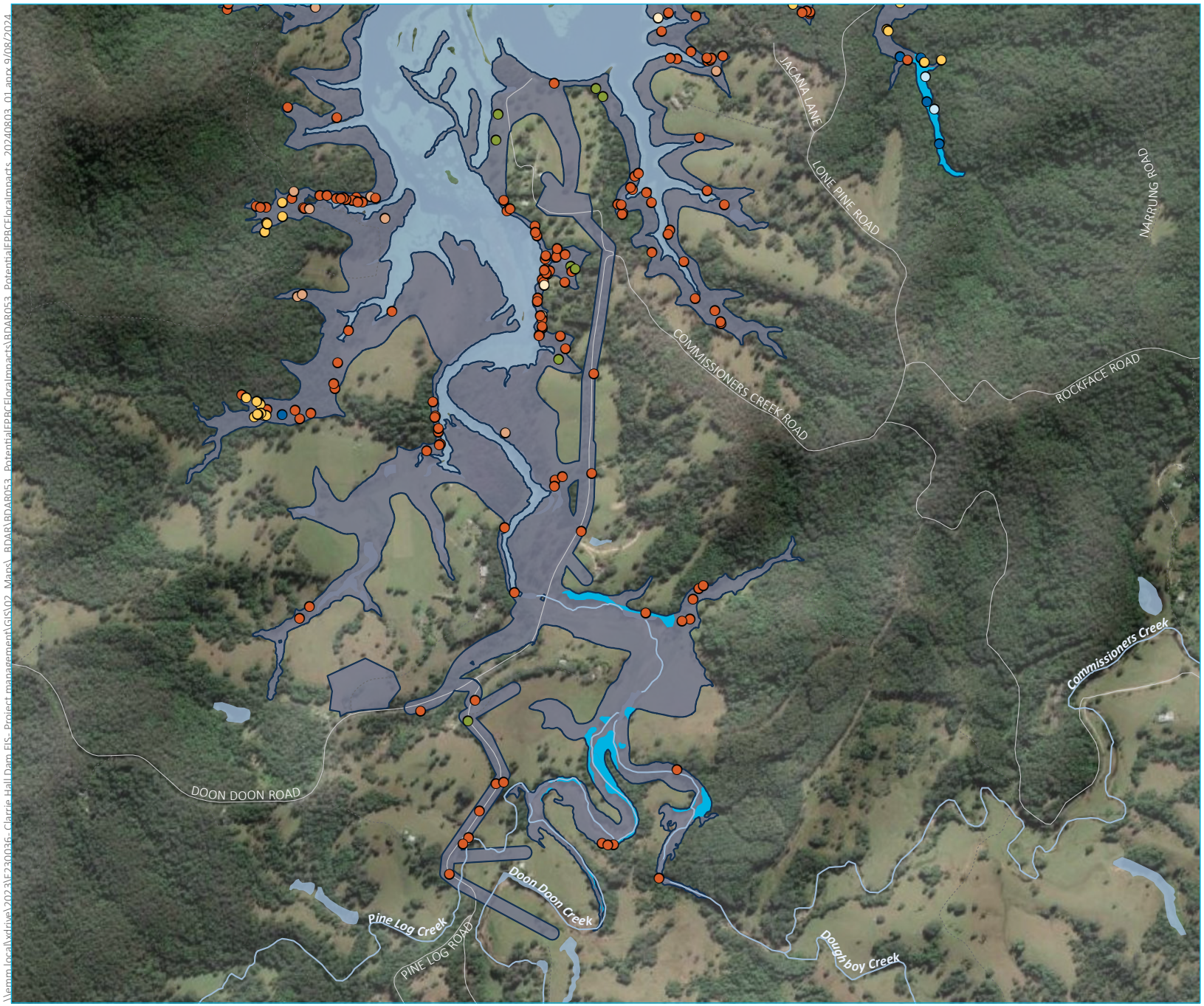

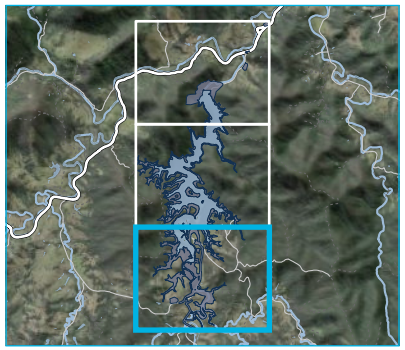

KEY

- Subject land

EPBC Act listed threatened flora species and ecological communities | EPBC status

- *Corokia whiteana* | E
- *Endiandra hayesii* | V
- *Macadamia tetraphylla* | V
- *Marsdenia longiloba* | V
- *Rhodamnia rubescens* | CE
- *Rhodomyrtus psidioides* | CE
- *Syzygium moorei* | V
- Lowland Rainforest of subtropical Australia | CE

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Potential direct impacts to EPBC Act listed threatened ecological communities and threatened flora species

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Figure 9.1

EMM
creating opportunities

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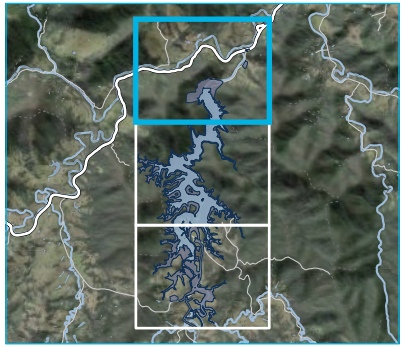

KEY

- Subject land

EPBC listed threatened fauna and migratory species | EPBC status

- South-eastern Glossy Black-cockatoo | V
- Pouched Frog | V
- Large-eared Pied Bat | E
- Lathams Snipe | V, Mi
- Giant Barred Frog | V
- Koala | E
- Grey-headed Flying Fox | V
- Rufous Fantail | Mi
- Spectacled Monarch | Mi
- Mitchell's Rainforest Snail | CE
- Southern Pink Underwing Moth (larval foodplant location) | E

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Potential direct impacts to EPBC Act listed migratory and threatened species
Page 1 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 9.2

EMM
creating opportunities

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 0.5 1 km
GDA2020 MGA Zone 56

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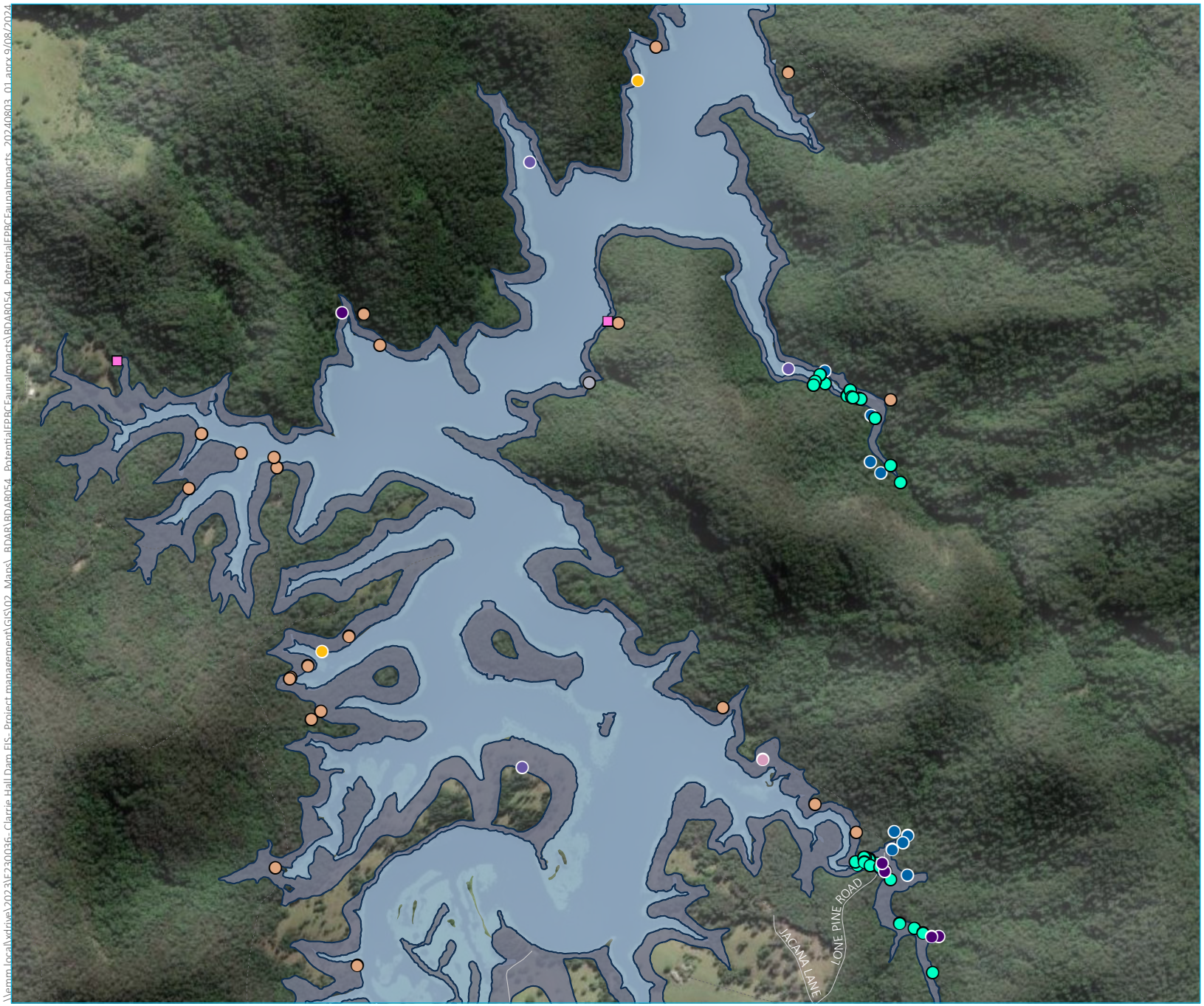

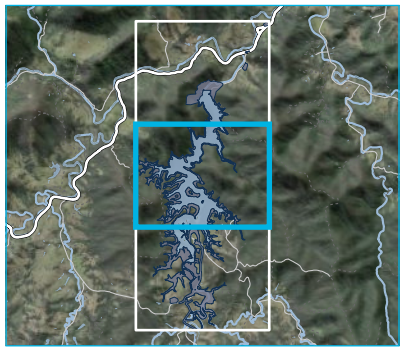

KEY

Subject land

EPBC listed threatened fauna and migratory species | EPBC status

- South-eastern Glossy Black-cockatoo | V
- Pouched Frog | V
- Large-eared Pied Bat | E
- Lathams Snipe | V, Mi
- Giant Barred Frog | V
- Koala | E
- Grey-headed Flying Fox | V
- Rufous Fantail | Mi
- Spectacled Monarch | Mi
- Mitchell's Rainforest Snail | CE
- Southern Pink Underwing Moth (larval foodplant location) | E

Existing environment

- Major road
- Minor road
- Vehicular track
- Waterbody

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 0.5 1 km

GDA2020 MGA Zone 56

N

Potential direct impacts to EPBC Act listed migratory and threatened species
Page 2 of 3

Clarrie Hall Dam EIS
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Figure 9.2

EMM creating opportunities

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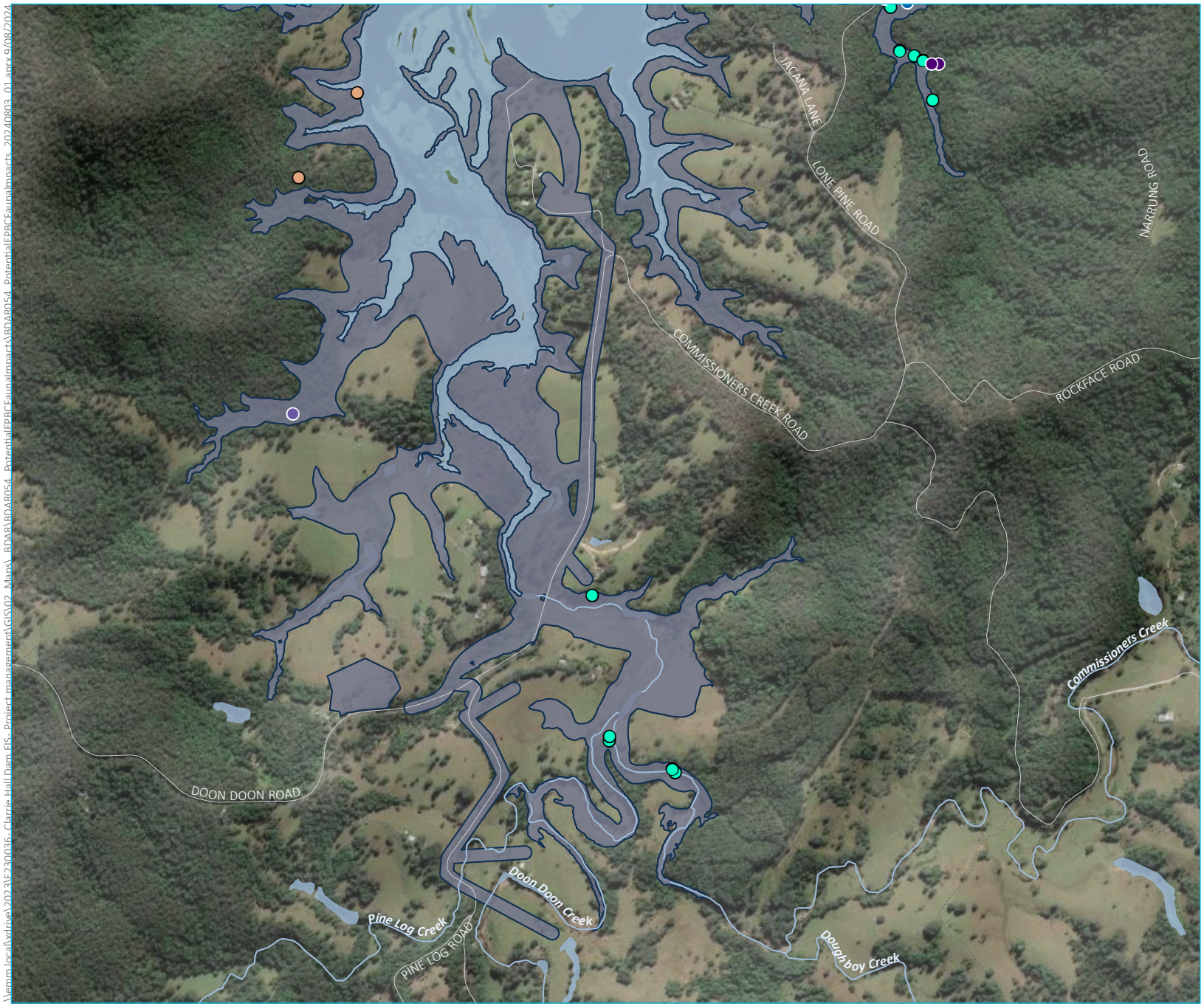

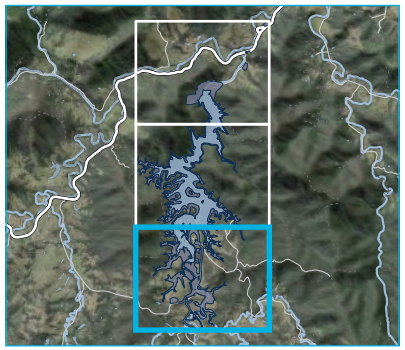

KEY

Subject land

EPBC listed threatened fauna and migratory species | EPBC status

- South-eastern Glossy Black-cockatoo | V
- Pouched Frog | V
- Large-eared Pied Bat | E
- Lathams Snipe | V, Mi
- Giant Barred Frog | V
- Koala | E
- Grey-headed Flying Fox | V
- Rufous Fantail | Mi
- Spectacled Monarch | Mi
- Mitchell's Rainforest Snail | CE
- Southern Pink Underwing Moth (larval foodplant location) | E

Existing environment

- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Potential direct impacts to EPBC Act listed migratory and threatened species
Page 3 of 3

Clarrie Hall Dam EIS
Biodiversity Development Assessment Report
Figure 9.2

Source: EMM (2024); KBR (2024); DCSSS (2024); ESRI (2024)

0 0.5 1 km
GDA2020 MGA Zone 56

N

creating opportunities

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9.2 Biosecurity Act 2015

All plants in NSW are regulated with a general biosecurity duty under the Biosecurity Act. There is an obligation for the Proposal to ensure that the biosecurity risks of all weed species recorded on the subject land are prevented, eliminated or minimised, so far as is reasonably practicable.

Six weed species detected in the subject land are listed as regional priority weeds for the North Coast region. Table 9.28 outlines these species and the prescribed biosecurity duty.

Table 9.28 Priority weeds within the subject land

Species	Biosecurity duty (DPI, n.d.)
Madeira vine (*Anredera cordifolia*)	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Climbing Asparagus Fern (*Asparagus plumosus*)	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Groundsel bush (*Baccharis halimifolia*)	**Regional Recommended Measure** Tweed Shire LGA is part of the core infestation (containment) zone for this species. Whole of region: Land managers should mitigate the risk of the plant being introduced to their land. A person should not buy, sell, move, carry or release the plant into the environment. Exclusion zone: Notify local control authority if found. Land managers should eradicate the plant from the land and keep the land free of the plant. Core infestation: Land managers should mitigate spread of the plant from their land. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.
Green Cestrum (*Cestrum parqui*)	**Regional Recommended Measure** Tweed Shire LGA is part of the core infestation (containment) zone for this species. Whole of region: Land managers should mitigate the risk of the plant being introduced to their land. A person should not buy, sell, move, carry or release the plant into the environment. Exclusion zone: Notify local control authority if found. Land managers should eradicate the plant from the land and keep the land free of the plant. Core infestation: Land managers should mitigate spread of the plant from their land. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.
Lantana (*Lantana camara*)	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Fireweed (*Senecio madagascariensis*)	**Prohibition on certain dealings** Must not be imported into the state, sold, bartered, exchanged or offered for sale.

Four of the above weed species are also listed as under the National Weed Strategy as Weeds of National Environmental Significance (WONS). These species are regulated by a prohibition on dealings and cannot be imported into the state, bartered exchanged or offered for sale:

- Madeira vine (*Anredera cordifolia*)
- Climbing Asparagus Fern (*Asparagus plumosus*)
- Fireweed (*Senecio madagascariensis*)
- Lantana (*Lantana camara*).

10 Conclusion

This BDAR has been prepared in accordance with the BAM (DPIE, 2020), the biodiversity related SEARs issued by DPE with input from the Commonwealth DCCEEW, and the associated agency-specific assessment requirements. Additional assessment of impacts under the EPBC Act has been completed in Section 9 for the purpose of assessment by the Commonwealth DCCEEW.

Several studies were undertaken to determine the options to augment the Tweed District water supply, which concluded raising of Clarrie Hall Dam wall was the preferent option. This was based on the infrastructure present at the existing Dam and the avoidance of needing to flood an entirely new catchment with the correspondingly higher magnitude of biodiversity loss amongst other impacts.

Biodiversity surveys within the subject land and surrounding area commenced in 2016 and continued until early 2024.

Three PCTs were recorded within the subject land, one of which constitutes the BC Act listed Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion EEC and the EPBC Act listed Lowland Rainforest of Subtropical Australia CEEC.

A total of twelve threatened fauna and fourteen threatened flora species were recorded within the subject land. The BDAR has assessed the potential for SAII recorded within the subject land in accordance with Section 9.1.1 of the BAM (DPIE, 2020). Assessments were completed for nine species.

The mitigation actions proposed within this BDAR have been prepared to address the management of the uncertain, temporary, indirect, and prescribed impacts of the Proposal on native flora and fauna.

To compensate for the residual impacts of the Proposal, 4,9945 ecosystems credits are required to compensate for impacts on native PCTs and ecosystem credit species. In addition to ecosystem credits, the Proposal also requires a total of 35,133 species credits. Tweed Shire Council will compensate for these residual impacts through the implementation of a biodiversity offset strategy.

This BDAR has also considered impacts to species listed under the EPBC Act. Significant impact assessments concluded that the Proposal has potential to cause significant impacts to the following fauna species; Pouched Frog, Glossy Black-Cockatoo, Giant Barred Frog, Koala, Grey-headed Flying-fox, Mitchell's Rainforest Snail and following flora species; Scrub Turpentine, Corokia, Slender Marsdenia, Native Guava and Red Lilly Pilly. A significant impact is also likely for the EPBC Act listed Lowland Rainforest of Subtropical Australia CEEC. As such the Proposal has been declared a controlled action. As the Proposal is being assessed in accordance with the bilateral agreement between the Commonwealth and NSW government, impacts to MNES will be compensated through the implementation of the Biodiversity Offset Strategy.

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Appendix A
BDAR requirements

EMM
creating opportunities

A.1 Compliance with BDAR minimum information requirements

Table A.1 Compliance with BDAR minimum information requirements (Appendix K of the BAM (DPIE, 2020)

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Introduction	**Chapters 2 and 3**	**Information**	
		Introduction to the biodiversity assessment including:	
		☒ brief description of the proposal	Section 1.2 Section 1.3
		☒ identification of subject land boundary, including:	
		☒ operational footprint (if BDAR)	Section 1.3 Figure 3.1 and Figure 3.2
		☒ construction footprint indicating clearing associated with temporary/ancillary construction facilities and infrastructure (if BDAR)	Section 1.3 Figure 3.1 and Figure 3.2
		☐ land proposed for biodiversity certification (if BCAR)	N/A
		☒ general description of the subject land	Section 1.6
		☒ sources of information used in the assessment, including reports and spatial data	Section 1.9
		Maps and tables (in document)	
		☒ Map of the subject land boundary showing the final proposal footprint, including the construction footprint for any clearing associated with temporary/ancillary construction facilities and infrastructure (if BDAR)	Figure 3.1 and Figure 3.2
Landscape	**Sections 3.1 and 3.2, Appendix E**	**Information**	
		Identification of site context components and landscape features, including:	
		☒ general description of subject land topographic and hydrological setting, geology, and soils	Section 3
		☒ per cent native vegetation cover in the assessment area (as described in BAM Section 3.2)	Section 3.6
		☒ IBRA bioregions and subregions (as described in BAM Subsection 3.1.3(2.))	Section 3.1

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ rivers and streams classified according to stream order (as described in BAM Subsection 3.1.3(3.) and Appendix E)	Section 3.2.1
		☒ wetlands within, adjacent to and downstream of the site (as described in BAM Subsection 3.1.3(3.))	Section 3.2.2
		☒ connectivity of different areas of habitat (as described in BAM Subsection 3.1.3(5–6.))	Section 3.3
		☒ karst, caves, crevices, cliffs, rocks, and other geological features of significance and for vegetation clearing proposals, soil hazard features (as described in BAM Subsections 3.1.3(7.) and 3.1.3(12.))	Section 3.4
		☒ areas of outstanding biodiversity value occurring on the subject land and assessment area (as described in BAM Subsection 3.1.3(8–9.))	Section 3.5
		☒ any additional landscape features identified in any SEARs for the proposal	Section 3.3.1
		☒ NSW (Mitchell) landscape on which the subject land occurs	Section 3.1
		Maps and tables (in document)	
		☒ Site Map	Figure 3.2
		☒ Property boundary	Figure 3.2
		☒ Boundary of subject land	Figure 3.2
		☒ Cadastre of subject land (including labelling of Lot and DP or section plan if relevant)	Figure 3.2
		☒ Landscape features identified in BAM Subsection 3.1.3	Figure 3.2
		☒ Location Map	Figure 3.1
		☒ Digital aerial photography at 1:1,000 scale or finer	Figure 3.1
		☒ Boundary of subject land	Figure 3.1
		☒ Assessment area (i.e. the subject land and either 1500 m buffer area or 500 m buffer for linear development)	Figure 3.1
		☒ Landscape features identified in BAM Subsection 3.1.3	Figure 3.1
		☒ Additional detail (e.g. local government area boundaries) relevant at this scale	Figure 3.1

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Landscape features identified in BAM Subsection 3.1.3 and to be shown on the Site Map and/or Location Map include:	
		☒ IBRA bioregions and subregions	Figure 3.1 and Figure 3.2
		☒ rivers, streams, and estuaries	Figure 3.1 and Figure 3.2
		☒ wetlands and important wetlands	Figure 3.1 and Figure 3.2
		☒ connectivity of different areas of habitat	Figure 3.1 and Figure 3.2
		☐ karst, caves, crevices, cliffs, rocks, and other geological features of significance and if required, soil hazard features	N/A
		☒ areas of outstanding biodiversity value occurring on the subject land and assessment area	Figure 3.1 and Figure 3.2
		☐ any additional landscape features identified in any SEARs for the proposal	N/A
		☒ NSW (Mitchell) landscape on which the subject land occurs	Figure 3.1 and Figure 3.2
		Data (to be supplied)	
		☒ All report maps as separate jpeg files	
		Individual digital shape files of:	
		☒ subject land boundary	
		☒ assessment area (i.e. subject land and 1,500 m buffer area) boundary	
		☒ cadastral boundary of subject land	
		☒ areas of native vegetation cover	
		☒ landscape features	
Native vegetation	**Chapter 4, Appendix A and Appendix H**	**Information**	
		☒ Identify native vegetation extent within the subject land, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery (as described in BAM Section 4.1(1–3.) and Subsection 4.1.1)	Section 3.6 Section 4.4.2

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		☒	Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2)	Section 4.4
		☒	Review of existing information on native vegetation including references to previous vegetation maps of the subject land and assessment area (described in BAM Section 4.1(3.) and Subsection 4.1.1)	Section 4.1
		☒	Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2	Section 4.3
		☐	Where relevant, describe the use of more appropriate local data, provide reasons that support the use of more appropriate local data and include the written confirmation from the decision-maker that they support the use of more appropriate local data (as described in BAM Subsection 1.4.2 and Appendix A)	N/A
		For each PCT within the subject land, describe:		
		☒	PCT name and ID	Table 4.5 - Table 4.7
		☒	vegetation class	Table 4.5 - Table 4.7
		☒	extent (ha) within subject land	Table 4.5 - Table 4.7
		☒	evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.))	Table 4.5 - Table 4.7
		☒	plant species relied upon for identification of the PCT and relative abundance of each species	Table 4.5 - Table 4.7
		☒	if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.))	Table 4.5 - Table 4.7
		☒	estimate of per cent cleared value of PCT (BAM Subsection 4.2.1(5.))	Table 4.5 - Table 4.7
		Describe the vegetation integrity assessment of the subject land, including:		
		☒	identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1)	Section 4.3.2, Section 4.4.2
		☒	description of vegetation zones within the subject land (as described in Operational Manual Stage 1 Table 2 and Subsection 3.3.2)	Section 4.3.2, Section 4.4.2
		☒	area (ha) of each vegetation zone	Section 4.3.2, Section 4.4.2
		☒	assessment of patch size (as described in BAM Subsection 4.3.2)	Table 4.13

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ survey effort (i.e. number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4 (1–2.)	Section 4.3.3 Table 4.5 - Table 4.10
		☒ use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.))	Table 4.5 - Table 4.10
		Where use of more appropriate local benchmark data is proposed (as described in BAM Subsection 1.4.2, BAM Subsection 4.3.3(5.) and BAM Appendix A):	
		☐ identify the PCT or vegetation class for which local benchmark data will be applied	N/A
		☐ identify published sources of local benchmark data (if benchmarks obtained from published sources)	N/A
		☐ describe methods of local benchmark data collection (if reference plots used to determine local benchmark data)	N/A
		☐ provide justification for use of local data rather than BioNet Vegetation Classification benchmark values	N/A
		☐ provide written confirmation from the decision-maker that they support the use of local benchmark data	N/A
		Maps and tables (in document)	
		☒ Map of native vegetation extent within the subject land at scale not greater than 1:10,000 including identification of all areas of native vegetation including areas that are ground cover only, cleared areas (as described in BAM Section 4.1(1–3.)) and all parts of the subject land that do not contain native vegetation (BAM Subsection 4.1.2)	Figure 4.1
		☒ Map of PCTs within the subject land (as described in BAM Section 4.2(1.))	Figure 4.1
		☒ Map of vegetation zones within the subject land (as described in BAM Subsection 4.3.1)	Figure 4.1
		☒ Map the location of floristic vegetation survey plots and vegetation integrity survey plots relative to PCT boundaries	Figure 4.1
		☒ Map of TEC distribution on the subject land and table of TEC listing, status, and area (ha)	Figure 4.1 Table 4.7
		☐ Map of patch size locations for each native vegetation zone and table of patch size areas (as described in BAM Subsection 4.3.2)	All zones assumed to have a patch size of >100 ha
		Table of current vegetation integrity scores for each vegetation zone within the site and including:	
		☒ composition condition score	Table 4.13

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ structure condition score	Table 4.13
		☒ function condition score	Table 4.13
		☒ presence of hollow bearing trees	Table 4.13
		Data (to be supplied)	
		☒ All report maps as separate jpeg files	
		☒ Plot field data (MS Excel format)	
		☒ Plot field datasheets	
		Digital shape files of:	
		☒ PCT boundaries within subject land	
		☒ TEC boundaries within subject land	
		☒ vegetation zone boundaries within subject land	
		☒ floristic vegetation survey and vegetation integrity plot locations	
Threatened species	**Chapter 5**	**Information**	
		Identify ecosystem credit species likely to occur on the subject land, including:	
		☒ list of ecosystem credit species derived from the BAM-C (as described in BAM Subsection 5.1.1 and Section 5.2(1.))	Table 5.1
		☒ justification and supporting evidence for exclusion of any ecosystem credit species based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	Table 5.1
		☒ justification for addition of any ecosystem credit species to the list	Table 5.1
		Identify species credit species likely to occur on the subject land, including:	
		☒ list of species credit species derived from the BAM-C (as described in BAM Subsection 5.1.1)	Table 5.2

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ justification and supporting evidence for exclusions based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	Table 5.2
		☒ justification and supporting evidence for exclusions based on degraded habitat constraints and/or microhabitats on which the species depends (as described in BAM Subsection 5.2.2)	Table 5.2 Section 5.4.1i
		☒ justification for addition of any species credit species to the list	Table 5.2
		From the list of candidate species credit species, identify:	
		☒ species assumed present within the subject land (if relevant) (as described in BAM Subsection 5.2.4(2.a.))	Section 5.4.2
		☒ species present within the subject land on the basis of being identified on an important habitat map for a species (as described in BAM Subsection 5.2.4(2.d.))	Section 5.4.2
		☒ species for which targeted surveys are to be completed to determine species presence (BAM Subsection 5.2.4(2.b.))	Section 5.4.2
		☒ species for which an expert report is to be used to determine species presence (BAM Subsection 5.2.4(2.c.))	Section 5.4.2
		Present the outcomes of species credit species assessments from:	
		☒ threatened species survey (as described in BAM Section 5.2.4)	Section 5.4.4
		☒ expert reports (if relevant) including justification for presence of the species and information used to make this determination (as described in BAM Subsection 5.2.4, Section 5.3, Box 3)	Appendix F
		Where survey has been undertaken include detailed information on:	
		☒ survey method and effort (as described in BAM Section 5.3)	Section 5.4.3
		☒ justification of survey method and effort (e.g. citation of peer-reviewed literature) if approach differs from the department's taxa-specific survey guides or where no relevant guideline has been published	Section 5.4.3
		☒ timing of survey in relation to requirements in the TBDC or the department's taxa-specific survey guides. Where survey was undertaken outside these guides include justification for the timing of surveys	Section 5.4.3
		☒ survey personnel and relevant experience	Details and experience of author/s and contributors
		☒ describe any limitations to surveys and how these were addressed/overcome	Section 1.4

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		Where an expert report has been used in place of survey (as described in BAM Section 5.3, Box 3), include:		
		☒	justification of the use of an expert report	Appendix F
		☒	identify the expert, provide evidence of their expert credentials and departmental approval of expert status	Appendix F
		☒	all requirements of Box 3 have been addressed in the expert report	Appendix F
		Where use of local data is proposed (BAM Subsection 1.4.2):		
		☐	identify relevant species	N/A
		☐	identify data to be amended	N/A
		☐	identify source of information for local data, e.g. published literature, additional survey data, etc.	N/A
		☐	justify use of local data in preference to VIS Classification or TBDC data	N/A
		☐	provide written confirmation from the decision-maker that they support the use of local data	N/A
		Species polygon completed for species credit species present within the subject land (assumed present or determined on the basis of survey, expert report or important habitat map) ensuring that:		
		☒	the unit of measure for each species is documented	Section 5.4.6
			for species assessed by area:	
		☒	the polygon includes the extent of suitable habitat for the target species within the subject land (as described in BAM Subsection 5.2.5)	Section 5.4.6
		☒	a description of, and evidence-based justification for, the habitat constraints, features or microhabitats used to map the species polygon including reference to information in the TBDC for that species and any buffers applied	Section 5.4.6
			for species assessed by counts of individuals:	
		☒	the number of individual plants present on the subject land (as described in BAM Subsection 5.2.5(3.))	Section 5.4.6
		☒	the method used to derive this number (i.e. threatened species survey or expert report) and evidence-based justification for the approach taken	Section 5.4.6

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		☒	the polygon includes all individuals located on the subject land with a buffer of 30 m around the individuals or groups of individuals on the subject land	Section 5.4.6
		☒	Identify the biodiversity risk weighting for each species credit species identified as present within the subject land (as described in BAM Section 5.4)	Table 8.3
		Maps and tables (in document)		
		☒	Table showing ecosystem credit species in accordance with BAM Subsection 5.1.1, and identifying:	Table 5.1
		☒	the ecosystem credit species removed from the list	Table 5.1
		☒	the sensitivity to gain class of each species	Table 5.1
		☒	Table detailing species credit species in accordance with BAM Section 5.2 and identifying:	
		☒	the species credit species removed from the list of species because the species is considered vagrant, out of geographic range or the habitat or microhabitat features are not present	Table 5.2
		☒	the candidate species credit species not recorded on the subject land as determined by targeted survey, expert report or important habitat map	Table 5.5 Table 5.19 - Table 5.27
		☒	Table detailing species credit species recorded or assumed as present within the subject land, habitat constraints or microhabitats associated with the species, counts of individuals (flora)/extent of suitable habitat (flora and fauna) (as described in BAM Subsection 5.2.6) and biodiversity risk weighting (BAM Section 5.4)	Table 5.5 Table 5.19 - Table 5.27
		☒	Map indicating the GPS coordinates of all individuals of each species recorded within the subject land and the species polygon for each species (as described in BAM Subsection 5.2.5)	Figure 5.8 - Figure 5.34
		Data (to be supplied)		
		☒	Digital shape files of suitable habitat identified for survey for each candidate species credit species	
		☒	Survey locations including GPS coordinates of any plots, transects, grids	
		☒	Digital shape files of each species polygon including GPS coordinates of located individuals	
		☒	Species polygon map in jpeg format	
		☒	Expert reports and any supporting data used to support conclusions of the expert report	

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		☒	Field datasheets detailing survey information including prevailing conditions, date, time, equipment used, etc.	
Prescribed impacts	**Chapter 6**	**Information**		
		Identify potential prescribed biodiversity impacts on threatened entities, including:		
		☒	karst, caves, crevices, cliffs, rocks and other geological features of significance (as described in BAM Subsection 6.1.1)	Section 7.2
		☒	occurrences of human-made structures and non-native vegetation (as described in BAM Subsection 6.1.2)	Section 7.2
		☒	corridors or other areas of connectivity linking habitat for threatened entities (as described in BAM Subsection 6.1.3)	Section 7.2
		☒	waterbodies or any hydrological processes that sustain threatened entities (as described in BAM Subsection 6.1.4)	Section 7.2
		☒	protected animals that may use the proposed wind farm development site as a flyway or migration route (as described in BAM Subsection 6.1.5)	Section 7.2
		☒	where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community (as described in BAM Subsection 6.1.6)	Section 7.2
		☒	Identify a list of threatened entities that may be dependent upon or may use habitat features associated with any of the prescribed impacts	Section 7.2
		☒	Describe the importance of habitat features to the species including, where relevant, impacts on life cycle or movement patterns (e.g. Subsection 6.1.3)	Section 7.2
		Where the proposed development is for a wind farm:		
		☐	identify a candidate list of protected animals that may use the development site as a flyway or migration route, including resident threatened aerial species, resident raptor species and nomadic and migratory species that are likely to fly over the proposal area (as described in BAM Subsection 6.1.5)	N/A
		☐	provide details of targeted survey for candidate species of wind farm developments undertaken in accordance with BAM Subsection 6.1.5(2–3.)	N/A
		☐	predict the habitual flight paths for nomadic and migratory species likely to fly over the subject land and map the likely habitat for resident threatened aerial and raptor species (BAM Subsection 6.1.5(4.))	N/A

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Where the proposal may result in vehicle strike:	
		☐ identify a list of threatened fauna or protected fauna species that are part of a TEC and at risk of vehicle strike due to the proposal	N/A
		Maps and tables (in document)	
		☐ Map showing location of any prescribed impact features (i.e. karst, caves, crevices, cliffs, rocks, human-made structures, etc.)	N/A
		☐ Map showing location of potential vehicle strike locations	N/A
		☐ Maps of habitual flight paths for nomadic and migratory species likely to fly over the site and maps of likely habitat for threatened aerial species resident on the site (for wind farm developments only)	N/A
		Data (to be supplied)	
		☒ Digital shape files of prescribed impact feature locations	
		☒ Prescribed impact features map in jpeg format	
Avoid and minimise impacts	**Chapter 7**	**Information**	
		Demonstration of efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the proposal location in accordance with Chapter 7, including an analysis of alternative:	
		☒ modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology	Section 7.1
		☒ routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route	Section 7.1
		☒ alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location	Section 7.1
		☒ alternative sites within a property on which the proposal is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site	Section 7.1
		☒ Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through proposal design (as described in BAM Sections 7.1 and 7.2)	Section 7.1

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		☒	Identification of any other site constraints that the proponent has considered in determining the location and design of the proposal (as described in BAM Subsection 7.2.1(3.))	Section 7.1
		☒	Detail measures or options considered but not implemented because they are not feasible and/or practical (e.g. due to site constraints)	Section 7.1
		Maps and tables (in document)		
		☒	Table of measures to be implemented to avoid and minimise the impacts of the proposal, including action, outcome, timing and responsibility	Table 7.3
		☐	Map of alternative footprints considered to avoid or minimise impacts on biodiversity values; and of the final proposal footprint, including construction and operation	
		☐	Maps demonstrating indirect impact zones where applicable	
		Data (to be supplied)		
		Digital shape files of:		
		☒	alternative and final proposal footprint	
		☒	direct and indirect impact zones	
		☒	Maps in jpeg format	
Assessment of impacts	**Chapter 8, Sections 8.1 and 8.2**	**Information**		
		☒	Determine the impacts on native vegetation and threatened species habitat, including a description of direct impacts of clearing of native vegetation, threatened ecological communities and threatened species habitat (as described in BAM Section 8.1)	Section 7.1.3i
		Assessment of indirect impacts on vegetation and threatened species and their habitat including (as described in BAM Section 8.2):		
		☒	description of the nature, extent, frequency, duration, and timing of indirect impacts of the proposal	Section 7.1.3ii
		☒	documenting the consequences to vegetation and threatened species and their habitat including evidence-based justifications	Section 7.1.3ii
		☒	reporting any limitations or assumptions, etc. made during the assessment	Section 7.1.3ii

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		☒	identification of the threatened entities and their habitat likely to be affected	Section 7.1.3ii
		Assessment of prescribed biodiversity impacts (as described in BAM Section 8.3) including:		
		☒	assessment of the nature, extent frequency, duration, and timing of impacts on the habitat of threatened species or ecological communities associated with:	
			☒ karst, caves, crevices, cliffs, rocks, and other features of geological significance	Section 7.2
			☒ human-made structures	Section 7.2
			☒ non-native vegetation	Section 7.2
			☒ connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Section 7.2
			☒ movement of threatened species that maintains their life cycle	Section 7.2
			☒ water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities	Section 7.2
		☐	assessment of the impacts of wind turbine strikes on protected animals	N/A
		☒	assessment of the impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	Section 7.2.1
		☒	evaluate the consequences of prescribed impacts	Section 7.2.1 – Section 7.2.2
		☒	describe impacts that are uncertain	Section 7.2
		☒	document limitations to data, assumptions, and predictions	Section 7.2
		Maps and tables		
		☒	Table showing change in vegetation integrity score for each vegetation zone as a result of identified impacts	Table 8.2
		Data		
		n/a		

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Mitigation and management of impacts	**Chapter 8, Sections 8.4 and 8.5**	**Information**	
		Identification of measures to mitigate or manage impacts in accordance with the recommendations in BAM Sections 8.4 and 8.5 including:	
		☒ techniques, timing, frequency and responsibility	Section 7.3
		☒ identify measures for which there is risk of failure	Section 7.3
		☒ evaluate the risk and consequence of any residual impacts	Section 7.3
		☒ document any adaptive management strategy proposed	Section 7.3
		Identification of measures for mitigating impacts related to:	
		☒ displacement of resident fauna (as described in BAM Subsection 8.4.1(2.))	Section 7.3
		☒ indirect impacts on native vegetation and habitat (as described in BAM Subsection 8.4.1(3.))	Section 7.3
		☒ mitigating prescribed biodiversity impacts (as described in BAM Subsection 8.4.2)	Section 7.3
		☒ Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (BAM Section 8.5)	Section 7.3
		Maps and tables (in document)	
		☒ Table of measures to be implemented before, during and after construction to mitigate and manage impacts of the proposal, including action, outcome, timing, and responsibility	Table 7.3
		Data	
		n/a	
Impact summary	**Chapter 9**	**Information**	
		Identification and assessment of impacts on TECs and threatened species that are at risk of a serious and irreversible impacts (SAII, in accordance with BAM Section 9.1) including:	
		☐ addressing all criteria in Subsection 9.1.1 for each TEC listed as at risk of an SAII present on the subject land	N/A
		☐ for each TEC, report the extent of the TEC in NSW	N/A

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ addressing all criteria in Subsection 9.1.2 for each threatened species at risk of an SAII present on the subject land	Section 7.4
		☒ for each threatened species, report the population size in NSW	Section 7.4
		☒ documenting assumptions made and/or limitations to information	Section 7.4
		☒ documenting all sources of data, information, references used or consulted	Section 7.4
		☒ clearly justifying why any criteria could not be addressed	Section 7.4
		☒ Identification of impacts requiring offset in accordance with BAM Section 9.2	Section 8.2
		☒ Identification of impacts not requiring offset in accordance with BAM Subsection 9.2.1(3.)	Section 8.1
		☒ Identification of areas not requiring assessment in accordance with BAM Section 9.3	Section 8.1
		Maps and tables (in document)	
		☐ Map showing the extent of TECs at risk of an SAII within the subject land	N/A
		☒ Map showing location of threatened species at risk of an SAII within the subject land	Figure 7.2 - Figure 7.10
		Map showing location of:	
		☒ impacts requiring offset	Figure 4.1 Figure 5.19 - Figure 5.34
		☒ impacts not requiring offset	Figure 4.1
		☒ areas not requiring assessment	Figure 4.1
		Data (to be supplied)	
		Digital shape files of:	
		☒ extent of TECs at risk of an SAII within the subject land	
		☒ location of threatened species at risk of an SAII within the subject land	
		☒ boundary of impacts requiring offset	

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		☒	boundary of impacts not requiring offset	
		☒	boundary of areas not requiring assessment	
		☒	Maps in jpeg format	
Impact summary	**Chapter 10**	**Information**		
		Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including:		
		☒	future vegetation integrity score for each vegetation zone within the subject land (Equation 25 and Equation 26 in BAM Appendix H)	Table 8.2
		☒	change in vegetation integrity score (BAM Subsection 8.1.1)	Table 8.2
		☒	number of required ecosystem credits for the direct impacts of the proposal on each vegetation zone within the subject land (BAM Subsection 10.1.2)	Table 8.2
		☒	biodiversity risk weighting for each	Table 8.2
		☒	number of required species credits for each candidate threatened species that is directly impacted on by the proposal (BAM Subsection 10.1.3)	Table 8.3
		Maps and tables (in document)		
		☒	Table of PCTs requiring offset and the number of ecosystem credits required	Table 8.2
		☒	Table of threatened species requiring offset and the number of species credits required	Table 8.3
		Data		
		☒	Submitted proposal in the BAM Calculator	
Biodiversity credit report	**Chapter 10**	**Information**		
		☒	Description of credit classes for ecosystem credits and species credits at the development or clearing site or land to be biodiversity certified (BAM Section 10.2)	Table 8.4 - Table 8.6
		☒	BAM credit report in pdf format	Appendix G

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Maps and tables (in report)	
		☒ Table of credit class and matching credit profile	Table 8.4 - Table 8.6
		Data (to be supplied)	
		☒ BAM credit report in pdf format	Appendix G

Appendix B
Agency correspondence

EMM
creating opportunities

B.1 Item 1

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
t: (02) 4910 0125

2 September 2020

Our ref: 18011550

Biodiversity and Conservation Division
NSW Department of Planning, Industry, and Environment
Level 8, 24 Mooney Street
Coffs Harbour NSW 2450

Attention: Dimitri Young

Dear Dimitri,

Clarrie Hall Dam Raising – Request for Confirmation of Survey Approach

Tweed Shire Council (TSC) is in the process of designing and seeking approval for the raising of the Clarrie Hall Dam wall by 8.5m (the project) at Doon Doon, NSW, from 61.5m to 70.0m AHD. The project is designated State Significant Infrastructure (SSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and has been declared a 'Controlled Action' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As an SSI, the impacts to biodiversity are being assessed using the Biodiversity Assessment Method (BAM; OEH, 2017). Eco Logical Australia (ELA) have been engaged by TSC to prepare the Environmental Impact Statement (EIS) including preparing the biodiversity assessment for the project.

Following a survey gap analysis prepared by ELA, TSC and ELA met with staff from Biodiversity and Conservation Division (BCD) on the 28 May 2020 to discuss the biodiversity assessment approach for the EIS. This letter and supporting information outlines the proposed survey strategy to address the BAM and seeks confirmation from BCD on the final survey approach.

ELA is seeking this confirmation prior to 18 September 2020 to allow adequate planning and resourcing.

If you have any queries, please contact me directly on (02) 4910 3413.

Regards,

Alex Pursche
Senior Ecologist

1. Introduction and summary of DPIE Actions

The intent of this letter is to seek concurrence on the survey strategy for all candidate threatened species identified by the BAM Calculator, and to provide a clear path to completion for remaining survey effort gaps identified by ELA.

Specifically, ELA request DPIE consider the content of this letter and previous surveys, and provide clear guidance on the following seven (7) actions for resolution:

- DPIE Action 1: We request DPIE approve the threatened flora survey strategy detailed in Section 4.3 of this letter
- DPIE Action 2: We request DPIE approve the proposed amphibian sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 of this letter.
- DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described in Section 4.4.2 of this letter, and that no further assessment is required.
- DPIE Action 4: We request DPIE approve the bat assessment approach described in Section 4.4.3 of this letter, and that no further field studies are required.
- DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala
- DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale based on previous survey effort conducted by TSC, and lack of existing suitable habitats
- DPIE Action 7: We request DPIE confirm no further reptile surveys required based on previous survey effort conducted by TSC

ELA is seeking this confirmation prior to 18 September 2020 to allow adequate planning and resourcing.

2. Background information

2.1 Background and gap analysis

The initial dam construction was subject to flora and fauna assessments prior to 1983, then again between 2016 and 2018 so there is already a high level understanding of the biodiversity values present within the subject site.

A gap analysis was undertaken by ELA to review the existing surveys conducted by TSC since 2016, to ensure compliance with NSW and Commonwealth survey guidelines. The gap analysis was reliant on the information provided by TSC in the following documents:

- Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam, Tweed Shire, NSW (Tweed Shire Council, 2017)
- Further Investigation of the Occupancy of *Mixophyes iteratus* within the Doon Doon Catchment (Tweed Shire Council, 2018)
- An inspection of the August 2019 bushfire at Terragon and Clarrie Hall Dam (Sally Cooper & Greg Lollback, 2019)

- Targeted Survey and Revised Impact Assessment for Red Lilly Pilly and Lowland Rainforest, Doon Doon Catchment (Tweed Shire Council, 2018)
- Scanned survey datasheets for birds, amphibians, Comb-crested Jacana, Koala, reptiles, mammals, as well as spotlighting and trapping results.

All of these documents can be provided to DPIE upon request or can be sourced from the project website (link as follows):

https://www.yoursaytweed.com.au/RaisingClarrieHall/widgets/183762/documents

2.2 Minimum survey guidelines for biodiversity assessments

As of August 2020, there are several flora and fauna survey guidelines in existence in NSW, some of which are generic, and some which have specific requirements for individual species. Broadly, the following published guidelines apply to biodiversity assessments under the BAM:

- The *Biodiversity Assessment Method* (OEH, 2017)
- *NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats* (DPIE, 2020)
- *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018)
- *Field survey methods for amphibians: Threatened species survey and assessment guidelines* (OEH, 2009)
- *DRAFT Threatened biodiversity survey and assessment: Guidelines for developments and activities* (DEC, 2004)

In addition, the Threatened Species Profile Database (TSPD) also contains specific survey and habitat assessment requirements for individual species, which is changed regularly.

Broadly, replication of survey effort for a biodiversity assessment in NSW is based on a 100ha replicate unit (200 ha west of the ranges), and so the raising of Clarrie Hall Dam would require two replicate units of survey across the disturbance footprint. Based on the guidelines above, this would require:

- As per the BAM: a vegetation integrity assessment by conducting BAM plots at the appropriate frequency for the vegetation zone size
- a threatened flora survey using the two-stage grid approach (DPIE, 2020)
- up to 16 harp trap and 16 ANABAT nights per 50 ha habitat (DPIE, 2019)
- a targeted amphibian survey over two nights in appropriate habitats (OEH, 2009)
- two replicate fauna sites (one per 100 ha) in accordance with DEC (2004 draft) including at each site:
    - a 1ha bird survey (with unspecified repeated surveys)
    - 100 elliot trap nights for small mammals
    - 24 pitfall trap nights for mammals, amphibians, invertebrates, and reptiles
    - 1 hour spotlighting on two nights
    - 30 minute reptile and habitat searches on two occasions
    - Call playback for nocturnal species
    - As well as other methods such as hair tubes and reptile funnels.

The methods above are generally targeted to the species in question, and the most appropriate method(s) to maximise detection is selected. The draft 2004 guidelines do not contain any detail on contemporary methods such as infrared cameras.

In addition to those methods described above, Spot Assessment Technique (SAT) surveys are the unofficial method for assessing Koala habitat for development activities.

Details of the minimum survey, as well the survey undertaken to date for each candidate fauna species are detailed in Appendix E.

2.3 Survey effort summary

2.3.1 Threatened flora survey

Threatened flora surveys were conducted by TSC staff from October 2016 to June 2017 on the dates as described below in Table 1. Generally, the flora surveys included floristic data capture using methodologies described in the *Framework for Biodiversity Assessment* (OEH, 2014), as well as targeted surveys in 16 gullies across the inundation area.

Table 1 Tweed Shire Council threatened flora survey effort

Survey methodology	Dates of survey	Total effort (days)
Vegetation community validation & FBA plots	31/10/16 – 3/11/16, 8 – 11/11/16, 14/11/16, 16 – 18/11/16, 29/11/16 – 2/12/16	16
Targeted threatened species survey (within inundation area)	6 – 7/12/16, 13 – 16/12/16, 22/12/16	7
Targeted threatened species survey (outside inundation area)	7/3/17 (half-day), 13/3/17, 20, 22, & 24/3/17	4.5
Additional vegetation community validation & FBA plots around dam wall	7 – 8/6/17	2
Total		**29.5 days**

Targeted flora surveys by TSC identified the following nine threatened species within and nearby to the disturbance footprint as described in Table 2. Of these species, five are listed under the EPBC Act as Vulnerable.

Table 2 Threatened flora identified by TSC during 2016 and 2017 surveys

Scientific name	Common name	BC Act	EPBC Act	Impacted	Not impacted	Total
Corokia whiteana	Corokia	Vulnerable	Vulnerable	8	40	48
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	30	41	71
Endiandra muelleri subsp. *bracteata*	Green-leaved Rose Walnut	Vulnerable	Not listed	210	240	450
Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	Not listed	1243	4552	5795

Scientific name	Common name	BC Act	EPBC Act	Impacted	Not impacted	Total
Grevillea hilliana	White Yiel Yiel	Endangered	Not listed	0	1	1
Lepiderema pulchella	fine-leaved tuckeroo	Vulnerable	Not listed	1	0	1
Marsdenia longiloba	Clear Milkvine	Endangered	Vulnerable	13	27	40
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	147	83	230
Syzygium moorei	Durobby	Vulnerable	Vulnerable	2	13	15

2.3.2 Threatened fauna survey

The majority of threatened fauna surveys were conducted at 20 'core sites' whereby a complete fauna survey was undertaken using a variety of active search and trapping methods targeting reptiles, mammals, diurnal and nocturnal birds, and amphibians.

The survey design was implemented prior to the release of the BAM, and as such was designed as a more broad biodiversity assessment, rather than a targeted threatened species survey. The methods implemented are outlined in Table 3.

Table 3 Tweed Shire Council threatened fauna survey effort

Survey type	Number of sites	Replicates per site	Repeat per site	Total effort
Aquatic bird transect	1	1	1	1
Terrestrial bird survey	32	1	3	96
Reptile and amphibian search	32	1	2	64
Nocturnal search	20	1	3	60
Koala SAT	32	1	1	32
Diurnal search	32	1	3	96
Call playback	20	1	1-3	>20
Terrestrial elliot traps	20	20	4	1600
Pitfall traps	20	5	4	400
Cage traps	20	1	4	80
Funnel traps	20	5	4	400
Camera trap	32	2	14	896
Nocturnal amphibian search (Targeted creekline searches)	2	1	1	2
Harp trap	3	1	1-2	>3
Ultrasonic detector (ANABAT)	14	1	1-2	>14
Site condition assessment	32	1	1	32

The fauna surveys undertaken by TSC identified across the site:

- 19 amphibians
- 111 bird species
- 34 mammals
- 24 reptile species.

Of these species recorded, 26 are BC Act listed threatened species, and four (4) are listed under the EPBC Act (Appendix B). Species previously recorded are detailed in the table below. Of these 25 species, seven (7) are species credits, and eight are dual credit species in which only breeding habitat is calculated as a species credit. Four of these species are candidates for Serious and Irreversible Impacts (SAII). Those species that are species credits, or dual species, will have credits calculated for them where the suitable habitat feature is known or likely to be impacted by the proposal. Those dual credit species that are known from the site, but the breeding or important habitat is not present or impacted, will not have species credits calculated.

Additional species may be added to this list as the assessment progresses.

3. Gap analysis

3.1 Gap analysis review

The gap analysis identified the survey effort required to satisfy the BAM for each targeted survey group, as described in the survey methodologies in Section 2.2 above. The gap analysis also considered threatened species survey guidelines published by the Commonwealth Department of the Environment (2010).

The gap analysis partitioned the biodiversity survey requirements into several functional groups, based on the following survey requirements:

- Plant Community Type Mapping & Vegetation Integrity Assessment
- Threatened flora surveys
- Threatened fauna surveys and habitat mapping for forest owls, birds, invertebrates, reptiles, amphibians, and mammals.

3.2 Gap analysis outcomes

The gap analysis identified that for the majority of threatened fauna (particularly mammals, reptiles, and birds), the existing survey effort conducted by TSC was in excess of the minimum requirements for a site ~140 ha in size. The gap analysis did however identify that several survey gaps were present, in particular:

- threatened flora surveys within wet sclerophyll forests
- detailed threatened amphibian surveys outside of the two main tributaries through Mount Jerusalem National Park
- targeted surveys for breeding habitats for hollow-dependent fauna
- targeted surveys for Microchiropteran bats.

4. Surveys by ELA in 2020

4.1 Preliminary site inspections

Following the gap analysis, a site inspection was conducted by ELA ecologists from 9 – 13 March 2020, and specifically collected the following data points:

- vegetation validation: dominant three canopy, shrub, and ground cover species present
- fauna habitat: presence of hollow-bearing trees, logs, litter, and proximity to water sources
- hollow bearing trees: large trees and stags with suitable habitat for breeding forest owls and birds
- threatened species: where incidentally identified during the site inspection.

The site inspection identified seven threatened flora species previously identified by TSC.

4.2 Plant Community Type and Vegetation Integrity Assessment

Detailed surveys were carried out by ELA botanists from 14 – 18 April and 8 – 12 June 2020, whereby 35 full floristic plots were conducted in accordance with the BAM and identified the following four Plant Community Types (PCTs) in a variety of condition states:

- 770 Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion
- 827 Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast
- 1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
- 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion

These PCTs occur generally in high condition across the inundation area (weed free remnant vegetation), but also have pockets of lower condition vegetation with either more weed ingress or recent disturbance from fire. Of these PCTs, 770 and 1302 are both consistent with *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions* which is listed as Endangered under the BC Act, and *Lowland Rainforest of Subtropical Australia* which is listed as Critically Endangered under the EPBC Act.

In addition to those areas of native vegetation identified in the PCTs above, there are areas of cleared land and native plantation within the inundation area:

- Dunn's white gum plantation
- Hoop pine plantation
- Paddocks/parklands.

These areas of cleared land and native plantation will not be calculated as a loss during the final impact assessment.

The area of each PCT to be impacted, as well as the number of plots and listing status is detailed in Table 4 below. The survey effort and PCT mapping has been competed to comply with the minimum requirements of the BAM.

Complete profiles for each vegetation zone can be found in Appendix B.

Detailed breakdown of the areas of each vegetation zone, as well as PCT justifications will be provided in the BDAR.

Table 4 Vegetation zones and plots completed

Veg Zone	PCT ID	PCT Name	BC Act	EPBC Act	Condition	Area (ha)	Plots required	Plots surveyed
1 - 770 High	770	Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion	EEC	CEEC	High	1.88	2	2
2 - 827 High	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			High	65.99	5	6
3 - 827 Mod	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Moderate	42.65	4	7
4 - 827 Low	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Low	12.05	3	3
5 - 827 Burnt	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Burnt	13.65	3	3
6 - 1073 Mod	1073	Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion			Moderate	1.38	1	2
7 - 1302 High	1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	EEC	CEEC	High	2.51	2	4
8 - 1302 Mod	1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	EEC	CEEC	Moderate	0.87	1	2
Sub total Native vegetation						**140.98**	**21**	**29**
Cleared land	n/a	Dunn's white gum plantation			Low	7.9	N/A	2
Cleared land	n/a	Hoop pine plantation			Low	4.66	N/A	2
Cleared land	n/a	Paddocks/parklands			Low	69.42	N/A	2
Total area						**222.96**	**n/a**	**35**

4.3 Threatened flora assessment

Seventy-three threatened flora species are proposed as candidate species for the targeted survey, 12 of which have already been identified onsite as shown in Table 5 below. Two of these species are planted specimens, and six are potentially SAII.

Table 5 Threatened flora identified to date onsite

Species	Common	BC Act	EPBC Act	SAII
Corokia whiteana	Corokia	Vulnerable	Vulnerable	Yes
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	No
Endiandra muelleri subsp. bracteata	Green leaved Rose Walnut	Endangered	Not listed	Yes
Grammatis stenophyla	Narrow-leaf Finger Fern	Endangered	Not listed	No
Grevillea hilliana (planted)	White Yiel Yiel	Endangered	Not listed	Yes
Lepiderema pulchella	Fine-leaved Tuckeroo	Vulnerable	Not listed	Yes
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Vulnerable	No
Marsdenia longiloba	Slender Marsdenia	Endangered	Vulnerable	No
Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Not listed	Yes
Rhodomyrtus psidioides	Native Guava	Critically Endangered	Not listed	No
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	No
Syzygium moorei (planted)	Durobby	Vulnerable	Vulnerable	Yes

A threatened flora survey will be undertaken in late October – early November 2020 to coincide with the appropriate flowering and detection time for candidate species (Appendix D).

The survey plan has been adapted from the *NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats* (DPIE, 2020), whereby the strategy for sites >50ha has been applied. Typically, this would be a multistage approach using vertices on a 100m grid, however the shape of the current disturbance footprint is incompatible with this approach. As such, the inundation boundary has been allocated a survey vertex every 100m (in suitable habitats) along the internal boundary as the stage 1 approach (Figure 1). These will be inspected as per the survey guide for large sites in the appropriate time of year. Should threatened flora be identified, the area between the adjacent vertices will be searched in detail for any additional species.

This process is repeated at each vertex until all target sites have been assessed. All previous threatened flora records will then be incorporated into the results from the 2020 survey strategy.

DPIE Action 1: We request DPIE approve the threatened flora survey strategy above

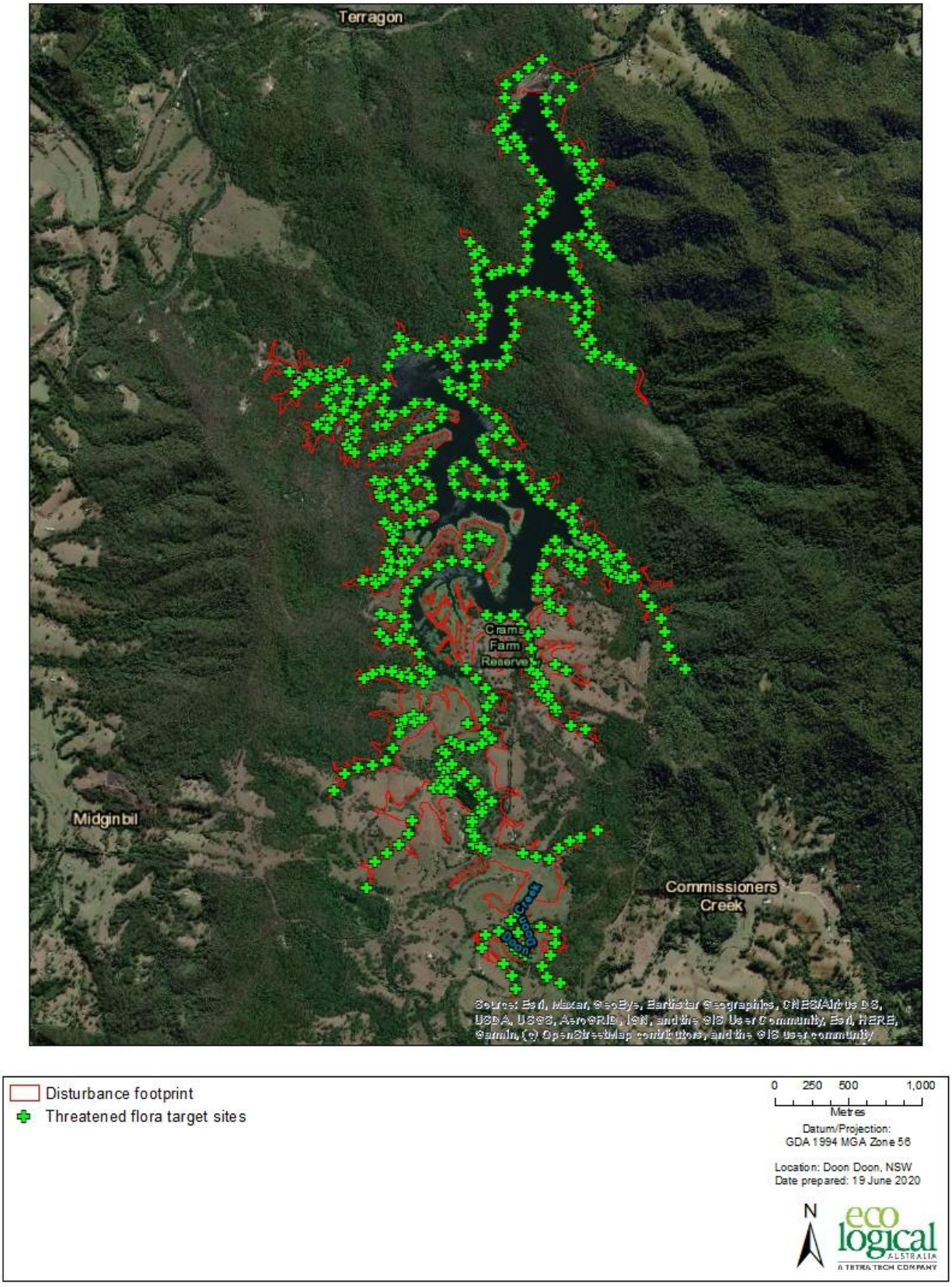


Figure 1 Threatened flora survey strategy

4.4 Threatened fauna assessment

The following section contains the proposed survey strategy for threatened fauna within the disturbance footprint.

We request DPIE confirm this strategy to be appropriate for inclusion within the formal BDAR.

4.4.1 Threatened fauna – amphibians

There are five (5) candidate threatened amphibians, three of which are known to site in discrete pockets of habitat. In order to appropriately extrapolate the findings across the disturbance footprint, a four stage approach is proposed:

1. Define habitat features for candidate species
2. Map habitats across the disturbance footprint
3. Conduct a sub-sampling survey in 2020 during appropriate weather conditions
4. Extrapolate findings across the site.

These steps are detailed in the sections and tables below.

4.4.1.1 Define habitat features for candidate species

A threatened amphibian habitat assessment was developed using information provided in the Threatened Species Profile Database, as well as considering specific habitat descriptions in the Threatened Species Profile Database and *Reptiles and Amphibians of Australia* (Cogger, 2018), as well as specialist input from Frank Lemckert. Key habitat features for each of the candidate species are detailed in Table 6.

Table 6 Threatened amphibian habitat assessment

Feature	*Assa darlingtoni*	*Litoria brevipalmata*	*Mixophyes fleayi*	*Mixophyes iteratus*	*Philoria loveridgei*
Benched rocky stream					Yes
Bogs created from human-modification to natural flows					Yes
Boggy headwaters of rainforest streams and soaks					Yes
Deep leaf litter	Yes	Yes	Yes	Yes	Yes
Emergent vegetation		Yes			
Ephemeral drainage		Yes – they breed where water pools after flowing		Yes	
Gravel stream			Yes		
Groundwater soak					Yes
Lomandra sp. and vegetated riparian ground cover			Yes	Yes	

Feature	*Assa darlingtoni*	*Litoria brevipalmata*	*Mixophyes fleayi*	*Mixophyes iteratus*	*Philoria loveridgei*
Moist substrates (mosses etc)	Yes				Yes
Overhanging banks				Yes	
Permanent drainage		Yes	Yes	Yes	
Permanent water		Yes	Yes	Yes	
Rainforest	Yes	Yes	Yes (within 750m of streams)	Yes (within 50m of drainage)	Yes
Rotting logs	Yes				Yes
Wet sclerophyll forest	Yes (within 50m of rainforest)	Yes	Yes (within 750m of streams)	Yes (within 50m of drainage)	Maybe

4.4.1.2 Map habitats across the disturbance footprint

The habitat assessment was conducted at 39 locations across the dam to understand what broad habitat types were present, and was used to stratify the site into five (5) habitat types for amphibians. Details of habitat results will be provided in the final BDAR.

The habitat features considered during the assessment are descried in Table 6 above, and the habitat types are described in Table 7.

Importantly, the habitat types will be used as a surrogate for further sub-sampling across the disturbance footprint.

The spatial distribution of amphibian habitats across the site is currently under development.

Table 7 Amphibian habitat results

Stream type	Habitat features	Threatened species	Photograph
1 – Permanent drainages in remnant rainforest	Common features: Rainforest with deep leaf litter, permanent clear flowing water, undercut banks, rotting logs, *Lomandra* sp, sand and gravel substrate Occasional features Benched streams, moist mosses Absent features Boggy headwaters, modified boggy areas, emergent aquatic vegetation, weeds	Known *Assa darlingtoni* *Mixophyes iteratus* *Philoria loveridgei* Potential *Mixophyes fleayi* Unlikely *Litoria brevipalmata*	
2 – Complex ephemeral drainages in rainforest and wet sclerophyll forest	Common features: Rainforest and wet sclerophyll forest with deep leaf litter, benched streams, moist mosses, ,rotting logs Occasional features Permanent clear flowing water, undercut banks, sand and gravel substrate, *Lomandra* sp Absent features Boggy headwaters, modified boggy areas, emergent aquatic vegetation, weeds	Known No species known Potential *Assa darlingtoni* *Philoria loveridgei* Unlikely *Mixophyes fleayi* *Mixophyes iteratus* *Litoria brevipalmata*	

Stream type	Habitat features	Threatened species	Photograph
3 – Simple ephemeral drainage in wet sclerophyll forest	Common features: Wet sclerophyll forest with deep leaf litter, rotting logs Occasional features Gravel substrates, weeds, *Lomandra* sp Absent features Rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, emergent aquatic vegetation, undercut banks, sand substrate	Known No species known Potential *Assa darlingtoni* Unlikely *Litoria brevipalmata* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	
4 – Forested dam fringe	Common features: Emergent aquatic vegetation, wet sclerophyll forest with deep leaf litter Occasional features Rotting logs Absent features Rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, *Lomandra* sp, undercut banks, sand and gravel substrate	Known No species known Potential *Assa darlingtoni* Unlikely *Litoria brevipalmata* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	

Stream type	Habitat features	Threatened species	Photograph
5 – Permanent water adjacent to cleared land	Common features: Emergent aquatic vegetation, weeds, cleared grassland Occasional features Wet sclerophyll forest with deep leaf litter, rotting logs , turbid water Absent features Gravel substrates rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, emergent aquatic vegetation *Lomandra* sp, undercut banks, sand substrate	Known No species known Potential *Litoria brevipalmata* Unlikely *Assa darlingtoni* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	

4.4.1.3 Conduct a sub-sampling survey in 2020 during appropriate weather conditions

Two sites in each stream type (10 sites total) are proposed to be surveyed during appropriate seasonal and weather conditions. The location of these sites will be spread across the disturbance footprint, and supplements the existing data collected by TSC (as described in Table 3).

Data collected regarding threatened species occupancy in habitats will be extrapolated across similar stream types.

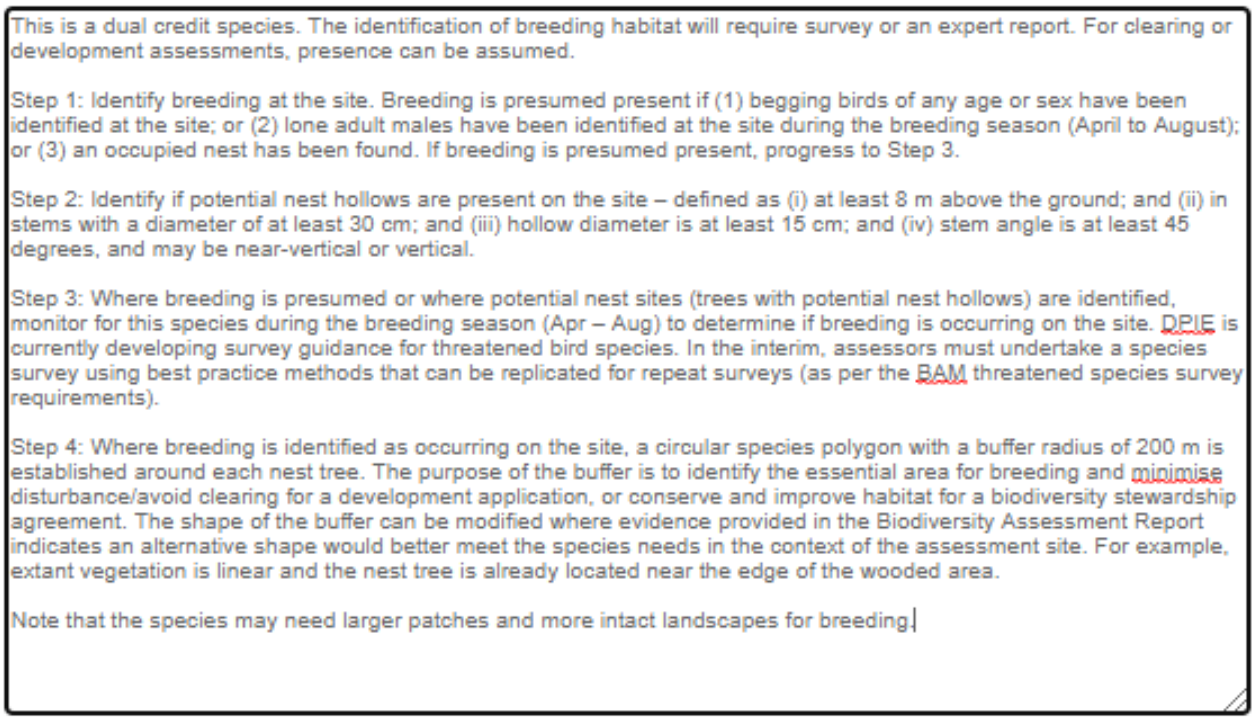
DPIE Action 2: We request DPIE approve the proposed sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 above.

4.4.2 Threatened fauna – diurnal & nocturnal birds

Ten candidate species have been identified for this assessment, three of which have been identified onsite by TSC or ELA (Glossy Black-cockatoo, White-bellied Sea-eagle, & White-eared Monarch). The gap analysis identified that the survey effort conducted at 32 sites is significantly in excess of the minimum requirement for diurnal birds, and that no further survey would be required.

Of these species, Glossy Black-cockatoo and White-bellied Sea Eagle are dual species, whereby their foraging habitat is considered an ecosystem credit, and only the breeding habitat is considered a species credit.

For Glossy Black-cockatoo, the species was identified on numerous occasions in March 2020 across the disturbance area. As such, additional survey is required to determine whether known breeding habitat is present. The identification of breeding habitat as per the Threatened Species Profile Database is shown below:


This is a dual credit species. The identification of breeding habitat will require survey or an expert report. For clearing or development assessments, presence can be assumed.

Step 1: Identify breeding at the site. Breeding is presumed present if (1) begging birds of any age or sex have been identified at the site; or (2) lone adult males have been identified at the site during the breeding season (April to August); or (3) an occupied nest has been found. If breeding is presumed present, progress to Step 3.

Step 2: Identify if potential nest hollows are present on the site – defined as (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical.

Step 3: Where breeding is presumed or where potential nest sites (trees with potential nest hollows) are identified, monitor for this species during the breeding season (Apr – Aug) to determine if breeding is occurring on the site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Step 4: Where breeding is identified as occurring on the site, a circular species polygon with a buffer radius of 200 m is established around each nest tree. The purpose of the buffer is to identify the essential area for breeding and minimise disturbance/avoid clearing for a development application, or conserve and improve habitat for a biodiversity stewardship agreement. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area.

Note that the species may need larger patches and more intact landscapes for breeding.

Figure 2 Glossy Black-cockatoo breeding habitat requirements (TSPD, 2020)

In order to determine whether breeding habitat is present, ELA conducted an inspection of all hollow-bearing trees within the disturbance footprint during the breeding season, to consider whether any of these trees were currently in use. This survey was conducted over a five day period from 21 – 25 July 2020 by ELA ecologists and accredited assessors Alex Pursche and Tom Schmidt.

In accordance with Step 1 above, the survey failed to identify any begging birds, lone adult males, or occupied nests. The only occupancy of the species identified was nearby to the dam wall, where a pair of birds were observed feeding in an *Allocasuarina torulosa*. No other individuals were observed.

In accordance with step 2, potential hollows were mapped across the disturbance footprint, and each inspected for hollow size and limb configuration. The hollow-bearing tree inspection also included a search for whitewash and casts from *Tyto* sp,

In the absence of any formal guidelines on the occupancy of the species, and given the lack of individuals identified (only one pair), it is unlikely that more than one of the hollow-bearing trees are used for breeding. The occupancy of the trees within the disturbance footprint is even less likely when considering the intact vegetation surrounding the dam, as well as the exposed position of these trees in the landscape (along the existing water front).

Forest owls such as Sooty Owl and Masked Owl were also considered during this assessment, as they are both known to occur within the locality. These species are both dual credit species, and have specific habitat requirements for breeding habitat (as described below in Figure 3 and Figure 4).

On sites where the species is determined to be present AND suitable caves are present AND breeding has been detected/proven any impact could be serious and irreversible. Any other impact on the species habitat is unlikely to be a potential serious and irreversible impact.

Where a hollow bearing tree has been identified as a breeding site in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Figure 3 Sooty Owl breeding habitat requirements (TSPD, 2020)

Patch size selected is based on that fact that the species will use areas that are quite small, especially as foraging habitat but also as roosting habitat and occasionally as breeding habitat. In Tas and Vic Masked owls have been recording nesting in paddock trees. Note that the species has been found to nest in caves in Tasmania (and maybe the Nullabor?) but there is no evidence to suggest that this occurs in NSW. Dead stags are especially popular for roosting/breeding habitat and are a limited resource due to natural attrition.

Where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Figure 4 Masked Owl breeding habitat requirements (TSPD, 2020)

Both of these habitat descriptions are non-distinct and provide little guidance for the field assessment of each of these species breeding habitats, and makes reference to documents such as "*BAM threatened*

species survey requirements" which currently are not publicly known. As such the habitat preferences of these two species has been adopted from the *Recovery Plan for Large Forest Owls* (DEC, 2006), which identifies the following breeding preferences for each species (Table 8):

Table 8 Forest owl roosting and nesting habitats (DEC, 2006)

Species	Roosting habitat	Nesting habitat
Sooty Owl	Hollows in live or occasionally dead trees, eucalypt or rainforest species, in moist forest; among dense foliage in rainforest gullies; caves, recesses or ledges in cliffs or banks. Roost sites are in the darkest and most secluded or sheltered positions in the forest. Foliage roosts are typically in narrow, gloomy side-gullies near creek junctions or below dry waterfalls, less than 10 m from drainage lines. Foliage roosts used are rainforest species, tree ferns and vine tangles. Hollows used are usually less than 100 m from streams, and are also used as nest sites or have similar characteristics to those used for nesting.	Old hollow trees, eucalypt or rainforest species, usually live but stags are occasionally used, in unlogged, unburnt gullies and lower slopes within 100 m of streams, with hollows greater than 40 cm wide and greater than 100 cm deep; surrounded by canopy trees. Also nests in caves. Hollow entrances are at least 16 m above ground, in trees of at least 120 cm diameter at breast height.
Masked Owl	Hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves or recesses in cliffs. Hollow sites can be in a variety of topographic positions, from gully to upper slope, and are also used as nest sites or have similar characteristics to those used for nesting. Roost sites in trees are greater than 5 m above the ground.	Old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams. Nest sites may be subject to a variety of disturbance regimes, which make nest trees susceptible to loss (wind throw and burning). Hollow entrances are at least 3 m above ground, in trees of at least 90 cm diameter at breast height.

In order to assess whether breeding habitat is present for either of these species, a diurnal survey reviewing each potential tree for whitewash and casts was undertaken by ELA Ecologists concurrently with the Glossy Black-cockatoo survey. Whitewash is a good indication of occupancy of the potential tree, as both of these species have high site fidelity for breeding sites.

In order to determine if the species were present during the breeding season, 4 call playback sites over 4 nights (16 sites total) as well as a spotlighting circumnavigation of the dam shoreline was conducted during the evenings of 21-24 July 2020 using a small open boat. The use of the boat provides better line of sight and ease of access throughout the inundation area. During this survey, Masked Owl was not recorded as being present within the disturbance footprint during the breeding season.

This survey did identify numerous Sooty Owls within the bushland surrounding the disturbance footprint (species observed or heard at multiple locations each night). Despite this observation, there is little evidence that the species is using the hollow-bearing trees along the foreshore, as all the calls were originating from gully heads several hundred meters away from the disturbance footprint. Combined with the lack of whitewash and specific roosting and nesting requirements as described in the *Recovery Plan for Large Forest Owls* (such as sheltered, sub-canopy roosts), it is unlikely that any breeding habitat will be impacted by the raising of Clarrie Hall Dam. No further forest owl surveys are proposed.

DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described above, and that no further assessment is required.

4.4.3 Threatened fauna – bats

The *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018) requires a minimum of 16 harp trap and 16 ANABAT nights for threatened microchiropteran bat candidate species. This assessment considers the following four candidate microchiropteran bats:

- *Chalinolobus dwyeri*
- *Miniopterus australis*
- *Miniopterus orianae oceanensis*
- *Vespadelus troughtoni*
- *Myotis Macropus.*

Myotis Macropus is known from the site and is frequently observed skimming over the water in the evenings (including during inclement winter weather), and so this species does not require any further field assessment. Of the remaining species, all are cave-dwelling for the breeding phase of their life-cycle, as is described in the TSPD, and shown below in Figure 5 to Figure 8.

In addition, many of these species only have a handful of known maternity caves, and the discovery of another would be a significant find for the species.

The topography and soil at within the inundation area does not contain any cave or cliff features that contain potential bat breeding habitats. The only place that may serve as a habitat for these species is the artificial rock faces at the dam wall (Photograph 1), whereby the aggregate may contain temporary roosting sites. There are no fissures in this feature that would contain the appropriate thermal and structural components to support a breeding site for any of the candidate species.

Similarly a review of cliffline and cave habitat within 10km of the disturbance footprint was undertaken to identify any potential sites whose buffer may extend into the inundation area (as there are several suitable cliffline features within the nearby National Parks). The regional review identified that there are numerous suitable cliffline features within Wollumbin, Nightcap, and Mount Jerusalem National Parks, however a 2km buffer (as per *V. troughtoni*) around these features would not be impacted by the disturbance footprint (Figure 9). Similarly, the smaller 100m buffer for other species would not be impacted.

As such, the identification of any of these species within the footprint would not constitute an impact to species (or dual) credit habitats, as defined by the BAM. The survey strategy for these species is to therefore not undertake any further assessment, as impacts would be incorporated into the ecosystem calculation for the project.

DPIE Action 4: We request DPIE approve the bat assessment approach described above, and that no further field studies are required.

Photograph 1 Clarrie Hall Dam Wall

The species is a full species credit because it can not be reliably predicted to occur on a site based on vegetation and other landscape features (either foraging or breeding). This species usually gives birth to twins.
SAII threshold is potential breeding habitat and presence of breeding individuals. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat.
Species mapping polygon for breeding habitat must use high resolution aerial imagery and topographic maps to identify features on the subject land (caves, scarps, cliffs etc). Polygon must be at least 100m wide (or 50m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid (see Threatened Bat Survey Guide). All breeding habitat on or within 100m of the subject land and the area immediately surrounding the feature must be identified.
All habitat on the subject land should also be mapped if present. Use high resolution aerial imagery and topographic maps to identify potential roost habitat features on the subject land within 2km caves, scarps, cliffs etc. Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features.

Figure 5 Chalinolobus dwyeri s species habitat description (TSPD, 2020)

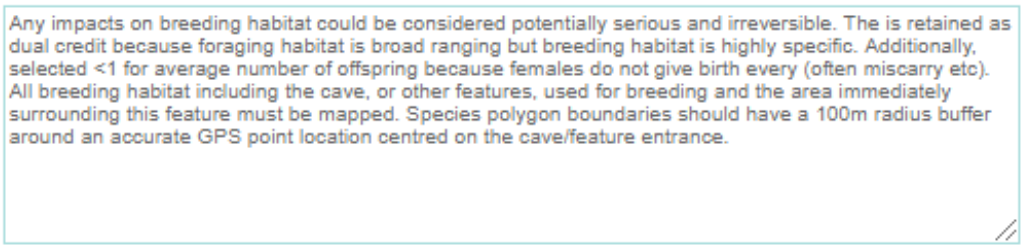


Figure 6 Miniopterus australis species habitat description (TSPD, 2020)

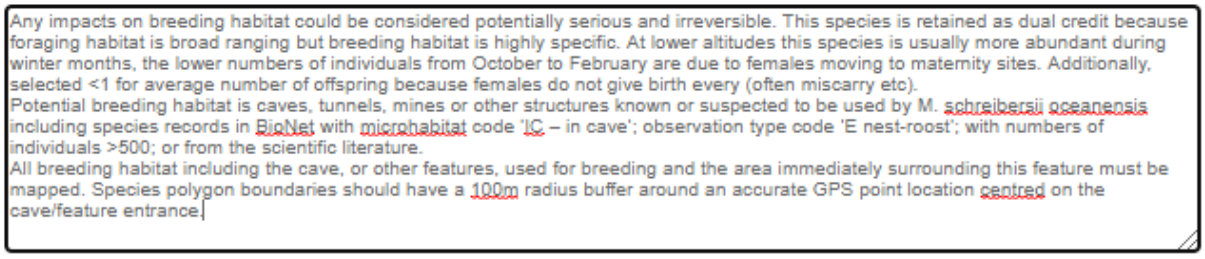


Figure 7 Miniopterus orianae oceanensis breeding habitat description (TSPD, 2020)

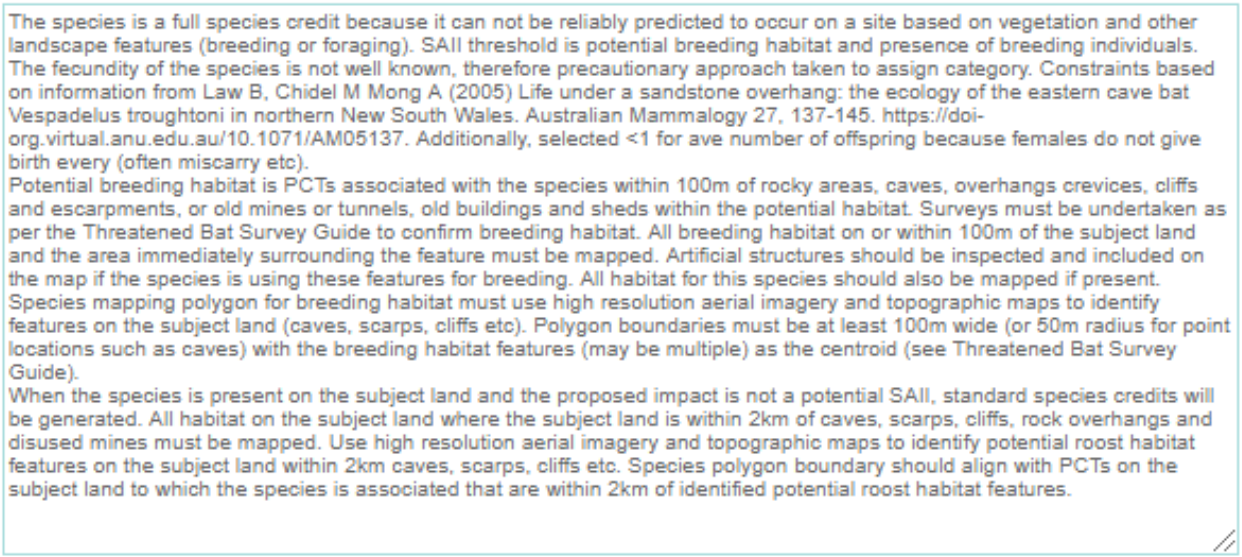


Figure 8 *Vespadelus troughtoni* species credit description (TSPD, 2020)

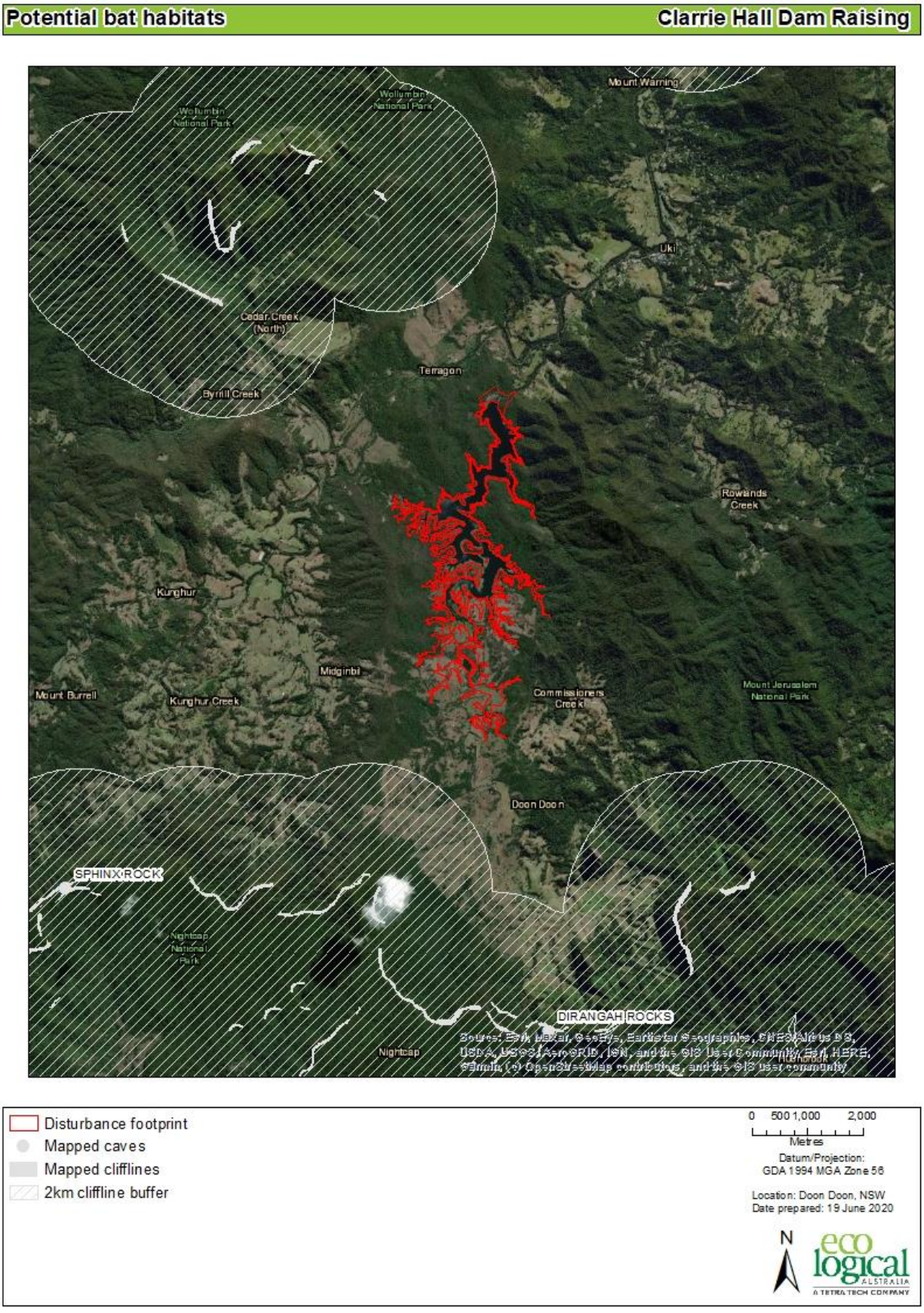


Figure 9 Potential bat habitat within the region

4.4.4 Threatened fauna – mammals

TSC conducted significant mammal surveys across the disturbance area as well as adjacent forests. The survey effort conducted to date is significantly in excess of the minimum requirements (Appendix E). The only species whereby additional information is requested is for Koala and Brush-tailed Phascogale.

4.4.4.1 Koala

Koala is a dual credit species, whereby foraging habitat is considered an ecosystem credit, and only important habitats are calculated as species credits. The TSPD contains the following guidance on assessing important habitats for Koala (Figure 13):

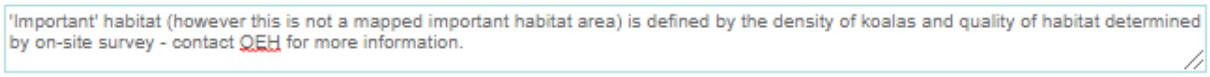


Figure 10 Koala habitat description (TSPD, 2020).

Previous koala habitat mapping has been undertaken by TSC and is presented in the attached flora and fauna assessment. Given that this species is known from the inundation area and adjacent sclerophyll forests, the assessor requests that guidance be provided on the methodology for mapping important habitats across the disturbance area.

DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala

4.4.4.2 Brush-tailed Phascogale

This species inhabits open forest and woodlands along the NSW coastline and ranges. This species uses hollows in smooth-barked trees for refugia, and forages predominately on insects and spiders. This species generally is not found in the wet sclerophyll forests and rainforests that are present within the inundation area.

The TSPD contains detailed information regarding the survey for this species, and specifies (Figure 14) that up to 10 cameras per ha of habitat are required, and that for sites over 10ha, a modified camera approach may be sought from DPIE. This request is to be accompanied by PCT mapping and vegetation plot sheets (both included in this letter).

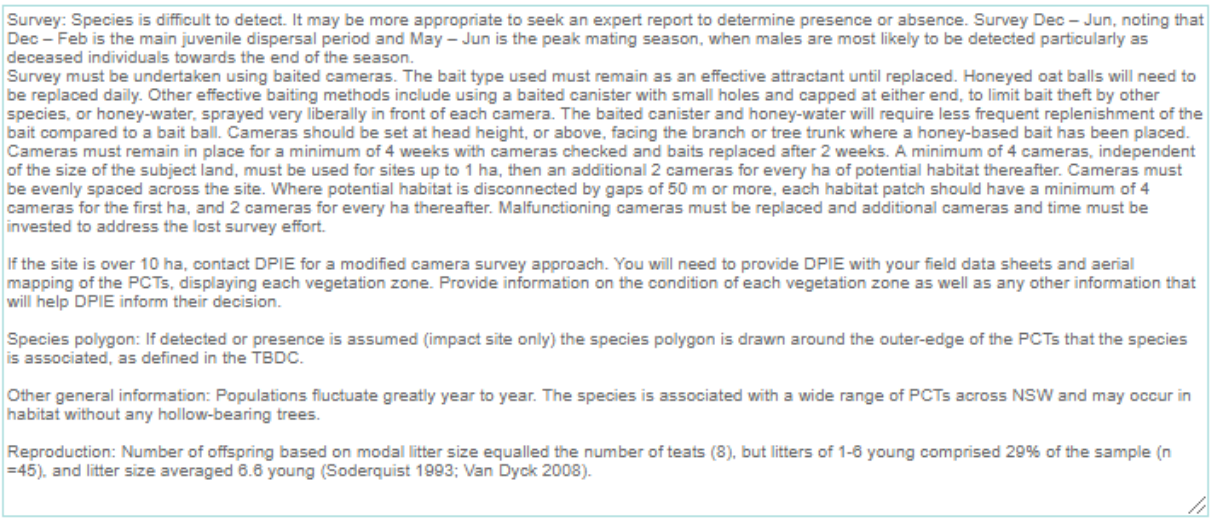


Figure 11 Survey guidance for Brush-tailed Phascogale (TSPD, 2020)

Given the extensive survey effort already undertaken by TSC (Appendix A & Appendix E), and the lack of habitats for this species present within the disturbance area, no additional survey should be undertaken for this species.

DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale

4.4.5 Threatened fauna – reptiles

The survey effort conducted by TSC is considered to be considerably above the minimum requirements for candidate threatened reptiles for this assessment. No further surveys are proposed.

DPIE Action 7: We request DPIE confirm no further reptile surveys required.

Appendix A Tweed Shire Council Report

See link as follows:

https://www.yoursaytweed.com.au/RaisingClarrieHall/widgets/183762/documents

Appendix B Threatened species records

Table 9 Threatened fauna identified at Clarrie Hall Dam by TSC

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
Amphibia	*Assa darlingtoni*	Pouched Frog	Vulnerable	Not listed	Species	Area	No
Amphibia	*Mixophyes iteratus*	Giant Barred Frog	Endangered	Endangered	Species	Area	No
Amphibia	*Philoria loveridgei*	Loveridge's Frog	Endangered	Not listed	Species	Area	No
Aves	*Amaurornis moluccana*	Pale-vented Bush Hen	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Carterornis leucotis*	White-eared Monarch	Vulnerable	Not listed	Species	Area	No
Aves	*Podargus ocellatus*	Marbled frogmouth	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus magnificus*	Wompoo Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus regina*	Rose-crowned Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus superbus*	Superb Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Irediparra gallinacea*	Comb-crested Jacana	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Calyptorhynchus lathami*	Glossy Black-cockatoo	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No
Aves	*Menura alberti*	Alberts Lyrebird	Vulnerable	Not listed	Species	Area	No
Aves	*Tyto novaehollandiae*	Masked Owl	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
Aves	*Tyto tenebricosa*	Sooty Owl	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	Yes
Mammalia - arboreal	*Phascolarctos cinereus*	Koala	Vulnerable	Vulnerable	Dual	Important habitat only - undefined	No
Mammalia - bats	*Miniopterus australis*	Little Bent-winged Bat	Vulnerable	Not listed	Dual	Circular polygon around breeding caves only	Yes
Mammalia - bats	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	Vulnerable	Not listed	Dual	Circular polygon around breeding caves only	Yes
Mammalia - bats	*Myotis macropus*	Southern Myotis	Vulnerable	Not listed	Species	Vegetation within 200m of waterbody	No
Mammalia - bats	*Nyctimene robinsoni*	Eastern Tube-nosed Bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Nyctophilus bifax*	Eastern Long-eared Bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Pteropus poliocephalus*	Grey-headed Flying-fox	Vulnerable	Vulnerable	Dual	Camp sites only	No
Mammalia - bats	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Vespadelus troughtoni*	Eastern Cave Bat	Vulnerable	Not listed	Species	2km from potential roosts (caves, cliffs, disused mines etc). Breeding habitat caves only.	Yes (breeding)
Mammalia - terrestrial	*Potorous tridactylus*	Long-nosed Potoroo	Vulnerable	Vulnerable	Species	Dense habitats in wet	No

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
						sclerophyll or rainforest	

Appendix C Plant Community Type Profiles

Table 10 Zone 1 PCT770 High condition

770 - Coachwood - Soft Corkwood - Crabapple warm temperate rainforest of the NSW North Coast Bioregion	
Vegetation formation/class	Rainforests/Northern Warm Temperate Rainforests
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia
	This community occurs in narrow bands along drainage courses in protected gullies or in larger areas on sheltered slopes. Mid-storey and canopy cover is often high. This community is characterised by an upper stratum of *Ceratopetalum apetalum* (Coachwood), *Schizomeria ovata* (Crabapple) and *Endiandra globosa* (Black Walnut) with *Lophostemon confertus* (Brush Box) and some *Eucalyptus* spp. occurring occasionally and on the community ecotone. Some mid-storey species occasionally occur as canopy trees. The mid-storey is made up of species including *Archontophoenix cunninghamiana*, *Neolitsea dealbata*, *Acmena smithii*, *Ackama paniculosa, Sloanea* spp., *Flindersia* spp. and *Cryptocarya* spp. The ground layer varies in cover but often comprising of *Blechnum cartilagineum,* with other ferns, herbs and grasses occurring at lower levels. Climbers are a common feature including *Cissus* spp., *Ripogonum* spp., *Echinostephia aculeata*, *Gynochthodes jasminoides*, *Smilax* spp., *Flagellaria indica* and *Calamus muelleri*.
Characteristic canopy trees	*Ceratopetalum apetalum, Schizomeria ovata, Endiandra globosa, Lophostemon confertus*
Characteristic mid-storey	*Archontophoenix cunninghamiana, Acmena smithii, Ackama paniculosa, Neolitsea dealbata, Cryptocarya* spp., *Eupomatia laurina, Synoum glandulosum* subsp. *glandulosum, Sloanea* spp., *Cissus* spp.
Characteristic groundcovers	*Blechnum cartilagineum, Adiantum* spp., *Dianella* spp., *Calochlaena dubia, Lomandra* spp.
Mean native richness	58
Exotic species / HTW cover	*Lantana camara* / 0
Condition	Good condition
Variation and disturbance	Little to no disturbance, some old forestry tracks are present which are regenerating well. Smaller patches of this zone show an influence/overlap from adjacent 827 communities.
% cleared in NSW	0.3%
No. sites sampled	2
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Endiandra hayesii, Marsdenia longiloba, Syzygium hodgkinsoniae, Grammitis stenophylla, Rhodamnia rubescens, Rhodomyrtus psidioides*
Fauna habitats	Dense vegetation for ground mammals and rainforest birds. Amphibian habitat in streams. Potential for small hollow bearing trees. Occasional koala feed trees (*E. propinqua*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo (in community ecotone).
Justification	Similar PCTs occur in the region including 1130 and 1201 however PCT 770 represents the best fit given the dominant canopy species.

Composition	**Structure**	**Function**	**Vegetation Integrity Score**
94.7	29.2	64.7	56.3

Table 11 Zone 2 PCT 827 High condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (High)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community occurs on moderately exposed areas around the dam. This community is characterised by an upper stratum of *Lophostemon confertus* (Brush Box) and various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus propinqua* (Grey gum). The mid-storey is made up of species including *Acmena smithii*, *Endiandra globosa*, *Archontophoenix cunninghamiana*, *Cryptocarya* spp., *Archirhodomyrtus beckleri*, *Schizomeria ovata*, *Polyscias elegans* and *Allocasuarina torulosa*. Some species typically found in the mid-storey of this community including *Alphitonia excelsa*, *Endiandra globosa* and *Allocasuarina torulosa* occasionally occur as canopy trees. The ground layer is variable but generally has a high cover of *Blechnum cartilagineum*, *Calochlaena dubia* and *Hypolepis muelleri,* with *Lomandra* spp. and *Oplismenus imbecillis* also common. Other ferns, herbs and grasses occur at lower levels including *Aneilema acuminatum*, *Entolasia marginata* and *Pseuderanthemum variabile*. Climbers occurring include *Cissus* spp., *Dioscorea transversa*, *Geitonoplesium cymosum*, *Gynochthodes jasminoides* and *Smilax* spp.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp.*, Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp.*, Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	50
Exotic species / HTW cover	*Cinnamomum camphora, Ardisia crenata, Passiflora edulis, Paspalum mandiocanum, Ageratina riparia, Passiflora edulis, Commelina benghalensis* / 2%
Condition	High
Variation and disturbance	Little to no disturbance. Evidence of historic logging and old forestry tracks are present which are regenerating well. Old fences are occasionally found which have minimal impact to community
% cleared in NSW	Not listed
No. sites sampled	6
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens, Corokia whiteana*
Fauna habitats	Dense vegetation for ground mammals and rainforest birds. Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the dominant canopy species.

Composition	Structure	Function	Vegetation Integrity Score
94.2	47.8	73.8	69.3

Table 12: Zone 3 PCT 827 Moderate condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Moderate)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is the equivalent of 827 high but with a moderate occurrence of exotic species and/or a modified vegetation structure. This community is characterised by an upper stratum of various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood). The mid-storey cover is generally low compared to the 827 High condition zone, with the exception of some sites with dense mid-storey regrowth. The ground layer is variable but generally fern cover is lower and grass cover is higher. Grasses include *Oplismenus* spp., *Entolasia marginata*, *Cynodon dactylon*, *Imperata cylindrica* and *Paspalum mandiocanum*. Climbers are present in low numbers except where regrowth is high or where the mid-storey is relatively intact.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp., *Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp., *Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	40
Exotic species / HTW cover	*Andropogon virginicus, Ageratina riparia, Ageratina adenophora, Anredera cordifolia, Asparagus plumosus, Axonopus compressus, Bidens pilosa, Cinnamomum camphora, Conyza bonariensis, Citrus x taitensis, Commelina benghalensis, Desmodium uncinatum, Hypochaeris radicata, Lantana camara, Ligustrum lucidum, Onopordum acanthium, Ochna serrulata, Passiflora edulis, Paspalum mandiocanum, Senecio madagascariensis, Setaria sphacelata, Solanum capsicoides, Sporobolus africanus, Stellaria media, Senna septemtrionalis, Kalanchoe sp., Sonchus oleraceus, Tradescantia fluminensis* / 8%
Condition	Moderate
Variation and disturbance	Areas likely previously cleared with varying levels of regrowth. The upper canopy cover is relatively intact though mature Camphor laurels may be present. Variation in mid-storey condition occurs including areas of high mid-storey regrowth, degraded mid-storey regrowth, or mown mid-storey and groundcover.
% cleared in NSW	Not listed
No. sites sampled	7
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	Potential for small hollows. Presence of koala feed trees (*E. microcorys*, *E. propinqua*, *E. grandis*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
89	37.7	87.1	66.4

Table 13: Zone 4 PCT 827 Low condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Low)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is the equivalent of 827 High but with a high occurrence of exotic species and/or a highly modified community structure. This community is characterised by an upper stratum of Eucalypts including *Lophostemon confertus* (Brush Box) and *Eucalyptus grandis* (Flooded Gum) and occasional disturbance related pioneer species such as *Alphitonia excelsa* (Red Ash) and *Flindersia schottiana* (Bumpy Ash). *Cinnamomum camphora* (Camphor laurel) may be the dominant canopy cover is some areas. The mid-storey cover is generally low compared to the equivalent high condition community, except for sites with dense mid-storey regrowth in canopy gaps. The ground layer is variable but generally fern cover is lower and grass cover is higher. Grasses include *Oplismenus* spp., *Entolasia marginata*, *Cynodon dactylon*, *Imperata cylindrica* and *Paspalum mandiocanum*. Climbers are present in low numbers except where regrowth is high.
Characteristic canopy trees	*Lophostemon confertus*, *Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Mallotus philippinensis, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	Variable but may include *Pteridium esculentum, Ottochloa gracillima, Oplismenus imbecillis, Entolasia marginata, Lomandra longifolia* and *Paspalum mandiocanum*
Mean native richness	40
Exotic species / HTW cover	*Ageratina adenophora, Cinnamomum camphora, Lantana camara, Senna septemtrionalis, Paspalum mandiocanum* / 35%
Condition	Low
Variation and disturbance	Areas previously cleared with degraded regrowth. The upper canopy cover is present but often sparse and mature Camphor laurels are likely to occur. Midstorey and ground cover is variable in this zone ranging from very sparse midstorey and exotic groundcover, to dense midstorey regrowth. This zone also includes some small patches of regrowth with exotic grass groundcover in otherwise cleared areas.
% cleared in NSW	Not listed
No. sites sampled	3
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	Foraging for rainforest birds. Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
84.5	12	61.8	39.8

Table 14: Zone 5 PCT 827 Burnt condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Burnt)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests
Conservation status	Not listed
	This community is the equivalent of 827 High but was burnt in an uncontrolled fire in 2019. The fire intensity was low-moderate which mostly affected the ground cover and mid-storey vegetation leaving the canopy intact. Similarly to 827 High, this community is characterised by an upper stratum of *Lophostemon confertus* (Brush Box) and various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood). The mid-storey is made up of mesic species including *Endiandra globosa*, *Cryptocarya* spp., *Elaeocarpus* spp., *Polyscias elegans* and *Allocasuarina torulosa*. Some of these species occasionally occur as canopy trees. Small dead trees and shrubs are present in the mid-storey with many species responding to fire with basal coppicing. The ground layer is variable but generally has high cover of *Blechnum cartilagineum*, *Calochlaena dubia* and *Hypolepis muelleri,* with *Lomandra* spp. and *Oplismenus imbecillis* also common. Other herbs and grasses including *Aneilema acuminatum*, *Entolasia marginata* and *Pseuderanthemum variabile* show higher cover compared to 827 High presumably due to higher levels of light. The cover and abundance of exotic species is also higher in 827 Burnt compared to 827 High. Climbers occurring include *Cissus* spp., *Dioscorea transversa*, *Geitonoplesium cymosum*, *Gynochthodes jasminoides* and *Smila*x spp.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp., *Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp., *Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	49
Exotic species / HTW cover	*Ageratina riparia, Cinnamomum camphor, Crassocephalum crepidioides, Passiflora edulis, Phytolacca octandra, Senecio madagascariensis, Solanum mauritianum, Solanum nigrum, Sonchus oleraceus* / 2%
Condition	Burnt
Variation and disturbance	Burnt at low-moderate intensity. Evidence of historic logging.
% cleared in NSW	Not listed
No. sites sampled	3
Threatened flora species	*Endiandra muelleri* subsp*. bracteata, Marsdenia longiloba, Rhodamnia rubescens, Rhodomyrtus psidioides*
Fauna habitats	Potential for small hollow bearing trees. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
95.8	17.3	63.8	47.3

Table 15: Zone 6 PCT1073 Moderate condition

1073 - Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion (Mod)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is characterised by an upper stratum of Eucalypts including *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus microcorys* (Tallowwood), *E. propinqua* (Grey Gum), *E. robusta* (Swamp Mahogany) and *Syncarpia glomulifera* (Turpentine). Occurrence of *Lophostemon confertus* (Brush Box) and *E. grandis* (Flooded Gum) is lower than PCT 827. The mid-storey cover is low with some regrowth occurring including *Glochidion ferdinandi*, *Acacia* spp., *Melia azedarach*, *Jagera pseudorhus* and *Alphitonia excelsa*. The ground layer is a combination of native and exotic grasses with some herbaceous species. Grasses include *Ottochloa gracillima*, *Entolasia marginata*, *Imperata cylindrica*, *Paspalum mandiocanum*, *Cymbopogon refractus*, *Andropogon virginicus* and *Setaria sphacelata*.
Characteristic canopy trees	*Corymbia intermedia, Eucalyptus microcorys, E. propinqua, E. robusta, Syncarpia Glomulifera*
Characteristic mid-storey	*Acmena smithii, Mallotus philippinensis, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Ottochloa gracillima, Entolasia marginata, Imperata cylindrica, Cymbopogon refractus*
Mean native richness	36
Exotic species / HTW cover	*Lantana camara, Paspalum mandiocanum, Andropogon virginicus, Setaria sphacelata* / 33.2%
Condition	Moderate
Variation and disturbance	Areas previously cleared with low mid-storey cover likely due to periodic slashing. The upper canopy trees are well developed.
% cleared in NSW	0.4
No. sites sampled	2
Threatened flora species	
Fauna habitats	Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua*) and potential occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Similar PCTs occur in the region (827, 826 1285, 1569) however, 1073 best reflects the dominant Eucalypt species in this community and absence of *Eucalyptus grandis* and *Lophostemon confertus*.

Composition	Structure	Function	Vegetation Integrity Score
65	16.2	53.6	38.4

Table 16:Zone 7 PCT1302 High condition

1302 – White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (High)			
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest		
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions		
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia		
	This community occurs in gullies, forming in a narrow band along streams where there is an accumulation of alluvial material. This community is characterised by an upper stratum dominated by *Archontophoenix cunninghamiana* (Bangalow Palm) with occasional emergent including *Lophostemon confertus* (Brush Box) and *Endiandra globosa* (Black Walnut), particularly on the sloping community ecotone. The mid-storey cover is generally low in wet areas or moderate in slightly elevated areas and includes *Acmena smithii, Cryptocarya* spp., *Neolitsea dealbata, Ceratopetalum apetalum, Schizomeria ovata* and *Backhousia myrtifolia*. These species may occasionally form the upper strata in low amounts. The ground layer cover is generally low but may comprise of ferns and grasslike plants including *Blechnum cartilagineum, Adiantum formosum*, and *Lomandra* spp. Climbers include *Cissus hypoglauca*, *Calamus muelleri* and *Flagellaria indica*.		
Characteristic canopy trees	*Archontophoenix cunninghamiana, Endiandra globosa, Lophostemon confertus*		
Characteristic mid-storey	*Acmena smithii, Cryptocarya* spp., *Neolitsea dealbata, Ceratopetalum apetalum, Schizomeria ovata, Backhousia myrtifolia, Sloanea australis, Cissus hypoglauca, Calamus muelleri, Linospadix monostachyos, Flagellaria indica*		
Characteristic groundcovers	*Blechnum cartilagineum, Adiantum formosum, Lomandra* spp.		
Mean native richness	44		
Exotic species / HTW cover	0%		
Condition	High		
Variation and disturbance	Small amount of historic disturbance from logging, and natural disturbance related to high stream flow events. Canopy of Bangalow Palm consistent across all sites.		
% cleared in NSW	0.75		
No. sites sampled	4		
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Corokia whiteana, Rhodomyrtus psidioides, Rhodamnia rubescens*, *Endiandra hayesii*		
Fauna habitats	High cover and foraging resources for rainforest birds and amphibian habitat		
Justification	This community is likely to be different in structure and floristic composition to the type location for 1302, however 1302 is the best fit for *Archontophoenix cunninghamiana* as a dominant canopy tree. Other PCTs with a similar floristic composition include 770 and 1201, but lack *A. cunninghamiana* as a dominant species.		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
80.6	26.1	70.4	52.9

Table 17: Zone 8 PCT1302 Moderate condition

1302 – White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (Moderate)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia
	This community occurs in the southern portion of the dam along watercourses in sheltered positions where there is a history of disturbance. The floristic composition of this community is variable, but sites are linked by the early succession stage of regrowth in comparison to well-developed rainforest in other vegetation zones in the study area. The upper stratum may comprise of *Endiandra globosa* (Black Walnut), *Tristaniopsis laurina* (Water Gum), *Backhousia myrtifolia* (Grey Myrtle), *Lophostemon confertus* (Brush Box) and *Pseudoweinmannia lachnocarpa* (Rose Marara). The mid-storey is made up by various mesic species including *Guioa semiglauca, Backhousia myrtifolia, Wilkiea huegeliana, Ficus coronata, Archidendron grandiflorum, Elaeocarpus obovatus, Neolitsea dealbata, Aphananthe philippinensis, Acmena smithii* and *Elattostachys nervosa*. The ground layer cover is dominated by ferns and herbaceous species including *Adiantum hispidulum, Hypolepis glandulifera, Aneilema acuminatum* and *Calochlaena dubia*. Climbers include *Calamus muelleri, Austrocallerya australis, Cissus* spp., *Maclura cochinchinensis* and *Trophis scandens*.
Characteristic canopy trees	*Endiandra globosa, Tristaniopsis laurina, Backhousia myrtifolia, Lophostemon confertus, Pseudoweinmannia lachnocarpa*
Characteristic mid-storey	*Guioa semiglauca, Backhousia myrtifolia, Wilkiea huegeliana, Ficus coronata, Archidendron grandiflorum, Elaeocarpus obovatus, Neolitsea dealbata, Aphananthe philippinensis, Acmena smithii, Elattostachys nervosa*
Characteristic groundcovers	*Adiantum hispidulum, Hypolepis glandulifera, Aneilema acuminatum, Calochlaena dubia*
Mean native richness	42
Exotic species / HTW cover	*Ardisia crenata, Ageratina* spp., *Anredera cordifolia, Cinnamomum camphora, Lantana camara, Passiflora edulis, Tradescantia fluminensis* / 10.8%
Condition	Moderate
Variation and disturbance	Areas likely previously partially or entirely cleared, with early succession regrowth. These is some variation in floristic composition in this zone which is likely related to disturbance history and environmental conditions.
% cleared in NSW	0.75
No. sites sampled	2
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	High cover and foraging resources for rainforest birds and amphibian habitat in streams
Justification	This community is likely to be different in structure and floristic composition to the type location for 1302, however 1302 is the best fit for closed forests in various stages of regeneration with various dominant species. Other PCTs with a similar floristic composition include 770 and 1201

Composition	Structure	Function	Vegetation Integrity Score
78.6	12.9	51.4	37.4

Table 18: Cleared land – *Eucalyptus dunnii* plantation

***Eucalyptus dunnii* (Dunn's white gum) plantation**			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community contains planted *Eucalyptus dunnii* (Dunn's white gum). The plantation appears to be partially harvested or thinned. The mid-storey cover is low with small amounts of scattered regrowth occurring including *Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri* and *Maclura cochinchinensis*. Exotic species make up a high proportion of the mid-storey including *Lantana camara, Cinnamomum camphor, Citrus* x *taitensis* and *Sida rhombifolia*. The ground layer cover is dominated by exotic grasses including *Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata* and *Axonopus compressus* with native grasses and herbaceous species detected at low levels including *Oplismenus aemulus* and *Lobelia purpurascens*.		
Characteristic canopy trees	*Eucalyptus dunnii*		
Characteristic mid-storey	*Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri, Maclura cochinchinensis, Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia*		
Characteristic groundcovers	*Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus, Oplismenus aemulus, Lobelia purpurascens*		
Mean native richness	15		
Exotic species / HTW cover	*Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia, Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus* / 32.6%		
Condition	Low		
Variation and disturbance	Areas previously cleared, converted to pasture and planted with *E. dunnii*. Degraded mid-storey regrowth likely due to periodic slashing		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Rhodamnia rubescens*		
Fauna habitats	Low potential for hollow-bearing trees, variable cover		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Table 19: Cleared land - *Araucaria cunninghamii* plantation

***Araucaria cunninghamii* (Hoop pine) plantation**			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community contains planted *Araucaria cunninghamii* (Hoop pine). The mid-storey cover is very low with minimal regrowth occurring from species including *Acacia melanoxylon*, *Ficus fraseri, Maclura cochinchinensis* and *Parsonsia straminea*. The ground layer cover is dominated by exotic grasses including *Paspalum mandiocanum*, *Sporobolus africanus*, *Setaria sphacelata* and *Axonopus compressus* with native grasses and herbaceous species detected at low levels including *Oplismenus aemulus* and *Lobelia purpurascens*.		
Characteristic canopy trees	*Eucalyptus dunnii*		
Characteristic mid-storey	*Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri, Maclura cochinchinensis, Lantana camara, Cinnamomum camphor, Sida rhombifolia*		
Characteristic groundcovers	*Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus, Oplismenus aemulus, Lobelia purpurascens*		
Mean native richness	25		
Exotic species / HTW cover	*Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia, Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus* / 4.1%		
Condition	Low		
Variation and disturbance	Areas previously cleared and planted with *Araucaria cunninghamii*, mid-storey and ground cover regrowth largely supressed		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	*Rhodamnia rubescens*		
Fauna habitats	High canopy cover, limited foraging resources		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Table 20: Cleared land – exotic pastures

Exotic pastures			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community occurs around the southern end of the dam and is dominated by exotic grasses and herbs which are maintained with regular slashing including *Axonopus compressus* (Broad-leaved Carpet Grass), *Pennisetum clandestina* (Kikuyu) and *Paspalum mandiocanum* (Broad-leaved Paspalum). Some native ground covers such as *Cynodon dactylon* (Couch) and *Centella asiatica* (Indian Pennywort) may occasionally occur. Cleared areas are generally paddocks managed for agriculture or parklands at Cram's Farm Reserve. While the community is characterised as a treeless community, isolated paddock trees occur sporadically in some areas which range from mature Eucalypts to small isolated patches of *Acacia melanoxylon* (Blackwood).		
Characteristic canopy trees	Predominately treeless with occasional isolated paddock trees and very small patches of regrowth, usually Eucalyptus spp. and Acacia spp.		
Characteristic mid-storey	absent		
Characteristic groundcovers	*Axonopus compressus, Pennisetum clandestina, Paspalum mandiocanum, Paspalum dilatatum, Digitaria* spp., *Cynodon dactylon, Cyperus* spp.		
Mean native richness	5		
Exotic species / HTW cover	*Axonopus compressus, Pennisetum clandestina, Paspalum mandiocanum, Paspalum dilatatum, Senecio jacobaea* / 32.6%		
Condition	Low		
Variation and disturbance	Areas previously cleared and sown with exotic pasture species and regularly slashed		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	n/a		
Fauna habitats	Limited habitat opportunities		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Appendix D Plant Community Type mapping

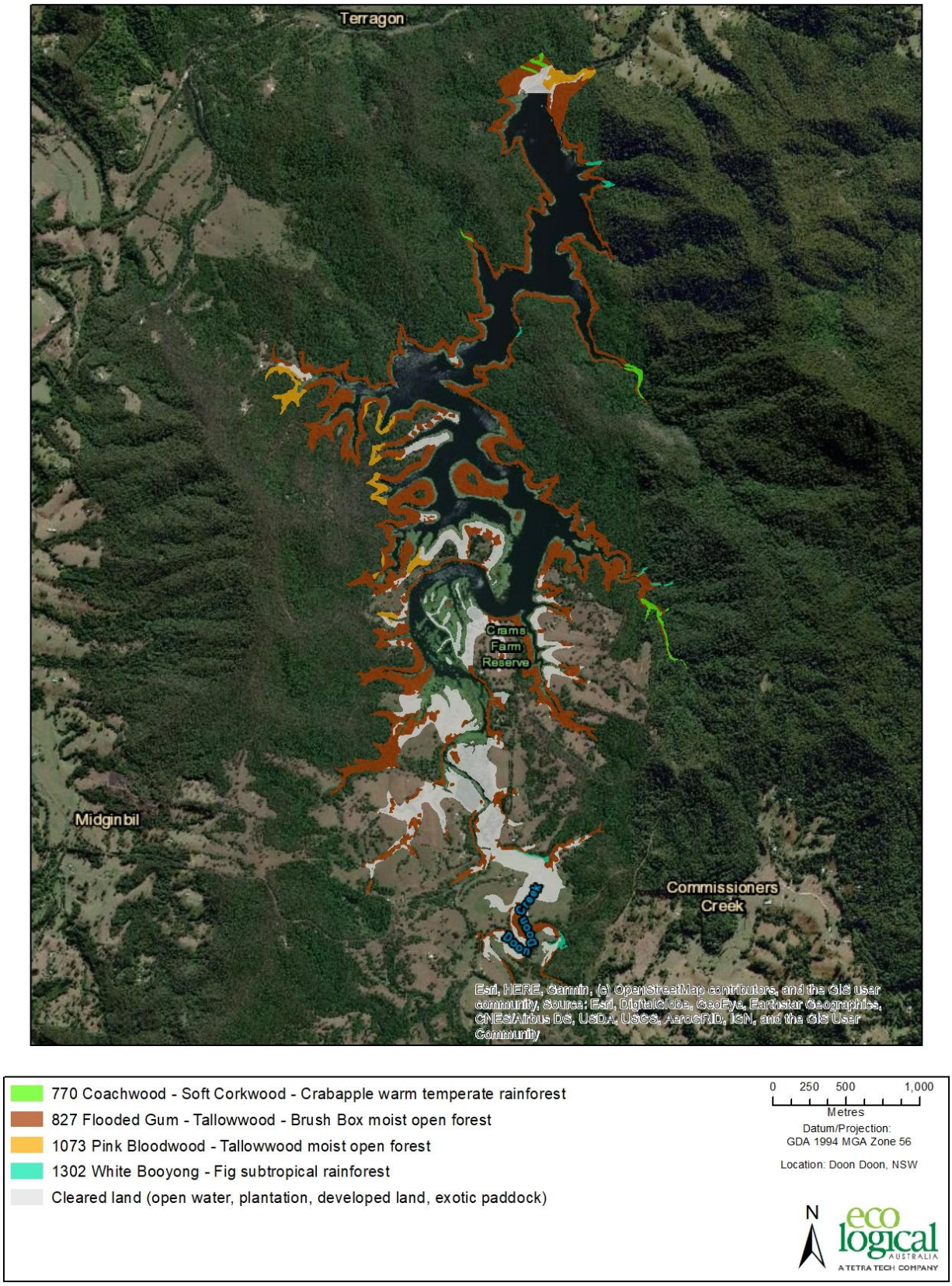


Figure 12 Plant community types

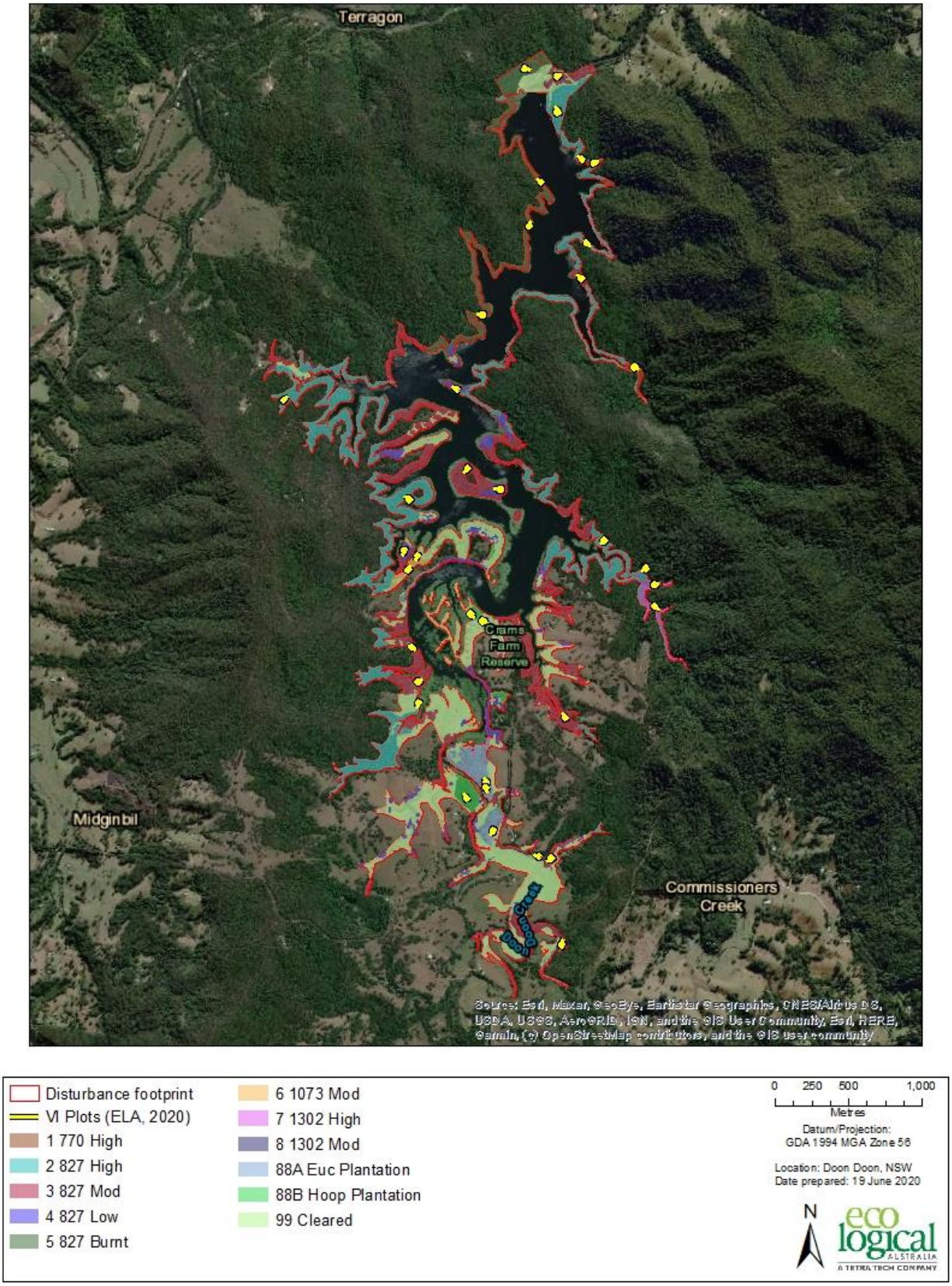


Figure 13 Vegetation zones and survey effort

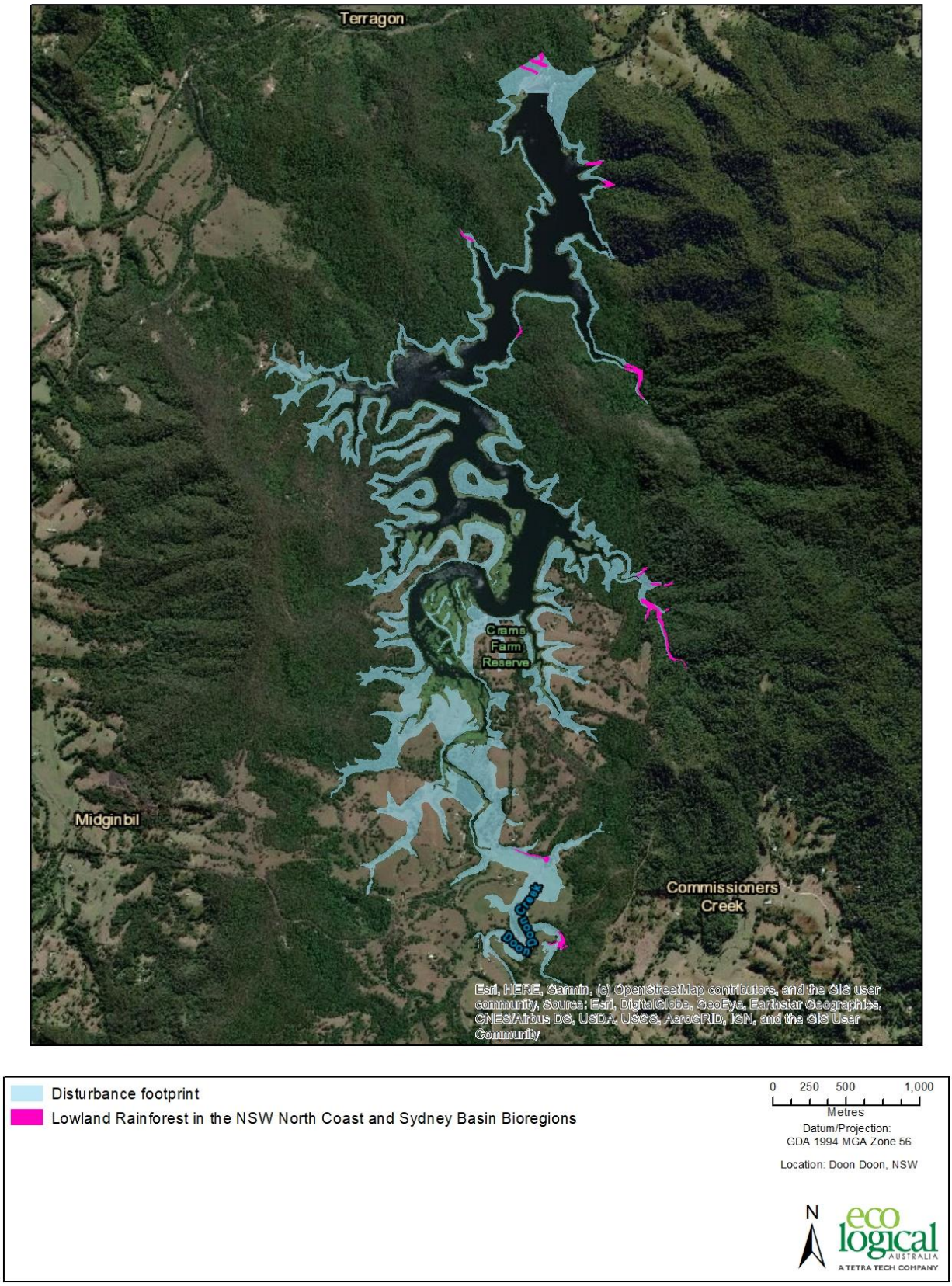


Figure 14 Threatened Ecological Communities

Appendix E Floristic Data

| Family | Species | Common Name | Listing Status | ROTAP | Exotic | High Threat Weed | Growth Form Group | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | | Plot 9 | | | Plot 10 | | | Plot 11 | | | Plot 12 | | | Plot 13 | | | Plot 14 | | | Plot 15 | | | Plot 16 | | | Plot 17 | | | Plot 18 | | | Plot 19 | | |
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Plot	PCT	Area	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeSte m5to9	funTreeSte m10to19	funTreeSte m20to29	funTreeSte m30to49	funTreeSte m50to79	funTreeReg een	funHighThreatExotic
Plot 1	827	13.65	101	Burnt	56	530264	6853775	320	13	9	3	6	2	9	36.8	12.0	0.5	0.8	3.2	17.2	0	5	91	72	1	1	1	1	1	1	0.0
Plot 2	770	2.76	101	High	56	529922	6853637	236	20	12	2	4	5	17	35.2	5.9	0.2	0.6	2.7	8.7	0	2	70	95	1	1	1	1	1	1	0.2
Plot 3	827	66.6	101	High	56	530201	6853795	230	20	9	2	3	3	14	93.2	2.5	1.1	0.3	25.2	3.5	4	7	77.2	73	1	1	1	1	1	1	0.0
Plot 4	827	42.71	101	Mod	56	529922	6853637	300	18	15	5	4	6	11	55.3	2.5	0.7	0.6	0.9	5.4	0	4	56	36	1	1	1	1	0	1	16.1
Plot 5	827	66.6	101	High	56	530217	6853240	150	19	9	5	6	4	12	51.1	8.3	0.6	0.6	30.3	1.7	0	5	75.6	61	1	1	1	1	0	1	0.1
Plot 6	827	13.65	101	Burnt	56	529829	6853336	300	14	7	5	3	1	9	24.1	0.9	0.5	0.4	20.0	1.1	0	6	54	69	1	1	1	1	0	1	0.3
Plot 7	770	1.63	101	High	56	530541	6852394	110	16	8	2	4	8	16	24.7	1.7	0.4	0.5	1.2	54.3	1	12	50	51	1	1	1	1	1	1	0.0
Plot 8	827	13.65	101	Burnt	56	529524	6852743	220	17	13	5	9	4	19	14.2	2.0	0.8	1.3	15.4	3.2	0	4	35	96	1	1	1	1	0	1	5.0
Plot 9	827	12.05	101	Low	56	529354	6852231	240	15	10	5	2	2	9	15.3	1.3	0.6	0.2	10.1	16.0	0	0	58.8	230	1	1	1	1	1	1	45.2
Plot 10	827	42.71	101	Mod	56	529423	6851707	185	7	4	4	0	1	4	22.8	5.3	65.4	0.0	0.1	0.5	0	3	21	82	1	1	1	0	0	1	4.3
Plot 11	827	12.05	101	Low	56	529646	6851559	200	5	6	5	1	3	8	21.1	5.1	48.6	0.3	0.5	0.9	0	2	24	52	1	1	1	0	0	1	15.3
Plot 12	827	66.6	101	High	56	529025	6851480	260	12	13	4	4	4	13	23.2	1.6	8.5	0.5	5.5	18.1	0	5	69	38	1	1	1	1	1	1	8.4
Plot 13	827	12.05	101	Low	56	528984	6851154	175	15	7	6	3	3	15	3.2	0.9	25.5	0.4	0.5	2.0	0	9	68.8	62	1	0	1	1	0	1	43.2
Plot 14	1073	1.38	101	Mod	56	529077	6851116	180	5	8	11	1	1	4	24.3	0.9	23.1	0.2	0.2	0.4	2	5	8.6	28	1	1	1	1	1	1	25.8
Plot 15	1073	1.38	101	Mod	56	529006	6851001	25	9	8	10	6	1	8	26.9	1.1	16.7	4.5	0.1	0.8	0	6	28	26	1	1	1	1	1	1	40.6
Plot 16	0	4.66	101	88B Hoop Plant	56	529430	6850719	150	10	2	3	6	2	5	63.0	0.2	25.2	0.6	0.2	0.5	0	4	67	6	1	1	1	1	1	1	1.0
Plot 17	770	1.63	101	High	56	529795	6854421	90	15	16	4	7	3	15	67.6	7.1	5.3	1.4	5.0	33.7	0	6	35	132	1	1	1	1	0	1	0.0
Plot 18	827	42.71	101	Mod	56	530012	6854364	45	18	18	4	4	1	15	47.9	7.5	2.7	0.8	0.2	5.1	1	0	90.6	32	1	1	1	1	0	1	1.6
Plot 19	827	66.6	101	High	56	530031	6854114	330	15	15	4	4	4	7	38.5	18.9	0.6	0.9	15.4	21.3	1	2	94.6	28	1	1	1	1	1	1	0.1
Plot 20	1302	2.76	101	High	56	530678	6850769	90	13	8	4	1	3	13	50.2	6.4	0.6	0.1	0.6	34.7	1	0	72	22	1	1	1	1	1	1	0.0
Plot 21	1302	2.76	101	High	56	530672	6850906	220	14	10	2	4	5	13	39.4	21.1	0.3	0.4	0.7	43.0	2	0	82	61	1	1	1	1	1	1	0.0
Plot 22	1302	2.76	101	High	56	530635	6851029	220	11	11	1	3	4	13	7.1	3.0	0.2	0.3	0.4	65.2	2	0	98.2	31	1	1	1	1	0	1	0.0
Plot 23	827	66.6	101	High	56	530353	6851219	220	21	10	4	2	2	10	51.6	3.5	1.0	0.5	5.1	4.8	1	0	84	50	1	1	1	1	1	1	0.4
Plot 24	1302	0.87	101	Mod	56	530050	6848453	20	13	4	4	1	3	11	9.7	60.3	0.5	0.2	8.1	1.9	0	1	48	20	1	1	1	1	1	1	21.3
Plot 25	1302	0.87	101	Mod	56	529909	6849060	280	16	10	1	4	5	11	18.2	71.4	0.2	0.4	5.9	1.6	0	0	65	20	1	1	1	1	0	0	0.3
Plot 26	827	4.71	101	Mod	56	529991	6849060	30	12	7	5	5	4	9	25.2	55.8	1.6	0.5	5.4	2.6	0	0	58	8	1	1	1	1	0	1	6.0
Plot 27	0	68.81	101	99 Cleared	56	529510	6850668	100	0	0	2	1	0	0	0.0	0.0	75.0	0.1	0.0	0.0	0	0	10	0	0	0	0	0	0	0	25.0
Plot 28	827	66.6	101	High	56	528158	6852159	30	15	12	4	2	1	14	38.7	22.9	5.8	0.3	0.2	2.7	0	0	78	10	1	1	1	1	1	1	5.3
Plot 29	827	42.71	101	Mod	56	530081	6849997	310	16	10	2	4	3	17	29.2	66.0	0.2	0.7	0.3	5.2	3	1	97	22	1	1	1	1	0	1	0.2
Plot 30	0	7.9	101	88A Euc Plant	56	529592	6849249	200	6	2	1	4	0	0	20.9	0.3	0.1	0.5	0.0	0.0	0	0	12	18	1	1	1	1	1	1	93.3
Plot 31	827	42.71	101	Mod	56	529032	6850496	140	8	3	6	7	2	4	38.5	0.3	5.8	0.9	0.3	0.4	9	1	93	3	1	1	1	1	1	1	0.8
Plot 32	0	68.81	101	99 Cleared	56	529083	6850118	180	0	0	3	2	1	0	0.0	0.0	4.2	0.4	0.1	0.0	0	0	70	0	0	0	0	0	0	0	40.1
Plot 33	827	42.71	101	Mod	56	529067	6850243	25	5	0	5	2	1	3	21.2	0.0	20.8	0.2	0.2	0.3	2	2	90.6	0	2	2	2	2	2	1	25.4
Plot 34	0	4.66	101	88B Hoop Plant	56	529414	6849448	300	5	5	2	5	1	3	60.4	0.5	2.2	0.5	0.2	0.3	0	0	81	0	0	0	0	1	1	1	7.1
Plot 35	0	7.9	101	88A Euc Plant	56	529545	6849555	320	4	0	1	1	0	3	10.9	0.0	0.1	0.1	0.0	0.3	0	1	44	0	1	1	1	1	1	1	80.8
Plot 36	0	7.9	101	88A Euc Plant	56	529537	6849542	140	11	2	1	3	1	5	22.2	0.5	0.2	0.3	0.2	1.0	0	0	58	0	0	0	0	0	1	1	88.1

Appendix F Threatened flora survey strategy

Table 21 Threatened flora survey strategy

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acacia bakeri	Marblewood	Marblewood grows in or near lowland subtropical rainforest, in adjacent eucalypt forest and in regrowth of both.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Acalypha eremorum	Acalypha	Subtropical rainforest, dry rainforest and vine thickets.	YES	YES							YES	YES	YES	YES
Archidendron hendersonii	White Lace Flower	White Lace Flower occurs in riverine and lowland subtropical rainforest, littoral rainforest, coastal cypress pine forest and their ecotones. It is found on a variety of soils including coastal sands and those derived from basalt and metasediments.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Arthraxon hispidus	Hairy Jointgrass	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	YES	YES	YES	YES							YES	YES
Baloghia marmorata	Jointed Baloghia	In NSW, Jointed Baloghia is found in subtropical rainforest, notophyll vine forest and wet sclerophyll forest on soils derived from basalt. Found between 150m and 550m above sea level.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Belvisia mucronata	Needle-leaf Fern	Forms small clumps on trees or rocks in dry rainforest or along creeks in moist open forest. Occurs in low numbers at all sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bosistoa transversa	Yellow Satinheart	Three-leaved Bosistoa grows in wet sclerophyll forest, dry sclerophyll forest and rainforest including highly disturbed habitat up to 300 m in altitude.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Brachyscome ascendens	Border Ranges Daisy	Montane shrubland on clifftops and benches in thin, rocky soils of basaltic origin.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bulbophyllum globuliforme	Hoop Pine Orchid	Grows on Hoop Pines in upland subtropical rainforest. It is usually found on the upper trunk and branches of the Hoop Pines which protrude from the general rainforest canopy.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cassia marksiana	Cassia marksiana	Found in littoral and riverine rainforest, and in regrowth vegetation on farmland and along roadsides. It prefers more fertile soil-types and is often found in low and flat sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Choricarpia subargentea	Giant Ironwood	Giant Ironwood is found in dry rainforest regrowth consisting of thickets growing in steeply sloping paddocks on basalt-derived soil as well as in sub-tropical and warm temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Clematis fawcettii	Northern Clematis	Drier rainforest, usually near streams.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Coatesia paniculata	Axe-Breaker	Axe-Breaker is found in dry subtropical rainforest and vine scrub, often along rivers.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Corchorus cunninghamii	Native Jute	Occurs in ecotones between wet eucalypt forest and dry to dry-subtropical rainforest on sheltered slopes and gullies, and grassy, open forest on exposed slopes and ridges.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Corokia whiteana	Corokia	The inland populations are found at the boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cryptocarya foetida	Stinking Cryptocarya	Found in littoral, warm temperate and subtropical rainforest, wet sclerophyll forest and Camphor laural forest usually on sandy soils, but mature trees are also known on basalt soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cupaniopsis serrata	Smooth Tuckeroo	Rocky hillsides and subtropical and dry rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cynanchum elegans	White-flowered Wax Plant	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cyperus rupicola	Cliff Sedge	Cliff Sedge grows amongst rocks on the exposed tops of cliffs and on cliff faces or at the base of cliffs, near forest.	YES	YES	YES								YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cyperus semifertilis	Missionary Nutgrass	Occurs in open forest dominated by White Mahogany and wet sclerophyll forest with Sydney Blue Gum and Brush Box.	YES	YES									YES	YES
Davidsonia jerseyana	Davidson's Plum	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m).Many trees are isolated in paddocks and on roadsides in former rainforest habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Davidsonia johnsonii	Smooth Davidson's Plum	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m).Many trees are isolated in paddocks and on roadsides in cleared land.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Dendrocnide moroides	Gympie Stinger	Occurs in lowland rainforest, especially in gaps or other disturbed sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Desmodium acanthocladum	Thorny Pea	Dry rainforest and fringes of riverine subtropical rainforest. On basalt-derived soils at low elevations. Much of its habitat has been cleared for agriculture.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Diospyros mabacea	Red-fruited Ebony	Usually grows as an understorey tree in lowland subtropical rainforest, often close to rivers. Soils are generally basalt-derived or alluvial.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Diploglottis campbellii	Small-leaved Tamarind	Confined to the warm subtropical rainforests of the NSW-Queensland border lowlands and adjacent low ranges.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Doryanthes palmeri	Giant Spear Lily	Giant Spear Lily occurs on exposed rocky outcrops on infertile soils or on bare rock.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Drynaria rigidula	Basket Fern	Grows on plants, rocks or on the ground, Usually found in rainforest but also in moist eucalypt and Swamp Oak forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Eidothea hardeniana	Nightcap Oak	The species occurs in upland warm temperate rainforest, usually near creeks.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Elaeocarpus sedentarius	Minyon Quandong	Warm temperate or subtropical rainforest, and where rainforest and wet eucalypt forest meet. Often associated with Brush Box.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Elaeocarpus williamsianus	Hairy Quandong	Subtropical to warm temperate rainforest, including regrowth areas where it has apparently regrown from root suckers after clearing. Soils are derived from metasediments.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra floydii	Crystal Creek Walnut	Warm temperate, subtropical rainforest or wet sclerophyll forest with Brush Box overstorey, and in and Camphor Laurel forest. The species can occur in disturbed and regrowth sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra hayesii	Rusty Rose Walnut	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils. The species occurs in regrowth and highly modified forms of these habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Occurs in subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Euphrasia bella	Pretty Eyebright	On the edge of cliffs near cool temperate rainforest with Antarctic Beech .The environment is wet but well-drained.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Floydia praealta	Ball Nut	Riverine and subtropical rainforest, usually on soils derived from basalt.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fontainea australis	Southern Fontainea	Southern Fontainea is found in lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest in the Nightcap Range.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Gossia fragrantissima	Sweet Myrtle	Dry subtropical and riverine rainforest. As it can coppice from roots left in the ground when rainforest is cleared, it	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		is found at several sites as isolated plants in paddocks or regrowth.												
Grammitis stenophylla	Narrow-leaf Finger Fern	Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Grevillea hilliana	White Yiel Yiel	White Yiel Yiel grows in subtropical rainforest, often on basalt-derived soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Hibbertia hexandra	Tree Guinea Flower	Tree Guinea Flower typically grows in heath, open forest or rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Hicksbeachia pinnatifolia	Red Boppel Nut	Subtropical rainforest, moist eucalypt forest and Brush Box forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Isoglossa eranthemoides	Isoglossa	Understorey of lowland subtropical rainforest, in moist situations on floodplains and slopes. Underlying soils are derived from basalt, metasediments or gabbro.									YES	YES	YES	
Lepiderema pulchella	Fine-leaved Tuckeroo	Lowland subtropical rainforest in NSW. Found on infertile metasediments, fertile basalts and backswamp alluvium in the Tweed Valley.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lindsaea brachypoda	Short-footed Screw Fern	Very moist habitats in subtropical or warm-temperate rainforest or palm forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Macadamia tetraphylla	Rough-shelled Bush Nut	Found in subtropical rainforest, usually near the coast.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Marsdenia longiloba	Slender Marsdenia	Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.	YES	YES									YES	YES
Melicope vitiflora	Coast Euodia	Coast Euodia grows in subtropical and littoral rainforest. All populations are thought to be small.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Myrsine richmondensis	Ripple-leaf Muttonwood	Subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil and alluvial deposits.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Flowers have been recorded in October and November, fruits have been observed from December to March.												
Niemeyera whitei	Rusty Plum, Plum Boxwood	Found in gully, warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest. It occurs on poorer soils in areas below 600 metres above sea level.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Oberonia complanata	Yellow-flowered King of the Fairies	This species grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes (including stabilised sands), stream-side areas, swampy forests and mangroves.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ochrosia moorei	Southern Ochrosia	Southern Ochrosia is found in riverine and lowland subtropical rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Owenia cepiodora	Onion Cedar	Subtropical and dry rainforest on or near soils derived from basalt.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ozothamnus vagans	Wollumbin Dogwood	Mostly recorded from open situations on the margins of, or within, wet sclerophyll forest, subtropical rainforest and cool temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Peristeranthus hillii	Brown Fairy-chain Orchid	Restricted to coastal and near-coastal environments, particularly Littoral Rainforest and the threatened ecological community Lowland Rainforest on Floodplain.									YES	YES		
Phyllanthus microcladus	Brush Sauropus	Usually found on banks of creeks and rivers, in streamside rainforest or dry rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Plectranthus nitidus	Nightcap Plectranthus	Grows on rocky cliff-faces and boulders, in the shelter and shade provided by the adjacent rainforest and dry rainforest. Co-occurs with and Crofton Weed.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pomaderris notata	McPherson Range Pomaderris	McPherson Range Pomaderris is known from rocky basalt ranges in montane heaths and scrubs or in scrubby rainforest on valley floors.							YES	YES	YES	YES	YES	
Psilotum complanatum	Flat Fork Fern	Grows in moist tropical or subtropical rainforest, or moist eucalypt forest.		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Randia moorei	Spiny Gardenia	Spiny Gardenis occurs in subtropical, riverine, littoral and dry rainforest. In NSW, Hoop Pine and Brush Box are common canopy species.It is found along moist scrubby water courses at altitudes up to 360 m asl, with most records below 100 m asl.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhodamnia rubescens	Scrub Turpentine	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhodomyrtus psidioides	Native Guava	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhynchosia acuminatissima	Pointed Trefoil	Pointed Trefoil is found in or near dry rainforest dominated by Hoop Pine.	YES	YES							YES	YES	YES	YES
Sarcochilus dilatatus	Brown Butterfly Orchid	Grows on trees in littoral rainforest, subtropical rainforest, dry rainforest and streamside forests, mainly at low to medium (up to 500m) altitudes. Plants favour Hoop Pine as a host.	YES	YES	YES									YES
Sarcochilus fitzgeraldii	Ravine Orchid	The Ravine Orchid grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m. Occasional clumps are found on the bases of fibrous-barked trees.										YES	YES	YES
Sarcochilus weinthalii	Blotched Sarcochilus	Rainforest, wet schlerophyll, dry rainforest and drier scrubs, often in isolated patches, from 300 to 900 m in altitude.Can occur on Basalt-capped plateaus, shelves and escarpments.									YES	YES		
Senna acclinis	Rainforest Cassia	Grows on the margins of subtropical, littoral and dry rainforests.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sophora fraseri	Brush Sophora	Brush Sophora is usually found in wet situations in wet sclerophyll forest or vine forest, often near rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Symplocos baeuerlenii	Small-leaved Hazelwood	Occurs in sub-tropical and warm temperate rainforest on less fertile soils derived from rhyolite.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Syzygium hodgkinsoniae	Red Lilly Pilly	Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Syzygium moorei	Durobby	Durobby is found in subtropical and riverine rainforest at low altitude. It often occurs as isolated remnant paddock trees.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Tinospora tinosporoides	Arrow-head Vine	Wetter subtropical rainforest, including littoral rainforest, on fertile, basalt-derived soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Uromyrtus australis	Peach Myrtle	Warm temperate rainforest on less fertile soils derived from rhyolite rock. Often associated with Coachwood	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Appendix G Threatened fauna survey strategy

Table 22 Threatened fauna survey strategy

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Amphibia	*Litoria brevipalmata*	Green-thighed Frog	Species	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Staged assessment proposed as described in section 1.6.1
Amphibia	*Mixophyes fleayi*	Fleay's Barred Frog	Species	Rainforest and wet eucalypt forest of the escarpment and foothills, usually close to gravely streams. The species occurs along stream habitats from first to third order streams (i.e. small streams close to their origin through to permanent streams with grades of 1 in 50) but is not found in ponds or ephemeral pools.	YES	YES	YES						YES	YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	TSC survey OK – species not present
Amphibia	*Mixophyes iteratus*	Giant Barred Frog	Species	Giant Barred Frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats
Amphibia	*Philoria loveridgei*	Loveridge's Frog	Species	This frog is dependent on high moisture levels, occurring in the headwaters of small streams and about soaks where ground-water is continually present and close to the surface. It favours subtropical and warm temperate rainforest and wet eucalypt forest, but also occurs in moist eucalypt forest where rocky outcropping creates surface water.	YES									YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats
Amphibia	*Assa darlingtoni*	Pouched Frog	Species	Pouched frogs live in cool, moist rainforest, including Antarctic Beech, or moist eucalypt forest in mountainous areas, mostly above 800 m but have been found as low as 300m.They spend most of the time in damp leaf litter, or under rocks and rotten logs.	YES	YES	YES						YES	YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	Species/ Ecosystem	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur.				YES	YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in summer and species identified onsite. 4 days survey conducted by ELA in July 2020 failed to confirm any breeding sites for the species.	Survey conducted in July by ELA inspecting all potential breeding trees. Only a single pair was identified, outside the inundation zone. Hollow-bearing trees within the disturbance footprint are unlikely to be breeding habitat for this species. No further survey proposed.
Aves	*Atrichornis rufescens*	Rufous Scrub-bird	Species	Rufous Scrub-birds are now confined to high-altitude (above 600m elevation) subtropical, warm temperate and cool temperate rainforests, and wet sclerophyll forests.	YES								YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period.	TSC survey OK - Species not present
Aves	*Carterornis leucotis*	White-eared Monarch	Species	In NSW, White-eared Monarchs occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: Species identified onsite by ELA in July 2020	Calculate credits in appropriate habitats
Aves	*Cyclopsitta diophthalma coxeni*	Coxen's Fig-Parrot	Species	Usually recorded from drier rainforests and adjacent wetter eucalypt forest but rarely seen due to its small size and cryptic habits. Also found in the wetter lowland rainforests that are now largely cleared in NSW.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 35.64 hrs total bird survey	TSC survey OK - Species not present
Aves	*Dasyornis brachypterus*	Eastern Bristlebird	Species	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	YES	YES	YES	YES	YES				YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33.33 hrs bird survey in survey period	TSC survey OK - Species not present
Aves	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Species/ Ecosystem	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.							YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: One eyie identified onsite and in-use in July 2020.	Calculate credits for breedong habitat
Aves	*Hieraaetus morphnoides*	Little Eagle	Species/ Ecosystem	Occupies open eucalypt forest, woodland or open woodland.								YES	YES	YES			Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Lophoictinia isura*	Square-tailed Kite	Species/ Ecosystem	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	YES								YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	TSC survey OK - Species not present
Aves	*Menura alberti*	Albert's Lyrebird	Species	Mainly occur in the wettest rainforests or wet sclerophyll forests with a wet understorey, often of rainforest plants. Higher densities of Albert's Lyrebirds occur in association with a canopy of eucalypts compared with rainforest lacking eucalypts (for equivalent climate), and in wet sclerophyll forest with greater weights of litter and logs and slower rates of litter decomposition.						YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	Calculate credits in appropriate habitats
Aves	*Turnix melanogaster*	Black-breasted Button-quail	Species	Preferred habitat includes drier low closed forests, including dry rainforests, vine forest and vine thickets, often in association with Hoop Pine, and Bottletree scrubs. have long been unclear, having been placed variously in their own order, or with the Galliformes or Gruiformes. Recent studies have shown that the button-quails are actually related to the gulls and terns and their relatives (Charadriiformes).	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 35.64 hrs total bird survey	TSC survey OK - Species not present
Aves	*Ninox connivens*	Barking Owl	Species/ Ecosystem	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland.		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species not identified onsite. No further survey proposed.	TSC survey OK - Species not present
Aves	*Ninox strenua*	Powerful Owl	Species/ Ecosystem	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.		YES	YES	YES	YES								Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species not identified onsite. No further survey proposed.	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Tyto novaehollandiae*	Masked Owl	Species/ Ecosystem	Lives in dry eucalypt forests and woodlands from sea level to 1100 m.					YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species identified onsite by TSC. Species not identified during breeding season and unlikely to be utilising hollow-bearing trees within disturbance footprint. No further survey proposed.	Survey OK - Species known from site but breeding habitat not present. No further assessment required.
Aves	*Tyto tenebricosa*	Sooty Owl	Species/ Ecosystem	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.					YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species identified onsite by TSC. Species identified at numerous sites during breeding season, however no pairs duetting unlikely to be utilising hollow-bearing trees within disturbance footprint. No further survey proposed.	Survey OK - Species known from site but breeding habitat not present. No further assessment required.
Mammalia - bats	*Chalinolobus dwyeri*	Large-eared Pied Bat	Species	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin, frequenting low to mid-elevation dry open forest and woodland close to these features.	YES										YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Miniopterus australis*	Little Bent-winged Bat	Species/ Ecosystem	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Only five nursery sites /maternity colonies are known in Australia.	YES	YES										YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Miniopterus orianae oceanensis*	Eastern Bentwing-bat	Species/ Ecosystem	Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	YES	YES										YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Mammalia - bats	*Vespadelus troughtoni*	Eastern Cave Bat	Species	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	YES										YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Myotis macropus*	Southern Myotis	Species	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around waterbodies and forest habitats Survey undertaken: 3 harp trap 14 ANABAT nights	Calculate credits in appropriate habitats
Mammalia - bats	*Pteropus poliocephalus*	Grey-headed Flying-fox	Species/ Ecosystem	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.										YES	YES	YES	Minimum survey requirement: Searches for camps Survey undertaken: 32 sites habitat assessment 61.95 hours spotlighting	Survey OK - breeding habitat not present
Mammalia - arboreal and terrestrial	*Cercartetus nanus*	Eastern Pygmy-possum	Species	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha 100 elliot trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights 1600 elliot trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and terrestrial	*Macropus parma*	Parma Wallaby	Species	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: None specified Survey undertaken: 80 cage trap nights 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and	*Petaurus norfolcensis*	Squirrel Glider	Species	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: None specified Survey undertaken: 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Mammalia - arboreal and terrestrial	*Phascolarctos cinereus*	Koala	Species/ Ecosystem	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	<u>Minimum survey requirement</u>: SAT surveys Camera traps spotlighting Call playback <u>Survey undertaken:</u> 45.64 person hours SAT at 32 sites 896 camera trap nights Spotlighting at 32 sites	Calculate credits - Request 'Important habitat' criteria
Mammalia - arboreal and terrestrial	*Planigale maculata*	Common Planigale	Species	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	<u>Minimum survey requirement:</u> 24 pitfall trap nights per 100 ha 100 elliot trap nights per 100 ha spotlighting <u>Survey undertaken:</u> 400 pitfall trap nights 1600 elliot trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and terrestrial	*Antechinus arktos*	Black-tailed Antechinus	Species	The species is found in cool subtropical cloud forest / rainforest comprising complex notophyll vine forest and simple microphyll fern forest featuring a low canopy, very dense vines and a rocky substrate.							YES	YES					n/a	Site not suitable. Species removed from assessment
Mammalia - arboreal and terrestrial	*Phascogale tapoatafa*	Brush-tailed Phascogale	Species	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west ot the divide.	YES	YES	YES	YES	YES	YES						YES	<u>Minimum survey requirement</u>: 10 camera traps per ha in suitable habitats. DPIE request plot data and habitat mapping to formalise approach (provided in this letter) <u>Survey undertaken:</u> 896 camera trap nights Spotlighting at 32 sites	Spotlighting survey appropriate for this species. Habitats not suitable. No further survey required.
Mammalia - arboreal and terrestrial	*Aepyprymnus rufescens*	Rufous Bettong	Species	Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	<u>Minimum survey requirement</u>: None specified <u>Survey undertaken:</u> 80 cage trap nights 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Cacophis harriettae*	White-crowned Snake	Species	Favours low to mid-elevation dry eucalypt forest and woodland, particularly areas with a varied and well-developed litter layer, where their prey of small lizards may be more abundant.	YES	YES	YES	YES					YES	YES	YES	YES	<u>Minimum survey requirement:</u> 24 pitfall trap nights per 100 ha spotlighting <u>Survey undertaken:</u> 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Reptilia	*Coeranoscincus reticulatus*	Three-toed Snake-tooth Skink	Species	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	YES	YES	YES	YES					YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Hoplocephalus bitorquatus*	Pale-headed Snake	Species	The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest.	YES	YES	YES								YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Hoplocephalus stephensii*	Stephens' Banded Snake	Species	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Stephens' Banded Snake is nocturnal, and shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	Calculate credits in appropriate habitats
Invertebrates	*Nurus atlas*	Atlas Rainforest Ground-beetle	Species	Low-elevation rainforest and wet eucalypt forest with a well-developed rainforest understorey.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment
Invertebrates	*Nurus brevis*	Shorter Rainforest Ground-beetle	Species	Subtropical and warm temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment
Invertebrates	*Phyllodes imperialis* southern subspecies	Southern Pink Underwing Moth	Species	The Southern Pink Underwing Moth is found in subtropical rainforest below about 600 m elevation.Potential breeding habitat is restricted to areas where the caterpillar's food plant, a native rainforest vine, Carronia multisepalea, occurs in subtropical rainforest.	YES	YES								YES	YES	YES	No survey requirement published	Conduct survey of host plant concurrently with flora surveys
Invertebrates	*Thersites mitchellae*	Mitchell's Rainforest Snail	Species	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment

Our Ref: DOC20/725252
Your Ref: 18011550

Ecological Australia
19 Bolton Street
Newcastle NSW 2300

Attention: Mr Alex Pursche

Dear Mr Pursche

RE: Clarrie Hall Dam Raising – Request for Confirmation of BAM Survey Approach

Thank you for your e-mail dated 3 September 2020 about the Clarrie Hall Dam Raising project seeking comments from the Biodiversity and Conservation Division (BCD) of the Environment, Energy and Science Group in the Department of Planning, Industry and Environment on the Biodiversity Assessment Method (BAM) survey approach. I appreciate the opportunity to provide input.

We have reviewed the gap analysis prepared by Ecological Australia (ELA) which was attached to your e-mail. The gap analysis outlines the proposed survey strategy to address the BAM and seeks confirmation from the BCD on the final survey approach.

We have addressed your specific requests below:

- *DPIE Action 1: We request DPIE approve the threatened flora survey strategy detailed in Section 4.3 of this letter.*

  We have reviewed section 4.3 and agree with the proposed approach.

- *DPIE Action 2: We request DPIE approve the proposed amphibian sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 of this letter.*

  We have reviewed the proposed amphibian sub-sampling approach and agree with the proposed approach.

- *DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described in Section 4.4.2 of this letter, and that no further assessment is required.*

  For glossy black-cockatoo, I understand that the species was identified on numerous occasions in March 2020 across the disturbance area. The Threatened Species Profile Database provides a four-step process to identify breeding habitat.

The information provided indicates that ELA conducted an inspection of all hollow-bearing trees within the disturbance footprint during the breeding season, to consider whether any of these trees were currently in use.

ELA then concluded that, '*In the absence of any formal guidelines on the occupancy of the species, and given the lack of individuals identified (only one pair), it is unlikely that more than one of the hollow-bearing trees are used for breeding*'.

It is not clear whether the four-step process of identifying breeding habitat for this species has been completed or not, as the above statement is not definitive.

Step three of that process requires that any identified potential hollows are monitored during the breeding season to determine if breeding is occurring on the site.

Either the required monitoring has occurred, and a conclusion can be made, or further survey work may be required. Further clarification will be required in the preparation of the Biodiversity Development Assessment Report (BDAR).

In relation to the forest owls, we note the field work undertaken to date and agree no further survey work is required. However adequate justification will need to be provided in the BDAR that survey work has been undertaken to establish breeding habitat on site.

- *DPIE Action 4: We request DPIE approve the bat assessment approach described in Section 4.4.3 of this letter, and that no further field studies are required.*

  The *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018) is currently being updated.

  However, we note that the ELA proposal is to not undertake any bat surveys as the *Myotis macropus* is already known from the site and the habitat for the other four candidate microchiropteran bats is not considered to be present.

  We do not support ruling out the four candidate microchiropteran bats based on habitat. Surveys will need to be undertaken in accordance with the survey guidelines to verify the absence/presence of the candidate species.

  Please note that in accordance with section 6.4 of the BAM, a species polygon will need to be provided for all confirmed species credit species.

  We are happy to liaise with ELA to ensure the survey requirements and species polygons adequately reflect the BAM and the soon-to-be updated guideline.

- *DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala.*

  Please note that while koalas are currently listed as a dual credit species in the Threatened Biodiversity Data Collection (TBDC), they should be treated as a species credit species. Potential koala habitat is any vegetation community that contains one or more koala feed/use trees. Please refer to the list of koala feed/use trees in the *State Environmental Planning Policy (Koala Habitat Protection) 2019* and *A review of koala tree use across New South Wales* (OEH, 2018).

  The presence/absence of koalas is required to be confirmed within the potential koala habitat on the subject land through targeted survey and the level of survey effort justified in the BDAR. Please note that scratch marks are not considered to be reliable indicators of koala presence.

The koala species polygon should be mapped to the extent of the Plant Community Type (PCT) (containing one or more koala use/fee trees, as detailed above) in which presence was confirmed. Connectivity between PCTs with confirmed koala presence must be considered in the overall extent of the species polygon, with justification for the decisions provided in the BDAR. Please note, we are currently developing a BAM survey guide for the koala and as such this advice may change. We would be pleased to discuss this further before the BDAR is finalised or if you require further guidance specific to this site.

- *DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale based on previous survey effort conducted by TSC, and lack of existing suitable habitats.*

  We have reviewed the information provided and agree that enough survey work has been completed for the brush-tailed phascogale.

- *DPIE Action 7: We request DPIE confirm no further reptile surveys required based on previous survey effort conducted by TSC*

  We have reviewed the information provided and agree that enough survey work has been completed for reptiles.

If you have any questions about this advice, please do not hesitate to contact Mr Krister Waern, Senior Operations Officer, at krister.waern@environment.nsw.gov.au or 6640 2503.

Yours sincerely

29 September 2020

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

B.2 Item 2

Lyrebirds at Clarrie Hall Dam in regard to the BDAR

Designated impact within the BDAR

Within the Biodiversity Development Assessment Report (BDAR), it was reported that Albert's lyrebird (*Menura alberi*) would lose 130.88 ha of habitat due to the proposed raising of Clarrie Hall Dam (CHD). This 130.88 ha equates to 4186 biodiversity credits. The Albert's lyrebird is listed as a 'species credit species' under the Biodiversity Assessment Method. Table 38 (page 99) of the BDAR states that, 'All vegetation zones are considered habitat except for Zone 4 827 Low'.

The four vegetation types within the disturbance zone include (taken from Table 53 of the BDAR):

Table 53 of the BDAR: Direct impacts to native vegetation.

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
770	Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion	Northern Warm Temperate Rainforests	Rainforests	3.7
827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast	North Coast Wet Sclerophyll Forests	Wet Sclerophyll Forests (Shrubby sub-formation)	134.53
1073	Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	North Coast Wet Sclerophyll Forests	Wet Sclerophyll Forests (Shrubby sub-formation)	1.38
1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	Subtropical Rainforests	Rainforests	3.13

There was 11.86 ha of PCT 827 that was designated as having Low condition (Table 56 of the BDAR) and this was excluded as lyrebird habitat.

Previous survey effort

During the preliminary impact assessment surveys undertaken at CHD, Tweed Shire Council (TSC) surveyed 14, 250 m-long transects within forest that falls within the disturbance zone and 8 transects within forest that fall outside the disturbance zone. Each transect was surveyed three times. Additionally, a camera trap was located at each location for a period of two weeks. Multiple visits were made to each transect. During the surveys, one lyrebird was detected via a camera trap approximately 115 m from the

disturbance zone (Figure 1), on the eastern side of CHD. The whole disturbance zone was also walked by Eco Logical for the purpose of conducting a flora survey during October and November, 2020.

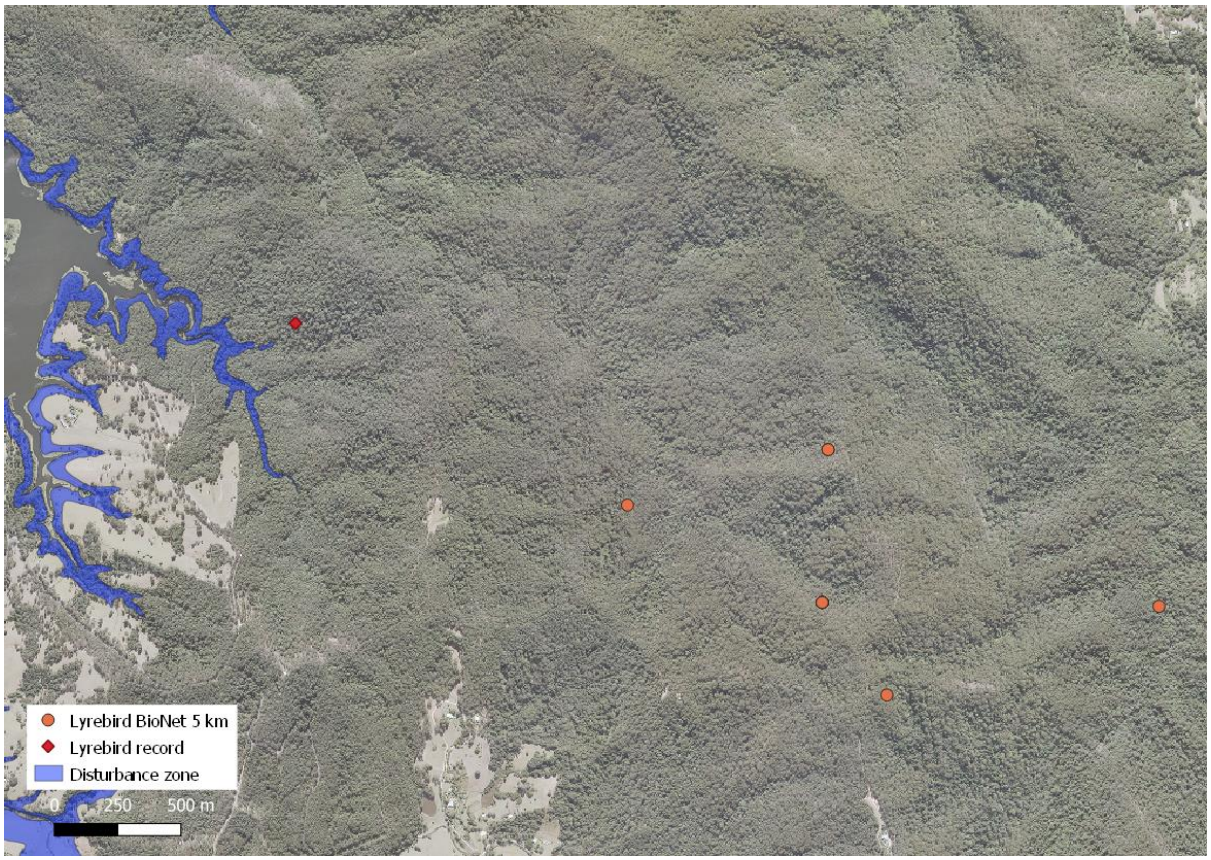

Figure 1. The location (within 20 m) of the lyrebird detection at Clarrie Hall Dam (red diamond) with other nearby sightings taken from BioNet.

Habitat preferences

There are only a small number of peer-reviewed scientific publications that mention habitat preferences of the Albert's lyrebird and there are no known studies that have quantified habitat selection by the species. Publications before the 1990s dominate literature and mention occurrences and associated habitat type (Higgins et al. 2001). In summary, the species has been mostly found in rainforest and wet sclerophyll forest with a moist understorey (Higgins et al. 2001). Specifically, higher densities of Albert's lyrebird have been reported where habitat contains deep litter and logs with a moist ground layer.

Because of the lack of studies that have focused on habitat selection of Albert's lyrebird and the often generalised habitat associations, Tweed Shire Council interviewed two ecologists who have extensive experience with the species. David Charley (DC) is an

ecologist that has much experience surveying birds within the Tweed Shire and South-East Queensland. He currently is contracted by TSC to conduct regular lyrebird monitoring surveys within the Tweed shire. In regard to habitat preference of Albert's lyrebird, DC stated that he has found that the species prefers wet ecosystems - rainforest or very moist wet sclerophyll forest - and uses this habitat as a core part of their small home range. The species will roam outside the core habitat into dryer habitat, especially in wetter climatic conditions and outside the breeding season. DC mentioned that home range size varies with productivity and around Mt Nullum and Numinbah home range size is approximately 4-6 ha in size.

TSC also interviewed Fiona Backhouse, a PhD student at the Western Sydney University, who is currently studying the species, in areas that include the Tweed Shire. While her research focuses primarily on vocalisation within the species, she stated that densities of Albert's lyrebird appeared higher where there was extensive rainforest and that home ranges were relatively small.

In summary, it appears that from reviewing literature and interviewing researchers currently studying the Albert's lyrebird, the species prefers rainforest and a very wet ground layer with logs and deep leaf litter. Surrounding habitat within a home range is suboptimal.

Survey effort

DC stated that the species is reliably sampled using camera traps all year round, however, the species may demonstrate avoidance to humans. The area and width of the proposed disturbance zone were described to DC, who felt that with the effort made by TSC, the species would have been detected if it occupied the narrow disturbance zone.

Likelihood of occupancy

Based on expert opinion and literature Albert's lyrebird home ranges should contain patches of rainforest. While there are numerous rainforest gullies that run into the disturbance zone, many have steep sides that limits the extent of surrounding rainforest. The steep topography also results in drier soil, which provides unfavourable foraging habitat for the Albert's lyrebird. Hence, it is unlikely that lyrebird occupy these areas. Survey effort and the associated lack of sightings within the disturbance zone support the idea that habitat for this species is mostly lacking within the disturbance zone.

The location where the Albert's lyrebird was sighted is within a southerly facing slope with a gully positioned at the bottom of the slope (see Figure 2). The gully runs into the disturbance zone, which coincides with Bangalow palm rainforest. The slope provides a moist environment with associated rainforest and wet sclerophyll forest. Based on habitat features and topography, an estimate of likely occupancy associated with the lyrebird sighting has been made (Figure 2). The area of likely occupancy that overlaps the disturbance zone is 0.55 ha. It is also possible the adjacent to-be-inundated rainforest that extends southward is also occupied by Albert's lyrebird, which is an additional 2.27 ha. It is likely that there is a total 2.82 ha of Albert's lyrebird habitat within the disturbance zone.

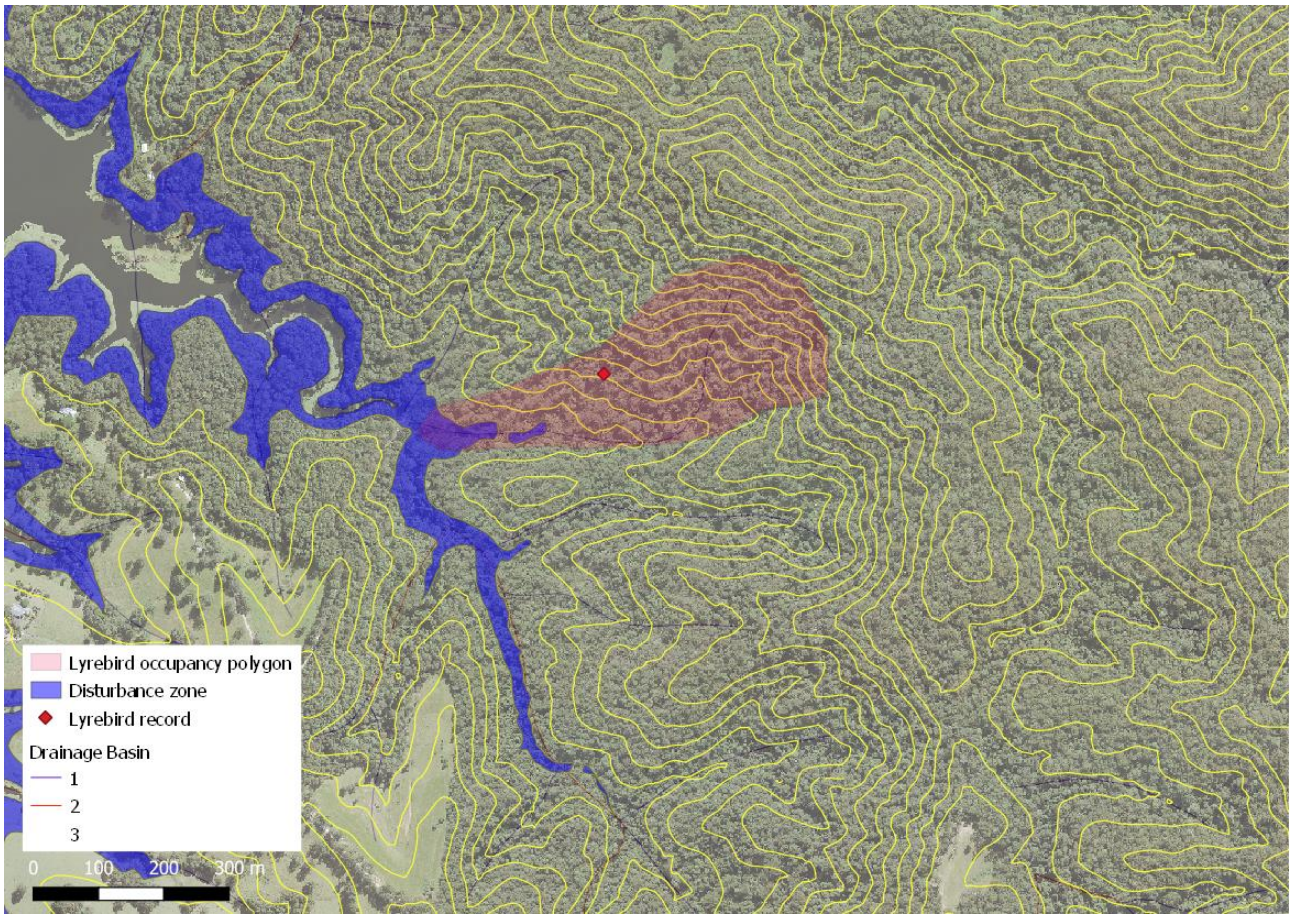

Figure 2. Estimated lyrebird occupancy at Clarrie Hall Dam and overlap with the disturbance zone.

BDAR process

The BDAR requires supporting literature to justify the inclusion of 130.88 ha of lyrebird habitat within the disturbance zone. The BAM requires a targeted survey or an expert

report to confirm presence of a species credit species. Or alternatively, the proponent assumes the species is present. Considering that suitable surveys have already occurred within the disturbance zone without species occurrence, there is a valid reason to exclude the Albert's Lyrebird from the calculator. Additionally, if further assessment of the Albert's lyrebird habitat is required, the assessor must use literature or other evidence to determine microhabitat requirements of the species. Or an expert report is compiled.

Conclusion

Literature and researcher opinion suggests that rainforest/very wet sclerophyll forest and a wet ground layer with logs and deep leaf litter is a core component of the species' home range. This habitat is largely missing from the disturbance zone and conducted surveys support the idea that Albert's lyrebird home range does not occupy most of this area.

Bibliography

Backhouse, F., Dalziell, A.H., Macgrath, R.D., Rice, A.N., Crisologo, T.L. and Welbergen, J.A. (2020). Differential geographic patterns in song components of male Albert's lyrebird. Ecology and Evolution. DOI: 10.1002/ece3.7225.

Higgins, P.J., Peter, J.M. and Steele, W.K. (2001). Handbook of Australian, New Zealand and Antarctic Birds. Volume 5. Flycatchers to Chats. Oxford University Press, Melbourne. ISBN: 0195532589.

David Hannah

From: David Hannah
Sent: Tuesday, 21 February 2023 5:31 PM
To: David Hannah
Cc: David Hannah
Subject: FW: BCD Response - Meeting re Draft BDAR on 1 July 2021 - Clarrie Hall Dam project

-----Original Message-----
From: Dimitri Young [mail to:Dimitri.Young@environment.nsw.gov.au]
Sent: 14 July 2021 3:50 PM
To: David Hannah [mail to:DHannah@tweed.nsw.gov.au]
CC: Krister Waern [mail to:Krister.Waern@environment.nsw.gov.au]
Subject: BCD Response - Meeting re Draft BDAR on 1 July 2021 - Clarrie Hall Dam project

CAUTION! External Sender
Dear Mr Hannah

Thank you for meeting with the Biodiversity and Conservation Division of the Department of Planning, Industry and Environment on 1 July 2021 to discuss the draft Biodiversity Development Assessment Report (BDAR) results for the project to raise the wall of the Clarrie Hall Dam. I appreciate the opportunity to provide further early input.

During our meeting we used the term microhabitats when discussing candidate species. For clarity, although microhabitats can be used to identify suitable habitat, the term 'microhabitats' is more clearly referenced in section 6.4.1.17 of the Biodiversity Assessment Method 2017 (BAM) in relation to identifying candidate species credit species for further assessment.

As discussed, once the candidate species credit species for further assessment have been determined, there are several relevant sections in the BAM in relation to how these candidate species credit species are assessed as set out below:

- *Section 6.4.1.21 of the BAM states that an assessor must establish whether each species credit species is present, or is likely to use suitable habitat on the subject land by either assuming the species is present, or undertaking a threatened species survey, or obtaining an expert report.*
- *Section 6.4.1.24 of the BAM states that where appropriate surveys have been undertaken and the species credit species is not present, no further assessment is required.*
- *Section 6.4.1.26 of the BAM states that where a survey confirms that a species credit species is present, or it is assumed to be present, then the assessor must prepare a species polygon.*
- *Section 6.4.1.27 of the BAM states that the species polygon must identify the suitable habitat for a species credit species*.

The accredited assessor appears to have assumed presence for several species credit species due to their habitat requirements being present and that the species has been recorded locally.

The accredited assessor has stated in the draft BDAR that the numerous species polygons are due to:

> *NSW and Commonwealth regulators will likely view Council owned lands within and connected to the development footprint as single units of habitat. This is especially the case where the habitat forms one*

contiguous corridor or patch of similar quality and type of habitat. For this project, the area in question forms over a 10,000 ha patch of vegetation and habitat with little to no features that distinguish between inside and outside the development footprint. This lack of distinction would likely weaken an argument to only consider a small portion of habitat inside the footprint compared with the area outside the footprint.

This may be appropriate for species that are cryptic and difficult to identify by survey, such as the Stephen's Banded Snake.

I understand the Tweed Shire Council has undertaken targeted surveys for species-credit species in the impact area and that these species were not recorded there. If the assessor is satisfied that these targeted surveys of the impact area occurred within the last five years and used approved survey guidelines or, where such guidelines were not available, agreed best-practice methods for that species, then that species would not require further assessment or a species polygon.

A species polygon is required for each species credit species confirmed or assumed to be present, however the species polygon does not need to encompass all of the associated Plant Community Type (PCT) if there is justification that parts of the PCT are not suitable habitat for the species credit species.

You should also be aware that the Biodiversity Conservation Regulation 2017 contains variation rules that provide some flexibility by allowing offsetting with a broader suite of biodiversity that is the same, or more threatened, than the biodiversity impacted. Use of the variation rules to allow offsetting with this broader suite of biodiversity must be approved by the decision maker through conditions of consent.

Before applying the variation rules, the proponent must demonstrate to the decision maker that they have been unable to find like-for-like credits after following the reasonable steps, set out in the **Ancillary rules: Reasonable steps to seek like-for-like biodiversity credits (PDF 58KB)**. In summary, these steps are:

- checking the credit register for the required credits
- contacting landholders on the landholder expression of interest register
- lodging an expression of interest on the credits wanted register.

Further information on the offset rules is available on our website at https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity-offsets-scheme/offset-obligations-and-credit-trading/offset-rules.

The BCD would be happy to have further discussions with the council to assist in finalising the draft BDAR.

If you have any questions, please contact Mr Krister Waern, Senior Operations Officer, on 6640 2503 or krister.waern@environment.nsw.gov.au.

Yours sincerely

Dimitri Young
Acting Director, North East Branch

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From: Krister Waern
Sent: Friday, 2 July 2021 9:25 AM
To: Dimitri Young
Subject: Clarrie Hall Dam further advice

Dimitri some thoughts for consideration….lets discuss at catch up

Hi David,

Thank you for the meeting on 1 July 2021 to discuss the draft BDAR results for Clarrie Hall Dam.

As discussed there are several relevant sections in the Biodiversity Assessment Method (2017) in relation to threatened species.

> *Section 6.4.1.24 states that where appropriate surveys have been undertaken and the species credit species is not present, no further assessment is required.*
> *Section 6.4.1.27 states that the species polygon must identify the suitable habitat for a species credit species*.

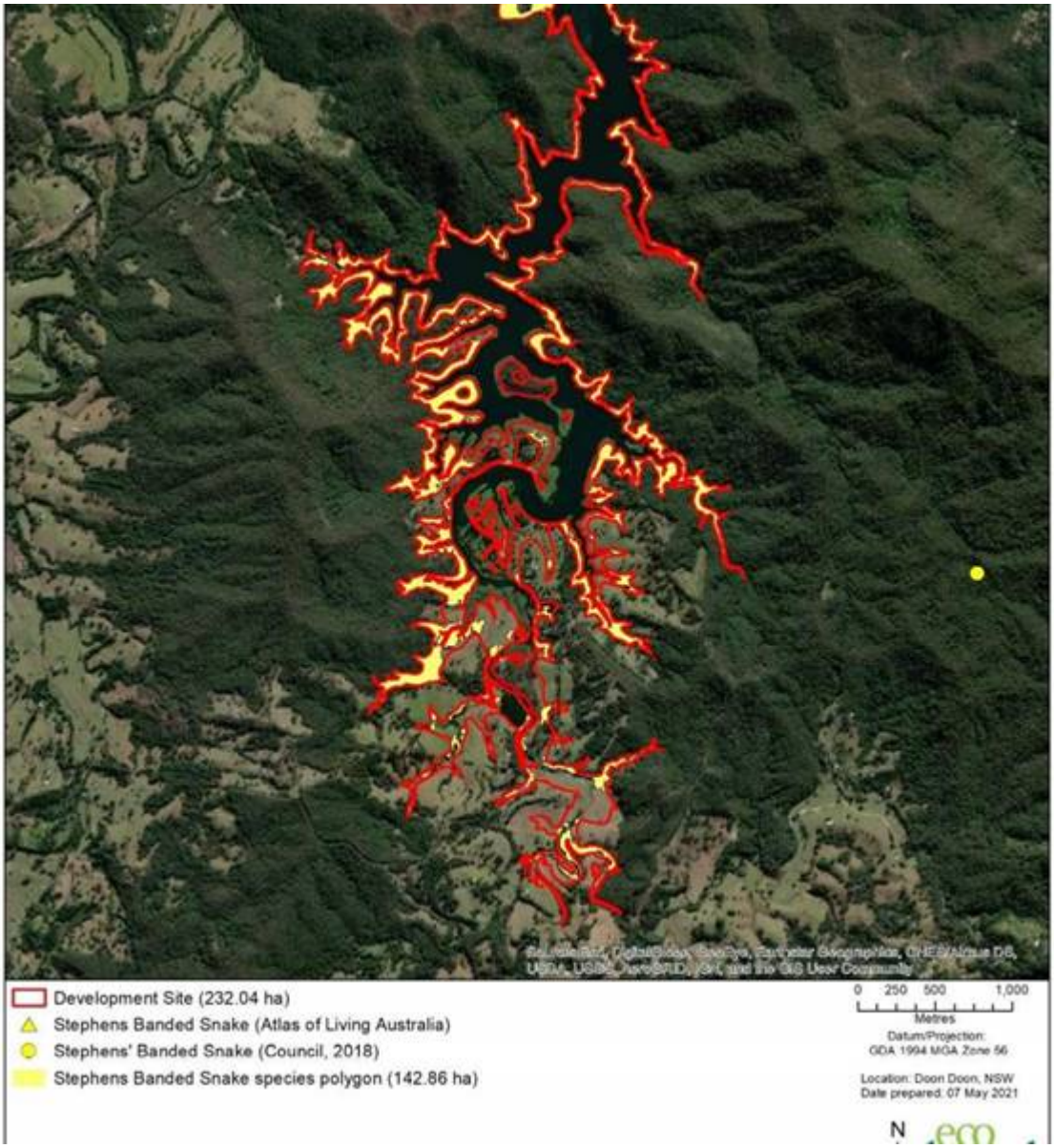
The species polygon does not need to encompass all of the associated PCT if there is justification that parts of the PCT are not suitable habitat for the species credit species.

During our meeting we used the term microhabitats. Although microhabitats can be used to identify suitable habitat, the term microhabitats is more clearly referenced in section 6.4.1.17 in relation to identifying candidate species credit species for further assessment.

ELA have stated that the numerous species polygons are due to,

> *NSW and Commonwealth regulators will likely view Council owned lands within and connected to the development footprint as single units of habitat. This is especially the case where the habitat forms one contiguous corridor or patch of similar quality and type of habitat. For this project, the area in question forms over a 10,000 ha patch of vegetation and habitat with little to no features that distinguish between inside and outside the development footprint. This lack of distinction would likely weaken an argument to only consider a small portion of habitat inside the footprint compared with the area outside the footprint.*

In 2016, surveys were undertaken by Council to further understand the biodiversity values of the dam and surrounding bushland areas. These surveys are close to the 5 year timeframe associated with a valid record. From the species polygon for the Stephens Banded Snake below, there is only one 2016 record more than 1km away from the development impact area. ELA have assumed presence due to that record and have provided a species polygon covering 142ha. A targeted survey in the development footprint may have been a better approach to determine presence/absence within the impact area.



Krister Waern
Senior Operations Officer, North East Planning Unit

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The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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David Hannah

From: David Hannah
Sent: Tuesday, 21 February 2023 5:36 PM
To: David Hannah
Cc: David Hannah
Subject: FW: RE: Clarrie Hall Dam raising - preliminary BDAR review

-----Original Message-----
From: David Hannah [mail to:DHannah@tweed.nsw.gov.au]
Sent: 24 June 2021 1:19 PM
To: Dimitri Young [mail to:Dimitri.Young@environment.nsw.gov.au],Krister Waern [mail to:Krister.Waern@environment.nsw.gov.au]
Subject: RE: Clarrie Hall Dam raising - preliminary BDAR review

Please find link to BDARV2. Please advise if there are any issues downloading the link.

https://databox-apps.opaas.net.au/shares/file/WT63XXVORpH/

regards
David Hannah

From: David Hannah
Sent: Thursday, 24 June 2021 1:12 PM
To: 'Dimitri Young' ; 'Krister Waern'
Subject: Clarrie Hall Dam raising - preliminary BDAR review

Hi Dimitri and Krister,

Council would appreciate your assistance in discussing and clarifying aspects of the draft BDAR V2 for the proposed Raising of Clarrie hall Dam (SSI REF).

Given the magnitude of the costs of the project credit liability and feasibility of finding credits for some entities, accurate and thorough justification for species presence/absence and level of impact is critical for this assessment.

Topics for discussion are as follows:

- The use of survey information to determine presence / absence of candidate species including of use of local data and scientific literature to refine habitat areas for some species

Attached is a memo prepared by Council issued to Eco Logical (ELA) titled: Memo Preliminary BDAR review additional information. This memo was provided following Council's review of a preliminary version of the BDAR issued in March 2021. We have concerns that habitat for species such as the Alberts Lyrebird, Long-nosed Potoroo and Stephens banded snake which were not recorded within the development site, but identified by ELA as occurring almost throughout the entire development footprint (140ha) is substantially overestimated. Council ecologists believe that based on survey effort and species habitat knowledge, habitat for Albert's lyrebird, Potoroo and Stephens banded snake

is either marginal or unlikely to occur. ELA's response titled: 18ARM11550 – Memo response and species recalc v)b (see attached) argued that unless there is a direct reliance on species specific microhabitat features, the NSW and Commonwealth regulators would perceive the connectivity of the vegetation as not precluding a species from occurring (see discussion on page 2 of ELA memo).

Council also asked ELA to clarify the BAM process in relation to calculating habitat polygons for *Myotis macropus* and *Philoria loveridgei* – the latter species being recorded outside the inundation area but the 50m habitat buffer resulting in an impact to this species. *Thersites mitchellae* (Mitchell's Rainforest Snail) was also misidentified by ELA in the preliminary BDAR resulting in habitat for this species occurring throughout the development footprint. At the request of Council, a species expert was engaged and the habitat polygon for MRS was reduced from approx. 140 ha to 0.82ha.

In summary, Council would like to discuss ELA's interpretation of the application of the BAM by the regulator in regards to the mapping of habitats .

Council's position is that we believe the Albert's Lyrebird, Potoroo and Stephens banded snake do not occupy the development site (or at the very least a much reduced area in relation to Albert's Lyrebird) because habitat is marginal, not because it is ideal, but unfilled or because the area is occupied and the species have been undetected. Based on our sampling effort and methodology, our findings suggest that the area is not occupied as determined by the use of ecologists who are suitable to conduct the work (Council and ELA). The BAM approach supports the use of fieldwork to determine the presence of a species, in contrast to extrapolation of records outside the development footprint based on broad-scale assumptions on species habitat selection. Eco Logical found our survey effort to be valid – and they didn't do further targeted surveys for these species. Also, ELA spent a considerable amount of time on site and not add records for these species.

- Understanding the calculation of populations and ranges in regards to assessment of SAII impacts to candidate species and significant impact assessments

Within the BDAR, there seems to be variability in approach to how flora populations are defined and assessed. A population seems to be assumed to be very localised which is very unlikely for plants, especially rainforest species dispersed by birds. However the assumed population range seems to vary from 500 m from the dam to 1.5 km to 5 km to 10,000 ha to sub-region to region. An example is the loss of one *Lepiderema* seedling as contributing to a SAII – noting that although this species is restricted in geographic distribution, is relatively widespread in the Tweed.

I will send the draft BDAR V2 using a file transfer site as further information to assist us in our discussion – noting that I appreciate you have limited time to review.

Regards
David Hannah
0410031775

B.3 Item 3

David Hannah

From: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Sent: Thursday, 15 July 2021 1:15 PM
To: David Hannah
Cc: Krister Waern
Subject: RE: Clarrie Hall Dam raising offsets

CAUTION! External Sender

Hi David
That accurately summarises our discussion.
Cheers
D

Dimitri Young
Senior Team Leader Planning, North East Branch

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From: David Hannah <DHannah@tweed.nsw.gov.au>
Sent: Friday, 9 July 2021 3:45 PM
To: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Subject: RE: Clarrie Hall Dam raising offsets

Hi Dimitri,

Thanks for your time today to discuss your thoughts on the information requirements relating to offsetting approaches to be discussed within the CHDR EIS. The take away message was that the role of the BDAR is to discuss and present the credit liability of the proposal and not discuss offsetting approaches and strategies.

The approach therefore would be as follows:

The EIS would include a section on Biodiversity impacts. Within this section, the proposed offsetting approach would be discussed and would include:

- A description of the type and amount of credits to be retired
- Potential options and issues associated with retiring credits
- A proposal to meet all or part of the credit liability through other measures such as land transfer to the NP estate
- A description of the biodiversity values of parcels proposed for land transfer (similar PCTs, Threatened Spp etc)
- Strategic value of these parcels to the NP Estate (e.g. strategic management advantages, percentage increase in adjacent reserves area etc) and
- Evidence of support from NPWS

I will be discussing this approach further with the NSW DPIE next week

Chs
David H

From: David Hannah
Sent: Tuesday, 6 July 2021 3:38 PM
To: dimitri.young@environment.nsw.gov.au
Subject: Clarrie Hall Dam raising offsets

Hi Dimitri,

This may be a question for BCD, DPIE Planning, or both…but interested in your thoughts

Could you clarify how much detail is required in the Clarrie Hall Dam raising EIS to ensure the option of retiring biodiversity credits through other mechanisms such as land transfer to National Park is part of the proposal.

Section 7.14(3) of the BC Act may allow the planning minister some discretion on how biodiversity credits are retired for SSI. Council owns very high biodiversity value land adjacent Mebbin National Park that has the same PCTs and many of the same threatened spp as those impacted by the proposal. Local National Park staff have also advised that these parcels are of strategic management importance to National Parks.

The draft BDAR does not provide much detail on offsetting other than the following paragraph. The yellow highlight is meant to draw attention to other offsetting sites and opportunities such as the lots at Mebbin…

In order to satisfy the offset requirement for residual and unavoidable impacts, Tweed Shire Council propose to establish biodiversity offsets on Council owned land surrounding Clarrie Hall Dam and other suitable parcels of Council owned land within the shire. The establishment of offset sites may be through establishing Biodiversity Stewardship Sites (BSS's) or through other mechanisms such as the transfer of high biodiversity value land to the National Park estate. A preliminary review has determined that many of the ecosystem credit requirements can be satisfied on retained lands at Clarrie Hall Dam. Similarly, species credits are likely to be available on these lands, given their immediate proximity to known areas of threatened species habitats within the development site. Should the total credit requirement be not available from Council owned land, Tweed Shire Council may source credits from other BSS's, the credit market, or payment to the Biodiversity Conservation Fund

thanks

David Hannah B/AppSc., PG/Dip Sc.
Senior Environmental Scientist

TWEED SHIRE COUNCIL

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B.4 Item 4

David Hannah

From: David Hannah
Sent: Monday, 7 March 2022 8:45 AM
To: Water Admin
Cc: Robert Siebert
Subject: FW: BCD Response - FW: BAM - 5 year survey data limit
Attachments: CHD Raising_Expiration of survey data.pdf

Hi Water Admin, could you please register this email to Clarrie Hall Dam Raising EIS (Brief WAT70)

Thanks
David H

From: David Hannah
Sent: Monday, 7 March 2022 8:44 AM
To: 'Dimitri Young' <Dimitri.Young@environment.nsw.gov.au>
Cc: Krister Waern <krister.waern@environment.nsw.gov.au>; Robert Siebert <RSiebert@tweed.nsw.gov.au>; 'Ben Cox' <Ben.Cox@planning.nsw.gov.au>
Subject: RE: BCD Response - FW: BAM - 5 year survey data limit

Hi Dimitri,

Please find attached for your consideration and approval a report titled: Request for the use of species survey data collected in 2016 for a BDAR submitted in 2022, Clarrie Hall Dam Raising (SSI 9458), March 2022.

Please call or email if you have any questions or require further clarification.

Regards
David Hannah

From: Dimitri Young [mailto:Dimitri.Young@environment.nsw.gov.au]
Sent: Tuesday, 10 August 2021 11:00 AM
To: Corporate Email <tsc@tweed.nsw.gov.au>
Cc: David Hannah <DHannah@tweed.nsw.gov.au>; Greg Lollback <GLollback@tweed.nsw.gov.au>; Krister Waern <krister.waern@environment.nsw.gov.au>
Subject: BCD Response - FW: BAM - 5 year survey data limit

CAUTION! External Sender

Dear Mr Hannah

Thank you for your e-mail below about the five year survey limit for data to support application of the Biodiversity Assessment Method 2020 (BAM 2020) to the Clarrie Hall Dam project, seeking comments from the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment. I appreciate the opportunity to provide input and apologise for the delay ion responding.

The reference to the five year survey limit is identified in the BAM 2020 Operational Manual Stage 1, section 3.4 where it states that,

> *If a field survey has been undertaken on the subject land within five years of the current proposal lodgement date, and that survey meets the requirements of the BAM, including this section of the Manual, the assessor can use the results in place of an onsite survey. The use of a past survey must be documented in the BAR. Surveys undertaken more than five years prior to the proposal lodgement date may be used to inform the*

assessment process but cannot be used in place of a species survey. This is to ensure results are current with respect to site condition, structural attributes and species presence. Note, where biodiversity values have changed dramatically within five years (e.g. land use has changed) onsite assessment is required.

This means that surveys undertaken less than five years prior to the lodgement date can be used if they meet BAM survey requirements unless biodiversity values have changed. Surveys undertaken more than five years prior to the lodgement date can be used to inform the assessment process.

If there are specific species surveys which will be more than five years old and the Tweed Shire Council wishes to use these results in place of a further species survey, then the council will need to provide further justification for the Department's consideration including:

- an overview of any changes that may or may not have occurred on the site in relation to site condition and structural attributes which may affect the species presence,
- description of the survey methods and effort
- indication of dates on which the surveys were conducted
- indication of the personnel who conducted the surveys and their skills/expertise in survey for the target species
- analysis of alignment with BAM survey requirements (as specified in the Threatened Biodiversity Data Collection and relevant survey guides published by the Department)

If there are any species that you are particularly concerned about we would be happy to review that information and provide more definitive advice.

If you have any questions about this matter, please do not hesitate to contact Mr Krister Waern, Senior Operations Officer, at krister.waern@environment.nsw.gov.au or 6640 2503.

Yours sincerely

Dimitri Young
Senior Team Leader Planning, North East Branch

Biodiversity and Conservation | Department of Planning, Industry and Environment
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From: David Hannah <DHannah@tweed.nsw.gov.au>
Sent: Tuesday, 20 July 2021 3:48 PM
To: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Cc: Greg Lollback <GLollback@tweed.nsw.gov.au>
Subject: BAM - 5 year survey data limit

Hi Dimitri,

We have discussed previously there being a 5 year limit on threatened species survey data. We are getting very close to that limit for some of the survey data collected for the Clarrie Hall dam raising proposal. Could you advise where in the legislation and/or BAM this is referred to and what flexibility, if any, there is to this 5 year limit.

The first fauna survey for the proposal was undertaken 21st November 2016 to 18th January 2017 in three x 6 day survey blocks over that period. There has been follow up targeted surveys in February 2017 and January 2018 for Mixophyes iteratus and ELA, Council's EIS consultants, have also completed targeted flora and fauna surveys in 2020 and early 2021.

If the EIS (including BDAR) was lodged prior to 18 January, 2022, would the survey data included in the BDAR meet the requirements of the BAM data limit timeframe? It is noted that we would need to update the BDAR from BAM2017 to BAM2020 if lodging after October 2021?

Happy to discuss if easier.

Thanks
David H

David Hannah B/AppSc., PG/Dip Sc.
Senior Environmental Scientist

TWEED SHIRE COUNCIL

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TWEED SHIRE COUNCIL

Request for the use of species survey data collected in 2016 for a BDAR submitted in 2022

Clarrie Hall Dam Raising (SSI 9458)

March 2022

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Introduction

Clarrie Hall Dam is located within the Tweed Shire, 15 kilometres (km) south-west of Murwillumbah on the north coast of New South Wales. It is operated by Tweed Shire Council (Council) as part of the drinking water supply network for the Tweed Shire. Council is proposing to increase the dam wall height by 8.5 metres (m) to provide a Full Supply Level (FSL) height of 70 m Australian Height Datum (AHD) (RL70 m), thereby increasing the capacity of the dam from 16,000 megalitres (ML) to approximately 42,300 ML (the proposal).

The proposal is designated State Significant Infrastructure (SSI 9458) under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) and has been declared a 'Controlled Action' under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The Secretary's Environmental Assessment Requirements (SEARs) issued April 2019 required that the impacts to biodiversity be assessed using the Biodiversity Assessment Method (BAM; OEH, 2017). The SEARs were updated on the 26 November 2021 in accordance with Planning Circular PS 21-005 and now require biodiversity impacts to be assessed using BAM 2020.

A draft Environmental Impact Statement (EIS) was issued by Council's EIS consultants on the 31 August 2021. The EIS has been reviewed and a scope of works is being prepared to address Council's review and finalise the EIS, including addressing the updated SEARs. As a result of the further time required to complete the EIS, some species survey data collected between November 2016 and January 2017 has reached the 5 year data expiration limit for use in the BAM Calculator as identified in the BAM 2020 Operational Manual Stage 1, section 3.4.

This report provides background and justification and seeks approval for the use of species survey data collected between November 2016 and January 2017 in the BAM and Biodiversity Development Assessment Report (BDAR) to be considered by the NSW Biodiversity & Conservation Division (BCD) of the Department of Planning and Environment (DPE).

Biodiversity assessment background

Council conducted a preliminary flora and fauna impact assessment for the dam raising commencing November 2016 (TSC, 2017). The NSW State Government published the BAM in May 2018, which was after Council completed their assessment. Council engaged Eco Logical Australia (ELA) in November 2019 to prepare the EIS, which included the preparation of a BDAR.

A gap analysis was undertaken by ELA to review surveys conducted by Council to ensure compliance with BAM. Council and ELA met with staff from BCD on the 28 May 2020 to discuss the biodiversity assessment approach for the EIS. A letter and gap analysis report outlining the proposed survey strategy was forwarded to the BCD on the 2 September 2020. BCD provided correspondence endorsing the survey approach dated 29 September 2020 (BCD Ref: DOC20/725252).

During 2020 and early 2021, ELA conducted all plant community type mapping, vegetation integrity assessments, and threatened plant surveys within the project disturbance footprint in accordance with the BAM 2017 and associated guidelines. For fauna, ELA identified that for the majority of threatened fauna (particularly mammals, reptiles, and birds), the existing survey effort conducted by Council from the 21 November 2016 to the 18 January 2017 was in excess of the minimum requirements for a site ~140 ha in size. The gap analysis did however identify that several survey gaps for fauna were present, in particular:

- detailed threatened amphibian surveys outside of the two main tributaries assessed by Council
- targeted surveys for breeding habitats for hollow-dependent fauna and

- targeted surveys for Microchiropteran bats.

Surveys to address these gaps were completed by ELA during 2020 and 2021. A draft BDAR was prepared by ELA and lodged with Council for review on the 31 August 2021.

A scope of work, is currently being prepared to update the BDAR to be consistent with the BAM2020. This scope includes addressing advice from BCD dated 4 September 2021 to Council regarding excluding species polygons for a species credit species that were not detected during surveys (Dimitri Young, BCD. Email to David Hannah, Tweed Shire Council. 3/9/2021).

Expiration of biodiversity survey data for use in the BAM

As noted above, delays in finalising the EIS has resulted in the fauna surveys conducted by Council during November 2016 to January 2017 exceeding the 5-year limit of data used for species surveys. The BAM 2020 Operational Manual Stage 1, section 3.4 states:

If a field survey has been undertaken on the subject land within five years of the current proposal lodgement date, and that survey meets the requirements of the BAM, including this section of the Manual, the assessor can use the results in place of an onsite survey. The use of a past survey must be documented in the BAR. Surveys undertaken more than five years prior to the proposal lodgement date may be used to inform the assessment process but cannot be used in place of a species survey. This is to ensure results are current with respect to site condition, structural attributes and species presence. Note, where biodiversity values have changed dramatically within five years (e.g. land use has changed) onsite assessment is required.

Council's correspondence with BCD (see Appendix A) indicated that data greater than five years-old can be used for a species survey (subject to those surveys meeting the BAM requirements as noted in correspondence) if justification for the use of such data demonstrates environmental conditions within the site have not changed between initial collection of data and time of submission.

The following sections provide a description of:

- survey methods and corresponding effort, dates and personnel involved in data collection
- the alignment of surveys to the BAM survey requirements and
- an overview of site conditions that may affect species presence – particularly in relation to the surveys at or reaching the 5 year survey data expiration timeframe.

Survey methods, effort and alignment to the BAM survey requirements

Tweed Shire Council – flora surveys

Vegetation community validation surveys and floristic data plots using methodologies described in the Framework for Biodiversity Assessment (OEH, 2014) were completed by Council between the 31 October 2016 and 2 February 2017 with additional surveys completed in June 2017 associated with the dam wall area.

Threatened flora species searches using the methodology described in the NSW Guide to Surveying Threatened Plants (OEH 2016) were undertaken during December 2016 (within the inundation area) and during March 2017 (outside the inundation area). Effort is summarised in Table 1 below.

Table 1: Tweed Shire Council vegetation community and flora species survey effort

Survey methodology	Dates of survey	Total effort (days)
Vegetation community validation & FBA plots	31/10/16 – 3/11/16, 8 – 11/11/16, 14/11/16, 16 – 18/11/16, 29/11/16 – 2/12/16	16
Targeted threatened species survey (within inundation area)	6 – 7/12/16, 13 – 16/12/16, 22/12/16	7
Targeted threatened species survey (outside inundation area)	7/3/17 (half-day), 13/3/17, 20, 22, & 24/3/17	4.5
Additional vegetation community validation & FBA plots around dam wall	7 – 8/6/17	2
Total		**29.5 days**

Vegetation surveys undertaken by Council were primarily conducted by Sally Cooper (BEnvSC) with assistance from Michael Corke (BSc), Michael Banks (BEnvSc), Tanya Fountain (BEnvSc), Aiden Sloman (BSc) and an external consultant Lui Weber (BSc.Hons). All surveyors were familiar with local vegetation and could identify communities and threatened species. Sally Cooper is an accredited BAM assessor.

Tweed Shire Council – fauna surveys

The majority of fauna surveys undertaken by Council were located at 32 stratified, randomly placed sites, with 19 occurring within the disturbance footprint and 13 sites located within close proximity, but outside the disturbance footprint. Surveys using these sites include terrestrial bird surveys, nocturnal surveys, reptile surveys, Spot Assessment Technique surveys (Phillips and Callaghan 2011) and pitfall, cage, funnel, Elliot and camera trapping. Targeted surveys focussing only on the proposed disturbance footprint included a jacana survey that covered the full extent of the dam, harp trapping, Anabat acoustic recordings and frog surveys. Two additional camera trapping periods, one within bushfire affected land on the north western side of the dam (discussed further below) and the other focusing on an anomalous quoll record on private land to the west of the dam took place in October 2019 and June-July 2021 respectively. A general search around the dam wall was also undertaken in July 2017. Fauna survey effort undertaken by Council is summarised in Table 2, with further details on survey effort also provided in ELA's gap analysis report (ELA, 2020), and explained in detail in TSC (2017; https://www.yoursaytweed.com.au/RaisingClarrieHall)

Council's fauna surveys were guided by the draft Threatened biodiversity survey and assessment: Guidelines for developments and activities (DEC, 2004) and were assessed by ELA during their gap analysis as being significantly in excess of the minimum requirement for diurnal birds, threatened reptiles, and mammals with the exception of an updated survey approach for amphibians, the Glossy Black-cockatoo and forest owls, and a revised bat assessment approach.

Council fauna surveys were conducted by David Hannah (BAppSc/PGDip SC), Ben Lewis (BSc), Greg Lollback (BSc/PhD), Mitchell Alward (BEnvPlan) and Leyton Tierney (BSc). David Hannah, Ben Lewis and Greg Lollback have extensive experience in surveying birds, mammals and frogs, while David Hannah and Ben Lewis also have extensive experience surveying reptiles. Ben Lewis also has extensive experience in conducting targeted surveys of threatened species such as potoroo, frogs and reptiles. David Hannah is an accredited BAM assessor

Table 2. Fauna survey work conducted by TSC between 2016 and 2021.

Date	Survey method	Replicates	Effort
21 November 2016-18 January 2017	Terrestrial bird plots (200 m x 100 m) for 20 min x 3 visits per plot	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	96
21 November 2016-18 January 2017	Nocturnal search plots (200 m x 100 m) for 20 min x 32 visits. Included nocturnal bird and mammal playback	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	60
21 November 2016-18 January 2017	Diurnal reptile/amphibian search plots 200 m x 50 m) for 20 min x 3 visits	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	64
21 November 2016-18 January 2017	Spot Assessment Technique – 30 trees within 200 m x 100 m	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	32
21 November 2016-18 January 2017	Pitfall trapping – 5 x 20 L buckets (4 m apart) connected with drift fence x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	400
21 November 2016-18 January 2017	Funnel trapping – 4 traps per site x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	400
21 November 2016-18 January 2017	Elliot trapping – 10 baited traps along 200 m transect x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	1600
21 November 2016-18 January 2017	Cage trapping – one baited (herbivore) trap x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	80
21 November 2016-18 January 2017	Camera trapping – 1 trap per site baited with herbivore and carnivore lures x 16 nights	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	896
March 2017	Jacana count via watercraft	Full extent of waterway	1
21 November 2016-18 January 2017	Harp traps – 1-2 night deployment	2 sites within the proposed disturbance footprint and one outside	>3
21 November 2016-18	Anabat acoustic recorder – 1-2 night deployment	12 sites within the proposed disturbance footprint and 4 sites outside, but within close	>14

Date	Survey method	Replicates	Effort
January 2017		proximity of the proposed disturbance footprint	
July 2017	Camera trapping –Each site baited with herbivore and carnivore lures x 16 nights	4 sites within disturbance footprint around dam wall	64
July 2017	General meandering search	Proposed wall construction footprint x 6 hours	6hrs
July 2017	Spot Assessment Technique – 30 trees	Proposed wall construction footprint	1
February 2017 and early 2018	Frog surveys	Various 2nd and 3rd order waterways within the proposed disturbance footprint and in the Doon Doon catchment	-
October 2019	Camera trapping –Each site baited with herbivore and carnivore lures x 16 nights	Eight sites within the bushfire affected area. Two sites within the disturbance footprint and 6 sites within close proximity of the proposed disturbance footprint	128
June/July 2021	Camera trapping –Each site baited carnivore lures x 32 nights	Six sites located in rainforest gullies in close proximity to historic quoll sighting. Two sites within the proposed disturbance footprint and 4 sites outside the proposed disturbance footprint, but within close proximity	192

All surveys were within and directly adjacent to the disturbance footprint (except for Jacana surveys which were from the water)

Eco Logical Australia – vegetation and threatened flora species surveys

ELA undertook vegetation validation surveys followed by vegetation integrity plots (VI plots) within vegetation zones determined by ELA in accordance with Section 5.3 of the BAM 2017. BAM vegetation surveys were undertaken within the development site by ELA Senior Ecologist and Accredited Assessor Liz Brown and ELA Ecologist Liam Scanlan on 13 to 17 April 2020, and 8 to 12 June 2020. One additional floristic plot was undertaken on 24 May 2021 by ELA Principal Botanist Alan House. A total of 37 full-floristic and vegetation integrity plots were surveyed to identify PCTs and TECs within the development site footprint in accordance with the minimum requirements of the BAM. This included six (6) VI plots undertaken in areas of non-remnant vegetation including regularly slashed grassy paddocks and parklands, *Araucaria cunninghamii* plantations and *Eucalyptus dunnii* plantations, for the purpose of collecting field data in areas that will not be assessed under the BAM.

Threatened flora surveys conducted by ELA were informed by the targeted threatened flora surveys conducted by Council at 16 gullies in the development site during 2016 (see Table 1 for Council survey dates), and targeted those species identified as candidate species by the BAMC. The survey plan by ELA was adapted from the NSW Survey Guide for the biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE, 2020), whereby the strategy for sites >50 ha was applied. A total of 442 point surveys were undertaken. Areas of cleared land, including paddocks and plantation were not assessed. In the case that threatened flora were identified, a search was undertaken from that vertex to the next, to capture any threatened flora that occurred between the two points within the development site. Due to the narrow area of disturbance along the shoreline of Clarrie Hall Dam, a secondary grid was not conducted as the meander survey by multiple observers adequately covered the target area, resulting in a total of 157.1 km of meanders between point surveys during the October / November 2020 survey period.

Incidental observations of threatened flora collected during other survey trips conducted by ELA (such as the site inspection in March 2020, and the VI plot surveys in June 2020) were also included in the flora survey, where appropriate.

All previous threatened flora records identified by Council in 2016 and 2017 were revisited, then incorporated into the results from the 2020 survey strategy. Where spatial data provided by Council correctly indicated the number of stems present for a species, or, where the number of stems in the field appeared to be less than the number estimated by Council, the higher count was carried forward into the BDAR assessment.

The survey methodology and adaptation of the survey guideline was discussed and approved through consultation with the BCD. Targeted surveys under the draft Survey guidelines for Australia's Threatened Orchids (Commonwealth of Australia, 2013) requires meanders and transects in suitable habitat for EPBC Act listed species; ELAs method is consistent with this requirement.

Flora surveys were conducted over a nine (9) day period from 26 October to 3 November 2020 by ELA ecologists Alan House, Lachlan Copeland, Liam Scanlan and Chris Ormond. The ELA survey team was specifically selected for their knowledge in species within the region.

The initial vegetation site inspection was carried out by ELA Senior Ecologist and Accredited Assessor Alex Pursche and ELA Ecologists Camille Roberge and Liam Scanlan. BAM vegetation surveys were undertaken within the development site by ELA Senior Ecologist and Accredited Assessor Liz Brown and ELA Ecologist Liam Scanlan on 13 to 17 April, and 8 to 12 June 2020. One additional floristic plot was undertaken on 24 May 2021 by ELA Principal Botanist Alan House.

Flora surveys were conducted by Alex Pursche (BSc(Hons)/PhD), Liam Scanlon (BSC (Hons)/BSC (Env Studies)), Liz Brown (BSc), Camille Roberge () Lachlan Copeland (BNatRes(Hons)/PhD), Chris Ormond (BSc) and Alan House (BBot(Hons)/PhD).

Table 3. Flora surveys conducted by ELA in 2020.

Date	Survey method	Replicates
March 2020	Validation survey points – rapid assessment that classifies dominant canopy, mid-storey and ground species. Disturbance level noted.	112 survey points
April 2020-June 2020	Vegetation integrity survey. 20m x 50 m and 20 m x 20 m plots.	37 plots
October 2020-November 2020	Threatened flora general searches within 20 m radius area and multiple observer meander surveys between point surveys	442 plots (56 ha) 57.1 km of meanders

Eco Logical Australia – fauna surveys

ELA used Council's fauna species surveys undertaken from the 21 November 2016 to the 18 January 2017 to partially or completely fulfil the requirements of the BAM 2017. This includes the use of Council's bird surveys, reptile surveys, nocturnal surveys, pitfall trapping, funnel trapping, Elliot trapping, cage trapping, camera trapping, SAT sampling, frog surveys, Anabat surveys and harp trapping.

To completely conform to survey guidelines, ELA undertook the following additional surveys in 2020 and 2021:

- amphibian habitat assessments and surveys
- Hollow Bearing Tree mapping, forest owl surveys using call broadcast methods, and surveys focusing on owl nesting habitat
- raptor habitat assessment
- glossy black-cockatoo (*Calyptorhynchus lathami*) nesting habitat searches

- microbat surveys
- Mitchell's rainforest snail (*Thersites mitchellae*) surveys, including an expert opinion report, and
- surveys for pink underwing moth (*Phyllodes imperialis*).

Signs and sightings for fauna were also recorded during flora and reconnaissance surveys.

Survey effort for fauna conducted by ELA is summarised in ELAs gap analysis report, and discussed in detail within s4.4. of the draft BDAR (previously supplied to BCD).

Fauna surveys and habitat surveys undertaken by ELA were conducted by Alex Pursche (BSc(Hons)/PhD), Tom Schmidt (BEnvSc & Man/BEnvSc(Hons)), Liam Scanlan (BSC (Hons)/BSC (Env Studies)), Loren Appleby (BSc), Daniel McKenzie (BSc (Hons)) and Jo Davis (BSc (Hons)). Both Alex Pursche and Tom Schmidt are accredited BAM assessors.

Summary of current and expired data

Vegetation and threatened flora data

ELA used the vegetation assessments and threatened flora species surveys completed by Council to inform their assessment process. ELA completed vegetation and flora surveys during 2020 and early 2021 in accordance with the BAM 2017. Council's vegetation and threatened flora data was used to inform ELAs assessment. In particular, counts of threatened plants were included into the BAM where these counts were greater than ELAs counts. The data was not used in place of ELAs species surveys as ELA revisited all of Council's threatened flora survey sites in addition to undertaking their own threatened flora surveys to address the BAM.

As a result, the plant community type mapping, vegetation integrity assessments, and threatened flora species surveys completed by ELA during 2020 and 2021 fulfil the requirements of the BAM for the proposal, and are all within the 5-year survey limit for data to support a BDAR.

Fauna species credit species surveys

Fauna species surveys undertaken by Council from November 2016 to January 2017 have been used to prepare the draft BDAR. This data has passed the five year expiration timeframe stipulated within OEH (2018).

Specifically, the Council surveys (listed in Table 2) that were used in the draft BDAR that have lapsed are:

- Diurnal bird surveys
- Nocturnal surveys
- SAT surveys
- Diurnal reptile surveys
- Pitfall/Elliot trap/majority of camera trap/funnel trap/cage trap surveys

Consequentially, it would be unlikely that the occurrence of the following candidate species credit species (nominated within the draft BDAR) would be adequately assessed if the above data could not be used in the draft BDAR (taken from Table 25 of the Eco Logical Australia 2021 and after consideration of distribution and habitat requirements):

Birds

Rufous Scrub-bird - Atrichornis rufescens
Coxen's Fig-Parrot - Cyclopsitta diophthalma coxeni;

Eastern Bristlebird - Dasyornis brachypterus;
Square-tailed Kite - Lophoictinia isura;
Black-breasted Button-quail - Turnix melanogaster;
Albert's Lyrebird - Menura alberti;
White-eared Monarch - Carterornis leucotis;

Reptiles
White-crowned Snake - Cacophis harriettae
Three-toed Snake-tooth Skink - Coeranoscincus reticulatus;
Pale-headed Snake - Hoplocephalus bitorquatus;
Stephen's Banded Snake - Hoplocephalus stephensii;

Mammals
Koala - Phascolarctos cinereus;
Long-nosed Potoroo - Potorous tridactylus;

Invertebrates
Atlas Rainforest Ground-beetle - Nurus atlas;
Shorter Rainforest Ground-beetle - Nurus brevis;

Has habitat changed?

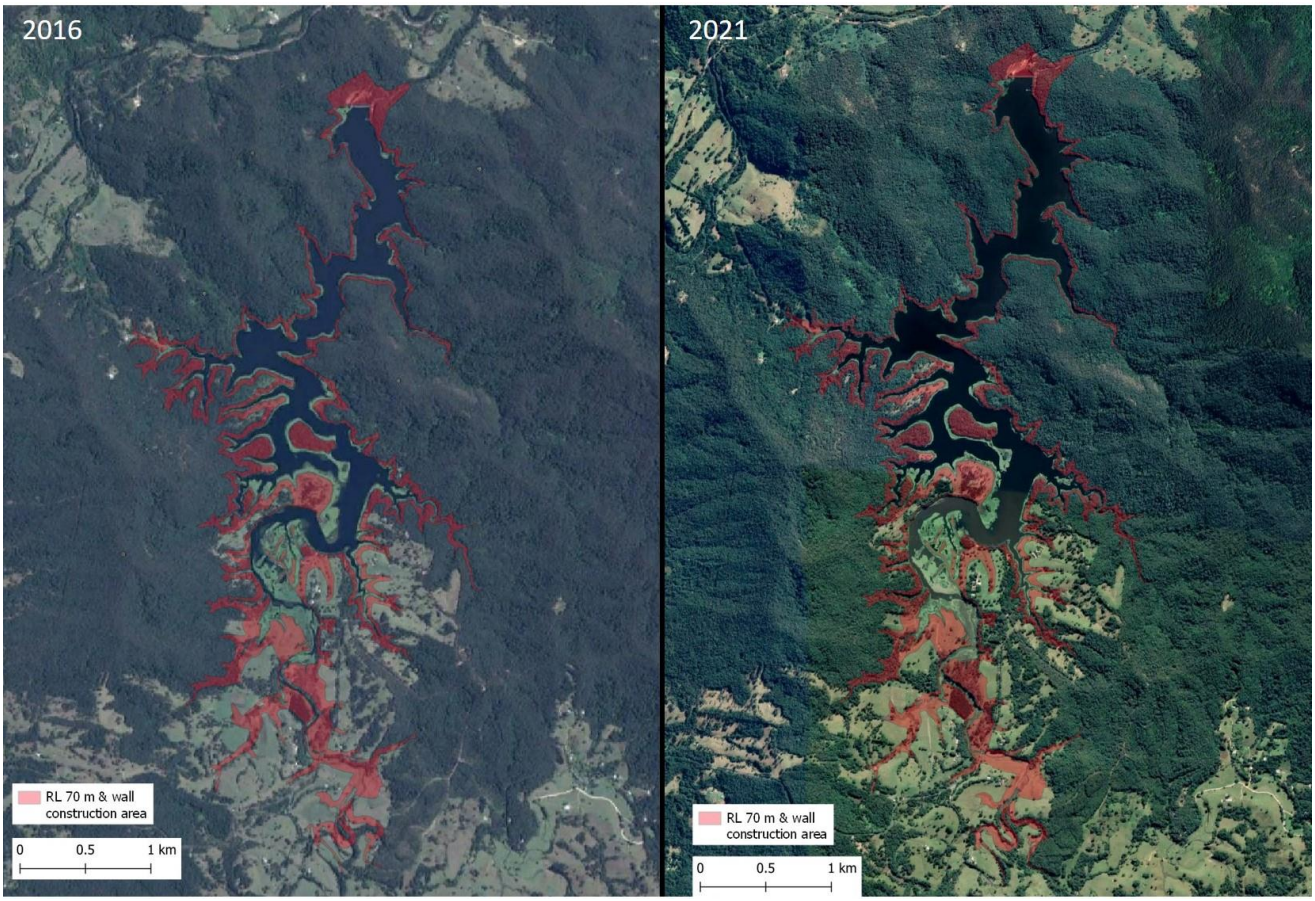
The landscape buffering the dam is predominantly vegetated with bushland, comprising a mosaic of mature and young regrowth forest, along with pockets of remnant forest. There is also cleared land associated with former pasture, which is regularly slashed, and passive recreational areas (e.g. Cram's Farm). All Council owned land is managed for drinking water protection.

Council either owned or has acquired the majority of land within the Proposal disturbance footprint prior to 2016. Land management practices in the period from 2016-2022 have not changed and forest cover has remained the same (Attachment A). Forestry ceased many years before the 2016/17 studies commenced and cropping is restricted to small-scale practices away from the proposed disturbance footprint. Much of the forested land to be inundated is on steep country that either was not grazed heavily or actively excluded grazing. Cropping practices have also not changed.

Tweed Shire Council's vegetation surveys of the proposed disturbance footprint were undertaken simultaneously with the Council's fauna surveys in late 2016 to mid-2017. From this work, vegetation was categorised into PCTs. The mapping of vegetation and PCT classification during Council's assessment aligned to PCT categories allocated within the draft BDAR (Section 3.1.2), suggesting that vegetation and therefore habitat, had remained largely unchanged between the short period of 2017 to 2020. Additionally, camera trapping undertaken by Council in 2019 and 2021 recorded similar fauna compositions to sampling that was conducted in 2016/2017.

A fire described and assessed in s 3.5.1 of the draft BDAR occurred in a portion of the development site in August 2019, which occurred between the 2016/2017 Council sampling period and the ELA sampling period. The fire was a low-intensity burn that affected the mid-storey and ground canopy (Eco Logical Australia 2021) and burnt approximately 105 ha of land owned by Council, of which about 18.5 ha was within the development site. As discussed in the draft BDAR, the fire decreased in impact as it burnt from west to east. This is likely due to the sheltered gullies with more mesic ground layer, and downslope burn direction of the fire. As required by the Guideline for applying the BAM at severely burnt sites (DPIE, 2020), an assessment of the severity of the 2019 burn is required to determine whether parts of the development site are considered 'severely burnt'. Based on the floristic data collected across the site, as well as observations made by Council staff in the days following the fire (Cooper & Lollback, 2019), the site is not considered to be 'severely burnt'. All future assessment of PCT827 – burnt has been treated the same as unburnt areas of the development site.

Figure 1. Aerial imagery showing forest cover in 2016 and 2020.



Implication and conclusion

Council has been issued a draft EIS including draft BDAR for the proposal. The draft BDAR is being updated to comply with the BAM 2020 and a scope of work is being prepared to finalise the draft EIS. Council is intending to lodge the EIS for public exhibition mid 2022 once the EIS has been updated.

Council has commissioned a significant amount of work to assess biodiversity impacts of the proposal. Assessment of PCTs including vegetation integrity assessments and threatened flora surveys were undertaken by ELA during 2020-2021 and fully comply with the BAM

An approach was developed by ELA, and subsequently endorsed by BCD, to couple fauna surveys conducted by Council in 2016-2017 with surveys conducted by ELA in 2020-2021 to meet the fauna survey requirements of the BAM. A BDAR was prepared on this basis. Given the lack of change in land management and condition of vegetation and therefore habitat between 2016/2017 and 2022, seeks approval for the use of species survey data collected in 2016/2017 for a BDAR to be completed in 2022.

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Tweed Shire Council (TSC) (2017). Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam, Tweed Shire, NSW.

Appendix A. Letter from BCD to TSC about expiration of data according to BAM

From: Dimitri Young [mailto:Dimitri.Young@environment.nsw.gov.au]
Sent: Tuesday, 10 August 2021 11:00 AM
To: Corporate Email <tsc@tweed.nsw.gov.au>
Cc: David Hannah <DHannah@tweed.nsw.gov.au>; Greg Lollback <GLollback@tweed.nsw.gov.au>; Krister Waern <krister.waern@environment.nsw.gov.au>
Subject: BCD Response - FW: BAM - 5 year survey data limit

CAUTION! External Sender
Dear Mr Hannah

Thank you for your e-mail below about the five year survey limit for data to support application of the Biodiversity Assessment Method 2020 (BAM 2020) to the Clarrie Hall Dam project, seeking comments from the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment. I appreciate the opportunity to provide input and apologise for the delay ion responding.

The reference to the five year survey limit is identified in the BAM 2020 Operational Manual Stage 1, section 3.4 where it states that,

> *If a field survey has been undertaken on the subject land within five years of the current proposal lodgement date, and that survey meets the requirements of the BAM, including this section of the Manual, the assessor can use the results in place of an onsite survey. The use of a past survey must be documented in the BAR. Surveys undertaken more than five years prior to the proposal lodgement date may be used to inform the assessment process but cannot be used in place of a species survey. This is to ensure results are current with respect to site condition, structural attributes and species presence. Note, where biodiversity values have changed dramatically within five years (e.g. land use has changed) onsite assessment is required.*

This means that surveys undertaken less than five years prior to the lodgement date can be used if they meet BAM survey requirements unless biodiversity values have changed. Surveys undertaken more than five years prior to the lodgement date can be used to inform the assessment process.

If there are specific species surveys which will be more than five years old and the Tweed Shire Council wishes to use these results in place of a further species survey, then the council will need to provide further justification for the Department's consideration including:

- an overview of any changes that may or may not have occurred on the site in relation to site condition and structural attributes which may affect the species presence,
- description of the survey methods and effort
- indication of dates on which the surveys were conducted
- indication of the personnel who conducted the surveys and their skills/expertise in survey for the target species
- analysis of alignment with BAM survey requirements (as specified in the Threatened Biodiversity Data Collection and relevant survey guides published by the Department)

If there are any species that you are particularly concerned about we would be happy to review that information and provide more definitive advice.

If you have any questions about this matter, please do not hesitate to contact Mr Krister Waern, Senior Operations Officer, at krister.waern@environment.nsw.gov.au or 6640 2503.

Yours sincerely

Dimitri Young
Senior Team Leader Planning, North East Branch

Biodiversity and Conservation | Department of Planning, Industry and Environment
T 02 6659 8272 | **F** 6651 5356 | **E** dimitri.young@environment.nsw.gov.au
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tsc@tweed.nsw.gov.au
www.tweed.nsw.gov.au

PO Box 816
Murwillumbah NSW 2484

Your ref: E-mail dated 07/03/2022
Our ref: DOC22/175151

General Manager
Tweed Shire Council
PO Box 816
MURWILLUMBAH NSW 2484

Attention: Mr David Hannah

Dear Mr Green

RE: Request for the use of species survey data collected in 2016 for a BDAR submitted in 2022, Clarrie Hall Dam Raising - SSI 9458

Thank you for your e-mail dated 7 March 2022 about the request to use species survey data collected in 2016 for a Biodiversity Development Assessment Report (BDAR) submitted in 2022 for the Clarrie Hall Dam Raising project, seeking comments from the Biodiversity and Conservation Division (BCD) of the Biodiversity, Conservation and Science Directorate in the Environment, Energy and Science Group of the Department of Planning and Environment. I appreciate the opportunity to provide input and apologise for the delay in responding.

On 10 August 2022, the BCD advised the Tweed Shire Council via e-mail that if there are specific species surveys which will be more than five years old when the BDAR for the Clarrie Hall Dam Raising project is lodged and the council wishes to use these results in place of a further species survey, then the council will need to provide further justification for the Department's consideration including:

1. an overview of any changes that may or may not have occurred on the site in relation to site condition and structural attributes which may affect the species presence,
2. description of the survey methods and effort
3. indication of dates on which the surveys were conducted
4. indication of the personnel who conducted the surveys and their skills/expertise in survey for the target species
5. analysis of alignment with Biodiversity Assessment Method (BAM) survey requirements (as specified in the Threatened Biodiversity Data Collection and relevant survey guides published by the Department)

We have reviewed the documents supplied and advise that adequate information has been submitted to satisfy points 2, 3 and 4 above. However, several issues are apparent with the information provided to satisfy points 1 and 5 above.

The information submitted to address Point 1 above indicates that 37 full-floristic and vegetation integrity plots have been surveyed in 2020/21 to identify Plant Community Types (PCTs) and Threatened Ecological Communities (TECs) within the development site footprint in accordance with the minimum requirements of the BAM 2020, and that this mapping aligned with vegetation mapping initially undertaken for Council. However, no evidence has been provided to support this claim.

The vegetation mapping and vegetation condition from the 2020/21 surveys should be compared with vegetation mapping and vegetation condition from the original surveys undertaken in 2016 and 2017 to justify this claim. This could be done by using GIS overlays to compare the extent of mapped PCTs recorded during the 2016/17 flora survey with those from the 2020/21 flora survey, and by comparing vegetation condition data for each PCT collected in 2016/17 with that collected in 2020/21 flora surveys, including presence of hollows and other fauna habitat features.

The information submitted to address Point 5 above indicates that fauna survey work conducted between 2016 and 2021 including survey date, survey method, number of replicates and effort as shown in Table 2 of the submitted information. However, it is unclear whether 'effort' relates to person hours, and how this effort relates to the minimum survey requirements in the BAM 2020.

A comparison should be undertaken to demonstrate how the fauna survey work meets the minimum requirements of the BAM 2020. We have provided an example below of how this comparison could be done, noting that additional targeted surveys would need to be completed for any candidate species where suitable habitat occurs, if surveys do not meet BAM 2020 minimum requirements, or if surveys have not been previously undertaken.

Date	Survey Method	Replicates	Effort	Comparison to BAM 2020
21 November 2016- 18 January 2017	Diurnal reptile/amphibian search plots (200 m x 50 m) for 20 minutes x 3 visits	19 plots within the proposed disturbance footprint, and 13 outside, but in close proximity to the disturbance footprint	64 (specify if this is person hours)	Has the survey been undertaken during the time specified for each species with potential to occur in the Threatened Biodiversity Database Collection (TBDC)? *For example, Giant barred frog Mixophyes iteratus should be surveyed between October and March.* What are the specifications in the Department's threatened species survey guidelines? Does this survey comply with those Guidelines? *For example, NSW Survey Guide for Threatened Frogs specifies Giant Barred Frog should be surveyed between October and March, using 500 m transects within suitable breeding habitat, total effort 480 minutes, number of repeat surveys 4.* Has each PCT management zone been adequately surveyed to enable the extent of a species polygon to be determined? *For example, has each species been surveyed within each PCT management zone where potential habitat occurs?*

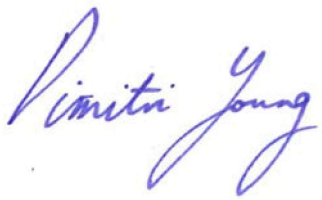
In summary, the BCD requests the following additional information from the council:

1. A comparison of the extent and condition of vegetation mapped in the 2016/17 and 2020/21 flora surveys to demonstrate that no changes have occurred in site conditions and structural attributes between those dates.

2. Justification of how the fauna survey work conducted between 2016 and 2021 meets the minimum survey requirements in the BAM 2020.

If you have any questions about this advice, please do not hesitate to contact Ms Vanessa Owen, Senior Project Officer, at vanessa.owen@environment.nsw.gov.au or 4927 3116.

Yours sincerely



29 April 2022

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

B.5 Item 5

David Hannah

From: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Sent: Friday, 3 September 2021 3:29 PM
To: David Hannah
Subject: BCD Response - RE: Clarrie Hall Dam raising - draft BDAR

CAUTION! External Sender

Dear Mr Hannah

Thank you for your e-mail below to the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment seeking advice on the interpretation of various parts of the Biodiversity Assessment Method (BAM) 2017. I appreciate the opportunity to provide ongoing input.

Section 6.4.1.26 of the BAM 2017 states that:

> *6.4.1.26*
> *Where either:*
> *(a) a survey or expert report confirms that a species credit species is present, or is likely to use the suitable habitat, on the subject land, or*
> *(b) a species credit species is assumed to be present on the development site, clearing site or land proposed to be biodiversity certified*
>
> *the assessor must prepare a species polygon for each species credit species.*

The BCD advises that part (a) of this section is interpreted as follows:

- the '*survey*' applies to confirming the species credit species '*is present*' on the subject land, and
- the '*expert report*' applies to confirming the species credit species '*is likely to use the suitable habitat*' on the subject land.

Hence, if targeted surveys of the subject land for species credit species undertaken in accordance with published survey guidelines, or agreed best-practice survey techniques where such guidelines are not available, do not detect the species on the subject land, then a species polygon is not required as the species has not been confirmed as present on the subject land.

The BCD also advises that the *Biodiversity Conservation Act 2016* only applies within NSW. Thus, Serious and Irreversible Impact assessment under the BAM 2017 where the IBRA Region (and/or subregion) extends beyond the NSW state boundary, must only consider that part of the region (and/or sub region) that occurs within NSW.

If you require any further information on this matter, then please do not hesitate to contact me via the details below.

Yours sincerely

Dimitri Young
Senior Team Leader Planning, North East Branch

Biodiversity and Conservation | Department of Planning, Industry and Environment
T 02 6659 8272 | **F** 6651 5356 | **E** dimitri.young@environment.nsw.gov.au

Locked Bag 914, (Level 8, 24 Moonee Street), Coffs Harbour NSW 2450
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From: David Hannah <DHannah@tweed.nsw.gov.au>
Sent: Wednesday, 25 August 2021 8:08 AM
To: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Subject: FW: Clarrie Hall Dam raising - draft BDAR

Hi Dimitri,

Touching base to see if you have had a chance to follow up on the advice relating to application of Section 6.4.1.26 of the BAM (e.g. doing surveys for spp credit spp, not finding them, but assuming presence given habitat to known records in landscape is contiguous), and the use of Queensland records in the discussion of SAII.

Regards
David Hannah

_____
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BCD Response - Further Advice - RE: BCD Response - RE: Clarrie Hall Dam raising - draft BDAR

Sent: 21 October 2021 4:11 PM

From: Dimitri Young

To: David Hannah;

4 Attachments

image002.jpg (6 KB); image004.jpg (6 KB); image005.jpg (5 KB); image006.jpg (6 KB);

Dear Mr Hannah

Thank you for your e-mail below to the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment seeking advice on the interpretation of the Biodiversity Assessment Method (BAM) 2020. I appreciate the opportunity to provide ongoing input and apologise for the delay in responding.

Despite the difference in the wording between section 5.2.5.1(a) of the BAM 2020 and section 6.4.1.26 of the BAM 2017 in relation to species polygons, I confirm the advice provided in my e-mail to you dated 3 September 2021 applies to the BAM 2020.

Hence, under the BAM 2020, if targeted surveys of the subject land for species credit species undertaken in accordance with published survey guidelines, or agreed best-practice survey techniques where such guidelines are not available, do not detect the species on the subject land, then a species polygon is not required as the species has not been confirmed as present on the subject land.

Yours sincerely

Dimitri Young
Senior Team Leader Planning, North East Branch

Biodiversity and Conservation | Department of Planning, Industry and Environment
T 02 6659 8272 | **F** 6651 5356 | **E** dimitri.young@environment.nsw.gov.au
Locked Bag 914, (Level 8, 24 Moonee Street), Coffs Harbour NSW 2450
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NSW GOVERNMENT | Planning, Industry & Environment

From: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Sent: Thursday, 7 October 2021 4:22 PM
To: EES BCD Planning North East Mailbox <planning.northeast@environment.nsw.gov.au>
Subject: FW: BCD Response - RE: Clarrie Hall Dam raising - draft BDAR

Hi Hannah

Pls cm9 and return to me.
Tks
D

Dimitri Young
Senior Team Leader Planning, North East Branch

Biodiversity and Conservation | Department of Planning, Industry and Environment
T 02 6659 8272 | **F** 6651 5356 | **E** dimitri.young@environment.nsw.gov.au
Locked Bag 914, (Level 8, 24 Moonee Street), Coffs Harbour NSW 2450
www.dpie.nsw.gov.au

From: David Hannah <DHannah@tweed.nsw.gov.au>
Sent: Wednesday, 6 October 2021 3:23 PM
To: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Subject: FW: BCD Response - RE: Clarrie Hall Dam raising - draft BDAR

Hi Dimitri,

Could I clarify that the application of Section 6.4.1.26 of the BAM 2017 in regards to the advice you provide in your email below carries over to the application of Section 5.2.5 (point 1(a)) of BAM 2020.

S5.2.5 point 1(a) (Bam 2020) reads:
1. A species polygon must be prepared in accordance with Box 2 for each species credit species if:
a. a survey, expert report or important habitat map confirms that the species is present or is likely to use suitable habitat on the subject land, or…

That is, subject to your comments regarding adequacy of the targeted surveys, if a targeted survey does not detect the species on the subject land then a species polygon is not required etc…

Regards
David Hannah

From: Ben Cox [mailto:Ben.Cox@planning.nsw.gov.au]
Sent: Wednesday, 6 October 2021 3:04 PM
To: David Hannah <DHannah@tweed.nsw.gov.au>
Cc: Lloyd Eley-Smith <Lloyd.Eley-Smith@planning.nsw.gov.au>
Subject: RE: BCD Response - RE: Clarrie Hall Dam raising - draft BDAR

Good Morning David,

Thanks for sending this information through.

I've noted that the information referred to below concerns BAM 2017. As discussed yesterday, BAM 2020 is likely to be the method that will be relevant to the EIS. Can you please check whether this has been altered at all in BAM 2020, or remains unchanged?

Regards,

Benjamin Cox
Senior Environmental Assessment Officer
Water Assessments | State Significant Acceleration
Planning and Assessment | Department of Planning, Industry and Environment
T 02 9995 6524 **E** ben.cox@planning.nsw.gov.au
4 Parramatta Square (Locked Bag 5022), Parramatta 2124
www.dpie.nsw.gov.au

The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: David Hannah <DHannah@tweed.nsw.gov.au>
Sent: Tuesday, 5 October 2021 6:09 PM
To: Ben Cox <Ben.Cox@planning.nsw.gov.au>
Subject: FW: BCD Response - RE: Clarrie Hall Dam raising - draft BDAR

Hi Ben, please find below advice from Dimitri Young regarding the interpretation of Section 6.4.1.26 of the BAM 2017 in relation to requiring a species credit species habitat polygon where these species were not detected during surveys.

Regards
David Hannah

From: Dimitri Young [mailto:Dimitri.Young@environment.nsw.gov.au]
Sent: Friday, 3 September 2021 3:29 PM
To: David Hannah <DHannah@tweed.nsw.gov.au>
Subject: BCD Response - RE: Clarrie Hall Dam raising - draft BDAR

CAUTION! External Sender
Dear Mr Hannah

Thank you for your e-mail below to the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment seeking advice on the interpretation of various parts of the Biodiversity Assessment Method (BAM) 2017. I appreciate the opportunity to provide ongoing input.

Section 6.4.1.26 of the BAM 2017 states that:

> *6.4.1.26*
> *Where either:*
> *(a) a survey or expert report confirms that a species credit species is present, or is likely to use the suitable habitat, on the subject land, or*
> *(b) a species credit species is assumed to be present on the development site, clearing site or land proposed to be biodiversity certified*

the assessor must prepare a species polygon for each species credit species.

The BCD advises that part (a) of this section is interpreted as follows:

- the '*survey*' applies to confirming the species credit species '*is present*' on the subject land, and
- the '*expert report*' applies to confirming the species credit species '*is likely to use the suitable habitat*' on the subject land.

Hence, if targeted surveys of the subject land for species credit species undertaken in accordance with published survey guidelines, or agreed best-practice survey techniques where such guidelines are not available, do not detect the species on the subject land, then a species polygon is not required as the species has not been confirmed as present on the subject land.

The BCD also advises that the *Biodiversity Conservation Act 2016* only applies within NSW. Thus, Serious and Irreversible Impact assessment under the BAM 2017 where the IBRA Region (and/or subregion) extends beyond the NSW state boundary, must only consider that part of the region (and/or sub region) that occurs within NSW.

If you require any further information on this matter, then please do not hesitate to contact me via the details below.

Yours sincerely

Dimitri Young
Senior Team Leader Planning, North East Branch

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From: David Hannah <DHannah@tweed.nsw.gov.au>
Sent: Wednesday, 25 August 2021 8:08 AM
To: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Subject: FW: Clarrie Hall Dam raising - draft BDAR

Hi Dimitri,

Touching base to see if you have had a chance to follow up on the advice relating to application of Section 6.4.1.26 of the BAM (e.g. doing surveys for spp credit spp, not finding them, but assuming presence given habitat to known records in landscape is contiguous), and the use of Queensland records in the discussion of SAII.

Regards
David Hannah

_____

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B.6 Item 6

Council Reference:
Your Reference: **DOC22**

TWEED SHIRE COUNCIL

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tsc@tweed.nsw.gov.au
www.tweed.nsw.gov.au

PO Box 816
Murwillumbah NSW 2484

Please address all communications to the General Manager

ABN: 90 178 732 496

2 August 2022

Dimitri Young
Biodiversity and Conservation
Level 8, 24 Moonee Street (Locked Bag 914)
COFFS HARBOUR NSW 2450

Via email: Dimitri.Young@environment.nsw.gov.au

Dear Mr Young

Request for the use of species survey data collecting in 2016 for a BDAR submitted in 2022, Clarrie Hall Dam Raising - SSI9458

Thank you for your email dated 29 April 2022 (Appendix A), where you addressed Tweed Shire Council's (TSC) queries about the use of fauna survey data collected in 2016 for a Biodiversity Development Assessment Report (henceforth referred to as "BDAR". Please note that this document was issued to the Biodiversity Conservation Division on 24 June 2021). Within your letter, you requested that TSC:

A. Compare vegetation mapping and vegetation condition data from 2016/17 and 2020/21 to support the claim that site condition and structural attributes have not changed since the fauna data was collected. It was suggested that this could be done by using GIS overlays to compare extent of PCTs for both survey periods and by comparing flora survey data;

B. A comparison should be made to demonstrate fauna work conducted in 2016-2021 meets the minimum survey requirements in the BAM 2020

The below information sets out to address Biodiversity Conservation Division's (BCD) request to TSC for the purpose of using fauna survey data collected in 2016/17 in a BDAR associated with the raising of Clarrie Hall Dam (CHD).

Point A

A comparison between vegetation PCTs (mapping)

Surveys conducted in 2016/17 resulted in the mapping of four plant community types (PCTs) within the proposed development site. Vegetation mapping/validation during the 2016/17 survey used methodologies described in the Framework for Biodiversity Assessment (OEH 2014). These communities were PCT 770 (Coachwood/soft corkwood/crabapple warm temperate rainforest of the NSW North Coast bioregion), 827 (flooded gum/tallowwood/brushbox moist open forest of the coastal ranges of the North Coast), 1073 (pink bloodwood/tallowwood moist open forest of the far northern ranges of the NSW North Coast bioregion) and 1302 (white booyong/fig subtropical rainforest of the NSW North Coast bioregion). Surveys of the proposed development site conducted by ELA in 2020 (using methodology that conformed to the Biodiversity Assessment Method 2017 (BAM2017; OEH 2017) resulted in vegetation community classification that included the above PCTs with the additional PCTs: 812 (Dunn's white gum plantation); 887 (hoop pine plantation); 1068 (pepperberry/giant stinging tree/fig lowland rainforest in the NSW North Coast bioregion). Differences in PCT occurrence and percentage composition (Table 1) can be partially attributed to modifications to the development site during preparation of the EIS. For example, PCT 1068 was found downstream of the dam wall, which was not surveyed in 2016/17. Likewise, the quarry area was not surveyed in 2016/17, but was included in the development site in 2020. Surveys in 2016/17 acknowledged the presence of PCTs 812 and 887 and BAM surveys were conducted in these PCT types, however, these PCTs were not mapped at that time.

Table 1. Comparison between PCTs mapped within the proposed development site between the 2016/2017 survey period and the 2020 survey period. Data sourced from Eco Logical Australia (2021) and TSC (2017).

PCT	2016/17	2020	Area (ha)		% of development site	
			2016/2017	2020	2016/2017	2020
770	✓	✓	2.98	4.28	2.5	2.9
827	✓	✓	108.48	137.86	90.7	93.4
1068			0	0.42	0	0.3
1073	✓	✓	6.16	1.38	5.2	0.9
1302	✓	✓	1.93	3.66	1.6	2.5
Total within forested area			**119.55**	**147.60**	**100**	**100**
812		✓	0	7.91	0.0	5.4
887		✓	0	0.42	0.0	0.3

Overall, PCT composition within the forested areas – PCT 770, 827 and 1068 - of CHD between the two surveys were similar. This similarity comprises over 90% of the development site. A visual comparison of PCT distribution within the development site between the two vegetation surveys is presented in Appendix B.

A comparison of vegetation composition, structure and function

Vegetation surveys in varying PCTs within the development site were completed in 2016/2017 by TSC as well as in 2020 by Eco Logical Australia. Survey effort is shown in Table 2. Both sets of surveys used BAM methodology. However, the surveys in 2016/17 collected forb and fern data that was incorporated into other groundcover data, whereas the data collected during 2020 separated forb and fern categories from other groundcover data. Hence, overall vegetation integrity (VI) scores could not be calculated from the 2016/17 data set.

Table 2. Vegetation survey effort for different PCTs within the development site. Plot size for both survey periods conformed to BAM 2017 (OEH 2017), as did most variables collected. The 2016/17 data was collected by TSC and the 2020 data was collected by ELA.

PCT	Number of flora survey plots*	
	2016/17	2020
770	2	3
812	1	3
827	8	19
887	1	2
1068	0	0
1073	1	2
1302	0	5

*Plot size is stipulated in Section 5 of the BAM 2017 – nested plots of 50 m x 20 m, 20 m x 20 m and 1 x 1 m.

The vegetation data collected for both survey periods consisted of composition, structure and function, which can then be used to calculate Vegetation Integrity scores. These scores are used to assess vegetation condition in BAM 2017 (OEH 2017). The data collected by ELA completely conformed to BAM 2017 (OEH 2017) and Vegetation Integrity scores can be calculated from this dataset. However, the data collected in 2016/17 combined forbs, ferns and other forms into one category and therefore, Vegetation Integrity score cannot be calculated due to the combining of variables. The raw data for both datasets is presented in Appendix C.

A non-metric multidimensional scaling ordination (NMDS) was performed to compare vegetation variables (mentioned above) that were collected at each site. The data used in the analysis is presented in Appendix D. For the analysis, the Bray-Curtis dissimilarity measure was used and data was square-root transformed and standardised using the Wisconsin double standardisation. Convergence was found after 38 iterations. A stress plot (Figure 1) indicates suitable ordination fit. An ordination plot (Figure 2) shows much overlap in plots between sampling periods, which is better demonstrated in Figure 3. The results demonstrate that the collected vegetation data (or vegetation condition), which conforms to BAM sampling methodology, does not differ between sampling periods. This suggests that there has been no pattern of change in vegetation integrity between 2016/17 and 2020.

It is important to note that a comparison of the raw data from all variables, as performed in the NMDS, is a better comparison than comparing just VI scores, which is a single value that no doubt loses data information as the variable values are compressed into a single score.

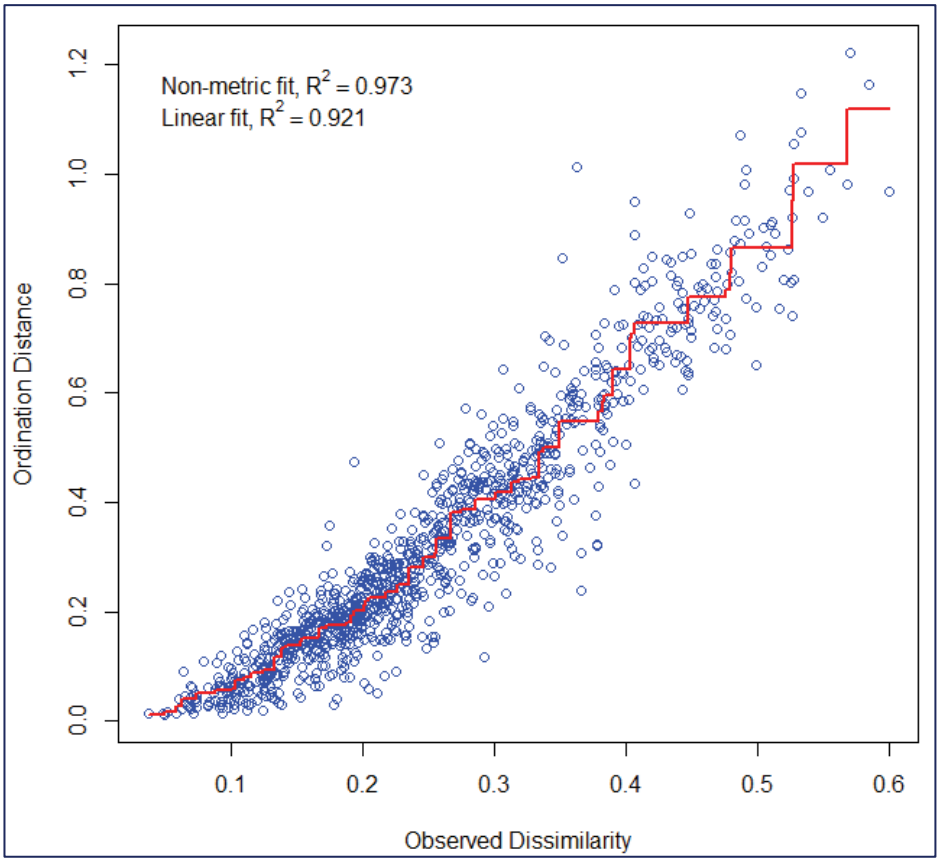

Figure 1. Stress plot of the NMDS. Analysis fit of the data is suitable and suggests good model performance.

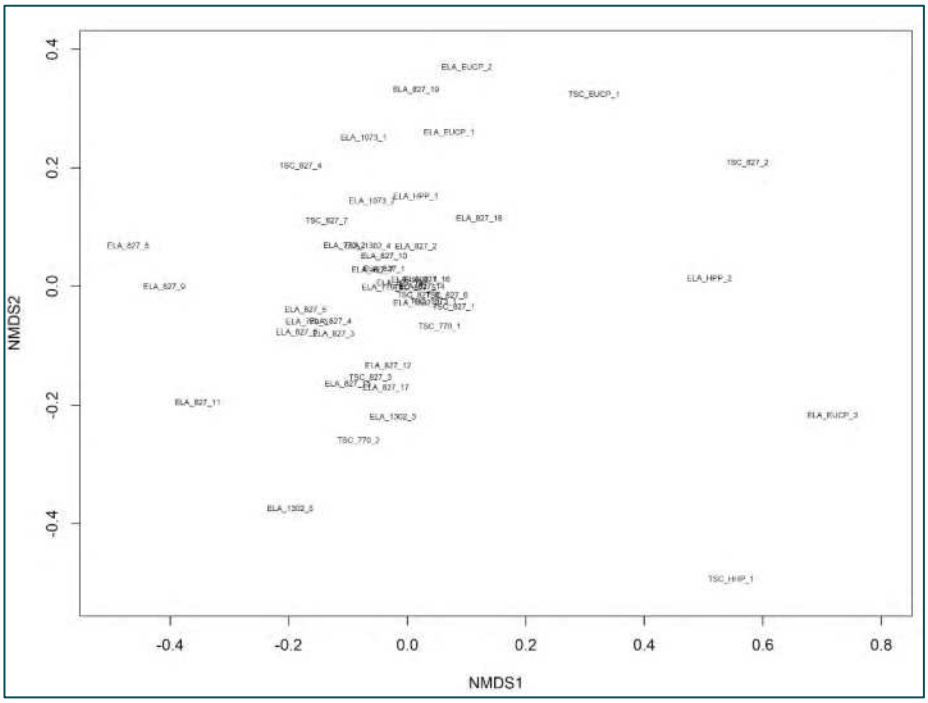

Figure 2. Ordination plot from the NMDS analysis. ELA = data collected during 2020; TSC = data collected during 2016/17. PCTs are 770, 812, 827, 887, 1073 and 1302 (see Table 2). EUCP = PCT 812 and HPP = PCT 887.

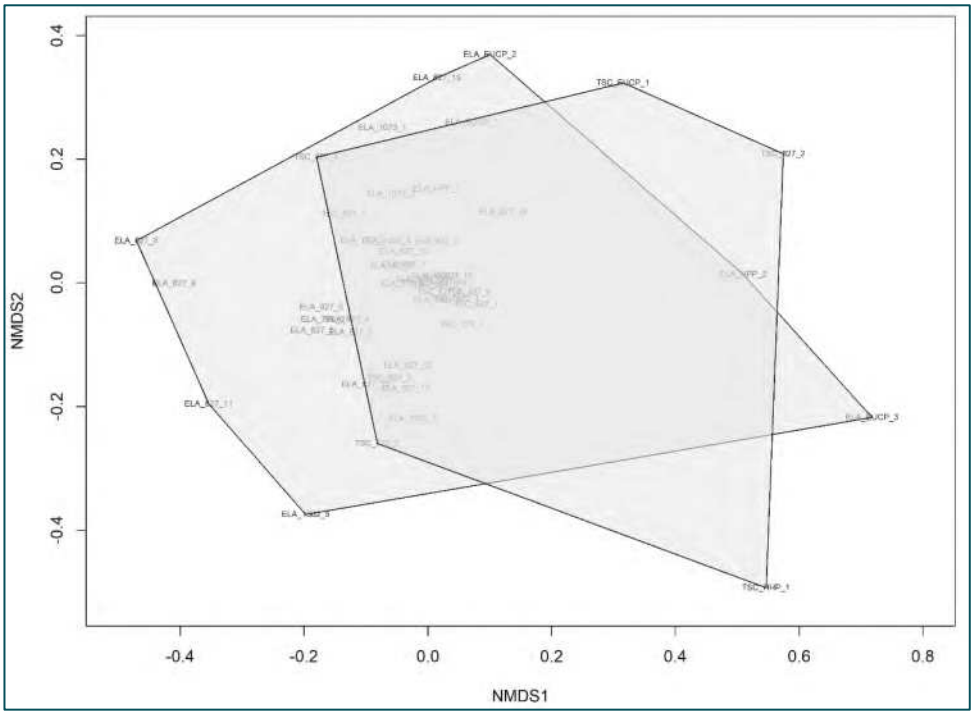

Figure 3. Ordination plot from the NMDS analysis with group polygons for the 2016/17 data and the 2020 data. Note the significant overlap of plot characteristics between sampling periods. ELA = data collected during 2020; TSC = data collected during 2016/17. PCTs are 770, 812, 827, 887, 1073 and 1302 (see Table 2). EUCP = PCT 812 and HPP = PCT 887.

Conclusion of data comparison and discussion of land management

The above comparison of mapped PCTs and vegetation composition and structural data between surveys conducted during 2016/17 and 2020/21, as requested by BCD (see Appendix A), strongly suggests no change in vegetation and therefore fauna habitat between the survey dates. This is of no surprise due to consistent land management of the catchment and more specifically, the proposed development site. Clarrie Hall Dam is a drinking water supply and the water and land around it is managed to protect this asset. Hence, no changes in land management within the proposed disturbance footprint have occurred. The lack of change in land management has ensured that few anthropogenic changes have occurred to the disturbance site over the period in question. An argument for lack of vegetation change through consistent land management practices was presented in a document from TSC to BCD in March 2022 (see Appendix E).

Point B

Point B focuses on previous fauna work conducted in 2016/17 meeting minimum survey requirements under BAM 2020. There are two components to the argument that are discussed below:

1. Are the fauna surveys conducted in 2016/17 compliant (meeting minimum survey requirements) with BAM 2017;
2. Do changes made in BAM methodology (2017 to 2020) render any fauna surveys conducted in 2016/17 unsuitable to be used in a future BDAR;

Point B is broken into two components because the question of the 2016/17 data's suitability to be used in a BDAR has been raised with BCD previously and has been addressed below.

Compliance with the BAM 2017

Eco Logical Australia (ELA) were previously engaged by TSC to submit an Environmental Impact Statement for the raising of Clarrie Hall Dam. ELA prepared a draft BDAR (Eco Logical Australia 2021) under BAM 2017 (OEH 2017). In preparation of conducting an environmental impact assessment, ELA wrote to BCD on 2nd September 2020 seeking BCD's approval of a proposed survey design (see Appendix F). Specifically, ELA asked if their proposed methods to survey:

- Frogs (quoted as "DPIE Action 2" in the letter);

- Glossy black-cockatoo (“DPIE Action 3”);
- Forest owls (“DPIE Action 3”);
- Microchiropteran bats (“DPIE Action 4”);

were suitable. Furthermore, ELA asked BCD in this letter if the previous surveys undertaken by TSC in 2016/17 fulfilled the minimum requirements for brush-tailed phascogale (“DPIE Action 6”) and reptiles (“DPIE Action 7”).

The letter also summarises the 2016/17 survey effort and states that the survey exceeded minimum required effort for mammals, reptiles and birds (except some hollow-dependent birds).

On 29th September 2020, BCD replied to ELA’s letter requesting approval of survey design (Appendix G). The following is a summary of the letter:

- DPIE Action 2, as proposed by ELA, was confirmed by BCD. That is, the proposed effort to sample frogs was judged by BCD to fulfill minimum requirements under BAM 2017 (OEH 2018).
- DPIE Action 3: BCD stated further information was required to determine if the proposed survey design for glossy black-cockatoo was sufficient to fulfill minimum survey requirements;
- DPIE Action 3: No further work to survey for owls was required, however, there was uncertainty to whether the proposed owl breeding habitat survey design by ELA was suitable to fulfill minimum requirements;
- DPIE Action 4: BCD stated that the proposal by ELA was unsuitable and further surveys for 4 candidate species (*Chalinolobus dwyeri*, *Miniopterus australis, Miniopterus orianae oceansis*, *Vespadelus troughtoni*) would be required;
- DPIE Action 6: BCD stated that survey effort from the 2016/17 surveys fulfilled the minimum survey requirement for brush-tailed phascogale;
- DPIE Action 7: BCD stated that survey effort from the 2016/17 surveys fulfilled the minimum survey requirement for reptiles.

In response to the request for further information in relation to assessment of glossy-black cockatoo habitat and assessment methodology for forest owls (DPIE Action 3),

ELA provided clarification of assessment methodology in Section 4.4.3 of the draft BDAR (Eco Logical Australia 2021). Also see Appendix H for a summary.

In response to BCD's statement that 4 microchiropteran bat species required further assessment (see DPIE Action 4, above), ELA conducted desktop analysis and field surveys that fulfilled the minimum BAM 2017 requirements for these species. See Appendix H and section 4.4.4 of the draft BDAR for further details on methodology and the fulfilment of minimum requirements.

There was no formal approval of survey effort from BCD in their response letter (Appendix G) regarding general birds, terrestrial and arboreal mammals and invertebrates. The effort undertaken by TSC in 2016/17 to survey these groups of species was reviewed by a BAM Accredited Assessor and deemed to have exceeded the minimum required survey effort for mammals, birds and invertebrates, excluding the pink underwing moth. Additionally, BCD did not request further information about these animal groups in their response to ELA's letter (Appendix G). Surveys for the pink underwing moth were conducted by ELA and are detailed in section 4.4.6 in the draft BDAR and summarised in Appendix H.

Survey effort conducted by TSC in 2016/2017 and by ELA in 2020 for these species/animal groups is listed in Appendix H. Appendix H also lists BAM 2017 minimum requirements. For further details of survey method and effort of fauna, BCD can also read TSC (2017) and ELA (2021), which have previously been supplied to BCD. A detailed list of fauna survey effort undertaken by ELA with comparison of minimum survey requirements is included in Appendix F (the letter's Appendix G). The fieldwork undertaken by TSC and ELA fulfils specified requirements associated with BAM 2017 (OEH 2017).

Compliance with BAM 2020

Changes from BAM 2017 OEH 2017) to BAM 2020 (DPIE 2020a) are listed within DPIE (2020b). There were no changes listed to fauna survey methods or required effort between BAM 2017 and BAM 2020. Hence, it is assumed that fauna surveys and effort undertaken in 2016/17 and 2020 that meet minimum requirements under the BAM 2017 (OEH 2017), also meet the minimum requirements under the BAM 2020 (DPIE 2020a).

Conclusions

This letter addresses BCD's requests to provide supporting evidence for a lack of vegetation change at CHD between 2016 and 2020 and demonstration that previous fauna survey effort meets survey requirements under BAM 2020. Additional supporting documentation is also cited and has been previously provided to BCD.

Analysis of survey data collected during 2016/2017 and 2020 indicates a lack of vegetation change between this period. This finding was expected, as the proposed development site has been continually managed over this period by TSC for the purpose of water security and consequentially, there has been no change in land management practice.

A review of correspondence between ELA and BCD verified some survey methodology completed by TSC in 2016/17 as meeting the requirements of the BAM2017. Gaps in TSC's survey were identified by ELA. ELA either addressed these gaps in the BDAR or approached BCD with a methodology to address these gaps, with BCD either giving confirmation of survey approach or requesting further information and justification in the BDAR. This review indicates that previous fauna surveys conducted by TSC in 2016/17 and ELA in 2020 meets the requirements of BAM 2020.

Should you wish to discuss the matter further or require additional information, please contact either David Hannah on 0410 031 775 or Greg Lollback on 02 6670 2501.

Yours sincerely

David Hannah
Senior Planning Applications Officer

References

Department of Environment and Conservation (DEC) (2004). Threatened species survey and assessment: guidelines for development and activities (working draft). New South Wales Department of Environment and Conservation, Hurstville, NSW.

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Office of Environment and Heritage (OEH) (2017). Biodiversity assessment method. State of NSW.

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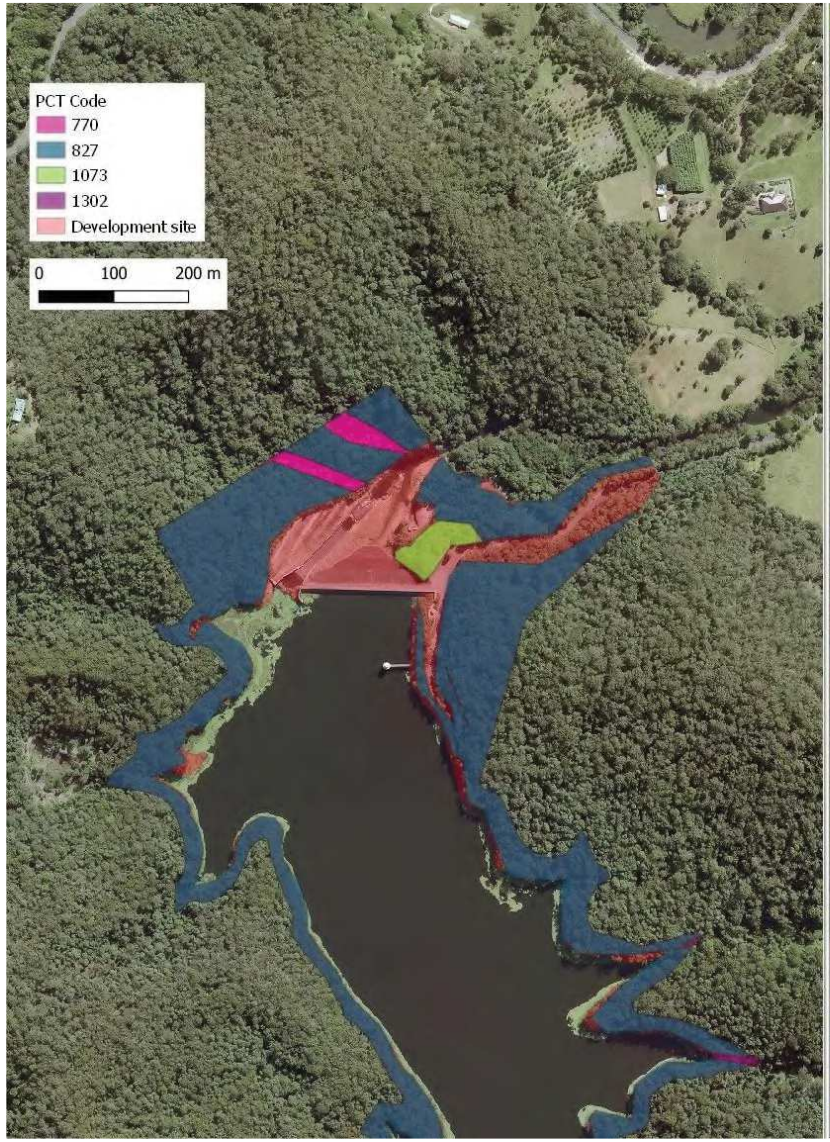
Office of Environment and Heritage (Accessed 2020). NSW BioNet Threatened Biodiversity Profile Data Collection. Accessed 2020.

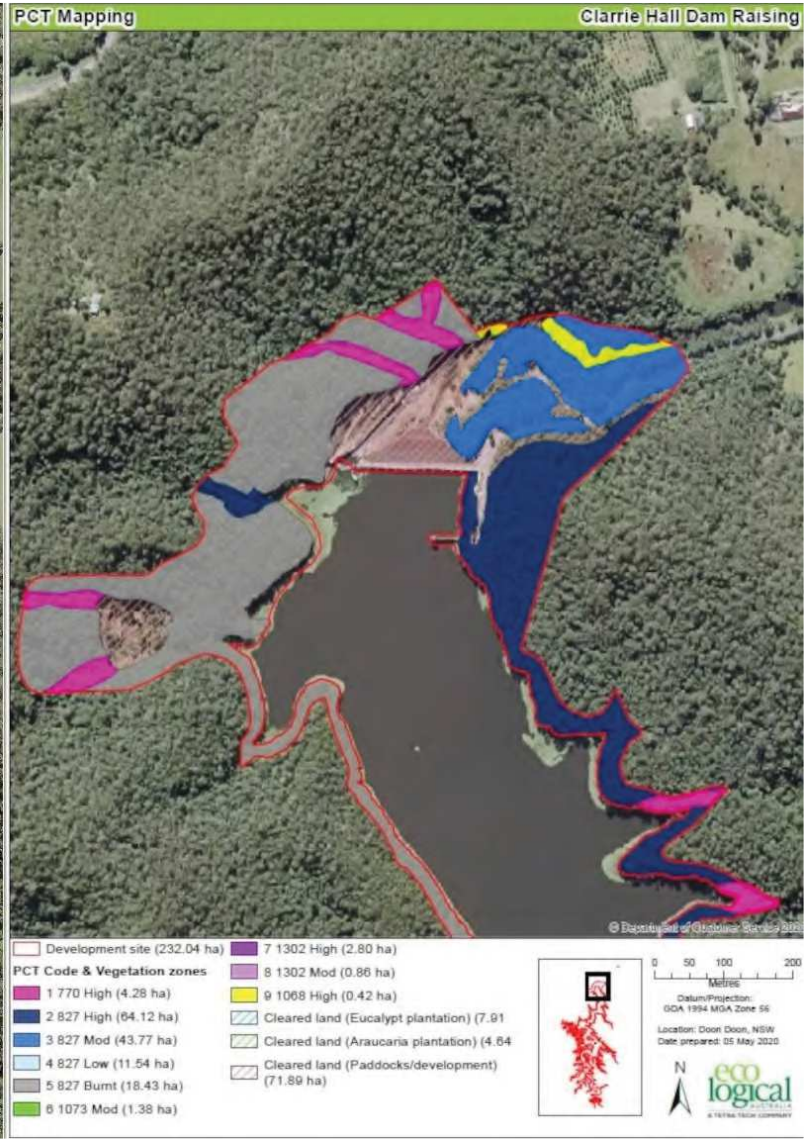
Tweed Shire Council (TSC) (2017). Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam, Tweed Shire, NSW

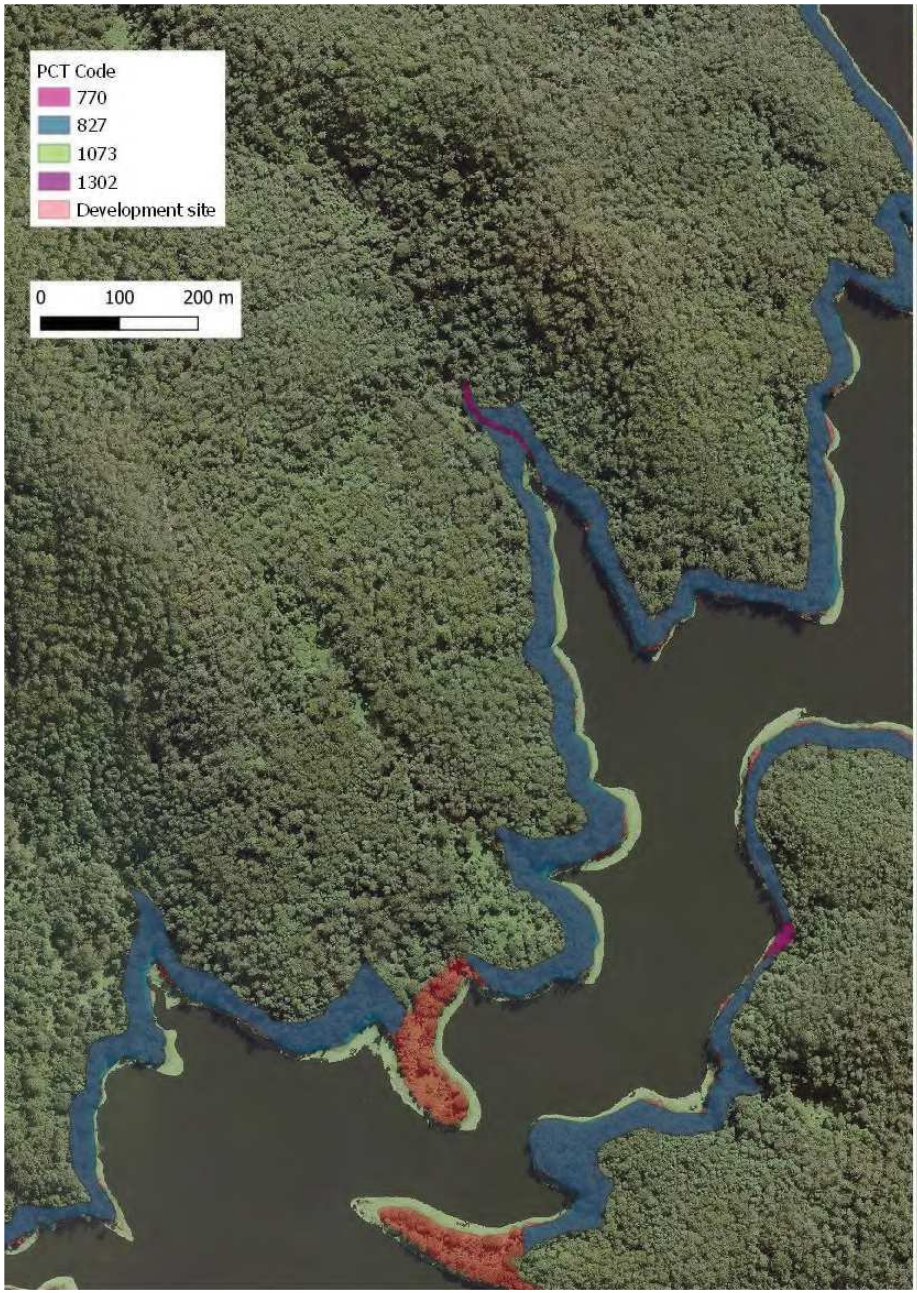
Appendix A. Letter to Tweed Shire Council from Biodiversity Conservation Division regarding the expiration of survey data

Appendix B. A visual comparison of mapped PCTs between the 2016/17 and the 2020 flora surveys

The 2016/17 mapping is shown on the left and the 2020 mapping is shown on the right.



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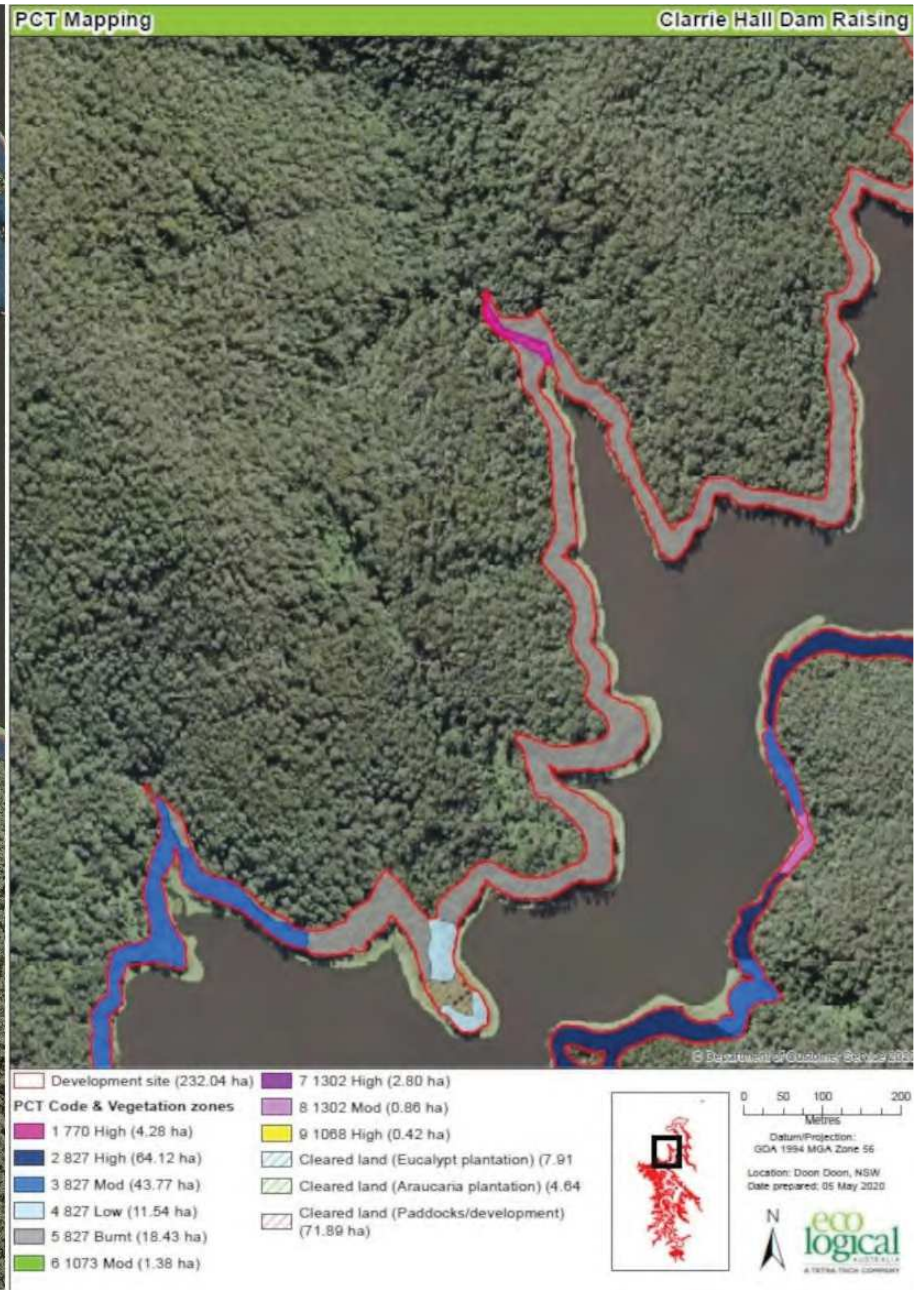
PCT Mapping
Clarrie Hall Dam Raising
Development site (232.04 ha)
PCT Code & Vegetation zones
1 770 High (4.28 ha)
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5 827 Burnt (18.43 ha)
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8 1302 Mod (0.86 ha)
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Cleared land (Paddocks/development) (71.89 ha)
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Location: Doon Doon, NSW
Date prepared: 05 May 2020
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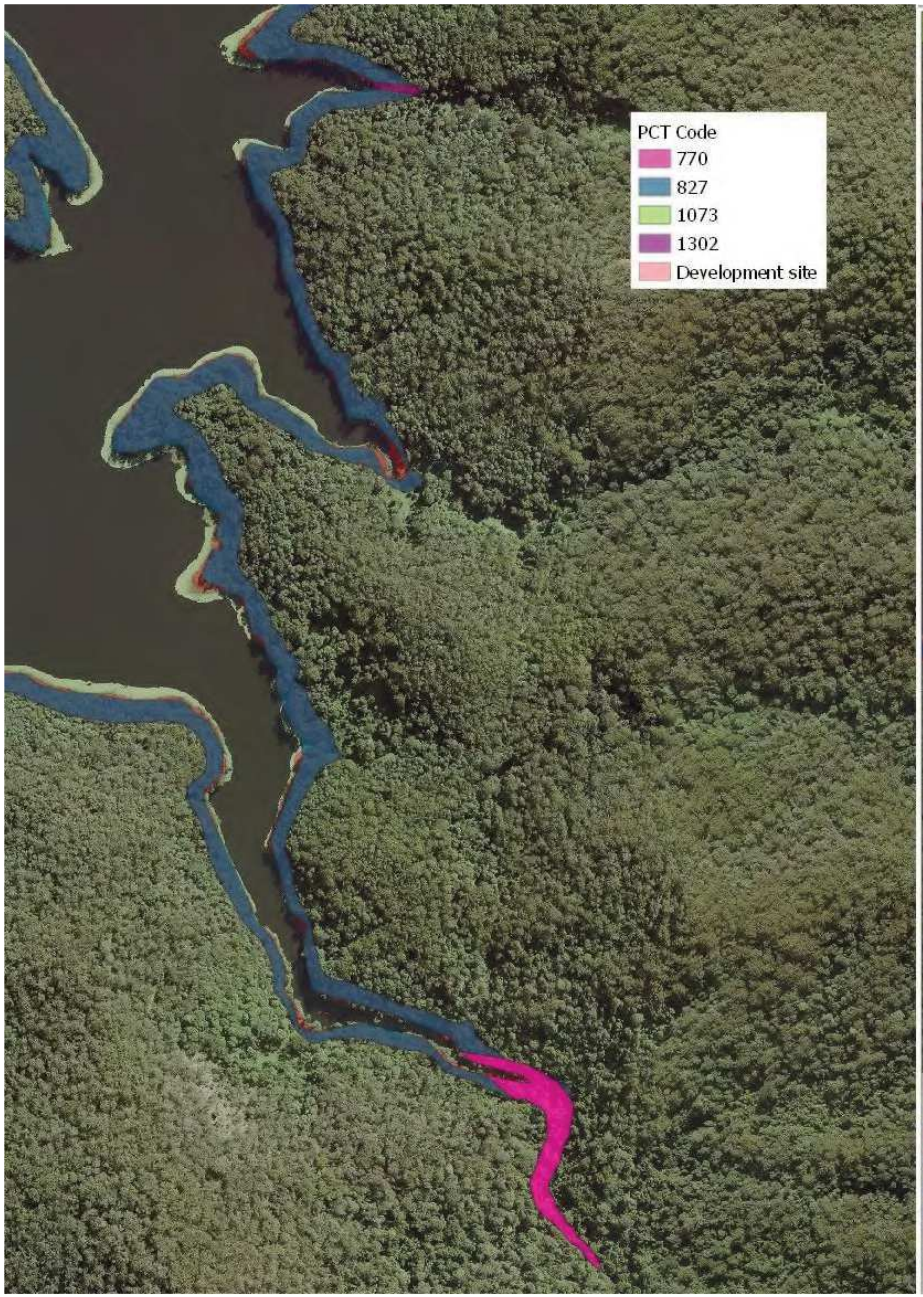
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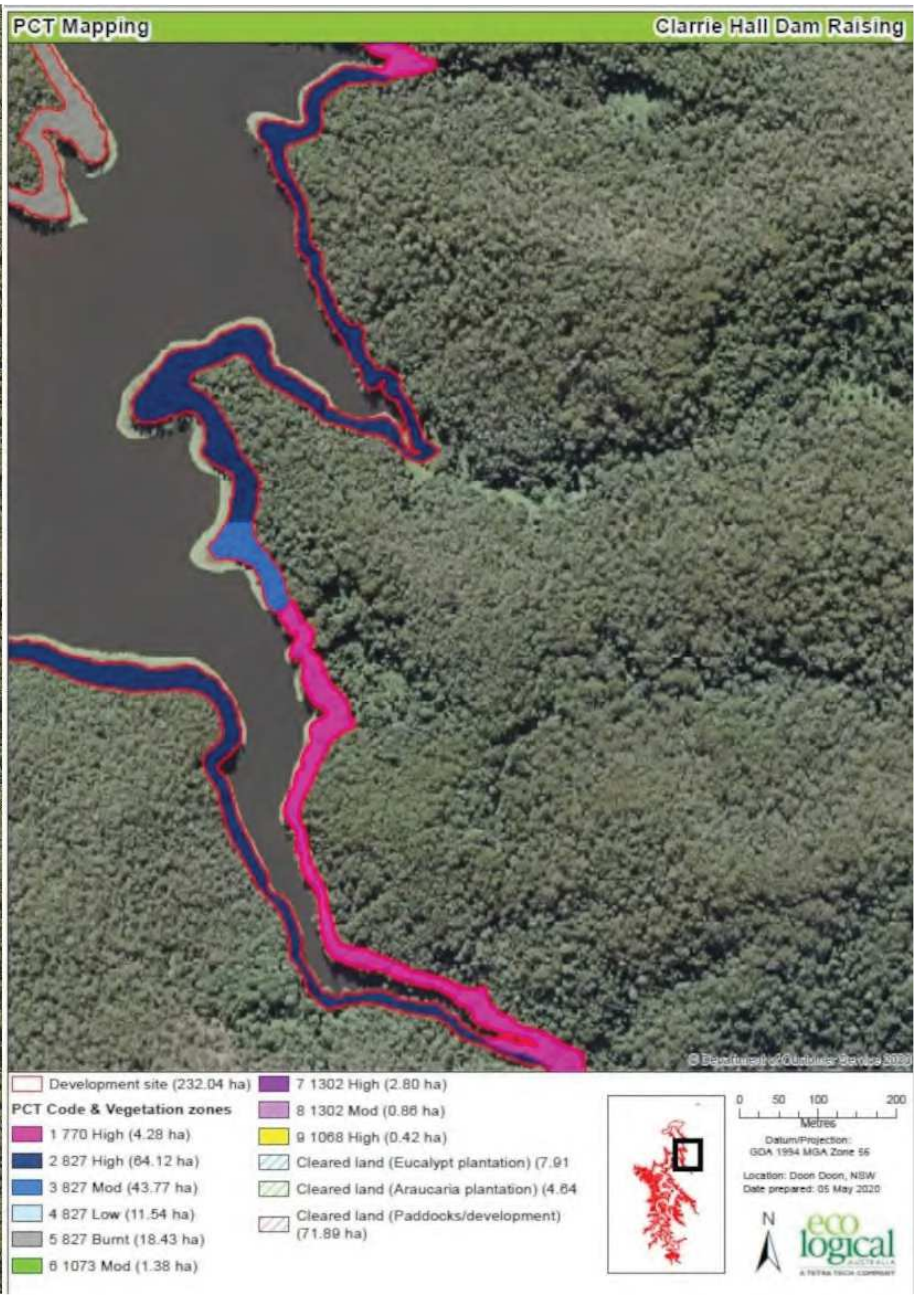
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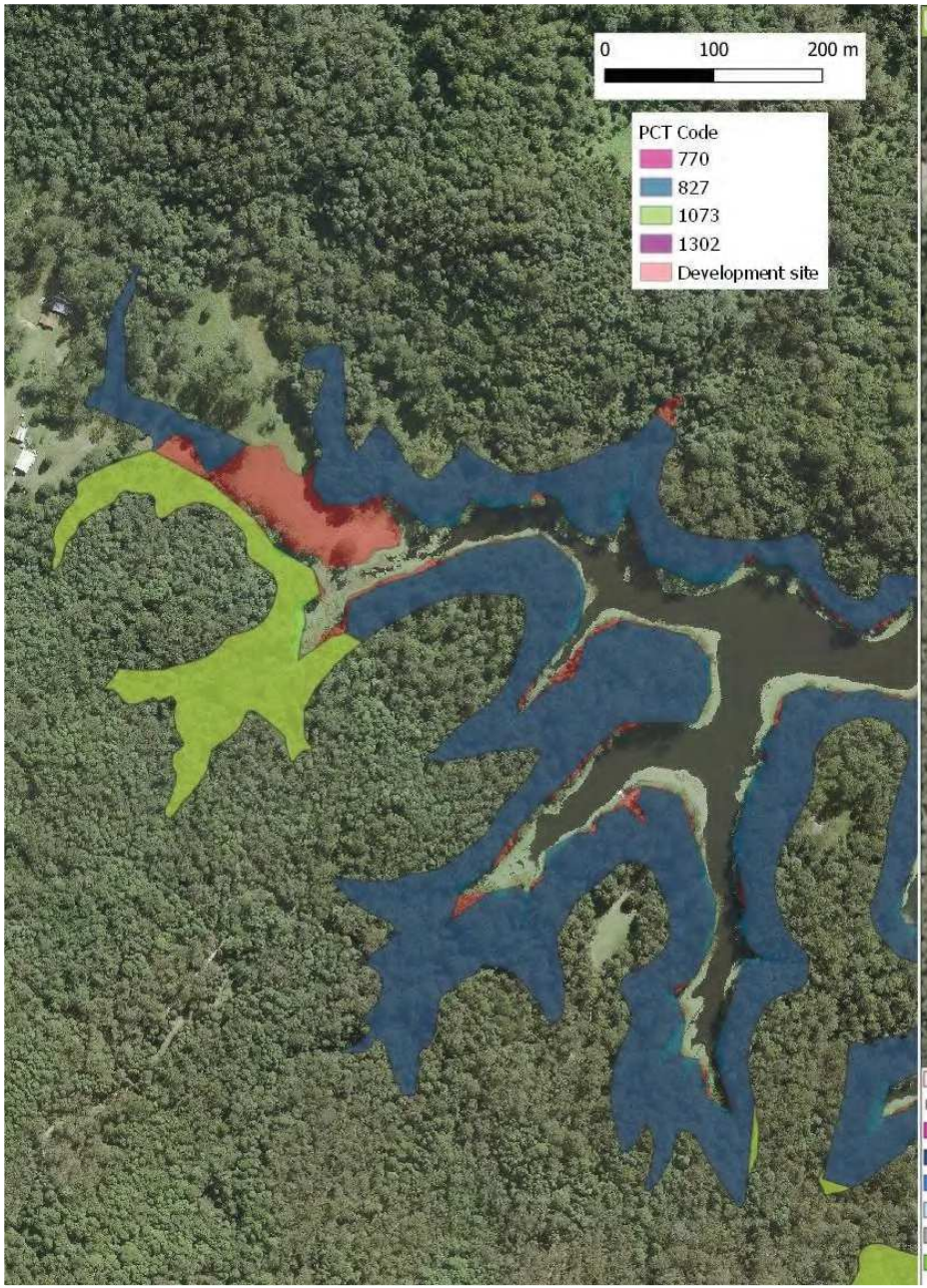
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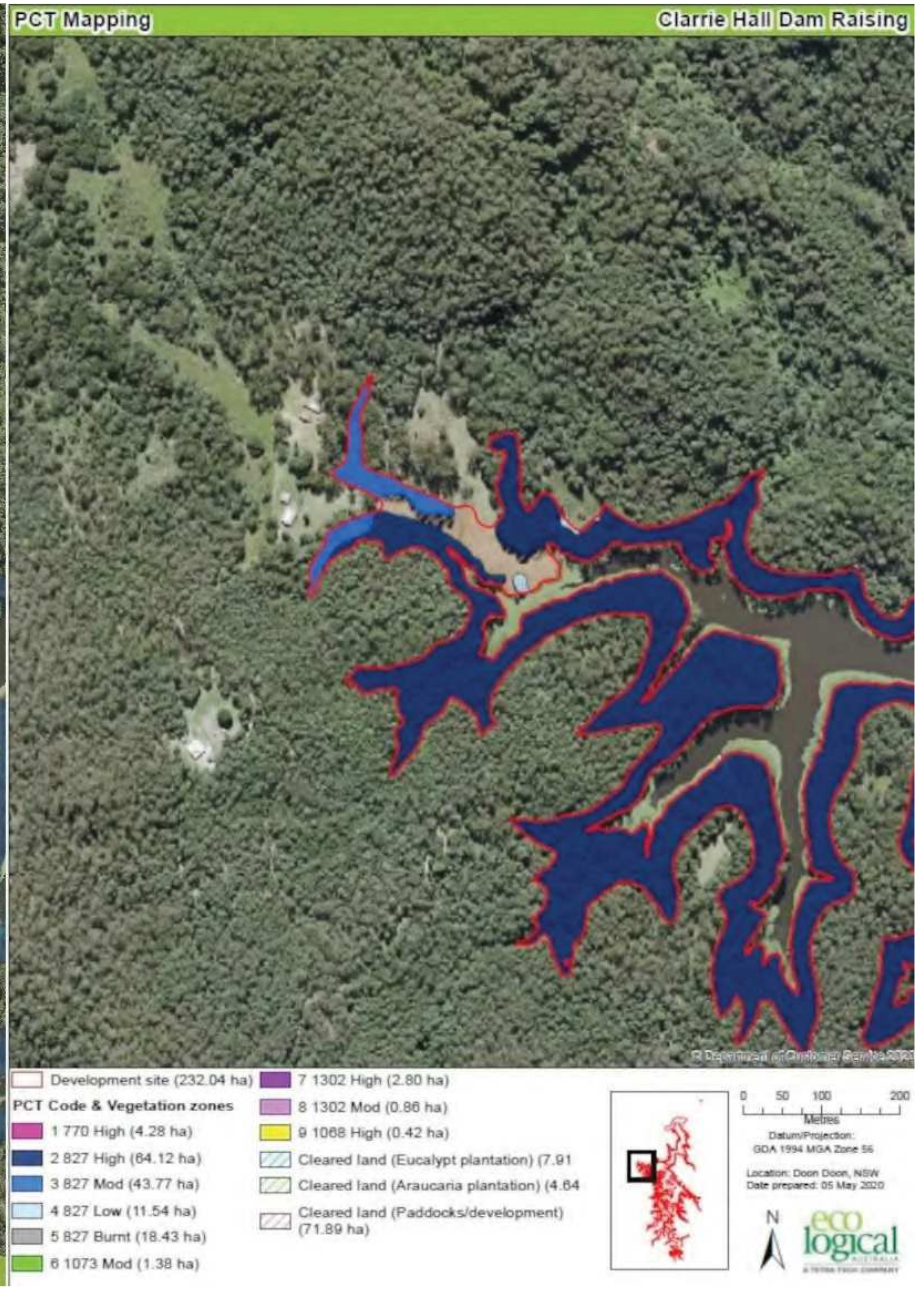
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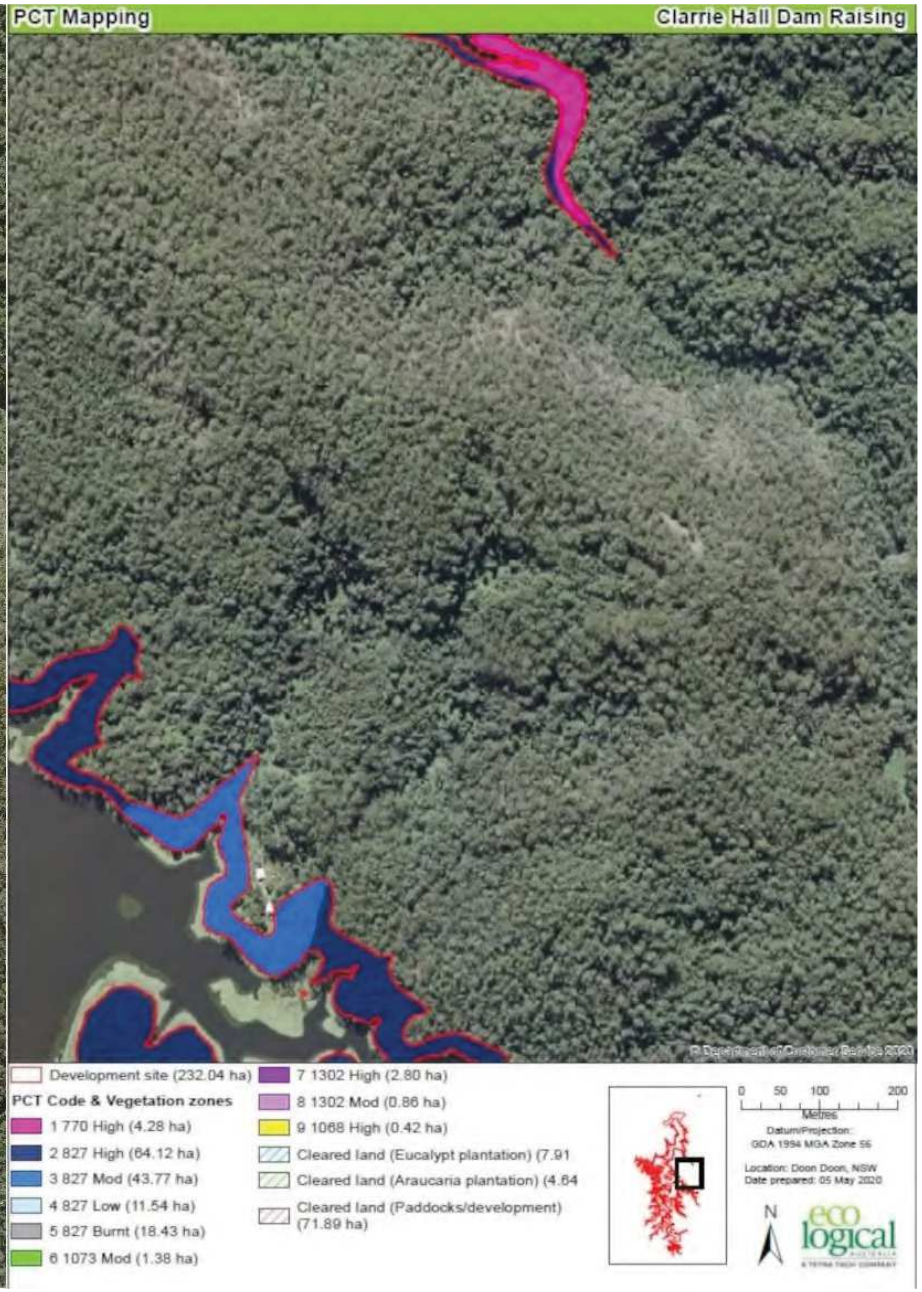
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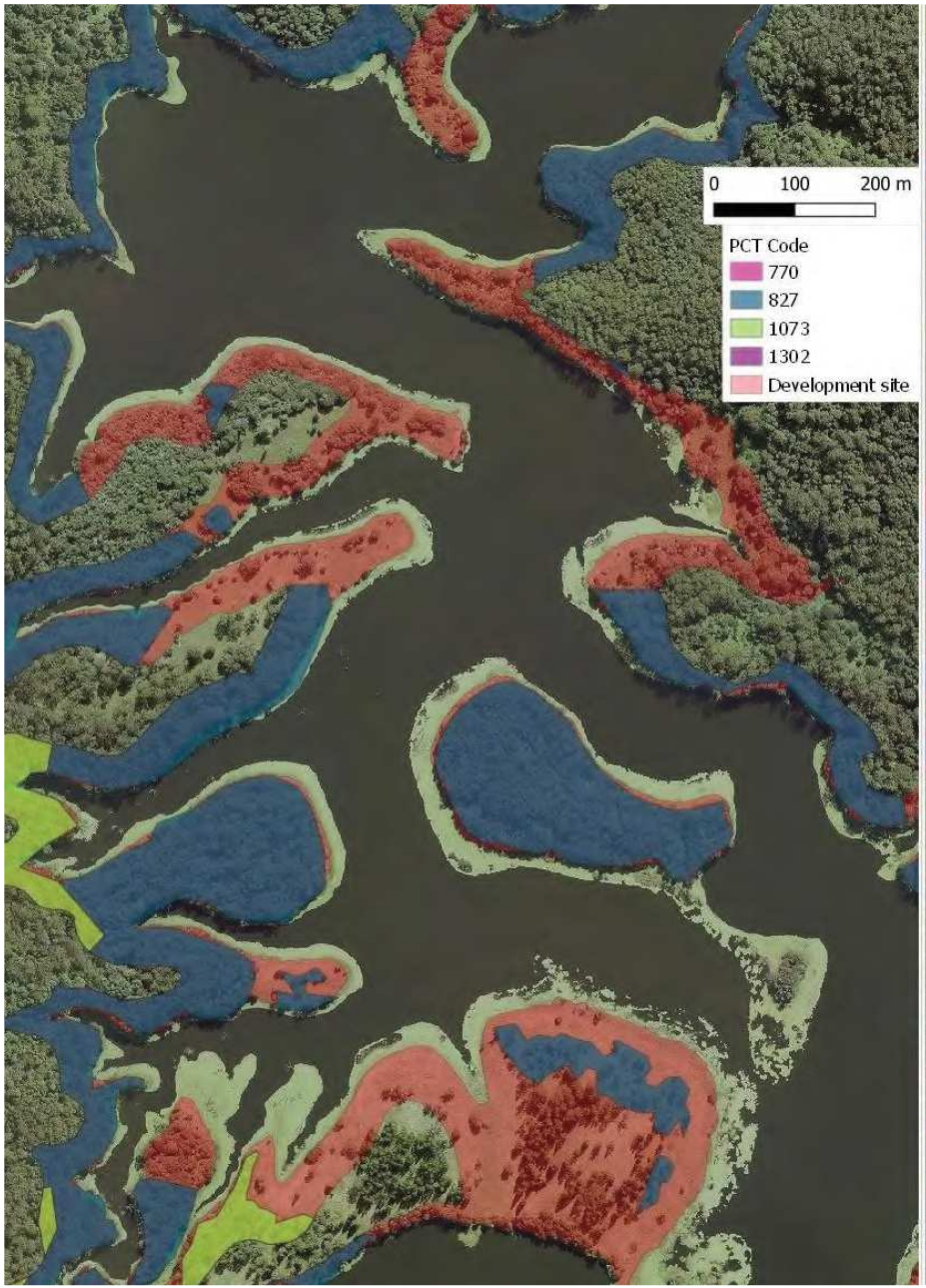
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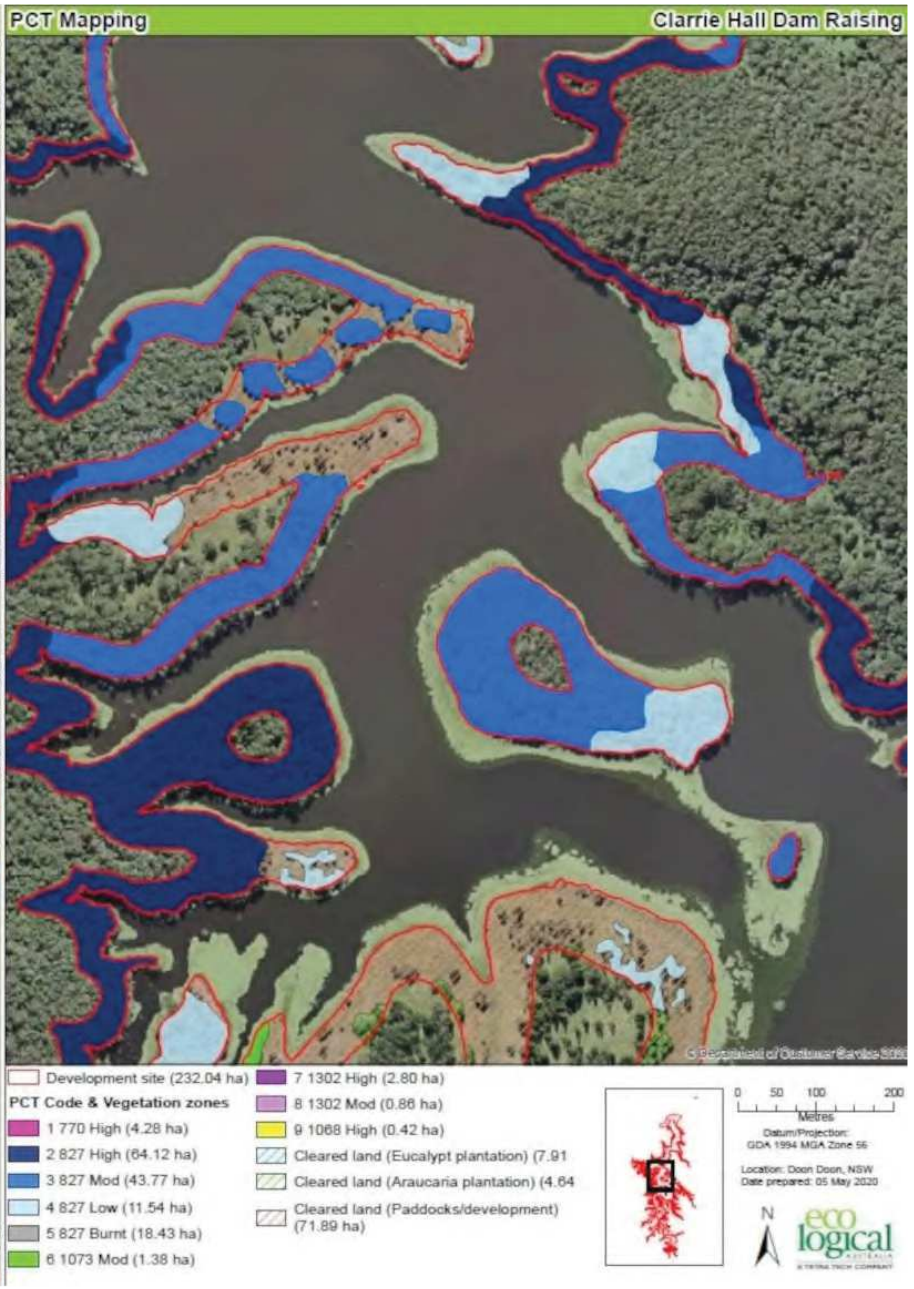
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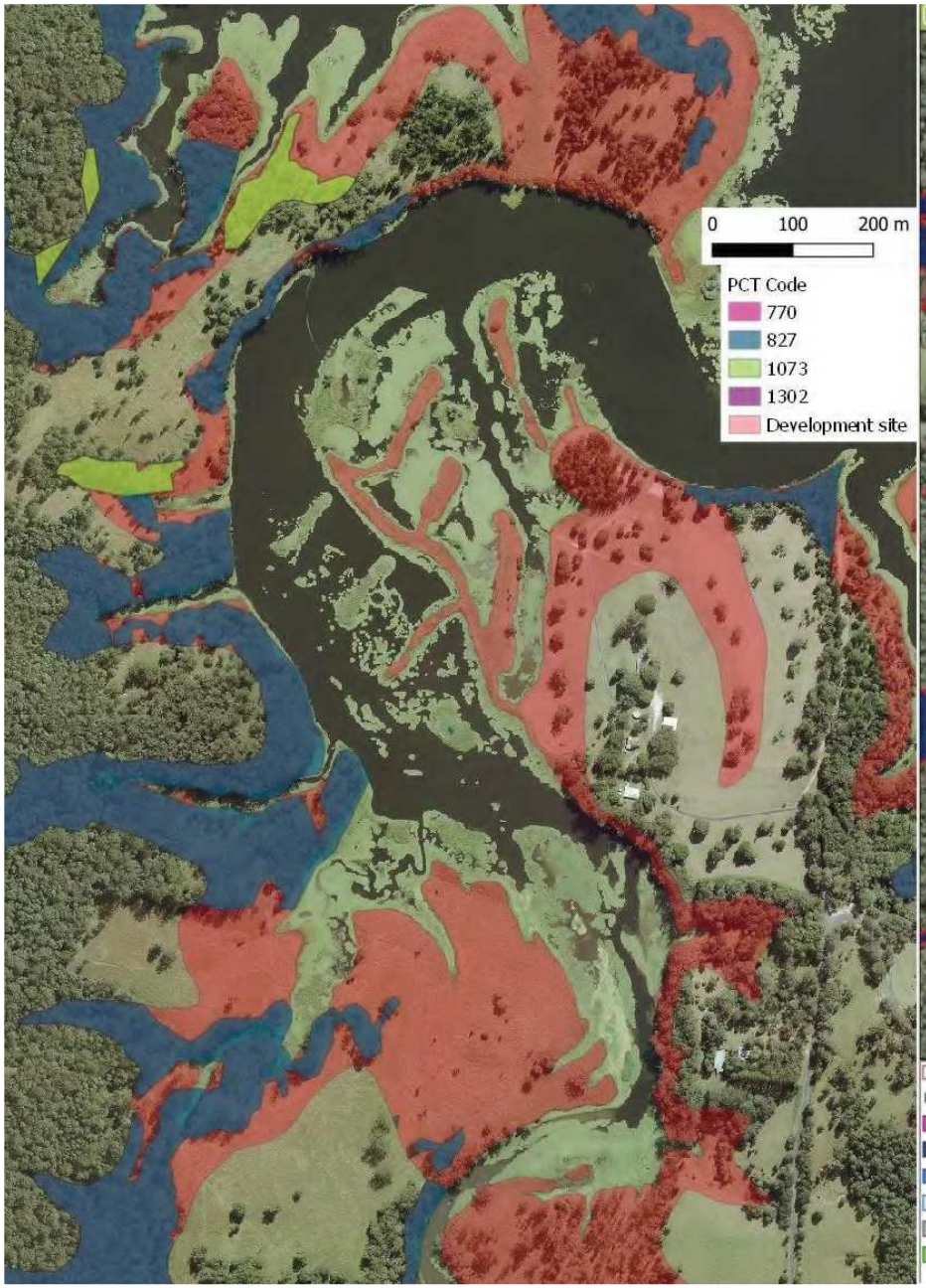
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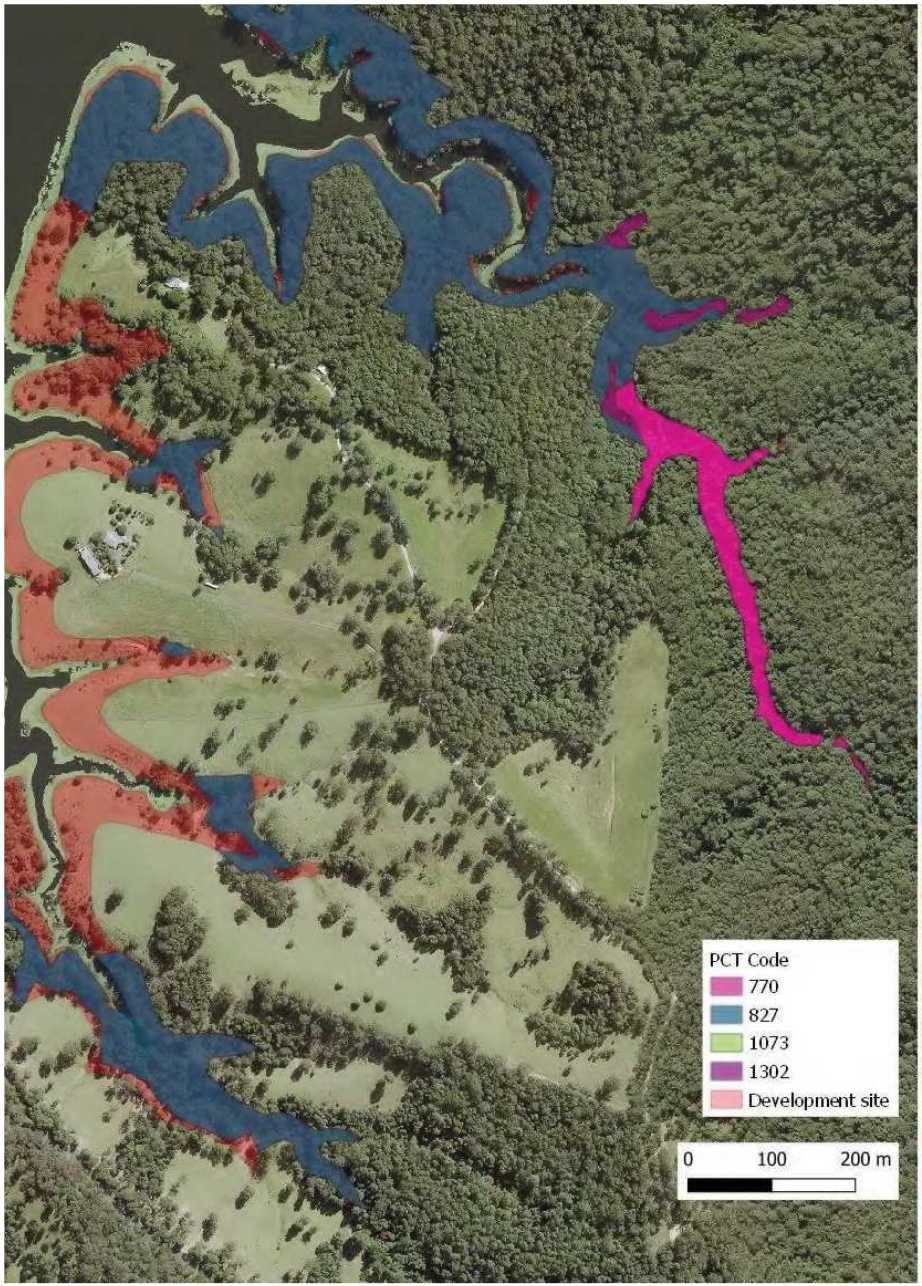
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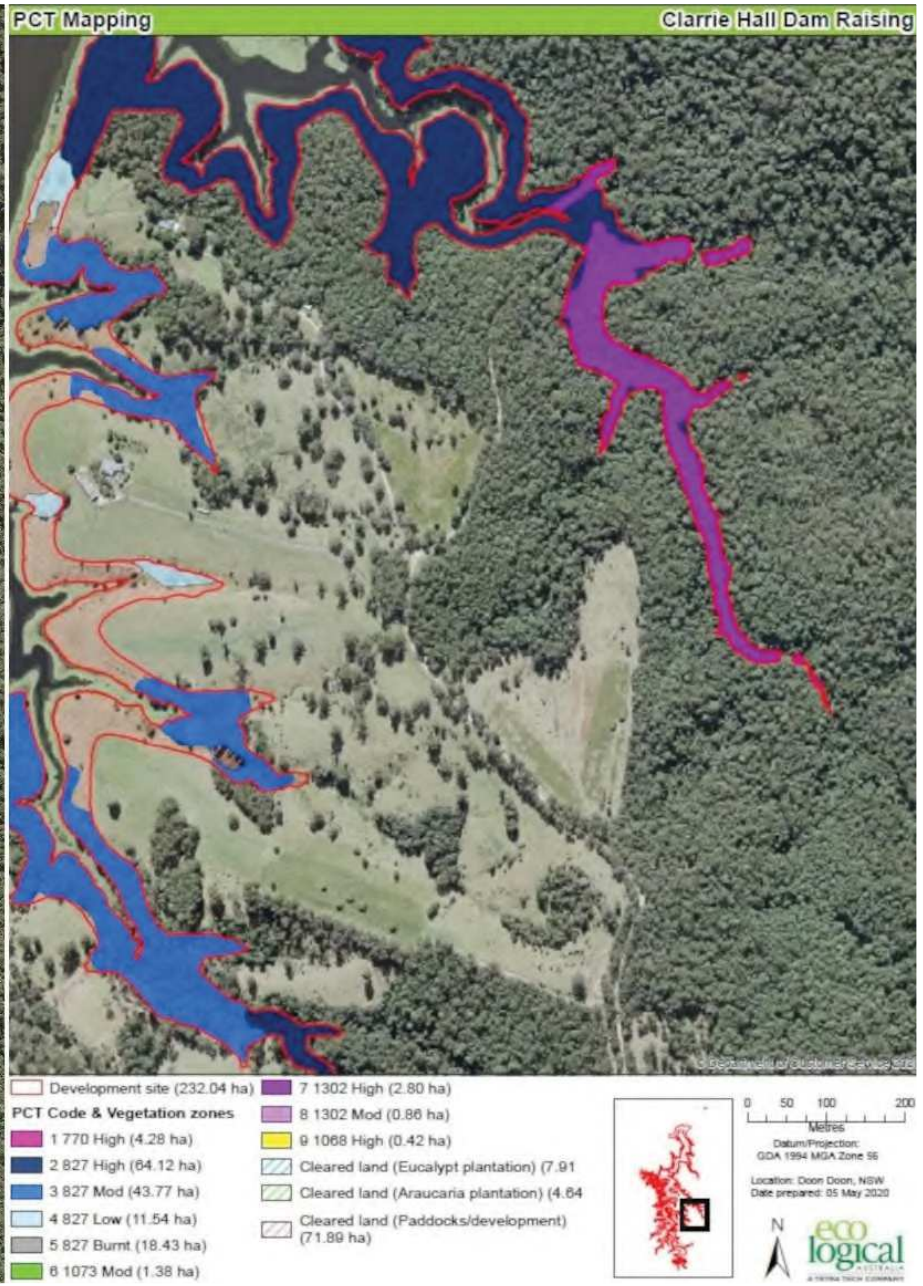
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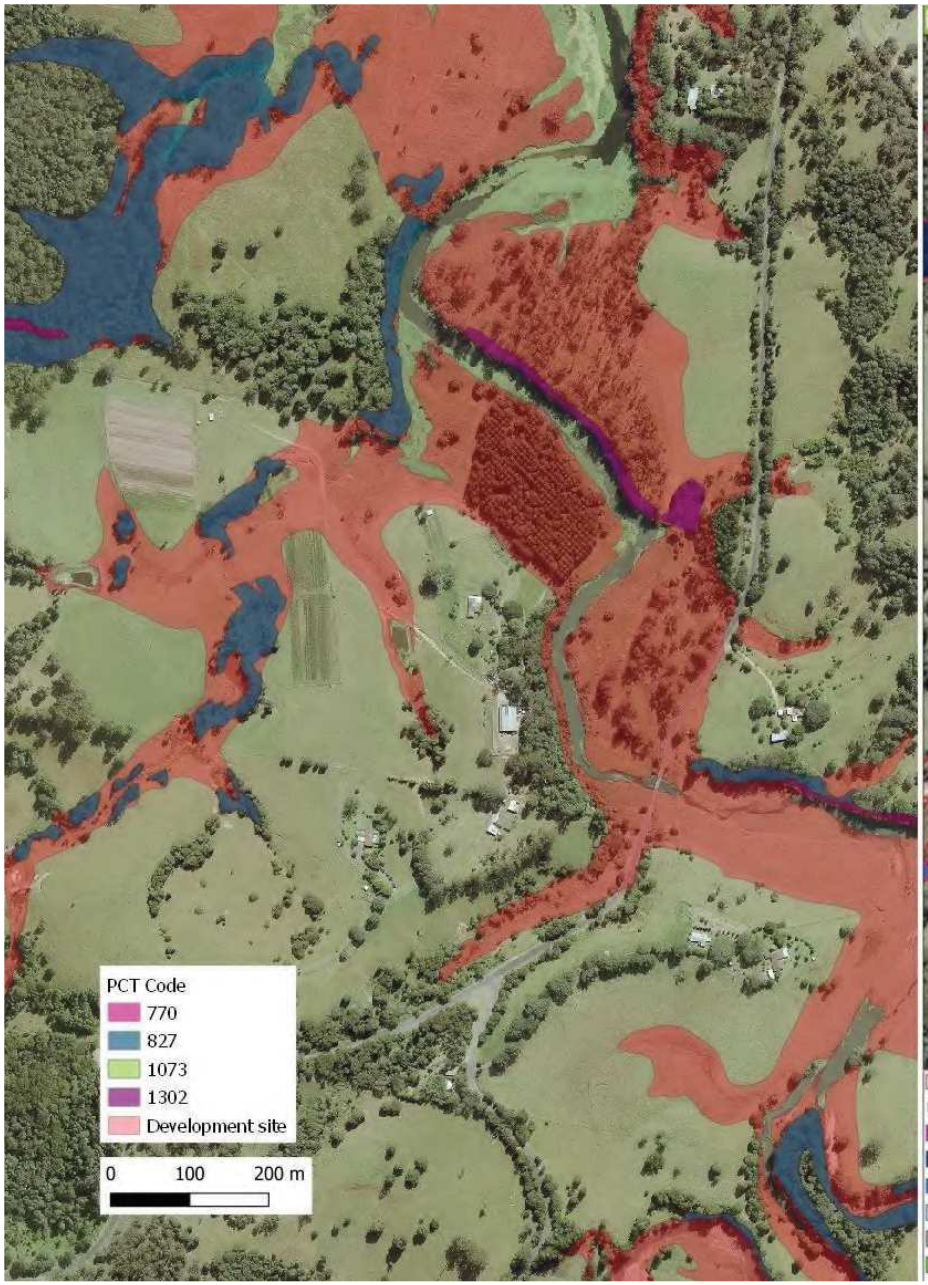
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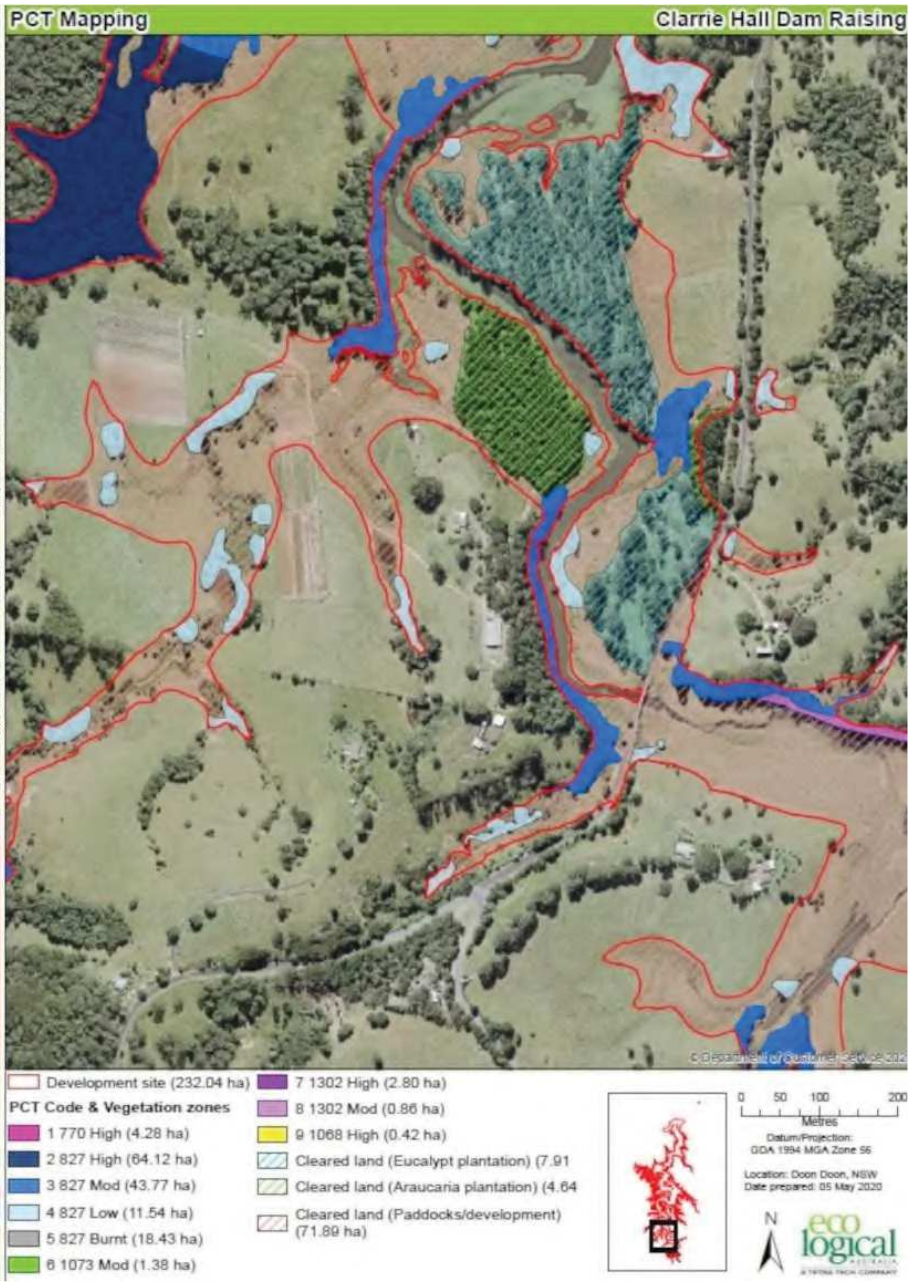
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Cleared land (Araucaria plantation) (4.64
Cleared land (Paddocks/development) (71.89 ha)
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Metres
Datum/Projection:
GDA 1994 MGA Zone 56
Location: Doon Doon, NSW
Date prepared: 05 May 2020
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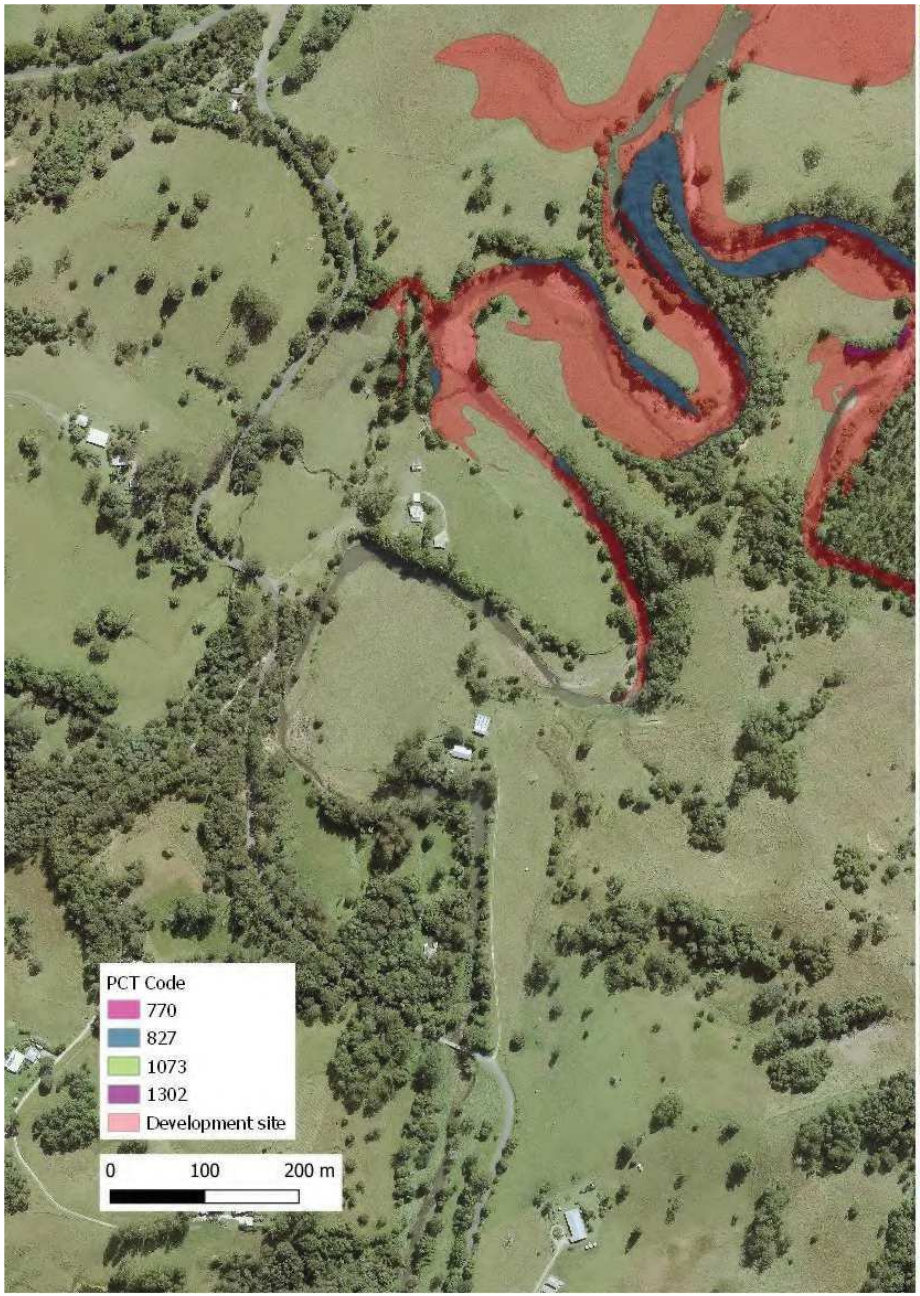
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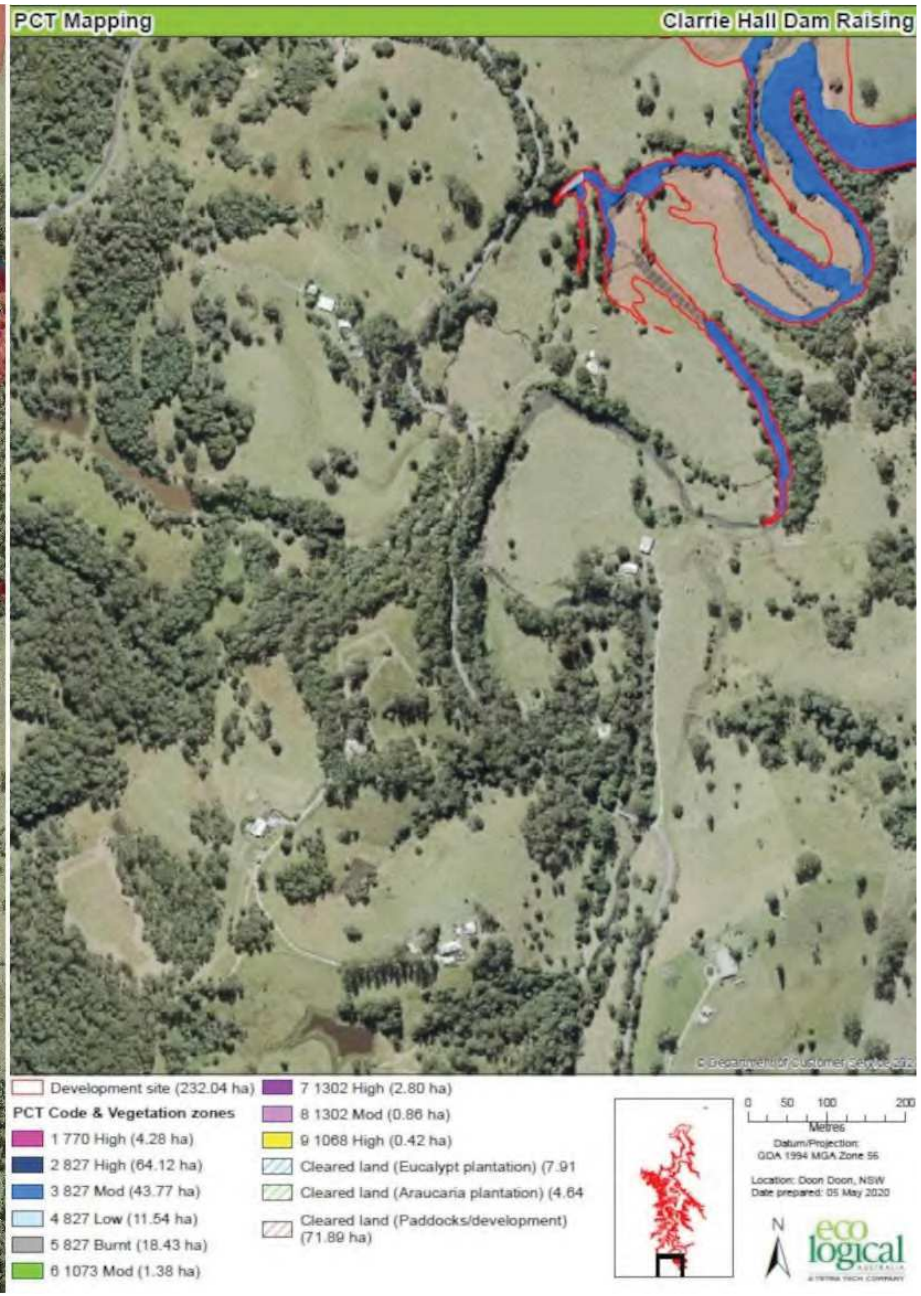
827
1073
1302
Development site
0
100
200 m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Clarrie Hall Dam Raising
Development site (232.04 ha)
PCT Code & Vegetation zones
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2 827 High (64.12 ha)
3 827 Mod (43.77 ha)
4 827 Low (11.54 ha)
5 827 Burnt (18.43 ha)
6 1073 Mod (1.38 ha)
7 1302 High (2.80 ha)
8 1302 Mod (0.86 ha)
9 1068 High (0.42 ha)
Cleared land (Eucalypt plantation) (7.91
Cleared land (Araucaria plantation) (4.64
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Metres
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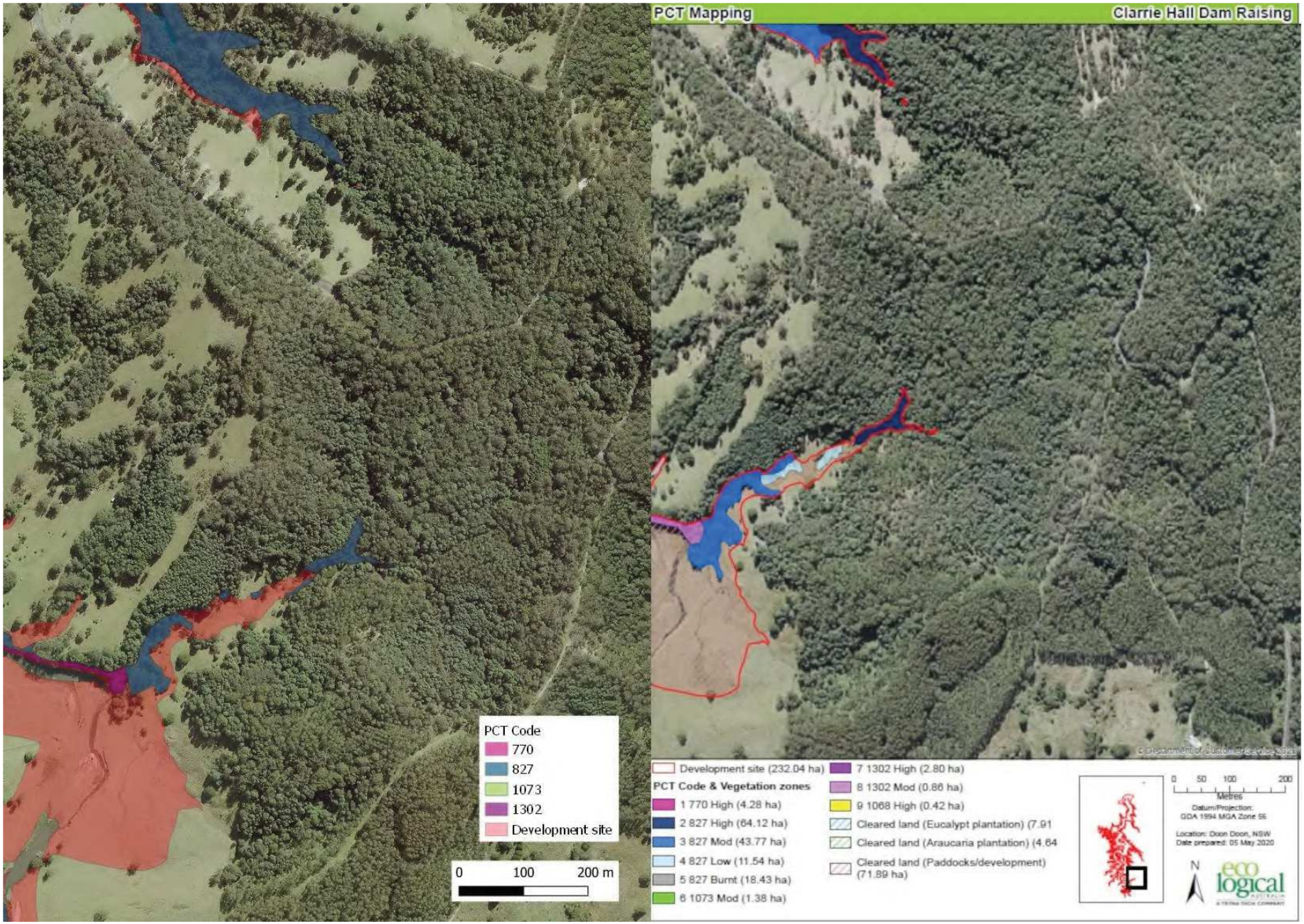
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Clarrie Hall Dam Raising
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Datum/Projection:
GDA 1994 MGA Zone 56
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Date prepared: 05 May 2020
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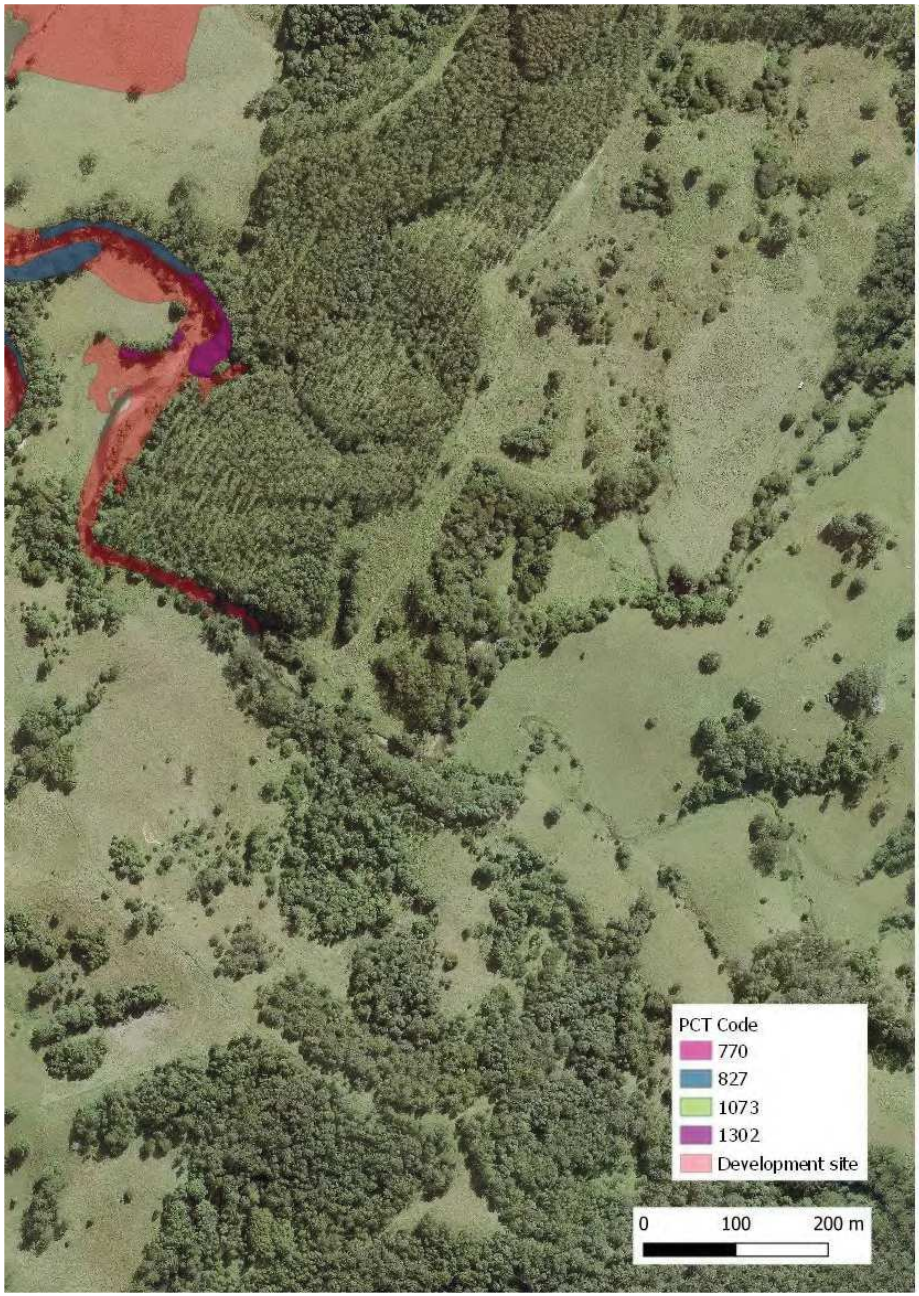
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1302
Development site
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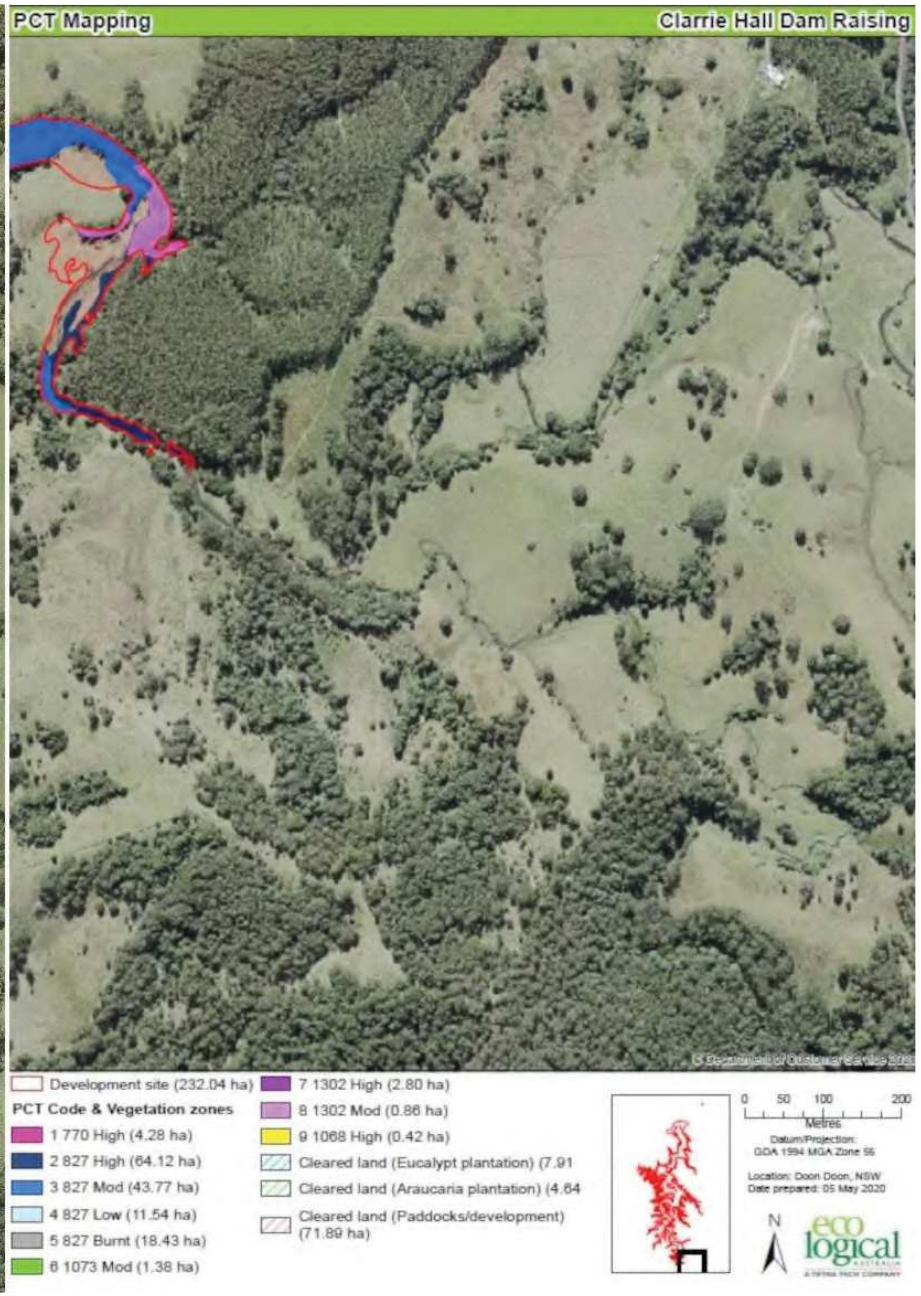
200 m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Clarrie Hall Dam Raising
Development site (232.04 ha)
PCT Code & Vegetation zones
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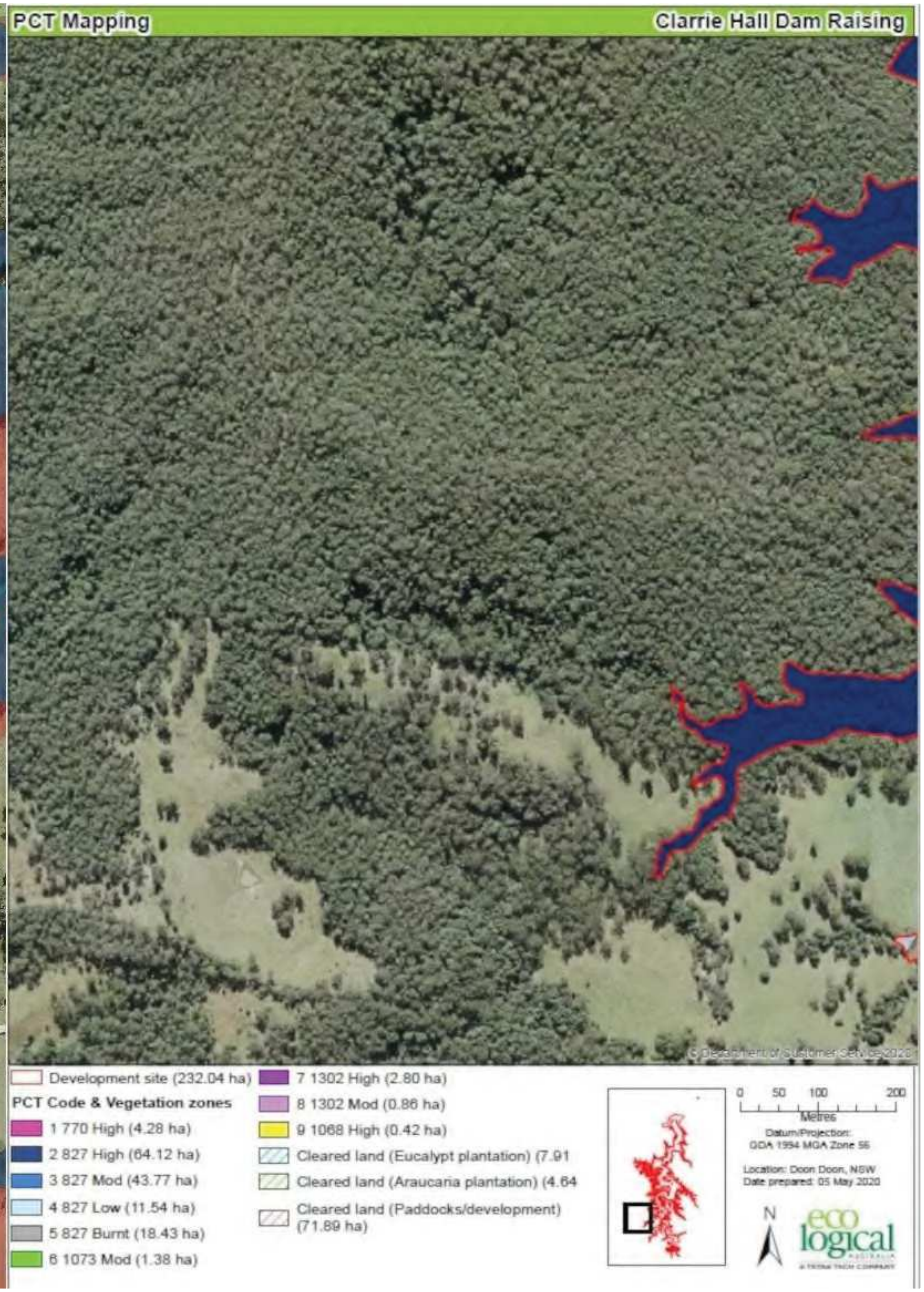
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PCT Code & Vegetation zones
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Location: Doon Doon, NSW
Date prepared: 05 May 2020
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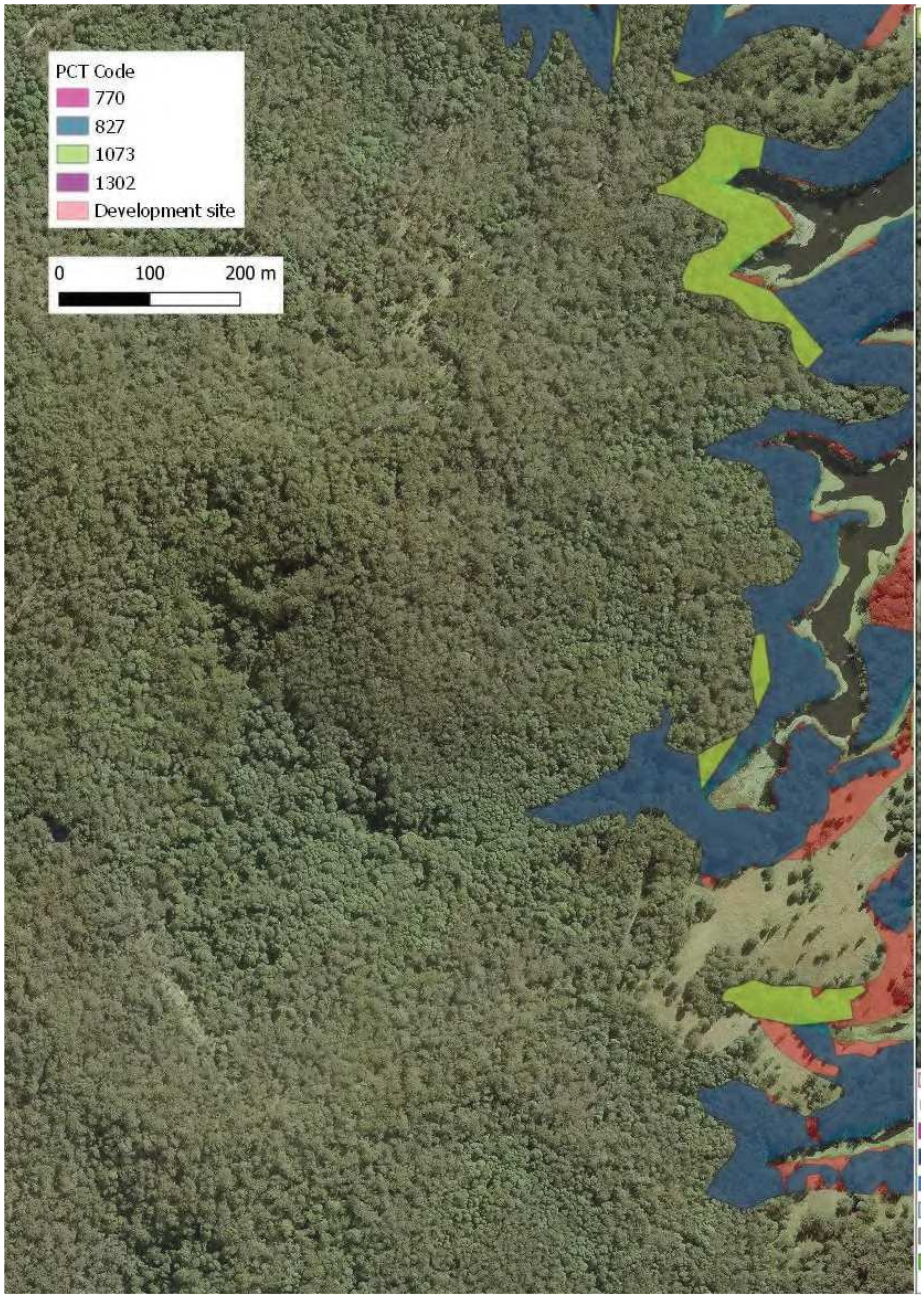
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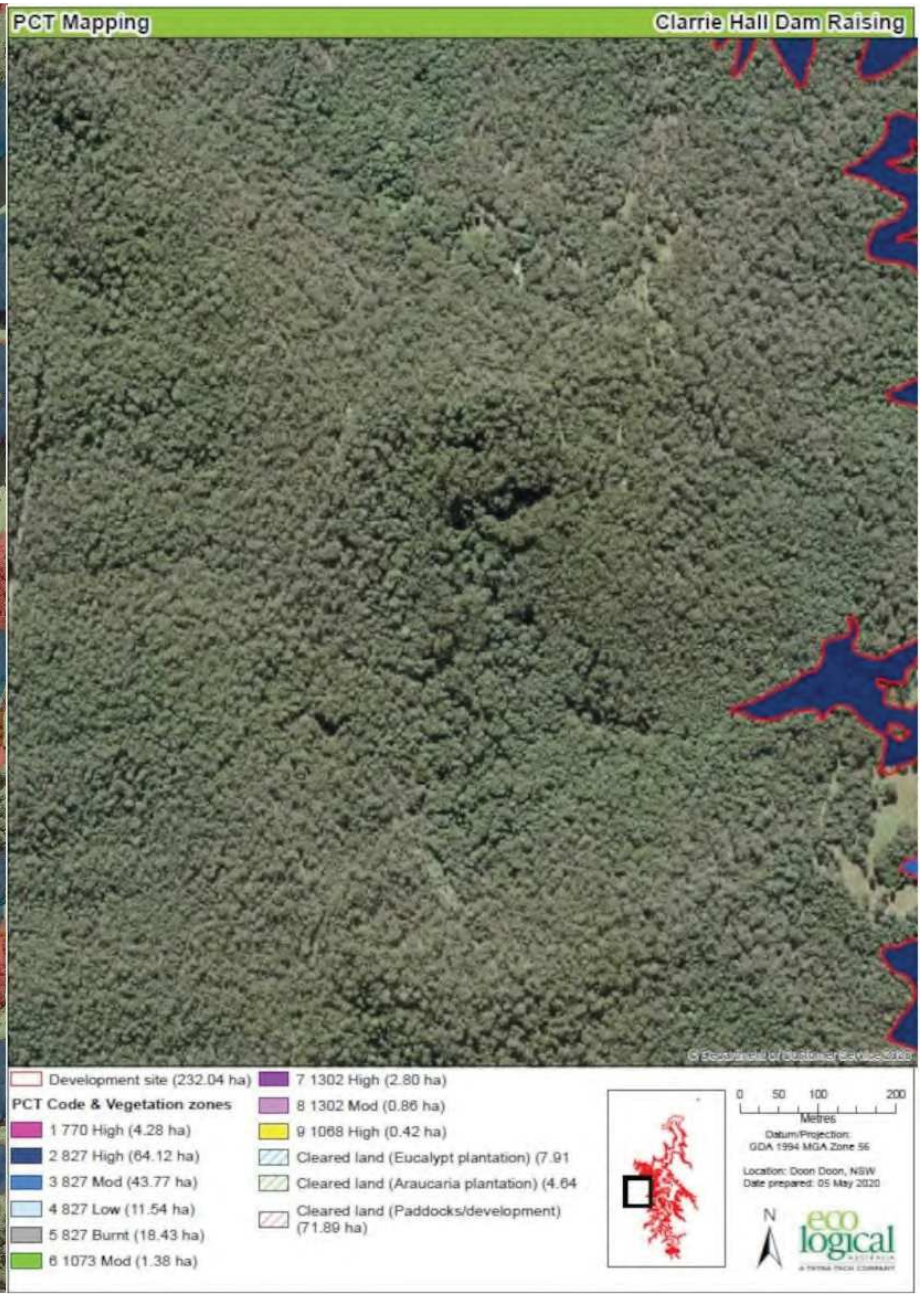
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Development site (232.04 ha)
PCT Code & Vegetation zones
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770
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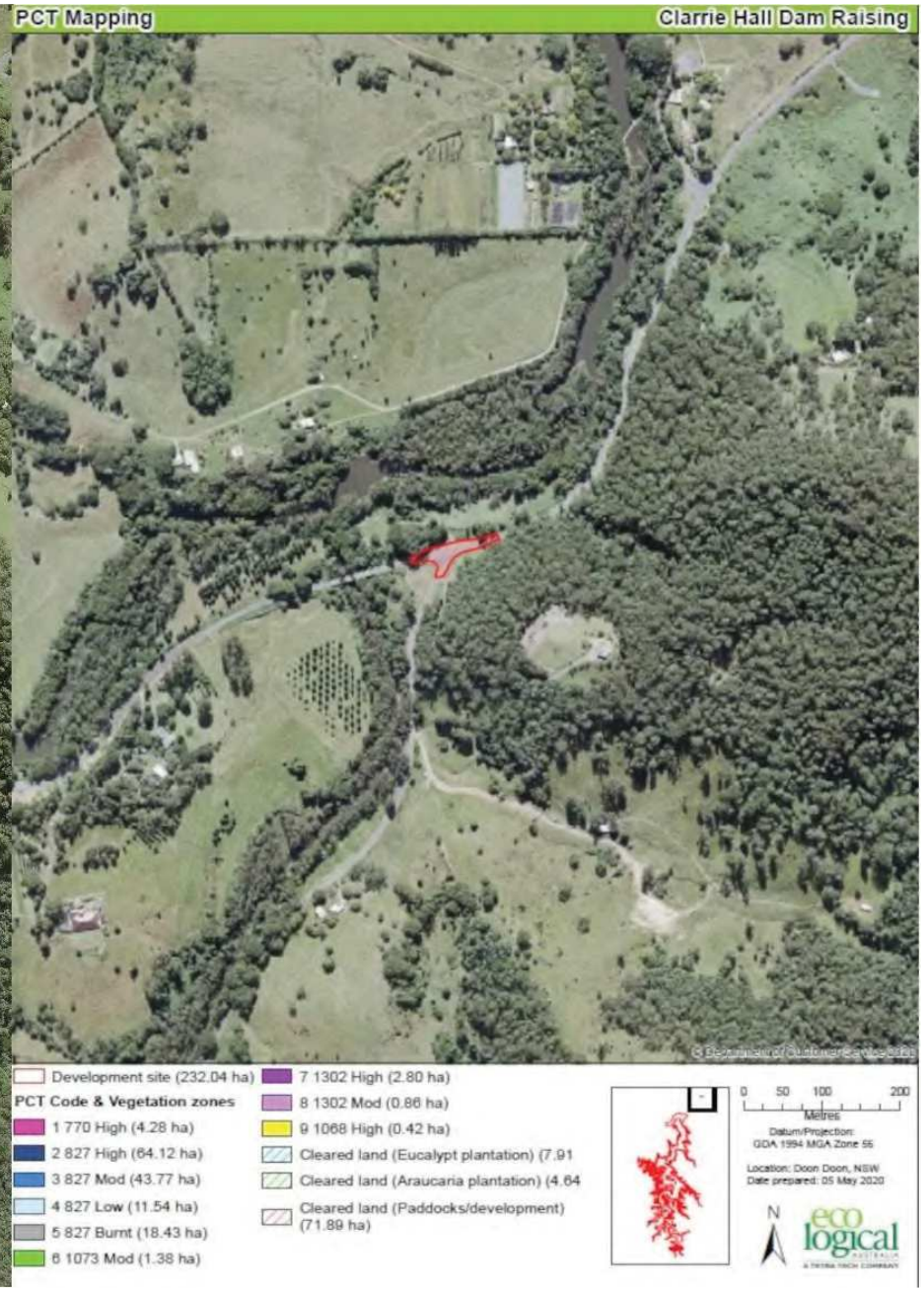
Development site
0
100
200 m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Clarrie Hall Dam Raising
Development site (232.04 ha)
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0
50
100
200
Metres
Datum/Projection:
GDA 1994 MGA Zone 56
Location: Doon Doon, NSW
Date prepared: 05 May 2020
N
eco logical

Appendix C. Vegetation data from BAM plots collected during 2016/17 and 2020

Table C1. Vegetation data using the BAM method collected by ELA.

Plot ID	PCT ID	Composition							Structure						Function										
				Tree	Shrub	Grass	Forb	Fern	Other	Tree	Shrub	Grass	Forb	Fern	Other	Large trees	HBTs	Litter cover	Fallen log length	Tree stem (5 to 9)	Tree stem (10 to 19)	Tree stem (20 to 29)	Tree stem (30 to 49)	Tree stem (50 to 79)	Tree regeneration	High threat exotic cover
Plot 1	827			13	9	3	6	2	9	36.8	12	0.5	0.8	3.2	17.2	0	5	91	72	1	1	1	1	1	1	0
Plot 2	770			20	12	2	4	5	16	35.2	5.9	0.2	0.6	2.7	8.5	0	2	70	95	1	1	1	1	1	1	0.2
Plot 3	827			20	9	2	3	3	13	93.2	2.5	1.1	0.3	25.2	3.4	4	7	77.2	73	1	1	1	1	1	1	0
Plot 4	827			18	15	5	4	6	10	55.3	2.5	0.7	0.6	0.9	5.1	0	4	56	36	1	1	1	1	0	1	16.1
Plot 5	827			19	9	5	5	4	11	51.1	8.3	0.6	0.5	30.3	1.6	0	5	75.6	61	1	1	1	1	0	1	0.1
Plot 6	827			14	7	5	3	1	9	24.1	0.9	0.5	0.4	20	1.1	0	6	54	69	1	1	1	1	0	1	0.3
Plot 7	770			16	8	2	4	8	15	24.7	1.7	0.4	0.5	1.2	54.2	1	12	50	51	1	1	1	1	1	1	0
Plot 8	827			17	13	5	8	4	19	14.2	2	0.8	1.1	15.4	3.2	0	4	35	96	1	1	1	1	0	1	5
Plot 9	827			15	10	5	2	2	8	15.3	1.3	0.6	0.2	10.1	15.9	0	0	58.8	230	1	1	1	1	1	1	45.2
Plot 10	827			7	4	4	0	1	3	22.8	5.3	65.4	0	0.1	0.3	0	3	21	82	1	1	1	0	0	1	4.3
Plot 11	827			5	6	5	0	3	7	21.1	5.1	48.6	0	0.5	0.8	0	2	24	52	1	1	1	0	0	1	15.3
Plot 12	827			12	13	4	4	4	12	23.2	1.6	8.5	0.5	5.5	18	0	5	69	38	1	1	1	1	1	1	8.4
Plot 13	827			15	7	6	3	3	14	3.2	0.9	25.5	0.4	0.5	1.6	0	9	68.8	62	1	0	1	1	0	1	43.2
Plot 14	1073			5	8	11	0	1	4	24.3	0.9	23.1	0	0.2	0.4	2	5	8.6	28	1	1	1	1	1	1	25.8
Plot 15	1073			9	8	10	5	1	8	26.9	1.1	16.7	0.5	0.1	0.8	0	6	28	26	1	1	1	1	1	1	40.6
Plot 16	n/a			10	2	3	5	2	4	63	0.2	25.2	0.5	0.2	0.4	0	4	67	6	1	1	1	1	1	1	1
Plot 17	770			15	16	4	7	3	14	67.6	7.1	5.3	1.4	5	33.6	0	6	35	132	1	1	1	1	0	1	0

Plot 18	827			18	18	4	4	1	14	47.9	7.5	2.7	0.8	0.2	4.9	1	0	90.6	32	1	1	1	1	0	1	1.6
Plot 19	827			15	15	4	4	4	7	38.5	18.9	0.6	0.9	15.4	21.3	1	2	94.6	28	1	1	1	1	1	1	0.1
Plot 20	1302			13	8	4	1	3	12	50.2	6.4	0.6	0.1	0.6	34.4	1	0	72	22	1	1	1	1	1	1	0
Plot 21	1302			14	10	2	4	5	12	39.4	21.1	0.3	0.4	0.7	42.9	2	0	82	61	1	1	1	1	1	1	0
Plot 22	1302			11	11	1	3	4	12	7.1	3	0.2	0.3	0.4	65.1	2	0	98.2	31	1	1	1	1	0	1	0
Plot 23	827			21	10	4	2	2	9	51.6	3.5	1	0.5	5.1	4.4	1	0	84	50	1	1	1	1	1	1	0.4
Plot 24	1302			13	4	4	1	3	10	9.7	60.3	0.5	0.2	8.1	1.8	0	1	48	20	1	1	1	1	1	1	21.3
Plot 25	1302			16	10	1	4	5	10	18.2	71.4	0.2	0.4	5.9	1.5	0	0	65	20	1	1	1	0	0	1	0.3
Plot 26	827			12	7	5	4	4	8	25.2	55.8	1.6	0.4	5.4	2.5	0	0	58	8	1	1	1	1	0	1	6
Plot 27	n/a			0	0	2	1	0	0	0	0	75	0.1	0	0	0	0	10	0	0	0	0	0	0	0	25
Plot 28	827			15	12	4	1	1	13	38.7	22.9	5.8	0.2	0.2	1.7	0	0	78	10	1	1	1	1	1	1	5.3
Plot 29	827			16	10	2	4	3	16	29.2	66	0.2	0.7	0.3	4.9	3	1	97	22	1	1	1	1	0	1	0.2
Plot 30	n/a			6	2	1	3	0	0	20.9	0.3	0.1	0.3	0	0	0	0	12	18	1	1	1	1	1	1	93.3
Plot 31	827			8	3	6	6	2	4	38.5	0.3	5.8	0.8	0.3	0.4	9	1	93	3	1	1	1	1	1	1	0.8
Plot 32	n/a			0	0	3	2	1	0	0	0	4.2	0.4	0.1	0	0	0	70	0	0	0	0	0	0	0	40.1
Plot 33	827			5	0	5	1	1	3	21.2	0	20.8	0.1	0.2	0.3	2	2	90.6	0	2	2	2	2	2	1	25.4
Plot 34	n/a			5	5	2	4	1	3	60.4	0.5	2.2	0.4	0.2	0.3	0	0	81	0	0	0	0	1	1	1	7.1
Plot 35	n/a			4	0	1	0	0	3	10.9	0	0.1	0	0	0.3	0	1	44	0	1	1	1	1	1	1	80.8
Plot 36	n/a			11	2	1	2	1	4	22.2	0.5	0.2	0.2	0.2	0.7	0	0	58	0	0	0	0	0	1	1	88.1

Table C2. Vegetation data using the BAM method collected by TSC.

Plot	Composition				Structure							Function				
	Upper strata richness	Mid strata richness	Grass richness	Low strata richness	Upper strata cover	Mid strata cover	Grass cover	Other low cover	HBT count	Litter cover	Log (linear m)	10-20 cm DBH count	20-30 cm DBH count	30-50 cm DBH count	50-80 cm DBH count	Large tree (>80 cm) count
TSC_770_1	13	22	0	24	80	30	0	20	3	77	45	61	18	7	2	2
TSC_827_1	11	20	1	20	80	15	0.5	4	0	90	20	40	14	4	3	3
TSC_1073_1	6	15	1	20	70	8	1	4	0	80	69	27	5	10	3	0
TSC_827_2	1	1	3	12	35	0	16	0.5	1	50	0	0	0	5	1	1
TSC_827_3	8	14	3	22	70	6	0.5	2	0	80	65	45	22	6	0	0
TSC_827_4	9	1	0	22	60	20	0	10	1	10	295	29	12	5	7	0
TSC_827_5	9	13	4	13	45	10	0.5	25	0	75	45	16	5	11	3	1
TSC_827_6	16	12	1	23	70	3	5	3	0	98	44	22	5	9	4	2
TSC_827_7	8	7	3	13	40	8	<1	35	0	0	74	28	17	2	3	0
TSC_HHP_1	1	2	1	11	65	0.5	0.5	0.5	0	40	0	0	0	29	0	0
TSC_EUCP_1	1	3	3	3	35	0	1	1	0	10	65	0	3	8	4	0
TSC_827_8	11	12	3	18	40	15	0.5	5	0	95	75	39	11	7	10	1
TSC_770_2	9	12	0	12	70	50	0	5	0	98	202	66	17	1	0	0

Appendix D. Vegetation data from BAM plots collected during 2016/17 and 2020 that was used for the multivariate analysis

Site	Upper species richness	Mid species richness	Grass species richness	Low species richness	Upper cover	Mid cover	Grass cover	Low cover	Count of HBTs	Litter cover	Log (linear m)	DBH 10-20 cm presence	DBH 20-30 cm presence	DBH 30-50 cm presence	DBH 50-80 cm presence	Large tree (>80 cm DBH) count
ELA_1073_1	5	8	11	5	24.3	0.9	23.1	0.6	5	8.6	28	1	1	1	1	2
ELA_1073_2	9	8	10	14	26.9	1.1	16.7	1.4	6	28	26	1	1	1	1	0
ELA_1302_1	13	8	4	16	50.2	6.4	0.6	35.1	0	72	22	1	1	1	1	1
ELA_1302_2	14	10	2	21	39.4	21.1	0.3	44	0	82	61	1	1	1	1	2
ELA_1302_3	11	11	1	19	7.1	3	0.2	65.8	0	98.2	31	1	1	1	0	2
ELA_1302_4	13	4	4	14	9.7	60.3	0.5	10.1	1	48	20	1	1	1	1	0
ELA_1302_5	16	10	1	19	18.2	71.4	0.2	7.8	0	65	20	1	1	0	0	0
ELA_770_1	20	12	2	25	35.2	5.9	0.2	11.8	2	70	95	1	1	1	1	0
ELA_770_2	16	8	2	27	24.7	1.7	0.4	55.9	12	50	51	1	1	1	1	1
ELA_770_3	15	16	4	24	67.6	7.1	5.3	40	6	35	132	1	1	1	0	0
ELA_827_1	13	9	3	17	36.8	12	0.5	21.2	5	91	72	1	1	1	1	0
ELA_827_10	12	13	4	20	23.2	1.6	8.5	24	5	69	38	1	1	1	1	0
ELA_827_11	15	7	6	20	3.2	0.9	25.5	2.5	9	68.8	62	0	1	1	0	0
ELA_827_12	18	18	4	19	47.9	7.5	2.7	5.9	0	90.6	32	1	1	1	0	1
ELA_827_13	15	15	4	15	38.5	18.9	0.6	37.6	2	94.6	28	1	1	1	1	1
ELA_827_14	21	10	4	13	51.6	3.5	1	10	0	84	50	1	1	1	1	1
ELA_827_15	12	7	5	16	25.2	55.8	1.6	8.3	0	58	8	1	1	1	0	0
ELA_827_16	15	12	4	15	38.7	22.9	5.8	2.1	0	78	10	1	1	1	1	0
ELA_827_17	16	10	2	23	29.2	66	0.2	5.9	1	97	22	1	1	1	0	3
ELA_827_18	8	3	6	12	38.5	0.3	5.8	1.5	1	93	3	1	1	1	1	9
ELA_827_19	5	0	5	5	21.2	0	20.8	0.6	2	90.6	0	1	1	1	1	0
ELA_827_2	20	9	2	19	93.2	2.5	1.1	28.9	7	77.2	73	1	1	1	1	4
ELA_827_3	18	15	5	20	55.3	2.5	0.7	6.6	4	56	36	1	1	1	0	0
ELA_827_4	19	9	5	20	51.1	8.3	0.6	32.4	5	75.6	61	1	1	1	0	0
ELA_827_5	14	7	5	13	24.1	0.9	0.5	21.5	6	54	69	1	1	1	0	0
ELA_827_6	17	13	5	31	14.2	2	0.8	19.7	4	35	96	1	1	1	0	0

ELA_827_7	15	10	5	12	15.3	1.3	0.6	26.2	0	58.8	230	1	1	1	1	0
ELA_827_8	7	4	4	4	22.8	5.3	65.4	0.4	3	21	82	1	1	0	0	0
ELA_827_9	5	6	5	10	21.1	5.1	48.6	1.3	2	24	52	1	1	0	0	0
ELA_EUCP_1	6	2	1	3	20.9	0.3	0.1	0.3	0	12	18	1	1	1	1	0
ELA_EUCP_2	4	0	1	3	10.9	0	0.1	0.3	1	44	0	1	1	1	1	0
ELA_EUCP_3	11	2	1	7	22.2	0.5	0.2	1.1	0	58	0	0	0	0	1	0
ELA_HPP_1	10	2	3	11	63	0.2	25.2	1.1	4	67	6	1	1	1	1	0
ELA_HPP_2	5	5	2	8	60.4	0.5	2.2	0.9	0	81	0	0	0	1	1	2
TSC_1073_1	6	15	1	20	70	8	1	4	0	80	69	1	1	1	1	0
TSC_770_1	13	22	0	24	80	30	0	20	3	77	45	1	1	1	1	2
TSC_770_2	9	12	0	12	70	50	0	5	0	98	202	1	1	1	0	0
TSC_827_1	11	20	1	20	80	15	0.5	4	0	90	20	1	1	1	1	3
TSC_827_2	1	1	3	12	35	0	16	0.5	1	50	0	0	0	1	1	1
TSC_827_3	8	14	3	22	70	6	0.5	2	0	80	65	1	1	1	0	0
TSC_827_4	9	1	0	22	60	20	0	10	1	10	295	1	1	1	1	0
TSC_827_5	9	13	4	13	45	10	0.5	25	0	75	45	1	1	1	1	1
TSC_827_6	16	12	1	23	70	3	5	3	0	98	44	1	1	1	1	2
TSC_827_7	8	7	3	13	40	8	0	35	0	0	74	1	1	1	1	0
TSC_827_8	11	12	3	18	40	15	0.5	5	0	95	75	1	1	1	1	1
TSC_EUCP_1	1	3	3	3	35	0	1	1	0	10	65	0	1	1	1	0
TSC_HHP_1	1	2	1	11	65	0.5	0.5	0.5	0	40	0	0	0	1	0	0

Appendix E. Letter from Tweed Shire Council to Biodiversity Conservation Division regarding the expiration of survey data

TWEED SHIRE COUNCIL

Request for the use of species survey data collected in 2016 for a BDAR submitted in 2022

Clarrie Hall Dam Raising (SSI 9458)

March 2022

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Introduction

Clarrie Hall Dam is located within the Tweed Shire, 15 kilometres (km) south-west of Murwillumbah on the north coast of New South Wales. It is operated by Tweed Shire Council (Council) as part of the drinking water supply network for the Tweed Shire. Council is proposing to increase the dam wall height by 8.5 metres (m) to provide a Full Supply Level (FSL) height of 70 m Australian Height Datum (AHD) (RL70 m), thereby increasing the capacity of the dam from 16,000 megalitres (ML) to approximately 42,300 ML (the proposal).

The proposal is designated State Significant Infrastructure (SSI 9458) under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) and has been declared a 'Controlled Action' under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The Secretary's Environmental Assessment Requirements (SEARs) issued April 2019 required that the impacts to biodiversity be assessed using the Biodiversity Assessment Method (BAM; OEH, 2017). The SEARs were updated on the 26 November 2021 in accordance with Planning Circular PS 21-005 and now require biodiversity impacts to be assessed using BAM 2020.

A draft Environmental Impact Statement (EIS) was issued by Council's EIS consultants on the 31 August 2021. The EIS has been reviewed and a scope of works is being prepared to address Council's review and finalise the EIS, including addressing the updated SEARs. As a result of the further time required to complete the EIS, some species survey data collected between November 2016 and January 2017 has reached the 5 year data expiration limit for use in the BAM Calculator as identified in the BAM 2020 Operational Manual Stage 1, section 3.4.

This report provides background and justification and seeks approval for the use of species survey data collected between November 2016 and January 2017 in the BAM and Biodiversity Development Assessment Report (BDAR) to be considered by the NSW Biodiversity & Conservation Division (BCD) of the Department of Planning and Environment (DPE).

Biodiversity assessment background

Council conducted a preliminary flora and fauna impact assessment for the dam raising commencing November 2016 (TSC, 2017). The NSW State Government published the BAM in May 2018, which was after Council completed their assessment. Council engaged Eco Logical Australia (ELA) in November 2019 to prepare the EIS, which included the preparation of a BDAR.

A gap analysis was undertaken by ELA to review surveys conducted by Council to ensure compliance with BAM. Council and ELA met with staff from BCD on the 28 May 2020 to discuss the biodiversity assessment approach for the EIS. A letter and gap analysis report outlining the proposed survey strategy was forwarded to the BCD on the 2 September 2020. BCD provided correspondence endorsing the survey approach dated 29 September 2020 (BCD Ref: DOC20/725252).

During 2020 and early 2021, ELA conducted all plant community type mapping, vegetation integrity assessments, and threatened plant surveys within the project disturbance footprint in accordance with the BAM 2017 and associated guidelines. For fauna, ELA identified that for the majority of threatened fauna (particularly mammals, reptiles, and birds), the existing survey effort conducted by Council from the 21 November 2016 to the 18 January 2017 was in excess of the minimum requirements for a site ~140 ha in size. The gap analysis did however identify that several survey gaps for fauna were present, in particular:

- detailed threatened amphibian surveys outside of the two main tributaries assessed by Council
- targeted surveys for breeding habitats for hollow-dependent fauna and

- targeted surveys for Microchiropteran bats.

Surveys to address these gaps were completed by ELA during 2020 and 2021. A draft BDAR was prepared by ELA and lodged with Council for review on the 31 August 2021.

A scope of work, is currently being prepared to update the BDAR to be consistent with the BAM2020. This scope includes addressing advice from BCD dated 4 September 2021 to Council regarding excluding species polygons for a species credit species that were not detected during surveys (Dimitri Young, BCD. Email to David Hannah, Tweed Shire Council. 3/9/2021).

Expiration of biodiversity survey data for use in the BAM

As noted above, delays in finalising the EIS has resulted in the fauna surveys conducted by Council during November 2016 to January 2017 exceeding the 5-year limit of data used for species surveys. The BAM 2020 Operational Manual Stage 1, section 3.4 states:

If a field survey has been undertaken on the subject land within five years of the current proposal lodgement date, and that survey meets the requirements of the BAM, including this section of the Manual, the assessor can use the results in place of an onsite survey. The use of a past survey must be documented in the BAR. Surveys undertaken more than five years prior to the proposal lodgement date may be used to inform the assessment process but cannot be used in place of a species survey. This is to ensure results are current with respect to site condition, structural attributes and species presence. Note, where biodiversity values have changed dramatically within five years (e.g. land use has changed) onsite assessment is required.

Council's correspondence with BCD (see Appendix A) indicated that data greater than five years-old can be used for a species survey (subject to those surveys meeting the BAM requirements as noted in correspondence) if justification for the use of such data demonstrates environmental conditions within the site have not changed between initial collection of data and time of submission.

The following sections provide a description of:

- survey methods and corresponding effort, dates and personnel involved in data collection
- the alignment of surveys to the BAM survey requirements and
- an overview of site conditions that may affect species presence – particularly in relation to the surveys at or reaching the 5 year survey data expiration timeframe.

Survey methods, effort and alignment to the BAM survey requirements

Tweed Shire Council – flora surveys

Vegetation community validation surveys and floristic data plots using methodologies described in the Framework for Biodiversity Assessment (OEH, 2014) were completed by Council between the 31 October 2016 and 2 February 2017 with additional surveys completed in June 2017 associated with the dam wall area.

Threatened flora species searches using the methodology described in the NSW Guide to Surveying Threatened Plants (OEH 2016) were undertaken during December 2016 (within the inundation area) and during March 2017 (outside the inundation area). Effort is summarised in Table 1 below.

Table 1: Tweed Shire Council vegetation community and flora species survey effort

Survey methodology	Dates of survey	Total effort (days)
Vegetation community validation & FBA plots	31/10/16 – 3/11/16, 8 – 11/11/16, 14/11/16, 16 – 18/11/16, 29/11/16 – 2/12/16	16
Targeted threatened species survey (within inundation area)	6 – 7/12/16, 13 – 16/12/16, 22/12/16	7
Targeted threatened species survey (outside inundation area)	7/3/17 (half-day), 13/3/17, 20, 22, & 24/3/17	4.5
Additional vegetation community validation & FBA plots around dam wall	7 – 8/6/17	2
Total		**29.5 days**

Vegetation surveys undertaken by Council were primarily conducted by Sally Cooper (BEnvSC) with assistance from Michael Corke (BSc), Michael Banks (BEnvSc), Tanya Fountain (BEnvSc), Aiden Sloman (BSc) and an external consultant Lui Weber (BSc.Hons). All surveyors were familiar with local vegetation and could identify communities and threatened species. Sally Cooper is an accredited BAM assessor.

Tweed Shire Council – fauna surveys

The majority of fauna surveys undertaken by Council were located at 32 stratified, randomly placed sites, with 19 occurring within the disturbance footprint and 13 sites located within close proximity, but outside the disturbance footprint. Surveys using these sites include terrestrial bird surveys, nocturnal surveys, reptile surveys, Spot Assessment Technique surveys (Phillips and Callaghan 2011) and pitfall, cage, funnel, Elliot and camera trapping. Targeted surveys focussing only on the proposed disturbance footprint included a jacana survey that covered the full extent of the dam, harp trapping, Anabat acoustic recordings and frog surveys. Two additional camera trapping periods, one within bushfire affected land on the north western side of the dam (discussed further below) and the other focusing on an anomalous quoll record on private land to the west of the dam took place in October 2019 and June-July 2021 respectively. A general search around the dam wall was also undertaken in July 2017. Fauna survey effort undertaken by Council is summarised in Table 2, with further details on survey effort also provided in ELA's gap analysis report (ELA, 2020), and explained in detail in TSC (2017; https://www.yoursaytweed.com.au/RaisingClarrieHall)

Council's fauna surveys were guided by the draft Threatened biodiversity survey and assessment: Guidelines for developments and activities (DEC, 2004) and were assessed by ELA during their gap analysis as being significantly in excess of the minimum requirement for diurnal birds, threatened reptiles, and mammals with the exception of an updated survey approach for amphibians, the Glossy Black-cockatoo and forest owls, and a revised bat assessment approach.

Council fauna surveys were conducted by David Hannah (BAppSc/PGDip SC), Ben Lewis (BSc), Greg Lollback (BSc/PhD), Mitchell Alward (BEnvPlan) and Leyton Tierney (BSc). David Hannah, Ben Lewis and Greg Lollback have extensive experience in surveying birds, mammals and frogs, while David Hannah and Ben Lewis also have extensive experience surveying reptiles. Ben Lewis also has extensive experience in conducting targeted surveys of threatened species such as potoroo, frogs and reptiles. David Hannah is an accredited BAM assessor

Table 2. Fauna survey work conducted by TSC between 2016 and 2021.

Date	Survey method	Replicates	Effort
21 November 2016-18 January 2017	Terrestrial bird plots (200 m x 100 m) for 20 min x 3 visits per plot	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	96
21 November 2016-18 January 2017	Nocturnal search plots (200 m x 100 m) for 20 min x 32 visits. Included nocturnal bird and mammal playback	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	60
21 November 2016-18 January 2017	Diurnal reptile/amphibian search plots 200 m x 50 m) for 20 min x 3 visits	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	64
21 November 2016-18 January 2017	Spot Assessment Technique – 30 trees within 200 m x 100 m	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	32
21 November 2016-18 January 2017	Pitfall trapping – 5 x 20 L buckets (4 m apart) connected with drift fence x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	400
21 November 2016-18 January 2017	Funnel trapping – 4 traps per site x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	400
21 November 2016-18 January 2017	Elliot trapping – 10 baited traps along 200 m transect x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	1600
21 November 2016-18 January 2017	Cage trapping – one baited (herbivore) trap x 4 nights	12 plots within the proposed disturbance footprint and 8 plots outside, but in close proximity to the proposed disturbance footprint	80
21 November 2016-18 January 2017	Camera trapping – 1 trap per site baited with herbivore and carnivore lures x 16 nights	19 plots within the proposed disturbance footprint and 13 plots outside, but in close proximity to the proposed disturbance footprint	896
March 2017	Jacana count via watercraft	Full extent of waterway	1
21 November 2016-18 January 2017	Harp traps – 1-2 night deployment	2 sites within the proposed disturbance footprint and one outside	>3
21 November 2016-18	Anabat acoustic recorder – 1-2 night deployment	12 sites within the proposed disturbance footprint and 4 sites outside, but within close	>14

Date	Survey method	Replicates	Effort
January 2017		proximity of the proposed disturbance footprint	
July 2017	Camera trapping –Each site baited with herbivore and carnivore lures x 16 nights	4 sites within disturbance footprint around dam wall	64
July 2017	General meandering search	Proposed wall construction footprint x 6 hours	6hrs
July 2017	Spot Assessment Technique – 30 trees	Proposed wall construction footprint	1
February 2017 and early 2018	Frog surveys	Various 2nd and 3rd order waterways within the proposed disturbance footprint and in the Doon Doon catchment	-
October 2019	Camera trapping –Each site baited with herbivore and carnivore lures x 16 nights	Eight sites within the bushfire affected area. Two sites within the disturbance footprint and 6 sites within close proximity of the proposed disturbance footprint	128
June/July 2021	Camera trapping –Each site baited carnivore lures x 32 nights	Six sites located in rainforest gullies in close proximity to historic quoll sighting. Two sites within the proposed disturbance footprint and 4 sites outside the proposed disturbance footprint, but within close proximity	192

All surveys were within and directly adjacent to the disturbance footprint (except for Jacana surveys which were from the water)

Eco Logical Australia – vegetation and threatened flora species surveys

ELA undertook vegetation validation surveys followed by vegetation integrity plots (VI plots) within vegetation zones determined by ELA in accordance with Section 5.3 of the BAM 2017. BAM vegetation surveys were undertaken within the development site by ELA Senior Ecologist and Accredited Assessor Liz Brown and ELA Ecologist Liam Scanlan on 13 to 17 April 2020, and 8 to 12 June 2020. One additional floristic plot was undertaken on 24 May 2021 by ELA Principal Botanist Alan House. A total of 37 full-floristic and vegetation integrity plots were surveyed to identify PCTs and TECs within the development site footprint in accordance with the minimum requirements of the BAM. This included six (6) VI plots undertaken in areas of non-remnant vegetation including regularly slashed grassy paddocks and parklands, *Araucaria cunninghamii* plantations and *Eucalyptus dunnii* plantations, for the purpose of collecting field data in areas that will not be assessed under the BAM.

Threatened flora surveys conducted by ELA were informed by the targeted threatened flora surveys conducted by Council at 16 gullies in the development site during 2016 (see Table 1 for Council survey dates), and targeted those species identified as candidate species by the BAMC. The survey plan by ELA was adapted from the NSW Survey Guide for the biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE, 2020), whereby the strategy for sites >50 ha was applied. A total of 442 point surveys were undertaken. Areas of cleared land, including paddocks and plantation were not assessed. In the case that threatened flora were identified, a search was undertaken from that vertex to the next, to capture any threatened flora that occurred between the two points within the development site. Due to the narrow area of disturbance along the shoreline of Clarrie Hall Dam, a secondary grid was not conducted as the meander survey by multiple observers adequately covered the target area, resulting in a total of 157.1 km of meanders between point surveys during the October / November 2020 survey period.

Incidental observations of threatened flora collected during other survey trips conducted by ELA (such as the site inspection in March 2020, and the VI plot surveys in June 2020) were also included in the flora survey, where appropriate.

All previous threatened flora records identified by Council in 2016 and 2017 were revisited, then incorporated into the results from the 2020 survey strategy. Where spatial data provided by Council correctly indicated the number of stems present for a species, or, where the number of stems in the field appeared to be less than the number estimated by Council, the higher count was carried forward into the BDAR assessment.

The survey methodology and adaptation of the survey guideline was discussed and approved through consultation with the BCD. Targeted surveys under the draft Survey guidelines for Australia's Threatened Orchids (Commonwealth of Australia, 2013) requires meanders and transects in suitable habitat for EPBC Act listed species; ELAs method is consistent with this requirement.

Flora surveys were conducted over a nine (9) day period from 26 October to 3 November 2020 by ELA ecologists Alan House, Lachlan Copeland, Liam Scanlan and Chris Ormond. The ELA survey team was specifically selected for their knowledge in species within the region.

The initial vegetation site inspection was carried out by ELA Senior Ecologist and Accredited Assessor Alex Pursche and ELA Ecologists Camille Roberge and Liam Scanlan. BAM vegetation surveys were undertaken within the development site by ELA Senior Ecologist and Accredited Assessor Liz Brown and ELA Ecologist Liam Scanlan on 13 to 17 April, and 8 to 12 June 2020. One additional floristic plot was undertaken on 24 May 2021 by ELA Principal Botanist Alan House.

Flora surveys were conducted by Alex Pursche (BSc(Hons)/PhD), Liam Scanlon (BSC (Hons)/BSC (Env Studies)), Liz Brown (BSc), Camille Roberge () Lachlan Copeland (BNatRes(Hons)/PhD), Chris Ormond (BSc) and Alan House (BBot(Hons)/PhD).

Table 3. Flora surveys conducted by ELA in 2020.

Date	Survey method	Replicates
March 2020	Validation survey points – rapid assessment that classifies dominant canopy, mid-storey and ground species. Disturbance level noted.	112 survey points
April 2020-June 2020	Vegetation integrity survey. 20m x 50 m and 20 m x 20 m plots.	37 plots
October 2020-November 2020	Threatened flora general searches within 20 m radius area and multiple observer meander surveys between point surveys	442 plots (56 ha) 57.1 km of meanders

Eco Logical Australia – fauna surveys

ELA used Council's fauna species surveys undertaken from the 21 November 2016 to the 18 January 2017 to partially or completely fulfil the requirements of the BAM 2017. This includes the use of Council's bird surveys, reptile surveys, nocturnal surveys, pitfall trapping, funnel trapping, Elliot trapping, cage trapping, camera trapping, SAT sampling, frog surveys, Anabat surveys and harp trapping.

To completely conform to survey guidelines, ELA undertook the following additional surveys in 2020 and 2021:

- amphibian habitat assessments and surveys
- Hollow Bearing Tree mapping, forest owl surveys using call broadcast methods, and surveys focusing on owl nesting habitat
- raptor habitat assessment
- glossy black-cockatoo (*Calyptorhynchus lathami*) nesting habitat searches

- microbat surveys
- Mitchell's rainforest snail (*Thersites mitchellae*) surveys, including an expert opinion report, and
- surveys for pink underwing moth (*Phyllodes imperialis*).

Signs and sightings for fauna were also recorded during flora and reconnaissance surveys.

Survey effort for fauna conducted by ELA is summarised in ELAs gap analysis report, and discussed in detail within s4.4. of the draft BDAR (previously supplied to BCD).

Fauna surveys and habitat surveys undertaken by ELA were conducted by Alex Pursche (BSc(Hons)/PhD), Tom Schmidt (BEnvSc & Man/BEnvSc(Hons)), Liam Scanlan (BSC (Hons)/BSC (Env Studies)), Loren Appleby (BSc), Daniel McKenzie (BSc (Hons)) and Jo Davis (BSc (Hons)). Both Alex Pursche and Tom Schmidt are accredited BAM assessors.

Summary of current and expired data

Vegetation and threatened flora data

ELA used the vegetation assessments and threatened flora species surveys completed by Council to inform their assessment process. ELA completed vegetation and flora surveys during 2020 and early 2021 in accordance with the BAM 2017. Council's vegetation and threatened flora data was used to inform ELAs assessment. In particular, counts of threatened plants were included into the BAM where these counts were greater than ELAs counts. The data was not used in place of ELAs species surveys as ELA revisited all of Council's threatened flora survey sites in addition to undertaking their own threatened flora surveys to address the BAM.

As a result, the plant community type mapping, vegetation integrity assessments, and threatened flora species surveys completed by ELA during 2020 and 2021 fulfil the requirements of the BAM for the proposal, and are all within the 5-year survey limit for data to support a BDAR.

Fauna species credit species surveys

Fauna species surveys undertaken by Council from November 2016 to January 2017 have been used to prepare the draft BDAR. This data has passed the five year expiration timeframe stipulated within OEH (2018).

Specifically, the Council surveys (listed in Table 2) that were used in the draft BDAR that have lapsed are:

- Diurnal bird surveys
- Nocturnal surveys
- SAT surveys
- Diurnal reptile surveys
- Pitfall/Elliot trap/majority of camera trap/funnel trap/cage trap surveys

Consequentially, it would be unlikely that the occurrence of the following candidate species credit species (nominated within the draft BDAR) would be adequately assessed if the above data could not be used in the draft BDAR (taken from Table 25 of the Eco Logical Australia 2021 and after consideration of distribution and habitat requirements):

Birds

Rufous Scrub-bird - Atrichornis rufescens
Coxen's Fig-Parrot - Cyclopsitta diophthalma coxeni;

Eastern Bristlebird - Dasyornis brachypterus;
Square-tailed Kite - Lophoictinia isura;
Black-breasted Button-quail - Turnix melanogaster;
Albert's Lyrebird - Menura alberti;
White-eared Monarch - Carterornis leucotis;

Reptiles
White-crowned Snake - Cacophis harriettae
Three-toed Snake-tooth Skink - Coeranoscincus reticulatus;
Pale-headed Snake - Hoplocephalus bitorquatus;
Stephen's Banded Snake - Hoplocephalus stephensii;

Mammals
Koala - Phascolarctos cinereus;
Long-nosed Potoroo - Potorous tridactylus;

Invertebrates
Atlas Rainforest Ground-beetle - Nurus atlas;
Shorter Rainforest Ground-beetle - Nurus brevis;

Has habitat changed?

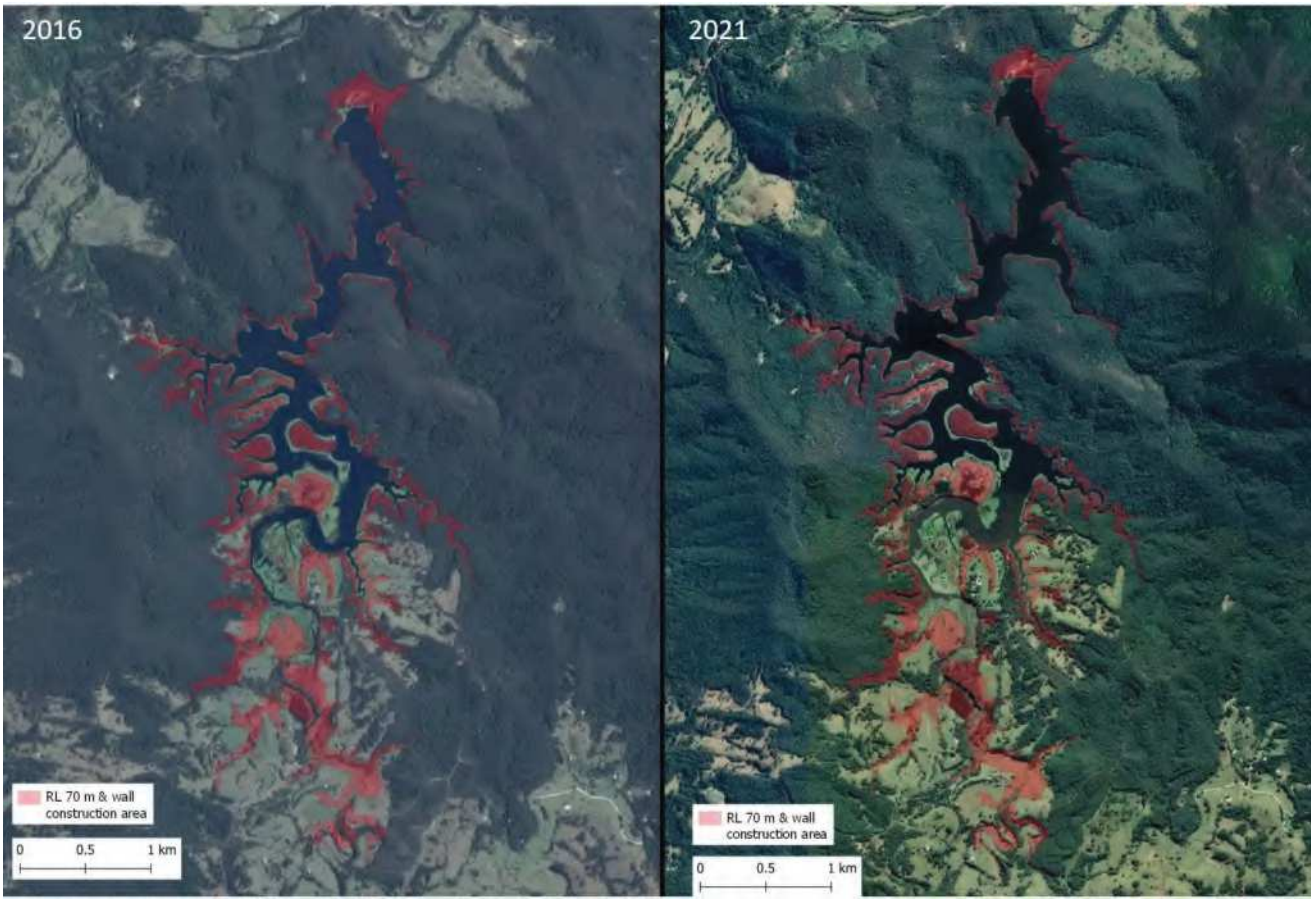
The landscape buffering the dam is predominantly vegetated with bushland, comprising a mosaic of mature and young regrowth forest, along with pockets of remnant forest. There is also cleared land associated with former pasture, which is regularly slashed, and passive recreational areas (e.g. Cram's Farm). All Council owned land is managed for drinking water protection.

Council either owned or has acquired the majority of land within the Proposal disturbance footprint prior to 2016. Land management practices in the period from 2016-2022 have not changed and forest cover has remained the same (Attachment A). Forestry ceased many years before the 2016/17 studies commenced and cropping is restricted to small-scale practices away from the proposed disturbance footprint. Much of the forested land to be inundated is on steep country that either was not grazed heavily or actively excluded grazing. Cropping practices have also not changed.

Tweed Shire Council's vegetation surveys of the proposed disturbance footprint were undertaken simultaneously with the Council's fauna surveys in late 2016 to mid-2017. From this work, vegetation was categorised into PCTs. The mapping of vegetation and PCT classification during Council's assessment aligned to PCT categories allocated within the draft BDAR (Section 3.1.2), suggesting that vegetation and therefore habitat, had remained largely unchanged between the short period of 2017 to 2020. Additionally, camera trapping undertaken by Council in 2019 and 2021 recorded similar fauna compositions to sampling that was conducted in 2016/2017.

A fire described and assessed in s 3.5.1 of the draft BDAR occurred in a portion of the development site in August 2019, which occurred between the 2016/2017 Council sampling period and the ELA sampling period. The fire was a low-intensity burn that affected the mid-storey and ground canopy (Eco Logical Australia 2021) and burnt approximately 105 ha of land owned by Council, of which about 18.5 ha was within the development site. As discussed in the draft BDAR, the fire decreased in impact as it burnt from west to east. This is likely due to the sheltered gullies with more mesic ground layer, and downslope burn direction of the fire. As required by the Guideline for applying the BAM at severely burnt sites (DPIE, 2020), an assessment of the severity of the 2019 burn is required to determine whether parts of the development site are considered 'severely burnt'. Based on the floristic data collected across the site, as well as observations made by Council staff in the days following the fire (Cooper & Lollback, 2019), the site is not considered to be 'severely burnt'. All future assessment of PCT827 – burnt has been treated the same as unburnt areas of the development site.

Figure 1. Aerial imagery showing forest cover in 2016 and 2020.



Implication and conclusion

Council has been issued a draft EIS including draft BDAR for the proposal. The draft BDAR is being updated to comply with the BAM 2020 and a scope of work is being prepared to finalise the draft EIS. Council is intending to lodge the EIS for public exhibition mid 2022 once the EIS has been updated.

Council has commissioned a significant amount of work to assess biodiversity impacts of the proposal. Assessment of PCTs including vegetation integrity assessments and threatened flora surveys were undertaken by ELA during 2020-2021 and fully comply with the BAM

An approach was developed by ELA, and subsequently endorsed by BCD, to couple fauna surveys conducted by Council in 2016-2017 with surveys conducted by ELA in 2020-2021 to meet the fauna survey requirements of the BAM. A BDAR was prepared on this basis. Given the lack of change in land management and condition of vegetation and therefore habitat between 2016/2017 and 2022, seeks approval for the use of species survey data collected in 2016/2017 for a BDAR to be completed in 2022.

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Tweed Shire Council (TSC) (2017). Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam, Tweed Shire, NSW.

Appendix A. Letter from BCD to TSC about expiration of data according to BAM

From: Dimitri Young [mailto:Dimitri.Young@environment.nsw.gov.au]
Sent: Tuesday, 10 August 2021 11:00 AM
To: Corporate Email <tsc@tweed.nsw.gov.au>
Cc: David Hannah <DHannah@tweed.nsw.gov.au>; Greg Lollback <GLollback@tweed.nsw.gov.au>; Krister Waern <krister.waern@environment.nsw.gov.au>
Subject: BCD Response - FW: BAM - 5 year survey data limit

CAUTION! External Sender
Dear Mr Hannah

Thank you for your e-mail below about the five year survey limit for data to support application of the Biodiversity Assessment Method 2020 (BAM 2020) to the Clarrie Hall Dam project, seeking comments from the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment. I appreciate the opportunity to provide input and apologise for the delay ion responding.

The reference to the five year survey limit is identified in the BAM 2020 Operational Manual Stage 1, section 3.4 where it states that,

> *If a field survey has been undertaken on the subject land within five years of the current proposal lodgement date, and that survey meets the requirements of the BAM, including this section of the Manual, the assessor can use the results in place of an onsite survey. The use of a past survey must be documented in the BAR. Surveys undertaken more than five years prior to the proposal lodgement date may be used to inform the assessment process but cannot be used in place of a species survey. This is to ensure results are current with respect to site condition, structural attributes and species presence. Note, where biodiversity values have changed dramatically within five years (e.g. land use has changed) onsite assessment is required.*

This means that surveys undertaken less than five years prior to the lodgement date can be used if they meet BAM survey requirements unless biodiversity values have changed. Surveys undertaken more than five years prior to the lodgement date can be used to inform the assessment process.

If there are specific species surveys which will be more than five years old and the Tweed Shire Council wishes to use these results in place of a further species survey, then the council will need to provide further justification for the Department's consideration including:

- an overview of any changes that may or may not have occurred on the site in relation to site condition and structural attributes which may affect the species presence,
- description of the survey methods and effort
- indication of dates on which the surveys were conducted
- indication of the personnel who conducted the surveys and their skills/expertise in survey for the target species
- analysis of alignment with BAM survey requirements (as specified in the Threatened Biodiversity Data Collection and relevant survey guides published by the Department)

If there are any species that you are particularly concerned about we would be happy to review that information and provide more definitive advice.

If you have any questions about this matter, please do not hesitate to contact Mr Krister Waern, Senior Operations Officer, at krister.waern@environment.nsw.gov.au or 6640 2503.

Yours sincerely

Dimitri Young
Senior Team Leader Planning, North East Branch

Biodiversity and Conservation | Department of Planning, Industry and Environment
T 02 6659 8272 | **F** 6651 5356 | **E** dimitri.young@environment.nsw.gov.au
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TWEED
SHIRE COUNCIL

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Murwillumbah NSW 2484

Appendix F. Letter from Eco Logical Australia to Biodiversity Conservation Division seeking verification of survey methodology

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
t: (02) 4910 0125

2 September 2020

Our ref: 18011550

Biodiversity and Conservation Division
NSW Department of Planning, Industry, and Environment
Level 8, 24 Mooney Street
Coffs Harbour NSW 2450

Attention: Dimitri Young

Dear Dimitri,

Clarrie Hall Dam Raising – Request for Confirmation of Survey Approach

Tweed Shire Council (TSC) is in the process of designing and seeking approval for the raising of the Clarrie Hall Dam wall by 8.5m (the project) at Doon Doon, NSW, from 61.5m to 70.0m AHD. The project is designated State Significant Infrastructure (SSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and has been declared a 'Controlled Action' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As an SSI, the impacts to biodiversity are being assessed using the Biodiversity Assessment Method (BAM; OEH, 2017). Eco Logical Australia (ELA) have been engaged by TSC to prepare the Environmental Impact Statement (EIS) including preparing the biodiversity assessment for the project.

Following a survey gap analysis prepared by ELA, TSC and ELA met with staff from Biodiversity and Conservation Division (BCD) on the 28 May 2020 to discuss the biodiversity assessment approach for the EIS. This letter and supporting information outlines the proposed survey strategy to address the BAM and seeks confirmation from BCD on the final survey approach.

ELA is seeking this confirmation prior to 18 September 2020 to allow adequate planning and resourcing.

If you have any queries, please contact me directly on (02) 4910 3413.

Regards,

Alex Pursche
Senior Ecologist

1. Introduction and summary of DPIE Actions

The intent of this letter is to seek concurrence on the survey strategy for all candidate threatened species identified by the BAM Calculator, and to provide a clear path to completion for remaining survey effort gaps identified by ELA.

Specifically, ELA request DPIE consider the content of this letter and previous surveys, and provide clear guidance on the following seven (7) actions for resolution:

- DPIE Action 1: We request DPIE approve the threatened flora survey strategy detailed in Section 4.3 of this letter
- DPIE Action 2: We request DPIE approve the proposed amphibian sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 of this letter.
- DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described in Section 4.4.2 of this letter, and that no further assessment is required.
- DPIE Action 4: We request DPIE approve the bat assessment approach described in Section 4.4.3 of this letter, and that no further field studies are required.
- DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala
- DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale based on previous survey effort conducted by TSC, and lack of existing suitable habitats
- DPIE Action 7: We request DPIE confirm no further reptile surveys required based on previous survey effort conducted by TSC

ELA is seeking this confirmation prior to 18 September 2020 to allow adequate planning and resourcing.

2. Background information

2.1 Background and gap analysis

The initial dam construction was subject to flora and fauna assessments prior to 1983, then again between 2016 and 2018 so there is already a high level understanding of the biodiversity values present within the subject site.

A gap analysis was undertaken by ELA to review the existing surveys conducted by TSC since 2016, to ensure compliance with NSW and Commonwealth survey guidelines. The gap analysis was reliant on the information provided by TSC in the following documents:

- Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam, Tweed Shire, NSW (Tweed Shire Council, 2017)
- Further Investigation of the Occupancy of *Mixophyes iteratus* within the Doon Doon Catchment (Tweed Shire Council, 2018)
- An inspection of the August 2019 bushfire at Terragon and Clarrie Hall Dam (Sally Cooper & Greg Lollback, 2019)

- Targeted Survey and Revised Impact Assessment for Red Lilly Pilly and Lowland Rainforest, Doon Doon Catchment (Tweed Shire Council, 2018)
- Scanned survey datasheets for birds, amphibians, Comb-crested Jacana, Koala, reptiles, mammals, as well as spotlighting and trapping results.

All of these documents can be provided to DPIE upon request or can be sourced from the project website (link as follows):

https://www.yoursaytweed.com.au/RaisingClarrieHall/widgets/183762/documents

2.2 Minimum survey guidelines for biodiversity assessments

As of August 2020, there are several flora and fauna survey guidelines in existence in NSW, some of which are generic, and some which have specific requirements for individual species. Broadly, the following published guidelines apply to biodiversity assessments under the BAM:

- The *Biodiversity Assessment Method* (OEH, 2017)
- *NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats* (DPIE, 2020)
- *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018)
- *Field survey methods for amphibians: Threatened species survey and assessment guidelines* (OEH, 2009)
- *DRAFT Threatened biodiversity survey and assessment: Guidelines for developments and activities* (DEC, 2004)

In addition, the Threatened Species Profile Database (TSPD) also contains specific survey and habitat assessment requirements for individual species, which is changed regularly.

Broadly, replication of survey effort for a biodiversity assessment in NSW is based on a 100ha replicate unit (200 ha west of the ranges), and so the raising of Clarrie Hall Dam would require two replicate units of survey across the disturbance footprint. Based on the guidelines above, this would require:

- As per the BAM: a vegetation integrity assessment by conducting BAM plots at the appropriate frequency for the vegetation zone size
- a threatened flora survey using the two-stage grid approach (DPIE, 2020)
- up to 16 harp trap and 16 ANABAT nights per 50 ha habitat (DPIE, 2019)
- a targeted amphibian survey over two nights in appropriate habitats (OEH, 2009)
- two replicate fauna sites (one per 100 ha) in accordance with DEC (2004 draft) including at each site:
    - a 1ha bird survey (with unspecified repeated surveys)
    - 100 elliot trap nights for small mammals
    - 24 pitfall trap nights for mammals, amphibians, invertebrates, and reptiles
    - 1 hour spotlighting on two nights
    - 30 minute reptile and habitat searches on two occasions
    - Call playback for nocturnal species
    - As well as other methods such as hair tubes and reptile funnels.

The methods above are generally targeted to the species in question, and the most appropriate method(s) to maximise detection is selected. The draft 2004 guidelines do not contain any detail on contemporary methods such as infrared cameras.

In addition to those methods described above, Spot Assessment Technique (SAT) surveys are the unofficial method for assessing Koala habitat for development activities.

Details of the minimum survey, as well the survey undertaken to date for each candidate fauna species are detailed in Appendix E.

2.3 Survey effort summary

2.3.1 Threatened flora survey

Threatened flora surveys were conducted by TSC staff from October 2016 to June 2017 on the dates as described below in Table 1. Generally, the flora surveys included floristic data capture using methodologies described in the *Framework for Biodiversity Assessment* (OEH, 2014), as well as targeted surveys in 16 gullies across the inundation area.

Table 1 Tweed Shire Council threatened flora survey effort

Survey methodology	Dates of survey	Total effort (days)
Vegetation community validation & FBA plots	31/10/16 – 3/11/16, 8 – 11/11/16, 14/11/16, 16 – 18/11/16, 29/11/16 – 2/12/16	16
Targeted threatened species survey (within inundation area)	6 – 7/12/16, 13 – 16/12/16, 22/12/16	7
Targeted threatened species survey (outside inundation area)	7/3/17 (half-day), 13/3/17, 20, 22, & 24/3/17	4.5
Additional vegetation community validation & FBA plots around dam wall	7 – 8/6/17	2
Total		**29.5 days**

Targeted flora surveys by TSC identified the following nine threatened species within and nearby to the disturbance footprint as described in Table 2. Of these species, five are listed under the EPBC Act as Vulnerable.

Table 2 Threatened flora identified by TSC during 2016 and 2017 surveys

Scientific name	Common name	BC Act	EPBC Act	Impacted	Not impacted	Total
Corokia whiteana	Corokia	Vulnerable	Vulnerable	8	40	48
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	30	41	71
Endiandra muelleri subsp. *bracteata*	Green-leaved Rose Walnut	Vulnerable	Not listed	210	240	450
Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	Not listed	1243	4552	5795

Scientific name	Common name	BC Act	EPBC Act	Impacted	Not impacted	Total
Grevillea hilliana	White Yiel Yiel	Endangered	Not listed	0	1	1
Lepiderema pulchella	fine-leaved tuckeroo	Vulnerable	Not listed	1	0	1
Marsdenia longiloba	Clear Milkvine	Endangered	Vulnerable	13	27	40
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	147	83	230
Syzygium moorei	Durobby	Vulnerable	Vulnerable	2	13	15

2.3.2 Threatened fauna survey

The majority of threatened fauna surveys were conducted at 20 'core sites' whereby a complete fauna survey was undertaken using a variety of active search and trapping methods targeting reptiles, mammals, diurnal and nocturnal birds, and amphibians.

The survey design was implemented prior to the release of the BAM, and as such was designed as a more broad biodiversity assessment, rather than a targeted threatened species survey. The methods implemented are outlined in Table 3.

Table 3 Tweed Shire Council threatened fauna survey effort

Survey type	Number of sites	Replicates per site	Repeat per site	Total effort
Aquatic bird transect	1	1	1	1
Terrestrial bird survey	32	1	3	96
Reptile and amphibian search	32	1	2	64
Nocturnal search	20	1	3	60
Koala SAT	32	1	1	32
Diurnal search	32	1	3	96
Call playback	20	1	1-3	>20
Terrestrial elliot traps	20	20	4	1600
Pitfall traps	20	5	4	400
Cage traps	20	1	4	80
Funnel traps	20	5	4	400
Camera trap	32	2	14	896
Nocturnal amphibian search (Targeted creekline searches)	2	1	1	2
Harp trap	3	1	1-2	>3
Ultrasonic detector (ANABAT)	14	1	1-2	>14
Site condition assessment	32	1	1	32

The fauna surveys undertaken by TSC identified across the site:

- 19 amphibians
- 111 bird species
- 34 mammals
- 24 reptile species.

Of these species recorded, 26 are BC Act listed threatened species, and four (4) are listed under the EPBC Act (Appendix B). Species previously recorded are detailed in the table below. Of these 25 species, seven (7) are species credits, and eight are dual credit species in which only breeding habitat is calculated as a species credit. Four of these species are candidates for Serious and Irreversible Impacts (SAII). Those species that are species credits, or dual species, will have credits calculated for them where the suitable habitat feature is known or likely to be impacted by the proposal. Those dual credit species that are known from the site, but the breeding or important habitat is not present or impacted, will not have species credits calculated.

Additional species may be added to this list as the assessment progresses.

3. Gap analysis

3.1 Gap analysis review

The gap analysis identified the survey effort required to satisfy the BAM for each targeted survey group, as described in the survey methodologies in Section 2.2 above. The gap analysis also considered threatened species survey guidelines published by the Commonwealth Department of the Environment (2010).

The gap analysis partitioned the biodiversity survey requirements into several functional groups, based on the following survey requirements:

- Plant Community Type Mapping & Vegetation Integrity Assessment
- Threatened flora surveys
- Threatened fauna surveys and habitat mapping for forest owls, birds, invertebrates, reptiles, amphibians, and mammals.

3.2 Gap analysis outcomes

The gap analysis identified that for the majority of threatened fauna (particularly mammals, reptiles, and birds), the existing survey effort conducted by TSC was in excess of the minimum requirements for a site ~140 ha in size. The gap analysis did however identify that several survey gaps were present, in particular:

- threatened flora surveys within wet sclerophyll forests
- detailed threatened amphibian surveys outside of the two main tributaries through Mount Jerusalem National Park
- targeted surveys for breeding habitats for hollow-dependent fauna
- targeted surveys for Microchiropteran bats.

4. Surveys by ELA in 2020

4.1 Preliminary site inspections

Following the gap analysis, a site inspection was conducted by ELA ecologists from 9 – 13 March 2020, and specifically collected the following data points:

- vegetation validation: dominant three canopy, shrub, and ground cover species present
- fauna habitat: presence of hollow-bearing trees, logs, litter, and proximity to water sources
- hollow bearing trees: large trees and stags with suitable habitat for breeding forest owls and birds
- threatened species: where incidentally identified during the site inspection.

The site inspection identified seven threatened flora species previously identified by TSC.

4.2 Plant Community Type and Vegetation Integrity Assessment

Detailed surveys were carried out by ELA botanists from 14 – 18 April and 8 – 12 June 2020, whereby 35 full floristic plots were conducted in accordance with the BAM and identified the following four Plant Community Types (PCTs) in a variety of condition states:

- 770 Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion
- 827 Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast
- 1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
- 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion

These PCTs occur generally in high condition across the inundation area (weed free remnant vegetation), but also have pockets of lower condition vegetation with either more weed ingress or recent disturbance from fire. Of these PCTs, 770 and 1302 are both consistent with *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions* which is listed as Endangered under the BC Act, and *Lowland Rainforest of Subtropical Australia* which is listed as Critically Endangered under the EPBC Act.

In addition to those areas of native vegetation identified in the PCTs above, there are areas of cleared land and native plantation within the inundation area:

- Dunn's white gum plantation
- Hoop pine plantation
- Paddocks/parklands.

These areas of cleared land and native plantation will not be calculated as a loss during the final impact assessment.

The area of each PCT to be impacted, as well as the number of plots and listing status is detailed in Table 4 below. The survey effort and PCT mapping has been competed to comply with the minimum requirements of the BAM.

Complete profiles for each vegetation zone can be found in Appendix B.

Detailed breakdown of the areas of each vegetation zone, as well as PCT justifications will be provided in the BDAR.

Table 4 Vegetation zones and plots completed

Veg Zone	PCT ID	PCT Name	BC Act	EPBC Act	Condition	Area (ha)	Plots required	Plots surveyed
1 - 770 High	770	Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion	EEC	CEEC	High	1.88	2	2
2 - 827 High	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			High	65.99	5	6
3 - 827 Mod	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Moderate	42.65	4	7
4 - 827 Low	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Low	12.05	3	3
5 - 827 Burnt	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Burnt	13.65	3	3
6 - 1073 Mod	1073	Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion			Moderate	1.38	1	2
7 - 1302 High	1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	EEC	CEEC	High	2.51	2	4
8 - 1302 Mod	1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	EEC	CEEC	Moderate	0.87	1	2
Sub total Native vegetation						**140.98**	**21**	**29**
Cleared land	n/a	Dunn's white gum plantation			Low	7.9	N/A	2
Cleared land	n/a	Hoop pine plantation			Low	4.66	N/A	2
Cleared land	n/a	Paddocks/parklands			Low	69.42	N/A	2
Total area						**222.96**	**n/a**	**35**

4.3 Threatened flora assessment

Seventy-three threatened flora species are proposed as candidate species for the targeted survey, 12 of which have already been identified onsite as shown in Table 5 below. Two of these species are planted specimens, and six are potentially SAII.

Table 5 Threatened flora identified to date onsite

Species	Common	BC Act	EPBC Act	SAII
Corokia whiteana	Corokia	Vulnerable	Vulnerable	Yes
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	No
Endiandra muelleri subsp. bracteata	Green leaved Rose Walnut	Endangered	Not listed	Yes
Grammatis stenophyla	Narrow-leaf Finger Fern	Endangered	Not listed	No
Grevillea hilliana (planted)	White Yiel Yiel	Endangered	Not listed	Yes
Lepiderema pulchella	Fine-leaved Tuckeroo	Vulnerable	Not listed	Yes
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Vulnerable	No
Marsdenia longiloba	Slender Marsdenia	Endangered	Vulnerable	No
Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Not listed	Yes
Rhodomyrtus psidioides	Native Guava	Critically Endangered	Not listed	No
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	No
Syzygium moorei (planted)	Durobby	Vulnerable	Vulnerable	Yes

A threatened flora survey will be undertaken in late October – early November 2020 to coincide with the appropriate flowering and detection time for candidate species (Appendix D).

The survey plan has been adapted from the *NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats* (DPIE, 2020), whereby the strategy for sites >50ha has been applied. Typically, this would be a multistage approach using vertices on a 100m grid, however the shape of the current disturbance footprint is incompatible with this approach. As such, the inundation boundary has been allocated a survey vertex every 100m (in suitable habitats) along the internal boundary as the stage 1 approach (Figure 1). These will be inspected as per the survey guide for large sites in the appropriate time of year. Should threatened flora be identified, the area between the adjacent vertices will be searched in detail for any additional species.

This process is repeated at each vertex until all target sites have been assessed. All previous threatened flora records will then be incorporated into the results from the 2020 survey strategy.

DPIE Action 1: We request DPIE approve the threatened flora survey strategy above

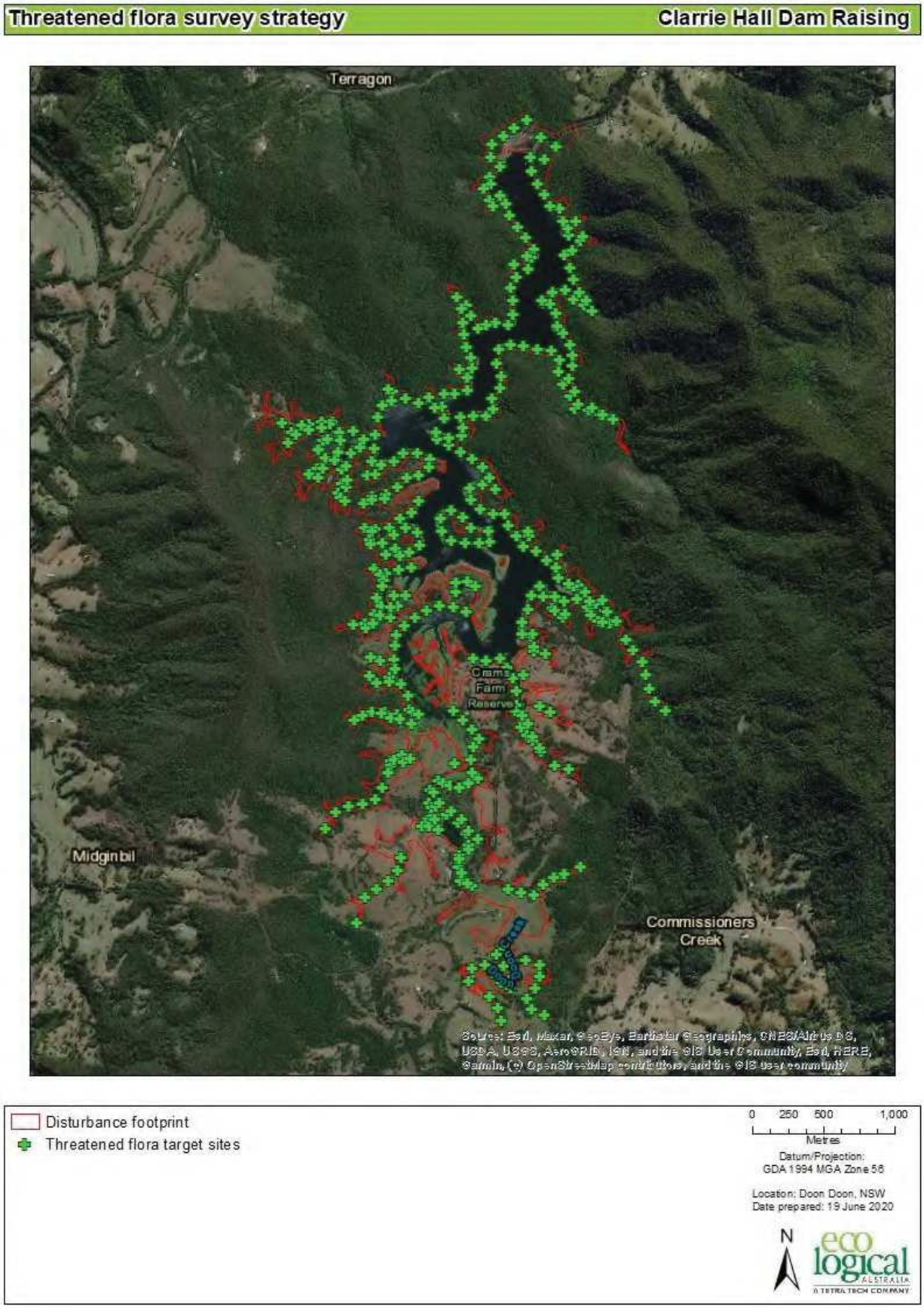


Figure 1 Threatened flora survey strategy

4.4 Threatened fauna assessment

The following section contains the proposed survey strategy for threatened fauna within the disturbance footprint.

We request DPIE confirm this strategy to be appropriate for inclusion within the formal BDAR.

4.4.1 Threatened fauna – amphibians

There are five (5) candidate threatened amphibians, three of which are known to site in discrete pockets of habitat. In order to appropriately extrapolate the findings across the disturbance footprint, a four stage approach is proposed:

1. Define habitat features for candidate species
2. Map habitats across the disturbance footprint
3. Conduct a sub-sampling survey in 2020 during appropriate weather conditions
4. Extrapolate findings across the site.

These steps are detailed in the sections and tables below.

4.4.1.1 Define habitat features for candidate species

A threatened amphibian habitat assessment was developed using information provided in the Threatened Species Profile Database, as well as considering specific habitat descriptions in the Threatened Species Profile Database and *Reptiles and Amphibians of Australia* (Cogger, 2018), as well as specialist input from Frank Lemckert. Key habitat features for each of the candidate species are detailed in Table 6.

Table 6 Threatened amphibian habitat assessment

Feature	*Assa darlingtoni*	*Litoria brevipalmata*	*Mixophyes fleayi*	*Mixophyes iteratus*	*Philoria loveridgei*
Benched rocky stream					Yes
Bogs created from human-modification to natural flows					Yes
Boggy headwaters of rainforest streams and soaks					Yes
Deep leaf litter	Yes	Yes	Yes	Yes	Yes
Emergent vegetation		Yes			
Ephemeral drainage		Yes – they breed where water pools after flowing		Yes	
Gravel stream			Yes		
Groundwater soak					Yes
Lomandra sp. and vegetated riparian ground cover			Yes	Yes	

Feature	*Assa darlingtoni*	*Litoria brevipalmata*	*Mixophyes fleayi*	*Mixophyes iteratus*	*Philoria loveridgei*
Moist substrates (mosses etc)	Yes				Yes
Overhanging banks				Yes	
Permanent drainage		Yes	Yes	Yes	
Permanent water		Yes	Yes	Yes	
Rainforest	Yes	Yes	Yes (within 750m of streams)	Yes (within 50m of drainage)	Yes
Rotting logs	Yes				Yes
Wet sclerophyll forest	Yes (within 50m of rainforest)	Yes	Yes (within 750m of streams)	Yes (within 50m of drainage)	Maybe

4.4.1.2 Map habitats across the disturbance footprint

The habitat assessment was conducted at 39 locations across the dam to understand what broad habitat types were present, and was used to stratify the site into five (5) habitat types for amphibians. Details of habitat results will be provided in the final BDAR.

The habitat features considered during the assessment are descried in Table 6 above, and the habitat types are described in Table 7.

Importantly, the habitat types will be used as a surrogate for further sub-sampling across the disturbance footprint.

The spatial distribution of amphibian habitats across the site is currently under development.

Table 7 Amphibian habitat results

Stream type	Habitat features	Threatened species	Photograph
1 – Permanent drainages in remnant rainforest	Common features: Rainforest with deep leaf litter, permanent clear flowing water, undercut banks, rotting logs, *Lomandra* sp, sand and gravel substrate Occasional features Benched streams, moist mosses Absent features Boggy headwaters, modified boggy areas, emergent aquatic vegetation, weeds	Known *Assa darlingtoni* *Mixophyes iteratus* *Philoria loveridgei* Potential *Mixophyes fleayi* Unlikely *Litoria brevipalmata*	
2 – Complex ephemeral drainages in rainforest and wet sclerophyll forest	Common features: Rainforest and wet sclerophyll forest with deep leaf litter, benched streams, moist mosses, ,rotting logs Occasional features Permanent clear flowing water, undercut banks, sand and gravel substrate, *Lomandra* sp Absent features Boggy headwaters, modified boggy areas, emergent aquatic vegetation, weeds	Known No species known Potential *Assa darlingtoni* *Philoria loveridgei* Unlikely *Mixophyes fleayi* *Mixophyes iteratus* *Litoria brevipalmata*	

Stream type	Habitat features	Threatened species	Photograph
3 – Simple ephemeral drainage in wet sclerophyll forest	Common features: Wet sclerophyll forest with deep leaf litter, rotting logs Occasional features Gravel substrates, weeds, *Lomandra* sp Absent features Rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, emergent aquatic vegetation, undercut banks, sand substrate	Known No species known Potential *Assa darlingtoni* Unlikely *Litoria brevipalmata* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	
4 – Forested dam fringe	Common features: Emergent aquatic vegetation, wet sclerophyll forest with deep leaf litter Occasional features Rotting logs Absent features Rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, *Lomandra* sp, undercut banks, sand and gravel substrate	Known No species known Potential *Assa darlingtoni* Unlikely *Litoria brevipalmata* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	

Stream type	Habitat features	Threatened species	Photograph
5 – Permanent water adjacent to cleared land	Common features: Emergent aquatic vegetation, weeds, cleared grassland Occasional features Wet sclerophyll forest with deep leaf litter, rotting logs , turbid water Absent features Gravel substrates rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, emergent aquatic vegetation *Lomandra* sp, undercut banks, sand substrate	Known No species known Potential *Litoria brevipalmata* Unlikely *Assa darlingtoni* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	

4.4.1.3 Conduct a sub-sampling survey in 2020 during appropriate weather conditions

Two sites in each stream type (10 sites total) are proposed to be surveyed during appropriate seasonal and weather conditions. The location of these sites will be spread across the disturbance footprint, and supplements the existing data collected by TSC (as described in Table 3).

Data collected regarding threatened species occupancy in habitats will be extrapolated across similar stream types.

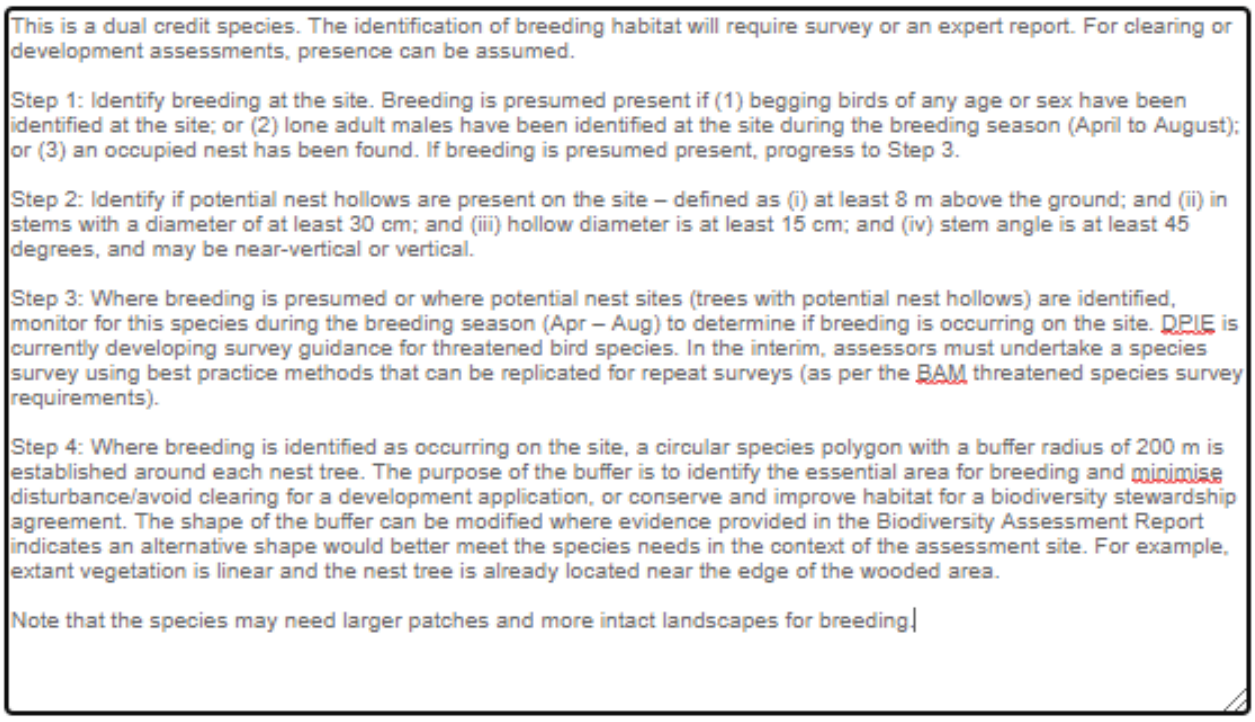
DPIE Action 2: We request DPIE approve the proposed sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 above.

4.4.2 Threatened fauna – diurnal & nocturnal birds

Ten candidate species have been identified for this assessment, three of which have been identified onsite by TSC or ELA (Glossy Black-cockatoo, White-bellied Sea-eagle, & White-eared Monarch). The gap analysis identified that the survey effort conducted at 32 sites is significantly in excess of the minimum requirement for diurnal birds, and that no further survey would be required.

Of these species, Glossy Black-cockatoo and White-bellied Sea Eagle are dual species, whereby their foraging habitat is considered an ecosystem credit, and only the breeding habitat is considered a species credit.

For Glossy Black-cockatoo, the species was identified on numerous occasions in March 2020 across the disturbance area. As such, additional survey is required to determine whether known breeding habitat is present. The identification of breeding habitat as per the Threatened Species Profile Database is shown below:



This is a dual credit species. The identification of breeding habitat will require survey or an expert report. For clearing or development assessments, presence can be assumed.

Step 1: Identify breeding at the site. Breeding is presumed present if (1) begging birds of any age or sex have been identified at the site; or (2) lone adult males have been identified at the site during the breeding season (April to August); or (3) an occupied nest has been found. If breeding is presumed present, progress to Step 3.

Step 2: Identify if potential nest hollows are present on the site – defined as (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical.

Step 3: Where breeding is presumed or where potential nest sites (trees with potential nest hollows) are identified, monitor for this species during the breeding season (Apr – Aug) to determine if breeding is occurring on the site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Step 4: Where breeding is identified as occurring on the site, a circular species polygon with a buffer radius of 200 m is established around each nest tree. The purpose of the buffer is to identify the essential area for breeding and minimise disturbance/avoid clearing for a development application, or conserve and improve habitat for a biodiversity stewardship agreement. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area.

Note that the species may need larger patches and more intact landscapes for breeding.

Figure 2 Glossy Black-cockatoo breeding habitat requirements (TSPD, 2020)

In order to determine whether breeding habitat is present, ELA conducted an inspection of all hollow-bearing trees within the disturbance footprint during the breeding season, to consider whether any of these trees were currently in use. This survey was conducted over a five day period from 21 – 25 July 2020 by ELA ecologists and accredited assessors Alex Pursche and Tom Schmidt.

In accordance with Step 1 above, the survey failed to identify any begging birds, lone adult males, or occupied nests. The only occupancy of the species identified was nearby to the dam wall, where a pair of birds were observed feeding in an *Allocasuarina torulosa*. No other individuals were observed.

In accordance with step 2, potential hollows were mapped across the disturbance footprint, and each inspected for hollow size and limb configuration. The hollow-bearing tree inspection also included a search for whitewash and casts from *Tyto* sp,

In the absence of any formal guidelines on the occupancy of the species, and given the lack of individuals identified (only one pair), it is unlikely that more than one of the hollow-bearing trees are used for breeding. The occupancy of the trees within the disturbance footprint is even less likely when considering the intact vegetation surrounding the dam, as well as the exposed position of these trees in the landscape (along the existing water front).

Forest owls such as Sooty Owl and Masked Owl were also considered during this assessment, as they are both known to occur within the locality. These species are both dual credit species, and have specific habitat requirements for breeding habitat (as described below in Figure 3 and Figure 4).

On sites where the species is determined to be present AND suitable caves are present AND breeding has been detected/proven any impact could be serious and irreversible. Any other impact on the species habitat is unlikely to be a potential serious and irreversible impact.

Where a hollow bearing tree has been identified as a breeding site in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Figure 3 Sooty Owl breeding habitat requirements (TSPD, 2020)

Patch size selected is based on that fact that the species will use areas that are quite small, especially as foraging habitat but also as roosting habitat and occasionally as breeding habitat. In Tas and Vic Masked owls have been recording nesting in paddock trees. Note that the species has been found to nest in caves in Tasmania (and maybe the Nullabor?) but there is no evidence to suggest that this occurs in NSW. Dead stags are especially popular for roosting/breeding habitat and are a limited resource due to natural attrition.

Where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Figure 4 Masked Owl breeding habitat requirements (TSPD, 2020)

Both of these habitat descriptions are non-distinct and provide little guidance for the field assessment of each of these species breeding habitats, and makes reference to documents such as "*BAM threatened*

species survey requirements" which currently are not publicly known. As such the habitat preferences of these two species has been adopted from the *Recovery Plan for Large Forest Owls* (DEC, 2006), which identifies the following breeding preferences for each species (Table 8):

Table 8 Forest owl roosting and nesting habitats (DEC, 2006)

Species	Roosting habitat	Nesting habitat
Sooty Owl	Hollows in live or occasionally dead trees, eucalypt or rainforest species, in moist forest; among dense foliage in rainforest gullies; caves, recesses or ledges in cliffs or banks. Roost sites are in the darkest and most secluded or sheltered positions in the forest. Foliage roosts are typically in narrow, gloomy side-gullies near creek junctions or below dry waterfalls, less than 10 m from drainage lines. Foliage roosts used are rainforest species, tree ferns and vine tangles. Hollows used are usually less than 100 m from streams, and are also used as nest sites or have similar characteristics to those used for nesting.	Old hollow trees, eucalypt or rainforest species, usually live but stags are occasionally used, in unlogged, unburnt gullies and lower slopes within 100 m of streams, with hollows greater than 40 cm wide and greater than 100 cm deep; surrounded by canopy trees. Also nests in caves. Hollow entrances are at least 16 m above ground, in trees of at least 120 cm diameter at breast height.
Masked Owl	Hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves or recesses in cliffs. Hollow sites can be in a variety of topographic positions, from gully to upper slope, and are also used as nest sites or have similar characteristics to those used for nesting. Roost sites in trees are greater than 5 m above the ground.	Old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams. Nest sites may be subject to a variety of disturbance regimes, which make nest trees susceptible to loss (wind throw and burning). Hollow entrances are at least 3 m above ground, in trees of at least 90 cm diameter at breast height.

In order to assess whether breeding habitat is present for either of these species, a diurnal survey reviewing each potential tree for whitewash and casts was undertaken by ELA Ecologists concurrently with the Glossy Black-cockatoo survey. Whitewash is a good indication of occupancy of the potential tree, as both of these species have high site fidelity for breeding sites.

In order to determine if the species were present during the breeding season, 4 call playback sites over 4 nights (16 sites total) as well as a spotlighting circumnavigation of the dam shoreline was conducted during the evenings of 21-24 July 2020 using a small open boat. The use of the boat provides better line of sight and ease of access throughout the inundation area. During this survey, Masked Owl was not recorded as being present within the disturbance footprint during the breeding season.

This survey did identify numerous Sooty Owls within the bushland surrounding the disturbance footprint (species observed or heard at multiple locations each night). Despite this observation, there is little evidence that the species is using the hollow-bearing trees along the foreshore, as all the calls were originating from gully heads several hundred meters away from the disturbance footprint. Combined with the lack of whitewash and specific roosting and nesting requirements as described in the *Recovery Plan for Large Forest Owls* (such as sheltered, sub-canopy roosts), it is unlikely that any breeding habitat will be impacted by the raising of Clarrie Hall Dam. No further forest owl surveys are proposed.

DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described above, and that no further assessment is required.

4.4.3 Threatened fauna – bats

The *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018) requires a minimum of 16 harp trap and 16 ANABAT nights for threatened microchiropteran bat candidate species. This assessment considers the following four candidate microchiropteran bats:

- *Chalinolobus dwyeri*
- *Miniopterus australis*
- *Miniopterus orianae oceanensis*
- *Vespadelus troughtoni*
- *Myotis Macropus.*

Myotis Macropus is known from the site and is frequently observed skimming over the water in the evenings (including during inclement winter weather), and so this species does not require any further field assessment. Of the remaining species, all are cave-dwelling for the breeding phase of their life-cycle, as is described in the TSPD, and shown below in Figure 5 to Figure 8.

In addition, many of these species only have a handful of known maternity caves, and the discovery of another would be a significant find for the species.

The topography and soil at within the inundation area does not contain any cave or cliff features that contain potential bat breeding habitats. The only place that may serve as a habitat for these species is the artificial rock faces at the dam wall (Photograph 1), whereby the aggregate may contain temporary roosting sites. There are no fissures in this feature that would contain the appropriate thermal and structural components to support a breeding site for any of the candidate species.

Similarly a review of cliffline and cave habitat within 10km of the disturbance footprint was undertaken to identify any potential sites whose buffer may extend into the inundation area (as there are several suitable cliffline features within the nearby National Parks). The regional review identified that there are numerous suitable cliffline features within Wollumbin, Nightcap, and Mount Jerusalem National Parks, however a 2km buffer (as per *V. troughtoni*) around these features would not be impacted by the disturbance footprint (Figure 9). Similarly, the smaller 100m buffer for other species would not be impacted.

As such, the identification of any of these species within the footprint would not constitute an impact to species (or dual) credit habitats, as defined by the BAM. The survey strategy for these species is to therefore not undertake any further assessment, as impacts would be incorporated into the ecosystem calculation for the project.

DPIE Action 4: We request DPIE approve the bat assessment approach described above, and that no further field studies are required.

Photograph 1 Clarrie Hall Dam Wall

The species is a full species credit because it can not be reliably predicted to occur on a site based on vegetation and other landscape features (either foraging or breeding). This species usually gives birth to twins.
SAII threshold is potential breeding habitat and presence of breeding individuals. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat.
Species mapping polygon for breeding habitat must use high resolution aerial imagery and topographic maps to identify features on the subject land (caves, scarps, cliffs etc). Polygon must be at least 100m wide (or 50m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid (see Threatened Bat Survey Guide). All breeding habitat on or within 100m of the subject land and the area immediately surrounding the feature must be identified.
All habitat on the subject land should also be mapped if present. Use high resolution aerial imagery and topographic maps to identify potential roost habitat features on the subject land within 2km caves, scarps, cliffs etc. Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features.

Figure 5 Chalinolobus dwyeri s species habitat description (TSPD, 2020)

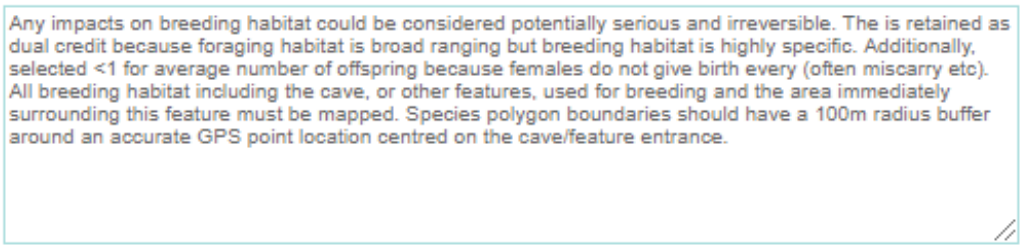


Figure 6 Miniopterus australis species habitat description (TSPD, 2020)

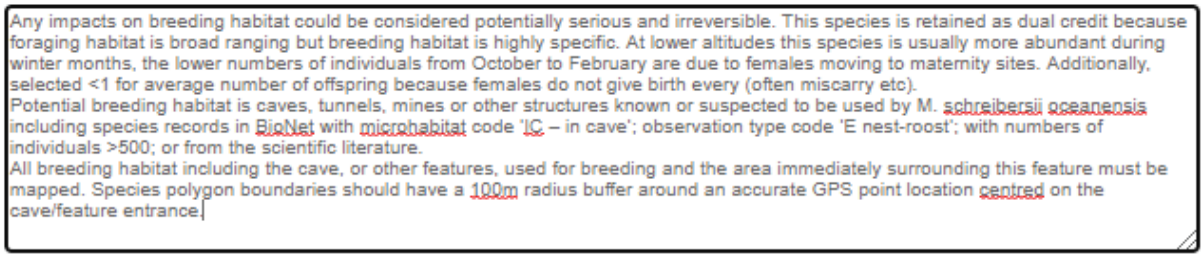


Figure 7 Miniopterus orianae oceanensis breeding habitat description (TSPD, 2020)

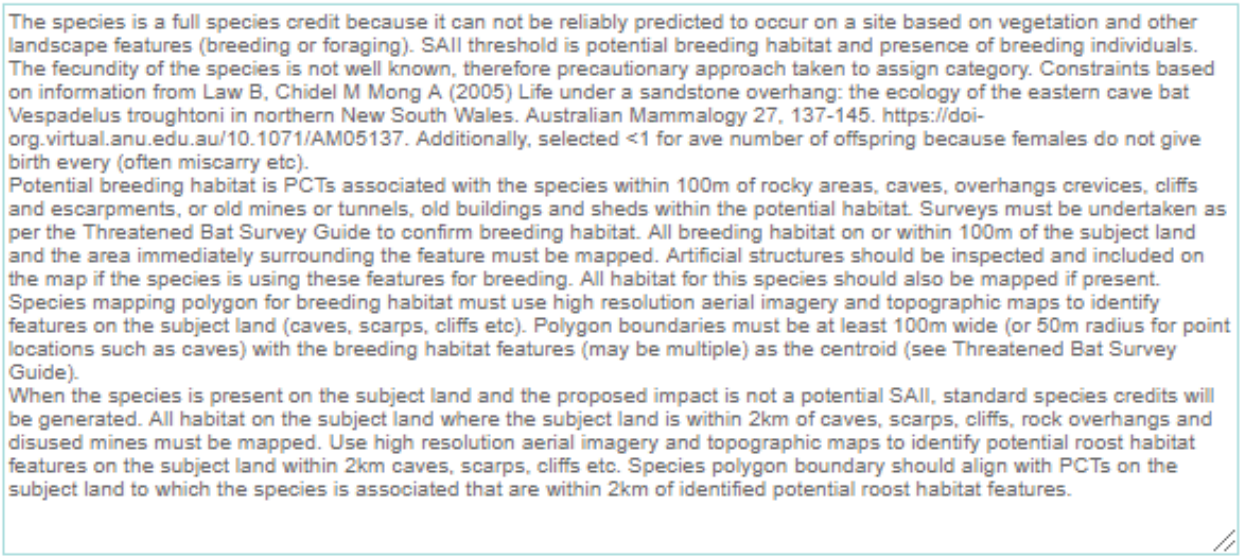


Figure 8 *Vespadelus troughtoni* species credit description (TSPD, 2020)

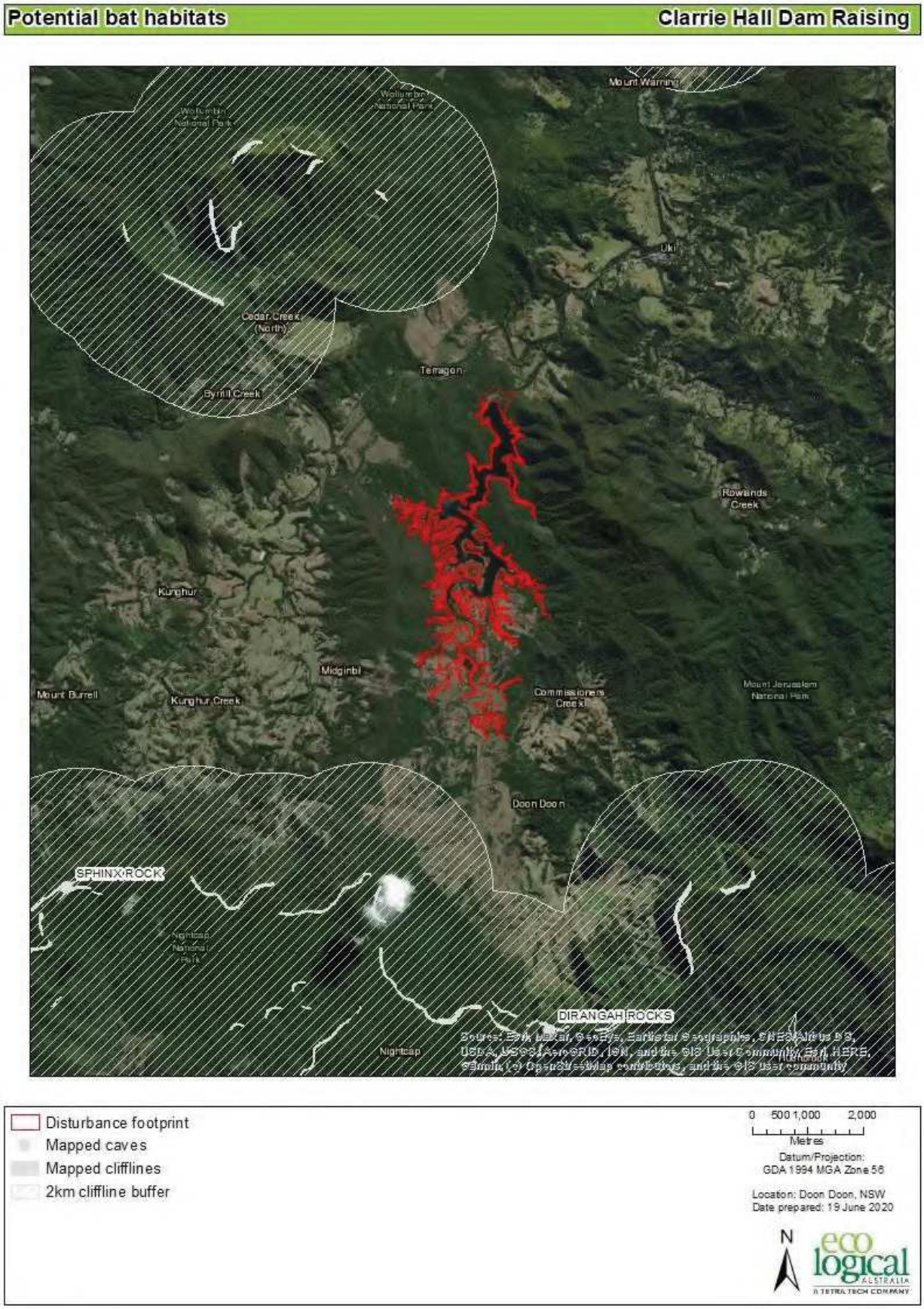


Figure 9 Potential bat habitat within the region

4.4.4 Threatened fauna – mammals

TSC conducted significant mammal surveys across the disturbance area as well as adjacent forests. The survey effort conducted to date is significantly in excess of the minimum requirements (Appendix E). The only species whereby additional information is requested is for Koala and Brush-tailed Phascogale.

4.4.4.1 Koala

Koala is a dual credit species, whereby foraging habitat is considered an ecosystem credit, and only important habitats are calculated as species credits. The TSPD contains the following guidance on assessing important habitats for Koala (Figure 13):

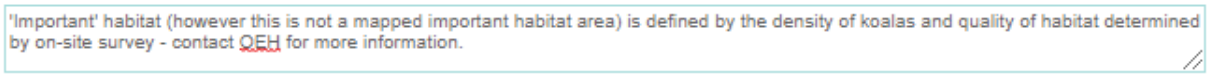


Figure 10 Koala habitat description (TSPD, 2020).

Previous koala habitat mapping has been undertaken by TSC and is presented in the attached flora and fauna assessment. Given that this species is known from the inundation area and adjacent sclerophyll forests, the assessor requests that guidance be provided on the methodology for mapping important habitats across the disturbance area.

DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala

4.4.4.2 Brush-tailed Phascogale

This species inhabits open forest and woodlands along the NSW coastline and ranges. This species uses hollows in smooth-barked trees for refugia, and forages predominately on insects and spiders. This species generally is not found in the wet sclerophyll forests and rainforests that are present within the inundation area.

The TSPD contains detailed information regarding the survey for this species, and specifies (Figure 14) that up to 10 cameras per ha of habitat are required, and that for sites over 10ha, a modified camera approach may be sought from DPIE. This request is to be accompanied by PCT mapping and vegetation plot sheets (both included in this letter).

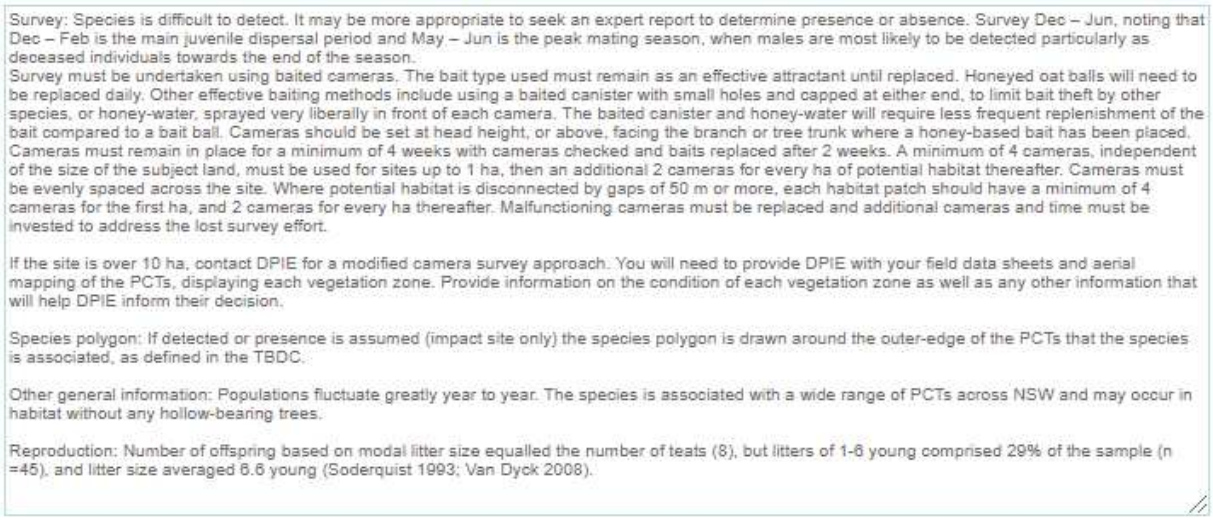


Figure 11 Survey guidance for Brush-tailed Phascogale (TSPD, 2020)

Given the extensive survey effort already undertaken by TSC (Appendix A & Appendix E), and the lack of habitats for this species present within the disturbance area, no additional survey should be undertaken for this species.

DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale

4.4.5 Threatened fauna – reptiles

The survey effort conducted by TSC is considered to be considerably above the minimum requirements for candidate threatened reptiles for this assessment. No further surveys are proposed.

DPIE Action 7: We request DPIE confirm no further reptile surveys required.

Appendix A Tweed Shire Council Report

See link as follows:

https://www.yoursaytweed.com.au/RaisingClarrieHall/widgets/183762/documents

Appendix B Threatened species records

Table 9 Threatened fauna identified at Clarrie Hall Dam by TSC

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
Amphibia	*Assa darlingtoni*	Pouched Frog	Vulnerable	Not listed	Species	Area	No
Amphibia	*Mixophyes iteratus*	Giant Barred Frog	Endangered	Endangered	Species	Area	No
Amphibia	*Philoria loveridgei*	Loveridge's Frog	Endangered	Not listed	Species	Area	No
Aves	*Amaurornis moluccana*	Pale-vented Bush Hen	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Carterornis leucotis*	White-eared Monarch	Vulnerable	Not listed	Species	Area	No
Aves	*Podargus ocellatus*	Marbled frogmouth	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus magnificus*	Wompoo Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus regina*	Rose-crowned Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus superbus*	Superb Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Irediparra gallinacea*	Comb-crested Jacana	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Calyptorhynchus lathami*	Glossy Black-cockatoo	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No
Aves	*Menura alberti*	Alberts Lyrebird	Vulnerable	Not listed	Species	Area	No
Aves	*Tyto novaehollandiae*	Masked Owl	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
Aves	*Tyto tenebricosa*	Sooty Owl	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	Yes
Mammalia - arboreal	*Phascolarctos cinereus*	Koala	Vulnerable	Vulnerable	Dual	Important habitat only - undefined	No
Mammalia - bats	*Miniopterus australis*	Little Bent-winged Bat	Vulnerable	Not listed	Dual	Circular polygon around breeding caves only	Yes
Mammalia - bats	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	Vulnerable	Not listed	Dual	Circular polygon around breeding caves only	Yes
Mammalia - bats	*Myotis macropus*	Southern Myotis	Vulnerable	Not listed	Species	Vegetation within 200m of waterbody	No
Mammalia - bats	*Nyctimene robinsoni*	Eastern Tube-nosed Bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Nyctophilus bifax*	Eastern Long-eared Bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Pteropus poliocephalus*	Grey-headed Flying-fox	Vulnerable	Vulnerable	Dual	Camp sites only	No
Mammalia - bats	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Vespadelus troughtoni*	Eastern Cave Bat	Vulnerable	Not listed	Species	2km from potential roosts (caves, cliffs, disused mines etc). Breeding habitat caves only.	Yes (breeding)
Mammalia - terrestrial	*Potorous tridactylus*	Long-nosed Potoroo	Vulnerable	Vulnerable	Species	Dense habitats in wet	No

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
						sclerophyll or rainforest	

Appendix C Plant Community Type Profiles

Table 10 Zone 1 PCT770 High condition

770 - Coachwood - Soft Corkwood - Crabapple warm temperate rainforest of the NSW North Coast Bioregion	
Vegetation formation/class	Rainforests/Northern Warm Temperate Rainforests
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia
	This community occurs in narrow bands along drainage courses in protected gullies or in larger areas on sheltered slopes. Mid-storey and canopy cover is often high. This community is characterised by an upper stratum of *Ceratopetalum apetalum* (Coachwood), *Schizomeria ovata* (Crabapple) and *Endiandra globosa* (Black Walnut) with *Lophostemon confertus* (Brush Box) and some *Eucalyptus* spp. occurring occasionally and on the community ecotone. Some mid-storey species occasionally occur as canopy trees. The mid-storey is made up of species including *Archontophoenix cunninghamiana*, *Neolitsea dealbata*, *Acmena smithii*, *Ackama paniculosa, Sloanea* spp., *Flindersia* spp. and *Cryptocarya* spp. The ground layer varies in cover but often comprising of *Blechnum cartilagineum,* with other ferns, herbs and grasses occurring at lower levels. Climbers are a common feature including *Cissus* spp., *Ripogonum* spp., *Echinostephia aculeata*, *Gynochthodes jasminoides*, *Smilax* spp., *Flagellaria indica* and *Calamus muelleri*.
Characteristic canopy trees	*Ceratopetalum apetalum, Schizomeria ovata, Endiandra globosa, Lophostemon confertus*
Characteristic mid-storey	*Archontophoenix cunninghamiana, Acmena smithii, Ackama paniculosa, Neolitsea dealbata, Cryptocarya* spp., *Eupomatia laurina, Synoum glandulosum* subsp. *glandulosum, Sloanea* spp., *Cissus* spp.
Characteristic groundcovers	*Blechnum cartilagineum, Adiantum* spp., *Dianella* spp., *Calochlaena dubia, Lomandra* spp.
Mean native richness	58
Exotic species / HTW cover	*Lantana camara* / 0
Condition	Good condition
Variation and disturbance	Little to no disturbance, some old forestry tracks are present which are regenerating well. Smaller patches of this zone show an influence/overlap from adjacent 827 communities.
% cleared in NSW	0.3%
No. sites sampled	2
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Endiandra hayesii, Marsdenia longiloba, Syzygium hodgkinsoniae, Grammitis stenophylla, Rhodamnia rubescens, Rhodomyrtus psidioides*
Fauna habitats	Dense vegetation for ground mammals and rainforest birds. Amphibian habitat in streams. Potential for small hollow bearing trees. Occasional koala feed trees (*E. propinqua*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo (in community ecotone).
Justification	Similar PCTs occur in the region including 1130 and 1201 however PCT 770 represents the best fit given the dominant canopy species.

Composition	**Structure**	**Function**	**Vegetation Integrity Score**
94.7	29.2	64.7	56.3

Table 11 Zone 2 PCT 827 High condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (High)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community occurs on moderately exposed areas around the dam. This community is characterised by an upper stratum of *Lophostemon confertus* (Brush Box) and various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus propinqua* (Grey gum). The mid-storey is made up of species including *Acmena smithii*, *Endiandra globosa*, *Archontophoenix cunninghamiana*, *Cryptocarya* spp., *Archirhodomyrtus beckleri*, *Schizomeria ovata*, *Polyscias elegans* and *Allocasuarina torulosa*. Some species typically found in the mid-storey of this community including *Alphitonia excelsa*, *Endiandra globosa* and *Allocasuarina torulosa* occasionally occur as canopy trees. The ground layer is variable but generally has a high cover of *Blechnum cartilagineum*, *Calochlaena dubia* and *Hypolepis muelleri*, with *Lomandra* spp. and *Oplismenus imbecillis* also common. Other ferns, herbs and grasses occur at lower levels including *Aneilema acuminatum*, *Entolasia marginata* and *Pseuderanthemum variabile*. Climbers occurring include *Cissus* spp., *Dioscorea transversa*, *Geitonoplesium cymosum*, *Gynochthodes jasminoides* and *Smilax* spp.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp*., Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp., *Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	50
Exotic species / HTW cover	*Cinnamomum camphora, Ardisia crenata, Passiflora edulis, Paspalum mandiocanum, Ageratina riparia, Passiflora edulis, Commelina benghalensis* / 2%
Condition	High
Variation and disturbance	Little to no disturbance. Evidence of historic logging and old forestry tracks are present which are regenerating well. Old fences are occasionally found which have minimal impact to community
% cleared in NSW	Not listed
No. sites sampled	6
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens, Corokia whiteana*
Fauna habitats	Dense vegetation for ground mammals and rainforest birds. Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the dominant canopy species.

Composition	Structure	Function	Vegetation Integrity Score
94.2	47.8	73.8	69.3

Table 12: Zone 3 PCT 827 Moderate condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Moderate)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is the equivalent of 827 high but with a moderate occurrence of exotic species and/or a modified vegetation structure. This community is characterised by an upper stratum of various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood). The mid-storey cover is generally low compared to the 827 High condition zone, with the exception of some sites with dense mid-storey regrowth. The ground layer is variable but generally fern cover is lower and grass cover is higher. Grasses include *Oplismenus* spp., *Entolasia marginata*, *Cynodon dactylon*, *Imperata cylindrica* and *Paspalum mandiocanum*. Climbers are present in low numbers except where regrowth is high or where the mid-storey is relatively intact.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp., *Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp., *Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	40
Exotic species / HTW cover	*Andropogon virginicus, Ageratina riparia, Ageratina adenophora, Anredera cordifolia, Asparagus plumosus, Axonopus compressus, Bidens pilosa, Cinnamomum camphora, Conyza bonariensis, Citrus x taitensis, Commelina benghalensis, Desmodium uncinatum, Hypochaeris radicata, Lantana camara, Ligustrum lucidum, Onopordum acanthium, Ochna serrulata, Passiflora edulis, Paspalum mandiocanum, Senecio madagascariensis, Setaria sphacelata, Solanum capsicoides, Sporobolus africanus, Stellaria media, Senna septemtrionalis, Kalanchoe sp., Sonchus oleraceus, Tradescantia fluminensis* / 8%
Condition	Moderate
Variation and disturbance	Areas likely previously cleared with varying levels of regrowth. The upper canopy cover is relatively intact though mature Camphor laurels may be present. Variation in mid-storey condition occurs including areas of high mid-storey regrowth, degraded mid-storey regrowth, or mown mid-storey and groundcover.
% cleared in NSW	Not listed
No. sites sampled	7
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	Potential for small hollows. Presence of koala feed trees (*E. microcorys*, *E. propinqua*, *E. grandis*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
89	37.7	87.1	66.4

Table 13: Zone 4 PCT 827 Low condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Low)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is the equivalent of 827 High but with a high occurrence of exotic species and/or a highly modified community structure. This community is characterised by an upper stratum of Eucalypts including *Lophostemon confertus* (Brush Box) and *Eucalyptus grandis* (Flooded Gum) and occasional disturbance related pioneer species such as *Alphitonia excelsa* (Red Ash) and *Flindersia schottiana* (Bumpy Ash). *Cinnamomum camphora* (Camphor laurel) may be the dominant canopy cover is some areas. The mid-storey cover is generally low compared to the equivalent high condition community, except for sites with dense mid-storey regrowth in canopy gaps. The ground layer is variable but generally fern cover is lower and grass cover is higher. Grasses include *Oplismenus* spp., *Entolasia marginata*, *Cynodon dactylon*, *Imperata cylindrica* and *Paspalum mandiocanum*. Climbers are present in low numbers except where regrowth is high.
Characteristic canopy trees	*Lophostemon confertus*, *Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Mallotus philippinensis, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	Variable but may include *Pteridium esculentum, Ottochloa gracillima, Oplismenus imbecillis, Entolasia marginata, Lomandra longifolia* and *Paspalum mandiocanum*
Mean native richness	40
Exotic species / HTW cover	*Ageratina adenophora, Cinnamomum camphora, Lantana camara, Senna septemtrionalis, Paspalum mandiocanum* / 35%
Condition	Low
Variation and disturbance	Areas previously cleared with degraded regrowth. The upper canopy cover is present but often sparse and mature Camphor laurels are likely to occur. Midstorey and ground cover is variable in this zone ranging from very sparse midstorey and exotic groundcover, to dense midstorey regrowth. This zone also includes some small patches of regrowth with exotic grass groundcover in otherwise cleared areas.
% cleared in NSW	Not listed
No. sites sampled	3
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	Foraging for rainforest birds. Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
84.5	12	61.8	39.8

Table 14: Zone 5 PCT 827 Burnt condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Burnt)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests
Conservation status	Not listed
	This community is the equivalent of 827 High but was burnt in an uncontrolled fire in 2019. The fire intensity was low-moderate which mostly affected the ground cover and mid-storey vegetation leaving the canopy intact. Similarly to 827 High, this community is characterised by an upper stratum of *Lophostemon confertus* (Brush Box) and various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood). The mid-storey is made up of mesic species including *Endiandra globosa*, *Cryptocarya* spp., *Elaeocarpus* spp., *Polyscias elegans* and *Allocasuarina torulosa*. Some of these species occasionally occur as canopy trees. Small dead trees and shrubs are present in the mid-storey with many species responding to fire with basal coppicing. The ground layer is variable but generally has high cover of *Blechnum cartilagineum*, *Calochlaena dubia* and *Hypolepis muelleri,* with *Lomandra* spp. and *Oplismenus imbecillis* also common. Other herbs and grasses including *Aneilema acuminatum*, *Entolasia marginata* and *Pseuderanthemum variabile* show higher cover compared to 827 High presumably due to higher levels of light. The cover and abundance of exotic species is also higher in 827 Burnt compared to 827 High. Climbers occurring include *Cissus* spp., *Dioscorea transversa*, *Geitonoplesium cymosum*, *Gynochthodes jasminoides* and *Smila*x spp.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp., *Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp., *Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	49
Exotic species / HTW cover	*Ageratina riparia, Cinnamomum camphor, Crassocephalum crepidioides, Passiflora edulis, Phytolacca octandra, Senecio madagascariensis, Solanum mauritianum, Solanum nigrum, Sonchus oleraceus* / 2%
Condition	Burnt
Variation and disturbance	Burnt at low-moderate intensity. Evidence of historic logging.
% cleared in NSW	Not listed
No. sites sampled	3
Threatened flora species	*Endiandra muelleri* subsp*. bracteata, Marsdenia longiloba, Rhodamnia rubescens, Rhodomyrtus psidioides*
Fauna habitats	Potential for small hollow bearing trees. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
95.8	17.3	63.8	47.3

Table 15: Zone 6 PCT1073 Moderate condition

1073 - Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion (Mod)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is characterised by an upper stratum of Eucalypts including *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus microcorys* (Tallowwood), *E. propinqua* (Grey Gum), *E. robusta* (Swamp Mahogany) and *Syncarpia glomulifera* (Turpentine). Occurrence of *Lophostemon confertus* (Brush Box) and *E. grandis* (Flooded Gum) is lower than PCT 827. The mid-storey cover is low with some regrowth occurring including *Glochidion ferdinandi*, *Acacia* spp., *Melia azedarach*, *Jagera pseudorhus* and *Alphitonia excelsa*. The ground layer is a combination of native and exotic grasses with some herbaceous species. Grasses include *Ottochloa gracillima*, *Entolasia marginata*, *Imperata cylindrica*, *Paspalum mandiocanum*, *Cymbopogon refractus*, *Andropogon virginicus* and *Setaria sphacelata*.
Characteristic canopy trees	*Corymbia intermedia, Eucalyptus microcorys, E. propinqua, E. robusta, Syncarpia Glomulifera*
Characteristic mid-storey	*Acmena smithii, Mallotus philippinensis, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Ottochloa gracillima, Entolasia marginata, Imperata cylindrica, Cymbopogon refractus*
Mean native richness	36
Exotic species / HTW cover	*Lantana camara, Paspalum mandiocanum, Andropogon virginicus, Setaria sphacelata* / 33.2%
Condition	Moderate
Variation and disturbance	Areas previously cleared with low mid-storey cover likely due to periodic slashing. The upper canopy trees are well developed.
% cleared in NSW	0.4
No. sites sampled	2
Threatened flora species	
Fauna habitats	Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua*) and potential occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Similar PCTs occur in the region (827, 826 1285, 1569) however, 1073 best reflects the dominant Eucalypt species in this community and absence of *Eucalyptus grandis* and *Lophostemon confertus*.

Composition	Structure	Function	Vegetation Integrity Score
65	16.2	53.6	38.4

Table 16:Zone 7 PCT1302 High condition

1302 – White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (High)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia
	This community occurs in gullies, forming in a narrow band along streams where there is an accumulation of alluvial material. This community is characterised by an upper stratum dominated by *Archontophoenix cunninghamiana* (Bangalow Palm) with occasional emergent including *Lophostemon confertus* (Brush Box) and *Endiandra globosa* (Black Walnut), particularly on the sloping community ecotone. The mid-storey cover is generally low in wet areas or moderate in slightly elevated areas and includes *Acmena smithii, Cryptocarya* spp., *Neolitsea dealbata, Ceratopetalum apetalum, Schizomeria ovata* and *Backhousia myrtifolia*. These species may occasionally form the upper strata in low amounts. The ground layer cover is generally low but may comprise of ferns and grasslike plants including *Blechnum cartilagineum, Adiantum formosum*, and *Lomandra* spp. Climbers include *Cissus hypoglauca*, *Calamus muelleri* and *Flagellaria indica*.
Characteristic canopy trees	*Archontophoenix cunninghamiana, Endiandra globosa, Lophostemon confertus*
Characteristic mid-storey	*Acmena smithii, Cryptocarya* spp., *Neolitsea dealbata, Ceratopetalum apetalum, Schizomeria ovata, Backhousia myrtifolia, Sloanea australis, Cissus hypoglauca, Calamus muelleri, Linospadix monostachyos, Flagellaria indica*
Characteristic groundcovers	*Blechnum cartilagineum, Adiantum formosum, Lomandra* spp.
Mean native richness	44
Exotic species / HTW cover	0%
Condition	High
Variation and disturbance	Small amount of historic disturbance from logging, and natural disturbance related to high stream flow events. Canopy of Bangalow Palm consistent across all sites.
% cleared in NSW	0.75
No. sites sampled	4
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Corokia whiteana, Rhodomyrtus psidioides, Rhodamnia rubescens*, *Endiandra hayesii*
Fauna habitats	High cover and foraging resources for rainforest birds and amphibian habitat
Justification	This community is likely to be different in structure and floristic composition to the type location for 1302, however 1302 is the best fit for *Archontophoenix cunninghamiana* as a dominant canopy tree. Other PCTs with a similar floristic composition include 770 and 1201, but lack *A. cunninghamiana* as a dominant species.

Composition	Structure	Function	Vegetation Integrity Score
80.6	26.1	70.4	52.9

Table 17: Zone 8 PCT1302 Moderate condition

1302 – White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (Moderate)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia
	This community occurs in the southern portion of the dam along watercourses in sheltered positions where there is a history of disturbance. The floristic composition of this community is variable, but sites are linked by the early succession stage of regrowth in comparison to well-developed rainforest in other vegetation zones in the study area. The upper stratum may comprise of *Endiandra globosa* (Black Walnut), *Tristaniopsis laurina* (Water Gum), *Backhousia myrtifolia* (Grey Myrtle), *Lophostemon confertus* (Brush Box) and *Pseudoweinmannia lachnocarpa* (Rose Marara). The mid-storey is made up by various mesic species including *Guioa semiglauca, Backhousia myrtifolia, Wilkiea huegeliana, Ficus coronata, Archidendron grandiflorum, Elaeocarpus obovatus, Neolitsea dealbata, Aphananthe philippinensis, Acmena smithii* and *Elattostachys nervosa*. The ground layer cover is dominated by ferns and herbaceous species including *Adiantum hispidulum, Hypolepis glandulifera, Aneilema acuminatum* and *Calochlaena dubia*. Climbers include *Calamus muelleri, Austrocallerya australis, Cissus* spp., *Maclura cochinchinensis* and *Trophis scandens*.
Characteristic canopy trees	*Endiandra globosa, Tristaniopsis laurina, Backhousia myrtifolia, Lophostemon confertus, Pseudoweinmannia lachnocarpa*
Characteristic mid-storey	*Guioa semiglauca, Backhousia myrtifolia, Wilkiea huegeliana, Ficus coronata, Archidendron grandiflorum, Elaeocarpus obovatus, Neolitsea dealbata, Aphananthe philippinensis, Acmena smithii, Elattostachys nervosa*
Characteristic groundcovers	*Adiantum hispidulum, Hypolepis glandulifera, Aneilema acuminatum, Calochlaena dubia*
Mean native richness	42
Exotic species / HTW cover	*Ardisia crenata, Ageratina* spp., *Anredera cordifolia, Cinnamomum camphora, Lantana camara, Passiflora edulis, Tradescantia fluminensis* / 10.8%
Condition	Moderate
Variation and disturbance	Areas likely previously partially or entirely cleared, with early succession regrowth. These is some variation in floristic composition in this zone which is likely related to disturbance history and environmental conditions.
% cleared in NSW	0.75
No. sites sampled	2
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	High cover and foraging resources for rainforest birds and amphibian habitat in streams
Justification	This community is likely to be different in structure and floristic composition to the type location for 1302, however 1302 is the best fit for closed forests in various stages of regeneration with various dominant species. Other PCTs with a similar floristic composition include 770 and 1201

Composition	Structure	Function	Vegetation Integrity Score
78.6	12.9	51.4	37.4

Table 18: Cleared land – *Eucalyptus dunnii* plantation

***Eucalyptus dunnii* (Dunn's white gum) plantation**			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community contains planted *Eucalyptus dunnii* (Dunn's white gum). The plantation appears to be partially harvested or thinned. The mid-storey cover is low with small amounts of scattered regrowth occurring including *Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri* and *Maclura cochinchinensis*. Exotic species make up a high proportion of the mid-storey including *Lantana camara, Cinnamomum camphor, Citrus* x *taitensis* and *Sida rhombifolia*. The ground layer cover is dominated by exotic grasses including *Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata* and *Axonopus compressus* with native grasses and herbaceous species detected at low levels including *Oplismenus aemulus* and *Lobelia purpurascens*.		
Characteristic canopy trees	*Eucalyptus dunnii*		
Characteristic mid-storey	*Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri, Maclura cochinchinensis, Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia*		
Characteristic groundcovers	*Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus, Oplismenus aemulus, Lobelia purpurascens*		
Mean native richness	15		
Exotic species / HTW cover	*Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia, Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus* / 32.6%		
Condition	Low		
Variation and disturbance	Areas previously cleared, converted to pasture and planted with *E. dunnii*. Degraded mid-storey regrowth likely due to periodic slashing		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Rhodamnia rubescens*		
Fauna habitats	Low potential for hollow-bearing trees, variable cover		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Table 19: Cleared land - *Araucaria cunninghamii* plantation

***Araucaria cunninghamii* (Hoop pine) plantation**			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community contains planted *Araucaria cunninghamii* (Hoop pine). The mid-storey cover is very low with minimal regrowth occurring from species including *Acacia melanoxylon*, *Ficus fraseri, Maclura cochinchinensis* and *Parsonsia straminea*. The ground layer cover is dominated by exotic grasses including *Paspalum mandiocanum*, *Sporobolus africanus*, *Setaria sphacelata* and *Axonopus compressus* with native grasses and herbaceous species detected at low levels including *Oplismenus aemulus* and *Lobelia purpurascens*.		
Characteristic canopy trees	*Eucalyptus dunnii*		
Characteristic mid-storey	*Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri, Maclura cochinchinensis, Lantana camara, Cinnamomum camphor, Sida rhombifolia*		
Characteristic groundcovers	*Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus, Oplismenus aemulus, Lobelia purpurascens*		
Mean native richness	25		
Exotic species / HTW cover	*Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia, Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus* / 4.1%		
Condition	Low		
Variation and disturbance	Areas previously cleared and planted with *Araucaria cunninghamii*, mid-storey and ground cover regrowth largely supressed		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	*Rhodamnia rubescens*		
Fauna habitats	High canopy cover, limited foraging resources		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Table 20: Cleared land – exotic pastures

Exotic pastures			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community occurs around the southern end of the dam and is dominated by exotic grasses and herbs which are maintained with regular slashing including *Axonopus compressus* (Broad-leaved Carpet Grass), *Pennisetum clandestina* (Kikuyu) and *Paspalum mandiocanum* (Broad-leaved Paspalum). Some native ground covers such as *Cynodon dactylon* (Couch) and *Centella asiatica* (Indian Pennywort) may occasionally occur. Cleared areas are generally paddocks managed for agriculture or parklands at Cram's Farm Reserve. While the community is characterised as a treeless community, isolated paddock trees occur sporadically in some areas which range from mature Eucalypts to small isolated patches of *Acacia melanoxylon* (Blackwood).		
Characteristic canopy trees	Predominately treeless with occasional isolated paddock trees and very small patches of regrowth, usually Eucalyptus spp. and Acacia spp.		
Characteristic mid-storey	absent		
Characteristic groundcovers	*Axonopus compressus, Pennisetum clandestina, Paspalum mandiocanum, Paspalum dilatatum, Digitaria* spp., *Cynodon dactylon, Cyperus* spp.		
Mean native richness	5		
Exotic species / HTW cover	*Axonopus compressus, Pennisetum clandestina, Paspalum mandiocanum, Paspalum dilatatum, Senecio jacobaea* / 32.6%		
Condition	Low		
Variation and disturbance	Areas previously cleared and sown with exotic pasture species and regularly slashed		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	n/a		
Fauna habitats	Limited habitat opportunities		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Appendix D Plant Community Type mapping

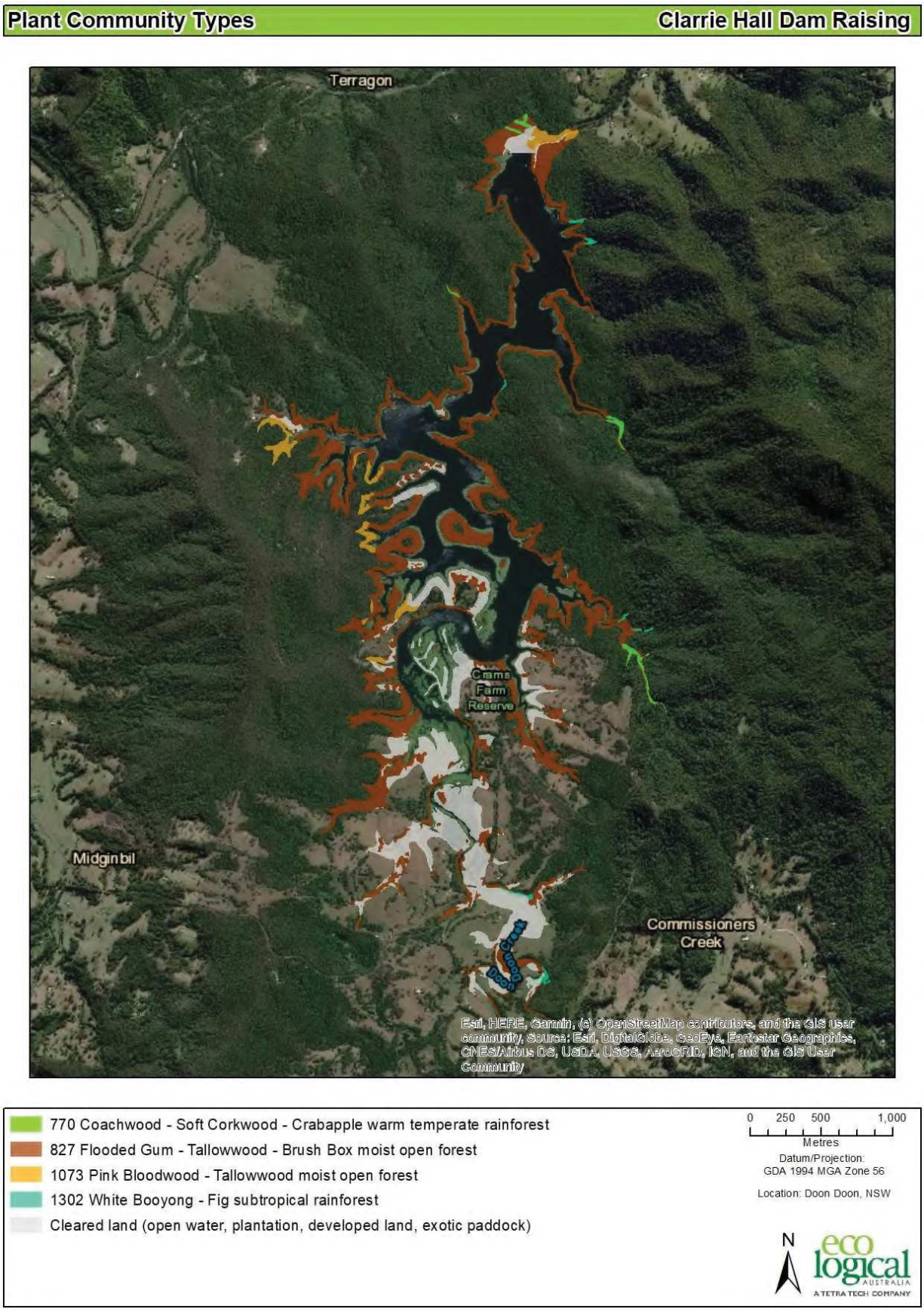


Figure 12 Plant community types

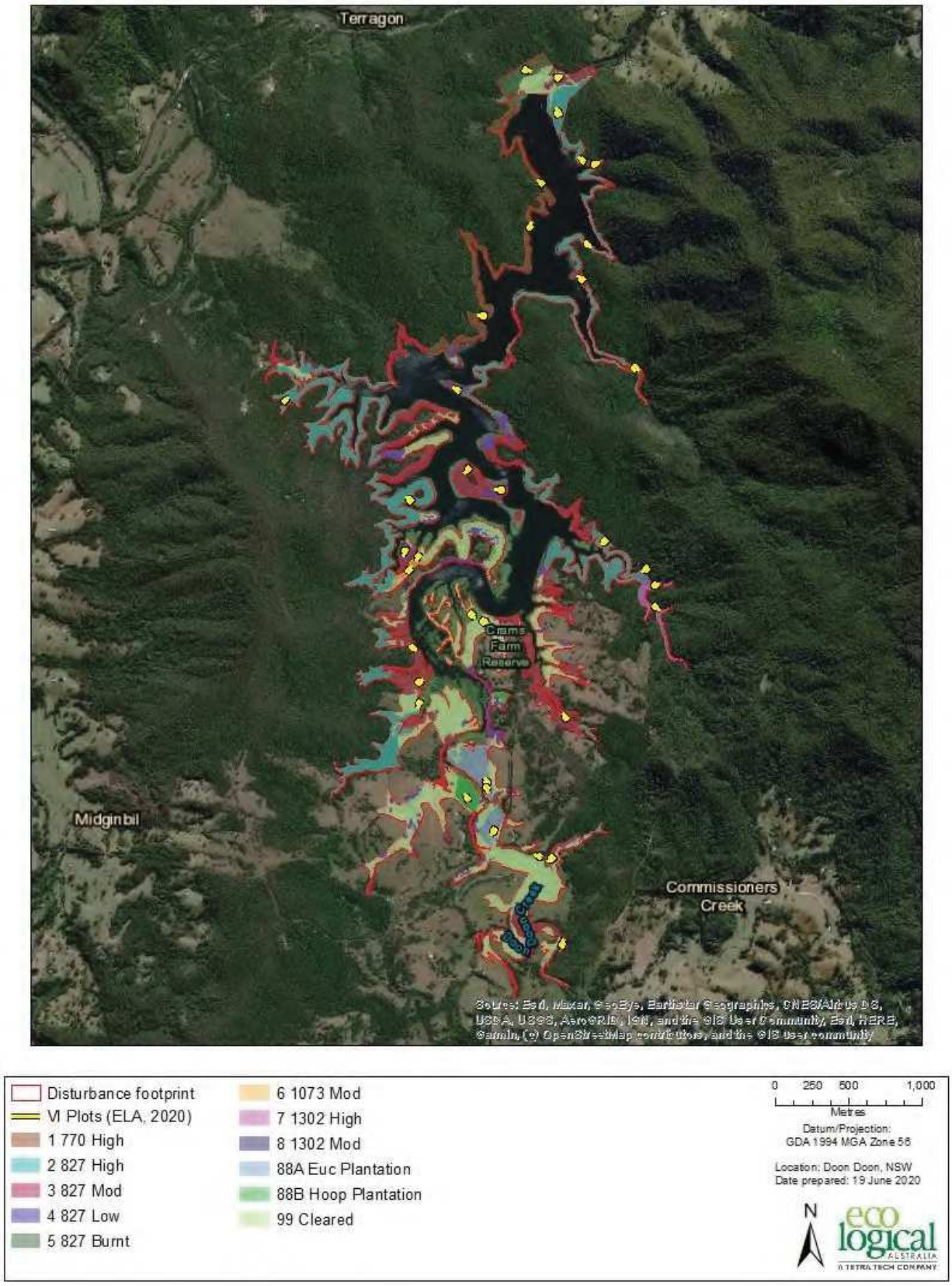


Figure 13 Vegetation zones and survey effort

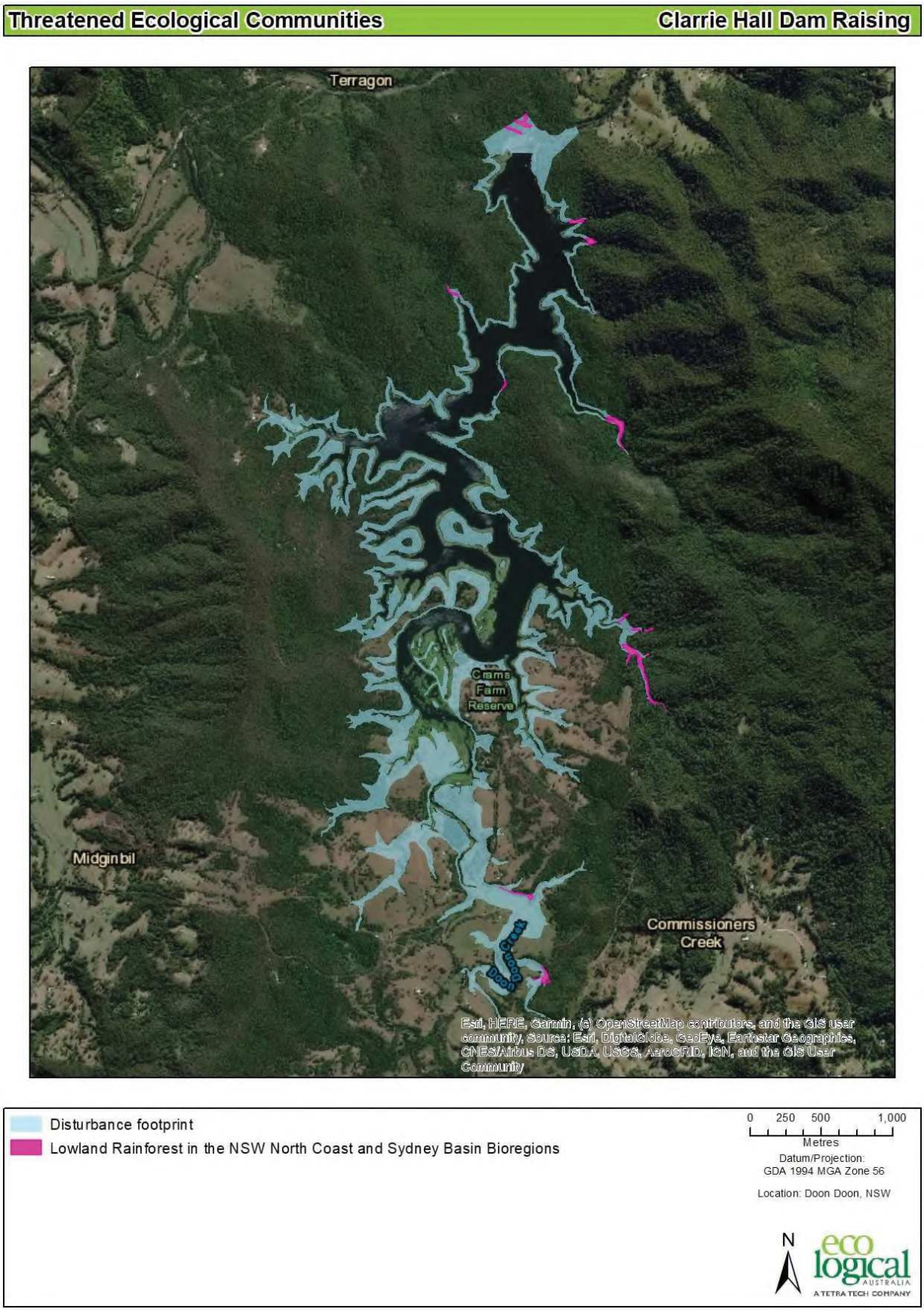


Figure 14 Threatened Ecological Communities

Appendix E Floristic Data

| Family | Species | Common Name | Listing Status | ROTAP | Exotic | High Threat Weed | Growth Form Group | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | | Plot 9 | | | Plot 10 | | | Plot 11 | | | Plot 12 | | | Plot 13 | | | Plot 14 | | | Plot 15 | | | Plot 16 | | | Plot 17 | | | Plot 18 | | | Plot 19 | | |
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Plot	PCT	Area	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeSte m5to9	funTreeSte m10to19	funTreeSte m20to29	funTreeSte m30to49	funTreeSte m50to79	funTreeReg en	funHighThreatExotic
Plot 1	827	13.65	101	Burnt	56	530264	6853775	320	13	9	3	6	2	9	36.8	12.0	0.5	0.8	3.2	17.2	0	5	91	72	1	1	1	1	1	1	0.0
Plot 2	770	2.76	101	High	56	529922	6853637	236	20	12	2	4	5	17	35.2	5.9	0.2	0.6	2.7	8.7	0	2	70	95	1	1	1	1	1	1	0.2
Plot 3	827	66.6	101	High	56	530201	6853795	230	20	9	2	3	3	14	93.2	2.5	1.1	0.3	25.2	3.5	4	7	77.2	73	1	1	1	1	1	1	0.0
Plot 4	827	42.71	101	Mod	56	529922	6853637	300	18	15	5	4	6	11	55.3	2.5	0.7	0.6	0.9	5.4	0	4	56	36	1	1	1	1	0	1	16.1
Plot 5	827	66.6	101	High	56	530217	6853240	150	19	9	5	6	4	12	51.1	8.3	0.6	0.6	30.3	1.7	0	5	75.6	61	1	1	1	1	0	1	0.1
Plot 6	827	13.65	101	Burnt	56	529829	6853336	300	14	7	5	3	1	9	24.1	0.9	0.5	0.4	20.0	1.1	0	6	54	69	1	1	1	1	0	1	0.3
Plot 7	770	1.63	101	High	56	530541	6852394	110	16	8	2	4	8	16	24.7	1.7	0.4	0.5	1.2	54.3	1	12	50	51	1	1	1	1	1	1	0.0
Plot 8	827	13.65	101	Burnt	56	529524	6852743	220	17	13	5	9	4	19	14.2	2.0	0.8	1.3	15.4	3.2	0	4	35	96	1	1	1	1	0	1	5.0
Plot 9	827	12.05	101	Low	56	529354	6852231	240	15	10	5	2	2	9	15.3	1.3	0.6	0.2	10.1	16.0	0	0	58.8	230	1	1	1	1	1	1	45.2
Plot 10	827	42.71	101	Mod	56	529423	6851707	185	7	4	4	0	1	4	22.8	5.3	65.4	0.0	0.1	0.5	0	3	21	82	1	1	1	0	0	1	4.3
Plot 11	827	12.05	101	Low	56	529646	6851559	200	5	6	5	1	3	8	21.1	5.1	48.6	0.3	0.5	0.9	0	2	24	52	1	1	1	0	0	1	15.3
Plot 12	827	66.6	101	High	56	529025	6851480	260	12	13	4	4	4	13	23.2	1.6	8.5	0.5	5.5	18.1	0	5	69	38	1	1	1	1	1	1	8.4
Plot 13	827	12.05	101	Low	56	528984	6851154	175	15	7	6	3	3	15	3.2	0.9	25.5	0.4	0.5	2.0	0	9	68.8	62	1	0	1	1	0	1	43.2
Plot 14	1073	1.38	101	Mod	56	529077	6851116	180	5	8	11	1	1	4	24.3	0.9	23.1	0.2	0.2	0.4	2	5	8.6	28	1	1	1	1	1	1	25.8
Plot 15	1073	1.38	101	Mod	56	529006	6851001	25	9	8	10	6	1	8	26.9	1.1	16.7	4.5	0.1	0.8	0	6	28	26	1	1	1	1	1	1	40.6
Plot 16	0	4.66	101	88B Hoop Plant	56	529430	6850719	150	10	2	3	6	2	5	63.0	0.2	25.2	0.6	0.2	0.5	0	4	67	6	1	1	1	1	1	1	1.0
Plot 17	770	1.63	101	High	56	529795	6854421	90	15	16	4	7	3	15	67.6	7.1	5.3	1.4	5.0	33.7	0	6	35	132	1	1	1	1	0	1	0.0
Plot 18	827	42.71	101	Mod	56	530012	6854364	45	18	18	4	4	1	15	47.9	7.5	2.7	0.8	0.2	5.1	1	0	90.6	32	1	1	1	1	0	1	1.6
Plot 19	827	66.6	101	High	56	530031	6854114	330	15	15	4	4	4	7	38.5	18.9	0.6	0.9	15.4	21.3	1	2	94.6	28	1	1	1	1	1	1	0.1
Plot 20	1302	2.76	101	High	56	530678	6850769	90	13	8	4	1	3	13	50.2	6.4	0.6	0.1	0.6	34.7	1	0	72	22	1	1	1	1	1	1	0.0
Plot 21	1302	2.76	101	High	56	530672	6850906	220	14	10	2	4	5	13	39.4	21.1	0.3	0.4	0.7	43.0	2	0	82	61	1	1	1	1	1	1	0.0
Plot 22	1302	2.76	101	High	56	530635	6851029	220	11	11	1	3	4	13	7.1	3.0	0.2	0.3	0.4	65.2	2	0	98.2	31	1	1	1	1	0	1	0.0
Plot 23	827	66.6	101	High	56	530353	6851219	220	21	10	4	2	2	10	51.6	3.5	1.0	0.5	5.1	4.8	1	0	84	50	1	1	1	1	1	1	0.4
Plot 24	1302	0.87	101	Mod	56	530050	6848453	20	13	4	4	1	3	11	9.7	60.3	0.5	0.2	8.1	1.9	0	1	48	20	1	1	1	1	1	1	21.3
Plot 25	1302	0.87	101	Mod	56	529909	6849060	280	16	10	1	4	5	11	18.2	71.4	0.2	0.4	5.9	1.6	0	0	65	20	1	1	1	0	0	1	0.3
Plot 26	827	4.71	101	Mod	56	529991	6849060	30	12	7	5	5	4	9	25.2	55.8	1.6	0.5	5.4	2.6	0	0	58	8	1	1	1	1	0	1	6.0
Plot 27	0	68.81	101	99 Cleared	56	529510	6850668	100	0	0	2	1	0	0	0.0	0.0	75.0	0.1	0.0	0.0	0	0	10	0	0	0	0	0	0	0	25.0
Plot 28	827	66.6	101	High	56	528158	6852159	30	15	12	4	2	1	14	38.7	22.9	5.8	0.3	0.2	2.7	0	0	78	10	1	1	1	1	1	1	5.3
Plot 29	827	42.71	101	Mod	56	530081	6849997	310	16	10	2	4	3	17	29.2	66.0	0.2	0.7	0.3	5.2	3	1	97	22	1	1	1	1	0	1	0.2
Plot 30	0	7.9	101	88A Euc Plant	56	529592	6849249	200	6	2	1	4	0	0	20.9	0.3	0.1	0.5	0.0	0.0	0	0	12	18	1	1	1	1	1	1	93.3
Plot 31	827	42.71	101	Mod	56	529032	6850496	140	8	3	6	7	2	4	38.5	0.3	5.8	0.9	0.3	0.4	9	1	93	3	1	1	1	1	1	1	0.8
Plot 32	0	68.81	101	99 Cleared	56	529083	6850118	180	0	0	3	2	1	0	0.0	0.0	4.2	0.4	0.1	0.0	0	0	70	0	0	0	0	0	0	0	40.1
Plot 33	827	42.71	101	Mod	56	529067	6850243	25	5	0	5	2	1	3	21.2	0.0	20.8	0.2	0.2	0.3	2	2	90.6	0	2	2	2	2	2	1	25.4
Plot 34	0	4.66	101	88B Hoop Plant	56	529414	6849448	300	5	5	2	5	1	3	60.4	0.5	2.2	0.5	0.2	0.3	0	0	81	0	0	0	0	1	1	1	7.1
Plot 35	0	7.9	101	88A Euc Plant	56	529545	6849555	320	4	0	1	1	0	3	10.9	0.0	0.1	0.1	0.0	0.3	0	1	44	0	1	1	1	1	1	1	80.8
Plot 36	0	7.9	101	88A Euc Plant	56	529537	6849542	140	11	2	1	3	1	5	22.2	0.5	0.2	0.3	0.2	1.0	0	0	58	0	0	0	0	0	1	1	88.1

Appendix F Threatened flora survey strategy

Table 21 Threatened flora survey strategy

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acacia bakeri	Marblewood	Marblewood grows in or near lowland subtropical rainforest, in adjacent eucalypt forest and in regrowth of both.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Acalypha eremorum	Acalypha	Subtropical rainforest, dry rainforest and vine thickets.	YES	YES							YES	YES	YES	YES
Archidendron hendersonii	White Lace Flower	White Lace Flower occurs in riverine and lowland subtropical rainforest, littoral rainforest, coastal cypress pine forest and their ecotones. It is found on a variety of soils including coastal sands and those derived from basalt and metasediments.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Arthraxon hispidus	Hairy Jointgrass	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	YES	YES	YES	YES							YES	YES
Baloghia marmorata	Jointed Baloghia	In NSW, Jointed Baloghia is found in subtropical rainforest, notophyll vine forest and wet sclerophyll forest on soils derived from basalt. Found between 150m and 550m above sea level.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Belvisia mucronata	Needle-leaf Fern	Forms small clumps on trees or rocks in dry rainforest or along creeks in moist open forest. Occurs in low numbers at all sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bosistoa transversa	Yellow Satinheart	Three-leaved Bosistoa grows in wet sclerophyll forest, dry sclerophyll forest and rainforest including highly disturbed habitat up to 300 m in altitude.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Brachyscome ascendens	Border Ranges Daisy	Montane shrubland on clifftops and benches in thin, rocky soils of basaltic origin.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bulbophyllum globuliforme	Hoop Pine Orchid	Grows on Hoop Pines in upland subtropical rainforest. It is usually found on the upper trunk and branches of the Hoop Pines which protrude from the general rainforest canopy.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cassia marksiana	Cassia marksiana	Found in littoral and riverine rainforest, and in regrowth vegetation on farmland and along roadsides. It prefers more fertile soil-types and is often found in low and flat sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Choricarpia subargentea	Giant Ironwood	Giant Ironwood is found in dry rainforest regrowth consisting of thickets growing in steeply sloping paddocks on basalt-derived soil as well as in sub-tropical and warm temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Clematis fawcettii	Northern Clematis	Drier rainforest, usually near streams.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Coatesia paniculata	Axe-Breaker	Axe-Breaker is found in dry subtropical rainforest and vine scrub, often along rivers.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Corchorus cunninghamii	Native Jute	Occurs in ecotones between wet eucalypt forest and dry to dry-subtropical rainforest on sheltered slopes and gullies, and grassy, open forest on exposed slopes and ridges.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Corokia whiteana	Corokia	The inland populations are found at the boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cryptocarya foetida	Stinking Cryptocarya	Found in littoral, warm temperate and subtropical rainforest, wet sclerophyll forest and Camphor laural forest usually on sandy soils, but mature trees are also known on basalt soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cupaniopsis serrata	Smooth Tuckeroo	Rocky hillsides and subtropical and dry rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cynanchum elegans	White-flowered Wax Plant	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cyperus rupicola	Cliff Sedge	Cliff Sedge grows amongst rocks on the exposed tops of cliffs and on cliff faces or at the base of cliffs, near forest.	YES	YES	YES								YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cyperus semifertilis	Missionary Nutgrass	Occurs in open forest dominated by White Mahogany and wet sclerophyll forest with Sydney Blue Gum and Brush Box.	YES	YES									YES	YES
Davidsonia jerseyana	Davidson's Plum	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m).Many trees are isolated in paddocks and on roadsides in former rainforest habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Davidsonia johnsonii	Smooth Davidson's Plum	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m).Many trees are isolated in paddocks and on roadsides in cleared land.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Dendrocnide moroides	Gympie Stinger	Occurs in lowland rainforest, especially in gaps or other disturbed sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Desmodium acanthocladum	Thorny Pea	Dry rainforest and fringes of riverine subtropical rainforest. On basalt-derived soils at low elevations. Much of its habitat has been cleared for agriculture.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Diospyros mabacea	Red-fruited Ebony	Usually grows as an understorey tree in lowland subtropical rainforest, often close to rivers. Soils are generally basalt-derived or alluvial.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Diploglottis campbellii	Small-leaved Tamarind	Confined to the warm subtropical rainforests of the NSW-Queensland border lowlands and adjacent low ranges.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Doryanthes palmeri	Giant Spear Lily	Giant Spear Lily occurs on exposed rocky outcrops on infertile soils or on bare rock.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Drynaria rigidula	Basket Fern	Grows on plants, rocks or on the ground, Usually found in rainforest but also in moist eucalypt and Swamp Oak forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Eidothea hardeniana	Nightcap Oak	The species occurs in upland warm temperate rainforest, usually near creeks.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Elaeocarpus sedentarius	Minyon Quandong	Warm temperate or subtropical rainforest, and where rainforest and wet eucalypt forest meet. Often associated with Brush Box.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Elaeocarpus williamsianus	Hairy Quandong	Subtropical to warm temperate rainforest, including regrowth areas where it has apparently regrown from root suckers after clearing. Soils are derived from metasediments.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra floydii	Crystal Creek Walnut	Warm temperate, subtropical rainforest or wet sclerophyll forest with Brush Box overstorey, and in and Camphor Laurel forest. The species can occur in disturbed and regrowth sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra hayesii	Rusty Rose Walnut	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils. The species occurs in regrowth and highly modified forms of these habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Occurs in subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Euphrasia bella	Pretty Eyebright	On the edge of cliffs near cool temperate rainforest with Antarctic Beech .The environment is wet but well-drained.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Floydia praealta	Ball Nut	Riverine and subtropical rainforest, usually on soils derived from basalt.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fontainea australis	Southern Fontainea	Southern Fontainea is found in lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest in the Nightcap Range.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Gossia fragrantissima	Sweet Myrtle	Dry subtropical and riverine rainforest. As it can coppice from roots left in the ground when rainforest is cleared, it	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		is found at several sites as isolated plants in paddocks or regrowth.												
Grammitis stenophylla	Narrow-leaf Finger Fern	Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Grevillea hilliana	White Yiel Yiel	White Yiel Yiel grows in subtropical rainforest, often on basalt-derived soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Hibbertia hexandra	Tree Guinea Flower	Tree Guinea Flower typically grows in heath, open forest or rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Hicksbeachia pinnatifolia	Red Boppel Nut	Subtropical rainforest, moist eucalypt forest and Brush Box forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Isoglossa eranthemoides	Isoglossa	Understorey of lowland subtropical rainforest, in moist situations on floodplains and slopes. Underlying soils are derived from basalt, metasediments or gabbro.									YES	YES	YES	
Lepiderema pulchella	Fine-leaved Tuckeroo	Lowland subtropical rainforest in NSW. Found on infertile metasediments, fertile basalts and backswamp alluvium in the Tweed Valley.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lindsaea brachypoda	Short-footed Screw Fern	Very moist habitats in subtropical or warm-temperate rainforest or palm forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Macadamia tetraphylla	Rough-shelled Bush Nut	Found in subtropical rainforest, usually near the coast.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Marsdenia longiloba	Slender Marsdenia	Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.	YES	YES									YES	YES
Melicope vitiflora	Coast Euodia	Coast Euodia grows in subtropical and littoral rainforest. All populations are thought to be small.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Myrsine richmondensis	Ripple-leaf Muttonwood	Subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil and alluvial deposits.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Flowers have been recorded in October and November, fruits have been observed from December to March.												
Niemeyera whitei	Rusty Plum, Plum Boxwood	Found in gully, warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest. It occurs on poorer soils in areas below 600 metres above sea level.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Oberonia complanata	Yellow-flowered King of the Fairies	This species grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes (including stabilised sands), stream-side areas, swampy forests and mangroves.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ochrosia moorei	Southern Ochrosia	Southern Ochrosia is found in riverine and lowland subtropical rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Owenia cepiodora	Onion Cedar	Subtropical and dry rainforest on or near soils derived from basalt.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ozothamnus vagans	Wollumbin Dogwood	Mostly recorded from open situations on the margins of, or within, wet sclerophyll forest, subtropical rainforest and cool temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Peristeranthus hillii	Brown Fairy-chain Orchid	Restricted to coastal and near-coastal environments, particularly Littoral Rainforest and the threatened ecological community Lowland Rainforest on Floodplain.									YES	YES		
Phyllanthus microcladus	Brush Sauropus	Usually found on banks of creeks and rivers, in streamside rainforest or dry rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Plectranthus nitidus	Nightcap Plectranthus	Grows on rocky cliff-faces and boulders, in the shelter and shade provided by the adjacent rainforest and dry rainforest. Co-occurs with and Crofton Weed.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pomaderris notata	McPherson Range Pomaderris	McPherson Range Pomaderris is known from rocky basalt ranges in montane heaths and scrubs or in scrubby rainforest on valley floors.							YES	YES	YES	YES	YES	
Psilotum complanatum	Flat Fork Fern	Grows in moist tropical or subtropical rainforest, or moist eucalypt forest.		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Randia moorei	Spiny Gardenia	Spiny Gardenis occurs in subtropical, riverine, littoral and dry rainforest. In NSW, Hoop Pine and Brush Box are common canopy species.It is found along moist scrubby water courses at altitudes up to 360 m asl, with most records below 100 m asl.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhodamnia rubescens	Scrub Turpentine	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhodomyrtus psidioides	Native Guava	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhynchosia acuminatissima	Pointed Trefoil	Pointed Trefoil is found in or near dry rainforest dominated by Hoop Pine.	YES	YES							YES	YES	YES	YES
Sarcochilus dilatatus	Brown Butterfly Orchid	Grows on trees in littoral rainforest, subtropical rainforest, dry rainforest and streamside forests, mainly at low to medium (up to 500m) altitudes. Plants favour Hoop Pine as a host.	YES	YES	YES									YES
Sarcochilus fitzgeraldii	Ravine Orchid	The Ravine Orchid grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m. Occasional clumps are found on the bases of fibrous-barked trees.										YES	YES	YES
Sarcochilus weinthalii	Blotched Sarcochilus	Rainforest, wet schlerophyll, dry rainforest and drier scrubs, often in isolated patches, from 300 to 900 m in altitude.Can occur on Basalt-capped plateaus, shelves and escarpments.									YES	YES		
Senna acclinis	Rainforest Cassia	Grows on the margins of subtropical, littoral and dry rainforests.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sophora fraseri	Brush Sophora	Brush Sophora is usually found in wet situations in wet sclerophyll forest or vine forest, often near rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Symplocos baeuerlenii	Small-leaved Hazelwood	Occurs in sub-tropical and warm temperate rainforest on less fertile soils derived from rhyolite.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Syzygium hodgkinsoniae	Red Lilly Pilly	Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Syzygium moorei	Durobby	Durobby is found in subtropical and riverine rainforest at low altitude. It often occurs as isolated remnant paddock trees.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Tinospora tinosporoides	Arrow-head Vine	Wetter subtropical rainforest, including littoral rainforest, on fertile, basalt-derived soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Uromyrtus australis	Peach Myrtle	Warm temperate rainforest on less fertile soils derived from rhyolite rock. Often associated with Coachwood	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Appendix G Threatened fauna survey strategy

Table 22 Threatened fauna survey strategy

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Amphibia	*Litoria brevipalmata*	Green-thighed Frog	Species	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Staged assessment proposed as described in section 1.6.1
Amphibia	*Mixophyes fleayi*	Fleay's Barred Frog	Species	Rainforest and wet eucalypt forest of the escarpment and foothills, usually close to gravely streams. The species occurs along stream habitats from first to third order streams (i.e. small streams close to their origin through to permanent streams with grades of 1 in 50) but is not found in ponds or ephemeral pools.	YES	YES	YES						YES	YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	TSC survey OK – species not present
Amphibia	*Mixophyes iteratus*	Giant Barred Frog	Species	Giant Barred Frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats
Amphibia	*Philoria loveridgei*	Loveridge's Frog	Species	This frog is dependent on high moisture levels, occurring in the headwaters of small streams and about soaks where ground-water is continually present and close to the surface. It favours subtropical and warm temperate rainforest and wet eucalypt forest, but also occurs in moist eucalypt forest where rocky outcropping creates surface water.	YES									YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats
Amphibia	*Assa darlingtoni*	Pouched Frog	Species	Pouched frogs live in cool, moist rainforest, including Antarctic Beech, or moist eucalypt forest in mountainous areas, mostly above 800 m but have been found as low as 300m.They spend most of the time in damp leaf litter, or under rocks and rotten logs.	YES	YES	YES						YES	YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	Species/ Ecosystem	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur.				YES	YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in summer and species identified onsite. 4 days survey conducted by ELA in July 2020 failed to confirm any breeding sites for the species.	Survey conducted in July by ELA inspecting all potential breeding trees. Only a single pair was identified, outside the inundation zone. Hollow-bearing trees within the disturbance footprint are unlikely to be breeding habitat for this species. No further survey proposed.
Aves	*Atrichornis rufescens*	Rufous Scrub-bird	Species	Rufous Scrub-birds are now confined to high-altitude (above 600m elevation) subtropical, warm temperate and cool temperate rainforests, and wet sclerophyll forests.	YES								YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period.	TSC survey OK - Species not present
Aves	*Carterornis leucotis*	White-eared Monarch	Species	In NSW, White-eared Monarchs occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: Species identified onsite by ELA in July 2020	Calculate credits in appropriate habitats
Aves	*Cyclopsitta diophthalma coxeni*	Coxen's Fig-Parrot	Species	Usually recorded from drier rainforests and adjacent wetter eucalypt forest but rarely seen due to its small size and cryptic habits. Also found in the wetter lowland rainforests that are now largely cleared in NSW.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 35.64 hrs total bird survey	TSC survey OK - Species not present
Aves	*Dasyornis brachypterus*	Eastern Bristlebird	Species	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	YES	YES	YES	YES	YES				YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33.33 hrs bird survey in survey period	TSC survey OK - Species not present
Aves	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Species/ Ecosystem	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.							YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: One eyie identified onsite and in-use in July 2020.	Calculate credits for breedong habitat
Aves	*Hieraaetus morphnoides*	Little Eagle	Species/ Ecosystem	Occupies open eucalypt forest, woodland or open woodland.								YES	YES	YES			Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Lophoictinia isura*	Square-tailed Kite	Species/ Ecosystem	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	YES								YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	TSC survey OK - Species not present
Aves	*Menura alberti*	Albert's Lyrebird	Species	Mainly occur in the wettest rainforests or wet sclerophyll forests with a wet understorey, often of rainforest plants. Higher densities of Albert's Lyrebirds occur in association with a canopy of eucalypts compared with rainforest lacking eucalypts (for equivalent climate), and in wet sclerophyll forest with greater weights of litter and logs and slower rates of litter decomposition.						YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	Calculate credits in appropriate habitats
Aves	*Turnix melanogaster*	Black-breasted Button-quail	Species	Preferred habitat includes drier low closed forests, including dry rainforests, vine forest and vine thickets, often in association with Hoop Pine, and Bottletree scrubs. have long been unclear, having been placed variously in their own order, or with the Galliformes or Gruiformes. Recent studies have shown that the button-quails are actually related to the gulls and terns and their relatives (Charadriiformes).	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 35.64 hrs total bird survey	TSC survey OK - Species not present
Aves	*Ninox connivens*	Barking Owl	Species/ Ecosystem	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland.					YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species not identified onsite. No further survey proposed.	TSC survey OK - Species not present
Aves	*Ninox strenua*	Powerful Owl	Species/ Ecosystem	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.					YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species not identified onsite. No further survey proposed.	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Tyto novaehollandiae*	Masked Owl	Species/ Ecosystem	Lives in dry eucalypt forests and woodlands from sea level to 1100 m.					YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species identified onsite by TSC. Species not identified during breeding season and unlikely to be utilising hollow-bearing trees within disturbance footprint. No further survey proposed.	Survey OK - Species known from site but breeding habitat not present. No further assessment required.
Aves	*Tyto tenebricosa*	Sooty Owl	Species/ Ecosystem	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.					YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species identified onsite by TSC. Species identified at numerous sites during breeding season, however no pairs duetting unlikely to be utilising hollow-bearing trees within disturbance footprint. No further survey proposed.	Survey OK - Species known from site but breeding habitat not present. No further assessment required.
Mammalia - bats	*Chalinolobus dwyeri*	Large-eared Pied Bat	Species	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin, frequenting low to mid-elevation dry open forest and woodland close to these features.	YES										YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Miniopterus australis*	Little Bent-winged Bat	Species/ Ecosystem	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Only five nursery sites /maternity colonies are known in Australia.	YES	YES										YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Miniopterus orianae oceanensis*	Eastern Bentwing-bat	Species/ Ecosystem	Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	YES	YES										YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Mammalia - bats	*Vespadelus troughtoni*	Eastern Cave Bat	Species	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	YES										YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Myotis macropus*	Southern Myotis	Species	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around waterbodies and forest habitats Survey undertaken: 3 harp trap 14 ANABAT nights	Calculate credits in appropriate habitats
Mammalia - bats	*Pteropus poliocephalus*	Grey-headed Flying-fox	Species/ Ecosystem	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.										YES	YES	YES	Minimum survey requirement: Searches for camps Survey undertaken: 32 sites habitat assessment 61.95 hours spotlighting	Survey OK - breeding habitat not present
Mammalia - arboreal and terrestrial	*Cercartetus nanus*	Eastern Pygmy-possum	Species	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha 100 elliot trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights 1600 elliot trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and terrestrial	*Macropus parma*	Parma Wallaby	Species	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: None specified Survey undertaken: 80 cage trap nights 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and	*Petaurus norfolcensis*	Squirrel Glider	Species	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: None specified Survey undertaken: 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Mammalia - arboreal and terrestrial	*Phascolarctos cinereus*	Koala	Species/ Ecosystem	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: SAT surveys Camera traps spotlighting Call playback Survey undertaken: 45.64 person hours SAT at 32 sites 896 camera trap nights Spotlighting at 32 sites	Calculate credits - Request 'Important habitat' criteria
Mammalia - arboreal and terrestrial	*Planigale maculata*	Common Planigale	Species	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha 100 elliot trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights 1600 elliot trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and	*Antechinus arktos*	Black-tailed Antechinus	Species	The species is found in cool subtropical cloud forest / rainforest comprising complex notophyll vine forest and simple microphyll fern forest featuring a low canopy, very dense vines and a rocky substrate.							YES	YES					n/a	Site not suitable. Species removed from assessment
Mammalia - arboreal and terrestrial	*Phascogale tapoatafa*	Brush-tailed Phascogale	Species	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west ot the divide.	YES	YES	YES	YES	YES	YES						YES	Minimum survey requirement: 10 camera traps per ha in suitable habitats. DPIE request plot data and habitat mapping to formalise approach (provided in this letter) Survey undertaken: 896 camera trap nights Spotlighting at 32 sites	Spotlighting survey appropriate for this species. Habitats not suitable. No further survey required.
Mammalia - arboreal and terrestrial	*Aepyprymnus rufescens*	Rufous Bettong	Species	Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: None specified Survey undertaken: 80 cage trap nights 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Cacophis harriettae*	White-crowned Snake	Species	Favours low to mid-elevation dry eucalypt forest and woodland, particularly areas with a varied and well-developed litter layer, where their prey of small lizards may be more abundant.	YES	YES	YES	YES					YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Reptilia	*Coeranoscincus reticulatus*	Three-toed Snake-tooth Skink	Species	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	YES	YES	YES	YES					YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Hoplocephalus bitorquatus*	Pale-headed Snake	Species	The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest.	YES	YES	YES								YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Hoplocephalus stephensii*	Stephens' Banded Snake	Species	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Stephens' Banded Snake is nocturnal, and shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	Calculate credits in appropriate habitats
Invertebrates	*Nurus atlas*	Atlas Rainforest Ground-beetle	Species	Low-elevation rainforest and wet eucalypt forest with a well-developed rainforest understorey.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment
Invertebrates	*Nurus brevis*	Shorter Rainforest Ground-beetle	Species	Subtropical and warm temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment
Invertebrates	*Phyllodes imperialis* southern subspecies	Southern Pink Underwing Moth	Species	The Southern Pink Underwing Moth is found in subtropical rainforest below about 600 m elevation.Potential breeding habitat is restricted to areas where the caterpillar's food plant, a native rainforest vine, Carronia multisepalea, occurs in subtropical rainforest.	YES	YES								YES	YES	YES	No survey requirement published	Conduct survey of host plant concurrently with flora surveys
Invertebrates	*Thersites mitchellae*	Mitchell's Rainforest Snail	Species	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment

Appendix G. Letter from Biodiversity Conservation Division to Eco Logical Australia regarding verification of survey methodology

Appendix H. Undertaken survey effort for birds, breeding owl habitat, glossy black-cockatoo habitat, raptor habitat, arboreal and terrestrial mammals and microchiropteran bats.

Date	Target species	Survey method	Replicates	Effort	Comparison to BAM 2017 requirements
9-13 March 2020	Forest owls	Breeding habitat survey. General search within all the forested development site for breeding habitat	Survey area searched once	Two person search through the extent of forested land within the proposed development site (~114 ha). Time spent searching is unknown, however, search effort was conducted in each of the 5 days. Once candidate trees were found, the tree was searched for whitewash and casts.	BAM 2017: No guidance for field assessment. Breeding habitat preferences that from DEC (2006).
21-24 July 2020	Forest owls	Call playback was broadcast at sites within the proposed development site at four sites over four nights.	Four sites nearby potential habitat trees	30 min survey at each playback site for four nights. 30 min x 4 nights x 4 sites = 8 hours total	BAM 2017: No guidance for field assessment. Breeding habitat preferences that from DEC (2006).
21-24 July 2020	Forest owls	Circumnavigation of dam edge with spotlight	4 circumnavigations	7.6 km long x 4 times	BAM 2017: No guidance for field assessment. Breeding habitat preferences that from DEC (2006).

9-13 March 2020	Raptors	General search within the development footprint for nesting sites	Survey area searched once	Two person search through the extent of forested land within the proposed development site (~114 ha). Time spent searching is unknown. Once candidate trees were found, the tree was searched for whitewash and casts	No known recommendations or minimum survey effort
November 2016- January 2017	Diurnal forest and rainforest birds	200 m x 100 m plot for 20 min.	19 plots within development footprint x 3 visits. 13 more plots within close proximity to development site in contiguous forest	1 person x 20 min x 19 sites x 3 visits = 19 hours surveying. 1 person x 20 min x 13 sites x 3 visits = 13 hours	DEC (2004): area search over 1 ha for 20 min, replicated for each habitat type. The required number of repeat visits are not specified. Commonwealth of Australia (2010) recommends 9 hours total of surveying over 3 days from September to February for eastern bristlebird. Commonwealth of Australia recommends 5 days of surveying for Coxen's fig parrot (20 hours total).

19-13 March 2020	Glossy black-cockatoo	General search within all the forested development site for breeding habitat	Survey area searched once	Two person search through the extent of forested land within the proposed development site (~114 ha). Time spent searching is unknown, however, search effort was conducted each of the 5 days	Identification of breeding habitat, then potential nest hollows, then confirm breeding. If breeding is identified, estimate circular species polygon (BAM 2017)
21-25th July 2020	Glossy black-cockatoo	Breeding habitat surveys. Survey of whole development site - general search method. Potential habitat (hollow-bearing trees) searched for 10 minutes each. Method followed OEH (2020): Step 1 - signs of breeding searched; Step 2 - identification of potential nest trees where signs of breeding present; Step 3 - monitor potential nesting trees during breeding season; draw species polygon around actual nest trees	Survey area searched once	2 people. 42 HBTs inspected. Survey conducted over five days. Total effort = 42 x 10 min = 420 min	Identification of breeding habitat, then potential nest hollows, then confirm breeding. If breeding is identified, estimate circular species polygon (BAM 2017)

March 2017	Jacana	Count from canoe and motor boat	1 survey	2 observers 28.5 km of shoreline/shallow water surveyed	No known recommendations or minimum survey effort
Mid December 2016 - Mid January 2017	Small mammals, reptiles, amphibians, invertebrates	Pitfall sampling. Five buckets 20 L buckets spaced 4-5 m apart, with connecting 40 cm tall drift fence.	12 plots within development site; 8 plots within close proximity to development site in contiguous forest	4 nights of trapping per plot Total of 12 x 4 x 5 = 240 trap nights within development site 8 x 4 x 5 = 160 trap nights nearby to development site in contiguous habitat	Pitfall traps with at least 5 m of drift fence that is 30 cm high. Minimum 24 trap nights with pits open for at least 3-4 nights (DEC 2004)

Mid December 2016 - Mid January 2017	Mammal	General search for signs	19 plots within development site visits. 13 more plots in contiguous habitat to development site and nearby habitat	3 visits per site for 20 min per visit with 1 person surveying Total of 19 x 3 x 20 = 19 hours surveying within development site Total of 13 x 3 x 20 = 13 hours surveying nearby to development site in contiguous habitat	Search for scats and signs 30 min in each habitat (DEC 2004)
Mid December 2016 - Mid January 2017	Mammals	Elliot trap sampling. 10 baited traps evenly spaced along 200 m transect	12 plots within development site; 8 plots within close proximity to development site in contiguous forest	4 nights of trapping per plot Total of 12 x 4 x 10 = 480 trap nights within development footprint 8 x 4 x 10 = 320 trap nights in close proximity to development footprint	100 trap nights over 3-4 consecutive nights (DEC 2004)

Mid December 2016 - Mid January 2017	Mammals, birds, reptiles	1 camera trap with herbivore and carnivore lures per plot	19 plots within development site 13 more plots within close proximity to development site in contiguous forest	16 nights of trapping per plot Total of 19 x 16 = 304 trap nights in development site Total of 13 x 16 = 208 trap nights nearby to development site in contiguous habitat	For wild dogs, foxes and cats (DPI 2018): - minimum four week deployment - no specific recommendation on number of replicates or number of trap nights required No known recommendations or minimum survey effort
Mid December 2016 - Mid January 2017	Mammals, birds, reptiles	1 camera trap with herbivore and carnivore lures per plot	4 plots around dam wall within development site	16 nights of trapping per plot Total of 4 x 16 = 64 trap nights in development site	For wild dogs, foxes and cats (DPI 2018): - minimum four week deployment - no specific recommendation on number of replicates or number of trap nights required No known recommendations or minimum survey effort

Mid December 2016 - Mid January 2017	Mammal	1 Cage trap per plot	12 plots within development site; 8 plots within close proximity to development site in contiguous forest	4 nights of trapping per plot Total of 12 x 4 x 1 = 48 trap nights within development site 8 x 4 x 1 = 32 trap nights nearby to development site in contiguous habitat	24 trap nights over 3-4 consecutive nights
Mid December 2016 - Mid January 2017	Mammal, nocturnal bird, reptile	Spotlighting within 200 m x 100 m plot. Prior to the commencement of the general search, there was playback of koala, yellow-bellied glider, pale-vented bush hen, marbled frogmouth, powerful owl, barking owl, masked owl, sooty owl and grass owl. Each species was played on non-consecutive nights. Playback lasted 2-5 min, followed by 5 min of listening and then the 20 min survey.	19 plots within development site x 3 visits. 13 more plots within close proximity to development site in contiguous forest	3 visits per plot for a duration of 20 min per survey x 2 people per survey Total of 19 x 3 x 2 x 20 = 38 survey hours within the development site Total of 13 x 3 x 2 x 20 = 26 survey hours nearby to development site in contiguous habitat	Minimum 50 W spotlight (DEC 2004). Recommended playback period for owls: intermittent over 5 min (DEC 2004). DEC (2004) recommends for nocturnal birds: - site separation of 800 m-1 km; - playback with 5 visits per site for powerful owl, barking owl and grass owl; - 6 visits per site for sooty owl; - 8 visits per site for masked owl; - diurnal habitat search for pellets and hollows feasible; - number of replicates not specified For mammal (DEC 2004): - Spotlighting on foot 2 x 1 hour and 1 km up to 200 ha of stratification unit, walking at ~1 km per hour on 2 separate nights - Call playback (2 sites per habitat up to

					200 ha, with 2 visits per site on separate nights)

Mid December 2016 - Mid January 2017	Koala	SAT surveys. ~30 trees per plot	19 plots within development site x 3 visits. 13 more plots within close proximity to development site in contiguous forest	2 min per tree 19 x 30 x 2 min = 19 person hours surveying within the development site 13 x 30 x 2 min = 13 hours surveying nearby to development site in contiguous habitat	No known recommendations or minimum survey effort
July 2017	Koala	SAT surveys. ~30 trees per plot	1 site near dam wall within development site	2 min per tree 30 x 2 = 60 person minutes	No known recommendations or minimum survey effort
July 2017	Mammals, birds, reptiles and amphibians	General search	Around dam wall within development site.	2 hours searching with 2 people and 2 hours searching with one person = total 6 hours of searching	No known recommendations or minimum survey effort for general search of mammals. See above for birds.

Mid December 2016 - Mid January 2017	Microchiropteran bats	Anabat recorders. 1 trap per site	12 sites within development site. 4 sites within close proximity to development site in contiguous forest	1 night deployment 12 trap nights within the development site 4 trap nights nearby to development site in contiguous habitat	16 trapping nights of recording bat calls (OEH 2018)
Mid December 2016 - Mid January 2017	Microchiropteran bats	Harp trap. 1 trap per site	2 sites within development site. 1 site within close proximity to development site in contiguous forest	2 nights of sampling at each site within the development site. Total surveying = 2 x 2 = 4 trap nights 1 night of sampling at the single site within close proximity to development site in contiguous forest. Total surveying effort = 1 trap night	16 harp trap nights (OEH 2018)
2020	Microchiropteran bats	Landscape identification of cliffs and caves with 10 km buffer around potential breeding habitat			Habitat identification (OEH 2017)
30/11/2020 - 5/12/2020	Microchiropteran bats	Harp traps around the dam wall	4	Four nights. Total of 16 trap nights	16 harp trap nights (OEH 2018)

30/11/2020 - 5/12/2020	Microchiropteran bats	Bioacoustic surveys using Songmeter Minis	6	Four nights. Total of 24 trap nights	16 trapping nights of recording bat calls (OEH 2018)
Late October - early November 2020	Southern pink underwing moth	Survey for vine *Carronia multisepalea,* caterpillar and signs of herbivory. Point surveys with a radius of 20 m (1256 m^2) within the development site	442 points	Total of 55.5 ha searched within forested areas	Survey between October and February. No known recommendations or minimum survey effort
	Mitchell's rainforest snail	Detected during amphibian survey. Expert opinion report drafted to define polygon			As per BAM 2017

Your ref: Letter dated 2 August 2022
Our ref: DOC22/670325-2

General Manager
Tweed Shire Council
PO Box 816
MURWILLUMBAH NSW 2484

Attention: Mr David Hannah

Dear Mr Green

RE: Additional information regarding the request for the use of species survey data collecting in 2016 for a BDAR submitted in 2022, Clarrie Hall Dam Raising - SSI9458

Thank you for your letter dated 2 August 2022 to the Biodiversity and Conservation Division (BCD) of the Environment and Heritage Group in the Department of Planning and Environment providing additional information for the Tweed Shire Council's request to use species survey data collected in 2016 for the Clarrie Hall Dam Raising Project's Biodiversity Development Assessment Report (BDAR). I appreciate the opportunity to provide further input and apologise for the delay in responding.

The BCD has reviewed your letter including Appendices A to H and notes the extent and classification of vegetation mapping has been compared between 2016/17 and 2020/21 surveys as we requested.

We also note the extent and classification of Plant Community Type (PCT) mapping is generally similar between the two survey periods, and that the new occurrences of PCT1068, PCT812 and PCT887 in the 2020/21 survey appear to have arisen because these recent surveys covered parts of the subject site that were not surveyed in 2016/17.

Other notable changes between the 2016/17 and 2020/21 vegetation mapping include a decrease in PCT1073 by approximately 5% over the subject site, an increase in PCT827 of approximately 3%, and an increase in PCT1302 by approximately 1% over the subject site. These changes appear to have resulted from refinement of PCT polygon boundaries over the subject site, and not because of clearing.

The council has also compared the condition of the vegetation between the 2016/17 and 2020/21 surveys as we requested. The BCD notes that vegetation composition, structure and function data collected using the Biodiversity Assessment Method (BAM) 2017, did not differ between 2016/17 and 2020/21. In addition, no changes in land management over the subject site have occurred since the 2016/17 surveys.

Regarding the use of previous fauna surveys to inform the BDAR, we note the previous correspondence between Eco Logical Australia and the BCD dated 29 September 2020, which verified the survey methodology for frogs, reptiles and the brush-tailed phascogale completed in 2016/17 as meeting the requirements of the BAM 2017. In 2020/21 there was additional survey work undertaken for glossy-black cockatoo, owl breeding habitat, raptors, amphibians, Mitchell's rainforest snail, pink underwing moth and microbats.

Appendix H from your letter compares the fauna survey work undertaken in 2016/17 and 2020/21 with the BAM 2017 survey requirements. This shows that fauna survey work undertaken generally complies or exceeds the BAM 2017 survey requirements. The accredited assessor will need to demonstrate in the BDAR that the fauna survey methods are adequate to enable detection of threatened species with potential to occur on the subject site.

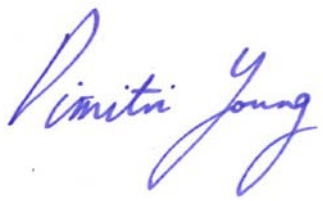
The Department has recently published the Koala Biodiversity Assessment Method Survey Guide (the Guide) which details survey methods and guidance when mapping species polygons for koala. We note the Spot Assessment Technique has already been used to survey koala over the subject site, and we request the council refers to and includes relevant information from the Guide when mapping a species polygon for koala over the subject site.

Based on the information provided to the BCD, it appears acceptable in this instance for fauna species survey data collected during 2016/17, and supplemented with further surveys in 2020/21, to be incorporated into a BDAR to be submitted in 2022.

Upon submission of a BDAR, the BCD will still review the vegetation mapping and species polygons for accuracy.

If you have any questions about this advice, please do not hesitate to contact Ms Vanessa Owen, Senior Project Officer, at vanessa.owen@environment.nsw.gov.au or 4927 3116.

Yours sincerely



19 September 2022

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

B.7 Item 7

Department of Planning and Environment

Your ref: e-mail dated 19/09/2022
Our ref: DOC22/836865-2

General Manager
Tweed Shire Council
PO Box 816
MURWILLUMBAH NSW 2484

Attention: Mr David Hannah

Dear Mr Green

RE: Extension of time regarding the request for the use of species survey data collected in 2016 for Clarrie Hall Dam Raising - SSI9458

Thank you for your e-mail dated 19 September 2022 to the Biodiversity and Conservation Division (BCD) of the Environment and Heritage Group in the Department of Planning and Environment requesting an extension of time for the Tweed Shire Council to use species survey data collected in 2016 for the Clarrie Hall Dam Raising Project's Biodiversity Development Assessment Report (BDAR). I appreciate the opportunity to provide further input and apologise for the delay in responding

This advice should be read in conjunction with the BCD's letter dated 19 September 2022 (DOC22/670325-2), where we concluded it was acceptable in this instance for fauna species survey data collected during 2016/17, and supplemented with further surveys in 2020/21, to be incorporated into a BDAR to be submitted in 2022.

We note from your e-mail dated that the consultant engaged to prepare the Environmental Impact Statement (EIS) for the Clarrie Hall Dam Raising Project was terminated, and that the council is in the process of shortlisting and engaging new consultants to complete the EIS. This will require preparation of an updated BDAR by a new accredited assessor, and the updated EIS including the updated BDAR, will not be completed until 2023.

The BCD has reviewed this timeframe and we consider that the advice we provided in our letter dated 19 September 2022 is valid for twelve months. If the BDAR has not been submitted by 19 September 2023, then the council will need to again demonstrate to the BCD that the extent and condition of vegetation and fauna habitat remains similar over the site to justify the use of 2016/17 fauna survey data.

If you have any questions about this advice, please do not hesitate to contact Ms Vanessa Owen, Senior Project Officer, at vanessa.owen@environment.nsw.gov.au or 4927 3116.

Yours sincerely

Dimitri Young

24 October 2022

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

B.8 Item 8

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28 June 2023

Dimitri Young
Senior Team Leader Planning
Biodiversity and Conservation Division, North East Branch
NSW Department of Planning, Industry and Environment
Level 8, 24 Mooney Street
Coffs Harbour NSW 2450

Re: Clarrie Hall Dam Raising Project - Terrestrial Ecology Survey Approach

Dear Dimitri,

EMM Consulting Pty Ltd (EMM) have been engaged by KBR to review and update the biodiversity assessment for the proposed Clarrie Hall Dam Raising (CHDR) EIS. EMM has now reviewed work undertaken by Tweed Shire Council (TSC) and the previous consultant, along with various correspondence with the Biodiversity Conservation Division (BCD). This review has potentially identified the need for additional surveys to meet the requirements of the Biodiversity Assessment Method (BAM). Prior to proceeding, Council, KBR, and EMM wishes to consult with BCD on this work and seek in-principle support for our proposed approach. This letter describes and quantifies the survey techniques and effort to complete the biodiversity assessment for the CHDR EIS.

1 Project background

Clarrie Hall Dam was constructed in 1983 by the New South Wales Department of Public Works and operated by the Tweed Shire Council (TSC) for the primary purpose of providing a drinking water supply to the Tweed Shire area.

Clarrie Hall Dam is located on Doon Doon Creek, a third-order stream forming a tributary of the south arm of the Tweed River. The dam is located in the suburb of Doon Doon, approximately 15 kilometres (km) south-west of Murwillumbah and 4 km south-west of Uki in the Tweed Shire.

The current dam has a catchment area of approximately 60 square kilometres (km^2) and a storage capacity of 16,000 million litres (ML). Water is released down Doon Doon Creek via release valves within an intake tower within the dam to the Tweed River, where it is subsequently harvested at the Bray Park Weir.

Due to increasing demand for water as a result of projected population growth, and the increasing uncertainty of water supply yield associated with climate change, there is a requirement to augment the Tweed Shire district water supply by 2026.

1.1 Concept design

TSC proposes to raise the wall of Clarrie Hall Dam by 8.5 metres (m) to a height of 70 metres Australian Height Datum (AHD) (AHD RL70), thereby increasing the capacity of the dam from 16,000 ML to approximately 42,300 ML to provide a secure water supply for the Tweed Shire until at least 2065 (the Proposal).

The concept design includes:

- constructing access roads to the construction areas and establishing the construction site
- re-establishing the quarry used to construct the existing dam
- removing and storing parapet walls for reuse
- increasing the base-width of the valley-side abutment and raising the concrete-faced rockfill embankment crest to RL70 AHD
- constructing a new concrete-lined spillway higher on the west abutment
- extending the upstream concrete face to the new crest height
- raising the intake tower and access bridge
- constructing a new section of the Clarrie Hall Dam Road to provide access to the east abutment of the dam wall
- establishing new recreation and operational facilities at the dam, including an amenities block, public shelters, viewing areas, interpretation signage, paths, car parks, landscaping, security fences, lighting, monitoring equipment and boat ramp
- removing or reconstructing impacted infrastructure at Crams Farm
- upgrading the Kyogle Road and Clarrie Hall Dam Road intersection
- constructing a new McCabes Bridge and realignment of one kilometre of approaches to McCabes Bridge.

The majority of the rockfill is to be obtained from the old quarry site adjacent to the dam with some smaller volumes extracted from excavation of the new spillway channel higher in the left abutment.

1.2 Planning approval

An application under Part 5, Division 5.2 (State Significant Infrastructure) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) was submitted to the NSW Department of Planning and Environment (DPE) in 2018 (SSI 9458). Secretary's Environmental Assessment Requirements (SEARs) were issued on 23 April 2019 and an Environmental Impact Statement (EIS) is being prepared under Part 5, Division 5.2 of the EP&A Act.

The biodiversity impacts will be considered under the provisions of the NSW *Biodiversity Conservation Act 2017* (BC Act), with impacts assessed in accordance with the Biodiversity Assessment Method (BAM, DPIE 2020) documented in a Biodiversity Development Assessment Report (BDAR).

The Proposal was also declared a controlled action under the Commonwealth *Environmental Protection and Biodiversity Act 1999* (EPBC Act). The SEARs were updated in response to the Proposal being declared a controlled action and the project will be assessed under the bilateral agreement between NSW and the Commonwealth, with impact to Matters of National Environmental Significance (MNES) assessed via the BAM and documented in the BDAR.

Revised SEARs were issued by DPE in November 2021 as the original SEARs had expired. These SEARs are due to expire in November 2023. TSC will be submitting a revised scoping report and SEARs application in July 2023.

1.3 Project history and previous consultation

A substantial amount of survey effort has already been completed for the project, including engagement with BCD. A summary of notable effort and engagement includes the following:

- Flora and fauna assessments were undertaken by TSC which will form part of the proposed survey effort for the project. Key documents include:
  - *Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam* (TSC 2017)
  - Further Investigation to the occupancy of *Mixophyes iteratus* within the Doon Doon Catchment (TSC n.d.)
  - *Targeted survey and revised impact assessment for Red Lilly Pilly and lowland rainforest, Doon Doon catchment - Addendum to the Flora and Fauna Assessment for the Proposed Raising of Clarrie Hall Dam* (TSC 2018).

In November 2019, TSC engaged Eco Logical Australia (ELA) to prepare an EIS and BDAR to support project approval. ELA completed a gap analysis on the biodiversity data collected by TSC, providing a survey plan to BCD (Letter from Alex Purshe to Dimitri Young, September 2020; refer to Appendix A.1). A response to the survey plan was received in September 2020 (Letter from Dimitri Young to Alex Purshe, September 2020; refer to Appendix A.2). ELA conducted a number of biodiversity assessments for the project, which are detailed in relevant sections of this letter. A draft BDAR was authored but was not submitted or finalised.

1.4 Purpose of this letter

TSC has engaged KBR and EMM, working in partnership, to complete the EIS and BDAR. EMM has completed a gap analysis to review work previously undertaken against contemporary requirements of the BAM. This review has potentially identified the need for additional surveys to meet the requirements of the BAM. Prior to proceeding, EMM wishes to consult with BCD on this work and seek in-principle support for our proposed approach.

To ensure alignment with the requirements of the BAM, as well as NSW (DEC 2004, DPIE 2020a, b, c, d) and Commonwealth (Commonwealth of Australia 2010a, 2010b, 2011a, 2011b, 2014) survey guidelines, EMM has prepared this letter to outline our approach to the biodiversity surveys. This will take into account biodiversity surveys undertaken to date, BCD's prior support of effort/survey techniques and recent changes to species listing, published guidelines, and previous project experience on similar projects.

2 Vegetation

2.1 Vegetation mapping and plots

Vegetation mapping was initially undertaken by TSC with ELA validating and refining the vegetation using rapid assessments in 2020. Rapid assessments were undertaken noting the dominant canopy, mid-storey, and ground species, as well as noting the level of disturbance present.

Vegetation integrity plots were completed by ELA in accordance with Section 5.3 of BAM 2020 in 2020 and 2021.

A desktop review by EMM of the work completed date supports the completed vegetation approach with a few modifications outlined below.

2.2 Rainforests

Three rainforest plant community types (PCTs) were described in the development site:

- PCT 770 Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion
- PCT 1068 Pepperberry – Giant Stinging Tree – Fig lowland rainforest in the NSW North Coast Bioregion
- PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion.

The rationale for mapping the three different PCTs was poorly justified and, in some instances, appeared a poor fit compared to plot data. We have conducted a review of all potential PCTs on a range of attributes, including plot data (species composition, coverage), landscape position and vegetation class. We have concluded that the rainforest has structural and species assemblages representing a subtropical rainforest, given the diversity of species and the multiple stratum present. This is opposed to warm temperate rainforests with a comparatively species poor canopy and lack of well-developed mid-storey. We conclude that the best fit for all areas of rainforest is PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion. Further analysis is provided in Appendix B.

2.3 Cleared areas

Cleared areas are largely restricted to the south of the development site. Whilst some plots have been completed in this area, we consider that the mapping is too coarse and requires revisiting, given small, wooded areas are observable in the aerial imagery. Additional vegetation mapping is proposed in these areas to separate small patches of woodland or scattered trees from true cleared areas.

Following vegetation mapping, BAM plots will be conducted at the required effort specified in the BAM. Vegetation integrity score and habitat assessments will be used to inform any further survey required, including the potential for BAM plots, and determine any offset requirements.

2.4 Planted areas

Plantations of Hoop Pine (*Araucaria cunninghamii*) and Dunn's White Gum (*Eucalyptus dunni*) occur in the south of the development footprint. We propose to use the BAM Streamlined assessment module planted native vegetation (DPE 2022) and have followed the decision-making flow chart as outlined in Figure 1 (DPE 2022).

1. *Does the planted native vegetation occur within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal?*

    a) The two plantations are discrete homogenous areas and are not part of a mosaic with remnant vegetation.

    b) Hoop Pine and Dunn's White Gum are both found within several PCTs within the sub-region; however, the species has not been recorded in any of the surrounding relatively intact vegetation and is not characteristic of any of the PCTs mapped in the study area.

2. *Is the planted native vegetation planted for the purpose of environmental rehabilitation or restoration under an existing conservation obligation listed in BAM Section 11.9(2.), and the primary objective was to replace or regenerate a plant community type or a threatened plant species population or its habitat?*

    a) No, the primary object of the planting was for commercial logging purposes.

3. *Is the planted or translocated native vegetation for the purpose of providing threatened species habitat under a project listed in Q3 of the Planted Native Vegetation Streamlined Assessment Module?*

    a) No, as above.

4. *Was the planted native vegetation undertaken voluntarily for revegetation, environmental rehabilitation or restoration without a legal obligation to secure or provide for management of the native vegetation?*

    a) No, as above.

5. *Is the native vegetation planted for functional, aesthetic, horticultural or plantation forestry purposes?*

    a) Yes, the native vegetation was planted for plantation forestry purposes.

In the decision-making flowchart at step 5, Section D.2 of the module can be applied. EMM understands that further assessment of the planted areas is required. The following will be considered in the BDAR: consideration of threatened species habitat, prescribed impacts, avoid and minimise principles, consideration of serious and irreversible impacts (S&II) and mitigation and management of impacts.

2.5 Plant community types present

This section provides a summary of the vegetation zones and areas mapped within the disturbance area, providing context for following discussion of survey effort and stratification for flora and fauna approach. Based on changes proposed above, three PCTs are present within the development footprint, comprising seven vegetation zones (Table 2.1).

Table 2.1 Plant community types recorded and other land cover within the development footprint

PCT	Vegetation class	Zone	BC Act	EPBC Act	Vegetation integrity score (VIS)	Area (ha)
827 Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast	North Coast Wet Sclerophyll Forests	High	n/a	n/a	68.9	64.12
		Mod	n/a	n/a	65.4	43.77
		Low	n/a	n/a	39.1	11.54
		Burnt	n/a	n/a	47.2	18.43
1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	North Coast Wet Sclerophyll Forests	Moderate	n/a	n/a	36.3	1.38
1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	Subtropical Rainforests	High	n/a	n/a	50–65	7.50
		Moderate	n/a	n/a	n/a	0.86
Other land cover						
Plantation - Dunn's White Gum (*Eucalyptus dunni*)	n/a	n/a	n/a	n/a	n/a	7.91
Plantation - Hoop Pine (*Araucaria cunninghamii*)	n/a	n/a	n/a	n/a	n/a	4.64
Cleared land	n/a	n/a	n/a	n/a	n/a	71.89

Notes: 1. The above represent preliminary data and the area of each vegetation zone/VIS may change during project refinement.

2. As discussed above cleared areas will be revisited with some areas remapped as separate vegetation zones.

3. The VIS for rainforest is an estimate only.

3 Flora

3.1 Candidate species

In accordance with Section 5.2.1 of the BAM, ecosystem credit species and species credit species in the Threatened Biodiversity Data Collection (TBDC) were identified for assessment if the species:

- is associated with PCTs recorded within the disturbance footprint
- is likely to be present, in the opinion of the assessor
- is predicted to occur by the EPBC Act Protected Matters Search Tool
- has been recorded on the disturbance footprint, or near the disturbance footprint in similar habitat, but is not predicted by the Calculator (e.g. based on review of ecological reports, environmental impact statements, scientific literature, presence on site during the survey).

Candidate flora species predicted by the BAM-C are shown in Table 3.1. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded.

Species are excluded in accordance with the BAM on the basis of habitat and/or geographic constraints. The one exception is the Hoop Pine Orchid (*Bulbophyllum globuliforme*). The Orchid is a threatened epiphytic species found in the canopy of Hoop Pine. Survey within the Hoop Pine plantation by ELA has identified it is of relatively young age. Literature suggest that the Orchid is typically found in trees greater than 100 years old, usually from 300 to 600 m altitude. We seek to exclude the species as a candidate species, considering the relatively young age of the plantation, the low altitude (77 AHD), and that the plantation not being part of a naturally occurring community, albeit noting that none of these altitudinal or habitat requirements are included in the BAM-C.

EMM seeks feedback from BCD on this candidate species assessment.

Table 3.1 Flora candidate species assessment

Scientific name	Common name	EPBC Act status	BC Act status	Habitat/geographic constraint	Sensitivity to gain	Habitat/geographic constraint present	Justification for addition or exclusion
Acacia bakeri	Marblewood	Not listed	Vulnerable	Within Mt Jerusalem National Park or within a 10 km buffer around this National Park	High	Yes	N/A
Acalypha eremorum	Acalypha	Not listed	Endangered	None	High	N/A	N/A
Acronychia littoralis	Scented Acronychia	Endangered	Endangered	Within 5 km of coast	High	No	Excluded as the subject site is not within 5 km of the coast.
Amyema plicatula	Amyema plicatula	Endangered	Endangered	None	High	N/A	N/A
Angiopteris evecta	Giant Fern	Not listed	Endangered	None	High	N/A	N/A
Archidendron hendersonii	White Lace Flower	Not listed	Vulnerable	None	High	N/A	N/A
Arthraxon hispidus	Hairy Jointgrass	Vulnerable	Vulnerable	None	High	N/A	N/A
Backhousia subargentea	Giant Ironwood	Not listed	Endangered	None	High	N/A	N/A
Baloghia marmorata	Jointed Baloghia	Vulnerable	Vulnerable	None	High	N/A	N/A
Belvisia mucronata	Needle-leaf Fern	Not listed	Endangered	None	High	N/A	N/A
Bosistoa transversa	Yellow Satinheart	Vulnerable	Vulnerable	None	High	N/A	N/A
Brachyscome ascendens	Border Ranges Daisy	Not listed	Endangered	None	High	N/A	N/A
Bulbophyllum globuliforme	Hoop Pine Orchid	Vulnerable	Vulnerable	Hoop pines	High	Yes	Excluded. The species requires old growth Hoop Pine in mesic habitats with abundant moss and other epiphytes typically found in higher altitude area. Refer to discussion in Section 3.1.
Cassia marksiana	Cassia marksiana	Not listed	Endangered	Within 20 km of Mount Nullum	High	Yes	Included as the subject site is within 20 km of Mount Nullum.
Choricarpia subargentea	Giant Ironwood	Not listed	Endangered	None	High	N/A	N/A
Clematis fawcettii	Northern Clematis	Vulnerable	Vulnerable	None	Moderate	N/A	N/A
Coatesia paniculata	Axe-Breaker	Not listed	Endangered	East of Kyogle	High	Yes	Included as the subject site is east of Kygole.
Corchorus cunninghamii	Native Jute	Endangered	Endangered	None	High	N/A	N/A
Corokia whiteana	Corokia	Vulnerable	Vulnerable	North of Lismore	High	Yes	Included as the species has been previously recorded within the disturbance footprint.
Cryptocarya foetida	Stinking Cryptocarya	Vulnerable	Vulnerable	None	High	N/A	N/A
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Vulnerable	None	Moderate	N/A	Excluded as the subject site is outside of the current known range and modelled range for the species (BioNet). Species highlighted by the PMST, there are no PCT associations.
Cupaniopsis serrata	Smooth Tuckeroo	Not listed	Endangered	None	High	N/A	N/A
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered	None	High	N/A	N/A
Cyperus rupicola	Cliff Sedge	Not listed	Vulnerable	None	High	N/A	N/A
Cyperus semifertilis	Missionary Nutgrass	Vulnerable	Endangered	None	High	N/A	N/A
Davidsonia jerseyana	Davidson's Plum	Endangered	Endangered	East of Tyalgum	High	Yes	Included as the subject site is east of Tyalgum.
Davidsonia johnsonii	Smooth Davidson's Plum	Endangered	Endangered	East of Nimbin	Very High	Yes	Included as the subject site is east of Nimbin.
Dendrocnide moroides	Gympie Stinger	Not listed	Endangered	None	High	N/A	N/A
Desmodium acanthocladum	Thorny Pea	Vulnerable	Vulnerable	None	High	N/A	N/A

Table 3.1 Flora candidate species assessment

Scientific name	Common name	EPBC Act status	BC Act status	Habitat/geographic constraint	Sensitivity to gain	Habitat/geographic constraint present	Justification for addition or exclusion
Diospyros mabacea	Red-fruited Ebony	Endangered	Endangered	None	High	N/A	N/A
Diploglottis campbellii	Small-leaved Tamarind	Endangered	Endangered	None	High	N/A	N/A
Doryanthes palmeri	Giant Spear Lily	Not listed	Vulnerable	None	High	N/A	N/A
Drynaria rigidula	Basket Fern	Not listed	Endangered	None	High	N/A	N/A
Eidothea hardeniana	Nightcap Oak	Critically Endangered	Endangered	Nightcap National Park	High	No	Excluded as the subject site is not within Nightcap National Park.
Elaeocarpus sedentarius	Minyon Quandong	Endangered	Endangered	None	High	N/A	N/A
Elaeocarpus williamsianus	Hairy Quandong	Endangered	Endangered	None	Very High	N/A	N/A
Endiandra floydii	Crystal Creek Walnut	Endangered	Endangered	None	High	N/A	N/A
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	None	High	N/A	Recorded
Endiandra muelleri subsp. *bracteata*	Green-leaved Rose Walnut	Not listed	Endangered	None	High	N/A	Recorded
Euphrasia bella	Pretty Eyebright	Vulnerable	Vulnerable	North of Kyogle and above 400 m altitude	High	No	Excluded as the subject site is below 400 m altitude.
Floydia praealta	Ball Nut	Vulnerable	Vulnerable	Within 45 km of coast	High	Yes	Included as the subject site is within 45 km of the coast.
Fontainea australis	Southern Fontainea	Vulnerable	Vulnerable	None	High	N/A	N/A
Gossia fragrantissima	Sweet Myrtle	Endangered	Endangered	None	High	N/A	N/A
Grammitis stenophylla	Narrow-leaf Finger Fern	Not listed	Endangered	None	Moderate	N/A	Included as the species has been previously recorded within the disturbance footprint.
Grevillea hilliana	White Yiel Yiel	Not listed	Endangered	None	High	N/A	Included as the species has been previously recorded within the disturbance footprint.
Hibbertia hexandra	Tree Guinea Flower	Not listed	Endangered	None	High	N/A	N/A
Hicksbeachia pinnatifolia	Red Boppel Nut	Vulnerable	Vulnerable	None	High	N/A	N/A
Isoglossa eranthemoides	Isoglossa	Endangered	Endangered	None	High	N/A	N/A
Lepiderema pulchella	Fine-leaved Tuckeroo	Not listed	Vulnerable	North of the southern arm of the Tweed River	High	No	Included as the species has been previously recorded within the disturbance footprint.
Lindsaea brachypoda	Short-footed Screw Fern	Not listed	Endangered	East of a line drawn north to south through Nimbin	High	Yes	Included as the species has been previously recorded within the disturbance footprint.
Macadamia integrifolia	Macadamia Nut	Vulnerable	Not listed	None	High	N/A	Included as a conservative measure as the species is not known to occur naturally in NSW; however, occurs in cultivation.
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Vulnerable	None	High	N/A	Included as the species has been previously recorded within the disturbance footprint.
Marsdenia longiloba	Slender Marsdenia	Vulnerable	Endangered	None	High	N/A	Included as the species has been previously recorded within the disturbance footprint.
Melicope vitiflora	Coast Euodia	Not listed	Endangered	None	High	N/A	N/A
Myrsine richmondensis	Ripple-leaf Muttonwood	Endangered	Endangered	None	High	N/A	N/A
Niemeyera whitei	Rusty Plum, Plum Boxwood	Not listed	Vulnerable	None	High	N/A	N/A
Oberonia complanata	Yellow-flowered King of the Fairies	Not listed	Endangered	None	High	N/A	N/A
Oberonia titania	Red-flowered King of the Fairies	Not listed	Vulnerable	None	High	N/A	N/A

Table 3.1 Flora candidate species assessment

Scientific name	Common name	EPBC Act status	BC Act status	Habitat/geographic constraint	Sensitivity to gain	Habitat/geographic constraint present	Justification for addition or exclusion
Ochrosia moorei	Southern Ochrosia	Endangered	Endangered	None	High	N/A	N/A
Owenia cepiodora	Onion Cedar	Vulnerable	Vulnerable	None	High	N/A	N/A
Ozothamnus vagans	Wollumbin Dogwood	Vulnerable	Endangered	None	High	N/A	N/A
Peristeranthus hillii	Brown Fairy-chain Orchid	Not listed	Vulnerable	Within 5 km of coast	High	No	Excluded as the subject site is not within 5 km of the coast.
Phaius australis	Southern Swamp Orchid	Endangered	Endangered	None	High	N/A	N/A
Phyllanthus microcladus	Brush Sauropus	Not listed	Endangered	None	Moderate	N/A	N/A
Phyllodes imperialis southern subspecies	Southern Pink Underwing Moth	Endangered	Endangered	None	Moderate	N/A	N/A
Plectranthus nitidus	Nightcap Plectranthus	Endangered	Endangered	None	High	N/A	N/A
Pomaderris notata	McPherson Range Pomaderris	Not listed	Vulnerable	None	High	N/A	N/A
Psilotum complanatum	Flat Fork Fern	Not listed	Endangered	None	High	N/A	N/A
Randia moorei	Spiny Gardenia	Endangered	Endangered	None	High	N/A	N/A
Rhodamnia maideniana	Smooth Scrub Turpentine	Not listed	Critically Endangered	None	High	N/A	N/A
Rhodamnia rubescens	Scrub Turpentine	Not listed	Critically Endangered	None	High	N/A	Included as the species has been previously recorded within the disturbance footprint.
Rhodomyrtus psidioides	Native Guava	Not listed	Critically Endangered	None	High	N/A	Included as the species has been previously recorded within the disturbance footprint.
Rhynchosia acuminatissima	Pointed Trefoil	Not listed	Vulnerable	None	High	N/A	N/A
Sarcochilus dilatatus	Brown Butterfly Orchid	Not listed	Endangered	None	High	N/A	N/A
Sarcochilus fitzgeraldii	Ravine Orchid	Vulnerable	Vulnerable	None	High	N/A	N/A
Sarcochilus hartmannii	Waxy Sarcochilus, Blue Knob Orchid	Vulnerable	Vulnerable	Cliff faces or rock outcrops within 100 m	Moderate	No	Excluded as the species favours cliff faces on steep narrow ridges supporting eucalypt forest and clefts in volcanic rock from 500 to 1,000 m in altitude. Species highlighted by the PMST, there are no PCT associations.
Sarcochilus weinthalii	Blotched Sarcochilus	Vulnerable	Vulnerable	None	High	N/A	N/A
Senna acclinis	Rainforest Cassia	Not listed	Endangered	None	High	N/A	N/A
Sophora fraseri	Brush Sophora	Vulnerable	Vulnerable	None	High	N/A	N/A
Symplocos baeuerlenii	Small-leaved Hazelwood	Vulnerable	Vulnerable	None	High	N/A	N/A
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	None	High	N/A	Included as the species has been previously recorded within the disturbance footprint.
Syzygium moorei	Durobby	Vulnerable	Vulnerable	Within 15 km of eastern boundary of Richmond - Tweed A Sub-region	High	No	Included as the species has been previously recorded within the disturbance footprint.
Thesium australe	Austral Toadflax, Toadflax	Vulnerable	Vulnerable	None	Moderate	N/A	Excluded as there are no records in close proximity to subject site. PCTs and habitat within the subject site do not align with the species requirements. Species highlighted by the PMST, there are no PCT associations.
Tinospora tinosporoides	Arrow-head Vine	Not listed	Vulnerable	None	High	N/A	N/A
Tylophora woollsii (syn. *Vincetoxicum woollsii*)	Cryptic Forest Twiner	Endangered	Endangered	None	High	N/A	Syn *Tylophora woollsii* - Potentially requires survey effort. Habitat appears aligned despite not associated with PCTs - Check new vs old PCTs. Recorded approximately 10 km away. Species highlighted by the PMST, there are no PCT associations.

Table 3.1 Flora candidate species assessment

Scientific name	Common name	EPBC Act status	BC Act status	Habitat/geographic constraint	Sensitivity to gain	Habitat/geographic constraint present	Justification for addition or exclusion
Uromyrtus australis	Peach Myrtle	Endangered	Endangered	Within 2 km of Whian Whian State Conservation Area, or the Goonengerry, Nightcap, or Mt Jerusalem National Parks	High	Yes	Included as the subject site is within 2 km of Mount Jerusalem National Park.
Westringia rupicola	null	Vulnerable	Not listed	Within 50 m of Rhyolitic or acid volcanic cliffs	High	No	Excluded as the subject site is outside of the current known range and modelled range for the species. No suitable habitat present in development area. Species highlighted by the PMST, there are no PCT associations.
Xylosma terrae-reginae	Queensland Xylosma	Not listed	Endangered	Within 5 km of coast	High	No	Excluded as the subject site is not within 5 km of the coast.
Zieria adenodonta	Wollumbin Zieria	Not listed	Endangered	Mount Warning National Park	High	No	Excluded as the subject site is not within Mount Warning National Park.

3.2 Flora survey effort and techniques

3.2.1 Targeted flora surveys undertaken by TSC

Threatened flora surveys were conducted by TSC over the following timeframes with two observers:

- October 2016 to June 2017 within disturbance footprint (7 days)
- March 2017 outside of the disturbance footprint (4.5 days)
- June 2017 close to the Dam wall (2 days).

Systematic parallel traverses were undertaken, typically set 20 m apart, given the growth form of the majority of the target species were rainforest trees. Surveys targeting small plants, such as threatened ferns and orchids on rock outcrops, were undertaken over small areas within closer parallel traverses to systematically search the specific habitat features of interest.

Nine days of effort was conducted in the disturbance footprint. A total of 16 gullies were targeted with an estimated area of 59.26 ha covered. Of the 59.26 ha surveyed, 21.86 ha was within the proposed disturbance footprint and 37.39 ha was outside and adjacent to the proposed disturbance footprint. This equates to approximately 15% surveyed of the disturbance area which has been assigned to PCTs (Table 2.1). Flora field effort is displayed on Figure 6 of the Flora and Fauna Assessment (TSC 2017).

3.2.2 Targeted flora surveys undertaken by ELA

Subsequently, a survey plan for flora was devised by ELA. This was adapted from the NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE 2020a). The large area method has been utilised, appropriate for areas of suitable habitat >50 ha. We note however, that this approach has been applied uniformly across the disturbance area, including PCTs where their total area is <50 ha.

The large area method typically uses survey points on a 100 m grid; however, the shape of the current development site is incompatible with this approach. As such, the inundation boundary was allocated a Phase 1 survey point every 100 m (in suitable habitats) along the internal boundary of the existing dam shoreline. A 20 m radius area surrounding these vertices was identified for Phase 1 survey of any candidate threatened species. This methodology and adaptation of the survey guideline was discussed and approved through consultation with BCD (Appendix A.1 and A.2).

A total of 442 point surveys were included in the survey plan and were surveyed in Phase 1. No evidence of Phase 2 surveys is provided by ELA. Areas of cleared land, including paddocks and plantations were not assessed.

3.3 Flora recorded and species polygons

The flora species and counts recorded within the disturbance area to date are provided in Table 3.2. The majority of species offsets are based on counts of individual plants. Where area-based species are recorded, the species polygons will be based on mapped microhabitat features or mapped vegetation zones aligned with the species records.

3.4 Summary of threatened flora surveys

Given the work completed to date, we request that BCD conduct a detailed review of the survey effort undertaken thus far to determine if survey effort is deemed adequate and undertaken as described in the original survey plan and survey guidelines. EMM will provide both the survey points, survey tracks and species recorded. EMM seek further guidance on whether stage one of the flora survey is adequate and further requirements for stage 2.

Table 3.2 Threatened flora recorded

Species name	Common name	BC Act	EPBC Act	TSC Count (2017)	Count ELA (2020)	Total	Count or area based species polygon
Corokia whiteana	Corokia	Vulnerable	Vulnerable	8	8	16	Count
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	30	1	31	Count
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Vulnerable	Not listed	210	42	252	Count
Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	Not listed	1,243	7 patches		Area
Grevillea hilliana (Planted)	White Yiel Yiel	Endangered	Not listed	Species identified outside of the development site	0		Count
Lepiderema pulchella	Fine-leaved tuckeroo	Vulnerable	Not listed	1	0	1	Count
Lindsaea brachypoda	Short-footed Screw Fern	Vulnerable	Not listed	0	10	10	Area
Macadamia tetraphylla	Bush Nut	Vulnerable	Vulnerable	0	2	2	Count
Marsdenia longiloba	Clear Milkvine	Endangered	Vulnerable	13	28	41	Area
Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Not listed	Not listed at time of survey	199	199	Count
Rhodomyrtus psidioides	Native Guava	Critically Endangered	Not listed	Not listed at time of survey	1,316	1,316	Area
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	147	38	185	Count
Syzygium moorei (Planted)	Durobby	Vulnerable	Vulnerable	2	0	2	Count

4 Fauna

4.1 Candidate species

In accordance with Section 5.2.1 of the BAM, ecosystem credit species and species credit species in the Threatened Biodiversity Data Collection (TBDC) were identified for assessment if the species:

- is associated with PCTs recorded within the disturbance footprint
- is likely to be present, in the opinion of the assessor
- is predicted to occur by the EPBC Act Protected Matters Search Tool
- has been recorded on the disturbance footprint or near the disturbance footprint in similar habitat but is not predicted by the Calculator (e.g. based on review of ecological reports, environmental impact statements, scientific literature, presence on site during the survey).

Candidate fauna species predicted by the BAM-C are shown in Table 4.1. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded.

Species are excluded in accordance with the BAM based on habitat and/or geographic constraints.

Several other species have also been excluded, which do not have habitat or geographic constraints listed in the BAM. EMM seeks feedback from BCD on this candidate species assessment.

The Black-tailed Antechinus (*Antechinus arktos*) has a restricted distribution and altitudinal range. It is described as occurring in areas of highest altitude and rainfall at the summit of the Tweed Volcano caldera of far south-east Queensland and north-east New South Wales. The species is found in cool subtropical cloud forest / rainforest comprising complex notophyll vine forest and simple microphyll fern forest featuring a low canopy, very dense vines and a rocky substrate. No such habitat exists in the disturbance area and at <100 m above sea level is not of sufficient altitude to support the species. We propose to exclude the Black-tailed Antechinus as a candidate species.

Three Philoria (Mountain Frog) species are listed as candidate species, as they are aligned with the PCTs recorded on the site. The species cannot be excluded based on the habitat constraints listed in the TBDC. Review of recent literature (Mahoney et al. 2022) with comprehensive distribution sampling and singular nucleotide polymorphism (SNP) analysis provides a clear distribution of the candidate species. The only species with its distribution in the Clarrie Hall Dam area is Loveridge's Frog (*Philoria loveridgei*). The best guide for species identification within *Philoria*, aside from genotyping, is geographic location, as none of the taxa are known to occur sympatrically (Mahoney et al. 2022). Loveridge's Frog has been recorded in one location adjacent to the disturbance footprint and will be assessed as a candidate species. We propose to rely on aural survey for the species rather than capture given that these taxa show overlapping colour variation, pattern, and body shape.

Table 4.1 Fauna candidate species assessment

Scientific name	Common name	EPBC Act status	BC Act status	Habitat/geographic constraint	Sensitivity to gain class	Habitat / geographic constraint present on site	Justification for addition or exclusion
Birds							
Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Critically Endangered	As per mapped areas	High Sensitivity to Potential Gain	No	Excluded from species credit assessment as the subject site is not within mapped areas.
Atrichornis rufescens	Rufous Scrub-bird	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Not listed	Living or dead tree with hollows greater than 15 cm diameter and greater than 5 m above ground.	High Sensitivity to Potential Gain	Yes	N/A
Carterornis leucotis	White-eared Monarch	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	Critically Endangered	Endangered	None	High Sensitivity to Potential Gain	N/A	N/A
Dasyornis brachypterus	Eastern Bristlebird	Endangered	Endangered	None	Moderate Sensitivity to Potential Gain	N/A	N/A
Haliaeetus leucogaster	White-bellied Sea-eagle	Vulnerable	Not listed	Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines	High Sensitivity to Potential Gain	Yes	N/A
Lophoictinia isura	Square-tailed Kite	Vulnerable	Not listed	Nest trees	Moderate Sensitivity to Potential Gain	N/A	N/A
Menura alberti	Albert's Lyrebird	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	Potential to occur	N/A
Ninox connivens	Barking Owl	Vulnerable	Not listed	Hollow bearing trees, living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	High Sensitivity to Potential Gain	Yes	N/A
Ninox strenua	Powerful Owl	Vulnerable	Not listed	Living or dead trees with hollow greater than 20 cm diameter.	High Sensitivity to Potential Gain	Yes	N/A
Turnix melanogaster	Black-breasted Button-quail	Critically Endangered	Vulnerable	None	High Sensitivity to Potential Gain	N/A	N/A
Tyto novaehollandiae	Masked Owl	Vulnerable	Not listed	Living or dead trees with hollows greater than 20 cm diameter.	High Sensitivity to Potential Gain	Yes	N/A
Tyto tenebricosa	Sooty Owl	Vulnerable	Not listed	Caves or clifflines/ledges; Living or dead trees with hollows greater than 20 cm diameter.	Very High Sensitivity to Potential Gain	Yes	N/A
Mammals							
Aepyprymnus rufescens	Rufous Bettong	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Antechinus arktos	Black-tailed Antechinus	Endangered	Endangered	None	High Sensitivity to Potential Gain	N/A	Excluded, based on lack of suitable habitats present. Refer to Section 4.1.
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable	Cliffs, within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels	Very High Sensitivity to Potential Gain	No	Excluded based on lack of suitable breeding habitat within 2 km of the disturbance area.
Macropus parma	Parma Wallaby	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Miniopterus australis	Little Bent-winged Bat	Vulnerable	Not listed	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code ‘IC – in cave’; observation type code ‘E nest-roost’; with numbers of individuals >500; or from the scientific literature.	Very High Sensitivity to Potential Gain	N/A	Excluded based on lack of suitable breeding habitat within or within close proximity to the disturbance area.
Miniopterus orianae oceanensis	Large Bentwing-bat	Vulnerable	Not listed	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500.	Very High Sensitivity to Potential Gain	No	Excluded based on lack of suitable breeding habitat within or within close proximity to the disturbance area.

Table 4.1 Fauna candidate species assessment

Scientific name	Common name	EPBC Act status	BC Act status	Habitat/geographic constraint	Sensitivity to gain class	Habitat / geographic constraint present on site	Justification for addition or exclusion
Myotis macropus	Southern Myotis	Vulnerable	Not listed	Hollow bearing trees within 200 m of riparian zone. Bridges, caves or artificial structures within 200 m of riparian zone. Waterbodies - this includes rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200 m of the site.	High Sensitivity to Potential Gain	Yes	N/A
Petaurus norfolcensis	Squirrel Glider	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable	Areas identified via survey as important habitat - based on density of koalas and quality of habitat.	High Sensitivity to Potential Gain	Yes	N/A
Planigale maculata	Common Planigale	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Potorous tridactylus	Long-nosed Potoroo	Vulnerable	Vulnerable	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest))	High Sensitivity to Potential Gain	Yes	N/A
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	Breeding camps	High Sensitivity to Potential Gain	N/A	N/A
Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	Not listed	Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds."	Very High Sensitivity to Potential Gain	N/A	Excluded based on lack of suitable breeding habitat within 2 km of the disturbance area.
Reptiles							
Cacophis harriettae	White-crowned Snake	Vulnerable	Not listed	Litter/Rocky areas, Surface rocks/Fallen/standing dead timber including logs/Or within 50 m of fallen timber including logs	High Sensitivity to Potential Gain	Yes	N/A
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	Vulnerable	Vulnerable	Leaf and bark litter, fallen/standing dead timber including logs, timber and logs on the ground	High Sensitivity to Potential Gain	Yes	N/A
Hoplocephalus bitorquatus	Pale-headed Snake	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Hoplocephalus stephensii	Stephens' Banded Snake	Vulnerable	Not listed	Hollow bearing trees or within 500 m of this habitat. Other, within 500 m of aboreal vine tangles. Fallen/standing dead timber including logs, or within 500 m of this habitat	High Sensitivity to Potential Gain	Yes	N/A
Amphibians							
Assa darlingtoni	Pouched Frog	Vulnerable	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Litoria brevipalmata	Green-thighed Frog	Vulnerable	Not listed	None	Moderate Sensitivity to Potential Gain	N/A	N/A
Mixophyes fleayi	Fleay's Barred Frog	Endangered	Endangered	North of Kyogle	Very High Sensitivity to Potential Gain	Yes	N/A
Mixophyes iteratus	Giant Barred Frog	Endangered	Endangered	None	Moderate Sensitivity to Potential Gain	N/A	N/A
Philoria kundagungan	Mountain Frog	Endangered	Not listed	Bogs created from human-modification to natural flows	High Sensitivity to Potential Gain	Potential to occur	Excluded, based on distribution. Refer to Section 4.1.
Philoria loveridgei	Loveridge's Frog	Endangered	Not listed	Boggy headwaters of rainforest streams and soaks	High Sensitivity to Potential Gain	Potential to occur	N/A
Philoria richmondensis	Philoria richmondensis	Endangered	Endangered	Semi-permanent/ephemeral wet areas: Boggy headwaters of streams, and soaks or within 1 km of bog.	High Sensitivity to Potential Gain	Potential to occur	Excluded, based on distribution. Refer to Section 4.1.
Invertebrates							
Nurus atlas	Atlas Rainforest Ground-beetle	Endangered	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Nurus brevis	Shorter Rainforest Ground-beetle	Endangered	Not listed	None	High Sensitivity to Potential Gain	N/A	N/A
Thersites mitchellae	Mitchell's Rainforest Snail	Endangered	Critically Endangered	None	High Sensitivity to Potential Gain	N/A	N/A

4.2 Fauna survey undertaken by Tweed Shire Council

4.2.1 Site based surveys

Threatened fauna surveys were undertaken by TSC between 21 November 2016 and 18 January 2016 aiming to detect a wide range of taxa as detailed in the *Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam* (TSC 2017). A total of 32 survey sites were established within the study area, which was divided into core and ancillary sites. The range of techniques utilised at each of these locations is displayed in Table 4.2.

Table 4.2 Fauna survey techniques utilised at each survey site

Method	Effort	Ancillary	Core
Diurnal bird survey (100 m x 200 m) 20 minutes repeated 3 times.	60 person minutes	✓	✓
Koala scat searches (100 m x 200 m)	30 trees	✓	✓
Camera trap (terrestrial) Universal and carnivore baits	16 nights	✓	✓
Reptile and amphibian searches 200 m x 100 m area. 30 minutes repeated 3 times 2 observers at Core sites 1 observer at ancillary sites	180 minutes core 90 minutes ancillary	✓	✓
One Havahart® 80 cm cage trap (universal bait)	4 nights		✓
1 x 1 m dirt pad	4 nights		✓
X 10 Elliot A traps – terrestrial (universal bait)	40 trap nights		✓
Five 20L pitfall buckets with drift fence over four nights	20 trap nights		✓
Four funnel traps (associated with the drift fencing above)	16 nights		✓
Spotlighting, two people 200 m x 100 m area for 20 mins. Repeated 3 times	120 minutes		✓
Call play back prior to spotlighting	20 minutes		✓
Recording of tree hollows			✓

4.2.2 Stratification of site-based fauna effort

At the time of TSC site surveys, vegetation mapping was yet to be refined. We have intersected vegetation mapping with the survey site locations to assist with quantifying the amount of effort per habitat type. The survey sites have also been categorised according to their proximity to disturbance area.

Table 4.3 Number of TSC survey sites within each vegetation zone

Vegetation zones	Ancillary	Core
827 high	3	7
827 mod	1	1
827 low	0	2
827 burnt	1	2
1302 high	1	1
1073 medium	0	0
Cleared	2	2
Subtotal	***15***	***8***
Distinct (well outside of disturbance footprint	***5***	***4***
Total	**20**	**12**

4.2.3 Additional targeted surveys undertaken by TSC

i Comb-crested Jacana (*Irediparra gallinacea*) survey

Comb-crested Jacana were targeted on 6 March 2017, while male and females were most likely to be paired. Surveys were targeted in areas where rafts of floating vegetation were present, including lilies. Approximately 28 km of survey effort was undertaken, predominately with a small motorboat, with canoe and pedestrian surveys also used to a lesser extent.

This species is an ecosystem species; however, no ecosystem offset will be generated as the open water vegetation is not aligned with PCTs. We propose to map the area of floating emergent vegetation and asses as a prescribed impact. The justification for this is based on the impact being temporary. Marginal vegetation and floating vegetation are anticipated to recolonise at the new dam surface level.

ii Giant Barred Frog (*Mixophyes iteratus*) and other stream-dwelling frog surveys

Two watercourses were investigated on separate nights (15 and 16 February 2017) for the Giant Barred Frog and other stream dwelling frog species, based on records of the species collected during the site-based surveys. Surveys extended from the dam edge to > 500 m from the inundation zone, with a width of up to 30 m searched. The survey was mostly visual and aural, with some call playback used to illicit response where no observations were made but habitat was considered suitable. This survey effort was similar to guidelines available at the time of the survey (DECC 2009) however more recent guidelines (DPIE 2020b) stipulate effort should be repeated over four nights.

Further stream frog surveys were undertaken in the same two watercourses on 27 February, 12 and 27 March 2020 (Col's Gully) and on 14 and 28 March and 2 April 2020 (Rainforest Gully).

iii Bats

To survey for insectivorous bats, harp traps were deployed for one or two nights at three locations within forested and cleared habitats.

Acoustic recorders (ANABAT units, SD1 and SD2 models) were also placed in 16 different locations for one or two nights, including both forested and cleared habitats.

4.2.4 Data expiry

The fauna surveys described in this section forms much of the targeted survey effort for the biodiversity assessment. These surveys were conducted between November 2016 to January 2017. Under the BAM, there is a five-year operational limit on data. An extension has been granted by BCD to use the data up to September 2023. We have conducted a gaps analysis of the work conducted on the project to data and have identified that further effort is required for both targeted flora, fauna, and vegetation. Several of the surveys require completion in spring and summer 2023/24 owing to seasonal restriction; hence, submission of an adequate BDAR by September 2023 is not possible.

Following the 2016/2017 surveys, the region experienced a drought with an uncontrolled bushfire, of generally low severity, burning a large area in the north-western areas adjacent to the dam. The fire occurred in August 2019, and was restricted to the under- and mid-storey. Climatically the region has experienced a period of above average rainfall from 2019, with the typical of 'La Nina' climatic oscillation declared from 2020 until early 2023. As such, a recent site visit in January 2023 observed that vegetation and fauna habitat within the disturbance area has recovered from both drought and bushfire with condition broadly comparable to 2016/2017.

We request that an extension for use of Council survey data is granted until September 2024. Whilst submission of the BDAR and EIS is currently planned for late summer/early autumn 2024, we wish to build in contingency in case of any unforeseen delays.

This survey plan assumes that the surveys conducted by TSC can be used as part of the survey effort to assess the candidate species. If an extension was not granted substantial revision to this survey plan would be required.

4.3 Additional work completed by ELA

Following the surveys completed by TSC, ELA have completed several additional surveys, including:

- targeted frog surveys
- mapping of hollow-bearing trees and assessment or forest owls and Glossy Black-cockatoo
- Glossy-black Cockatoo breeding surveys
- forest owl breeding surveys
- microbat survey.

Further survey detail is provided in Section Table 4.4.

4.4 Summary of survey effort completed and proposed for target species

This section details the survey techniques and cumulative effort completed to date and provides a comparison against survey guidelines. We have outlined our approach to bolster survey effort where required.

4.4.1 Stratification of fauna habitat

To determine stratification units for survey the following process was followed:

- PCT associations were confirmed using the TBDC and reviewed against current knowledge and local conditions to determine which PCTs were suitable for an individual species.
- The species' association with the vegetation condition classes was reviewed, and any condition classes deemed unsuitable were excluded. For example, species associated with treed habitat were deemed unlikely to occur in low condition areas or derived grasslands.
- A further review was undertaken to determine whether species were associated with specific habitat features. For example, some species will only occur in proximity to waterways, and thus only habitat within proximity to waterways is required to be surveyed.
- PCTs were then grouped up into vegetation formation using the NSW vegetation classification system (Keith 2004).

For species aligned with all PCTs on site and general habitat requirements the following stratification units were used for the purposes of defining areas of potential habitat and appropriate effort.

Table 4.4 Stratification units based on vegetation class

Stratification unit/vegetation class	PCT Name	Vegetation Formation	PCT impact area (ha)	Stratification unit area (ha)
North Coast Wet Sclerophyll Forests	827 Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast	Wet Sclerophyll Forests (Shrubby sub-formation)	137.86	139.24
	1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	Wet Sclerophyll Forests (Shrubby sub-formation)	1.38	
Subtropical Rainforests	1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	Rainforests	8.36	8.36

4.4.2 Diurnal birds

The following diurnal bird species are deemed candidate species requiring assessment:

- Rufous Scrub-bird
- White-eared Monarch
- Coxen's Fig-Parrot
- Eastern Bristlebird
- Black-breasted Button-quail
- Albert's Lyrebird
- Glossy Black-cockatoo (breeding habitat)
- Little Eagle (breeding habitat)

- Square-tailed Kite (breeding habitat)
- White-bellied Sea-eagle (breeding habitat)
- Red Goshawk.

Table 4.5 Diurnal Birds – survey techniques and effort

Survey technique and species targeted	Survey guidelines and effort completed to date	Proposed survey effort
Aural and visual survey Rufous Scrub-bird Coxen's Fig-Parrot Eastern Bristlebird Black-breasted Button-quail Albert's Lyrebird White-eared Monarch	These species are associated with most or all PCTs and stratification units. DEC (2004) has not resolved bird survey requirements and does not provide guidance on survey effort. DEWHA (2010a) was reviewed, and sympatric species survey efforts indicated a requirement for 8 hours over at least four days for sites less than 50 ha (total 480 minutes) (stratification unit). Diurnal bird surveys were undertaken by TSC for a total of 1,260 min total effort within the North Coast Wet Sclerophyll Forests stratification unit (139.24 ha). This is just shy of the 1,440 minutes. Required. The total effort within subtropical rainforests is 120 minutes which requires additional effort. All species with the exception of Coxen's Fig-parrot and White-eared Monarch will also be supplemented by the terrestrial camera trapping outlined for mammals.	We propose to conduct additional diurnal bird surveys within rainforests 360 minutes and wet sclerophyll forests 180 minutes to meet the required survey effort guidelines. Surveys will commence shortly after dawn and repeated over four days. A period of listening will commence on arrival to site for Albert's Lyrebird before commencing further visual and aural surveys. Effort will total at least 360 minutes. In order to capture optimal survey season for all species surveys will be conducted in winter 2023 suitable for Lyrebird (June–August) and in spring/summer for Rufous Scrub-bird (September–January). For species other than Lyrebird and Scrub-Bird, the proposed effort will be effectively doubles, given seasonal timeframe.
Terrestrial camera Rufous Scrub-bird Eastern Bristlebird Black-breasted Button-quail Albert's Lyrebird.	Whilst camera traps are not considered a primary method for bird survey, the listed species spend a significant amount of time foraging on or close to the ground and have the potential to be captured by camera traps. Current camera trap effort undertaken in the site-based assessment by TSC (2016/2017) includes 32 nights in the Subtropical Rainforests stratification unit and 272 nights in the North Coast Wet Sclerophyll forest.	A further 248 nights camera trap effort is proposed in the rainforest areas, primarily intended for terrestrial mammals. The North Coast Wet Sclerophyll Forests stratification unit has a further 568 nights are proposed. This survey effort will supplement diurnal bird surveys outlined above.
Nesting Raptors Square-tailed Kite White-bellied Sea Eagle Little Eagle Red Goshawk	Breeding: These species are dual credit species, whereby only the nesting sites generate species credits. Habitat assessment for these species was conducted concurrently with surveys by ELA in March and July 2020 identifying any potential nests (eyries). Once a nest is identified and the species is confirmed, no further survey is required. A buffer is then placed around the nest and impacts are calculated for the loss of the nest.	One White-bellied Sea Eagle nest has been recorded and buffered to produce a species polygon. Species credits have been calculated with no further work required.

Table 4.5 Diurnal Birds – survey techniques and effort

Survey technique and species targeted	Survey guidelines and effort completed to date	Proposed survey effort
Glossy Black-cockatoo (breeding)	The survey effort and targeted approach for the species has been presented to BCD and considered appropriate by BCD previously (A.1, A.2). No additional effort has been proposed. A summary is provided below. Glossy Black-cockatoo were recorded on four occasions in March 2020. To determine whether breeding habitat occurs the following method was used: • Mapping of hollow bearing trees within the disturbance footprint, including location, tree species, DBH and GPS location. • Traversing the majority of the existing shoreline of the Clarrie Hall Dam via boat and observing any Glossy Black-cockatoos present. • Inspecting each HBT for evidence of breeding (such as lone males, begging birds, or an occupied hollow) for approximately ten minutes. • Recording any other evidence of the species occupation at the site (such as feeding individuals in *Allocasuarina*).	No breeding has been identified hence no species polygon will be required for the species, noting that survey of hollow bearing trees have been restricted to the disturbance area only. We request that BCD confirm that the original assessment of the survey techniques and effort remain valid, given that no further guidelines for this species have been specified.

4.4.3 Nocturnal Birds

The following nocturnal bird species are deemed candidate species requiring assessment:

- Barking Owl
- Powerful Owl
- Masked Owl
- Sooty Owl.

In order to detect the species, DEC (2004) recommends call playback and spotlighting are undertaken. At least five visits are recommended for the Powerful Owl and Barking Owl, and eight visits for the Masked Owl. It is recommended that sites should be separated by 800 m to 1 km. Specific survey effort remains unresolved.

Significant effort has been undertaken to detect the species in 2016/2017 by TSC. Call playback was completed at 20 sites; Sooty Owl was targeted on at least one occasion for each site and 2–3 times where favourable habitat was present. Sooty Owl call playback lasted for 2 minutes with subsequent listening periods and call playback for other species. The survey of the 20 sites occurred over several weeks between 21 November 2016 and 18 January 2017. Following call playback, 20 minutes of spotlighting was conducted. This equates to 2,400 person minutes of spotlighting.

Masked Owl was infrequently recorded during the survey with Sooty Owl recorded eight times. The Powerful Owl and Barking Owl were considered absent with no further survey effort required.

As dual-credit species, the breeding habitat for the species required species offsets with foraging habitat considered an ecosystem credit. The approach to target breeding habitat is outlined in Table 4.6.

As surveys for the Forest Owls will target specific habitat attributes (breeding habitat) no stratification units have been defined. For the Barking Owl and Powerful Owl breeding can be identified by suitable habitat and either the presence of male and female birds, or calling to each other (duetting), or finding a nest, or existing breeding habitat being identified.

Table 4.6 Forest owl survey effort and approach undertaken by ELA

Hollow bearing tree mapping	Whilst Masked Owl and Sooty Owl may nest in caves, no such habitat exists in the disturbance area and therefore, breeding habitat was focused on hollow bearing trees. Hollow bearing trees within the disturbance area were mapped with hollows greater than 200 mm in diameter (potential breeding tree). Where identified, the following information was collected for each potential breeding tree: • tree species • diameter at breast height (DBH) in cm • number and size class of hollows • GPS location.
Whitewash and pellet survey	Hollow-bearing trees containing hollows greater than 200 mm were mapped within the disturbance footprint. To assess whether breeding habitat is present for either of these species, a diurnal survey reviewing each potential tree for whitewash and pellets was undertaken.
Call playback and spotlighting	To determine if the species were present during the breeding season four nights of call playback and spotlighting was undertaken between 21–24 July. Four sites were selected for call playback each night a 30-minute survey was undertaken, whereby contact calls for Masked Owl and Sooty Owl were played using a loudhailer. To supplement existing survey effort, Powerful Owl and Barking Owl calls were also undertaken. Call payback involved playing the species call for a period of 2 minutes, followed by 5 minutes of silence. If recorded, the location and number of the target species was also noted. Call playback sites were prioritised in areas where hollow-bearing trees of suitable size were observed. Spotlighting was undertaken over the same four nights as call playback. Spotlighting was undertaken by boat which provided an efficient way of surveying with good line of sight.

No Masked Owls were recorded during the breeding season survey and therefore have been excluded from further assessment.

Sooty Owl were recorded on multiple occasions. Their calls were noted as emanating from gullies occurring several hundred metres from the disturbance area. As no breeding was recorded within the disturbance area no species polygon is proposed for the species.

The above method was presented to BCD in 2020, Please confirm that the BCD's original assessment of the survey techniques and effort remain valid.

4.4.4 Microchiropteran Bats

The following Microchiropteran bats are deemed candidate species requiring assessment:

- Large-eared Pied Bat (*Miniopterus orianae oceanensis*)
- Eastern Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Southern Myotis (*Myotis macropus*)
- Eastern Cave Bat (*Vespadelus troughtonil*).

Several bat species were excluded as candidate species in Table 4.1 based on habitat requirements; however, for clarity further detail on the assessment approach is provided below.

For each species, the type of habitat required to be identified (breeding versus foraging) informs the survey requirements. For example, where identification of breeding habitat is required, searches for suitable habitat should be undertaken; if identification of foraging habitat is required, general surveys using acoustic devices and/or traps may suffice. Table 4.7 provides a summary of these items for each of the species listed above.

Table 4.7 Species survey requirements and habitat or species polygon requirements

Species	Identification / survey of breeding habitat required?	Survey of general habitat required?	Habitat/species polygon requirements
Southern Myotis	No	Yes	PCTs associated with the species within 200 m of any medium to large permanent creeks, rivers, lakes or other waterways with pools/ stretches 3 m or wider.
Eastern Cave Bat	Yes (potential SAII)	Yes, if breeding habitat occurs within 2 km	Breeding habitat: PCTs associated with the species within 100 m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat. Foraging habitat: PCTs associated with the species within 2 km of breeding habitat.
Large-eared Pied Bat	Yes (potential SAII)	Yes, if breeding habitat occurs within 2 km	Breeding habitat: PCTs associated with the species within 100 m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Foraging habitat: PCTs associated with the species within 2 km of breeding habitat.
Eastern Bent-winged Bat	Yes	No	All breeding habitat including the cave, or other features, used for breeding and the area immediately surrounding this feature must be mapped. Species polygon boundaries should have a 100 m radius buffer around a point location centred on the cave/feature entrance. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat.
Large Bent-winged Bat	Yes	No	PCTs associated with the species within 100 m of cave, or other features, used for breeding.

The survey techniques and effort conducted to date is summarised in Table 4.8.

Table 4.8 Methods and survey effort

Species and surveys required	Survey method/approach	Survey methods and effort
Breeding habitat identification (Eastern Cave Bat, Large-eared Pied Bat, Large Bent-winged Bat, Eastern Bent-winged Bat)	The entire study area was inspected for presence of potential breeding habitat for the species, with no caves or cliff features within the disturbance area. The existing dam wall was inspected but did not contain appropriate features to support a breeding site for any of the candidate species. There are no mines, derelict concrete buildings, culverts, or tunnels known nearby to the development site. A review of cliffline and cave habitat within 10 km of the disturbance footprint was undertaken to, with suitable cliffline features identified within Wollumbin, Nightcap, and Mount Jerusalem National Parks, however these features do not extend within a 2 km buffer of the disturbance footprint.	No breeding habitat for any of the cave roosting species occurs within the disturbance area or within 2 km of the breeding area, therefore no further surveys are required for these species.
Acoustic detection (Southern Myotis, Large-eared Pied Bat, Eastern Cave Bat)	Acoustic recorders (AnaBats) were also placed in 16 different locations, including both forested and cleared habitats during 2016/2017 surveys. Six Songmeters were deployed in from 30 November to 4 December 2020 (4 nights). Two of these units were deployed close to the dam wall to confirm that the dam wall was not used as roosting habitat. The remain units were placed upstream and downstream of the dam wall.	Candidate species recorded included: Large-eared Pied Bat, Eastern Bent-winged Bat, Large Bent-winged Bat and Southern Myotis.
Trapping (all species)	A harp trap was deployed for one or two nights at three locations within forested and cleared habitats during 2016/2017 surveys. Four harp traps were deployed in from 30 November to 4 December 2020 (4 nights). Two of these units were deployed close to the dam wall to confirm that the dam wall was not used as roosting habitat. The remain units were placed upstream and downstream of the dam wall.	

The disturbance area and an associated buffer of 2 km does not contain breeding habitat for cave roosting bats. As such, foraging habitat within close proximity to breeding habitat is also absent and the following may be removed as candidate species:

- Large-eared Pied Bat
- Eastern Bent-winged Bat
- Large Bent-winged Bat
- Eastern Cave Bat (*Vespadelus troughtonil*).

The Southern Myotis has been recorded on multiple occasions and a species polygon will be developed in accordance with the guidelines (OEH 2018); All waterbodies greater than 3 m within, or within 200 m of the disturbance area will be mapped. A 200 m buffer will be applied with all associated PCT in the buffer forming the species polygon.

Grey-headed Flying Fox

The Grey-headed Flying-fox is listed as a species/ecosystem credit species, with breeding camps requiring species credits being generated. Extensive surveys have been conducted throughout the disturbance area during 2016–2017 by TSC and subsequently in 2020 and 2021 by ELA, as outlined in this plan. Much of the survey effort was undertaken in the spring and summer months which is suitable for detection of breeding camps (October–December). Despite extensive cumulative effort, no roosting or breeding camps have been recorded within or close to the disturbance area. No further assessment is proposed.

4.4.5 Terrestrial and arboreal mammals

Methods and survey effort have been developed in accordance with the TBDC, DEC (2004), DSE (2011) and DSEWPaC (2011). Methods and survey effort are outlined in Table 4.9.

Table 4.9 Survey approach for terrestrial and arboreal mammals

Survey technique and species targeted	Survey guidelines and effort completed to date	Proposed survey effort
Baited terrestrial cameras Targeting terrestrial marsupials especially: • Rufous Bettong • Long-nosed Potoroo • Parma Wallaby • Eastern Pygmy-possum • Common Planigale[1]*	DSEWPaC (2011a) and the TBDC (DPIE 2022) suggest that baited camera traps may be of use in confirming the presence and identity the Rufous Bettong, and Long-nosed Potoroo. DSEWPaC (2011a) specifies approximately 10 cameras should be deployed per hectare. Across large scale projects this level of survey effort is unrealistic. Consultation undertaken with BCD for other projects determined that suitable effort would be 280 cameras trap nights, with 20 cameras deployed for 14 nights, per every 50 ha of habitat. Current camera trap effort undertaken in the site-based assessment by TSC (2016/2017) includes 32 camera trap nights in the Subtropical Rainforests stratification unit and 272 camera trap nights in the North Coast Wet Sclerophyll forest. TSC have provided rarefaction curves for the camera trapping undertaken to date (Appendix C), which indicated a declining return on increased survey effort given the plateau in species recorded.	We request BCD review the effort undertaken for camera trapping and the rarefaction curves (Appendix C) and provide advice on the remaining effort required. If the rarefaction curves are not taken into account the following additional effort is proposed. Subtropical Rainforests (8.36 ha) are relatively small in size; therefore, 20 cameras over 14 nights is appropriate (280 nights per vegetation unit). A further 248 camera trap nights is proposed to meet the guideline. The North Coast Wet Sclerophyll Forests stratification unit is (139.24 ha) with proposed effort 60 cameras over 14 nights (840 camera trap nights). A total of 272 nights have been recorded to date and, therefore, a further 568 nights are proposed to be completed.

[1] Common Planigale[1]* This is only considered supplementary given difficulty in confirming identification – may only be used to confirm presence/absence of small Dasyurids.

Table 4.9 Survey approach for terrestrial and arboreal mammals

Survey technique and species targeted	Survey guidelines and effort completed to date	Proposed survey effort
Spotlighting (All candidate species)	DSEWPaC (2011a) recommends two parallel 200 m transects per 5 ha site (or longer transects for larger sites). No survey effort for larger sites is specified but 1 km transects are mentioned. DEC (2004), specifies 2 x 1 km transects up to 200 ha of stratification unit, walking at approximately 1 km per hour on two separate nights. Current spotlighting effort undertaken in the site-based assessment by TSC (2016/2017) is 120 minutes in the Subtropical Rainforests stratification unit and 1,440 minutes in the North Coast Wet Sclerophyll forest.	We consider the effort in in the North Coast Wet Sclerophyll Forests to exceed both DEC (2004) and DSEWPaC (2011a) guidelines with no further effort proposed. We propose an additional two-night survey in Rainforest areas. Multiple patches will be surveyed to gain spatial spread given that discrete patches of habitat exist associated with gullies. Where necessary transects length will be scaled to the size of the habitat patch present.
Cage trap Long-nosed Potoroo	One Havahart® 80 cm cage trap (universal bait) was deployed in 12 wet sclerophyll sites (48 trap nights) and one rainforest site (four trap nights). DEC (2004) requires 24 trap nights over 3-4 consecutive days per 50 ha of stratification unit.	Effort is close to the draft DEC 2004 guidelines for the 139.24 ha wet sclerophyll forests. Effort is below guidelines for the rainforest stratification unit (8.36 ha) No further cage trapping is proposed. Camera trapping will provide adequate substitution.
Elliot A trapping Not suitable for any of the highlighted candidate species	10 Elliot traps were deployed by TSC (2017) over four night periods, with 12 sites selected in wet sclerophyll forest (480 trap nights) and one site in rainforest (40 trap nights) DEC (2004) states that sampling effort per stratification unit must equate to at least 100 trap nights.	Effort substantially exceeds the draft DEC 2004 guidelines for the 139 ha wet sclerophyll forests (480 trap nights compared to 300). Effort is below guidelines for the rainforest stratification unit (8.36 ha) with 40 traps nights compared to the required 100. No further Elliot trapping is proposed with pitfall traps being preferred to supplement effort in the rainforest areas.

Table 4.9 Survey approach for terrestrial and arboreal mammals

Survey technique and species targeted	Survey guidelines and effort completed to date	Proposed survey effort
Pitfall trapping Common Planigale (*Planigale maculata*)	Pitfall traps were deployed in 2016/2017 by TSC with 5, 20 L buckets deployed at each site over 4 nights. The buckets were spaced 4–5 m apart with a 40 cm high polythene drift fence connecting the buckets. The survey effort conducted by TSC council is 240 trap nights in the North Coast Wet Sclerophyll stratification units, spread over 12 sites. One site was conducted in the wet sclerophyll forests (20 traps nights). Current survey effort requirement from the TBDC include: Survey effort: Traps must remain in place for a minimum of four consecutive nights. A minimum of three pitfall trap arrays (two pits on the ends of a 10 m drift fence) must be used for an area of suitable habitat up to 1 ha. For suitable habitat, >1 ha – 10 ha, one additional pitfall trap array must be used for every additional hectare, with a maximum of 10 pitfall trap arrays for any one patch of suitable habitat. Where suitable habitat patches are separated by 200 m or greater, the same survey effort must be applied in each patch. If the combined mapped areas of suitable habitat on the disturbance footprint is >10 ha, contact the Department for a modified survey approach.	No survey effort guidelines are provided in the TBDC for areas greater than 10 ha. Please advise if the 240 trap nights in wet sclerophyll forest is sufficient effort. Stratifying pitfall effort in accordance with the TBDC, EMM have identified the 9 patches of rainforest within the disturbance area requiring assessment with 30 arrays required (This equates to 60 traps and 240 trap nights). Taking into account effort undertaken to date, 220 trap nights are required in the rainforests.
Koala (*Phascolarctos cinereus*)	Koalas were recorded throughout much of the development footprint.	The Koala species polygon includes all zones of PCTs aligned with the species (134.5 ha). Species credits will be calculated accordingly, and no further work is proposed
Squirrel Glider	The Squirrel Glider is only aligned with one PCT within the disturbance area – PCT 1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion which occurs in moderate condition, occupying just 1.38 ha of the disturbance area. No targeted surveys have been undertaken in the PCT; however, it is considered unlikely that the species would persist in the disturbance area with such a small area of potential habitat which has poor connectivity to other PCTs aligned with the species. No Squirrel Gliders or any unidentified gliders were observed during the 1,440 minutes of spotlighting survey effort within the disturbance area.	We would like to discuss the ability to exclude this species based on the survey effort undertaken to date including spotlighting in wet sclerophyll forests and the small area of potential habitat the disturbance area.

4.4.6 Reptiles

The survey approach for reptiles has previously been provided to BCD and received in principle support (Appendix A.1, A.2).

In 2022, the *Biodiversity Assessment Method survey guide for reptiles* (DPE 2022) was published providing specific survey guidance and effort for each reptile species.

Table 4.10 provides a summary of the survey techniques and effort undertaken to date for four candidate reptile species. None of the target species have been identified within the disturbance area to date.

Additional effort is proposed where necessary to meet the recent guidelines.

Table 4.10 Reptiles – survey techniques and effort

Survey technique and species targeted	Survey guidelines and effort completed to date	Proposed survey effort
Three-toed Snake-tooth Skink (*Coeranoscincus reticulatus*)	The species is aligned with all five PCTs recorded. Two stratification units have been identified based on vegetation class. • Subtropical Rainforests (7.5 ha) • North Coast Wet Sclerophyll Forests stratification unit (139 ha). DPE 2022 specifies habitat surveys must be undertaken including lifting debris and raking leaf litter for 120 person minutes, repeated over four days (480 total). In addition, 18 pitfall traps should monitored over four nights (72 trap nights). This effort is per 50 ha stratification unit. 2,610 minutes of habitat searches have been undertaken in the North Coast Wet Stratification unit (refer to Section 4.2). This exceeds the required effort of 1,440 minutes. The pitfall trap effort of the North Coast Wet Sclerophyll Forests stratification unit is 240 trap nights exceeding the 216 nights required. 270 minutes of habitat searches have been undertaken in the Subtropical Rainforests stratification unit.	An additional 210 person minutes of habitat searches is proposed to meet the survey guidelines in rainforest area. 20 trap nights (72 required) were conducted in the rainforests unit and therefore does not meet the guidelines. We propose to implement a further 52 trap nights to meet survey guidelines.
White-crowned Snake (*Cacophis harriettae*)	DPE 2022 specifies that this species requires surveying by either pitfall trapping or habitat searches at the same effort levels as for the Three-toed Snake-tooth Skink outlined above. This species is only aligned with PCTs in the North Coast Wet Sclerophyll Forests stratification unit where the majority of both the pitfall trapping and reptile searches have been undertaken to date.	Given that two techniques have been used at appropriate effort levels this species will not require further survey effort. The species may also receive further effort if additional surveys are undertaken for other reptile species.
Stephens banded snake (*Hoplocephalus stephensii*).	DPE 2022 specifies 120 person minutes of spotlighting, replicated over four nights (480 person minutes total), per 50 ha stratification unit. The species is aligned with all PCTs in the project area. A total of 1,920 minutes total is required in the North Coast Wet Sclerophyll Forests stratification unit (139 ha) and 480 minutes in the subtropical rainforest unit.	A total of 1,440 minutes of spotlighting has been undertaken in the North Coast Wet Sclerophyll Forests stratification unit. We propose to undertake a further 480 minutes of spotlighting to meet guidelines. 120 minutes of spotlighting has been undertaken in the Subtropical Rainforests. We propose to undertake a further 360 minutes spotlighting.

Table 4.10 Reptiles – survey techniques and effort

Survey technique and species targeted	Survey guidelines and effort completed to date	Proposed survey effort
Pale-headed Snake (*Hoplocephalus bitorquatus*)	The survey guidelines for this species specifies the same spotlighting effort as for the Stephens Banded Snake outlined above. In addition, for this species funnel traps are also required. Effort required includes 72 trap nights spread over 4 days in each stratification unit, equating to 72 trap nights in the rainforest stratification units and 216 trap nights in the Wet Sclerophyll Forests stratification unit.	A total of 240 of funnel traps nights have been completed in the North Coast Wet Sclerophyll Forests, exceeding the required effort. 16 trap nights have been completed in the Subtropical rainforests, a deficit of 66 nights to meet the guidelines. We request the BCD considered the cumulative effort undertaken to date (both spotlighting and funnel trapping), and the additional proposed spotlighting and provide an assessment of the validity of the approach without conducting any further funnel trapping in the rainforest areas. We consider it unlikely that the Pale-headed Snake will occur, based on the following: • not recorded to date despite substantial survey effort in Wet Sclerophyll Forests including pitfall trapping and spotlighting • no records of the species in the vicinity • the species favours dryer forest types and if it has not been recorded in the wet sclerophyll forest it unlikely to detected in the even wetter rainforests.

4.4.7 Frogs

Survey effort conducted in 2016 and 2017 by TSC is summarised in Section 4.2.1 and Section 4.2.3ii.

ELA subsequently conducted further targeted assessment for frogs. Frog habitat was mapped and categorised into five different types:

- permanent drainages in remnant rainforest
- complex ephemeral drainages
- simple ephemeral drainage
- forested dam fringe
- permanent water with cleared land.

Two sites were selected in each habitat type (ten total). A 20-minute audio-visual survey was conducted at each site, with two observers, repeated over two evenings. This equates to 80 person minutes at each site or 800 minutes total for the ten sites. The surveys were conducted by two people from 12–14 January 2021.

Three candidate species were recorded within the disturbance area:

- *Assa darlingtonia* (Pouched Frog)
- *Mixophyes iteratus* (Giant Barred Frog)
- *Philoria loveridgei* (Loveridge Frog).

The methods summarised above were provided to BCD in 2020 and received in principle support (Appendix A.1, A.1). *The NSW Survey Guide for Threatened Frogs* (DPIE 2020b) was subsequently published and provides updated survey effort guidelines and species-specific methodology.

EMM is currently working with TSC to define and map microhabitat features for each species. Once completed, each habitat type will be stratified is accordance with the NSW survey guide (DPIE 2020b). Once the method and effort are quantified, we wish to present this to BCD at a later date.

4.4.8 Invertebrates

Four threatened invertebrates are considered candidate species requiring further assessment as outlined in Table 4.11.

Table 4.11 Invertebrates – survey techniques and effort

Atlas Rainforest Ground-beetle (*Nurus atlas*) Shorter Rainforest Ground-beetle (*Nurus brevis*)	No guidelines are published for survey of these species. Both are cryptic, ambushing their prey from burrows with a cleared landing pad at the entrance. The Atlas Rainforest Ground-beetle is associated with all PCTs on site which appears rather conservative, given rainforest habitats are typically preferred. The Shorter Rainforest Ground-beetle is associated with PCT 1068 and 1302, both in the Subtropical Rainforest Vegetation Class. The most appropriate technique for these species is counting the distinctive burrows in appropriate habitat. Pitfall traps may detect males on occasion when they are searching for females, though this technique is not optimal and is seasonally dependant. Pitfall trapping in rainforests and wet sclerophyll have not detected the species to date.	Research entomologists have been contacted, who consider that project area is outside the species distribution. Therefore, we propose removal of the species. TSC have contacted Mick Adren who is willing to provide input on the distribution of the species to the BCD however given he works for NSW government he is concerned over conflict of interest for the provision of an expert report. Mick Adren is willing to discuss this issue with BCD.
Pink Underwing Moth (*Phyllodes imperialis*)	The exclusive larval host plant is Carronia Vine (*Carronia multisepalea*). Two of vines have been recorded to date within the survey area. The TBCD states adults require over-ripe hanging fruit (not on ground). Adults emerge in October and larval search is best in Feb. Adults live for around 30 days and lay about 80 eggs. The TBCD states the species can be survey for between October and February. We propose to survey for the larvae on the two hosts plants in the optimal survey period January/February and if this cannot be achieved then assume presence, with a species polygon based on the two host plant with an appropriate buffer.	The TBCD does not specify how a species polygon should be assigned for the species. We request that information is provided on an appropriate buffer distance from the host plant.
Mitchell's Rainforest Snail (*Thersites mitchellae*)	Two individuals of the Snail have been found within and adjacent to a patch of rainforest dominated by Bangalow Palm. In order to define a species polygon, Dr John Stanisic (a registered Expert for this species) was engaged which included field surveys and production of an expert report.	An expert report has been completed for this species to define a species polygon, The species polygon includes areas of Bangalow Palm rainforest along streams. This habitat is confined to the unnamed third order stream near Lone Pine Road. The development site will remove up to 0.82 ha of habitat for this species.

4.5 Other items

4.5.1 Assessment approach

The raising of the dam will create a 'ring' of additional inundation area which could be considered linear. Conversely, the development includes the dammed waterbody, dam wall, quarry, spillway and other ancillary infrastructure, which could be considered site-based. We wish to confirm with BCD the preferred assessment approach, either linear or site-based.

4.5.2 Assessment of prescribed flood impacts

The full supply level (FSL) of the proposed dam is 70 m AHD with peak maximum flood level (PMFL) modelled at 77 AHD. The PMFL is a theoretical level used for design purposes and is highly unlikely to occur and is, therefore, not suitable for assessing prescribed impacts.

EMM is currently working with the flood engineers to look at flood duration and extent. For other projects, we have looked at how long a flood event inundates vegetation (hours versus days), the extent of flooding and the frequency to determine the likelihood of prescribed impacts occurring. For example, if a flood events only occurs every 100 years and only inundates vegetation for a matter of hours, then this is unlikely to result in changes in vegetation composition or condition. However, if a flood event occurs every five years and inundates vegetation for several days, then this could result in change.

There is also potential for prescribed impacts to occur downstream of the dam due to changes in flow regime which will also require consideration. Downstream impacts will also require consideration under prescribed impacts. This could include the potential for more constant flow levels and cold-water input to Doon Doon Creek.

EMM will work with the flood engineers to understand these issues and come back to BCD for further discussion.

Yours sincerely,

Eugene Dodd
Associate Ecologist
edodd@emmconsulting.com.au

5 References

DEC (2004) *Threatened biodiversity survey and assessment: Guidelines for developments and activities (2004 working draft)*. Department of Environment and Conservation.

DECC (2009) *Threatened species survey and assessment guidelines: field survey methods for fauna: Amphibians*. Department of Environment and Climate Change.

DEWHA (2010a) *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of Environment, Water, Heritage and the Arts.

DEWHA (2010b) *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.* Department of Environment, Water, Heritage and the Arts.

DoE (2013) *Draft survey guidelines for Australia's Threatened Orchids*: guidelines for detecting orchids listed as 'threatened' under the Environment Protection and Biodiversity Conservation Act 1999.

DPIE (2020a) *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method*. Department of Planning, Industry and Environment.

DPIE (2020b) NSW Survey Guide for Threatened Frogs (DPIE, 2020).

DPIE (2020c) *Threatened Reptiles Biodiversity Assessment Method Survey Guide*. Department of Planning, Industry and Environment

DPIE 2022 *Streamlined Assessment Module – Planted Native Vegetation*. BAM Department of Planning, Industry and Environment.

DPIE (2023) *BioNet Atlas of NSW Wildlife Threatened Biodiversity Database Collection (TBDC)*. Department of Planning, Industry and Environment.

DSEWPaC (2011a) *Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of Environment, Heritage and the Arts.

DSEWPaC (2011b) *Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act*. Department of Sustainability, Environment, Water, Population and Communities.

OEH (2018) 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method. Office of Environment and Heritage.

Appendix A
Record of correspondence

EMM
creating opportunities

A.1 Letter from Alex Purshe to Dimitri Young, September 2020

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
t: (02) 4910 0125

2 September 2020

Our ref: 18011550

Biodiversity and Conservation Division
NSW Department of Planning, Industry, and Environment
Level 8, 24 Mooney Street
Coffs Harbour NSW 2450

Attention: Dimitri Young

Dear Dimitri,

Clarrie Hall Dam Raising – Request for Confirmation of Survey Approach

Tweed Shire Council (TSC) is in the process of designing and seeking approval for the raising of the Clarrie Hall Dam wall by 8.5m (the project) at Doon Doon, NSW, from 61.5m to 70.0m AHD. The project is designated State Significant Infrastructure (SSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and has been declared a 'Controlled Action' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As an SSI, the impacts to biodiversity are being assessed using the Biodiversity Assessment Method (BAM; OEH, 2017). Eco Logical Australia (ELA) have been engaged by TSC to prepare the Environmental Impact Statement (EIS) including preparing the biodiversity assessment for the project.

Following a survey gap analysis prepared by ELA, TSC and ELA met with staff from Biodiversity and Conservation Division (BCD) on the 28 May 2020 to discuss the biodiversity assessment approach for the EIS. This letter and supporting information outlines the proposed survey strategy to address the BAM and seeks confirmation from BCD on the final survey approach.

ELA is seeking this confirmation prior to 18 September 2020 to allow adequate planning and resourcing.

If you have any queries, please contact me directly on (02) 4910 3413.

Regards,

Alex Pursche
Senior Ecologist

1. Introduction and summary of DPIE Actions

The intent of this letter is to seek concurrence on the survey strategy for all candidate threatened species identified by the BAM Calculator, and to provide a clear path to completion for remaining survey effort gaps identified by ELA.

Specifically, ELA request DPIE consider the content of this letter and previous surveys, and provide clear guidance on the following seven (7) actions for resolution:

- DPIE Action 1: We request DPIE approve the threatened flora survey strategy detailed in Section 4.3 of this letter
- DPIE Action 2: We request DPIE approve the proposed amphibian sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 of this letter.
- DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described in Section 4.4.2 of this letter, and that no further assessment is required.
- DPIE Action 4: We request DPIE approve the bat assessment approach described in Section 4.4.3 of this letter, and that no further field studies are required.
- DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala
- DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale based on previous survey effort conducted by TSC, and lack of existing suitable habitats
- DPIE Action 7: We request DPIE confirm no further reptile surveys required based on previous survey effort conducted by TSC

ELA is seeking this confirmation prior to 18 September 2020 to allow adequate planning and resourcing.

2. Background information

2.1 Background and gap analysis

The initial dam construction was subject to flora and fauna assessments prior to 1983, then again between 2016 and 2018 so there is already a high level understanding of the biodiversity values present within the subject site.

A gap analysis was undertaken by ELA to review the existing surveys conducted by TSC since 2016, to ensure compliance with NSW and Commonwealth survey guidelines. The gap analysis was reliant on the information provided by TSC in the following documents:

- Flora and fauna survey and preliminary impact assessment for the proposed raising of Clarrie Hall Dam, Tweed Shire, NSW (Tweed Shire Council, 2017)
- Further Investigation of the Occupancy of *Mixophyes iteratus* within the Doon Doon Catchment (Tweed Shire Council, 2018)
- An inspection of the August 2019 bushfire at Terragon and Clarrie Hall Dam (Sally Cooper & Greg Lollback, 2019)

- Targeted Survey and Revised Impact Assessment for Red Lilly Pilly and Lowland Rainforest, Doon Doon Catchment (Tweed Shire Council, 2018)
- Scanned survey datasheets for birds, amphibians, Comb-crested Jacana, Koala, reptiles, mammals, as well as spotlighting and trapping results.

All of these documents can be provided to DPIE upon request or can be sourced from the project website (link as follows):

https://www.yoursaytweed.com.au/RaisingClarrieHall/widgets/183762/documents

2.2 Minimum survey guidelines for biodiversity assessments

As of August 2020, there are several flora and fauna survey guidelines in existence in NSW, some of which are generic, and some which have specific requirements for individual species. Broadly, the following published guidelines apply to biodiversity assessments under the BAM:

- The *Biodiversity Assessment Method* (OEH, 2017)
- *NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats* (DPIE, 2020)
- *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018)
- *Field survey methods for amphibians: Threatened species survey and assessment guidelines* (OEH, 2009)
- *DRAFT Threatened biodiversity survey and assessment: Guidelines for developments and activities* (DEC, 2004)

In addition, the Threatened Species Profile Database (TSPD) also contains specific survey and habitat assessment requirements for individual species, which is changed regularly.

Broadly, replication of survey effort for a biodiversity assessment in NSW is based on a 100ha replicate unit (200 ha west of the ranges), and so the raising of Clarrie Hall Dam would require two replicate units of survey across the disturbance footprint. Based on the guidelines above, this would require:

- As per the BAM: a vegetation integrity assessment by conducting BAM plots at the appropriate frequency for the vegetation zone size
- a threatened flora survey using the two-stage grid approach (DPIE, 2020)
- up to 16 harp trap and 16 ANABAT nights per 50 ha habitat (DPIE, 2019)
- a targeted amphibian survey over two nights in appropriate habitats (OEH, 2009)
- two replicate fauna sites (one per 100 ha) in accordance with DEC (2004 draft) including at each site:
    - a 1ha bird survey (with unspecified repeated surveys)
    - 100 elliot trap nights for small mammals
    - 24 pitfall trap nights for mammals, amphibians, invertebrates, and reptiles
    - 1 hour spotlighting on two nights
    - 30 minute reptile and habitat searches on two occasions
    - Call playback for nocturnal species
    - As well as other methods such as hair tubes and reptile funnels.

The methods above are generally targeted to the species in question, and the most appropriate method(s) to maximise detection is selected. The draft 2004 guidelines do not contain any detail on contemporary methods such as infrared cameras.

In addition to those methods described above, Spot Assessment Technique (SAT) surveys are the unofficial method for assessing Koala habitat for development activities.

Details of the minimum survey, as well the survey undertaken to date for each candidate fauna species are detailed in Appendix E.

2.3 Survey effort summary

2.3.1 Threatened flora survey

Threatened flora surveys were conducted by TSC staff from October 2016 to June 2017 on the dates as described below in Table 1. Generally, the flora surveys included floristic data capture using methodologies described in the *Framework for Biodiversity Assessment* (OEH, 2014), as well as targeted surveys in 16 gullies across the inundation area.

Table 1 Tweed Shire Council threatened flora survey effort

Survey methodology	Dates of survey	Total effort (days)
Vegetation community validation & FBA plots	31/10/16 – 3/11/16, 8 – 11/11/16, 14/11/16, 16 – 18/11/16, 29/11/16 – 2/12/16	16
Targeted threatened species survey (within inundation area)	6 – 7/12/16, 13 – 16/12/16, 22/12/16	7
Targeted threatened species survey (outside inundation area)	7/3/17 (half-day), 13/3/17, 20, 22, & 24/3/17	4.5
Additional vegetation community validation & FBA plots around dam wall	7 – 8/6/17	2
Total		**29.5 days**

Targeted flora surveys by TSC identified the following nine threatened species within and nearby to the disturbance footprint as described in Table 2. Of these species, five are listed under the EPBC Act as Vulnerable.

Table 2 Threatened flora identified by TSC during 2016 and 2017 surveys

Scientific name	Common name	BC Act	EPBC Act	Impacted	Not impacted	Total
Corokia whiteana	Corokia	Vulnerable	Vulnerable	8	40	48
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	30	41	71
Endiandra muelleri subsp. *bracteata*	Green-leaved Rose Walnut	Vulnerable	Not listed	210	240	450
Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	Not listed	1243	4552	5795

Scientific name	Common name	BC Act	EPBC Act	Impacted	Not impacted	Total
Grevillea hilliana	White Yiel Yiel	Endangered	Not listed	0	1	1
Lepiderema pulchella	fine-leaved tuckeroo	Vulnerable	Not listed	1	0	1
Marsdenia longiloba	Clear Milkvine	Endangered	Vulnerable	13	27	40
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	147	83	230
Syzygium moorei	Durobby	Vulnerable	Vulnerable	2	13	15

2.3.2 Threatened fauna survey

The majority of threatened fauna surveys were conducted at 20 'core sites' whereby a complete fauna survey was undertaken using a variety of active search and trapping methods targeting reptiles, mammals, diurnal and nocturnal birds, and amphibians.

The survey design was implemented prior to the release of the BAM, and as such was designed as a more broad biodiversity assessment, rather than a targeted threatened species survey. The methods implemented are outlined in Table 3.

Table 3 Tweed Shire Council threatened fauna survey effort

Survey type	Number of sites	Replicates per site	Repeat per site	Total effort
Aquatic bird transect	1	1	1	1
Terrestrial bird survey	32	1	3	96
Reptile and amphibian search	32	1	2	64
Nocturnal search	20	1	3	60
Koala SAT	32	1	1	32
Diurnal search	32	1	3	96
Call playback	20	1	1-3	>20
Terrestrial elliot traps	20	20	4	1600
Pitfall traps	20	5	4	400
Cage traps	20	1	4	80
Funnel traps	20	5	4	400
Camera trap	32	2	14	896
Nocturnal amphibian search (Targeted creekline searches)	2	1	1	2
Harp trap	3	1	1-2	>3
Ultrasonic detector (ANABAT)	14	1	1-2	>14
Site condition assessment	32	1	1	32

The fauna surveys undertaken by TSC identified across the site:

- 19 amphibians
- 111 bird species
- 34 mammals
- 24 reptile species.

Of these species recorded, 26 are BC Act listed threatened species, and four (4) are listed under the EPBC Act (Appendix B). Species previously recorded are detailed in the table below. Of these 25 species, seven (7) are species credits, and eight are dual credit species in which only breeding habitat is calculated as a species credit. Four of these species are candidates for Serious and Irreversible Impacts (SAII). Those species that are species credits, or dual species, will have credits calculated for them where the suitable habitat feature is known or likely to be impacted by the proposal. Those dual credit species that are known from the site, but the breeding or important habitat is not present or impacted, will not have species credits calculated.

Additional species may be added to this list as the assessment progresses.

3. Gap analysis

3.1 Gap analysis review

The gap analysis identified the survey effort required to satisfy the BAM for each targeted survey group, as described in the survey methodologies in Section 2.2 above. The gap analysis also considered threatened species survey guidelines published by the Commonwealth Department of the Environment (2010).

The gap analysis partitioned the biodiversity survey requirements into several functional groups, based on the following survey requirements:

- Plant Community Type Mapping & Vegetation Integrity Assessment
- Threatened flora surveys
- Threatened fauna surveys and habitat mapping for forest owls, birds, invertebrates, reptiles, amphibians, and mammals.

3.2 Gap analysis outcomes

The gap analysis identified that for the majority of threatened fauna (particularly mammals, reptiles, and birds), the existing survey effort conducted by TSC was in excess of the minimum requirements for a site ~140 ha in size. The gap analysis did however identify that several survey gaps were present, in particular:

- threatened flora surveys within wet sclerophyll forests
- detailed threatened amphibian surveys outside of the two main tributaries through Mount Jerusalem National Park
- targeted surveys for breeding habitats for hollow-dependent fauna
- targeted surveys for Microchiropteran bats.

4. Surveys by ELA in 2020

4.1 Preliminary site inspections

Following the gap analysis, a site inspection was conducted by ELA ecologists from 9 – 13 March 2020, and specifically collected the following data points:

- vegetation validation: dominant three canopy, shrub, and ground cover species present
- fauna habitat: presence of hollow-bearing trees, logs, litter, and proximity to water sources
- hollow bearing trees: large trees and stags with suitable habitat for breeding forest owls and birds
- threatened species: where incidentally identified during the site inspection.

The site inspection identified seven threatened flora species previously identified by TSC.

4.2 Plant Community Type and Vegetation Integrity Assessment

Detailed surveys were carried out by ELA botanists from 14 – 18 April and 8 – 12 June 2020, whereby 35 full floristic plots were conducted in accordance with the BAM and identified the following four Plant Community Types (PCTs) in a variety of condition states:

- 770 Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion
- 827 Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast
- 1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion
- 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion

These PCTs occur generally in high condition across the inundation area (weed free remnant vegetation), but also have pockets of lower condition vegetation with either more weed ingress or recent disturbance from fire. Of these PCTs, 770 and 1302 are both consistent with *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions* which is listed as Endangered under the BC Act, and *Lowland Rainforest of Subtropical Australia* which is listed as Critically Endangered under the EPBC Act.

In addition to those areas of native vegetation identified in the PCTs above, there are areas of cleared land and native plantation within the inundation area:

- Dunn's white gum plantation
- Hoop pine plantation
- Paddocks/parklands.

These areas of cleared land and native plantation will not be calculated as a loss during the final impact assessment.

The area of each PCT to be impacted, as well as the number of plots and listing status is detailed in Table 4 below. The survey effort and PCT mapping has been competed to comply with the minimum requirements of the BAM.

Complete profiles for each vegetation zone can be found in Appendix B.

Detailed breakdown of the areas of each vegetation zone, as well as PCT justifications will be provided in the BDAR.

Table 4 Vegetation zones and plots completed

Veg Zone	PCT ID	PCT Name	BC Act	EPBC Act	Condition	Area (ha)	Plots required	Plots surveyed
1 - 770 High	770	Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion	EEC	CEEC	High	1.88	2	2
2 - 827 High	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			High	65.99	5	6
3 - 827 Mod	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Moderate	42.65	4	7
4 - 827 Low	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Low	12.05	3	3
5 - 827 Burnt	827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast			Burnt	13.65	3	3
6 - 1073 Mod	1073	Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion			Moderate	1.38	1	2
7 - 1302 High	1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	EEC	CEEC	High	2.51	2	4
8 - 1302 Mod	1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	EEC	CEEC	Moderate	0.87	1	2
Sub total Native vegetation						**140.98**	**21**	**29**
Cleared land	n/a	Dunn's white gum plantation			Low	7.9	N/A	2
Cleared land	n/a	Hoop pine plantation			Low	4.66	N/A	2
Cleared land	n/a	Paddocks/parklands			Low	69.42	N/A	2
Total area						**222.96**	**n/a**	**35**

4.3 Threatened flora assessment

Seventy-three threatened flora species are proposed as candidate species for the targeted survey, 12 of which have already been identified onsite as shown in Table 5 below. Two of these species are planted specimens, and six are potentially SAII.

Table 5 Threatened flora identified to date onsite

Species	Common	BC Act	EPBC Act	SAII
Corokia whiteana	Corokia	Vulnerable	Vulnerable	Yes
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	No
Endiandra muelleri subsp. bracteata	Green leaved Rose Walnut	Endangered	Not listed	Yes
Grammatis stenophyla	Narrow-leaf Finger Fern	Endangered	Not listed	No
Grevillea hilliana (planted)	White Yiel Yiel	Endangered	Not listed	Yes
Lepiderema pulchella	Fine-leaved Tuckeroo	Vulnerable	Not listed	Yes
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Vulnerable	No
Marsdenia longiloba	Slender Marsdenia	Endangered	Vulnerable	No
Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Not listed	Yes
Rhodomyrtus psidioides	Native Guava	Critically Endangered	Not listed	No
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	No
Syzygium moorei (planted)	Durobby	Vulnerable	Vulnerable	Yes

A threatened flora survey will be undertaken in late October – early November 2020 to coincide with the appropriate flowering and detection time for candidate species (Appendix D).

The survey plan has been adapted from the *NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats* (DPIE, 2020), whereby the strategy for sites >50ha has been applied. Typically, this would be a multistage approach using vertices on a 100m grid, however the shape of the current disturbance footprint is incompatible with this approach. As such, the inundation boundary has been allocated a survey vertex every 100m (in suitable habitats) along the internal boundary as the stage 1 approach (Figure 1). These will be inspected as per the survey guide for large sites in the appropriate time of year. Should threatened flora be identified, the area between the adjacent vertices will be searched in detail for any additional species.

This process is repeated at each vertex until all target sites have been assessed. All previous threatened flora records will then be incorporated into the results from the 2020 survey strategy.

DPIE Action 1: We request DPIE approve the threatened flora survey strategy above

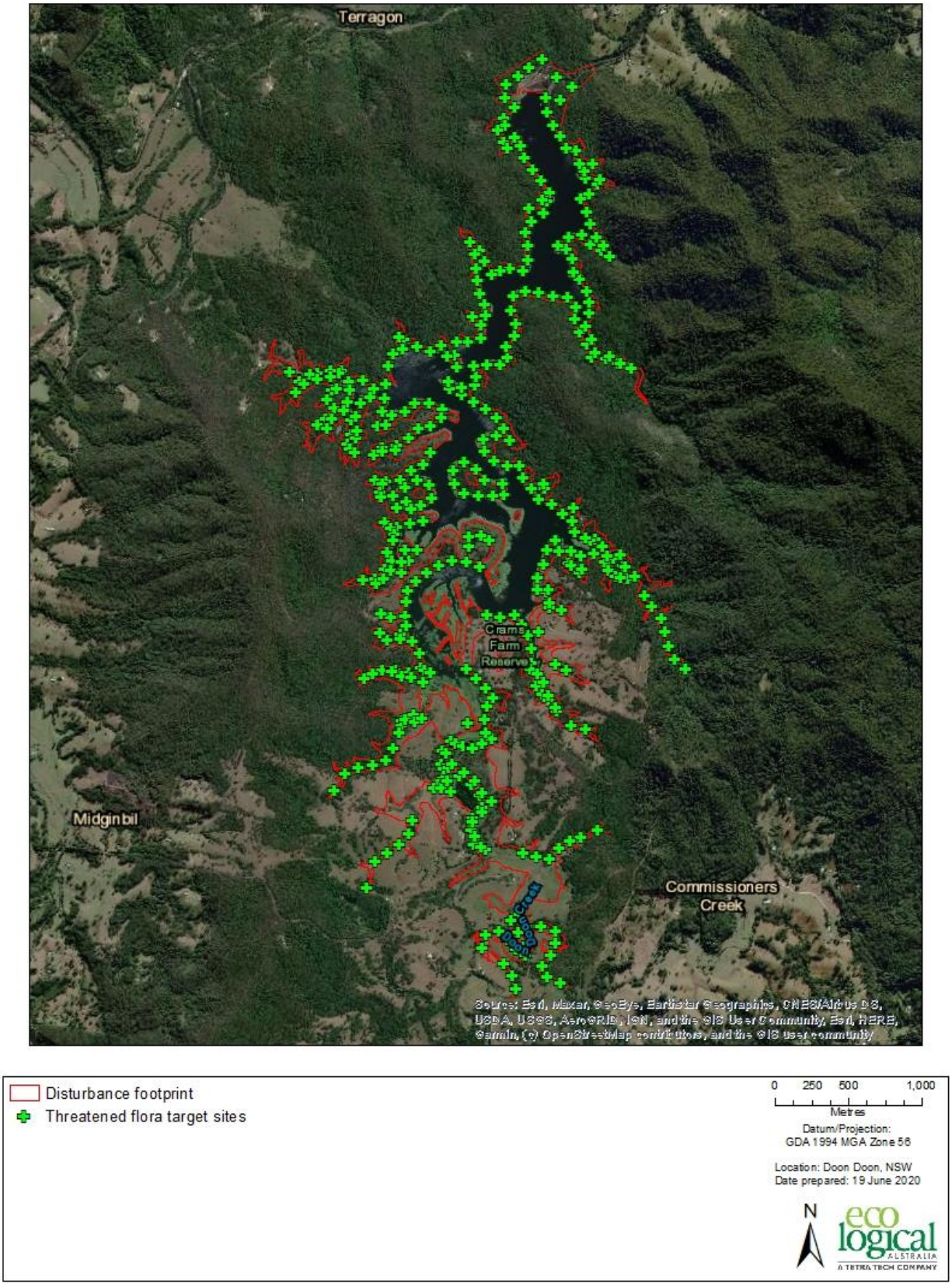


Figure 1 Threatened flora survey strategy

4.4 Threatened fauna assessment

The following section contains the proposed survey strategy for threatened fauna within the disturbance footprint.

We request DPIE confirm this strategy to be appropriate for inclusion within the formal BDAR.

4.4.1 Threatened fauna – amphibians

There are five (5) candidate threatened amphibians, three of which are known to site in discrete pockets of habitat. In order to appropriately extrapolate the findings across the disturbance footprint, a four stage approach is proposed:

1. Define habitat features for candidate species
2. Map habitats across the disturbance footprint
3. Conduct a sub-sampling survey in 2020 during appropriate weather conditions
4. Extrapolate findings across the site.

These steps are detailed in the sections and tables below.

4.4.1.1 Define habitat features for candidate species

A threatened amphibian habitat assessment was developed using information provided in the Threatened Species Profile Database, as well as considering specific habitat descriptions in the Threatened Species Profile Database and *Reptiles and Amphibians of Australia* (Cogger, 2018), as well as specialist input from Frank Lemckert. Key habitat features for each of the candidate species are detailed in Table 6.

Table 6 Threatened amphibian habitat assessment

Feature	*Assa darlingtoni*	*Litoria brevipalmata*	*Mixophyes fleayi*	*Mixophyes iteratus*	*Philoria loveridgei*
Benched rocky stream					Yes
Bogs created from human-modification to natural flows					Yes
Boggy headwaters of rainforest streams and soaks					Yes
Deep leaf litter	Yes	Yes	Yes	Yes	Yes
Emergent vegetation		Yes			
Ephemeral drainage		Yes – they breed where water pools after flowing		Yes	
Gravel stream			Yes		
Groundwater soak					Yes
Lomandra sp. and vegetated riparian ground cover			Yes	Yes	

Feature	*Assa darlingtoni*	*Litoria brevipalmata*	*Mixophyes fleayi*	*Mixophyes iteratus*	*Philoria loveridgei*
Moist substrates (mosses etc)	Yes				Yes
Overhanging banks				Yes	
Permanent drainage		Yes	Yes	Yes	
Permanent water		Yes	Yes	Yes	
Rainforest	Yes	Yes	Yes (within 750m of streams)	Yes (within 50m of drainage)	Yes
Rotting logs	Yes				Yes
Wet sclerophyll forest	Yes (within 50m of rainforest)	Yes	Yes (within 750m of streams)	Yes (within 50m of drainage)	Maybe

4.4.1.2 Map habitats across the disturbance footprint

The habitat assessment was conducted at 39 locations across the dam to understand what broad habitat types were present, and was used to stratify the site into five (5) habitat types for amphibians. Details of habitat results will be provided in the final BDAR.

The habitat features considered during the assessment are descried in Table 6 above, and the habitat types are described in Table 7.

Importantly, the habitat types will be used as a surrogate for further sub-sampling across the disturbance footprint.

The spatial distribution of amphibian habitats across the site is currently under development.

Table 7 Amphibian habitat results

Stream type	Habitat features	Threatened species	Photograph
1 – Permanent drainages in remnant rainforest	Common features: Rainforest with deep leaf litter, permanent clear flowing water, undercut banks, rotting logs, *Lomandra* sp, sand and gravel substrate Occasional features Benched streams, moist mosses Absent features Boggy headwaters, modified boggy areas, emergent aquatic vegetation, weeds	Known *Assa darlingtoni* *Mixophyes iteratus* *Philoria loveridgei* Potential *Mixophyes fleayi* Unlikely *Litoria brevipalmata*	
2 – Complex ephemeral drainages in rainforest and wet sclerophyll forest	Common features: Rainforest and wet sclerophyll forest with deep leaf litter, benched streams, moist mosses, ,rotting logs Occasional features Permanent clear flowing water, undercut banks, sand and gravel substrate, *Lomandra* sp Absent features Boggy headwaters, modified boggy areas, emergent aquatic vegetation, weeds	Known No species known Potential *Assa darlingtoni* *Philoria loveridgei* Unlikely *Mixophyes fleayi* *Mixophyes iteratus* *Litoria brevipalmata*	

Stream type	Habitat features	Threatened species	Photograph
3 – Simple ephemeral drainage in wet sclerophyll forest	Common features: Wet sclerophyll forest with deep leaf litter, rotting logs Occasional features Gravel substrates, weeds, *Lomandra* sp Absent features Rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, emergent aquatic vegetation, undercut banks, sand substrate	Known No species known Potential *Assa darlingtoni* Unlikely *Litoria brevipalmata* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	
4 – Forested dam fringe	Common features: Emergent aquatic vegetation, wet sclerophyll forest with deep leaf litter Occasional features Rotting logs Absent features Rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, *Lomandra* sp, undercut banks, sand and gravel substrate	Known No species known Potential *Assa darlingtoni* Unlikely *Litoria brevipalmata* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	

Stream type	Habitat features	Threatened species	Photograph
5 – Permanent water adjacent to cleared land	Common features: Emergent aquatic vegetation, weeds, cleared grassland Occasional features Wet sclerophyll forest with deep leaf litter, rotting logs , turbid water Absent features Gravel substrates rainforest, benched streams, moist mosses permanent clear flowing water, boggy headwaters, modified boggy areas, emergent aquatic vegetation *Lomandra* sp, undercut banks, sand substrate	Known No species known Potential *Litoria brevipalmata* Unlikely *Assa darlingtoni* *Mixophyes fleayi* *Mixophyes iteratus* *Philoria loveridgei*	

4.4.1.3 Conduct a sub-sampling survey in 2020 during appropriate weather conditions

Two sites in each stream type (10 sites total) are proposed to be surveyed during appropriate seasonal and weather conditions. The location of these sites will be spread across the disturbance footprint, and supplements the existing data collected by TSC (as described in Table 3).

Data collected regarding threatened species occupancy in habitats will be extrapolated across similar stream types.

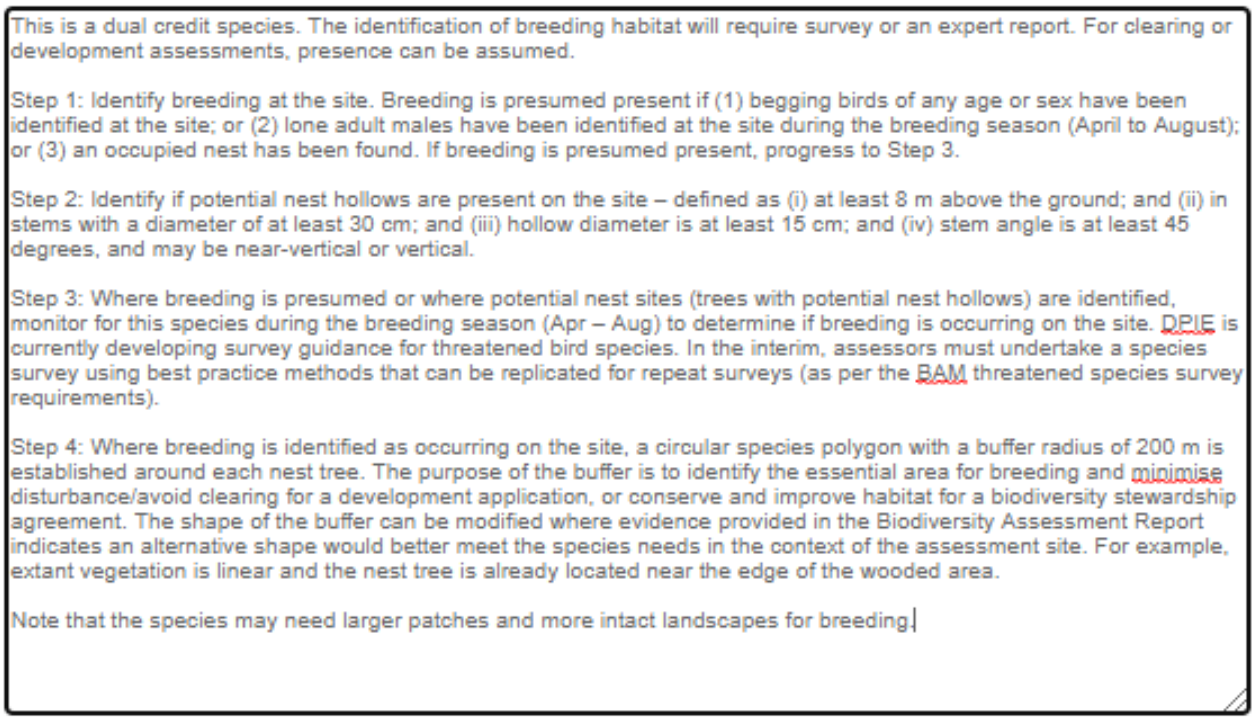
DPIE Action 2: We request DPIE approve the proposed sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 above.

4.4.2 Threatened fauna – diurnal & nocturnal birds

Ten candidate species have been identified for this assessment, three of which have been identified onsite by TSC or ELA (Glossy Black-cockatoo, White-bellied Sea-eagle, & White-eared Monarch). The gap analysis identified that the survey effort conducted at 32 sites is significantly in excess of the minimum requirement for diurnal birds, and that no further survey would be required.

Of these species, Glossy Black-cockatoo and White-bellied Sea Eagle are dual species, whereby their foraging habitat is considered an ecosystem credit, and only the breeding habitat is considered a species credit.

For Glossy Black-cockatoo, the species was identified on numerous occasions in March 2020 across the disturbance area. As such, additional survey is required to determine whether known breeding habitat is present. The identification of breeding habitat as per the Threatened Species Profile Database is shown below:


This is a dual credit species. The identification of breeding habitat will require survey or an expert report. For clearing or development assessments, presence can be assumed.

Step 1: Identify breeding at the site. Breeding is presumed present if (1) begging birds of any age or sex have been identified at the site; or (2) lone adult males have been identified at the site during the breeding season (April to August); or (3) an occupied nest has been found. If breeding is presumed present, progress to Step 3.

Step 2: Identify if potential nest hollows are present on the site – defined as (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical.

Step 3: Where breeding is presumed or where potential nest sites (trees with potential nest hollows) are identified, monitor for this species during the breeding season (Apr – Aug) to determine if breeding is occurring on the site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Step 4: Where breeding is identified as occurring on the site, a circular species polygon with a buffer radius of 200 m is established around each nest tree. The purpose of the buffer is to identify the essential area for breeding and minimise disturbance/avoid clearing for a development application, or conserve and improve habitat for a biodiversity stewardship agreement. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area.

Note that the species may need larger patches and more intact landscapes for breeding.

Figure 2 Glossy Black-cockatoo breeding habitat requirements (TSPD, 2020)

In order to determine whether breeding habitat is present, ELA conducted an inspection of all hollow-bearing trees within the disturbance footprint during the breeding season, to consider whether any of these trees were currently in use. This survey was conducted over a five day period from 21 – 25 July 2020 by ELA ecologists and accredited assessors Alex Pursche and Tom Schmidt.

In accordance with Step 1 above, the survey failed to identify any begging birds, lone adult males, or occupied nests. The only occupancy of the species identified was nearby to the dam wall, where a pair of birds were observed feeding in an *Allocasuarina torulosa*. No other individuals were observed.

In accordance with step 2, potential hollows were mapped across the disturbance footprint, and each inspected for hollow size and limb configuration. The hollow-bearing tree inspection also included a search for whitewash and casts from *Tyto* sp,

In the absence of any formal guidelines on the occupancy of the species, and given the lack of individuals identified (only one pair), it is unlikely that more than one of the hollow-bearing trees are used for breeding. The occupancy of the trees within the disturbance footprint is even less likely when considering the intact vegetation surrounding the dam, as well as the exposed position of these trees in the landscape (along the existing water front).

Forest owls such as Sooty Owl and Masked Owl were also considered during this assessment, as they are both known to occur within the locality. These species are both dual credit species, and have specific habitat requirements for breeding habitat (as described below in Figure 3 and Figure 4).

On sites where the species is determined to be present AND suitable caves are present AND breeding has been detected/proven any impact could be serious and irreversible. Any other impact on the species habitat is unlikely to be a potential serious and irreversible impact.

Where a hollow bearing tree has been identified as a breeding site in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Figure 3 Sooty Owl breeding habitat requirements (TSPD, 2020)

Patch size selected is based on that fact that the species will use areas that are quite small, especially as foraging habitat but also as roosting habitat and occasionally as breeding habitat. In Tas and Vic Masked owls have been recording nesting in paddock trees. Note that the species has been found to nest in caves in Tasmania (and maybe the Nullabor?) but there is no evidence to suggest that this occurs in NSW. Dead stags are especially popular for roosting/breeding habitat and are a limited resource due to natural attrition.

Where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. The purpose of the buffer is to minimise disturbance/avoid clearing, for a development application, or to conserve and improve habitat, for a biodiversity stewardship agreement, within the area essential for breeding. This includes habitat suitable for male roosts, feeding/grooming perches and fledgling requirements. It does not account for foraging habitat. The shape of the buffer can be modified where evidence provided in the Biodiversity Assessment Report indicates an alternative shape would better meet the species needs in the context of the assessment site. For example, extant vegetation is linear and the nest tree is already located near the edge of the wooded area. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).

Figure 4 Masked Owl breeding habitat requirements (TSPD, 2020)

Both of these habitat descriptions are non-distinct and provide little guidance for the field assessment of each of these species breeding habitats, and makes reference to documents such as "*BAM threatened*

species survey requirements" which currently are not publicly known. As such the habitat preferences of these two species has been adopted from the *Recovery Plan for Large Forest Owls* (DEC, 2006), which identifies the following breeding preferences for each species (Table 8):

Table 8 Forest owl roosting and nesting habitats (DEC, 2006)

Species	Roosting habitat	Nesting habitat
Sooty Owl	Hollows in live or occasionally dead trees, eucalypt or rainforest species, in moist forest; among dense foliage in rainforest gullies; caves, recesses or ledges in cliffs or banks. Roost sites are in the darkest and most secluded or sheltered positions in the forest. Foliage roosts are typically in narrow, gloomy side-gullies near creek junctions or below dry waterfalls, less than 10 m from drainage lines. Foliage roosts used are rainforest species, tree ferns and vine tangles. Hollows used are usually less than 100 m from streams, and are also used as nest sites or have similar characteristics to those used for nesting.	Old hollow trees, eucalypt or rainforest species, usually live but stags are occasionally used, in unlogged, unburnt gullies and lower slopes within 100 m of streams, with hollows greater than 40 cm wide and greater than 100 cm deep; surrounded by canopy trees. Also nests in caves. Hollow entrances are at least 16 m above ground, in trees of at least 120 cm diameter at breast height.
Masked Owl	Hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves or recesses in cliffs. Hollow sites can be in a variety of topographic positions, from gully to upper slope, and are also used as nest sites or have similar characteristics to those used for nesting. Roost sites in trees are greater than 5 m above the ground.	Old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams. Nest sites may be subject to a variety of disturbance regimes, which make nest trees susceptible to loss (wind throw and burning). Hollow entrances are at least 3 m above ground, in trees of at least 90 cm diameter at breast height.

In order to assess whether breeding habitat is present for either of these species, a diurnal survey reviewing each potential tree for whitewash and casts was undertaken by ELA Ecologists concurrently with the Glossy Black-cockatoo survey. Whitewash is a good indication of occupancy of the potential tree, as both of these species have high site fidelity for breeding sites.

In order to determine if the species were present during the breeding season, 4 call playback sites over 4 nights (16 sites total) as well as a spotlighting circumnavigation of the dam shoreline was conducted during the evenings of 21-24 July 2020 using a small open boat. The use of the boat provides better line of sight and ease of access throughout the inundation area. During this survey, Masked Owl was not recorded as being present within the disturbance footprint during the breeding season.

This survey did identify numerous Sooty Owls within the bushland surrounding the disturbance footprint (species observed or heard at multiple locations each night). Despite this observation, there is little evidence that the species is using the hollow-bearing trees along the foreshore, as all the calls were originating from gully heads several hundred meters away from the disturbance footprint. Combined with the lack of whitewash and specific roosting and nesting requirements as described in the *Recovery Plan for Large Forest Owls* (such as sheltered, sub-canopy roosts), it is unlikely that any breeding habitat will be impacted by the raising of Clarrie Hall Dam. No further forest owl surveys are proposed.

DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described above, and that no further assessment is required.

4.4.3 Threatened fauna – bats

The *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018) requires a minimum of 16 harp trap and 16 ANABAT nights for threatened microchiropteran bat candidate species. This assessment considers the following four candidate microchiropteran bats:

- *Chalinolobus dwyeri*
- *Miniopterus australis*
- *Miniopterus orianae oceanensis*
- *Vespadelus troughtoni*
- *Myotis Macropus.*

Myotis Macropus is known from the site and is frequently observed skimming over the water in the evenings (including during inclement winter weather), and so this species does not require any further field assessment. Of the remaining species, all are cave-dwelling for the breeding phase of their life-cycle, as is described in the TSPD, and shown below in Figure 5 to Figure 8.

In addition, many of these species only have a handful of known maternity caves, and the discovery of another would be a significant find for the species.

The topography and soil at within the inundation area does not contain any cave or cliff features that contain potential bat breeding habitats. The only place that may serve as a habitat for these species is the artificial rock faces at the dam wall (Photograph 1), whereby the aggregate may contain temporary roosting sites. There are no fissures in this feature that would contain the appropriate thermal and structural components to support a breeding site for any of the candidate species.

Similarly a review of cliffline and cave habitat within 10km of the disturbance footprint was undertaken to identify any potential sites whose buffer may extend into the inundation area (as there are several suitable cliffline features within the nearby National Parks). The regional review identified that there are numerous suitable cliffline features within Wollumbin, Nightcap, and Mount Jerusalem National Parks, however a 2km buffer (as per *V. troughtoni*) around these features would not be impacted by the disturbance footprint (Figure 9). Similarly, the smaller 100m buffer for other species would not be impacted.

As such, the identification of any of these species within the footprint would not constitute an impact to species (or dual) credit habitats, as defined by the BAM. The survey strategy for these species is to therefore not undertake any further assessment, as impacts would be incorporated into the ecosystem calculation for the project.

DPIE Action 4: We request DPIE approve the bat assessment approach described above, and that no further field studies are required.

Photograph 1 Clarrie Hall Dam Wall

The species is a full species credit because it can not be reliably predicted to occur on a site based on vegetation and other landscape features (either foraging or breeding). This species usually gives birth to twins.
SAII threshold is potential breeding habitat and presence of breeding individuals. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat.
Species mapping polygon for breeding habitat must use high resolution aerial imagery and topographic maps to identify features on the subject land (caves, scarps, cliffs etc). Polygon must be at least 100m wide (or 50m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid (see Threatened Bat Survey Guide). All breeding habitat on or within 100m of the subject land and the area immediately surrounding the feature must be identified.
All habitat on the subject land should also be mapped if present. Use high resolution aerial imagery and topographic maps to identify potential roost habitat features on the subject land within 2km caves, scarps, cliffs etc. Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features.

Figure 5 Chalinolobus dwyeri s species habitat description (TSPD, 2020)

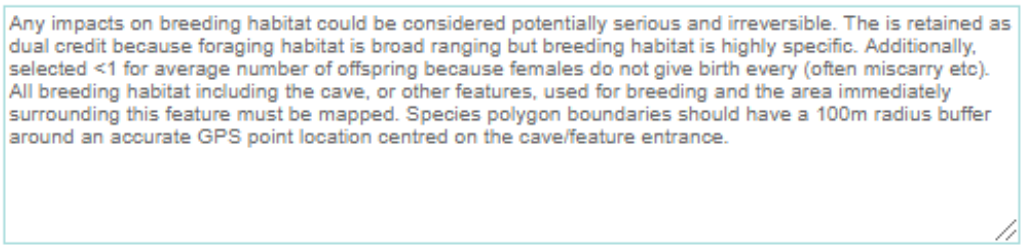


Figure 6 Miniopterus australis species habitat description (TSPD, 2020)

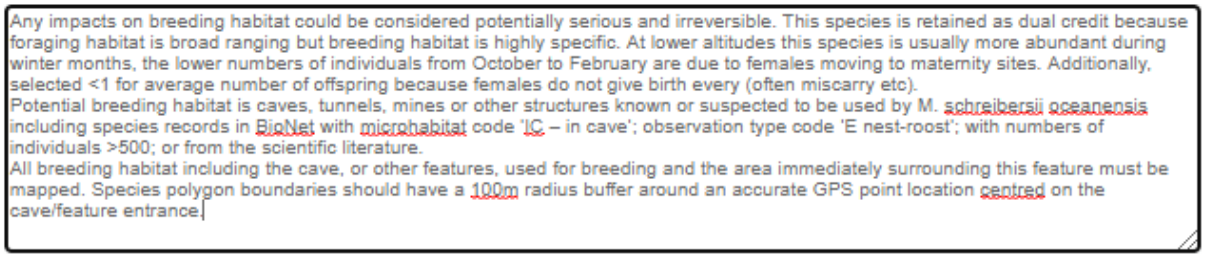


Figure 7 Miniopterus orianae oceanensis breeding habitat description (TSPD, 2020)

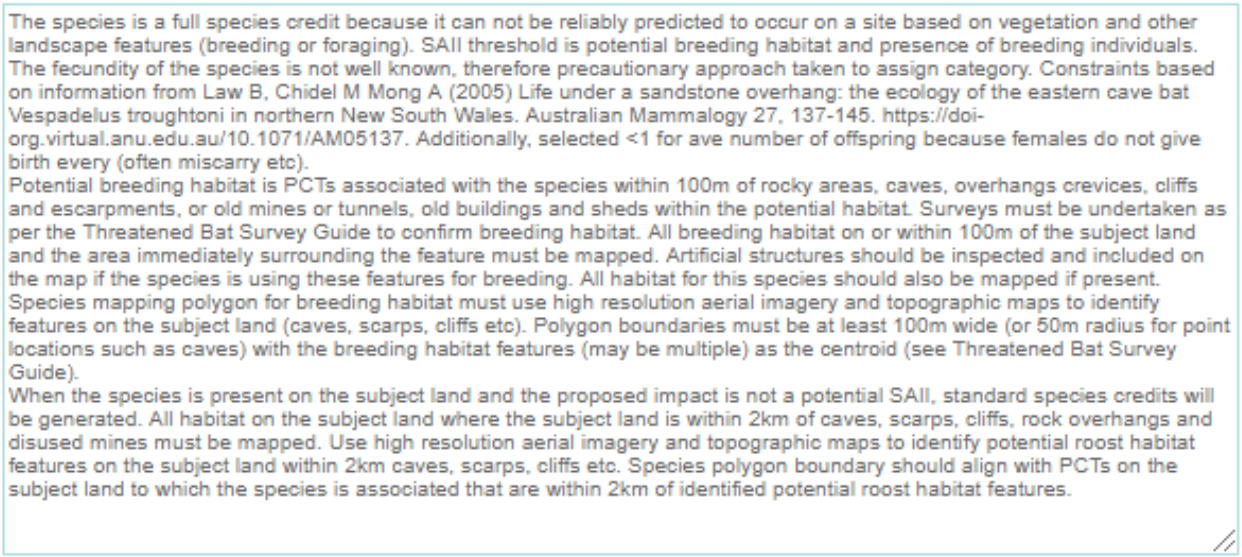


Figure 8 *Vespadelus troughtoni* species credit description (TSPD, 2020)

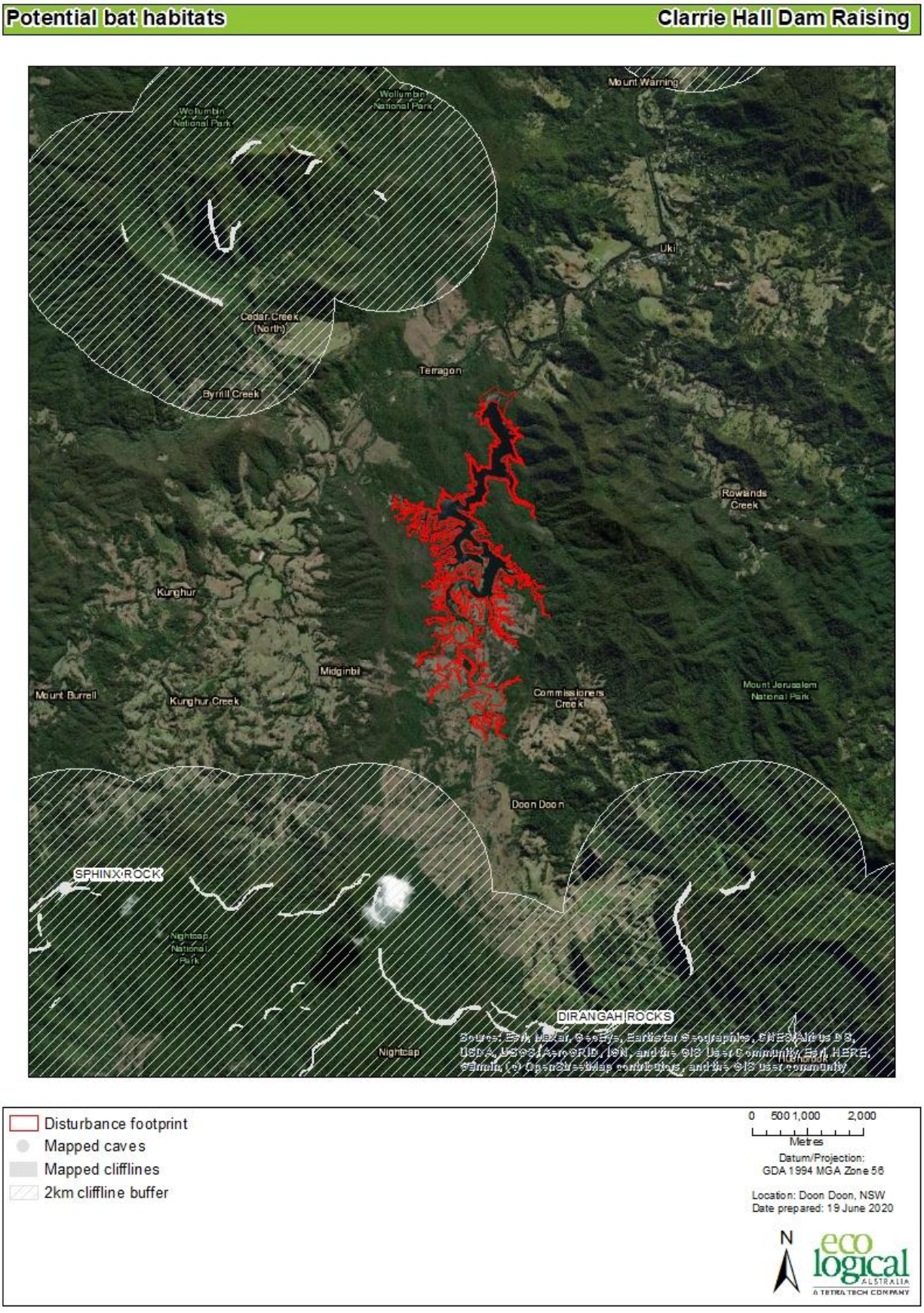


Figure 9 Potential bat habitat within the region

4.4.4 Threatened fauna – mammals

TSC conducted significant mammal surveys across the disturbance area as well as adjacent forests. The survey effort conducted to date is significantly in excess of the minimum requirements (Appendix E). The only species whereby additional information is requested is for Koala and Brush-tailed Phascogale.

4.4.4.1 Koala

Koala is a dual credit species, whereby foraging habitat is considered an ecosystem credit, and only important habitats are calculated as species credits. The TSPD contains the following guidance on assessing important habitats for Koala (Figure 13):

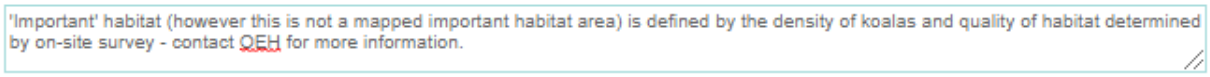


Figure 10 Koala habitat description (TSPD, 2020).

Previous koala habitat mapping has been undertaken by TSC and is presented in the attached flora and fauna assessment. Given that this species is known from the inundation area and adjacent sclerophyll forests, the assessor requests that guidance be provided on the methodology for mapping important habitats across the disturbance area.

DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala

4.4.4.2 Brush-tailed Phascogale

This species inhabits open forest and woodlands along the NSW coastline and ranges. This species uses hollows in smooth-barked trees for refugia, and forages predominately on insects and spiders. This species generally is not found in the wet sclerophyll forests and rainforests that are present within the inundation area.

The TSPD contains detailed information regarding the survey for this species, and specifies (Figure 14) that up to 10 cameras per ha of habitat are required, and that for sites over 10ha, a modified camera approach may be sought from DPIE. This request is to be accompanied by PCT mapping and vegetation plot sheets (both included in this letter).

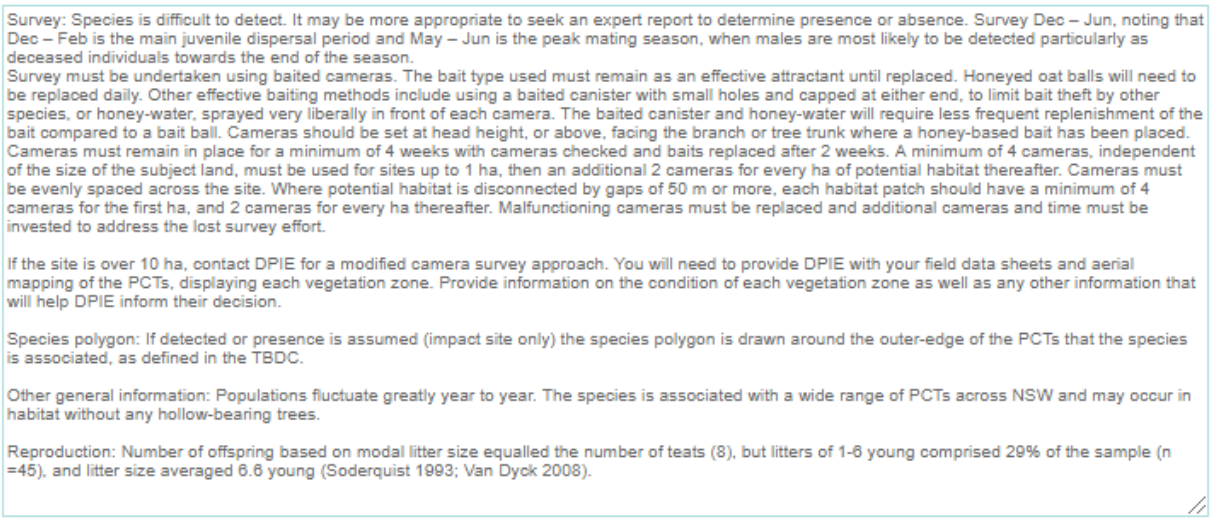


Figure 11 Survey guidance for Brush-tailed Phascogale (TSPD, 2020)

Given the extensive survey effort already undertaken by TSC (Appendix A & Appendix E), and the lack of habitats for this species present within the disturbance area, no additional survey should be undertaken for this species.

DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale

4.4.5 Threatened fauna – reptiles

The survey effort conducted by TSC is considered to be considerably above the minimum requirements for candidate threatened reptiles for this assessment. No further surveys are proposed.

DPIE Action 7: We request DPIE confirm no further reptile surveys required.

Appendix A Tweed Shire Council Report

See link as follows:

https://www.yoursaytweed.com.au/RaisingClarrieHall/widgets/183762/documents

Appendix B Threatened species records

Table 9 Threatened fauna identified at Clarrie Hall Dam by TSC

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
Amphibia	*Assa darlingtoni*	Pouched Frog	Vulnerable	Not listed	Species	Area	No
Amphibia	*Mixophyes iteratus*	Giant Barred Frog	Endangered	Endangered	Species	Area	No
Amphibia	*Philoria loveridgei*	Loveridge's Frog	Endangered	Not listed	Species	Area	No
Aves	*Amaurornis moluccana*	Pale-vented Bush Hen	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Carterornis leucotis*	White-eared Monarch	Vulnerable	Not listed	Species	Area	No
Aves	*Podargus ocellatus*	Marbled frogmouth	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus magnificus*	Wompoo Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus regina*	Rose-crowned Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Ptilinopus superbus*	Superb Fruit Dove	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Irediparra gallinacea*	Comb-crested Jacana	Vulnerable	Not listed	Ecosystem	n/a	n/a
Aves	*Calyptorhynchus lathami*	Glossy Black-cockatoo	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No
Aves	*Menura alberti*	Alberts Lyrebird	Vulnerable	Not listed	Species	Area	No
Aves	*Tyto novaehollandiae*	Masked Owl	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	No

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
Aves	*Tyto tenebricosa*	Sooty Owl	Vulnerable	Not listed	Dual	Circular polygon around breeding trees only	Yes
Mammalia - arboreal	*Phascolarctos cinereus*	Koala	Vulnerable	Vulnerable	Dual	Important habitat only - undefined	No
Mammalia - bats	*Miniopterus australis*	Little Bent-winged Bat	Vulnerable	Not listed	Dual	Circular polygon around breeding caves only	Yes
Mammalia - bats	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	Vulnerable	Not listed	Dual	Circular polygon around breeding caves only	Yes
Mammalia - bats	*Myotis macropus*	Southern Myotis	Vulnerable	Not listed	Species	Vegetation within 200m of waterbody	No
Mammalia - bats	*Nyctimene robinsoni*	Eastern Tube-nosed Bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Nyctophilus bifax*	Eastern Long-eared Bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Pteropus poliocephalus*	Grey-headed Flying-fox	Vulnerable	Vulnerable	Dual	Camp sites only	No
Mammalia - bats	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	Vulnerable	Not listed	Ecosystem	n/a	n/a
Mammalia - bats	*Vespadelus troughtoni*	Eastern Cave Bat	Vulnerable	Not listed	Species	2km from potential roosts (caves, cliffs, disused mines etc). Breeding habitat caves only.	Yes (breeding)
Mammalia - terrestrial	*Potorous tridactylus*	Long-nosed Potoroo	Vulnerable	Vulnerable	Species	Dense habitats in wet	No

Class	Species	Common	BC Act	EPBC Act	Credit type	Measure	SAII
						sclerophyll or rainforest	

Appendix C Plant Community Type Profiles

Table 10 Zone 1 PCT770 High condition

770 - Coachwood - Soft Corkwood - Crabapple warm temperate rainforest of the NSW North Coast Bioregion	
Vegetation formation/class	Rainforests/Northern Warm Temperate Rainforests
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia
	This community occurs in narrow bands along drainage courses in protected gullies or in larger areas on sheltered slopes. Mid-storey and canopy cover is often high. This community is characterised by an upper stratum of *Ceratopetalum apetalum* (Coachwood), *Schizomeria ovata* (Crabapple) and *Endiandra globosa* (Black Walnut) with *Lophostemon confertus* (Brush Box) and some *Eucalyptus* spp. occurring occasionally and on the community ecotone. Some mid-storey species occasionally occur as canopy trees. The mid-storey is made up of species including *Archontophoenix cunninghamiana*, *Neolitsea dealbata*, *Acmena smithii*, *Ackama paniculosa, Sloanea* spp., *Flindersia* spp. and *Cryptocarya* spp. The ground layer varies in cover but often comprising of *Blechnum cartilagineum,* with other ferns, herbs and grasses occurring at lower levels. Climbers are a common feature including *Cissus* spp., *Ripogonum* spp., *Echinostephia aculeata*, *Gynochthodes jasminoides*, *Smilax* spp., *Flagellaria indica* and *Calamus muelleri*.
Characteristic canopy trees	*Ceratopetalum apetalum, Schizomeria ovata, Endiandra globosa, Lophostemon confertus*
Characteristic mid-storey	*Archontophoenix cunninghamiana, Acmena smithii, Ackama paniculosa, Neolitsea dealbata, Cryptocarya* spp., *Eupomatia laurina, Synoum glandulosum* subsp. *glandulosum, Sloanea* spp., *Cissus* spp.
Characteristic groundcovers	*Blechnum cartilagineum, Adiantum* spp., *Dianella* spp., *Calochlaena dubia, Lomandra* spp.
Mean native richness	58
Exotic species / HTW cover	*Lantana camara* / 0
Condition	Good condition
Variation and disturbance	Little to no disturbance, some old forestry tracks are present which are regenerating well. Smaller patches of this zone show an influence/overlap from adjacent 827 communities.
% cleared in NSW	0.3%
No. sites sampled	2
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Endiandra hayesii, Marsdenia longiloba, Syzygium hodgkinsoniae, Grammitis stenophylla, Rhodamnia rubescens, Rhodomyrtus psidioides*
Fauna habitats	Dense vegetation for ground mammals and rainforest birds. Amphibian habitat in streams. Potential for small hollow bearing trees. Occasional koala feed trees (*E. propinqua*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo (in community ecotone).
Justification	Similar PCTs occur in the region including 1130 and 1201 however PCT 770 represents the best fit given the dominant canopy species.

Composition	**Structure**	**Function**	**Vegetation Integrity Score**
94.7	29.2	64.7	56.3

Table 11 Zone 2 PCT 827 High condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (High)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community occurs on moderately exposed areas around the dam. This community is characterised by an upper stratum of *Lophostemon confertus* (Brush Box) and various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus propinqua* (Grey gum). The mid-storey is made up of species including *Acmena smithii*, *Endiandra globosa*, *Archontophoenix cunninghamiana*, *Cryptocarya* spp., *Archirhodomyrtus beckleri*, *Schizomeria ovata*, *Polyscias elegans* and *Allocasuarina torulosa*. Some species typically found in the mid-storey of this community including *Alphitonia excelsa*, *Endiandra globosa* and *Allocasuarina torulosa* occasionally occur as canopy trees. The ground layer is variable but generally has a high cover of *Blechnum cartilagineum*, *Calochlaena dubia* and *Hypolepis muelleri,* with *Lomandra* spp. and *Oplismenus imbecillis* also common. Other ferns, herbs and grasses occur at lower levels including *Aneilema acuminatum*, *Entolasia marginata* and *Pseuderanthemum variabile*. Climbers occurring include *Cissus* spp., *Dioscorea transversa*, *Geitonoplesium cymosum*, *Gynochthodes jasminoides* and *Smilax* spp.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp.*, Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp.*, Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	50
Exotic species / HTW cover	*Cinnamomum camphora, Ardisia crenata, Passiflora edulis, Paspalum mandiocanum, Ageratina riparia, Passiflora edulis, Commelina benghalensis* / 2%
Condition	High
Variation and disturbance	Little to no disturbance. Evidence of historic logging and old forestry tracks are present which are regenerating well. Old fences are occasionally found which have minimal impact to community
% cleared in NSW	Not listed
No. sites sampled	6
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens, Corokia whiteana*
Fauna habitats	Dense vegetation for ground mammals and rainforest birds. Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the dominant canopy species.

Composition	Structure	Function	Vegetation Integrity Score
94.2	47.8	73.8	69.3

Table 12: Zone 3 PCT 827 Moderate condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Moderate)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is the equivalent of 827 high but with a moderate occurrence of exotic species and/or a modified vegetation structure. This community is characterised by an upper stratum of various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood). The mid-storey cover is generally low compared to the 827 High condition zone, with the exception of some sites with dense mid-storey regrowth. The ground layer is variable but generally fern cover is lower and grass cover is higher. Grasses include *Oplismenus* spp., *Entolasia marginata*, *Cynodon dactylon*, *Imperata cylindrica* and *Paspalum mandiocanum*. Climbers are present in low numbers except where regrowth is high or where the mid-storey is relatively intact.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp., *Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp., *Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	40
Exotic species / HTW cover	*Andropogon virginicus, Ageratina riparia, Ageratina adenophora, Anredera cordifolia, Asparagus plumosus, Axonopus compressus, Bidens pilosa, Cinnamomum camphora, Conyza bonariensis, Citrus x taitensis, Commelina benghalensis, Desmodium uncinatum, Hypochaeris radicata, Lantana camara, Ligustrum lucidum, Onopordum acanthium, Ochna serrulata, Passiflora edulis, Paspalum mandiocanum, Senecio madagascariensis, Setaria sphacelata, Solanum capsicoides, Sporobolus africanus, Stellaria media, Senna septemtrionalis, Kalanchoe sp., Sonchus oleraceus, Tradescantia fluminensis* / 8%
Condition	Moderate
Variation and disturbance	Areas likely previously cleared with varying levels of regrowth. The upper canopy cover is relatively intact though mature Camphor laurels may be present. Variation in mid-storey condition occurs including areas of high mid-storey regrowth, degraded mid-storey regrowth, or mown mid-storey and groundcover.
% cleared in NSW	Not listed
No. sites sampled	7
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	Potential for small hollows. Presence of koala feed trees (*E. microcorys*, *E. propinqua*, *E. grandis*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
89	37.7	87.1	66.4

Table 13: Zone 4 PCT 827 Low condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Low)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is the equivalent of 827 High but with a high occurrence of exotic species and/or a highly modified community structure. This community is characterised by an upper stratum of Eucalypts including *Lophostemon confertus* (Brush Box) and *Eucalyptus grandis* (Flooded Gum) and occasional disturbance related pioneer species such as *Alphitonia excelsa* (Red Ash) and *Flindersia schottiana* (Bumpy Ash). *Cinnamomum camphora* (Camphor laurel) may be the dominant canopy cover is some areas. The mid-storey cover is generally low compared to the equivalent high condition community, except for sites with dense mid-storey regrowth in canopy gaps. The ground layer is variable but generally fern cover is lower and grass cover is higher. Grasses include *Oplismenus* spp., *Entolasia marginata*, *Cynodon dactylon*, *Imperata cylindrica* and *Paspalum mandiocanum*. Climbers are present in low numbers except where regrowth is high.
Characteristic canopy trees	*Lophostemon confertus*, *Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Mallotus philippinensis, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	Variable but may include *Pteridium esculentum, Ottochloa gracillima, Oplismenus imbecillis, Entolasia marginata, Lomandra longifolia* and *Paspalum mandiocanum*
Mean native richness	40
Exotic species / HTW cover	*Ageratina adenophora, Cinnamomum camphora, Lantana camara, Senna septemtrionalis, Paspalum mandiocanum* / 35%
Condition	Low
Variation and disturbance	Areas previously cleared with degraded regrowth. The upper canopy cover is present but often sparse and mature Camphor laurels are likely to occur. Midstorey and ground cover is variable in this zone ranging from very sparse midstorey and exotic groundcover, to dense midstorey regrowth. This zone also includes some small patches of regrowth with exotic grass groundcover in otherwise cleared areas.
% cleared in NSW	Not listed
No. sites sampled	3
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Marsdenia longiloba, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	Foraging for rainforest birds. Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and low occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
84.5	12	61.8	39.8

Table 14: Zone 5 PCT 827 Burnt condition

827 – Flooded Gum – Tallowwood – Brush Box most open forest of the coastal ranges of the North Coast (Burnt)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests
Conservation status	Not listed
	This community is the equivalent of 827 High but was burnt in an uncontrolled fire in 2019. The fire intensity was low-moderate which mostly affected the ground cover and mid-storey vegetation leaving the canopy intact. Similarly to 827 High, this community is characterised by an upper stratum of *Lophostemon confertus* (Brush Box) and various Eucalypts including *Eucalyptus grandis* (Flooded Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus microcorys* (Tallowwood). The mid-storey is made up of mesic species including *Endiandra globosa*, *Cryptocarya* spp., *Elaeocarpus* spp., *Polyscias elegans* and *Allocasuarina torulosa*. Some of these species occasionally occur as canopy trees. Small dead trees and shrubs are present in the mid-storey with many species responding to fire with basal coppicing. The ground layer is variable but generally has high cover of *Blechnum cartilagineum*, *Calochlaena dubia* and *Hypolepis muelleri,* with *Lomandra* spp. and *Oplismenus imbecillis* also common. Other herbs and grasses including *Aneilema acuminatum*, *Entolasia marginata* and *Pseuderanthemum variabile* show higher cover compared to 827 High presumably due to higher levels of light. The cover and abundance of exotic species is also higher in 827 Burnt compared to 827 High. Climbers occurring include *Cissus* spp., *Dioscorea transversa*, *Geitonoplesium cymosum*, *Gynochthodes jasminoides* and *Smila*x spp.
Characteristic canopy trees	*Lophostemon confertus, Eucalyptus grandis, Syncarpia glomulifera, Eucalyptus microcorys*
Characteristic mid-storey	*Acmena smithii, Endiandra globosa, Archontophoenix cunninghamiana, Cryptocarya* spp., *Archirhodomyrtus beckleri, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Blechnum cartilagineum, Calochlaena dubia, Hypolepis muelleri, Lomandra* spp., *Oplismenus imbecillis, Aneilema acuminatum, Pseuderanthemum variabile*
Mean native richness	49
Exotic species / HTW cover	*Ageratina riparia, Cinnamomum camphor, Crassocephalum crepidioides, Passiflora edulis, Phytolacca octandra, Senecio madagascariensis, Solanum mauritianum, Solanum nigrum, Sonchus oleraceus* / 2%
Condition	Burnt
Variation and disturbance	Burnt at low-moderate intensity. Evidence of historic logging.
% cleared in NSW	Not listed
No. sites sampled	3
Threatened flora species	*Endiandra muelleri* subsp*. bracteata, Marsdenia longiloba, Rhodamnia rubescens, Rhodomyrtus psidioides*
Fauna habitats	Potential for small hollow bearing trees. Presence of koala feed trees (*E. microcorys, E. propinqua, E. grandis*) and occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Several similar PCTs occur in the region (826, 1073, 1285, 1569) but contain less Eucalypt diversity in the canopy. 827 was chosen to reflect the variety of Eucalyptus species making up the canopy across the development area.

Composition	Structure	Function	Vegetation Integrity Score
95.8	17.3	63.8	47.3

Table 15: Zone 6 PCT1073 Moderate condition

1073 - Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion (Mod)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	Not listed
	This community is characterised by an upper stratum of Eucalypts including *Corymbia intermedia* (Pink Bloodwood), *Eucalyptus microcorys* (Tallowwood), *E. propinqua* (Grey Gum), *E. robusta* (Swamp Mahogany) and *Syncarpia glomulifera* (Turpentine). Occurrence of *Lophostemon confertus* (Brush Box) and *E. grandis* (Flooded Gum) is lower than PCT 827. The mid-storey cover is low with some regrowth occurring including *Glochidion ferdinandi*, *Acacia* spp., *Melia azedarach*, *Jagera pseudorhus* and *Alphitonia excelsa*. The ground layer is a combination of native and exotic grasses with some herbaceous species. Grasses include *Ottochloa gracillima*, *Entolasia marginata*, *Imperata cylindrica*, *Paspalum mandiocanum*, *Cymbopogon refractus*, *Andropogon virginicus* and *Setaria sphacelata*.
Characteristic canopy trees	*Corymbia intermedia, Eucalyptus microcorys, E. propinqua, E. robusta, Syncarpia Glomulifera*
Characteristic mid-storey	*Acmena smithii, Mallotus philippinensis, Guioa semiglauca, Schizomeria ovata, Polyscias elegans, Alphitonia excelsa, Allocasuarina torulosa*
Characteristic groundcovers	*Ottochloa gracillima, Entolasia marginata, Imperata cylindrica, Cymbopogon refractus*
Mean native richness	36
Exotic species / HTW cover	*Lantana camara, Paspalum mandiocanum, Andropogon virginicus, Setaria sphacelata* / 33.2%
Condition	Moderate
Variation and disturbance	Areas previously cleared with low mid-storey cover likely due to periodic slashing. The upper canopy trees are well developed.
% cleared in NSW	0.4
No. sites sampled	2
Threatened flora species	
Fauna habitats	Potential for small hollows. Presence of koala feed trees (*E. microcorys, E. propinqua*) and potential occurrence of *Allocasuarina torulosa* for Glossy Black-cockatoo.
Justification	Similar PCTs occur in the region (827, 826 1285, 1569) however, 1073 best reflects the dominant Eucalypt species in this community and absence of *Eucalyptus grandis* and *Lophostemon confertus*.

Composition	Structure	Function	Vegetation Integrity Score
65	16.2	53.6	38.4

Table 16:Zone 7 PCT1302 High condition

1302 – White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (High)			
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest		
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions		
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia		
	This community occurs in gullies, forming in a narrow band along streams where there is an accumulation of alluvial material. This community is characterised by an upper stratum dominated by *Archontophoenix cunninghamiana* (Bangalow Palm) with occasional emergent including *Lophostemon confertus* (Brush Box) and *Endiandra globosa* (Black Walnut), particularly on the sloping community ecotone. The mid-storey cover is generally low in wet areas or moderate in slightly elevated areas and includes *Acmena smithii, Cryptocarya* spp., *Neolitsea dealbata, Ceratopetalum apetalum, Schizomeria ovata* and *Backhousia myrtifolia*. These species may occasionally form the upper strata in low amounts. The ground layer cover is generally low but may comprise of ferns and grasslike plants including *Blechnum cartilagineum, Adiantum formosum*, and *Lomandra* spp. Climbers include *Cissus hypoglauca*, *Calamus muelleri* and *Flagellaria indica*.		
Characteristic canopy trees	*Archontophoenix cunninghamiana, Endiandra globosa, Lophostemon confertus*		
Characteristic mid-storey	*Acmena smithii, Cryptocarya* spp., *Neolitsea dealbata, Ceratopetalum apetalum, Schizomeria ovata, Backhousia myrtifolia, Sloanea australis, Cissus hypoglauca, Calamus muelleri, Linospadix monostachyos, Flagellaria indica*		
Characteristic groundcovers	*Blechnum cartilagineum, Adiantum formosum, Lomandra* spp.		
Mean native richness	44		
Exotic species / HTW cover	0%		
Condition	High		
Variation and disturbance	Small amount of historic disturbance from logging, and natural disturbance related to high stream flow events. Canopy of Bangalow Palm consistent across all sites.		
% cleared in NSW	0.75		
No. sites sampled	4		
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Corokia whiteana, Rhodomyrtus psidioides, Rhodamnia rubescens*, *Endiandra hayesii*		
Fauna habitats	High cover and foraging resources for rainforest birds and amphibian habitat		
Justification	This community is likely to be different in structure and floristic composition to the type location for 1302, however 1302 is the best fit for *Archontophoenix cunninghamiana* as a dominant canopy tree. Other PCTs with a similar floristic composition include 770 and 1201, but lack *A. cunninghamiana* as a dominant species.		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
80.6	26.1	70.4	52.9

Table 17: Zone 8 PCT1302 Moderate condition

1302 – White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (Moderate)	
Vegetation formation/class/structure	Wet Sclerophyll Forests (Shrubby sub-formation)/North Coast Wet Sclerophyll Forests/Forest
Conservation status	NSW BC Act EEC: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	EPBC Act CEEC: Lowland Rainforest of Subtropical Australia
	This community occurs in the southern portion of the dam along watercourses in sheltered positions where there is a history of disturbance. The floristic composition of this community is variable, but sites are linked by the early succession stage of regrowth in comparison to well-developed rainforest in other vegetation zones in the study area. The upper stratum may comprise of *Endiandra globosa* (Black Walnut), *Tristaniopsis laurina* (Water Gum), *Backhousia myrtifolia* (Grey Myrtle), *Lophostemon confertus* (Brush Box) and *Pseudoweinmannia lachnocarpa* (Rose Marara). The mid-storey is made up by various mesic species including *Guioa semiglauca, Backhousia myrtifolia, Wilkiea huegeliana, Ficus coronata, Archidendron grandiflorum, Elaeocarpus obovatus, Neolitsea dealbata, Aphananthe philippinensis, Acmena smithii* and *Elattostachys nervosa*. The ground layer cover is dominated by ferns and herbaceous species including *Adiantum hispidulum, Hypolepis glandulifera, Aneilema acuminatum* and *Calochlaena dubia*. Climbers include *Calamus muelleri, Austrocallerya australis, Cissus* spp., *Maclura cochinchinensis* and *Trophis scandens*.
Characteristic canopy trees	*Endiandra globosa, Tristaniopsis laurina, Backhousia myrtifolia, Lophostemon confertus, Pseudoweinmannia lachnocarpa*
Characteristic mid-storey	*Guioa semiglauca, Backhousia myrtifolia, Wilkiea huegeliana, Ficus coronata, Archidendron grandiflorum, Elaeocarpus obovatus, Neolitsea dealbata, Aphananthe philippinensis, Acmena smithii, Elattostachys nervosa*
Characteristic groundcovers	*Adiantum hispidulum, Hypolepis glandulifera, Aneilema acuminatum, Calochlaena dubia*
Mean native richness	42
Exotic species / HTW cover	*Ardisia crenata, Ageratina* spp., *Anredera cordifolia, Cinnamomum camphora, Lantana camara, Passiflora edulis, Tradescantia fluminensis* / 10.8%
Condition	Moderate
Variation and disturbance	Areas likely previously partially or entirely cleared, with early succession regrowth. These is some variation in floristic composition in this zone which is likely related to disturbance history and environmental conditions.
% cleared in NSW	0.75
No. sites sampled	2
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Rhodomyrtus psidioides, Rhodamnia rubescens*
Fauna habitats	High cover and foraging resources for rainforest birds and amphibian habitat in streams
Justification	This community is likely to be different in structure and floristic composition to the type location for 1302, however 1302 is the best fit for closed forests in various stages of regeneration with various dominant species. Other PCTs with a similar floristic composition include 770 and 1201

Composition	Structure	Function	Vegetation Integrity Score
78.6	12.9	51.4	37.4

Table 18: Cleared land – *Eucalyptus dunnii* plantation

***Eucalyptus dunnii* (Dunn's white gum) plantation**			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community contains planted *Eucalyptus dunnii* (Dunn's white gum). The plantation appears to be partially harvested or thinned. The mid-storey cover is low with small amounts of scattered regrowth occurring including *Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri* and *Maclura cochinchinensis*. Exotic species make up a high proportion of the mid-storey including *Lantana camara, Cinnamomum camphor, Citrus* x *taitensis* and *Sida rhombifolia*. The ground layer cover is dominated by exotic grasses including *Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata* and *Axonopus compressus* with native grasses and herbaceous species detected at low levels including *Oplismenus aemulus* and *Lobelia purpurascens*.		
Characteristic canopy trees	*Eucalyptus dunnii*		
Characteristic mid-storey	*Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri, Maclura cochinchinensis, Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia*		
Characteristic groundcovers	*Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus, Oplismenus aemulus, Lobelia purpurascens*		
Mean native richness	15		
Exotic species / HTW cover	*Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia, Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus* / 32.6%		
Condition	Low		
Variation and disturbance	Areas previously cleared, converted to pasture and planted with *E. dunnii*. Degraded mid-storey regrowth likely due to periodic slashing		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	*Endiandra muelleri* subsp. *bracteata, Rhodamnia rubescens*		
Fauna habitats	Low potential for hollow-bearing trees, variable cover		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Table 19: Cleared land - *Araucaria cunninghamii* plantation

***Araucaria cunninghamii* (Hoop pine) plantation**			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community contains planted *Araucaria cunninghamii* (Hoop pine). The mid-storey cover is very low with minimal regrowth occurring from species including *Acacia melanoxylon*, *Ficus fraseri, Maclura cochinchinensis* and *Parsonsia straminea*. The ground layer cover is dominated by exotic grasses including *Paspalum mandiocanum*, *Sporobolus africanus*, *Setaria sphacelata* and *Axonopus compressus* with native grasses and herbaceous species detected at low levels including *Oplismenus aemulus* and *Lobelia purpurascens*.		
Characteristic canopy trees	*Eucalyptus dunnii*		
Characteristic mid-storey	*Guioa semiglauca, Trema tomentosa, Acacia melanoxylon, Ficus fraseri, Maclura cochinchinensis, Lantana camara, Cinnamomum camphor, Sida rhombifolia*		
Characteristic groundcovers	*Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus, Oplismenus aemulus, Lobelia purpurascens*		
Mean native richness	25		
Exotic species / HTW cover	*Lantana camara, Cinnamomum camphor, Citrus* x *taitensis, Sida rhombifolia, Paspalum mandiocanum, Sporobolus africanus, Setaria sphacelata, Axonopus compressus* / 4.1%		
Condition	Low		
Variation and disturbance	Areas previously cleared and planted with *Araucaria cunninghamii*, mid-storey and ground cover regrowth largely supressed		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	*Rhodamnia rubescens*		
Fauna habitats	High canopy cover, limited foraging resources		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Table 20: Cleared land – exotic pastures

Exotic pastures			
Vegetation formation/class/structure	Not applicable		
Conservation status	Not listed		
	This community occurs around the southern end of the dam and is dominated by exotic grasses and herbs which are maintained with regular slashing including *Axonopus compressus* (Broad-leaved Carpet Grass), *Pennisetum clandestina* (Kikuyu) and *Paspalum mandiocanum* (Broad-leaved Paspalum). Some native ground covers such as *Cynodon dactylon* (Couch) and *Centella asiatica* (Indian Pennywort) may occasionally occur. Cleared areas are generally paddocks managed for agriculture or parklands at Cram's Farm Reserve. While the community is characterised as a treeless community, isolated paddock trees occur sporadically in some areas which range from mature Eucalypts to small isolated patches of *Acacia melanoxylon* (Blackwood).		
Characteristic canopy trees	Predominately treeless with occasional isolated paddock trees and very small patches of regrowth, usually Eucalyptus spp. and Acacia spp.		
Characteristic mid-storey	absent		
Characteristic groundcovers	*Axonopus compressus, Pennisetum clandestina, Paspalum mandiocanum, Paspalum dilatatum, Digitaria* spp., *Cynodon dactylon, Cyperus* spp.		
Mean native richness	5		
Exotic species / HTW cover	*Axonopus compressus, Pennisetum clandestina, Paspalum mandiocanum, Paspalum dilatatum, Senecio jacobaea* / 32.6%		
Condition	Low		
Variation and disturbance	Areas previously cleared and sown with exotic pasture species and regularly slashed		
% cleared in NSW	n/a		
No. sites sampled	2		
Threatened flora species	n/a		
Fauna habitats	Limited habitat opportunities		
Similar PCTs	n/a		
Composition	**Structure**	**Function**	**Vegetation Integrity Score**
n/a	n/a	n/a	n/a

Appendix D Plant Community Type mapping

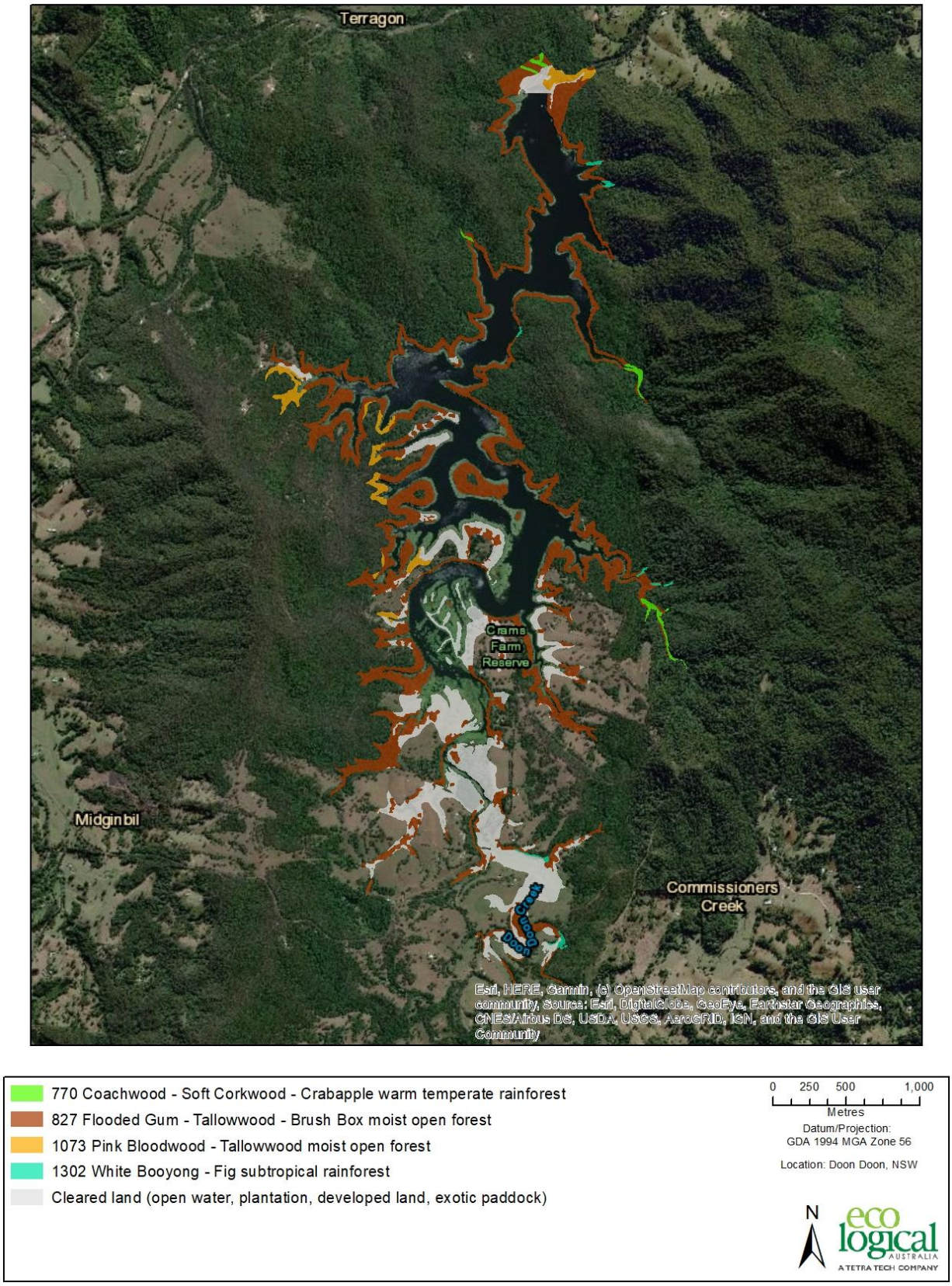


Figure 12 Plant community types

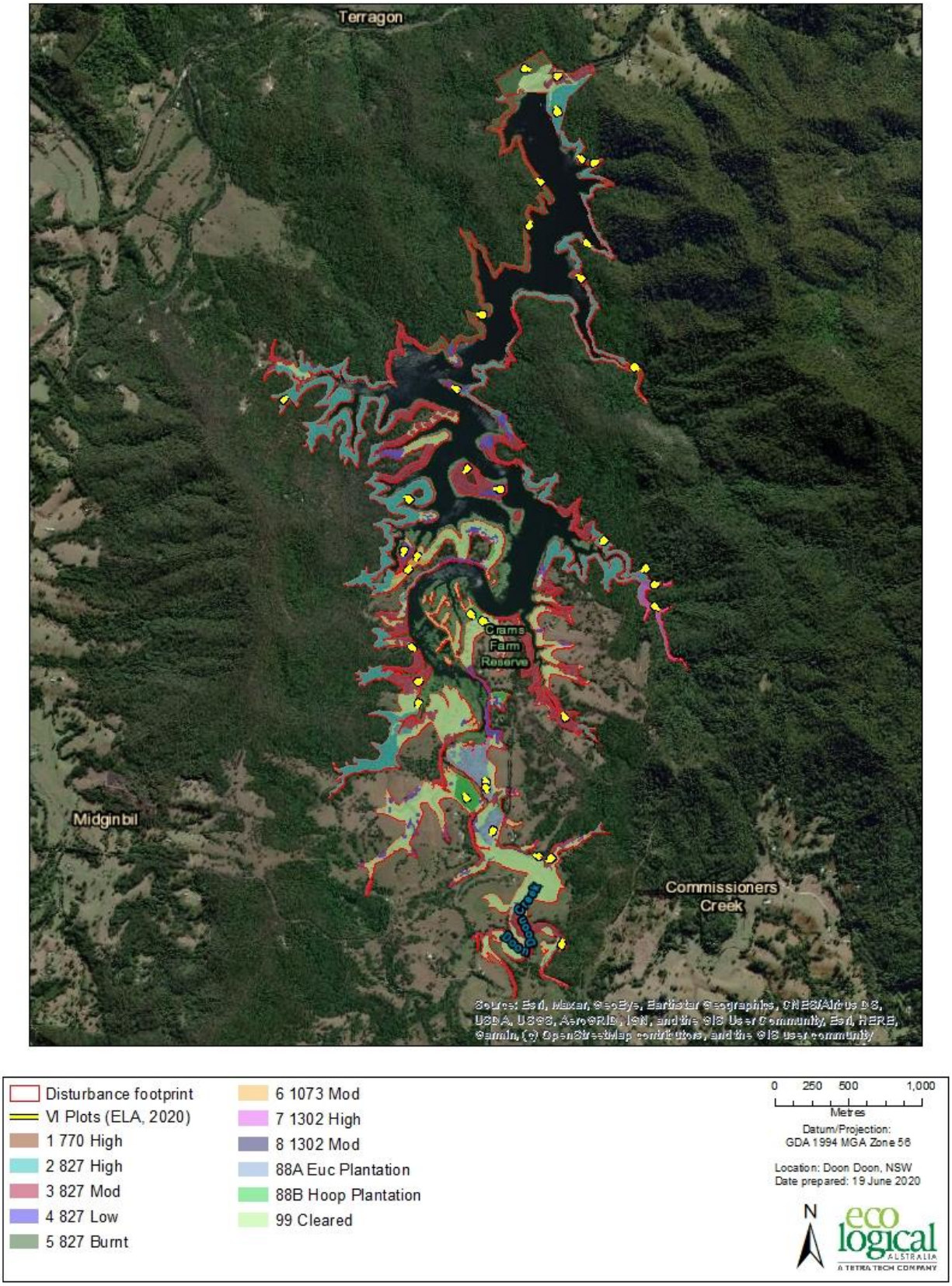


Figure 13 Vegetation zones and survey effort

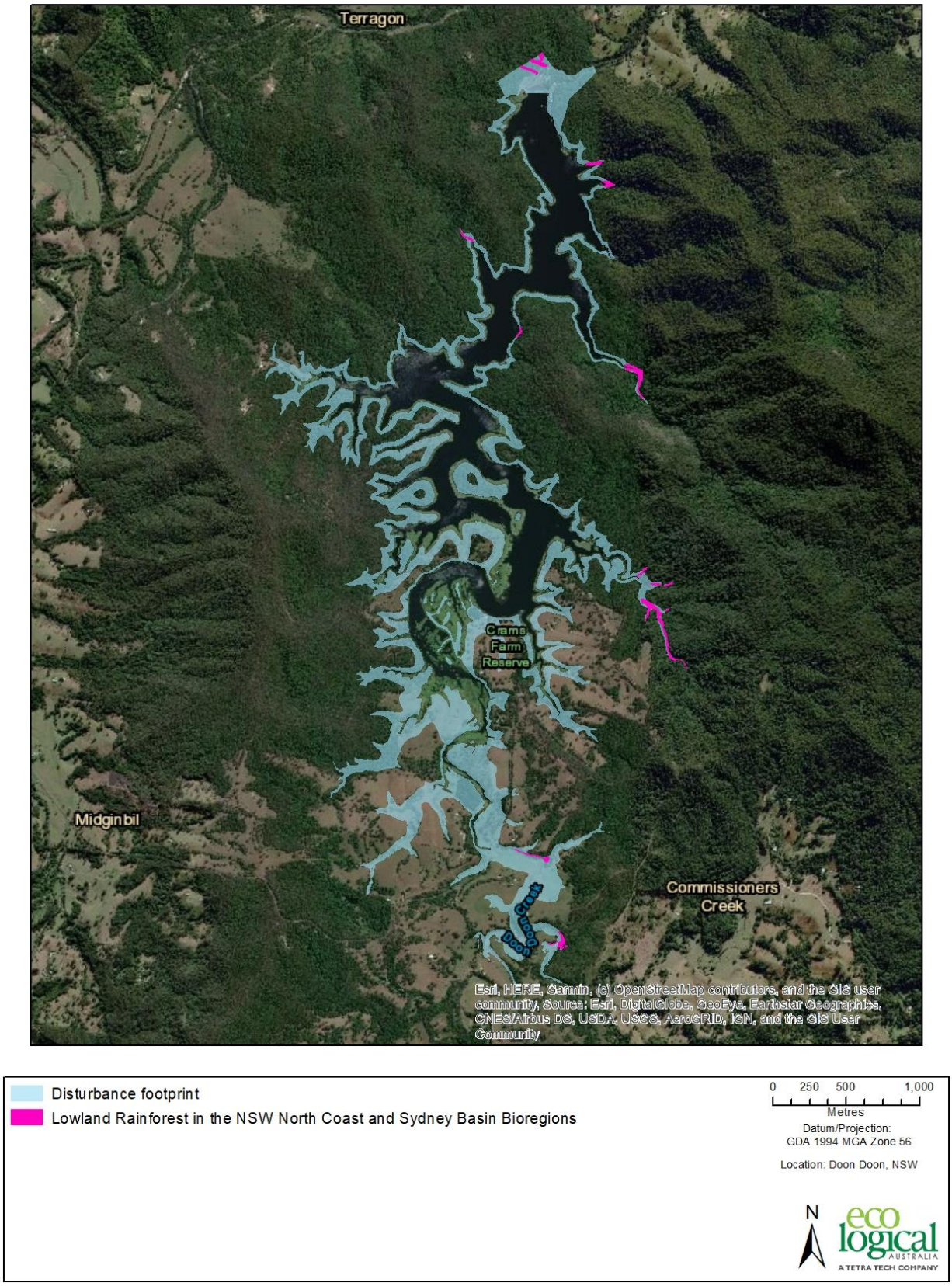


Figure 14 Threatened Ecological Communities

Appendix E Floristic Data

| Family | Species | Common Name | Listing Status | ROTAP | Exotic | High Threat Weed | Growth Form Group | Plot 1 | | | Plot 2 | | | Plot 3 | | | Plot 4 | | | Plot 5 | | | Plot 6 | | | Plot 7 | | | Plot 8 | | | Plot 9 | | | Plot 10 | | | Plot 11 | | | Plot 12 | | | Plot 13 | | | Plot 14 | | | Plot 15 | | | Plot 16 | | | Plot 17 | | | Plot 18 | | | Plot 19 | | |
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Plot	PCT	Area	patchsize	conditionclass	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeSte m5to9	funTreeSte m10to19	funTreeSte m20to29	funTreeSte m30to49	funTreeSte m50to79	funTreeReg een	funHighThreatExotic
Plot 1	827	13.65	101	Burnt	56	530264	6853775	320	13	9	3	6	2	9	36.8	12.0	0.5	0.8	3.2	17.2	0	5	91	72	1	1	1	1	1	1	0.0
Plot 2	770	2.76	101	High	56	529922	6853637	236	20	12	2	4	5	17	35.2	5.9	0.2	0.6	2.7	8.7	0	2	70	95	1	1	1	1	1	1	0.2
Plot 3	827	66.6	101	High	56	530201	6853795	230	20	9	2	3	3	14	93.2	2.5	1.1	0.3	25.2	3.5	4	7	77.2	73	1	1	1	1	1	1	0.0
Plot 4	827	42.71	101	Mod	56	529922	6853637	300	18	15	5	4	6	11	55.3	2.5	0.7	0.6	0.9	5.4	0	4	56	36	1	1	1	1	0	1	16.1
Plot 5	827	66.6	101	High	56	530217	6853240	150	19	9	5	6	4	12	51.1	8.3	0.6	0.6	30.3	1.7	0	5	75.6	61	1	1	1	1	0	1	0.1
Plot 6	827	13.65	101	Burnt	56	529829	6853336	300	14	7	5	3	1	9	24.1	0.9	0.5	0.4	20.0	1.1	0	6	54	69	1	1	1	1	0	1	0.3
Plot 7	770	1.63	101	High	56	530541	6852394	110	16	8	2	4	8	16	24.7	1.7	0.4	0.5	1.2	54.3	1	12	50	51	1	1	1	1	1	1	0.0
Plot 8	827	13.65	101	Burnt	56	529524	6852743	220	17	13	5	9	4	19	14.2	2.0	0.8	1.3	15.4	3.2	0	4	35	96	1	1	1	1	0	1	5.0
Plot 9	827	12.05	101	Low	56	529354	6852231	240	15	10	5	2	2	9	15.3	1.3	0.6	0.2	10.1	16.0	0	0	58.8	230	1	1	1	1	1	1	45.2
Plot 10	827	42.71	101	Mod	56	529423	6851707	185	7	4	4	0	1	4	22.8	5.3	65.4	0.0	0.1	0.5	0	3	21	82	1	1	1	0	0	1	4.3
Plot 11	827	12.05	101	Low	56	529646	6851559	200	5	6	5	1	3	8	21.1	5.1	48.6	0.3	0.5	0.9	0	2	24	52	1	1	1	0	0	1	15.3
Plot 12	827	66.6	101	High	56	529025	6851480	260	12	13	4	4	4	13	23.2	1.6	8.5	0.5	5.5	18.1	0	5	69	38	1	1	1	1	1	1	8.4
Plot 13	827	12.05	101	Low	56	528984	6851154	175	15	7	6	3	3	15	3.2	0.9	25.5	0.4	0.5	2.0	0	9	68.8	62	1	0	1	1	0	1	43.2
Plot 14	1073	1.38	101	Mod	56	529077	6851116	180	5	8	11	1	1	4	24.3	0.9	23.1	0.2	0.2	0.4	2	5	8.6	28	1	1	1	1	1	1	25.8
Plot 15	1073	1.38	101	Mod	56	529006	6851001	25	9	8	10	6	1	8	26.9	1.1	16.7	4.5	0.1	0.8	0	6	28	26	1	1	1	1	1	1	40.6
Plot 16	0	4.66	101	88B Hoop Plant	56	529430	6850719	150	10	2	3	6	2	5	63.0	0.2	25.2	0.6	0.2	0.5	0	4	67	6	1	1	1	1	1	1	1.0
Plot 17	770	1.63	101	High	56	529795	6854421	90	15	16	4	7	3	15	67.6	7.1	5.3	1.4	5.0	33.7	0	6	35	132	1	1	1	1	0	1	0.0
Plot 18	827	42.71	101	Mod	56	530012	6854364	45	18	18	4	4	1	15	47.9	7.5	2.7	0.8	0.2	5.1	1	0	90.6	32	1	1	1	1	0	1	1.6
Plot 19	827	66.6	101	High	56	530031	6854114	330	15	15	4	4	4	7	38.5	18.9	0.6	0.9	15.4	21.3	1	2	94.6	28	1	1	1	1	1	1	0.1
Plot 20	1302	2.76	101	High	56	530678	6850769	90	13	8	4	1	3	13	50.2	6.4	0.6	0.1	0.6	34.7	1	0	72	22	1	1	1	1	1	1	0.0
Plot 21	1302	2.76	101	High	56	530672	6850906	220	14	10	2	4	5	13	39.4	21.1	0.3	0.4	0.7	43.0	2	0	82	61	1	1	1	1	1	1	0.0
Plot 22	1302	2.76	101	High	56	530635	6851029	220	11	11	1	3	4	13	7.1	3.0	0.2	0.3	0.4	65.2	2	0	98.2	31	1	1	1	1	0	1	0.0
Plot 23	827	66.6	101	High	56	530353	6851219	220	21	10	4	2	2	10	51.6	3.5	1.0	0.5	5.1	4.8	1	0	84	50	1	1	1	1	1	1	0.4
Plot 24	1302	0.87	101	Mod	56	530050	6848453	20	13	4	4	1	3	11	9.7	60.3	0.5	0.2	8.1	1.9	0	1	48	20	1	1	1	1	1	1	21.3
Plot 25	1302	0.87	101	Mod	56	529909	6849060	280	16	10	1	4	5	11	18.2	71.4	0.2	0.4	5.9	1.6	0	0	65	20	1	1	1	1	0	0	0.3
Plot 26	827	4.71	101	Mod	56	529991	6849060	30	12	7	5	5	4	9	25.2	55.8	1.6	0.5	5.4	2.6	0	0	58	8	1	1	1	1	0	1	6.0
Plot 27	0	68.81	101	99 Cleared	56	529510	6850668	100	0	0	2	1	0	0	0.0	0.0	75.0	0.1	0.0	0.0	0	0	10	0	0	0	0	0	0	0	25.0
Plot 28	827	66.6	101	High	56	528158	6852159	30	15	12	4	2	1	14	38.7	22.9	5.8	0.3	0.2	2.7	0	0	78	10	1	1	1	1	1	1	5.3
Plot 29	827	42.71	101	Mod	56	530081	6849997	310	16	10	2	4	3	17	29.2	66.0	0.2	0.7	0.3	5.2	3	1	97	22	1	1	1	1	0	1	0.2
Plot 30	0	7.9	101	88A Euc Plant	56	529592	6849249	200	6	2	1	4	0	0	20.9	0.3	0.1	0.5	0.0	0.0	0	0	12	18	1	1	1	1	1	1	93.3
Plot 31	827	42.71	101	Mod	56	529032	6850496	140	8	3	6	7	2	4	38.5	0.3	5.8	0.9	0.3	0.4	9	1	93	3	1	1	1	1	1	1	0.8
Plot 32	0	68.81	101	99 Cleared	56	529083	6850118	180	0	0	3	2	1	0	0.0	0.0	4.2	0.4	0.1	0.0	0	0	70	0	0	0	0	0	0	0	40.1
Plot 33	827	42.71	101	Mod	56	529067	6850243	25	5	0	5	2	1	3	21.2	0.0	20.8	0.2	0.2	0.3	2	2	90.6	0	2	2	2	2	2	1	25.4
Plot 34	0	4.66	101	88B Hoop Plant	56	529414	6849448	300	5	5	2	5	1	3	60.4	0.5	2.2	0.5	0.2	0.3	0	0	81	0	0	0	0	1	1	1	7.1
Plot 35	0	7.9	101	88A Euc Plant	56	529545	6849555	320	4	0	1	1	0	3	10.9	0.0	0.1	0.1	0.0	0.3	0	1	44	0	1	1	1	1	1	1	80.8
Plot 36	0	7.9	101	88A Euc Plant	56	529537	6849542	140	11	2	1	3	1	5	22.2	0.5	0.2	0.3	0.2	1.0	0	0	58	0	0	0	0	0	1	1	88.1

Appendix F Threatened flora survey strategy

Table 21 Threatened flora survey strategy

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acacia bakeri	Marblewood	Marblewood grows in or near lowland subtropical rainforest, in adjacent eucalypt forest and in regrowth of both.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Acalypha eremorum	Acalypha	Subtropical rainforest, dry rainforest and vine thickets.	YES	YES							YES	YES	YES	YES
Archidendron hendersonii	White Lace Flower	White Lace Flower occurs in riverine and lowland subtropical rainforest, littoral rainforest, coastal cypress pine forest and their ecotones. It is found on a variety of soils including coastal sands and those derived from basalt and metasediments.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Arthraxon hispidus	Hairy Jointgrass	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	YES	YES	YES	YES							YES	YES
Baloghia marmorata	Jointed Baloghia	In NSW, Jointed Baloghia is found in subtropical rainforest, notophyll vine forest and wet sclerophyll forest on soils derived from basalt. Found between 150m and 550m above sea level.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Belvisia mucronata	Needle-leaf Fern	Forms small clumps on trees or rocks in dry rainforest or along creeks in moist open forest. Occurs in low numbers at all sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bosistoa transversa	Yellow Satinheart	Three-leaved Bosistoa grows in wet sclerophyll forest, dry sclerophyll forest and rainforest including highly disturbed habitat up to 300 m in altitude.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Brachyscome ascendens	Border Ranges Daisy	Montane shrubland on clifftops and benches in thin, rocky soils of basaltic origin.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bulbophyllum globuliforme	Hoop Pine Orchid	Grows on Hoop Pines in upland subtropical rainforest. It is usually found on the upper trunk and branches of the Hoop Pines which protrude from the general rainforest canopy.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cassia marksiana	Cassia marksiana	Found in littoral and riverine rainforest, and in regrowth vegetation on farmland and along roadsides. It prefers more fertile soil-types and is often found in low and flat sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Choricarpia subargentea	Giant Ironwood	Giant Ironwood is found in dry rainforest regrowth consisting of thickets growing in steeply sloping paddocks on basalt-derived soil as well as in sub-tropical and warm temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Clematis fawcettii	Northern Clematis	Drier rainforest, usually near streams.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Coatesia paniculata	Axe-Breaker	Axe-Breaker is found in dry subtropical rainforest and vine scrub, often along rivers.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Corchorus cunninghamii	Native Jute	Occurs in ecotones between wet eucalypt forest and dry to dry-subtropical rainforest on sheltered slopes and gullies, and grassy, open forest on exposed slopes and ridges.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Corokia whiteana	Corokia	The inland populations are found at the boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cryptocarya foetida	Stinking Cryptocarya	Found in littoral, warm temperate and subtropical rainforest, wet sclerophyll forest and Camphor laural forest usually on sandy soils, but mature trees are also known on basalt soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cupaniopsis serrata	Smooth Tuckeroo	Rocky hillsides and subtropical and dry rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cynanchum elegans	White-flowered Wax Plant	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cyperus rupicola	Cliff Sedge	Cliff Sedge grows amongst rocks on the exposed tops of cliffs and on cliff faces or at the base of cliffs, near forest.	YES	YES	YES								YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cyperus semifertilis	Missionary Nutgrass	Occurs in open forest dominated by White Mahogany and wet sclerophyll forest with Sydney Blue Gum and Brush Box.	YES	YES									YES	YES
Davidsonia jerseyana	Davidson's Plum	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m).Many trees are isolated in paddocks and on roadsides in former rainforest habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Davidsonia johnsonii	Smooth Davidson's Plum	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m).Many trees are isolated in paddocks and on roadsides in cleared land.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Dendrocnide moroides	Gympie Stinger	Occurs in lowland rainforest, especially in gaps or other disturbed sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Desmodium acanthocladum	Thorny Pea	Dry rainforest and fringes of riverine subtropical rainforest. On basalt-derived soils at low elevations. Much of its habitat has been cleared for agriculture.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Diospyros mabacea	Red-fruited Ebony	Usually grows as an understorey tree in lowland subtropical rainforest, often close to rivers. Soils are generally basalt-derived or alluvial.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Diploglottis campbellii	Small-leaved Tamarind	Confined to the warm subtropical rainforests of the NSW-Queensland border lowlands and adjacent low ranges.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Doryanthes palmeri	Giant Spear Lily	Giant Spear Lily occurs on exposed rocky outcrops on infertile soils or on bare rock.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Drynaria rigidula	Basket Fern	Grows on plants, rocks or on the ground, Usually found in rainforest but also in moist eucalypt and Swamp Oak forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Eidothea hardeniana	Nightcap Oak	The species occurs in upland warm temperate rainforest, usually near creeks.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Elaeocarpus sedentarius	Minyon Quandong	Warm temperate or subtropical rainforest, and where rainforest and wet eucalypt forest meet. Often associated with Brush Box.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Elaeocarpus williamsianus	Hairy Quandong	Subtropical to warm temperate rainforest, including regrowth areas where it has apparently regrown from root suckers after clearing. Soils are derived from metasediments.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra floydii	Crystal Creek Walnut	Warm temperate, subtropical rainforest or wet sclerophyll forest with Brush Box overstorey, and in and Camphor Laurel forest. The species can occur in disturbed and regrowth sites.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra hayesii	Rusty Rose Walnut	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils. The species occurs in regrowth and highly modified forms of these habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Occurs in subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Euphrasia bella	Pretty Eyebright	On the edge of cliffs near cool temperate rainforest with Antarctic Beech .The environment is wet but well-drained.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Floydia praealta	Ball Nut	Riverine and subtropical rainforest, usually on soils derived from basalt.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Fontainea australis	Southern Fontainea	Southern Fontainea is found in lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest in the Nightcap Range.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Gossia fragrantissima	Sweet Myrtle	Dry subtropical and riverine rainforest. As it can coppice from roots left in the ground when rainforest is cleared, it	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		is found at several sites as isolated plants in paddocks or regrowth.												
Grammitis stenophylla	Narrow-leaf Finger Fern	Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Grevillea hilliana	White Yiel Yiel	White Yiel Yiel grows in subtropical rainforest, often on basalt-derived soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Hibbertia hexandra	Tree Guinea Flower	Tree Guinea Flower typically grows in heath, open forest or rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Hicksbeachia pinnatifolia	Red Boppel Nut	Subtropical rainforest, moist eucalypt forest and Brush Box forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Isoglossa eranthemoides	Isoglossa	Understorey of lowland subtropical rainforest, in moist situations on floodplains and slopes. Underlying soils are derived from basalt, metasediments or gabbro.									YES	YES	YES	
Lepiderema pulchella	Fine-leaved Tuckeroo	Lowland subtropical rainforest in NSW. Found on infertile metasediments, fertile basalts and backswamp alluvium in the Tweed Valley.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lindsaea brachypoda	Short-footed Screw Fern	Very moist habitats in subtropical or warm-temperate rainforest or palm forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Macadamia tetraphylla	Rough-shelled Bush Nut	Found in subtropical rainforest, usually near the coast.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Marsdenia longiloba	Slender Marsdenia	Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.	YES	YES									YES	YES
Melicope vitiflora	Coast Euodia	Coast Euodia grows in subtropical and littoral rainforest. All populations are thought to be small.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Myrsine richmondensis	Ripple-leaf Muttonwood	Subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil and alluvial deposits.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Flowers have been recorded in October and November, fruits have been observed from December to March.												
Niemeyera whitei	Rusty Plum, Plum Boxwood	Found in gully, warm temperate or littoral rainforests and the adjacent understorey of moist eucalypt forest. It occurs on poorer soils in areas below 600 metres above sea level.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Oberonia complanata	Yellow-flowered King of the Fairies	This species grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes (including stabilised sands), stream-side areas, swampy forests and mangroves.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ochrosia moorei	Southern Ochrosia	Southern Ochrosia is found in riverine and lowland subtropical rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Owenia cepiodora	Onion Cedar	Subtropical and dry rainforest on or near soils derived from basalt.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ozothamnus vagans	Wollumbin Dogwood	Mostly recorded from open situations on the margins of, or within, wet sclerophyll forest, subtropical rainforest and cool temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Peristeranthus hillii	Brown Fairy-chain Orchid	Restricted to coastal and near-coastal environments, particularly Littoral Rainforest and the threatened ecological community Lowland Rainforest on Floodplain.									YES	YES		
Phyllanthus microcladus	Brush Sauropus	Usually found on banks of creeks and rivers, in streamside rainforest or dry rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Plectranthus nitidus	Nightcap Plectranthus	Grows on rocky cliff-faces and boulders, in the shelter and shade provided by the adjacent rainforest and dry rainforest. Co-occurs with and Crofton Weed.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pomaderris notata	McPherson Range Pomaderris	McPherson Range Pomaderris is known from rocky basalt ranges in montane heaths and scrubs or in scrubby rainforest on valley floors.							YES	YES	YES	YES	YES	
Psilotum complanatum	Flat Fork Fern	Grows in moist tropical or subtropical rainforest, or moist eucalypt forest.		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Randia moorei	Spiny Gardenia	Spiny Gardenis occurs in subtropical, riverine, littoral and dry rainforest. In NSW, Hoop Pine and Brush Box are common canopy species.It is found along moist scrubby water courses at altitudes up to 360 m asl, with most records below 100 m asl.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhodamnia rubescens	Scrub Turpentine	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhodomyrtus psidioides	Native Guava	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Rhynchosia acuminatissima	Pointed Trefoil	Pointed Trefoil is found in or near dry rainforest dominated by Hoop Pine.	YES	YES							YES	YES	YES	YES
Sarcochilus dilatatus	Brown Butterfly Orchid	Grows on trees in littoral rainforest, subtropical rainforest, dry rainforest and streamside forests, mainly at low to medium (up to 500m) altitudes. Plants favour Hoop Pine as a host.	YES	YES	YES									YES
Sarcochilus fitzgeraldii	Ravine Orchid	The Ravine Orchid grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m. Occasional clumps are found on the bases of fibrous-barked trees.										YES	YES	YES
Sarcochilus weinthalii	Blotched Sarcochilus	Rainforest, wet schlerophyll, dry rainforest and drier scrubs, often in isolated patches, from 300 to 900 m in altitude.Can occur on Basalt-capped plateaus, shelves and escarpments.									YES	YES		
Senna acclinis	Rainforest Cassia	Grows on the margins of subtropical, littoral and dry rainforests.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Scientific Name	Common Name	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sophora fraseri	Brush Sophora	Brush Sophora is usually found in wet situations in wet sclerophyll forest or vine forest, often near rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Symplocos baeuerlenii	Small-leaved Hazelwood	Occurs in sub-tropical and warm temperate rainforest on less fertile soils derived from rhyolite.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Syzygium hodgkinsoniae	Red Lilly Pilly	Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Syzygium moorei	Durobby	Durobby is found in subtropical and riverine rainforest at low altitude. It often occurs as isolated remnant paddock trees.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Tinospora tinosporoides	Arrow-head Vine	Wetter subtropical rainforest, including littoral rainforest, on fertile, basalt-derived soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Uromyrtus australis	Peach Myrtle	Warm temperate rainforest on less fertile soils derived from rhyolite rock. Often associated with Coachwood	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Appendix G Threatened fauna survey strategy

Table 22 Threatened fauna survey strategy

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Amphibia	*Litoria brevipalmata*	Green-thighed Frog	Species	Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Staged assessment proposed as described in section 1.6.1
Amphibia	*Mixophyes fleayi*	Fleay's Barred Frog	Species	Rainforest and wet eucalypt forest of the escarpment and foothills, usually close to gravely streams. The species occurs along stream habitats from first to third order streams (i.e. small streams close to their origin through to permanent streams with grades of 1 in 50) but is not found in ponds or ephemeral pools.	YES	YES	YES						YES	YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	TSC survey OK – species not present
Amphibia	*Mixophyes iteratus*	Giant Barred Frog	Species	Giant Barred Frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats
Amphibia	*Philoria loveridgei*	Loveridge's Frog	Species	This frog is dependent on high moisture levels, occurring in the headwaters of small streams and about soaks where ground-water is continually present and close to the surface. It favours subtropical and warm temperate rainforest and wet eucalypt forest, but also occurs in moist eucalypt forest where rocky outcropping creates surface water.	YES									YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats
Amphibia	*Assa darlingtoni*	Pouched Frog	Species	Pouched frogs live in cool, moist rainforest, including Antarctic Beech, or moist eucalypt forest in mountainous areas, mostly above 800 m but have been found as low as 300m.They spend most of the time in damp leaf litter, or under rocks and rotten logs.	YES	YES	YES						YES	YES	YES	YES	Minimum survey requirement: Two 100m transects on two nights after sufficient rain. Survey undertaken: 61.95 person hours spotlighting at 32 sites, plus additional survey in two rainforest gullies.	Calculate credits in appropriate habitats

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	Species/ Ecosystem	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur.				YES	YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in summer and species identified onsite. 4 days survey conducted by ELA in July 2020 failed to confirm any breeding sites for the species.	Survey conducted in July by ELA inspecting all potential breeding trees. Only a single pair was identified, outside the inundation zone. Hollow-bearing trees within the disturbance footprint are unlikely to be breeding habitat for this species. No further survey proposed.
Aves	*Atrichornis rufescens*	Rufous Scrub-bird	Species	Rufous Scrub-birds are now confined to high-altitude (above 600m elevation) subtropical, warm temperate and cool temperate rainforests, and wet sclerophyll forests.	YES								YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period.	TSC survey OK - Species not present
Aves	*Carterornis leucotis*	White-eared Monarch	Species	In NSW, White-eared Monarchs occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: Species identified onsite by ELA in July 2020	Calculate credits in appropriate habitats
Aves	*Cyclopsitta diophthalma coxeni*	Coxen's Fig-Parrot	Species	Usually recorded from drier rainforests and adjacent wetter eucalypt forest but rarely seen due to its small size and cryptic habits. Also found in the wetter lowland rainforests that are now largely cleared in NSW.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 35.64 hrs total bird survey	TSC survey OK - Species not present
Aves	*Dasyornis brachypterus*	Eastern Bristlebird	Species	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	YES	YES	YES	YES	YES				YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33.33 hrs bird survey in survey period	TSC survey OK - Species not present
Aves	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Species/ Ecosystem	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.							YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: One eyie identified onsite and in-use in July 2020.	Calculate credits for breedong habitat
Aves	*Hieraaetus morphnoides*	Little Eagle	Species/ Ecosystem	Occupies open eucalypt forest, woodland or open woodland.								YES	YES	YES			Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Lophoictinia isura*	Square-tailed Kite	Species/ Ecosystem	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	YES								YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	TSC survey OK - Species not present
Aves	*Menura alberti*	Albert's Lyrebird	Species	Mainly occur in the wettest rainforests or wet sclerophyll forests with a wet understorey, often of rainforest plants. Higher densities of Albert's Lyrebirds occur in association with a canopy of eucalypts compared with rainforest lacking eucalypts (for equivalent climate), and in wet sclerophyll forest with greater weights of litter and logs and slower rates of litter decomposition.						YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 33 hrs bird survey in survey period	Calculate credits in appropriate habitats
Aves	*Turnix melanogaster*	Black-breasted Button-quail	Species	Preferred habitat includes drier low closed forests, including dry rainforests, vine forest and vine thickets, often in association with Hoop Pine, and Bottletree scrubs. have long been unclear, having been placed variously in their own order, or with the Galliformes or Gruiformes. Recent studies have shown that the button-quails are actually related to the gulls and terns and their relatives (Charadriiformes).	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 35.64 hrs total bird survey	TSC survey OK - Species not present
Aves	*Ninox connivens*	Barking Owl	Species/ Ecosystem	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland.		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species not identified onsite. No further survey proposed.	TSC survey OK - Species not present
Aves	*Ninox strenua*	Powerful Owl	Species/ Ecosystem	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.		YES	YES	YES	YES								Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species not identified onsite. No further survey proposed.	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Aves	*Tyto novaehollandiae*	Masked Owl	Species/ Ecosystem	Lives in dry eucalypt forests and woodlands from sea level to 1100 m.					YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species identified onsite by TSC. Species not identified during breeding season and unlikely to be utilising hollow-bearing trees within disturbance footprint. No further survey proposed.	Survey OK - Species known from site but breeding habitat not present. No further assessment required.
Aves	*Tyto tenebricosa*	Sooty Owl	Species/ Ecosystem	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.					YES	YES	YES	YES					Minimum survey requirement: A 1ha diurnal bird survey repeated for every 100 ha replicate unit. Survey undertaken: 16 sites spotlighting and call playback in July 2020 by ELA supplements existing 32 site survey effort by TSC. Species identified onsite by TSC. Species identified at numerous sites during breeding season, however no pairs duetting unlikely to be utilising hollow-bearing trees within disturbance footprint. No further survey proposed.	Survey OK - Species known from site but breeding habitat not present. No further assessment required.
Mammalia - bats	*Chalinolobus dwyeri*	Large-eared Pied Bat	Species	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin, frequenting low to mid-elevation dry open forest and woodland close to these features.	YES										YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Miniopterus australis*	Little Bent-winged Bat	Species/ Ecosystem	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Only five nursery sites /maternity colonies are known in Australia.	YES	YES										YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Miniopterus orianae oceanensis*	Eastern Bentwing-bat	Species/ Ecosystem	Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	YES	YES										YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Mammalia - bats	*Vespadelus troughtoni*	Eastern Cave Bat	Species	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	YES										YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around cliffline and cave habitats Survey undertaken: 3 harp trap 14 ANABAT nights	No cave or cliff habitats within 2km of site. No further survey proposed.
Mammalia - bats	*Myotis macropus*	Southern Myotis	Species	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 16 harp trap nights and 16 ANABAT nights for every 50ha habitat around waterbodies and forest habitats Survey undertaken: 3 harp trap 14 ANABAT nights	Calculate credits in appropriate habitats
Mammalia - bats	*Pteropus poliocephalus*	Grey-headed Flying-fox	Species/ Ecosystem	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.										YES	YES	YES	Minimum survey requirement: Searches for camps Survey undertaken: 32 sites habitat assessment 61.95 hours spotlighting	Survey OK - breeding habitat not present
Mammalia - arboreal and terrestrial	*Cercartetus nanus*	Eastern Pygmy-possum	Species	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha 100 elliot trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights 1600 elliot trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and terrestrial	*Macropus parma*	Parma Wallaby	Species	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: None specified Survey undertaken: 80 cage trap nights 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and	*Petaurus norfolcensis*	Squirrel Glider	Species	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: None specified Survey undertaken: 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Mammalia - arboreal and terrestrial	*Phascolarctos cinereus*	Koala	Species/ Ecosystem	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	<u>Minimum survey requirement</u>: SAT surveys Camera traps spotlighting Call playback <u>Survey undertaken:</u> 45.64 person hours SAT at 32 sites 896 camera trap nights Spotlighting at 32 sites	Calculate credits - Request 'Important habitat' criteria
Mammalia - arboreal and terrestrial	*Planigale maculata*	Common Planigale	Species	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	<u>Minimum survey requirement:</u> 24 pitfall trap nights per 100 ha 100 elliot trap nights per 100 ha spotlighting <u>Survey undertaken:</u> 400 pitfall trap nights 1600 elliot trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Mammalia - arboreal and terrestrial	*Antechinus arktos*	Black-tailed Antechinus	Species	The species is found in cool subtropical cloud forest / rainforest comprising complex notophyll vine forest and simple microphyll fern forest featuring a low canopy, very dense vines and a rocky substrate.							YES	YES					n/a	Site not suitable. Species removed from assessment
Mammalia - arboreal and terrestrial	*Phascogale tapoatafa*	Brush-tailed Phascogale	Species	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west ot the divide.	YES	YES	YES	YES	YES	YES						YES	<u>Minimum survey requirement</u>: 10 camera traps per ha in suitable habitats. DPIE request plot data and habitat mapping to formalise approach (provided in this letter) <u>Survey undertaken:</u> 896 camera trap nights Spotlighting at 32 sites	Spotlighting survey appropriate for this species. Habitats not suitable. No further survey required.
Mammalia - arboreal and terrestrial	*Aepyprymnus rufescens*	Rufous Bettong	Species	Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	<u>Minimum survey requirement</u>: None specified <u>Survey undertaken:</u> 80 cage trap nights 896 camera trap nights Spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Cacophis harriettae*	White-crowned Snake	Species	Favours low to mid-elevation dry eucalypt forest and woodland, particularly areas with a varied and well-developed litter layer, where their prey of small lizards may be more abundant.	YES	YES	YES	YES					YES	YES	YES	YES	<u>Minimum survey requirement:</u> 24 pitfall trap nights per 100 ha spotlighting <u>Survey undertaken:</u> 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present

Class	*Scientific Name*	Common Name	Credit type	Habitat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Surveys undertaken by Council based on scanned datasheets & reports	Surveys strategy
Reptilia	*Coeranoscincus reticulatus*	Three-toed Snake-tooth Skink	Species	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	YES	YES	YES	YES					YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Hoplocephalus bitorquatus*	Pale-headed Snake	Species	The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest.	YES	YES	YES								YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK - Species not present
Reptilia	*Hoplocephalus stephensii*	Stephens' Banded Snake	Species	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Stephens' Banded Snake is nocturnal, and shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day.	YES	YES	YES							YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	Calculate credits in appropriate habitats
Invertebrates	*Nurus atlas*	Atlas Rainforest Ground-beetle	Species	Low-elevation rainforest and wet eucalypt forest with a well-developed rainforest understorey.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment
Invertebrates	*Nurus brevis*	Shorter Rainforest Ground-beetle	Species	Subtropical and warm temperate rainforest.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment
Invertebrates	*Phyllodes imperialis* southern subspecies	Southern Pink Underwing Moth	Species	The Southern Pink Underwing Moth is found in subtropical rainforest below about 600 m elevation.Potential breeding habitat is restricted to areas where the caterpillar's food plant, a native rainforest vine, Carronia multisepalea, occurs in subtropical rainforest.	YES	YES								YES	YES	YES	No survey requirement published	Conduct survey of host plant concurrently with flora surveys
Invertebrates	*Thersites mitchellae*	Mitchell's Rainforest Snail	Species	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Minimum survey requirement: 24 pitfall trap nights per 100 ha spotlighting Survey undertaken: 400 pitfall trap nights spotlighting at 32 sites	TSC survey OK & site not suitable. Species to be removed from assessment

A.2 Letter from Dimitri Young to Alex Purshe, September 2020

Our Ref: DOC20/725252
Your Ref: 18011550

Ecological Australia
19 Bolton Street
Newcastle NSW 2300

Attention: Mr Alex Pursche

Dear Mr Pursche

RE: Clarrie Hall Dam Raising – Request for Confirmation of BAM Survey Approach

Thank you for your e-mail dated 3 September 2020 about the Clarrie Hall Dam Raising project seeking comments from the Biodiversity and Conservation Division (BCD) of the Environment, Energy and Science Group in the Department of Planning, Industry and Environment on the Biodiversity Assessment Method (BAM) survey approach. I appreciate the opportunity to provide input.

We have reviewed the gap analysis prepared by Ecological Australia (ELA) which was attached to your e-mail. The gap analysis outlines the proposed survey strategy to address the BAM and seeks confirmation from the BCD on the final survey approach.

We have addressed your specific requests below:

- *DPIE Action 1: We request DPIE approve the threatened flora survey strategy detailed in Section 4.3 of this letter.*

  We have reviewed section 4.3 and agree with the proposed approach.

- *DPIE Action 2: We request DPIE approve the proposed amphibian sub-sampling approach based on stratified habitats across the site, conducting up to two (2) nights at two (2) sites within each stream type identified in Table 7 of this letter.*

  We have reviewed the proposed amphibian sub-sampling approach and agree with the proposed approach.

- *DPIE Action 3: We request DPIE approve the survey effort and habitat assessment approach for Glossy Black-cockatoo and forest owls described in Section 4.4.2 of this letter, and that no further assessment is required.*

  For glossy black-cockatoo, I understand that the species was identified on numerous occasions in March 2020 across the disturbance area. The Threatened Species Profile Database provides a four-step process to identify breeding habitat.

The information provided indicates that ELA conducted an inspection of all hollow-bearing trees within the disturbance footprint during the breeding season, to consider whether any of these trees were currently in use.

ELA then concluded that, '*In the absence of any formal guidelines on the occupancy of the species, and given the lack of individuals identified (only one pair), it is unlikely that more than one of the hollow-bearing trees are used for breeding'*.

It is not clear whether the four-step process of identifying breeding habitat for this species has been completed or not, as the above statement is not definitive.

Step three of that process requires that any identified potential hollows are monitored during the breeding season to determine if breeding is occurring on the site.

Either the required monitoring has occurred, and a conclusion can be made, or further survey work may be required. Further clarification will be required in the preparation of the Biodiversity Development Assessment Report (BDAR).

In relation to the forest owls, we note the field work undertaken to date and agree no further survey work is required. However adequate justification will need to be provided in the BDAR that survey work has been undertaken to establish breeding habitat on site.

- *DPIE Action 4: We request DPIE approve the bat assessment approach described in Section 4.4.3 of this letter, and that no further field studies are required.*

  The *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH, 2018) is currently being updated.

  However, we note that the ELA proposal is to not undertake any bat surveys as the *Myotis macropus* is already known from the site and the habitat for the other four candidate microchiropteran bats is not considered to be present.

  We do not support ruling out the four candidate microchiropteran bats based on habitat. Surveys will need to be undertaken in accordance with the survey guidelines to verify the absence/presence of the candidate species.

  Please note that in accordance with section 6.4 of the BAM, a species polygon will need to be provided for all confirmed species credit species.

  We are happy to liaise with ELA to ensure the survey requirements and species polygons adequately reflect the BAM and the soon-to-be updated guideline.

- *DPIE Action 5: We request DPIE provide additional guidance on 'important habitat' for Koala.*

  Please note that while koalas are currently listed as a dual credit species in the Threatened Biodiversity Data Collection (TBDC), they should be treated as a species credit species. Potential koala habitat is any vegetation community that contains one or more koala feed/use trees. Please refer to the list of koala feed/use trees in the *State Environmental Planning Policy (Koala Habitat Protection) 2019* and *A review of koala tree use across New South Wales* (OEH, 2018).

  The presence/absence of koalas is required to be confirmed within the potential koala habitat on the subject land through targeted survey and the level of survey effort justified in the BDAR. Please note that scratch marks are not considered to be reliable indicators of koala presence.

The koala species polygon should be mapped to the extent of the Plant Community Type (PCT) (containing one or more koala use/fee trees, as detailed above) in which presence was confirmed. Connectivity between PCTs with confirmed koala presence must be considered in the overall extent of the species polygon, with justification for the decisions provided in the BDAR. Please note, we are currently developing a BAM survey guide for the koala and as such this advice may change. We would be pleased to discuss this further before the BDAR is finalised or if you require further guidance specific to this site.

- *DPIE Action 6: Confirmation of no further survey required for Brush-tailed Phascogale based on previous survey effort conducted by TSC, and lack of existing suitable habitats.*

  We have reviewed the information provided and agree that enough survey work has been completed for the brush-tailed phascogale.

- *DPIE Action 7: We request DPIE confirm no further reptile surveys required based on previous survey effort conducted by TSC*

  We have reviewed the information provided and agree that enough survey work has been completed for reptiles.

If you have any questions about this advice, please do not hesitate to contact Mr Krister Waern, Senior Operations Officer, at krister.waern@environment.nsw.gov.au or 6640 2503.

Yours sincerely

29 September 2020

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

A.3 Letter from Dimitri Young to David Hannah, October 2022

Department of Planning and Environment

Your ref: e-mail dated 19/09/2022
Our ref: DOC22/836865-2

General Manager
Tweed Shire Council
PO Box 816
MURWILLUMBAH NSW 2484

Attention: Mr David Hannah

Dear Mr Green

RE: Extension of time regarding the request for the use of species survey data collected in 2016 for Clarrie Hall Dam Raising - SSI9458

Thank you for your e-mail dated 19 September 2022 to the Biodiversity and Conservation Division (BCD) of the Environment and Heritage Group in the Department of Planning and Environment requesting an extension of time for the Tweed Shire Council to use species survey data collected in 2016 for the Clarrie Hall Dam Raising Project's Biodiversity Development Assessment Report (BDAR). I appreciate the opportunity to provide further input and apologise for the delay in responding

This advice should be read in conjunction with the BCD's letter dated 19 September 2022 (DOC22/670325-2), where we concluded it was acceptable in this instance for fauna species survey data collected during 2016/17, and supplemented with further surveys in 2020/21, to be incorporated into a BDAR to be submitted in 2022.

We note from your e-mail dated that the consultant engaged to prepare the Environmental Impact Statement (EIS) for the Clarrie Hall Dam Raising Project was terminated, and that the council is in the process of shortlisting and engaging new consultants to complete the EIS. This will require preparation of an updated BDAR by a new accredited assessor, and the updated EIS including the updated BDAR, will not be completed until 2023.

The BCD has reviewed this timeframe and we consider that the advice we provided in our letter dated 19 September 2022 is valid for twelve months. If the BDAR has not been submitted by 19 September 2023, then the council will need to again demonstrate to the BCD that the extent and condition of vegetation and fauna habitat remains similar over the site to justify the use of 2016/17 fauna survey data.

If you have any questions about this advice, please do not hesitate to contact Ms Vanessa Owen, Senior Project Officer, at vanessa.owen@environment.nsw.gov.au or 4927 3116.

Yours sincerely

Dimitri Young

24 October 2022

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

Appendix B

Analysis of Rainforest PCT allocation

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B.1 Analysis of Rainforest PCT allocation

Three rainforest PCTs are described and mapped in the development site by ELA:

1. PCT 770 Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion

2. PCT 1068 Pepperberry - Giant Stinging Tree - Fig lowland rainforest in the NSW North Coast Bioregion

3. PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion.

Justification of these PCTs provided by other consultants was not persuasive and we have conducted a review of the PCTs to determine if the PCTs selected are the best match.

A PCT data power query was used to filter PCT to a shortlist. Filters included IBRA region with both NSW north coast and south-eastern Queensland selected, given the close proximity of the project to both. IBRA subregion was not used as a filter as experience has found that this may exclude PCTs prematurely. Vegetation formation was limited to 'Rainforests' and vegetation class to 'Subtropical Rainforests and Northern Warm Temperate Rainforests'. Following this, PCTs were removed where they had clear descriptions which excluded them from being suitable, that is, high altitude or a specific restricted location.

This left four potential PCTs, two of which were mapped by ELA in the development area (770 and 1302).

Table B.1 Rainforest PCTs mapped in the existing BDAR

PCT	PCT Name	Vegetation Class
770	Coachwood - Soft Corkwood - Crabapple warm temperate rainforest of the NSW North Coast Bioregion	Northern Warm Temperate Rainforests
1130	Sassafras - Crabapple - Soft Corkwood warm temperate rainforest of the North Coast	Northern Warm Temperate Rainforests
1201	Soft Corkwood - Yellow Carabeen - Cryptocarya spp. subtropical rainforest of the NSW North Coast Bioregion	Subtropical Rainforests
1302	White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	Subtropical Rainforests

B.1.1 Areas mapped as PCT 770

Analysis of the plot data for PCT 770 (three plots) shows a diverse canopy and midstory with a total of 40 species recorded in the BAM 'tree' growth form' category. There is variability of dominant species recorded within the plots both in terms of percent cover and abundance. Of the tree growth forms recorded in the plots, four species align with PCT 770 and three species each align with 1130, 1201 and 1302. None of the PCTs are a clear match, which can be explained by the diversity of the rainforest, with few species listed in the Bionet description for each PCT type.

Analysis of the plot data for all other growth forms found 81 species present and was more revealing. Comparison of the species occupying 5% cover or more revealed that Bangalow Palm (*Archontophoenix cunninghamiana*) was dominant in two plots and the second most dominant coverage in one plot. This species is only aligned with PCTs 1201 and 1302. Other species such as Walking Stick Palm (*Linospadix monostachya*) and Prickly Tree Fern (*Cyathea leichhardtiana*) are listed in the descriptions for PCT 770, 1201, and 1302. PCT 1130 does not have any aligned species (occupying 5% cover or more) and appears to be the worst match.

PCT 770 is part of the Northern Warm Temperate Rainforest Vegetation Class. This class is characterised by a remarkably even canopy, generally lacking emergents, and comprising 3 to 5 or rarely up to 15 tree species (Keith 2006). The midstory is typically lacking, with few epiphytes or palms. These rainforests occur on soils that are not fertile enough to support other rainforest types, such as Subtropical Rainforest. Given the complex canopy and midstory, and overall diversity the areas mapped as PCT 770 should be reassigned to a Subtropical Rainforest vegetation class (either 1201 or 1302). Subtropical Rainforests have a dense, multilayered canopy and a sub-canopy of smaller trees including palms.

Using species alignment alone, the rainforest could be a match for either 1201 or 1302; though if landscape is considered, then PCT 1302 is considered the best fit given that its landscape position is described as low altitudes on fertile soils near sea level, in sheltered mid altitude valleys or on basalt terraces.' The low altitude/sheltered mid-altitude valleys is aligned with the position of rainforest vegetation on site. In contrast PCT 1201 is described as occurring at intermediate to high altitude in high rainfall areas on moderately fertile to fertile soils on plateaux and high mountain gullies along the escarpment.

B.1.2 Areas mapped as PCT 1302

In the information provided by other consultant this community is described as:

> characterised by an upper stratum dominated by *Archontophoenix cunninghamiana* (Bangalow Palm) with occasional emergent including *Lophostemon confertus* (Brush Box) and *Endiandra globosa* (Black Walnut), particularly on the sloping community ecotone (ELA 2021)

Analysis of species composition of the plot data aligns best with either PCT 1302 or 1201; however, using the landscape description, PCT 1302 is best aligned. This PCT should remain; however, it may be necessary to assign a separate vegetation zone (e.g. PCT1302_bangalow), representing the dominance of the Palm.

B.1.3 Areas mapped as PCT 1068

ELA have mapped 0.42 ha of PCT 1068 high condition Pepperberry – Giant Stinging Tree – Fig lowland rainforest in the NSW North Coast Bioregion, which is mapped in the northern portion of the dam along watercourses below the existing dam wall. Vegetation integrity score has been provided and credits calculated for offsetting purposes.

This area is described in the BDAR as:

> The floristic composition of this community is strongly influenced by water and only occurs along the riparian zone downstream of the existing dam wall. The canopy includes *Casuarina cunninghamia, Derris involuta*, and *Tristaniopsis laurina*. The mid-storey is made up by various mesic species including *Guioa semiglauca, Backhousia myrtifolia, Cleistanthus cunninghamii, Wilkiea huegeliana, Cryptocarya laevigata,* and *Neolitsea dealbata*. The ground layer cover is dominated by ferns and herbaceous species including *Alpinia caerulea* and *Lomandra longifolia (*ELA 2021*).*

PCT 1068 does not appear a good match given that the few characteristic species are present, and the community is described in VIS as occurring on fertile soils in lowland river valleys which does not match the landscape position on site.

B.1.4 Summary

The rainforest within the disturbance footprint appears to have been mapped as different PCTs somewhat arbitrarily, perhaps to demonstrate observed differences. We acknowledge that there is not an immediately obvious best fit PCT, given that the VIS PCT descriptions are lacking in detail and do not contain comprehensive characteristic species lists. This is compounded since subtropical rainforests are known for their diversity.

We recommend mapping the rainforests as a single best matching PCT (1302) based on species, landscape position and vegetation class and, if necessary, spitting this up further into vegetation zones.

Appendix C
Camera trap refraction curves

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Rarefaction curves

Data collected from camera traps (provided to EMM) was analysed using rarefaction curves. The data used in the analysis and the R code used to run the analysis can be provided. The purpose of the analysis was to inform us of how many camera traps sites are required to suitably sample mammals identified by EMM. Two datasets were provided from 22 camera trap sites in forested habitat that were collected around CHD in 2016/17: a dataset of all species detected and a subset of this data that included only mammals. Camera traps were left out for a minimum 16 nights and baited for herbivores and carnivores. Data was bootstrapped 1000 times for each number of replicates. The graphic results are shown below. The red lines represent 95% CIs. The rarefaction curve for the dataset including all detected species shows a plateau at around 18-20 sites sampled (Figure 1), suggesting more sampling sites show little return for effort. The mammal dataset shows a plateau in the curve at approximately 15 sites sampled (Figure 2).

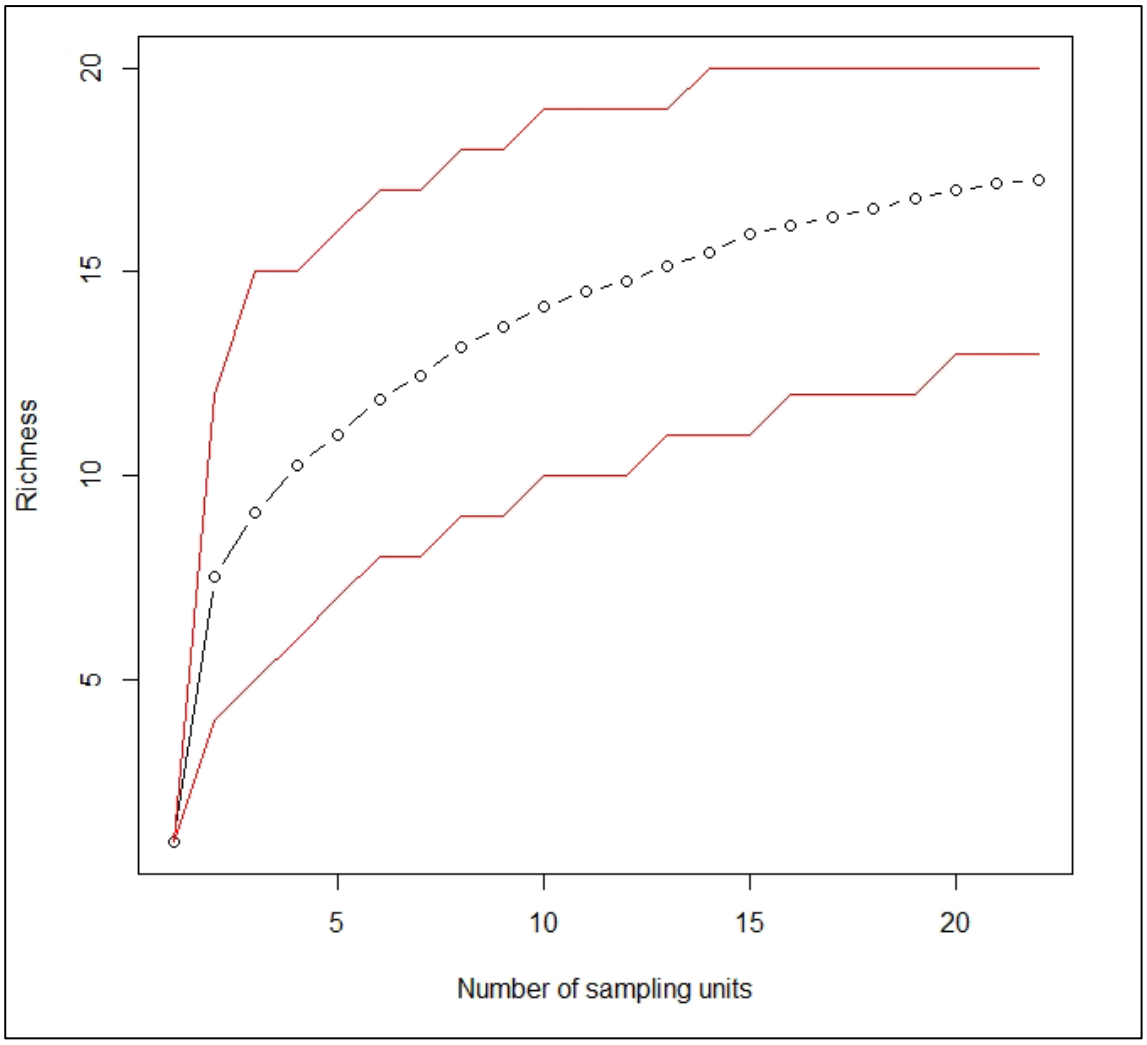


Figure 1. Rarefaction curve for all species detected on camera traps.

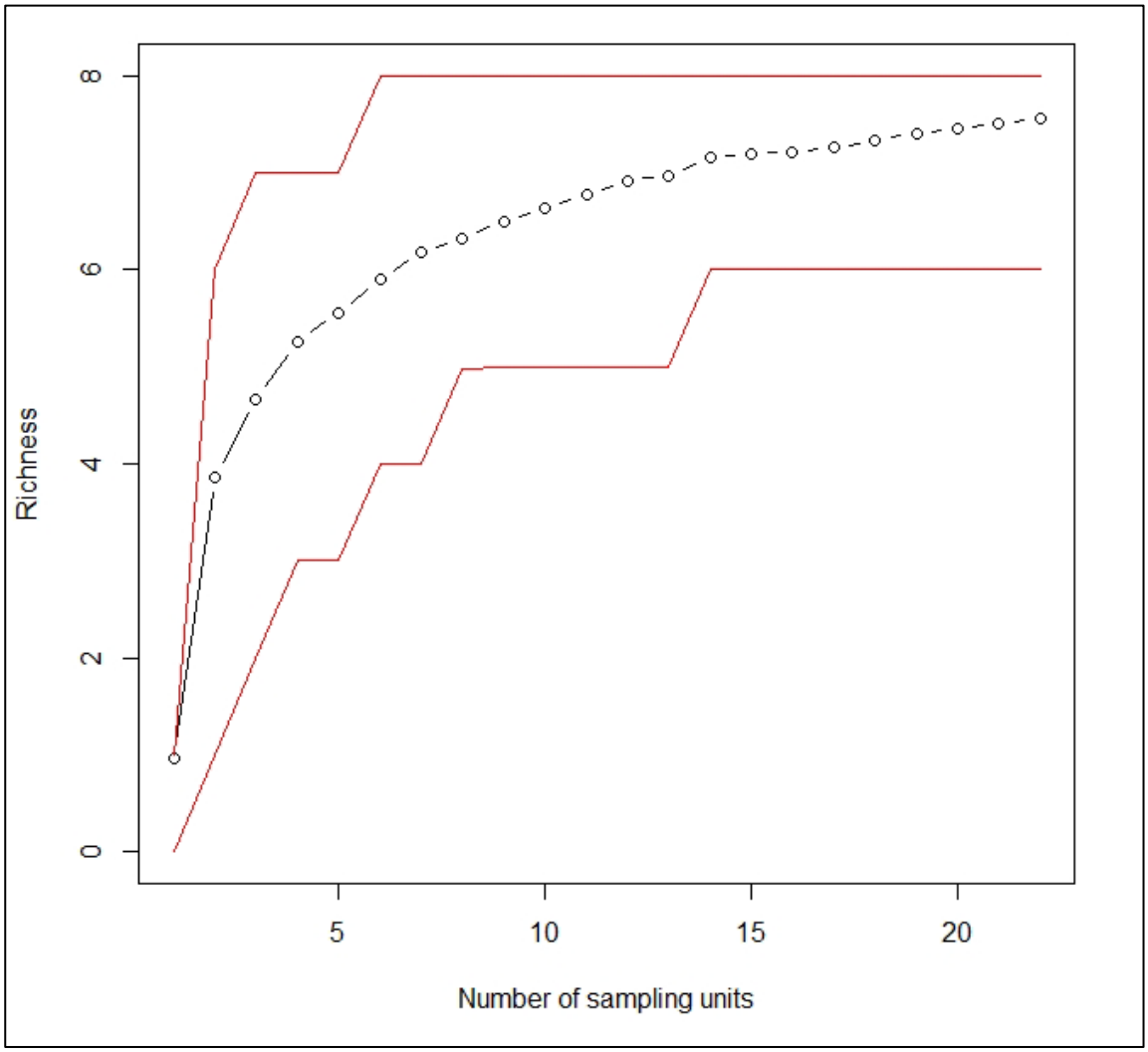


Figure 2. Rarefaction curve for mammals detected on camera traps.

B.9 Item 9

Your ref: email dated 30/06/2023
Our ref: DOC23/576802-7

General Manager
Tweed Shire Council
PO Box 816
Murwillumbah NSW 2484

Attention: Mr Greg Lollback

Dear Mr Green

RE: Clarrie Hall Dam Raising (SSI 9458) – request for biodiversity survey and assessment advice

Thank you for your e-mail dated 30 June 2023 to the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment about the Clarrie Hall Dam Raising project seeking comments on the Biodiversity Assessment Method (BAM) 2020 survey approach and renewed validation of using 2016 survey results in preparing the Biodiversity Development Assessment Report (BDAR). I appreciate the opportunity to provide input.

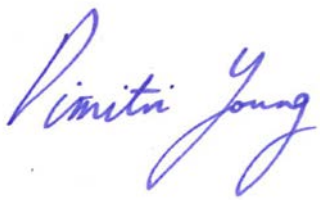
We have reviewed the gap analysis document prepared by EMM dated 28 June 2023, which was attached to your email. We have addressed your specific requests and discussed several issues identified during our review in **Attachment 1** to this letter.

The BCD has also reviewed the information provided by the Tweed Shire Council by e-mail dated 10 July 2023 in support of the request for an extension of time to use species survey data collected in 2016/17 for preparing the project BDAR.

Based on the information provided, it appears acceptable in this instance for fauna species survey data collected during 2016/17, and supplemented with further surveys in 2020/21, to be incorporated into a BDAR to be submitted no later than 30 September 2024. If the BDAR has not been submitted by this date, then the council will need to update the fauna survey data through additional fieldwork.

If you have any questions about this advice, please do not hesitate to contact Mr Don Owner, Senior Conservation Planning Officer, at don.owner@environment.nsw.gov.au or 6659 8239.

Yours sincerely



26 July 2023

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

Enclosure: Attachment 1: Detailed BCD comments – Clarrie Hall Dam Raising – request for biodiversity survey and assessment advice

Attachment 1: Detailed BCD comments – Clarrie Hall Dam Raising – request for biodiversity survey and assessment advice

The Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment has reviewed the gap analysis document prepared by EMM dated 28 June 2023 seeking advice about survey and assessment requirements for the Clarrie Hall Dam Raising project (SSI 9458). The BCD has also reviewed information provided by the Tweed Shire Council by e-mail dated 10 July 2023 in support of the request for an extension of time to use species survey data collected in 2016/17 for preparing the project BDAR. Our comments and recommendations are provided in Table 1 below.

Please note, given the large scale of the project and complexity of bilateral assessments, the following advice pertains only to the Clarrie Hall Dam wall raising project and is not applicable to any other project. The advice is not to be used in any context other than how it relates to the Clarrie Hall Dam wall raising project.

Table 1: BCD comments and recommendations

Matter discussed	Reference	BCD comments	BCD recommendations
1. Inconsistent calculations of vegetation zone extents.	Table 2.1 and Appendix A.1. Table 4	The extent of each vegetation zone on the subject land listed in Table 2.1 of the EMM document differs from the extent of vegetation zones identified by ELA in Table 4 of Appendix A of the EMM document.	Differences between ELA and EMM vegetation zone area calculations be reviewed and corrected or explained in the BDAR.
2. Clarify whether EcoLogical Australia (ELA) recorded Plant Community Type (PCT) 1068 on the subject land.	Appendix A.1. Table 4	Section 2.2 of the EMM document indicated ELA recorded the rainforest PCT 1068 in the development site. However, the PCT profiles and mapping prepared by ELA in Appendix A.1 of the EMM document did not list PCT 1068 as having been recorded on the subject land.	The ELA PCT profiles and mapping be reviewed to clarify whether PCT 1068 was recorded on the subject land.
3. Use the Plot to PCT Assignment tool to identify appropriate Eastern NSW PCTs.	Section 2.2	EMM has proposed amalgamating rainforest PCTs 770, 1302 and 1068, identified by ELA, into the rainforest PCT 1302. All these PCTs have been decommissioned in the BioNet Vegetation Classification Database and replaced with revised Eastern NSW PCTs.	The Plot to PCT assignment tool at https://bionet.shinyapps.io/vegplot/ be used to identify the most appropriate Eastern NSW PCT/s for all vegetation on the subject land and the analysis of results from the tool, be used in conjunction with relevant evidence and contextual information, to justify each PCT selection in the BDAR.

Matter raised	Reference	BCD comments	BCD recommendations
4. Circumstances when decommissioned PCTs can be used.	Section 2.2	Decommissioned PCTs can only be used instead of Eastern NSW PCTs if the status of the Biodiversity Assessment Method (BAM)-Calculator case was "in-progress" prior to release of the Eastern NSW PCTs on 14 April 2023. The assessor has considered PCTs 770, 1302 and 1068 as Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (EEC), hence amalgamating them into the same PCT would not affect the type or quantum of offset obligation generated for the project. Unlike PCTs 1302 and 1068, PCT 770 has not been identified in the BioNet Vegetation Classification Database as being associated with the Commonwealth EPBC Act listed Lowland Rainforest of Subtropical Australia Critically Endangered Ecological Community (CEEC). So, amalgamating PCT 770 into PCT 1302 may result in an over-estimation of the project impact on the Commonwealth listed CEEC.	If decommissioned PCTs are used, sufficient evidence and justification be obtained and presented in the BDAR to support re-assigning areas of PCT 770 to PCT 1302 to ensure offsets for the Commonwealth listed CEEC have been calculated correctly.
5. Re-sample vegetation integrity plots in bushfire affected areas.	Section 2.1 and Table 2.1	Section 2.1 of the EMM document indicates that vegetation integrity plots were completed by ELA in 2020. Parts of the subject land were impacted by bushfire in August 2019. Consequently, vegetation integrity scores are likely to have been reduced by fire in burnt areas subject to plot sampling.	Vegetation integrity plots undertaken in areas impacted by bushfire in 2019 be sampled again to ensure any increases in vegetation integrity from natural recovery have been recorded and considered when calculating biodiversity offset credit obligations.
6. BCD support for selection of candidate threatened flora species.	Section 3.1	The BCD supports the applicant's justification and logic used for selecting candidate threatened flora species provided in Table 3.1 of the EMM document.	No recommendation required
7. Incorrect conservation status provided for some Commonwealth listed threatened flora species.	Table 3.1	Some candidate flora species (e.g. *Rhodamnia rubescens* and *Rhodomyrtus psidioides*), which are currently listed as threatened on the EPBC Act have been identified in Tables 3.1 and 3.2 of the EMM document as 'not listed' on the EPBC Act.	The Commonwealth EPBC Act status of threatened flora species listed in Tables 3.1 and 3.2 of the EMM document be reviewed and updated where necessary.
8. Limit use of the large area targeted flora survey method.	Appendix A.1. section 4.3	ELA has applied a modified version of the large area threatened flora survey design described in section 4.4 of the NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE 2020), which was approved by the BCD. However, the large area assessment method is only to be applied for candidate flora species with more than 50 ha of suitable habitat on the subject land. ELA appears to	The parallel field traverse method described in section 4.1 of the NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE 2020) be used for all candidate threatened flora species where less than 50 ha of suitable habitat exists on the subject land.

Matter raised	Reference	BCD comments	BCD recommendations
		have misinterpreted the guidelines by assuming the method can be applied to all candidate threatened flora species when the subject land is greater than 50 ha.	
9. Parallel field traverse method to be used for Phase 2 of large area targeted flora surveys.	Appendix A.1. section 4.3	The ELA correspondence contained in Appendix A of the EMM document indicated phase 2 of the targeted flora survey would consist of detailed searching for additional individuals of threatened flora species between adjacent vertices. No description of the proposed detailed search method was provided.	The parallel field traverse method described in section 4.1 of the NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE 2020) be used between adjacent vertices for phase 2 of targeted threatened flora surveys.
10. Consider habitat suitability for the southern greater glider on the subject land.	Section 4.1	The BCD generally supports the applicant's justification and logic used for selecting candidate threatened fauna species provided in Table 4.1 of the EMM document. However, it is unclear whether the assessor has considered the possible occurrence of the southern greater glider (*Petauroides volans*) on the subject land.	Suitability of habitats on the subject land for the southern greater glider be considered in the BDAR when assessing candidate fauna species.
11. Stratification and reporting of targeted fauna surveys to be based on vegetation zones.	Section 4.4	Section 4.4. of the EMM document indicates that stratification of the subject land for assessing habitat suitability and informing targeted fauna surveys would be based on vegetation class. Section 5.2 of the BAM 2020 relies on site stratification for the purpose of assessing habitat suitability for candidate species being based on vegetation zones to ensure habitat constraints and condition states have been adequately considered.	Stratification of the subject land for assessing habitat suitability, informing targeted fauna surveys and reporting on survey effort be based on vegetation zones rather than vegetation classes.
12. Targeted threatened frog surveys to sample all isolated areas of suitable habitat.	Section 4.2.3 and	The BCD provided in-principle support for the amphibian sub-sampling approach described by ELA. However, ELA had not identified the spatial distribution of amphibian habitats across the subject land at the time of requesting the BCD's support for the approach.	Targeted threatened frog surveys be undertaken to sample all areas of isolated suitable habitat within each vegetation zone.
13. Potential suitable habitat for the giant barred frog *(Mixophyes iteratus)* has been under-estimated.	Appendix A.1. section 4.4.1	ELA has excluded stream type 2 amphibian habitats listed in Appendix A.1, Table 7 of the EMM document as potential habitat for the giant barred frog (*Mixophyes iteratus*). However, the combination of common and occasional habitat features listed as present in stream type 2 habitat are generally suitable for the species, particularly in areas where permanent pools are present.	Targeted surveys for the giant barred frog (*Mixophyes iteratus*) be expanded to include areas of stream type 2 habitat containing either permanent clear flowing water or permanent pools.
14. Tweed Shire Council (TSC) survey data can be included	Section 4.2.4	The BCD agrees there is unlikely to have been any perceptible change in habitat conditions since the TSC's previous data extension request and supports the assessor's proposed use of survey results undertaken by the TSC between November 2106	The reporting of TSC survey effort be expressed for each vegetation zone in the BDAR.

Matter raised	Reference	BCD comments	BCD recommendations
in the survey effort for the BDAR.		and January 2017 in contributing to the overall survey effort when preparing the BDAR.	
15. Sampling effort for diurnal bird surveys to be based on the Commonwealth guidelines.	Table 4.5	The DEC (2004) guidelines do not provide definitive recommendations of sampling effort for diurnal birds. However, the DEWHA (2010) guidelines do provide clear levels of sampling effort for several of the candidate diurnal bird species, including: • 9 hours of area searching over 3 days per 50 ha of suitable habitat for eastern bristlebird • 15 hours of area searching over 3 days per 50 ha of suitable habitat for black-breasted button quail, and • 15 hours over 4 days per 50 ha of suitable habitat when fig trees are fruiting for Coxen's fig-parrot. Given the project is a controlled action subject to the Bilateral Agreement between the NSW and Australian Governments under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the DEC (2004) guidelines are silent on overall sampling effort, the assessor should adopt the minimum sampling effort specified in the DEWHA (2010) guidelines for the EPBC Act listed species. The assessor can also apply the standard sampling effort of 8 hours over 4 days to the non-EPBC Act listed species to every 50 ha of suitable habitat. For example, PCT 827 includes 4 vegetation zones totalling 134.34 ha of suitable habitat for a non-EPBC Act listed target species. Sampling would need to include at least 8 hours of survey effort over 4 days per 50 ha (or less) of suitable habitat, which would equate to 24 hours of survey effort over 4 days. In the BDAR, the assessor would need to express the amount of sampling effort applied to each of the 4 vegetation zones containing PCT 827.	Aural and visual survey methods and sampling effort for EPBC Act listed candidate diurnal bird species be consistent with the Survey Guidelines for Australia's Threatened Birds (DEWHA 2010). Aural and visual survey methods and sampling effort for non-EPBC Act listed candidate diurnal bird species be at least 8 hours sampling effort conducted over 4 days per 50 ha of suitable habitat.
16. Importance of using experienced observers familiar with candidate species.	Table 4.5	Relevant survey guidelines for diurnal bird surveys emphasise the need for all surveys to be undertaken by experienced observers familiar with the target species.	Aural and visual surveys for candidate species, particularly diurnal birds, be undertaken by experienced observers familiar with each target species, with evidence of relevant observer experience provided in the BDAR.

Matter raised	Reference	BCD comments	BCD recommendations
17. Use sound recording devices as a supplementary diurnal bird sampling technique.	Table 4.5	Sound recording devices such as AudioMoths or Song Meters could be used as a supplementary survey technique to detect presence of rufous scrub-bird, eastern bristlebird and Albert's lyrebird.	Sound recording devices be used as a supplementary survey technique for detecting candidate diurnal bird species.
18. Monitor potential glossy black-cockatoo nest trees for breeding activity.	Table 4.5	The BCD noted in previous correspondence that it was unclear if potential glossy black-cockatoo nest trees had been monitored for occupancy during the breeding season as required by the Threatened Biodiversity Data Collection (TBDC).	Dusk census of each potential glossy black-cockatoo nest tree within the disturbance area be undertaken for a minimum duration of one hour during the breeding season.
19. Survey of dual credit bird species breeding habitat is adequate.	Table 4.5 and Table 4.6	Typically, the BCD would require an assessor to survey the dual credit bird species nesting habitat buffers specified in the TBDC to ensure potential impacts on nest trees have been adequately assessed and appropriate mitigation and offset measures formulated. For this project, the BCD accepts limiting the tree hollow survey to the area of direct impact due to: • the nature of the project being an alteration to an existing structure, and • the likely occurrence of alternative peripheral breeding habitat features (e.g. roosting, grooming and feeding perches) to be retained close to any potential nest trees within the large tracts of intact vegetation surrounding the subject land.	No recommendation required
20. No further assessment of forest owl breeding habitat is required.	Section 4.4.3	The BCD can confirm the targeted survey and breeding habitat assessment undertaken for the candidate forest owl species is satisfactory.	No recommendation required
21. Exclude threatened rainforest snails as potential candidate fauna species.	Table 4.11	The BCD would support the assessor excluding the atlas rainforest snail (*Nurus atlas*) and shorter rainforest ground beetle (*Nurus brevis*) as candidate species credit species based on the geographic limitations detailed in the relevant BioNet species profiles.	No recommendation required
22. Request advice about remote camera sampling density from the Biodiversity Offset Scheme Helpdesk.	Table 4.9	The assessor has referred to a remote camera sampling density of 20 cameras per 50 ha of suitable habitat, which was apparently approved by the BCD on other projects. The assessor has not provided a copy of any BCD correspondence to either verify the context of the BCD approval or clarify if the approval related to generic application of a sampling method or a site/project-specific application of a method.	An enquiry be submitted to the Biodiversity Offset Scheme Helpdesk to obtain site-specific survey advice for the use of remote cameras to detect both terrestrial and arboreal candidate fauna species.

Matter raised	Reference	BCD comments	BCD recommendations
23. Assessing the adequacy of pitfall trapping effort.	Table 4.9	The description of the pitfall trapping survey effort provided in Table 4.9 of the EMM document is difficult to comprehend without any mapping to illustrate the placement of trapping lines within each vegetation zone containing suitable habitat for the species. Therefore, the assessor should consider the adequacy of sampling effort using the advice provided in the BCD recommendation provided.	The total survey effort for common planigale be consistent with the following advice: • Where the area of suitable habitat for common planigale exceeds 10 ha, the following number of pitfall trap arrays are required: o **total suitable habitat >10 – 50 ha:** 10 arrays + three additional for every 10 ha of suitable habitat above 10 ha. For example, 20 ha of suitable habitat will require 13 arrays. o **total suitable habitat > 50 ha:** 22 arrays plus one additional for every 10 ha of suitable habitat above 10 ha. For example, 60 ha of suitable habitat will require 23 arrays. • The pitfall trap arrays must be evenly distributed across the suitable habitat. Traps must remain in place for a minimum of four consecutive nights. • The species polygon is drawn to 500 m either side of the PCT ecotonal boundary, or to the other PCT boundary, whichever is smaller.
24. Need to survey for squirrel glider in areas of suitable habitat.	Table 4.9	The assessor has indicated they would like to exclude squirrel glider as a candidate species based on there being only a small area of suitable habitat (i.e. 1.8 ha) identified for the species on the subject land. Despite only a relatively small area of suitable habitat for squirrel glider being considered present on the subject land, the assessor will need to survey for the species as a precautionary measure and to comply with the BAM 2020. The amount of survey already completed in other areas of the subject land cannot be taken into consideration for squirrel glider because the other areas have been identified as unsuitable habitat for the species.	Target survey for squirrel glider be undertaken in all areas of suitable habitat for the species on the subject land.
25. Reptile survey methods and sampling effort are adequate	Table 4.10	Survey methods and sampling effort applied to 3 of the 4 candidate reptile species either meet or exceed the requirements of the published survey guidelines and TBDC survey comments. The BCD accepts the justification provided to limit any further survey for the pale-headed snake (*Hoplocephalus bitorquatus*).	No recommendation required

Matter raised	Reference	BCD comments	BCD recommendations
26. Request advice about the pink underwing moth species polygon from the Biodiversity Offset Scheme Helpdesk	Table 4.11	The assessor has proposed the species polygon for the pink underwing moth to encompass only the two host plants of *Carronia multisepalea* and an appropriate buffer. The pink underwing moth requires presence of the host plant and areas of rainforest vegetation with sufficient canopy gap to allow filtered light to stimulate understorey vegetation and the host plant.	The species polygon for the pink underwing moth be drawn to encompass areas containing the host plant *Carronia multisepalea* and all areas of rainforest vegetation associated with the species in the TBDC with appropriate canopy gaps and filtered light to support understorey vegetation.
27. Apply the site-based approach	Section 4.5.1	The direct impact of the project would mainly be within the increased dam inundation zone, which shares some characteristics with a linear development. However, the indirect impacts, particularly for more highly mobile fauna species with larger home ranges, would be more appropriately assessed using the site-based assessment approach.	The site-based approach to applying the BAM be used by the assessor when preparing the BDAR.

B.10 Item 10

Level 3 175 Scott Street
Newcastle NSW 2300
02 4907 4800
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Memorandum

22 August 2023

To: Dimitri Young
Biodiversity and Conservation Division, North East Branch

From: Eugene Dodd

Subject: CHDR Project - Terrestrial ecology survey approach

Dear Dimitri,

EMM recently provided a survey plan for the Clarrie Hall Dam Raising (CHDR) project (E230037_L_20_Jun 23_Survey Methods and Effort_V3) with a response provide on the 26 July (Clarrie Hall Dam Raising (SSI 9458) – request for biodiversity survey and assessment advice).

Two meetings to discuss the survey plan have been held since, with attendance from DPIE, BCD, KBR, TSC and EMM. The first specifically discussed winter surveys (26/07/23), owing to the urgency of field surveys. A second more comprehensive discussion occurred on 09/08/23 which allowed time to interpret BCD's advice.

Table 1 incorporates BCD original comments (Attachment 1; Detailed BCD comments) with an additional column added to summarise the discussions from the two meetings and highlight areas where further advice is required or confirmation by BCD is warranted.

Green fill indicates the action is either minor or is considered resolved. Orange fill indicates that additional clarification is required from BCD or we wish to draw attention to the action.

EMM and the broader team appreciate the time and consideration BCD has given to the project so far.

Yours sincerely

Eugene Dodd
Associate Ecologist
edodd@emmconsulting.com.au

Appendix A
Summary of consultation

EMM
creating opportunities

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
1. Inconsistent calculations of vegetation zone extents.	Table 2.1 and Appendix A.1. Table 4	The extent of each vegetation zone on the subject land listed in Table 2.1 of the EMM document differs from the extent of vegetation zones identified by ELA in Table 4 of Appendix A of the EMM document.	Differences between ELA and EMM vegetation zone area calculations be reviewed and corrected or explained in the BDAR.	Action as part of BDAR revisions
2. Clarify whether EcoLogical Australia (ELA) recorded Plant Community Type (PCT) 1068 on the subject land.	Appendix A.1. Table 4	Section 2.2 of the EMM document indicated ELA recorded the rainforest PCT 1068 in the development site. However, the PCT profiles and mapping prepared by ELA in Appendix A.1 of the EMM document did not list PCT 1068 as having been recorded on the subject land.	The ELA PCT profiles and mapping be reviewed to clarify whether PCT 1068 was recorded on the subject	Will be resolved with reattribution of rainforest communities.
3. Use the Plot to PCT Assignment tool to identify appropriate Eastern NSW PCTs.	Section 2.2	EMM has proposed amalgamating rainforest PCTs 770, 1302 and 1068, identified by ELA, into the rainforest PCT 1302. All these PCTs have been decommissioned in the BioNet Vegetation Classification Database and replaced with revised Eastern NSW PCTs.	The Plot to PCT assignment tool at https://bionet.shinyapps.io/vegplot/ be used to identify the most appropriate Eastern NSW PCT/s for all vegetation on the subject land and the analysis of results from the tool, be used in conjunction with relevant evidence and contextual information, to justify each PCT selection in the BDAR.	We will consider tool if using new PCTs, though prior experience has found importing plot data to be problematic.

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
4. Circumstances when decommissioned PCTs can be used.	Section 2.2	Decommissioned PCTs can only be used instead of Eastern NSW PCTs if the status of the Biodiversity Assessment Method (BAM)-Calculator case was "in-progress" prior to release of the Eastern NSW PCTs on 14 April 2023. The assessor has considered PCTs 770, 1302 and 1068 as Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (EEC), hence amalgamating them into the same PCT would not affect the type or quantum of offset obligation generated for the project. Unlike PCTs 1302 and 1068, PCT 770 has not been identified in the BioNet Vegetation Classification Database as being associated with the Commonwealth EPBC Act listed Lowland Rainforest of Subtropical Australia Critically Endangered Ecological Community (CEEC). So, amalgamating PCT 770 into PCT 1302 may result in an over-estimation of the project impact on the Commonwealth listed CEEC.	If decommissioned PCTs are used, sufficient evidence and justification be obtained and presented in the BDAR to support re-assigning areas of PCT 770 to PCT 1302 to ensure offsets for the Commonwealth listed CEEC have been calculated correctly.	Potential to use existing PCT given the BAM Calculator case was in progress. Commonwealth will be revisited in the BDAR to ensure CEECs are accurately calculated.
5. Re-sample vegetation integrity plots in bushfire affected areas.	Section 2.1 and Table 2.1	Section 2.1 of the EMM document indicates that vegetation integrity plots were completed by ELA in 2020. Parts of the subject land were impacted by bushfire in August 2019. Consequently, vegetation integrity scores are likely to have been reduced by fire in burnt areas subject to plot sampling.	Vegetation integrity plots undertaken in areas impacted by bushfire in 2019 be sampled again to ensure any increases in vegetation integrity from natural recovery have been recorded and considered when calculating biodiversity offset credit obligations.	3-4 plots would be required in the 827_burnt, based on the areas. *BCD confirmed that the intent was to resample just the burnt plots.*
6. BCD support for selection of candidate threatened flora species.	Section 3.1	The BCD supports the applicant's justification and logic used for selecting candidate threatened flora species provided in Table 3.1 of the EMM document.	No recommendation required	No action required.

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
7. Incorrect conservation status provided for some Commonwealth listed threatened flora species.	Table 3.1	Some candidate flora species (e.g. *Rhodamnia rubescens* and *Rhodomyrtus psidioides*), which are currently listed as threatened on the EPBC Act have been identified in Tables 3.1 and 3.2 of the EMM document as 'not listed' on the EPBC Act.	The Commonwealth EPBC Act status of threatened flora species listed in Tables 3.1 and 3.2 of the EMM document be reviewed and updated where necessary.	Update
8. Limit use of the large area targeted flora survey method.	Appendix A.1. section 4.3	ELA has applied a modified version of the large area threatened flora survey design described in section 4.4 of the NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE 2020), which was approved by the BCD. However, the large area assessment method is only to be applied for candidate flora species with more than 50 ha of suitable habitat on the subject land. ELA appears to have misinterpreted the guidelines by assuming the method can be applied to all candidate threatened flora species when the subject land is greater than 50 ha.	The parallel field traverse method described in section 4.1 of the NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE 2020) be used for all candidate threatened flora species where less than 50 ha of suitable habitat exists on the subject land.	BCD requires that parallel transects are conducted in the rainforests (8.4 ha). EMM has assessed effort in these areas in accordance with stated methods and survey effort demonstrated by tracks by ELA. In conjunction with surveys conducted by council in 2016/2017 survey effort meets the guidelines in the majority of the areas. **We assume that BCD supports the use of combined flora effort of Council and ELA given the timeframe extension for the fauna data.** **If any gaps are found between ELA and council data EMM will fill into meet 5 m parallel transects.** We will confirm with ELA that Stage 1 of the flora method was completed as per the method stated in the draft BDAR and that lack of some survey tracks is an administrative / equipment / documentation error rather than lack of survey effort. It may reflect multiple observers being used but only one track taken for example

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
9. Parallel field traverse method to be used for Phase 2 of large area targeted flora surveys.	Appendix A.1. section 4.3	The ELA correspondence contained in Appendix A of the EMM document indicated phase 2 of the targeted flora survey would consist of detailed searching for additional individuals of threatened flora species between adjacent vertices. No description of the proposed detailed search method was provided.	The parallel field traverse method described in section 4.1 of the NSW Survey Guide for the Biodiversity Assessment Method – Surveying threatened plants and their habitats (DPIE 2020) be used between adjacent vertices for phase 2 of targeted threatened flora surveys.	Complete stage 2 of the large area method. Conduct parallel field traverses at width recommended according to growth form in DPIE 2020. Advice received during meeting. Where first stage detects a threatened species complete parallel transects. Transect spacing dependent on growth form and structure of community as outlined in DPIE 2020. Parallel transects extend to the adjacent vertices, assuming additional species are not detected.
10. Consider habitat suitability for the southern greater glider on the subject land.	10. Consider habitat suitability for the southern greater glider on the subject land.	10. Consider habitat suitability for the southern greater glider on the subject land.	10. Consider habitat suitability for the southern greater glider on the subject land.	Spotlighting effort as detailed previously has failed to detect the species.
11. Stratification and reporting of targeted fauna surveys to be based on vegetation zones.	Section 4.4	Section 4.4. of the EMM document indicates that stratification of the subject land for assessing habitat suitability and informing targeted fauna surveys would be based on vegetation class. Section 5.2 of the BAM 2020 relies on site stratification for the purpose of assessing habitat suitability for candidate species being based on vegetation zones to ensure habitat constraints and condition states have been adequately considered.	Stratification of the subject land for assessing habitat suitability, informing targeted fauna surveys and reporting on survey effort be based on vegetation zones rather than vegetation classes.	We understand that effort can be determined according to habitat area. The survey is then stratified across the zones so species occurrence can be inferred by presence/absence. BCD stated survey effort should be presented by vegetation zone or it may be necessary to assume presence.

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
12. Targeted threatened frog surveys to sample all isolated areas of suitable habitat.	Section 4.2.3 and	The BCD provided in-principle support for the amphibian sub-sampling approach described by ELA. However, ELA had not identified the spatial distribution of amphibian habitats across the subject land at the time of requesting the BCD's support for the approach.	Targeted threatened frog surveys be undertaken to sample all areas of isolated suitable habitat within each vegetation zone	Conduct additional surveys, targeting areas of isolated habitat. The in-principle support previously given to other consultants methods utilised the DECC 2009 guidelines. We assume that any further surveys conducted should be aligned with methods and effort as outlined in DPIE 2020. We propose to undertake a habitat verification field survey determine which isolated habitat require additional effort, followed by targeted survey in accordance with DPIE 2020. *We require further guidance on species polygons for frog, please refer to worked example below this table.*
13. Potential suitable habitat for the giant barred frog *(Mixophyes iteratus)* has been under-estimated.	Appendix A.1. section 4.4.1	ELA has excluded stream type 2 amphibian habitats listed in Appendix A.1, Table 7 of the EMM document as potential habitat for the giant barred frog (*Mixophyes iteratus*). However, the combination of common and occasional habitat features listed as present in stream type 2 habitat are generally suitable for the species, particularly in areas where permanent pools are present.	Targeted surveys for the giant barred frog (*Mixophyes iteratus*) be expanded to include areas of stream type 2 habitat containing either permanent clear flowing water or permanent pools.	Extend surveys to type 2 habitats and other isolated habitats.

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
14. Tweed Shire Council (TSC) survey data can be included in the survey effort for the BDAR.	Section 4.2.4	The BCD agrees there is unlikely to have been any perceptible change in habitat conditions since the TSC's previous data extension request and supports the assessor's proposed use of survey results undertaken by the TSC between November 2016 and January 2017 in contributing to the overall survey effort when preparing the BDAR.	The reporting of TSC survey effort be expressed for each vegetation zone in the BDAR.	Apply to BDAR

15. Sampling effort for diurnal bird surveys to be based on the Commonwealth guidelines.	Table 4.5	The DEC (2004) guidelines do not provide definitive recommendations of sampling effort for diurnal birds. However, the DEWHA (2010) guidelines do provide clear levels of sampling effort for several of the candidate diurnal bird species, including: • 9 hours of area searching over 3 days per 50 ha of suitable habitat for eastern bristlebird • 15 hours of area searching over 3 days per 50 ha of suitable habitat for black-breasted button quail, and • 15 hours over 4 days per 50 ha of suitable habitat when fig trees are fruiting for Coxen's fig-parrot. Given the project is a controlled action subject to the Bilateral Agreement between the NSW and Australian Governments under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the DEC (2004) guidelines are silent on overall sampling effort, the assessor should adopt the minimum sampling effort specified in the DEWHA (2010) guidelines for the EPBC Act listed species. The assessor can also apply the standard sampling effort of 8 hours over 4 days to the non-EPBC Act listed species to every 50 ha of suitable habitat. For example, PCT 827 includes 4 vegetation zones totalling 134.34 ha of suitable habitat for a non-EPBC Act listed target species. Sampling would need to include at least 8 hours of survey effort over 4 days per 50 ha (or less) of suitable habitat, which would equate to 24 hours of survey effort over 4 days. In the BDAR, the assessor would need to express the amount of sampling effort applied to each of the 4 vegetation zones containing PCT 827.	Aural and visual survey methods and sampling effort for EPBC Act listed candidate diurnal bird species be consistent with the Survey Guidelines for Australia's Threatened Birds (DEWHA 2010). Aural and visual survey methods and sampling effort for non-EPBC Act listed candidate diurnal bird species be at least 8 hours sampling effort conducted over 4 days per 50 ha of suitable habitat.	<u>Black-breasted Button Quail</u> No seasonal restrictions Not aligned with 827. Taking into account recent surveys (8 hrs total), further effort may be required to meet Commonwealth guidelines in the rainforest area. **Habitat suitable for the species is restricted to 8.4 ha – Can effort be reduced on a pro-rata basis given the Commonwealth stratification unit is 50 ha?** *BCD confirmed that survey could be reduced on a pro-rata basis providing that surveys were conducted over at least 3 days.* <u>Eastern Bristlebird</u> Aligned with all PCTs, however we intend to remove as a candidate species owing to the lack of tall and dense grassy understory. *BCD are satisfied that if microhabitats for the species are not present then the species can be included. EMM will support this assessment in the BDAR with PHD thesis (Stone, 2018)* Coxen's Fig Parrot habitat. Surveys have been conducted in accordance with the guidelines. Relatively few fig trees are present, however some are now coming into fruit. Targeted survey will be undertaken in the coming weeks.

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
15b.				Rufous scrub-bird Not aligned with Rainforest PCTs Exclude based on the species profile – 'Rufous Scrub-birds are now confined to high-altitude (above 600m elevation) subtropical, warm temperate and cool temperate rainforests, and wet sclerophyll forests.' noting Geographic restrictions within Scenic Rim region are absent. *BCD do not support use of 600 m altitudinal restriction in profile. Examine PHD thesis and any other literature to determine if species can be excluded on habitat basis. Alternatively request expert report or survey for the species.*
16. Importance of using experienced observers familiar with candidate species.	Table 4.5	Relevant survey guidelines for diurnal bird surveys emphasise the need for all surveys to be undertaken by experienced observers familiar with the target species.	Aural and visual surveys for candidate species, particularly diurnal birds, be undertaken by experienced observers familiar with each target species, with evidence of relevant observer experience provided in the BDAR.	Appropriately experienced ecologist will be used in the field, selected based on the species targeted. CV will be provided where necessary.
17. Use sound recording devices as a supplementary diurnal bird sampling technique.	Table 4.5	Sound recording devices such as AudioMoths or Song Meters could be used as a supplementary survey technique to detect presence of rufous scrub-bird, eastern bristlebird and Albert's lyrebird.	Sound recording devices be used as a supplementary survey technique for detecting candidate diurnal bird species.	We appreciate the option however we've opted to utilise experienced observers.

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
18. Monitor potential glossy black-cockatoo nest trees for breeding activity.	Table 4.5	The BCD noted in previous correspondence that it was unclear if potential glossy black-cockatoo nest trees had been monitored for occupancy during the breeding season as required by the Threatened Biodiversity Data Collection (TBDC).	Dusk census of each potential glossy black-cockatoo nest tree within the disturbance area be undertaken for a minimum duration of one hour during the breeding season.	1 hr HBT watches would limit the observer to one hollow watch per dusk period which would be impractical. Discussion with BCD indicated that the time period was negotiable. Surveys have been undertaken at 21 suitable HBTs for 30 minutes, adding to ELA's 10 minutes watches (40 minute total). No GBC were observed during the dusk surveys, nor were any GBC were observed incidentally over the five day period targeting other birds species. *BCD confirmed approach. Do not consider that ELA and EMM timing can be used additively.*
19. Survey of dual credit bird species breeding habitat is adequate.	Table 4.5 and Table 4.6	Typically, the BCD would require an assessor to survey the dual credit bird species nesting habitat buffers specified in the TBDC to ensure potential impacts on nest trees have been adequately assessed and appropriate mitigation and offset measures formulated. For this project, the BCD accepts limiting the tree hollow survey to the area of direct impact due to: • the nature of the project being an alteration to an existing structure, and • the likely occurrence of alternative peripheral breeding habitat features (e.g. roosting, grooming and feeding perches) to be retained close to any potential nest trees within the large tracts of intact vegetation surrounding the subject land.	No recommendation required	During the GBC surveys outlined above, surveyors looked so suitable hollows adjacent o the footprint. No further hollows were observed outside the footprint noting this is not exhaustive. An additional two hollows were recorded which were not previously noted. No further surveys to be completed.
20. No further assessment of forest owl breeding habitat is required.	Section 4.4.3	The BCD can confirm the targeted survey and breeding habitat assessment undertaken for the candidate forest owl species is satisfactory.	No recommendation required	No further surveys to be completed.

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
21. Exclude threatened rainforest snails as potential candidate fauna species.	Table 4.11	The BCD would support the assessor excluding the atlas rainforest snail (*Nurus atlas*) and shorter rainforest ground beetle (*Nurus brevis*) as candidate species credit species based on the geographic limitations detailed in the relevant BioNet species profiles.	No recommendation required	*EMM/TSC to place request to have TBCD updates based on advice from Mick Andrens advice.*
22. Request advice about remote camera sampling density from the Biodiversity Offset Scheme Helpdesk.	Table 4.9	The assessor has referred to a remote camera sampling density of 20 cameras per 50 ha of suitable habitat, which was apparently approved by the BCD on other projects. The assessor has not provided a copy of any BCD correspondence to either verify the context of the BCD approval or clarify if the approval related to generic application of a sampling method or a site/project-specific application of a method.	An enquiry be submitted to the Biodiversity Offset Scheme Helpdesk to obtain site-specific survey advice for the use of remote cameras to detect both terrestrial and arboreal candidate fauna species.	Email to BOS helpdesk sent 4/8/23 *If no response in 2 weeks then BCD will assist in follow up*

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

<table>
<tr><th>Matter Discussed</th><th>Reference</th><th>BCD Comments</th><th>BCD recommendations</th><th>Action required.</th></tr>
<tr>
<td>23. Assessing the adequacy of pitfall trapping effort.</td>
<td>Table 4.9</td>
<td>The description of the pitfall trapping survey effort provided in Table 4.9 of the EMM document is difficult to comprehend without any mapping to illustrate the placement of trapping lines within each vegetation zone containing suitable habitat for the species. Therefore, the assessor should consider the adequacy of sampling effort using the advice provided in the BCD recommendation provided.</td>
<td>The total survey effort for common Planigale be consistent with the following advice:
• Where the area of suitable habitat for common planigale exceeds 10 ha, the following number of pitfall trap arrays are required:
o total suitable habitat >10 – 50 ha: 10 arrays + three additional for every 10 ha of suitable habitat above 10 ha. For example, 20 ha of suitable habitat will require 13 arrays.
o total suitable habitat > 50 ha: 22 arrays plus one additional for every 10 ha of suitable habitat above 10 ha. For example, 60 ha of suitable habitat will require 23 arrays.
• The pitfall trap arrays must be evenly distributed across the suitable habitat. Traps must remain in place for a minimum of four consecutive nights.
• The species polygon is drawn to 500 m either side of the PCT ecotonal boundary, or to the other PCT boundary, whichever is smaller.</td>
<td>Habitat area is 150 ha (rounded to the nearest 10).
22 arrays plus 10 arrays are required, over for 4 nights.
Effort required is 256 trap nights.
268 trap nights have been conducted, therefore effort has been exceeded.
However only one array was located in Rainforest (20 trap nights).
Please advise on required effort to satisfy pitfall trapping in rainforest. Patches are separated by <200 m and are separated by PCTs aligned with the Planigale as per table below..
<table>
<tr><th>Location</th><th>Patches (ha)</th><th>Arrays required</th></tr>
<tr><td>1</td><td>0.38, 0.48, 0.41</td><td></td></tr>
<tr><td>2</td><td>0.24, 0.27</td><td></td></tr>
<tr><td>3</td><td>0.26, 0.24</td><td></td></tr>
<tr><td>4</td><td>0.16</td><td></td></tr>
<tr><td>5</td><td>2.89</td><td></td></tr>
<tr><td>6</td><td>2.8</td><td></td></tr>
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Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
24. Need to survey for squirrel glider in areas of suitable habitat.	Table 4.9	The assessor has indicated they would like to exclude squirrel glider as a candidate species based on there being only a small area of suitable habitat (i.e. 1.8 ha) identified for the species on the subject land. Despite only a relatively small area of suitable habitat for squirrel glider being considered present on the subject land, the assessor will need to survey for the species as a precautionary measure and to comply with the BAM 2020. The amount of survey already completed in other areas of the subject land cannot be taken into consideration for squirrel glider because the other areas have been identified as unsuitable habitat for the species.	Target survey for squirrel glider be undertaken in all areas of suitable habitat for the species on the subject land.	DEC (2004) requires 100 trap nights over 4 consecutive days per 50 ha of stratification unit. Given the very small area of aligned PCT (1.38 ha) we recommend 10 traps deployed over five nights, This equates to half the recommended trap effort (50 trap nights). This will result in saturation of the vegetation zone with 40 trap nights and approximate 30m spacing of traps. *BCD confirmed the above approach and have requested spotlighting if this has not already been completed in this area.*
25. Reptile survey methods and sampling effort are adequate	Table 4.10	Survey methods and sampling effort applied to 3 of the 4 candidate reptile species either meet or exceed the requirements of the published survey guidelines and TBDC survey comments. The BCD accepts the justification provided to limit any further survey for the pale-headed snake (*Hoplocephalus bitorquatus*).	No recommendation required	*BCD confirmed that the guidelines have been adequately applied. No further work proposed.*
26. Request advice about the pink underwing moth species polygon from the Biodiversity Offset Scheme Helpdesk	Table 4.11	The assessor has proposed the species polygon for the pink underwing moth to encompass only the two host plants of *Carronia multisepalea* and an appropriate buffer. The pink underwing moth requires presence of the host plant and areas of rainforest vegetation with sufficient canopy gap to allow filtered light to stimulate understorey vegetation and the host plant.	The species polygon for the pink underwing moth be drawn to encompass areas containing the host plant *Carronia multisepalea* and all areas of rainforest vegetation associated with the species in the TBDC with appropriate canopy gaps and filtered light to support understorey vegetation.	Email to BOS helpdesk sent 4/8/23

Table 1 **Summary of matters discussed, and actions required – Terrestrial ecology survey methods and techniques**

Matter Discussed	Reference	BCD Comments	BCD recommendations	Action required.
27. Apply the site-based approach	Section 4.5.1	The direct impact of the project would mainly be within the increased dam inundation zone, which shares some characteristics with a linear development. However, the indirect impacts, particularly for more highly mobile fauna species with larger home ranges, would be more appropriately assessed using the site-based assessment approach.	The site-based approach to applying the BAM	Apply the site-based approach.

Targeted Frog surveys

We assume that any further surveys required to target isolated habitat for frogs should be conducted in accordance with the 2020 survey guidelines.

We require assistance to interpret the requirements of the species polygons. This will inform where presence will be assumed or where further effort conducted to rule a species in or out. This is particularly pertinent where a species has already been recorded.

Pouched Frog (*Assa darlingtonia*)

Species is only aligned with rainforest PCTs

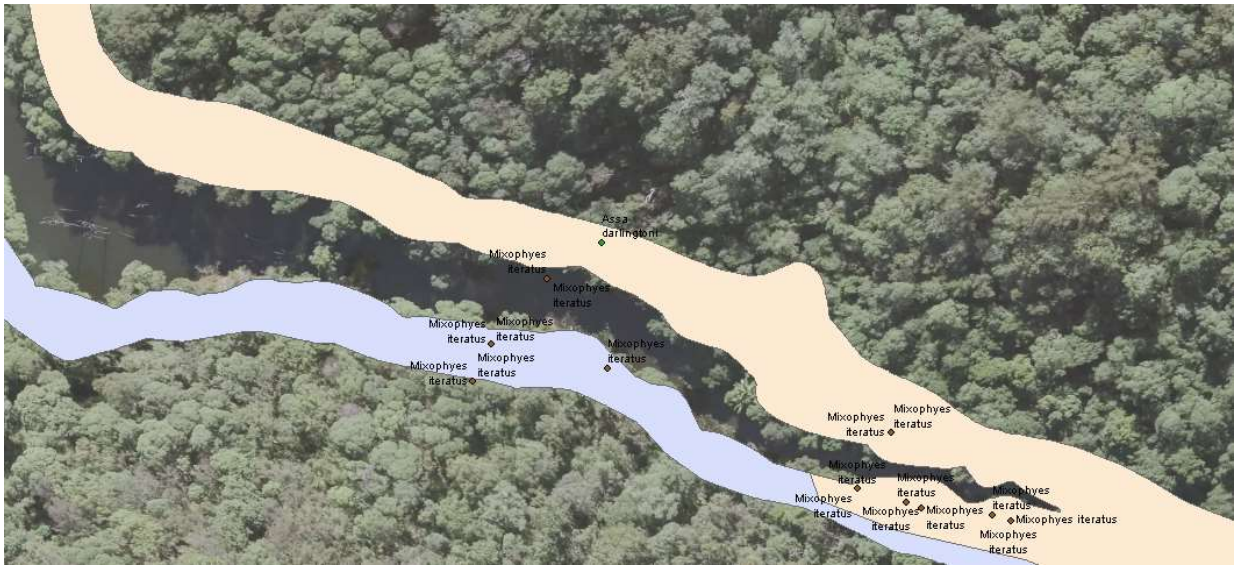
'*The species polygon boundary should align with any suitable vegetation type linked directly to the record and a buffer incorporating the PCTs with which it is associated within a 50 metre radius from the edge of the calling area*'

The intent of the species polygon above is somewhat ambiguous. Is it as simple as applying a 50 m buffer to the individual(s) recorded and using the aligned PCT area to form the species polygon. Or buffering a linked vegetation type?

Refer to example below, where *Assa* has been recorded at a single location within Rainforest (orange). Let's assume that a transect had been conducted within that specific rainforest patch, in accordance with the effort specified in the 2020 guidelines, but only one individual was recorded.

Would the species polygon be constructed using a 50 m buffer applied to one point location, intersected with both the disturbance footprint and aligned PCT. If this is the case then we will recommend further surveys to tightly define presence/absence to inform the species polygon throughout the continuous patch of rainforest

However if the entire area of the continuous rainforest patch requires offsetting, then no further survey effort would be recommended as it will not change the outcome of the species polygon.



B.11 Item 11

Fwd: BCD Response - RE Clarrie Hall Dam wall raising project - Camera trapping effort

David Hannah <DHannah@tweed.nsw.gov.au>

Fri 11/10/2023 3:13 PM

To:Kathryn Burton <Kathryn.Burton@kbr.com>
Cc:Eugene Dodd <edodd@emmconsulting.com.au>;Greg Lollback <GLollback@tweed.nsw.gov.au>

CAUTION: This email originated outside of the Organisation.

Hi Kathy and Eugene, please see response from Dimitri and Don from BCD on the camera trapping methodology. I am out in the field atm but will look through more closely when back in office.

Can we discuss finalising the methodology and approach once Eugene has had a chance to review.

Regards
David Hannah

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From: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Sent: Friday, November 10, 2023 12:16 pm
To: Corporate Email <tsc@tweed.nsw.gov.au>
Cc: David Hannah <DHannah@tweed.nsw.gov.au>; Greg Lollback <GLollback@tweed.nsw.gov.au>; Don Owner <Don.Owner@environment.nsw.gov.au>
Subject: BCD Response - RE Clarrie Hall Dam wall raising project - Camera trapping effort

Attention: Mr David Hannah

Dear David

Thank you for your e-mail below to the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment seeking comments on the review of fauna camera trapping effort for the proposed Clarrie Hall Dam raising BDAR prepared by Tweed Shire Council in October 2023.

We have reviewed the document you attached in conjunction with information provided by EMM to the BOS Helpdesk to inform their request for guidance on camera trapping survey effort.

We generally concur with the results of the rarefaction curve analysis contained in Appendix C of the terrestrial ecology survey approach provided by EMM in a letter dated 28 June 2023. The rarefaction curve analysis indicated the optimal sampling intensity for mammals is about 15 traps per Stratification Unit (SU).

For the purpose of preparing the Biodiversity Development Assessment Report for the Clarrie Hall Dam wall raising project, sampling effort should be based on SUs consisting of a combination of vegetation class and condition.

Based on EMM's subject land vegetation type table reproduced below, SUs on the subject land suitable for camera trap sampling include:

- North Coast Wet Sclerophyll Forest (WSF) High (64.12 ha),
- WSF Moderate (45.15 ha);
- WSF Low (11.54 ha),
- WSF Burnt (18.43 ha),
- Subtropical Rainforest (SRF) High (7.50 ha), and
- SRF Moderate (0.86 ha).

PCT	Vegetation class	Zone	Vegetation integrity score (VIS)	Area (ha)
827 Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast	North Coast Wet Sclerophyll Forests	High	68.9	64.12
		Mod	65.4	43.77
		Low	39.1	11.54
		Burnt	47.2	18.43
1073 Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	North Coast Wet Sclerophyll Forests	Moderate	36.3	1.38
1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	Subtropical Rainforests	High	50–65	7.50
		Moderate	n/a	0.86

Each SU should be sampled with at least 15 camera traps over a minimum of 14 nights. However, if the outcome of more recent Biodiversity Assessment Method plot flora survey in the WSF Burnt SU shows an improved condition comparable to the WSF Moderate SU, then these SUs can be combined for the purpose of camera sampling.

Also, camera sampling in the WSF Low SU should not be necessary if the target species have not been recorded by camera sampling in the WSF High and WSF Moderate SUs and any habitat constraints listed in the Threatened Biodiversity Data Collection are the same or less in the WSF Low SU than in the WSF High and WSF Moderate SUs. Conversely, if the targeted threatened species are recorded in either the WSF High or WSF Moderate SUs, then camera sampling in the WSF Low SU will be required to confirm species absence and justify excluding the SU from the species polygon. Alternatively, in these circumstances, the target species could be assumed present in the WSF Low SU.

Furthermore, given the very small extent of the SRF Moderate SU (e.g. 0.86 ha), it would be reasonable to combine it with the SRF High SU for the purpose of camera sampling.

Therefore, based on the requirements specified above, the BCD would expect a total of at least 45 camera traps to be used on the subject land over at least 14 nights (i.e. 15 cameras in the WSF High SU, 15 cameras in the WSF Moderate/Burnt SU and 15 cameras in the RF High/Moderate SU). Please note, the camera sampling effort can include any sampling already completed in each of the SUs during the 2016/17 surveys.

If you have any questions about this advice, please don't hesitate to contact Mr Don Owner, Senior Conservation Planning Officer, at don.owner@environment.nsw.gov.au or 6659 8239.

Yours sincerely
Dimitri

Dimitri Young
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation Division
Department of Planning and Environment

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Working days Monday to Friday, 09:00am - 05:00pm

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I acknowledge the traditional custodians of the land and pay respects to Elders past and present. I also acknowledge all the Aboriginal and Torres Strait Islander staff working with NSW Government at this time.

Please consider the environment before printing this email.

Don Owner
Senior Conservation Planning Officer, North East Branch
Biodiversity and Conservation Division
Department of Planning and Environment

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Coffs Harbour NSW 2450

Working days Monday to Friday

From: David Hannah <DHannah@tweed.nsw.gov.au>
Sent: Wednesday, 1 November 2023 11:46 AM
To: Dimitri Young <Dimitri.Young@environment.nsw.gov.au>
Cc: Don Owner <Don.Owner@environment.nsw.gov.au>; Greg Lollback <GLollback@tweed.nsw.gov.au>
Subject: Camera trapping effort at CHD

Hi Dimitri, hope you are well.

Regarding finalising a camera tapping survey effort for a BDAR currently being prepared for the Clarrie Hall Dam Raising proposal (SII 9458):

Council's EIS consultants EMM Pty Ltd (Eugene Dodd) contacted the BOS Help Desk on the 4 August 2023 to seek guidance on a camera trapping survey effort for target mammal species at Clarrie Hall Dam. The BOS Help Desk requested further information on the 11 August 2023 which was subsequently provided on the 14 August 2023. EMM then followed up for a response from the BOS Help Desk on the 30 August and 7 September 2023. See all correspondence attached.

The BOS Help Desk provided an update on the 27 September 2023 advising that they are unable to finalise survey guidance for the target species and if proceeding with surveys, then to:

- Use appropriate information from other published, peer-reviewed sources or guidelines published by other jurisdictions to assist
- Consult with the BCD Regional Planning team as relevant, prior to surveying.
- Provide details of applied survey approaches (timing, weather conditions, method and effort) and evidence-based justification for them in the BAR.

EMM now need to finalise the camera trapping survey methodology and complete the surveys. A report titled 'Review of fauna camera trapping effort for the proposed Clarrie Hall Dam raising BDAR' is attached to support an evidence based justification for the use of camera traps for the proposal.

Could the BCD please provide comment on the review by the 10 November 2023? Council and EMM are happy to meet with the BCD during this timeframe if preferred.

Regards
David Hannah
Tweed Shire Council
MOB: 0410 031 775

All official correspondence requiring a formal written response should be addressed to the General Manager, PO Box 816, Murwillumbah, 2484; or emailed to tsc@tweed.nsw.gov.au

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Appendix C
BAM plot data sheets

EMM
creating opportunities

BAM Site – Field Survey Form

Plot ID:	50_1302_H	**Date:**	17/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	530,747	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,850,597	**IBRA region:**	Scenic Rim	**Midline bearing:**	136
Plant Community Type:		1302: White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion		**Condition class:**	High	**PCT confidence:**	high
Vegetation Class:		Subtropical Rainforests		**EEC:**	yes	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	19
	Shrubs:	13
	Grasses etc.:	7
	Forbs:	5
	Ferns:	5
	Other:	13
Sum of Cover of native vascular plants by growth form group	Trees:	50.7
	Shrubs:	39.5
	Grasses etc.:	32.2
	Forbs:	5.3
	Ferns:	7.1
	Other:	42.6
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	48
80 + cm:	2		
50 – 79 cm:	3		
30 – 49 cm:	8		
20 – 29 cm:	17	Tree hollow count	3
10 – 19 cm:	19		
5 – 9 cm:	47		
< 5 cm:	27		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	60	90	70	80	50
Average litter cover (%):	70				

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

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	50_1302_H	**Date:**	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Syncarpia glomulifera (Turpentine)*	10	2		N
Tree (TG)	*Lophostemon confertus (Brush Box)*	10	2		N
Tree (TG)	*Sloanea woollsii (Yellow Carabeen)*	3	1		N
Shrub (SG)	*Backhousia myrtifolia (Grey Myrtle)*	35	20		N
Tree (TG)	*Allocasuarina torulosa (Forest Oak)*	6	1		N
Other (OG)	*Archontophoenix cunninghamiana (Bangalow Palm)*	35	20		N
Tree (TG)	*Endiandra globosa (Black Walnut)*	4	8		N
Shrub (SG)	*Syzygium oleosum (Blue Lilly Pilly)*	2	2		N
Tree (TG)	*Cyclophyllum longipetalum (Coast Canthium)*	8	20		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	1	3		N
Other (OG)	*Linospadix monostachyos (Walking-stick Palm)*	2	5		N
Shrub (SG)	*Synoum glandulosum subsp. glandulosum (Scentless Rosewood)*	0.5	3		N
Tree (TG)	*Acmena ingens (Red Apple)*	0.1	1		N
Shrub (SG)	*Pittosporum revolutum (Rough Fruit Pittosporum)*	0.5	5		N
Tree (TG)	*Mischocarpus pyriformis (Yellow Pear-fruit)*	0.4	4		N
Tree (TG)	*Trochocarpa laurina (Tree Heath)*	0.5	4		N
Shrub (SG)	*Psychotria simmondsiana (Small Psychotria)*	0.3	4		N
Tree (TG)	*Euroschinus falcatus var. falcatus (Ribbonwood)*	0.3	2		N
Shrub (SG)	*Croton verreauxii (Green Native Cascarilla)*	0.1	1		N
Tree (TG)	*Notelaea longifolia (Large Mock-olive)*	0.1	2		N
Shrub (SG)	*Hedraianthera porphyropetala (Hedraianthera)*	0.1	3		N
Shrub (SG)	*Breynia oblongifolia (Coffee Bush)*	0.1	1		N
Tree (TG)	*Flindersia bennettiana (Bennett's Ash)*	1	5		N
Tree (TG)	*Sarcopteryx stipata (Steelwood)*	1	5		N
Tree (TG)	*Jagera pseudorhus var. pseudorhus (Foambark Tree)*	0.1	2		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	2	10		N
Tree (TG)	*Neolitsea dealbata (Hairy-leaved Bolly Gum)*	0.1	2		N
Shrub (SG)	*Denhamia celastroides (Denhamia)*	0.1	2		N
Shrub (SG)	*Tabernaemontana pandacaqui (Banana Bush)*	0.1	1		N
Other (OG)	*Cordyline rubra (Palm-Lily)*	0.1	2		N
Tree (TG)	*Endiandra muelleri subsp. bracteata (Green-leaved Rose Walnut)*	0.1	1		N
Shrub (SG)	*Cryptocarya rigida (Forest Maple)*	0.1	2		N
Shrub (SG)	*Helicia ferruginea (Rusty Helicia)*	0.1	1		N
Shrub (SG)	*Acronychia pubescens (Hairy Acronychia)*	0.5	3		N
Tree (TG)	*Guioa semiglauca (Guioa)*	3	12		N
Grass & grasslike (GG)	*Lomandra confertifolia (Matrush)*	25	200		N
Grass & grasslike (GG)	*Ottochloa gracillima*	4	200		N
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	4	200		N
Grass & grasslike (GG)	*Lomandra longifolia (Spiny-headed Mat-rush)*	1	6		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	3	20		N
Fern (EG)	*Blechnum neohollandicum*	1	10		N
Fern (EG)	*Hypolepis muelleri (Harsh Ground Fern)*	1	10		N
Forb (FG)	*Tripladenia cunninghamii*	0.1	10		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	50_1302_H	Date:	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Pterostylis spp. (Greenhood)*	0.1	5		N
Forb (FG)	*Pterostylis sp. B*	0.1	5		N
Grass & grasslike (GG)	*Exocarya sclerioides*	0.1	2		N
Fern (EG)	*Adiantum silvaticum*	2	30		N
Grass & grasslike (GG)	*Lomandra spicata*	1	3		N
Grass & grasslike (GG)	*Carex polyantha*	0.1	1		N
Forb (FG)	*Dianella caerulea var. producta*	1	5		N
Other (OG)	*Calamus muelleri (Southern Lawyer Cane)*	2	4		N
Other (OG)	*Caelospermum paniculatum*	1	8		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	1	10		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.1	10		N
Other (OG)	*Flagellaria indica (Whip Vine)*	0.5	4		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.1	3		N
Other (OG)	*Echinostephia aculeata*	0.1	2		N
Other (OG)	*Ripogonum elseyanum (Hairy Supplejack)*	0.5	3		N
Other (OG)	*Cissus hypoglauca (Giant Water Vine)*	0.1	3		N
Other (OG)	*Dendrobium tetragonum (Tree Spider Orchid)*	0.1	2		N
Fern (EG)	*Asplenium australasicum (Bird's Nest Fern)*	0.1	2		N
Grass & grasslike (GG)	*Baloskion pallens*	1	8		N

BAM Site – Field Survey Form

Plot ID:	51_1302_L	**Date:**	18/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	528,945	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,852,554	**IBRA region:**	Scenic Rim	**Midline bearing:**	335
Plant Community Type:		1302: White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion		**Condition class:**	Low	**PCT confidence:**	high
Vegetation Class:		Subtropical Rainforests		**EEC:**	yes	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	23
	Shrubs:	9
	Grasses etc.:	3
	Forbs:	2
	Ferns:	4
	Other:	14
Sum of Cover of native vascular plants by growth form group	Trees:	148.9
	Shrubs:	7.1
	Grasses etc.:	6.2
	Forbs:	4.3
	Ferns:	0.8
	Other:	7.4
High Threat Weed cover:		18

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	30
80 + cm:	0		
50 – 79 cm:	3		
30 – 49 cm:	4		
20 – 29 cm:	10	Tree hollow count	0
10 – 19 cm:	20		
5 – 9 cm:	40		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	95	80	80	85
Average litter cover (%):	86				

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

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	51_1302_L	**Date:**	18/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Cinnamomum camphora (Camphor Laurel)	12	3		HTE
Tree (TG)	*Alphitonia excelsa (Red Ash)*	26	5		N
Tree (TG)	*Mallotus philippensis (Red Kamala)*	31	46		N
Tree (TG)	*Acacia melanoxylon (Blackwood)*	5	1		N
Tree (TG)	*Guioa semiglauca (Guioa)*	46	460		N
Tree (TG)	*Endiandra pubens (Hairy Walnut)*	3	1		N
Tree (TG)	*Elattostachys nervosa (Beetroot Tree)*	13.5	42		N
Tree (TG)	*Sarcopteryx stipata (Steelwood)*	5.5	10		N
Shrub (SG)	*Cryptocarya laevigata (Red-fruited Laurel)*	0.7	4		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.8	6		N
Shrub (SG)	*Cupaniopsis newmanii*	1	8		N
Tree (TG)	*Cyclophyllum longipetalum (Coast Canthium)*	1	6		N
Tree (TG)	*Scolopia braunii (Flintwood)*	0.6	5		N
Tree (TG)	*Polyscias elegans (Celery Wood)*	2.3	11		N
Shrub (SG)	*Wilkiea huegeliana (Veiny Wilkiea)*	1.2	7		N
Tree (TG)	*Cupaniopsis parvifolia (Small-leaved Tuckeroo)*	2.1	14		N
Tree (TG)	*Euroschinus falcatus var. falcatus (Ribbonwood)*	3	10		N
Tree (TG)	*Acmena smithii (Lilly Pilly)*	1.8	6		N
Tree (TG)	*Sloanea australis (Maiden's Blush)*	0.7	2		N
Shrub (SG)	*Ficus coronata (Creek Sandpaper Fig)*	2.5	10		N
	Citrus x taitensis (Rough Lemon)	0.5	2		E
	Lantana camara (Lantana)	6	22		HTE
Tree (TG)	*Endiandra globosa (Black Walnut)*	3.2	9		N
Shrub (SG)	*Syzygium oleosum (Blue Lilly Pilly)*	0.7	6		N
Tree (TG)	*Jagera pseudorhus var. pseudorhus (Foambark Tree)*	0.4	8		N
Tree (TG)	*Mallotus discolor (White Kamala)*	0.5	9		N
Tree (TG)	*Cryptocarya glaucescens (Jackwood)*	1.4	6		N
Other (OG)	*Archontophoenix cunninghamiana (Bangalow Palm)*	0.4	3		N
Shrub (SG)	*Aphananthe philippinensis (Rough-leaved Elm)*	0.4	10		N
Shrub (SG)	*Croton verreauxii (Green Native Cascarilla)*	0.2	7		N
Tree (TG)	*Cleistanthus cunninghamii (Cleistanthus)*	0.4	4		N
Shrub (SG)	*Pilidiostigma glabrum*	0.2	3		N
Shrub (SG)	*Gossia hillii (Scaly Myrtle)*	0.2	4		N
Tree (TG)	*Auranticarpa rhombifolia (Diamond-leaf Pittosporum)*	0.2	2		N
Tree (TG)	*Diploglottis australis (Native Tamarind)*	0.3	2		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	0.2	2		N
Grass & grasslike (GG)	*Ottochloa gracillima*	6	300		N
Forb (FG)	*Alpinia caerulea (Native Ginger)*	4	100		N
Forb (FG)	*Aneilema acuminatum*	0.3	30		N
Grass & grasslike (GG)	*Gahnia aspera (Rough Saw-sedge)*	0.1	3		N
Grass & grasslike (GG)	*Cyperus gracilis (Slender Flat-sedge)*	0.1	2		N
Fern (EG)	*Hypolepis muelleri (Harsh Ground Fern)*	0.1	4		N
Fern (EG)	*Pellaea falcata (Sickle Fern)*	0.1	3		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	51_1302_L	Date:	18/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Other (OG)	*Cissus antarctica (Water Vine)*	3	30		N
Other (OG)	*Cissus hypoglauca (Giant Water Vine)*	0.5	5		N
Other (OG)	*Embelia australiana*	0.5	20		N
Other (OG)	*Maclura cochinchinensis (Cockspur Thorn)*	0.5	15		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	1	20		N
Other (OG)	*Hibbertia scandens (Climbing Guinea Flower)*	0.5	5		N
	Passiflora subpeltata (White Passionflower)	0.2	6		E
Other (OG)	*Smilax australis (Lawyer Vine)*	0.2	8		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.1	8		N
Other (OG)	*Stephania japonica (Snake vine)*	0.1	5		N
Other (OG)	*Pandorea jasminoides (Bower Vine)*	0.1	5		N
Other (OG)	*Trophis scandens (Burny Vine)*	0.2	5		N
Other (OG)	*Flagellaria indica (Whip Vine)*	0.1	3		N
Other (OG)	*Austrosteenisia glabristyla (Giant Blood Vine)*	0.2	3		N
Fern (EG)	*Adiantum hispidulum (Rough Maidenhair)*	0.5	50		N
Fern (EG)	*Adiantum diaphanum (Filmy Maidenhair)*	0.1	10		N

BAM Site – Field Survey Form

Plot ID:	53_827_D	**Date:**	17/01/24	**Project number:**	E230037		**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,309	**Recorders:**	MH, JS			
Zone:	56	**Northing:**	6,849,965	**IBRA region:**	Scenic Rim		**Midline bearing:**	138
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Derived sedgeland		**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no		**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	7
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.2
	Grasses etc.:	57.5
	Forbs:	0.8
	Ferns:	0
	Other:	0
High Threat Weed cover:		2.7

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	1	3	5	1	2
Average litter cover (%):	2.4				

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

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	53_827_D	**Date:**	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Shrub (SG)	*Callistemon salignus (Willow Bottlebrush)*	0.2	5		N
	Paspalum scrobiculatum (Scrobic)	10	50		E
	Setaria sphacelata (South African Pigeon Grass)	8	50		E
Grass & grasslike (GG)	*Juncus usitatus*	19	60		N
Grass & grasslike (GG)	*Digitaria didactyla (Queensland Blue Couch)*	19	800		N
	Verbena hispida (Rough Verbena)	4	30		E
	Conyza sumatrensis (Tall fleabane)	3	10		E
	Verbena litoralis	3	10		E
	Cuphea carthagenensis	3	50		E
	Cyperus rotundus (Nutgrass)	0.5	10		E
	Cyperus eragrostis (Umbrella Sedge)	0.5	10		HTE
Grass & grasslike (GG)	*Cyperus exaltatus*	0.2	5		N
Forb (FG)	*Persicaria attenuata*	0.1	5		N
	Oxalis corniculata (Creeping Oxalis)	0.1	3		E
	Sporobolus pyramidalis	0.5	5		E
	Cyclospermum leptophyllum (Slender Celery)	0.1	2		E
	Solanum nigrum (Black-berry Nightshade)	0.1	5		E
	Setaria pumila (Pale Pigeon Grass)	0.5	5		E
Forb (FG)	*Centella asiatica (Indian Pennywort)*	0.5	25		N
	Senecio madagascariensis (Fireweed)	0.1	20		HTE
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	10	300		N
	Ambrosia artemisiifolia (Annual Ragweed)	1	7		E
	Conyza bonariensis (Flaxleaf Fleabane)	2	20		E
	Chloris gayana (Rhodes Grass)	2	20		HTE
Forb (FG)	*Mitrasacme pygmaea (Pygmy Bishop's Hat)*	0.1	1		N
	Paspalum mandiocanum (Broadleaf Paspalum)	0.1	3		HTE
Forb (FG)	*Commelina cyanea (Native Wandering Jew)*	0.1	5		N
Grass & grasslike (GG)	*Chloris ventricosa (Tall Chloris)*	0.3	20		N
Grass & grasslike (GG)	*Paspalum distichum (Water Couch)*	4	100		N
	Crassocephalum crepidioides (Thickhead)	0.1	1		E
Grass & grasslike (GG)	*Digitaria spp. (A Finger Grass)*	5	200		N

BAM Site – Field Survey Form

Plot ID:	54_827_D	**Date:**	17/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,379	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,850,065	**IBRA region:**	Scenic Rim	**Midline bearing:**	60
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Derived sedgeland	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	9
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	87.6
	Forbs:	3.6
	Ferns:	0
	Other:	0
High Threat Weed cover:		1.8

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	2	5	2	1	0
Average litter cover (%):	2				

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

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	54_827_D	**Date:**	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Paspalum distichum (Water Couch)*	15	150		N
Grass & grasslike (GG)	*Digitaria didactyla (Queensland Blue Couch)*	26	400		N
Grass & grasslike (GG)	*Juncus usitatus*	25	200		N
	Verbena hispida (Rough Verbena)	4	40		E
	Verbena litoralis	2	20		E
	Conyza sumatrensis (Tall fleabane)	3	30		E
Forb (FG)	*Eclipta prostrata*	2	20		N
	Cyperus eragrostis (Umbrella Sedge)	1	30		HTE
	Setaria sphacelata (South African Pigeon Grass)	1	5		E
	Cuphea carthagenensis	2	100		E
Forb (FG)	*Ludwigia octovalvis (Willow Primrose)*	1	20		N
	Chloris gayana (Rhodes Grass)	0.1	5		HTE
	Cyperus rotundus (Nutgrass)	0.5	20		E
Forb (FG)	*Alternanthera spp. (Joyweed)*	0.5	20		N
	Solanum nigrum (Black-berry Nightshade)	0.2	2		E
	Ageratum houstonianum	0.5	20		E
Grass & grasslike (GG)	*Chloris ventricosa (Tall Chloris)*	1	20		N
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	5	200		N
	Sporobolus pyramidalis	0.5	10		E
Forb (FG)	*Persicaria attenuata*	0.1	2		N
	Rumex crispus (Curled Dock)	0.1	1		E
	Urochloa mutica (Para Grass)	0.1	1		HTE
	Baccharis halimifolia (Groundsel Bush)	0.1	1		HTE
Grass & grasslike (GG)	*Gahnia sieberiana (Red-fruit Saw-sedge)*	0.1	1		N
	Paspalum mandiocanum (Broadleaf Paspalum)	0.5	5		HTE
Grass & grasslike (GG)	*Poaceae indeterminate (Grasses, reeds and bamboos)*	0.5	10		N
Grass & grasslike (GG)	*Poaceae indeterminate (Grasses, reeds and bamboos)*	1	10		N
Grass & grasslike (GG)	*Digitaria spp. (A Finger Grass)*	14	200		N

BAM Site – Field Survey Form

Plot ID:	55_827_L	**Date:**	17/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,578	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,849,904	**IBRA region:**	Scenic Rim	**Midline bearing:**	318
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Low	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	21
	Shrubs:	12
	Grasses etc.:	1
	Forbs:	3
	Ferns:	6
	Other:	8
Sum of Cover of native vascular plants by growth form group	Trees:	56.6
	Shrubs:	54.1
	Grasses etc.:	12
	Forbs:	8.5
	Ferns:	10.3
	Other:	3.3
High Threat Weed cover:		27.5

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	100
80 + cm:	0		
50 – 79 cm:	2		
30 – 49 cm:	20		
20 – 29 cm:	10	Tree hollow count	0
10 – 19 cm:	20		
5 – 9 cm:	40		
< 5 cm:	20		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	60	75	90	80
Average litter cover (%):	79				

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

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	55_827_L	**Date:**	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus grandis (Flooded Gum)*	14	4		N
	Cinnamomum camphora (Camphor Laurel)	25	9		HTE
Tree (TG)	*Allocasuarina torulosa (Forest Oak)*	6	3		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	3	2		N
Tree (TG)	*Tristaniopsis laurina (Kanooka)*	13	32		N
Tree (TG)	*Corymbia intermedia (Pink Bloodwood)*	1	1		N
Shrub (SG)	*Backhousia myrtifolia (Grey Myrtle)*	49	72		N
Tree (TG)	*Jagera pseudorhus var. pseudorhus (Foambark Tree)*	1	1		N
Shrub (SG)	*Syzygium oleosum (Blue Lilly Pilly)*	1	2		N
Tree (TG)	*Endiandra globosa (Black Walnut)*	2	1		N
Tree (TG)	*Flindersia bennettiana (Bennett's Ash)*	4	6		N
Tree (TG)	*Gmelina leichhardtii (White Beech)*	0.1	2		N
Tree (TG)	*Acmena smithii (Lilly Pilly)*	0.2	1		N
Tree (TG)	*Ficus spp.*	0.1	1		N
Shrub (SG)	*Wilkiea huegeliana (Veiny Wilkiea)*	2	8		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	2	8		N
Tree (TG)	*Notelaea longifolia (Large Mock-olive)*	0.8	4		N
Shrub (SG)	*Elaeodendron australe*	0.4	1		N
Tree (TG)	*Cyclophyllum longipetalum (Coast Canthium)*	2	6		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	3	8		N
Tree (TG)	*Endiandra pubens (Hairy Walnut)*	1	3		N
Tree (TG)	*Caldcluvia paniculosa (Soft Corkwood)*	0.4	2		N
Shrub (SG)	*Rhodamnia rubescens (Scrub Turpentine)*	0.1	2		N
Shrub (SG)	*Notelaea ovata*	0.1	2		N
Tree (TG)	*Guioa semiglauca (Guioa)*	2	6		N
Tree (TG)	*Sarcopteryx stipata (Steelwood)*	0.5	4		N
Shrub (SG)	*Pittosporum undulatum (Sweet Pittosporum)*	0.5	8		N
Shrub (SG)	*Pittosporum revolutum (Rough Fruit Pittosporum)*	0.1	2		N
	Lantana camara (Lantana)	2	8		HTE
Tree (TG)	*Mallotus philippensis (Red Kamala)*	0.4	4		N
	Senna septemtrionalis (Arsenic Bush)	0.2	4		E
Shrub (SG)	*Croton verreauxii (Green Native Cascarilla)*	0.2	4		N
Shrub (SG)	*Alchornea ilicifolia (Native Holly)*	0.4	7		N
	Citrus x taitensis (Rough Lemon)	0.1	1		E
Shrub (SG)	*Myrsine variabilis*	0.2	5		N
Shrub (SG)	*Psychotria loniceroides (Hairy Psychotria)*	0.1	2		N
	Ochna serrulata (Mickey Mouse Plant)	0.5	8		HTE
Tree (TG)	*Cupaniopsis parvifolia (Small-leaved Tuckeroo)*	0.1	2		N
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	6	200		N
Grass & grasslike (GG)	*Ottochloa gracillima*	12	300		N
Fern (EG)	*Adiantum hispidulum (Rough Maidenhair)*	4	100		N
Forb (FG)	*Aneilema acuminatum*	2	80		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	5	120		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	55_827_L	Date:	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Fern (EG)	*Blechnum spinulosum (Small Rasp Fern)*	1	30		N
Forb (FG)	*Gymnostachys anceps (Settler's Twine)*	0.5	5		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	0.5	12		N
Other (OG)	*Cissus antarctica (Water Vine)*	0.5	8		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.2	12		N
Other (OG)	*Trophis scandens (Burny Vine)*	0.1	4		N
Other (OG)	*Maclura cochinchinensis (Cockspur Thorn)*	0.3	10		N
	Passiflora edulis (Common Passionfruit)	0.1	2		E
Other (OG)	*Ripogonum elseyanum (Hairy Supplejack)*	1	10		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.5	5		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.2	5		N
Fern (EG)	*Arthropteris tenella*	0.1	1		N
Fern (EG)	*Pyrrosia rupestris (Rock Felt Fern)*	0.1	4		N
Fern (EG)	*Asplenium australasicum (Bird's Nest Fern)*	0.1	2		N

BAM Site – Field Survey Form

Plot ID:	56_827_B	**Date:**	18/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,521	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,852,738	**IBRA region:**	Scenic Rim	**Midline bearing:**	266
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Burnt	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	19
	Shrubs:	13
	Grasses etc.:	5
	Forbs:	7
	Ferns:	3
	Other:	19
Sum of Cover of native vascular plants by growth form group	Trees:	101.3
	Shrubs:	22.1
	Grasses etc.:	16.6
	Forbs:	13.3
	Ferns:	8.3
	Other:	13.7
High Threat Weed cover:		15

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	115
80 + cm:	0		
50 – 79 cm:	4		
30 – 49 cm:	9		
20 – 29 cm:	6	Tree hollow count	0
10 – 19 cm:	8		
5 – 9 cm:	15		
< 5 cm:	30		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	75	95	75	80	60
Average litter cover (%):	77				

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

Physiography and site features

Plot Disturbance

Most of the T2 layer has been removed by previous fires. Burnt stumps still present.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	56_827_B	**Date:**	18/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus grandis (Flooded Gum)*	17	2		N
Tree (TG)	*Lophostemon suaveolens (Swamp Mahogany, Swamp Turpentine)*	21	2		N
Tree (TG)	*Corymbia intermedia (Pink Bloodwood)*	4	1		N
	Cinnamomum camphora (Camphor Laurel)	10	13		HTE
Tree (TG)	*Alphitonia excelsa (Red Ash)*	16	27		N
Other (OG)	*Archontophoenix cunninghamiana (Bangalow Palm)*	2	1		N
Tree (TG)	*Cryptocarya glaucescens (Jackwood)*	7	23		N
Tree (TG)	*Commersonia bartramia (Brown Kurrajong)*	12	35		N
Shrub (SG)	*Duboisia myoporoides (Corkwood)*	8	34		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	10	43		N
Shrub (SG)	*Ficus coronata (Creek Sandpaper Fig)*	1	1		N
Shrub (SG)	*Trema tomentosa var. aspera (Native Peach)*	8	30		N
Other (OG)	*Cordyline petiolaris (Broad-leaved Palm Lily)*	3	3		N
Tree (TG)	*Polyscias elegans (Celery Wood)*	3	10		N
	Lantana camara (Lantana)	5	20		HTE
Tree (TG)	*Mallotus philippensis (Red Kamala)*	3	25		N
Tree (TG)	*Mallotus discolor (White Kamala)*	0.5	5		N
Shrub (SG)	*Synoum glandulosum subsp. glandulosum (Scentless Rosewood)*	3	15		N
Tree (TG)	*Acmena smithii (Lilly Pilly)*	0.5	5		N
Shrub (SG)	*Gossia hillii (Scaly Myrtle)*	0.1	2		N
	Solanum mauritianum (Wild Tobacco Bush)	0.5	10		E
Tree (TG)	*Toona ciliata (Red Cedar)*	0.2	2		N
Shrub (SG)	*Croton verreauxii (Green Native Cascarilla)*	0.1	1		N
Tree (TG)	*Melicope elleryana (Pink-flowered Doughwood)*	0.1	2		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	0.1	1		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.5	5		N
Shrub (SG)	*Cryptocarya rigida (Forest Maple)*	0.1	2		N
Tree (TG)	*Macaranga tanarius (Blush Macaranga)*	0.1	3		N
Shrub (SG)	*Persoonia adenantha*	0.5	5		N
Tree (TG)	*Glochidion sumatranum (Umbrella Cheese Tree)*	2	15		N
Tree (TG)	*Guioa semiglauca (Guioa)*	4	30		N
Shrub (SG)	*Eupomatia laurina (Bolwarra)*	0.5	3		N
Shrub (SG)	*Polyscias sambucifolia (Elderberry Panax)*	0.3	3		N
Shrub (SG)	*Breynia oblongifolia (Coffee Bush)*	0.1	1		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	0.3	2		N
Forb (FG)	*Alpinia caerulea (Native Ginger)*	2	50		N
Shrub (SG)	*Solanum stelligerum (Devil's Needles)*	0.1	3		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	7	50		N
	Oxalis corniculata (Creeping Oxalis)	0.1	5		E
Forb (FG)	*Viola hederacea (Ivy-leaved Violet)*	0.3	20		N
Fern (EG)	*Hypolepis muelleri (Harsh Ground Fern)*	0.3	10		N
Other (OG)	*Calochlaena dubia (Rainbow Fern)*	0.5	10		N
Fern (EG)	*Pteridium esculentum (Bracken)*	1	20		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	56_827_B	Date:	18/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Dianella caerulea var. producta*	0.5	3		N
Forb (FG)	*Dianella caerulea var. assera*	0.5	3		N
Grass & grasslike (GG)	*Ottochloa gracillima*	12	150		N
Grass & grasslike (GG)	*Oplismenus aemulus*	3	20		N
Forb (FG)	*Lobelia trigonocaulis (Forest Lobelia)*	6	100		N
Forb (FG)	*Lobelia purpurascens (whiteroot)*	2	50		N
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	2	30		N
Grass & grasslike (GG)	*Entolasia stricta (Wiry Panic)*	1	20		N
Grass & grasslike (GG)	*Cyperus gracilis (Slender Flat-sedge)*	0.1	5		N
Other (OG)	*Glycine tabacina (Variable Glycine)*	0.2	20		N
Grass & grasslike (GG)	*Lomandra longifolia (Spiny-headed Mat-rush)*	0.5	2		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.2	10		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.5	4		N
Other (OG)	*Flagellaria indica (Whip Vine)*	2	5		N
Other (OG)	*Billardiera scandens (Hairy Apple Berry)*	0.5	5		N
Other (OG)	*Stephania japonica (Snake vine)*	0.1	3		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	0.4	5		N
Other (OG)	*Maclura cochinchinensis (Cockspur Thorn)*	1	10		N
Shrub (SG)	*Rubus moluccanus (Molucca Bramble)*	0.3	8		N
Other (OG)	*Hibbertia scandens (Climbing Guinea Flower)*	0.1	4		N
Other (OG)	*Cissus hypoglauca (Giant Water Vine)*	1	4		N
Other (OG)	*Cissus antarctica (Water Vine)*	0.2	2		N
Other (OG)	*Aphanopetalum resinosum (Gum Vine)*	0.1	2		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.2	4		N
Other (OG)	*Echinostephia aculeata*	0.2	6		N
Other (OG)	*Kennedia rubicunda (Dusky Coral Pea)*	1	20		N
Other (OG)	*Embelia australiana*	0.5	5		N
	Passiflora edulis (Common Passionfruit)	1	10		E

BAM Site – Field Survey Form

Plot ID:	57_827_B	**Date:**	15/02/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,486	**Recorders:**	JS, DK		
Zone:	56	**Northing:**	6,852,935	**IBRA region:**	Scenic Rim	**Midline bearing:**	354
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Burnt	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	22
	Shrubs:	19
	Grasses etc.:	6
	Forbs:	7
	Ferns:	2
	Other:	10
Sum of Cover of native vascular plants by growth form group	Trees:	90.6
	Shrubs:	26.7
	Grasses etc.:	24.3
	Forbs:	3.4
	Ferns:	16
	Other:	1.8
High Threat Weed cover:		0.5

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	69
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	85	75	85	75	40
Average litter cover (%):	72				

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

Physiography and site features

Moderate slope, sandy loam soil (brown), aspect NE, well draining soils

Plot Disturbance

Recent fire

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	JS, DK	**Plot ID:**	57_827_B	**Date:**	15/02/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Lophostemon confertus (Brush Box)*	49	34		N
Tree (TG)	*Eucalyptus grandis (Flooded Gum)*	1	0		N
Tree (TG)	*Eucalyptus propinqua (Small-fruited Grey Gum)*	3	1		N
Tree (TG)	*Endiandra globosa (Black Walnut)*	27	23		N
Tree (TG)	*Alphitonia excelsa (Red Ash)*	0.1	1		N
Tree (TG)	*Corymbia intermedia (Pink Bloodwood)*	2	1		N
Tree (TG)	*Trochocarpa laurina (Tree Heath)*	1	2		N
Shrub (SG)	*Syzygium oleosum (Blue Lilly Pilly)*	2.5	4		N
Shrub (SG)	*Synoum glandulosum subsp. glandulosum (Scentless Rosewood)*	1.5	6		N
Tree (TG)	*Cryptocarya glaucescens (Jackwood)*	4	3		N
Shrub (SG)	*Myrsine variabilis*	0.5	5		N
Shrub (SG)	*Denhamia celastroides (Denhamia)*	0.5	5		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	0.5	2		N
Shrub (SG)	*Elaeocarpus reticulatus (Blueberry Ash)*	4	5		N
Shrub (SG)	*Pittosporum revolutum (Rough Fruit Pittosporum)*	0.4	2		N
Shrub (SG)	*Pilidiostigma glabrum*	0.4	8		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.3	5		N
Tree (TG)	*Acmena smithii (Lilly Pilly)*	0.5	5		N
Shrub (SG)	*Wilkiea huegeliana (Veiny Wilkiea)*	0.5	5		N
Shrub (SG)	*Persoonia adenantha*	0.4	10		N
Shrub (SG)	*Trema tomentosa var. aspera (Native Peach)*	5	30		N
Tree (TG)	*Melicope elleryana (Pink-flowered Doughwood)*	0.1	1		N
Tree (TG)	*Melicope rubra*	0.2	5		N
Tree (TG)	*Commersonia bartramia (Brown Kurrajong)*	0.4	5		N
Shrub (SG)	*Hovea acutifolia*	10	50		N
Shrub (SG)	*Zieria smithii (Sandfly Zieria)*	0.1	10		N
Shrub (SG)	*Hibiscus heterophyllus subsp. heterophyllus (Native Rosella)*	0.2	10		N
Tree (TG)	*Polyscias murrayi (Pencil Cedar)*	0.2	3		N
Tree (TG)	*Polyscias elegans (Celery Wood)*	0.2	4		N
	Lantana camara (Lantana)	0.3	3		HTE
Shrub (SG)	*Astrotricha latifolia*	0.2	5		N
Shrub (SG)	*Psychotria loniceroides (Hairy Psychotria)*	0.1	1		N
	Solanum mauritianum (Wild Tobacco Bush)	0.2	5		E
Shrub (SG)	*Polyscias sambucifolia (Elderberry Panax)*	0.1	4		N
Tree (TG)	*Jagera pseudorhus var. pseudorhus (Foambark Tree)*	0.1	2		N
Shrub (SG)	*Cupaniopsis newmanii*	0.1	1		N
Tree (TG)	*Archidendron grandiflorum (Pink Lace Flower)*	0.5	5		N
	Cinnamomum camphora (Camphor Laurel)	0.1	3		HTE
Tree (TG)	*Sarcopteryx stipata (Steelwood)*	0.2	3		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	0.1	5		N
Grass & grasslike (GG)	*Entolasia stricta (Wiry Panic)*	8	100		N
Grass & grasslike (GG)	*Ottochloa gracillima*	12	300		N
Grass & grasslike (GG)	*Lomandra longifolia (Spiny-headed Mat-rush)*	4	15		N

Project name:	E230037				
Recorders:	JS, DK	Plot ID:	57_827_B	Date:	15/02/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Fern (EG)	*Pteridium esculentum (Bracken)*	2	10		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	14	100		N
Forb (FG)	*Dianella caerulea var. producta*	2	8		N
Forb (FG)	*Desmodium rhytidophyllum*	0.3	5		N
Grass & grasslike (GG)	*Cyperus gracilis (Slender Flat-sedge)*	0.1	10		N
Grass & grasslike (GG)	*Oplismenus imbecillis*	0.1	5		N
Forb (FG)	*Aneilema acuminatum*	0.1	10		N
Forb (FG)	*Alpinia arundelliana (Native Ginger)*	0.2	10		N
Other (OG)	*Glycine tomentella (Woolly Glycine)*	0.1	3		N
Forb (FG)	*Alpinia caerulea (Native Ginger)*	0.2	5		N
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	0.5	50		N
Other (OG)	*Cordyline rubra (Palm-Lily)*	0.1	2		N
Forb (FG)	*Lobelia trigonocaulis (Forest Lobelia)*	0.1	20		N
Grass & grasslike (GG)	*Lepidosperma laterale (Variable Sword-sedge)*	0.1	2		N
Shrub (SG)	*Duboisia myoporoides (Corkwood)*	0.1	1		N
Shrub (SG)	*Ficus coronata (Creek Sandpaper Fig)*	0.1	1		N
Tree (TG)	*Toona ciliata (Red Cedar)*	0.1	1		N
Tree (TG)	*Schizomeria ovata (Crabapple)*	0.1	1		N
Other (OG)	*Stephania japonica (Snake vine)*	0.1	2		N
Other (OG)	*Kennedia rubicunda (Dusky Coral Pea)*	0.2	8		N
Other (OG)	*Smilax glyciphylla (Sweet Sarsparilla)*	0.3	5		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.1	5		N
Other (OG)	*Ripogonum elseyanum (Hairy Supplejack)*	0.5	2		N
Other (OG)	*Billardiera scandens (Hairy Apple Berry)*	0.2	5		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.1	1		N
	Passiflora suberosa (Cork Passionfruit)	0.1	1		HTE
Other (OG)	*Sicyos australis*	0.1	2		N

BAM Site – Field Survey Form

Plot ID:	58_827_B	**Date:**	15/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,931	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,853,612	**IBRA region:**	Scenic Rim	**Midline bearing:**	314
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Burnt	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	18
	Shrubs:	14
	Grasses etc.:	6
	Forbs:	9
	Ferns:	1
	Other:	14
Sum of Cover of native vascular plants by growth form group	Trees:	84.5
	Shrubs:	92.1
	Grasses etc.:	6.7
	Forbs:	1.9
	Ferns:	12
	Other:	53.2
High Threat Weed cover:		0.2

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	75
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	25		
20 – 29 cm:	19	Tree hollow count	0
10 – 19 cm:	18		
5 – 9 cm:	3		
< 5 cm:	8		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	80	65	90	80	35
Average litter cover (%):	70				

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

Physiography and site features

Easterly facing slope towards dam

Plot Disturbance

Previously burnt

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	58_827_B	**Date:**	15/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus microcorys (Tallowwood)*	34	12		N
Tree (TG)	*Eucalyptus resinifera (Red Mahogany)*	5	5		N
Tree (TG)	*Eucalyptus acmenoides (White Mahogany)*	5	4		N
Tree (TG)	*Corymbia intermedia (Pink Bloodwood)*	2	2		N
Tree (TG)	*Syncarpia glomulifera (Turpentine)*	7	7		N
Tree (TG)	*Lophostemon suaveolens (Swamp Mahogany, Swamp Turpentine)*	3	4		N
Tree (TG)	*Allocasuarina torulosa (Forest Oak)*	12	12		N
Tree (TG)	*Cryptocarya glaucescens (Jackwood)*	10	8		N
Shrub (SG)	*Elaeocarpus reticulatus (Blueberry Ash)*	9	22		N
Shrub (SG)	*Cryptocarya rigida (Forest Maple)*	16	85		N
Tree (TG)	*Trochocarpa laurina (Tree Heath)*	2	6		N
Tree (TG)	*Polyscias elegans (Celery Wood)*	2	6		N
Shrub (SG)	*Hovea acutifolia*	55	450		N
Other (OG)	*Cordyline petiolaris (Broad-leaved Palm Lily)*	1.5	5		N
Shrub (SG)	*Pilidiostigma glabrum*	3	20		N
Shrub (SG)	*Breynia oblongifolia (Coffee Bush)*	1	5		N
Shrub (SG)	*Polyscias sambucifolia (Elderberry Panax)*	4.5	32		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	1	12		N
Shrub (SG)	*Persoonia adenantha*	0.5	3		N
Shrub (SG)	*Astrotricha latifolia*	1	6		N
Shrub (SG)	*Denhamia celastroides (Denhamia)*	1	18		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	0.1	4		N
Tree (TG)	*Quintinia verdonii (Grey Possumwood)*	0.1	2		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	0.1	2		N
	Lantana camara (Lantana)	0.2	3		HTE
Tree (TG)	*Alphitonia excelsa (Red Ash)*	0.2	2		N
Shrub (SG)	*Eupomatia laurina (Bolwarra)*	0.4	8		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.3	4		N
Shrub (SG)	*Syzygium oleosum (Blue Lilly Pilly)*	0.3	6		N
Shrub (SG)	*Synoum glandulosum subsp. glandulosum (Scentless Rosewood)*	0.2	3		N
Tree (TG)	*Guioa semiglauca (Guioa)*	0.5	12		N
Tree (TG)	*Endiandra globosa (Black Walnut)*	0.2	1		N
Other (OG)	*Calochlaena dubia (Rainbow Fern)*	48	400		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	12	250		N
Forb (FG)	*Dianella caerulea var. producta*	0.3	20		N
Grass & grasslike (GG)	*Lomandra longifolia (Spiny-headed Mat-rush)*	0.4	40		N
Grass & grasslike (GG)	*Oplismenus aemulus*	2	200		N
	Paspalum scrobiculatum (Scrobic)	0.4	50		E
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	0.2	40		N
Grass & grasslike (GG)	*Entolasia stricta (Wiry Panic)*	0.5	50		N
Forb (FG)	*Vernonia cinerea*	0.1	3		N
Forb (FG)	*Lobelia trigonocaulis (Forest Lobelia)*	0.5	18		N
Grass & grasslike (GG)	*Lomandra spicata*	0.5	6		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	58_827_B	Date:	15/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Other (OG)	*Hibbertia dentata (Twining Guinea Flower)*	0.8	60		N
Grass & grasslike (GG)	*Oplismenus imbecillis*	3	100		N
Forb (FG)	*Desmodium gunnii (Slender Tick-trefoil)*	0.1	4		N
Grass & grasslike (GG)	*Ottochloa gracillima*	0.3	40		N
Forb (FG)	*Alpinia caerulea (Native Ginger)*	0.1	2		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.1	3		N
Other (OG)	*Clematicissus opaca (Pepper Vine)*	0.2	4		N
Other (OG)	*Stephania japonica (Snake vine)*	0.1	3		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.5	6		N
Other (OG)	*Hardenbergia violacea (False Sarsaparilla)*	0.1	3		N
Other (OG)	*Kennedia rubicunda (Dusky Coral Pea)*	0.5	15		N
Other (OG)	*Billardiera scandens (Hairy Apple Berry)*	0.5	30		N
Other (OG)	*Echinostephia aculeata*	0.1	8		N
Other (OG)	*Smilax glyciphylla (Sweet Sarsparilla)*	0.2	25		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.5	45		N
Other (OG)	*Eustrephus latifolius (Wombat Berry)*	0.1	3		N
Forb (FG)	*Lobelia purpurascens (whiteroot)*	0.2	50		N
Shrub (SG)	*Leucopogon juniperinus (Prickly Beard-heath)*	0.1	4		N
Shrub (SG)	*Solanum stelligerum (Devil's Needles)*	0.1	3		N
	Oxalis corniculata (Creeping Oxalis)	0.1	20		E
Forb (FG)	*Pomax umbellata (Pomax)*	0.2	20		N
Forb (FG)	*Desmodium rhytidophyllum*	0.2	15		N

BAM Site – Field Survey Form

Plot ID:	59_827_B	**Date:**	25/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,616	**Recorders:**	ED, JS		
Zone:	56	**Northing:**	6,854,102	**IBRA region:**	Scenic Rim	**Midline bearing:**	202
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Burnt	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	24
	Shrubs:	13
	Grasses etc.:	3
	Forbs:	4
	Ferns:	5
	Other:	14
Sum of Cover of native vascular plants by growth form group	Trees:	92.5
	Shrubs:	4.6
	Grasses etc.:	3.1
	Forbs:	0.7
	Ferns:	24.4
	Other:	7.6
High Threat Weed cover:		0.2

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	18
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	1
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	100	100	100	100	100
Average litter cover (%):	100				

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

Physiography and site features

25 deg slope, dark drown loamy soil.

Plot Disturbance

Historically logged, burnt approx 5 years ago

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	ED, JS	**Plot ID:**	59_827_B	**Date:**	25/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus grandis (Flooded Gum)*	30	4		N
Tree (TG)	*Eucalyptus microcorys (Tallowwood)*	3	0		N
Tree (TG)	*Schizomeria ovata (Crabapple)*	11.2	8		N
Tree (TG)	*Cryptocarya glaucescens (Jackwood)*	16.5	26		N
Tree (TG)	*Endiandra globosa (Black Walnut)*	21	25		N
Tree (TG)	*Euroschinus falcatus var. falcatus (Ribbonwood)*	2.6	7		N
Tree (TG)	*Caldcluvia paniculosa (Soft Corkwood)*	2.4	2		N
Tree (TG)	*Syncarpia glomulifera (Turpentine)*	2	1		N
Tree (TG)	*Lophostemon confertus (Brush Box)*	1	1		N
Shrub (SG)	*Syzygium oleosum (Blue Lilly Pilly)*	0.2	1		N
Shrub (SG)	*Archirhodomyrtus beckleri (Rose Myrtle)*	0.3	3		N
Tree (TG)	*Acronychia suberosa (Corky Acronychia)*	0.2	3		N
Tree (TG)	*Endiandra muelleri subsp. bracteata (Green-leaved Rose Walnut)*	0.1	1		N
Tree (TG)	*Sloanea woollsii (Yellow Carabeen)*	0.2	1		N
Tree (TG)	*Trochocarpa laurina (Tree Heath)*	0.7	4		N
Other (OG)	*Archontophoenix cunninghamiana (Bangalow Palm)*	0.5	2		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.2	1		N
Shrub (SG)	*Cryptocarya rigida (Forest Maple)*	1.5	20		N
Shrub (SG)	*Hovea acutifolia*	1	20		N
Other (OG)	*Cordyline rubra (Palm-Lily)*	0.1	2		N
Tree (TG)	*Archidendron grandiflorum (Pink Lace Flower)*	0.1	1		N
Shrub (SG)	*Eupomatia laurina (Bolwarra)*	0.4	5		N
Tree (TG)	*Mallotus discolor (White Kamala)*	0.1	1		N
Tree (TG)	*Commersonia bartramia (Brown Kurrajong)*	0.1	2		N
Tree (TG)	*Polyscias murrayi (Pencil Cedar)*	0.1	2		N
Tree (TG)	*Guioa semiglauca (Guioa)*	0.2	3		N
Tree (TG)	*Drypetes deplanchei (Yellow Tulipwood)*	0.2	2		N
Shrub (SG)	*Wilkiea huegeliana (Veiny Wilkiea)*	0.2	1		N
Shrub (SG)	*Synoum glandulosum subsp. glandulosum (Scentless Rosewood)*	0.4	3		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	0.2	3		N
	Cinnamomum camphora (Camphor Laurel)	0.2	5		HTE
Shrub (SG)	*Persoonia adenantha*	0.1	2		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	0.1	2		N
Shrub (SG)	*Pilidiostigma glabrum*	0.1	3		N
Shrub (SG)	*Pittosporum revolutum (Rough Fruit Pittosporum)*	0.1	1		N
Tree (TG)	*Alphitonia excelsa (Red Ash)*	0.1	1		N
Tree (TG)	*Neolitsea dealbata (Hairy-leaved Bolly Gum)*	0.2	2		N
Shrub (SG)	*Elaeocarpus reticulatus (Blueberry Ash)*	0.1	1		N
Shrub (SG)	*Astrotricha latifolia*	0.1	2		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	24	200		N
Other (OG)	*Calochlaena dubia (Rainbow Fern)*	2	20		N
Forb (FG)	*Alpinia arundelliana (Native Ginger)*	0.2	5		N
Forb (FG)	*Lobelia trigonocaulis (Forest Lobelia)*	0.2	5		N

Project name:	E230037				
Recorders:	ED, JS	Plot ID:	59_827_B	Date:	25/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Dianella caerulea var. producta*	0.2	8		N
Other (OG)	*Hibbertia dentata (Twining Guinea Flower)*	0.2	20		N
Grass & grasslike (GG)	*Entolasia stricta (Wiry Panic)*	1	10		N
Grass & grasslike (GG)	*Ottochloa gracillima*	2	40		N
Fern (EG)	*Hypolepis muelleri (Harsh Ground Fern)*	0.1	2		N
Forb (FG)	*Tripladenia cunninghamii*	0.1	3		N
Fern (EG)	*Asplenium australasicum (Bird's Nest Fern)*	0.1	2		N
Grass & grasslike (GG)	*Cyperus gracilis (Slender Flat-sedge)*	0.1	2		N
Other (OG)	*Smilax glyciphylla (Sweet Sarsparilla)*	3	40		N
Other (OG)	*Cissus hypoglauca (Giant Water Vine)*	0.5	10		N
Other (OG)	*Marsdenia longiloba (Slender Marsdenia)*	0.1	3		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.3	9		N
	Passiflora subpeltata (White Passionflower)	0.1	2		E
Other (OG)	*Echinostephia aculeata*	0.1	1		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	0.1	1		N
Other (OG)	*Flagellaria indica (Whip Vine)*	0.1	1		N
Other (OG)	*Kennedia rubicunda (Dusky Coral Pea)*	0.1	1		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.1	3		N
Shrub (SG)	*Trema tomentosa var. aspera (Native Peach)*	0.1	1		N
	Solanum mauritianum (Wild Tobacco Bush)	0.1	1		E
Fern (EG)	*Pyrrosia rupestris (Rock Felt Fern)*	0.1	2		N
Fern (EG)	*Platycerium bifurcatum (Elkhorn Fern)*	0.1	2		N
Other (OG)	*Stephania japonica (Snake vine)*	0.4	12		N

BAM Site – Field Survey Form

Plot ID:	60_827_P	**Date:**	18/01/24	**Project number:**	E230037		**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	530,132	**Recorders:**	MH, JS			
Zone:	56	**Northing:**	6,851,311	**IBRA region:**	Scenic Rim		**Midline bearing:**	12
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Planted		**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no		**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	26
	Shrubs:	13
	Grasses etc.:	3
	Forbs:	5
	Ferns:	5
	Other:	12
Sum of Cover of native vascular plants by growth form group	Trees:	89.9
	Shrubs:	9
	Grasses etc.:	19.5
	Forbs:	4.2
	Ferns:	1.1
	Other:	5.7
High Threat Weed cover:		7.6

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	45
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	6		
20 – 29 cm:	20	Tree hollow count	1
10 – 19 cm:	25		
5 – 9 cm:	15		
< 5 cm:	10		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	80	90	80	75	75
Average litter cover (%):	80				

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

Physiography and site features

Plot Disturbance

Planted

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	60_827_P	**Date:**	18/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Araucaria cunninghamii (Hoop Pine)*	34	8		N
	Araucaria bidwillii (Bunya Pine)	3	1		E
	Agathis robusta (Queensland Kauri)	12	4		E
Tree (TG)	*Podocarpus elatus (Plum Pine)*	4	1		N
Tree (TG)	*Stenocarpus sinuatus (Firewheel Tree)*	23	42		N
Tree (TG)	*Glochidion sumatranum (Umbrella Cheese Tree)*	2	2		N
Tree (TG)	*Flindersia australis (Crow's Ash)*	4.5	4		N
Tree (TG)	*Syzygium moorei (Durobby)*	8	4		N
Shrub (SG)	*Denhamia celastroides (Denhamia)*	0.6	3		N
Tree (TG)	*Gmelina leichhardtii (White Beech)*	2	4		N
Tree (TG)	*Flindersia bennettiana (Bennett's Ash)*	0.5	2		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	0.8	3		N
Shrub (SG)	*Callistemon salignus (Willow Bottlebrush)*	0.3	1		N
Tree (TG)	*Alphitonia excelsa (Red Ash)*	1	4		N
Tree (TG)	*Heritiera actinophylla (Black Booyong)*	0.5	1		N
Tree (TG)	*Grevillea robusta (Silky Oak)*	0.5	1		N
Tree (TG)	*Cinnamomum oliveri (Oliver's Sassafras)*	0.3	2		N
Tree (TG)	*Trochocarpa laurina (Tree Heath)*	0.3	1		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	0.5	5		N
Shrub (SG)	*Persoonia adenantha*	4	6		N
Tree (TG)	*Polyscias elegans (Celery Wood)*	0.3	1		N
Tree (TG)	*Ficus spp.*	0.2	1		N
	Syagrus romanzoffiana (Cocos Palm)	0.4	2		E
	Lantana camara (Lantana)	2	4		HTE
Tree (TG)	*Mallotus philippensis (Red Kamala)*	1	3		N
Tree (TG)	*Lepiderema pulchella (Fine-leaved Tuckeroo)*	0.5	1		N
Shrub (SG)	*Pittosporum undulatum (Sweet Pittosporum)*	0.3	1		N
Shrub (SG)	*Psychotria loniceroides (Hairy Psychotria)*	0.2	2		N
Tree (TG)	*Guioa semiglauca (Guioa)*	5	40		N
Tree (TG)	*Acmena smithii (Lilly Pilly)*	0.2	1		N
	Psidium cattleianum var. cattleianum (Strawberry Guava)	0.2	4		HTE
Tree (TG)	*Litsea australis (Brown Bolly Gum)*	0.1	1		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.2	4		N
Shrub (SG)	*Cryptocarya laevigata (Red-fruited Laurel)*	0.1	1		N
Shrub (SG)	*Syzygium oleosum (Blue Lilly Pilly)*	2	1		N
Shrub (SG)	*Myrsine variabilis*	1	5		N
Tree (TG)	*Jagera pseudorhus var. pseudorhus (Foambark Tree)*	0.2	3		N
Shrub (SG)	*Archirhodomyrtus beckleri (Rose Myrtle)*	0.1	1		N
	Schefflera actinophylla (Umbrella Tree)	0.1	1		HTE
Other (OG)	*Archontophoenix cunninghamiana (Bangalow Palm)*	0.3	5		N
Tree (TG)	*Macadamia integrifolia (Macadamia Nut)*	0.1	1		N
Shrub (SG)	*Pilidiostigma glabrum*	0.1	2		N
Tree (TG)	*Neolitsea dealbata (Hairy-leaved Bolly Gum)*	0.2	3		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	60_827_P	Date:	18/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Cinnamomum camphora (Camphor Laurel)	0.2	5		HTE
	Tradescantia fluminensis (Wandering Jew)	3	100		HTE
Grass & grasslike (GG)	*Lomandra confertifolia (Matrush)*	7	100		N
Grass & grasslike (GG)	*Ottochloa gracillima*	12	300		N
Forb (FG)	*Dianella caerulea var. assera*	0.3	5		N
Shrub (SG)	*Solanum stelligerum (Devil's Needles)*	0.1	1		N
	Paspalum scrobiculatum (Scrobic)	1	50		E
Forb (FG)	*Lobelia purpurascens (whiteroot)*	3	200		N
	Ardisia crenata (Coralberry)	2	30		E
Grass & grasslike (GG)	*Imperata cylindrica (Blady Grass)*	0.5	20		N
Shrub (SG)	*Clerodendrum floribundum var. floribundum*	0.1	1		N
Shrub (SG)	*Zieria arborescens (Stinkwood)*	0.1	2		N
	Urochloa mutica (Para Grass)	0.1	1		HTE
Forb (FG)	*Commelina cyanea (Native Wandering Jew)*	0.5	50		N
Forb (FG)	*Alpinia caerulea (Native Ginger)*	0.3	5		N
Fern (EG)	*Davallia solida var. pyxidata (Hare's Foot Fern)*	0.2	10		N
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	0.1	10		N
Fern (EG)	*Pteridium esculentum (Bracken)*	0.5	10		N
	Setaria sphacelata (South African Pigeon Grass)	0.5	20		E
Other (OG)	*Cissus hypoglauca (Giant Water Vine)*	0.2	2		N
Other (OG)	*Cissus antarctica (Water Vine)*	1	4		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.1	2		N
Other (OG)	*Echinostephia aculeata*	0.1	3		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	3	20		N
	Ipomoea cairica	2	20		HTE
Other (OG)	*Uvaria leichhardtii*	0.5	3		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.1	5		N
Other (OG)	*Pandorea jasminoides (Bower Vine)*	0.1	2		N
Other (OG)	*Ripogonum elseyanum (Hairy Supplejack)*	0.1	2		N
Other (OG)	*Maclura cochinchinensis (Cockspur Thorn)*	0.1	8		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.1	3		N
	Passiflora subpeltata (White Passionflower)	0.5	8		E
Fern (EG)	*Platycerium bifurcatum (Elkhorn Fern)*	0.1	1		N
Fern (EG)	*Asplenium australasicum (Bird's Nest Fern)*	0.1	2		N
Fern (EG)	*Pyrrosia confluens var. confluens (Horseshoe Felt Fern)*	0.2	5		N

BAM Site – Field Survey Form

Plot ID:	61_827_P	**Date:**	17/01/24	**Project number:**	E230037		**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,796	**Recorders:**	MH, JS			
Zone:	56	**Northing:**	6,850,310	**IBRA region:**	Scenic Rim		**Midline bearing:**	343
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Planted		**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no		**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	18
	Shrubs:	10
	Grasses etc.:	7
	Forbs:	4
	Ferns:	3
	Other:	13
Sum of Cover of native vascular plants by growth form group	Trees:	64.7
	Shrubs:	10
	Grasses etc.:	19.7
	Forbs:	4.4
	Ferns:	2.2
	Other:	4.3
High Threat Weed cover:		22.5

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	35
80 + cm:	0		
50 – 79 cm:	5		
30 – 49 cm:	12		
20 – 29 cm:	7	Tree hollow count	0
10 – 19 cm:	16		
5 – 9 cm:	17		
< 5 cm:	20		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	95	95	80	85
Average litter cover (%):	89				

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

Physiography and site features

Adjacent to natural drainage line into dam

Plot Disturbance

Lantana camara abundant

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	61_827_P	**Date:**	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Araucaria cunninghamii (Hoop Pine)*	49.4	63		N
	Cinnamomum camphora (Camphor Laurel)	17	7		HTE
Tree (TG)	*Eucalyptus microcorys (Tallowwood)*	5	1		N
Shrub (SG)	*Backhousia myrtifolia (Grey Myrtle)*	6.5	4		N
	Flindersia brayleyana	20	51		E
Tree (TG)	*Polyscias elegans (Celery Wood)*	1.3	4		N
Shrub (SG)	*Rhodamnia rubescens (Scrub Turpentine)*	0.3	2		N
Tree (TG)	*Cyclophyllum longipetalum (Coast Canthium)*	4.8	41		N
Tree (TG)	*Melicope elleryana (Pink-flowered Doughwood)*	0.5	1		N
Tree (TG)	*Mischocarpus pyriformis (Yellow Pear-fruit)*	0.5	2		N
Shrub (SG)	*Pilidiostigma glabrum*	1	5		N
Shrub (SG)	*Breynia oblongifolia (Coffee Bush)*	0.1	1		N
Other (OG)	*Archontophoenix cunninghamiana (Bangalow Palm)*	2	8		N
	Lantana camara (Lantana)	5	30		HTE
Shrub (SG)	*Pittosporum undulatum (Sweet Pittosporum)*	0.5	30		N
	Senna pendula	0.3	18		HTE
Tree (TG)	*Brachychiton acerifolius (Illawarra Flame Tree)*	0.1	1		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.5	5		N
Tree (TG)	*Melia azedarach (White Cedar)*	0.5	5		N
Tree (TG)	*Olea paniculata (Native Olive)*	0.1	4		N
Tree (TG)	*Guioa semiglauca (Guioa)*	0.3	15		N
	Ochna serrulata (Mickey Mouse Plant)	0.2	10		HTE
Tree (TG)	*Diploglottis australis (Native Tamarind)*	0.1	2		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	0.4	12		N
Shrub (SG)	*Synoum glandulosum subsp. glandulosum (Scentless Rosewood)*	0.4	8		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	0.1	5		N
Shrub (SG)	*Psychotria loniceroides (Hairy Psychotria)*	0.3	3		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	0.7	4		N
Shrub (SG)	*Wilkiea huegeliana (Veiny Wilkiea)*	0.7	4		N
Shrub (SG)	*Aphananthe philippinensis (Rough-leaved Elm)*	0.1	2		N
Tree (TG)	*Mallotus philippensis (Red Kamala)*	0.2	4		N
Tree (TG)	*Cupaniopsis parvifolia (Small-leaved Tuckeroo)*	0.1	2		N
Tree (TG)	*Grevillea robusta (Silky Oak)*	0.1	1		N
	Solanum capsicoides (Devil's Apple)	0.1	1		E
Grass & grasslike (GG)	*Ottochloa gracillima*	4	200		N
Grass & grasslike (GG)	*Oplismenus aemulus*	2	100		N
Grass & grasslike (GG)	*Lomandra confertifolia (Matrush)*	11	200		N
Forb (FG)	*Gymnostachys anceps (Settler's Twine)*	0.2	5		N
Forb (FG)	*Lobelia purpurascens (whiteroot)*	4	200		N
	Poaceae indeterminate (Grasses, reeds and bamboos)	0.1	5		E
Grass & grasslike (GG)	*Entolasia stricta (Wiry Panic)*	0.5	10		N
Shrub (SG)	*Wikstroemia indica*	0.1	1		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	0.1	4		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	61_827_P	Date:	17/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Other (OG)	*Calochlaena dubia (Rainbow Fern)*	0.1	2		N
Grass & grasslike (GG)	*Carex polyantha*	0.1	2		N
Forb (FG)	*Lobelia trigonocaulis (Forest Lobelia)*	0.1	1		N
Grass & grasslike (GG)	*Gahnia aspera (Rough Saw-sedge)*	0.1	3		N
Forb (FG)	*Dianella caerulea var. producta*	0.1	1		N
	Paspalum scrobiculatum (Scrobic)	3	60		E
Fern (EG)	*Pteridium esculentum (Bracken)*	2	5		N
Grass & grasslike (GG)	*Lomandra spicata*	2	30		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	0.5	12		N
Other (OG)	*Parsonsia rotata (Veinless Silkpod)*	0.2	8		N
Other (OG)	*Maclura cochinchinensis (Cockspur Thorn)*	0.3	10		N
	Passiflora subpeltata (White Passionflower)	0.1	4		E
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.1	10		N
Other (OG)	*Cissus antarctica (Water Vine)*	0.4	8		N
Other (OG)	*Echinostephia aculeata*	0.1	6		N
	Passiflora edulis (Common Passionfruit)	0.1	1		E
Other (OG)	*Smilax australis (Lawyer Vine)*	0.1	4		N
Other (OG)	*Flagellaria indica (Whip Vine)*	0.2	2		N
Other (OG)	*Parsonsia ventricosa (Acuminate Silkpod)*	0.1	3		N
Other (OG)	*Eustrephus latifolius (Wombat Berry)*	0.1	1		N
Other (OG)	*Smilax glyciphylla (Sweet Sarsparilla)*	0.1	1		N
Fern (EG)	*Asplenium australasicum (Bird's Nest Fern)*	0.1	2		N

BAM Site – Field Survey Form

Plot ID:	62_827_P	**Date:**	16/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,745	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,850,679	**IBRA region:**	Scenic Rim	**Midline bearing:**	155
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Planted	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	22
	Shrubs:	2
	Grasses etc.:	12
	Forbs:	4
	Ferns:	2
	Other:	8
Sum of Cover of native vascular plants by growth form group	Trees:	106
	Shrubs:	6
	Grasses etc.:	28.7
	Forbs:	11.7
	Ferns:	3.1
	Other:	1.8
High Threat Weed cover:		1.7

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	13
80 + cm:	1		
50 – 79 cm:	3		
30 – 49 cm:	12		
20 – 29 cm:	15	Tree hollow count	2
10 – 19 cm:	18		
5 – 9 cm:	9		
< 5 cm:	17		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	90	60	75	99
Average litter cover (%):	82.8				

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

Physiography and site features

Plot Disturbance

Planted vegetation around edge of dam, cleared tracks

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	62_827_P	**Date:**	16/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus grandis (Flooded Gum)*	24	6		N
Tree (TG)	*Eucalyptus propinqua (Small-fruited Grey Gum)*	4	2		N
Tree (TG)	*Eucalyptus acmenoides (White Mahogany)*	2	1		N
Tree (TG)	*Eucalyptus microcorys (Tallowwood)*	6	3		N
Tree (TG)	*Araucaria cunninghamii (Hoop Pine)*	27	12		N
Tree (TG)	*Lophostemon suaveolens (Swamp Mahogany, Swamp Turpentine)*	2	2		N
Tree (TG)	*Lophostemon confertus (Brush Box)*	3	4		N
Tree (TG)	*Allocasuarina torulosa (Forest Oak)*	4	6		N
Tree (TG)	*Cryptocarya glaucescens (Jackwood)*	3	4		N
Tree (TG)	*Flindersia schottiana (Cudgerie)*	3	5		N
	Cinnamomum camphora (Camphor Laurel)	0.5	1		HTE
Tree (TG)	*Syzygium luehmannii (Small-leaved Lilly Pilly)*	0.5	1		N
Tree (TG)	*Endiandra discolor (Rose Walnut)*	2	1		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	2	3		N
Tree (TG)	*Jagera pseudorhus var. pseudorhus (Foambark Tree)*	4	8		N
Tree (TG)	*Podocarpus elatus (Plum Pine)*	6	1		N
Tree (TG)	*Acacia melanoxylon (Blackwood)*	2	3		N
	Rhaphiolepis indica (Indian Hawthorn)	0.2	2		E
Tree (TG)	*Guioa semiglauca (Guioa)*	0.5	20		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	1	4		N
Tree (TG)	*Cyclophyllum longipetalum (Coast Canthium)*	2	6		N
Tree (TG)	*Cupaniopsis anacardioides (Tuckeroo)*	1	6		N
Tree (TG)	*Alphitonia excelsa (Red Ash)*	1	5		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	6	30		N
Shrub (SG)	*Pittosporum undulatum (Sweet Pittosporum)*	2	12		N
Shrub (SG)	*Persoonia adenantha*	4	4		N
	Lantana camara (Lantana)	1	3		HTE
	Senna pendula var. glabrata	0.2	2		HTE
Grass & grasslike (GG)	*Imperata cylindrica (Blady Grass)*	10	100		N
Grass & grasslike (GG)	*Oplismenus aemulus*	8	200		N
	Paspalum scrobiculatum (Scrobic)	2	50		E
Forb (FG)	*Lobelia purpurascens (whiteroot)*	10	300		N
Grass & grasslike (GG)	*Ottochloa gracillima*	4	100		N
Other (OG)	*Glycine clandestina (Twining glycine)*	0.1	20		N
Grass & grasslike (GG)	*Lomandra longifolia (Spiny-headed Mat-rush)*	0.2	20		N
Grass & grasslike (GG)	*Lomandra confertifolia (Matrush)*	0.1	5		N
Grass & grasslike (GG)	*Entolasia stricta (Wiry Panic)*	0.5	40		N
Forb (FG)	*Dianella caerulea var. assera*	0.2	2		N
Forb (FG)	*Dianella caerulea var. producta*	0.5	5		N
Forb (FG)	*Desmodium rhytidophyllum*	1	20		N
Grass & grasslike (GG)	*Scleria spp.*	0.1	5		N
Grass & grasslike (GG)	*Oplismenus imbecillis*	5	100		N
Grass & grasslike (GG)	*Paspalum distichum (Water Couch)*	0.1	5		N

Project name:	E230037				
Recorders:	MH, JS	Plot ID:	62_827_P	Date:	16/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Poaceae indeterminate (Grasses, reeds and bamboos)	5	60		E
Fern (EG)	*Pteridium esculentum (Bracken)*	3	12		N
Grass & grasslike (GG)	*Lomandra hystrix*	0.5	4		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.2	6		N
Other (OG)	*Eustrephus latifolius (Wombat Berry)*	0.1	3		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.2	5		N
Other (OG)	*Echinostephia aculeata*	0.1	3		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.1	1		N
Other (OG)	*Parsonsia straminea (Common Silkpod)*	0.5	4		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	0.5	4		N
Fern (EG)	*Pyrrosia confluens var. confluens (Horseshoe Felt Fern)*	0.1	1		N
Grass & grasslike (GG)	*Cyperus gracilis (Slender Flat-sedge)*	0.1	3		N
Grass & grasslike (GG)	*Gahnia aspera (Rough Saw-sedge)*	0.1	3		N
	Desmodium uncinatum (Silver-leaved Desmodium)	0.2	10		E

BAM Site – Field Survey Form

Plot ID:	64_827_G	**Date:**	15/02/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	531,396	**Recorders:**	PR		
Zone:	56	**Northing:**	6,855,991	**IBRA region:**	Scenic Rim	**Midline bearing:**	25
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Grassland	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	3
	Forbs:	3
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	30.1
	Forbs:	0.5
	Ferns:	0
	Other:	0
High Threat Weed cover:		53.2

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	10	10	25	10	15
Average litter cover (%):	14				

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

Physiography and site features

Cow paddock

Plot Disturbance

Cow paddock

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	PR	**Plot ID:**	64_827_G	**Date:**	15/02/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Cenchrus clandestinus (Kikuyu Grass)	15	100	no	HTE
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	20	200		N
	Paspalum dilatatum (Paspalum)	5	100		HTE
	Sporobolus fertilis (Giant Parramatta Grass)	3	300		HTE
	Paspalum mandiocanum (Broadleaf Paspalum)	30	2000		HTE
	Ambrosia artemisiifolia (Annual Ragweed)	0.2	20		E
	Cuphea carthagenensis	0.2	50		E
	Trifolium repens (White Clover)	4	500		E
Forb (FG)	*Centella asiatica (Indian Pennywort)*	0.2	50		N
	Gomphocarpus fruticosus (Narrow-leaved Cotton Bush)	0.3	40		E
	Verbena bonariensis (Purpletop)	0.1	20		E
Grass & grasslike (GG)	*Microlaena stipoides (Weeping Grass)*	10	400		N
	Aster subulatus (Wild Aster)	0.1	5		E
	Cyperus brevifolius	0.1	40		E
	Cenchrus setaceus (Fountain Grass)	0.1	2		HTE
	Citrus x taitensis (Rough Lemon)	0.1	1		E
Grass & grasslike (GG)	*Juncus usitatus*	0.1	15		N
	Medicago spp. (A Medic)	0.1	2		E
Forb (FG)	*Persicaria hydropiper (Water Pepper)*	0.2	10		N
Forb (FG)	*Ranunculus spp.*	0.1	1		N
	Prunella vulgaris (Self-heal)	0.1	5		E
	Senecio madagascariensis (Fireweed)	0.1	2		HTE

BAM Site – Field Survey Form

Plot ID:	65_827_G	**Date:**	15/02/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,661	**Recorders:**	JS, DK		
Zone:	56	**Northing:**	6,849,040	**IBRA region:**	Scenic Rim	**Midline bearing:**	115
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Grassland	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	6
	Forbs:	2
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	54.5
	Forbs:	1.2
	Ferns:	0
	Other:	0
High Threat Weed cover:		2.5

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	1
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	3	4	10	35	8
Average litter cover (%):	12				

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

Physiography and site features

Grassy plain adjacent to stream. Light reddish brown loamy sand, no aspect/flat, poorly draining

Plot Disturbance

Prior clearing. Grazing

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	JS, DK	**Plot ID:**	65_827_G	**Date:**	15/02/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Sporobolus pyramidalis	16	100		E
Grass & grasslike (GG)	*Juncus usitatus*	15	200		N
	Cirsium vulgare (Spear Thistle)	0.5	10		E
	Cyperus eragrostis (Umbrella Sedge)	0.5	15		HTE
	Verbena litoralis	1	25		E
Grass & grasslike (GG)	*Paspalum spp.*	5	50		N
	Setaria pumila (Pale Pigeon Grass)	7	100		E
Grass & grasslike (GG)	*Digitaria parviflora (Small-flowered Finger Grass)*	8	200		N
	Amaranthus spinosus (Needle Burr)	1	20		E
	Cuphea carthagenensis	4	100		E
Grass & grasslike (GG)	*Cyperus exaltatus*	0.5	20		N
Forb (FG)	*Persicaria decipiens (Slender Knotweed)*	0.5	10		N
	Conyza sumatrensis (Tall fleabane)	3	40		E
Grass & grasslike (GG)	*Digitaria didactyla (Queensland Blue Couch)*	6	100		N
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	20	300		N
	Conyza bonariensis (Flaxleaf Fleabane)	1	15		E
	Senecio madagascariensis (Fireweed)	1	30		HTE
	Sida rhombifolia (Paddy's Lucerne)	0.2	5		E
	Ageratum houstonianum	0.3	10		E
Forb (FG)	*Centella asiatica (Indian Pennywort)*	0.7	30		N
	Oxalis corniculata (Creeping Oxalis)	0.2	5		E
	Paspalum urvillei (Vasey Grass)	0.2	5		E
	Chloris gayana (Rhodes Grass)	1	25		HTE
	Paspalum notatum (Bahia Grass)	0.2	5		E
	Digitaria ciliaris (Summer Grass)	0.1	1		E
	Solanum nigrum (Black-berry Nightshade)	0.1	5		E

BAM Site – Field Survey Form

Plot ID:	66_827_G	**Date:**	18/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,877	**Recorders:**	MH, JS		
Zone:	56	**Northing:**	6,850,715	**IBRA region:**	Scenic Rim	**Midline bearing:**	199
Plant Community Type:		827: Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast		**Condition class:**	Grassland	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	6
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	85.1
	Forbs:	4.6
	Ferns:	0
	Other:	0
High Threat Weed cover:		0.2

BAM Attribute (1000 m2 plot) DBH			
DBH	**Tree stem count**	**Length of logs (m) (≥10 cm diameter, >50 cm in length)**	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	**Tree hollow count**	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	**1**	**2**	**3**	**4**	**5**
Subplot score (%):	0	0	1	1	1
Average litter cover (%):	0.6				

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

Physiography and site features

Grass approximately 0.1 m high

Plot Disturbance

Cleared grassland, grazing evident, cow pats adundant

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS	**Plot ID:**	66_827_G	**Date:**	18/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Digitaria didactyla (Queensland Blue Couch)*	63	1000		N
	Sporobolus pyramidalis	8	100		E
	Senecio madagascariensis (Fireweed)	0.2	30		HTE
	Gomphrena celosioides (Gomphrena Weed)	1	100		E
Grass & grasslike (GG)	*Paspalum distichum (Water Couch)*	12	300		N
Grass & grasslike (GG)	*Digitaria parviflora (Small-flowered Finger Grass)*	5	200		N
Forb (FG)	*Phyllanthus virgatus (Wiry Spurge)*	0.5	50		N
Forb (FG)	*Lobelia purpurascens (whiteroot)*	2.5	200		N
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	4	200		N
Grass & grasslike (GG)	*Cyperus exaltatus*	1	200		N
	Gamochaeta purpurea (Purple Cudweed)	0.1	20		E
Forb (FG)	*Centella asiatica (Indian Pennywort)*	1.5	100		N
Forb (FG)	*Persicaria strigosa*	0.1	20		N
	Cuphea carthagenensis	1	100		E
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	0.1	50		N

BAM Site – Field Survey Form

Plot ID:	70_1073_H	**Date:**	19/01/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,828	**Recorders:**	MH, JS, ED		
Zone:	56	**Northing:**	6,853,339	**IBRA region:**	Scenic Rim	**Midline bearing:**	30
Plant Community Type:		1073: Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion		**Condition class:**	High	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	24
	Shrubs:	10
	Grasses etc.:	8
	Forbs:	9
	Ferns:	1
	Other:	14
Sum of Cover of native vascular plants by growth form group	Trees:	82.8
	Shrubs:	7
	Grasses etc.:	16.5
	Forbs:	3.3
	Ferns:	10
	Other:	11.3
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	18
80 + cm:	0		
50 – 79 cm:	3		
30 – 49 cm:	19		
20 – 29 cm:	11	Tree hollow count	1
10 – 19 cm:	12		
5 – 9 cm:	9		
< 5 cm:	9		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	98	95	99	100	100
Average litter cover (%):	98.4				

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

Physiography and site features

Easterly facing slope

Plot Disturbance

Recently burnt (approx. 5 years ago)

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	MH, JS, ED	**Plot ID:**	70_1073_H	**Date:**	19/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus microcorys (Tallowwood)*	12	3		N
Tree (TG)	*Syncarpia glomulifera (Turpentine)*	3	1		N
Tree (TG)	*Corymbia intermedia (Pink Bloodwood)*	13	4		N
Tree (TG)	*Eucalyptus acmenoides (White Mahogany)*	12	3		N
Tree (TG)	*Lophostemon confertus (Brush Box)*	15.4	7		N
Tree (TG)	*Allocasuarina torulosa (Forest Oak)*	5.3	3		N
Tree (TG)	*Alphitonia excelsa (Red Ash)*	0.3	1		N
Shrub (SG)	*Backhousia myrtifolia (Grey Myrtle)*	3	6		N
Tree (TG)	*Endiandra globosa (Black Walnut)*	9.5	18		N
Tree (TG)	*Trochocarpa laurina (Tree Heath)*	2	2		N
Tree (TG)	*Schizomeria ovata (Crabapple)*	5	8		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	0.7	2		N
Shrub (SG)	*Elaeocarpus reticulatus (Blueberry Ash)*	1.5	5		N
Tree (TG)	*Guioa semiglauca (Guioa)*	3	5		N
Shrub (SG)	*Astrotricha latifolia*	1	4		N
Shrub (SG)	*Cryptocarya rigida (Forest Maple)*	0.5	2		N
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.1	1		N
Shrub (SG)	*Wilkiea huegeliana (Veiny Wilkiea)*	0.2	2		N
Tree (TG)	*Notelaea longifolia (Large Mock-olive)*	0.1	2		N
Tree (TG)	*Neolitsea dealbata (Hairy-leaved Bolly Gum)*	0.2	2		N
Shrub (SG)	*Persoonia adenantha*	0.1	2		N
Tree (TG)	*Endiandra muelleri subsp. bracteata (Green-leaved Rose Walnut)*	0.1	1		N
Tree (TG)	*Acacia maidenii (Maiden's Wattle)*	0.1	3		N
Tree (TG)	*Acmena smithii (Lilly Pilly)*	0.4	3		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	0.1	1		N
Shrub (SG)	*Hovea acutifolia*	0.2	7		N
Shrub (SG)	*Polyscias sambucifolia (Elderberry Panax)*	0.3	5		N
Tree (TG)	*Euroschinus falcatus var. falcatus (Ribbonwood)*	0.1	2		N
Tree (TG)	*Polyscias elegans (Celery Wood)*	0.1	1		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	10	100		N
Grass & grasslike (GG)	*Oplismenus aemulus*	4	200		N
Grass & grasslike (GG)	*Oplismenus imbecillis*	1	50		N
Other (OG)	*Calochlaena dubia (Rainbow Fern)*	8	15		N
Grass & grasslike (GG)	*Lomandra spicata*	0.5	20		N
Grass & grasslike (GG)	*Ottochloa gracillima*	10	400		N
Forb (FG)	*Dianella caerulea var. assera*	0.2	10		N
Forb (FG)	*Dianella caerulea var. producta*	0.2	10		N
Grass & grasslike (GG)	*Lomandra longifolia (Spiny-headed Mat-rush)*	0.5	20		N
Grass & grasslike (GG)	*Entolasia stricta (Wiry Panic)*	0.1	10		N
Forb (FG)	*Desmodium brachypodum (Large Tick-trefoil)*	0.1	2		N
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	0.2	20		N
Grass & grasslike (GG)	*Cyperus gracilis (Slender Flat-sedge)*	0.1	2		N
Other (OG)	*Cordyline rubra (Palm-Lily)*	0.1	2		N

Project name:	E230037				
Recorders:	MH, JS, ED	Plot ID:	70_1073_H	Date:	19/01/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Desmodium rhytidophyllum*	0.1	5		N
Forb (FG)	*Lobelia purpurascens (whiteroot)*	2	100		N
Other (OG)	*Glycine clandestina (Twining glycine)*	0.1	5		N
Forb (FG)	*Tripladenia cunninghamii*	0.2	4		N
Forb (FG)	*Pterostylis spp. (Greenhood)*	0.1	10		N
Other (OG)	*Kennedia rubicunda (Dusky Coral Pea)*	1	20		N
Other (OG)	*Marsdenia longiloba (Slender Marsdenia)*	0.1	2		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.1	2		N
Other (OG)	*Smilax glyciphylla (Sweet Sarsparilla)*	1	20		N
Other (OG)	*Billardiera scandens (Hairy Apple Berry)*	0.2	8		N
Other (OG)	*Embelia australiana*	0.2	3		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.1	4		N
Other (OG)	*Cissus antarctica (Water Vine)*	0.1	1		N
Other (OG)	*Echinostephia aculeata*	0.1	2		N
Other (OG)	*Geitonoplesium cymosum (Scrambling Lily)*	0.1	2		N
Other (OG)	*Parsonsia straminea (Common Silkpod)*	0.1	1		N
Grass & grasslike (GG)	*Lomandra confertifolia (Matrush)*	0.3	25		N
Shrub (SG)	*Pilidiostigma glabrum*	0.1	1		N
Shrub (SG)	*Trema tomentosa var. aspera (Native Peach)*	0.1	2		N
Tree (TG)	*Gmelina leichhardtii (White Beech)*	0.1	1		N
Tree (TG)	*Tristaniopsis laurina (Kanooka)*	0.1	2		N
Tree (TG)	*Commersonia bartramia (Brown Kurrajong)*	0.1	2		N
Forb (FG)	*Alpinia arundelliana (Native Ginger)*	0.2	4		N

BAM Site – Field Survey Form

Plot ID:	71_1073_H	**Date:**	15/02/24	**Project number:**	E230037	**Plot dimensions:**	20 x 50 m
Datum:	GDA94	**Easting:**	529,563	**Recorders:**	PR		
Zone:	56	**Northing:**	6,853,942	**IBRA region:**	Scenic Rim	**Midline bearing:**	60
Plant Community Type:		1073: Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion		**Condition class:**	High	**PCT confidence:**	high
Vegetation Class:		North Coast Wet Sclerophyll Forests		**EEC:**	no	**EEC confidence:**	high

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

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	21
	Shrubs:	20
	Grasses etc.:	4
	Forbs:	10
	Ferns:	3
	Other:	15
Sum of Cover of native vascular plants by growth form group	Trees:	25
	Shrubs:	13.4
	Grasses etc.:	5.6
	Forbs:	2.2
	Ferns:	15.3
	Other:	42.7
High Threat Weed cover:		0.4

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	125
80 + cm:	0		
50 – 79 cm:	4		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	1
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	95	90	95	100
Average litter cover (%):	94				

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

Physiography and site features

Moderately steep slope. Reddish fine siltstone/mudstone

Plot Disturbance

Previously logged. Minor weed invasion. Recently burnt.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E230037				
Recorders:	PR	**Plot ID:**	71_1073_H	**Date:**	15/02/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus acmenoides (White Mahogany)*	15	6		N
Tree (TG)	*Eucalyptus microcorys (Tallowwood)*	1	3		N
Tree (TG)	*Syncarpia glomulifera (Turpentine)*	4	8		N
Tree (TG)	*Lophostemon confertus (Brush Box)*	0.2	4		N
Shrub (SG)	*Elaeocarpus reticulatus (Blueberry Ash)*	4	15		N
Shrub (SG)	*Persoonia media*	0.1	3		N
Tree (TG)	*Macaranga tanarius (Blush Macaranga)*	0.2	2		N
Shrub (SG)	*Trema tomentosa var. aspera (Native Peach)*	2	8		N
Shrub (SG)	*Daviesia arborea*	3	20		N
Shrub (SG)	*Hovea acutifolia*	2	15		N
Tree (TG)	*Polyscias elegans (Celery Wood)*	0.1	1		N
Tree (TG)	*Alphitonia excelsa (Red Ash)*	0.1	3		N
Shrub (SG)	*Cryptocarya rigida (Forest Maple)*	0.2	1		N
Shrub (SG)	*Argophyllum nullumense (Silver Leaf)*	0.3	2		N
Tree (TG)	*Allocasuarina torulosa (Forest Oak)*	0.3	2		N
Tree (TG)	*Trochocarpa laurina (Tree Heath)*	0.6	3		N
Tree (TG)	*Euroschinus falcatus var. falcatus (Ribbonwood)*	0.2	15		N
Tree (TG)	*Guioa semiglauca (Guioa)*	0.2	10		N
Tree (TG)	*Commersonia bartramia (Brown Kurrajong)*	0.2	1		N
Shrub (SG)	*Melicope micrococca (Hairy-leaved Doughwood)*	0.2	1		N
Tree (TG)	*Toona ciliata (Red Cedar)*	0.1	1		N
Shrub (SG)	*Ficus coronata (Creek Sandpaper Fig)*	0.1	1		N
Shrub (SG)	*Polyscias sambucifolia (Elderberry Panax)*	0.2	4		N
Shrub (SG)	*Myrsine variabilis*	0.1	1		N
	Lantana camara (Lantana)	0.2	2		HTE
Shrub (SG)	*Breynia oblongifolia (Coffee Bush)*	0.1	2		N
Tree (TG)	*Corymbia intermedia (Pink Bloodwood)*	2	4		N
Other (OG)	*Kennedia rubicunda (Dusky Coral Pea)*	1	10		N
Other (OG)	*Smilax australis (Lawyer Vine)*	0.1	1		N
Other (OG)	*Hibbertia dentata (Twining Guinea Flower)*	0.2	6		N
Other (OG)	*Eustrephus latifolius (Wombat Berry)*	0.1	1		N
Other (OG)	*Dioscorea transversa (Native Yam)*	0.3	20		N
Other (OG)	*Billardiera scandens (Hairy Apple Berry)*	0.1	2		N
Fern (EG)	*Blechnum cartilagineum (Gristle Fern)*	15	300		N
Grass & grasslike (GG)	*Lomandra spp. (Mat-rush)*	0.1	2		N
Shrub (SG)	*Wilkiea huegeliana (Veiny Wilkiea)*	0.1	1		N
Forb (FG)	*Dianella caerulea (Blue Flax-lily)*	0.8	20		N
Shrub (SG)	*Pilidiostigma glabrum*	0.1	1		N
Shrub (SG)	*Astrotricha floccosa*	0.2			N
Other (OG)	*Glycine tomentella (Woolly Glycine)*	0.2	2		N
Forb (FG)	*Lobelia purpurascens (whiteroot)*	0.1	50		N
Grass & grasslike (GG)	*Ottochloa gracillima*	5	500		N
Forb (FG)	*Hybanthus stellarioides*	0.1	10		N

Project name:	E230037				
Recorders:	PR	Plot ID:	71_1073_H	Date:	15/02/24

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Forb (FG)	*Tripladenia cunninghamii*	0.3	30		N
Forb (FG)	*Alpinia caerulea (Native Ginger)*	0.2	3		N
Grass & grasslike (GG)	*Entolasia marginata (Bordered Panic)*	0.4	50		N
Forb (FG)	*Pseuderanthemum variabile (Pastel Flower)*	0.2	20		N
Other (OG)	*Gynochthodes jasminoides (Sweet Morinda)*	0.1	1		N
Forb (FG)	*Viola hederacea (Ivy-leaved Violet)*	0.2	20		N
Forb (FG)	*Lobelia trigonocaulis (Forest Lobelia)*	0.1	5		N
Other (OG)	*Glycine clandestina (Twining glycine)*	0.1	2		N
Tree (TG)	*Elattostachys nervosa (Beetroot Tree)*	0.1	1		N
Other (OG)	*Stephania japonica (Snake vine)*	0.1	2		N
Forb (FG)	*Oxalis chnoodes*	0.1	10		N
Fern (EG)	*Adiantum hispidulum (Rough Maidenhair)*	0.2	20		N
Shrub (SG)	*Rubus moluccanus (Molucca Bramble)*	0.1	2		N
Grass & grasslike (GG)	*Imperata cylindrica (Blady Grass)*	0.1	3		N
Shrub (SG)	*Denhamia silvestris (Narrow-leaved Orangebark)*	0.1	1		N
Other (OG)	*Cissus antarctica (Water Vine)*	0.1	1		N
Forb (FG)	*Physalis spp.*	0.1	1		N
Tree (TG)	*Elaeocarpus obovatus (Hard Quandong)*	0.2	2		N
Shrub (SG)	*Abrophyllum ornans (Native Hydrangea)*	0.3	1		N
Other (OG)	*Cissus hypoglauca (Giant Water Vine)*	0.1	2		N
	Cinnamomum camphora (Camphor Laurel)	0.2	3		HTE
Tree (TG)	*Cryptocarya microneura (Murrogun)*	0.1	1		N
Shrub (SG)	*Indigofera australis (Australian Indigo)*	0.1	2		N
Tree (TG)	*Glochidion ferdinandi (Cheese Tree)*	0.1	1		N
Other (OG)	*Parsonsia straminea (Common Silkpod)*	0.1	1		N
Tree (TG)	*Cryptocarya glaucescens (Jackwood)*	0.1	1		N
Tree (TG)	*Clerodendrum tomentosum (Hairy Clerodendrum)*	0.1	1		N
Shrub (SG)	*Rhodamnia rubescens (Scrub Turpentine)*	0.1	1		N
Fern (EG)	*Pteridium esculentum (Bracken)*	0.1	1		N
Other (OG)	*Calochlaena dubia (Rainbow Fern)*	40	400		N
Other (OG)	*Maclura cochinchinensis (Cockspur Thorn)*	0.1	1		N
Tree (TG)	*Ehretia acuminata var. acuminata (Koda)*	0.1	1		N

Appendix D
BAM-C import data

EMM
creating opportunities

D.1 BAM-C import data

Table D.1 BAM-C import data

Plot	PCT	Area (ha)	Patch	Condition	Zone	Easting	Northing	Bearing	Composition[1]						Structure[1]						Function								
									TG	SG	GG	FG	EG	OG	TG	SG	GG	FG	EG	OG	Large TGs	HBTs[2]	Litter	Fallen Logs	5-9	10-19	20-29	30-49	50-79	Regen	HTW[2]
58_827_B	827	19.04	101	Burnt	56	529931	6853612.0	314	18	14	6	9	1	14	84.5	92.1	6.7	1.9	12.0	53.2	0	0	70.0	75.0	1	1	1	1	0	1	0.2
56_827_B	827	19.04	101	Burnt	56	529521.8	6852739.0	266	19	13	5	7	3	19	101.3	22.1	16.6	13.3	8.3	13.7	4	0	77.0	115.0	1	1	1	1	1	1	15.0
57_827_B	827	19.04	101	Burnt	56	529486	6852935.0	354	22	19	6	7	2	10	90.6	26.7	24.3	3.4	16.0	1.8	1	0	72.0	69.0	0	0	0	0	1	0	0.5
59_827_B	827	19.04	101	Burnt	56	529616	6854102.0	202	24	13	3	4	5	14	92.5	4.6	3.1	0.7	24.4	7.6	1	1	100.0	18.0	1	1	1	1	1	1	0.2
54_827_D	827	4.58	101	Derived_ sedgeland	56	529379.2	6850066	60	0	0	7	4	0	0	0.0	0.0	86.1	3.6	0.0	0.0	0	0	2.0	0.0	0	0	0	0	0	0	1.8
53_827_D	827	4.58	101	Derived_ sedgeland	56	529309.2	6849965	138	0	1	7	4	0	0	0.0	0.2	57.5	0.8	0.0	0.0	0	0	2.4	0.0	0	0	0	0	0	0	2.7
66_827_G	827	64.06	101	Pasture	56	529877.5	6850715.0	199	0	0	6	4	0	0	0.0	0.0	85.1	4.6	0.0	0.0	0	0	0.6	0.0	0	0	0	0	0	0	0.2
65_827_G	827	64.06	101	Pasture	56	529661	6849041.0	115	0	0	6	2	0	0	0.0	0.0	54.5	1.2	0.0	0.0	0	0	12.0	1.0	0	0	0	0	0	0	2.5
64_827_G	827	64.06	101	Pasture	56	531396.5	6855991	25	0	0	3	3	0	0	0.0	0.0	30.1	0.5	0.0	0.0	0	0	14.0	0.0	0	0	0	0	0	0	53.2
Plot_27	827	64.06	101	Pasture	56	529510.3	6850670	100	0	0	2	1	0	0	0.0	0.0	75.0	0.1	0.0	0.0	0	0	10.0	0.0	0	0	0	0	0	0	25.0
Plot_32	827	64.06	101	Pasture	56	529083.7	6850120	180	0	0	3	2	1	0	0.0	0.0	4.2	0.4	0.1	0.0	0	0	70.0	0.0	0	0	0	0	0	0	40.1
Plot_3	827	72.13	101	High	56	530201.3	6853796.0	230	20	9	2	3	3	13	93.2	2.5	1.1	0.3	25.2	3.4	4	7	77.2	73.0	1	1	1	1	1	1	0.0
Plot_5	827	72.13	101	High	56	530217.7	6853242.0	150	19	9	5	5	4	11	51.1	8.3	0.6	0.5	30.3	1.6	0	5	75.6	61.0	1	1	1	1	0	1	0.1
Plot_12	827	72.13	101	High	56	529026	6851482.0	260	12	13	4	4	4	12	23.2	1.6	8.5	0.5	5.5	18.0	0	5	69.0	38.0	1	1	1	1	1	1	8.4
Plot_19	827	72.13	101	High	56	530031.1	6854115.0	330	15	15	4	4	4	7	38.5	18.9	0.6	0.9	15.4	21.3	1	2	94.6	28.0	1	1	1	1	1	1	0.1
Plot_23	827	72.13	101	High	56	530353.9	6851220.0	220	21	10	4	2	2	9	51.6	3.5	1.0	0.5	5.1	4.4	1	0	84.0	50.0	1	1	1	1	1	1	0.4
Plot_28	827	72.13	101	High	56	528158.1	6852160.0	30	15	12	4	1	1	13	38.7	22.9	5.8	0.2	0.2	1.7	0	0	78.0	10.0	1	1	1	1	1	1	5.3
55_827_L	827	25.50	101	Low	56	529578.1	6849905.0	318	21	12	1	3	6	8	56.6	54.1	12.0	8.5	10.3	3.3	2	0	79.0	100.0	1	1	1	1	1	1	27.5
Plot_9	827	25.50	101	Low	56	529354.9	6852232.0	240	15	10	5	2	2	8	15.3	1.3	0.6	0.2	10.1	15.9	0	0	58.8	230.0	1	1	1	1	1	1	45.2
Plot_11	827	25.50	101	Low	56	529646.2	6851561.0	200	5	6	5	0	3	7	21.1	5.1	48.6	0.0	0.5	0.8	0	2	24.0	52.0	1	1	1	0	0	1	15.3
Plot_13	827	25.50	101	Low	56	528984.6	6851156.0	175	15	7	6	3	3	14	3.2	0.9	25.5	0.4	0.5	1.6	0	9	68.8	62.0	1	0	1	1	0	1	43.2
Plot_4	827	31.27	101	Mod	56	530197.8	6852983.0	300	18	15	5	4	6	10	55.3	2.5	0.7	0.6	0.9	5.1	0	4	56.0	36.0	1	1	1	1	0	1	16.1
Plot_10	827	31.27	101	Mod	56	529423.9	6851709.0	185	7	4	4	0	1	3	22.8	5.3	65.4	0.0	0.1	0.3	0	3	21.0	82.0	1	1	1	0	0	1	4.3
Plot_18	827	31.27	101	Mod	56	530013	6854366.0	45	18	18	4	4	1	14	47.9	7.5	2.7	0.8	0.2	4.9	1	0	90.6	32.0	1	1	1	1	0	1	1.6
Plot_26	827	31.27	101	Mod	56	529991.6	6849061.0	30	12	7	5	4	4	8	25.2	55.8	1.6	0.4	5.4	2.5	0	0	58.0	8.0	1	1	1	1	0	1	6.0
Plot_31	827	31.27	101	Mod	56	529032.3	6850498.0	140	8	3	6	6	2	4	38.5	0.3	5.8	0.8	0.3	0.4	9	1	93.0	3.0	1	1	1	1	1	1	0.8
Plot_33	827	31.27	101	Mod	56	529068.1	6850244.0	25	5	0	5	1	1	3	21.2	0.0	20.8	0.1	0.2	0.3	2	2	90.6	0.0	2	2	2	2	2	1	25.4

Plot	PCT	Area (ha)	Patch	Condition	Zone	Easting	Northing	Bearing	Composition[1]						Structure[1]						Function								
									TG	SG	GG	FG	EG	OG	TG	SG	GG	FG	EG	OG	Large TGs	HBTs[2]	Litter	Fallen Logs	5-9	10-19	20-29	30-49	50-79	Regen	HTW[2]
62_827_P	827	6.10	101	Planted	56	529746	6850680.0	155	22	2	12	4	2	8	106.0	6.0	28.7	11.7	3.1	1.8	4	2	82.8	13.0	1	1	1	1	1	1	1.7
61_827_P	827	6.10	101	Planted	56	529796.7	6850311.0	343	18	10	7	4	3	13	64.7	10.0	19.7	4.4	2.2	4.3	5	0	89.0	35.0	1	1	1	1	1	1	22.5
60_827_P	827	6.10	101	Planted	56	530132.6	6851312.0	12	26	13	3	5	5	12	89.9	9.0	19.5	4.2	1.1	5.7	1	1	80.0	45.0	1	1	1	1	1	1	7.6
71_1073_H	1073	2.67	101	High	56	529563.8	6853943	60	21	20	4	10	3	15	25.0	13.4	5.6	2.2	15.3	42.7	5	1	94.0	125.0	1	1	1	1	1	1	0.4
70_1073_H	1073	2.67	101	High	56	529828.7	6853339	30	24	10	8	9	1	14	82.8	7.0	16.5	3.3	10.0	11.3	22	1	98.4	18.0	1	1	1	1	1	1	0.0
50_1302_H	1302	5.78	101	High	56	530747.7	6850597	136	19	13	7	5	5	13	50.7	39.5	32.2	5.3	7.1	42.6	2	3	70.0	48.0	1	1	1	1	1	1	0.0
Plot_7	1302	5.78	101	High	56	530541.4	6852396	110	16	8	2	4	8	15	24.7	1.7	0.4	0.5	1.2	54.2	1	12	50.0	51.0	1	1	1	1	1	1	0.0
Plot_17	1302	5.78	101	High	56	529799.7	6854429	90	15	16	4	7	3	14	67.6	7.1	5.3	1.4	5.0	33.6	0	6	35.0	132.0	1	1	1	1	0	1	0.0
51_1302_L	1302	2.99	101	Mod	56	528945.3	6852555	335	23	9	3	2	4	14	148.9	7.1	6.2	4.3	0.8	7.4	0	0	86.0	30.0	1	1	1	1	1	1	18.0
Plot_24	1302	2.99	101	Mod	56	530050.6	6848454	20	13	4	4	1	3	10	9.7	60.3	0.5	0.2	8.1	1.8	0	1	48.0	20.0	1	1	1	1	1	1	21.3
Plot_25	1302	2.99	101	Mod	56	529909.1	6849061	280	16	10	1	4	5	10	18.2	71.4	0.2	0.4	5.9	1.5	0	0	65.0	20.0	1	1	1	0	0	1	0.3

Notes: 1. TG = Tree, SG = Shrub, GG = Grass & Grass like, FG = Forb, EG = Fern and fern allies, OG = Other

2. HBT = Hollow bearing trees, HTW = High Threat Weed

Appendix E

Meteorological conditions during fauna survey

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E.1 Meteorological conditions during targeted fauna surveys

E.1.1 Amphibians

In accordance with Section 2.11.1 of the NSW Survey Guide for Threatened Frogs (DPIE, 2020), meteorological conditions are required to be documented, including:

- minimum and maximum temperatures
- rainfall in the previous 24 hours, seven days, and month
- humidity
- barometric pressure
- wind
- cloud cover
- moon phase.

Table E.1 provides an overview of the meteorological conditions during targeted amphibian surveys.

Table E.1 Meteorological conditions during amphibian surveys

Date	Start time	End time	Temperature during survey (°C)	Maximum daily temp (°C)	Rainfall 24hrs (mm)	Rainfall 7 days (mm)	Rainfall month (mm)	Humidity (%)	Barometric pressure (hPa)	Wind (km/h)	Cloud cover %	Moon phase
21 November 2016—18 January 2017	-	-	-	25.3–37.4 (max range during period)	-	-	253.3 (total during period)	-	-	-	-	-
15 February 2017	-	-	-	-	0	34.3	109.5	-	-	-	-	Waning gibbous
16 February 2017												Waning gibbous
12 January 2021	-	-	17.0–28.1	-	0.2	50.1	703.2	-	-	-	-	Waning crescent

Date	Start time	End time	Temperature during survey (°C)	Maximum daily temp (°C)	Rainfall 24hrs (mm)	Rainfall 7 days (mm)	Rainfall month (mm)	Humidity (%)	Barometric pressure (hPa)	Wind (km/h)	Cloud cover %	Moon phase
13 January 2021	-	-	17.0–29.1	-	0	50.3	478	-	-	-	-	New moon
14 January 2021	-	-	19.3–29.7	-	0	47.5	423	-	-	-	-	Waxing crescent
19 September 2023	-	-	-	25.1	0	1.5	38.9	-	-	-	-	Waxing crescent
20 September 2023	-	-	-	30.0	0	1.5	38.9	-	-	-	-	Waxing crescent
21 September 2023	-	-	-	34.8	0	0	38.9	-	-	-	-	Waxing crescent
22 September 2023	-	-	-	21.2	0	0	38.9	-	-	-	-	Waxing crescent
17 November 2023	8:30	13:15	22.4–28.6	30.9	0	50.2	116.3	72.4–92.2	-	-	-	Waxing crescent
30 November 2023	8:19	11:22	21.3–25.4	33.0	0	4.3	110.4	82.7–92.0	-	-	-	Waning gibbous
1 December 2023	8:30	11:21	21.7–27.0	34.8	1	3.5	111.4	65.4–81.9	-	-	-	Waning gibbous
7 December 2023	8:17	10:52	24.1–28.5	31.0	0	5	87.1	69.8–85.8	-	-	-	Waning crescent
24 January 2024	20:13	23:15	24.7	-	-	-	-	72.3	-	-	-	Waxing gibbous
1 February 2024	20:00	22:00	24.3	-	2.5	32.6	671.3	86.5	-	-	-	Waning gibbous
1 February 2024 (reference population check)	23:00	-	23.0	-	2.5	32.6	671.3	83.4	-	-	-	Waning gibbous

Date	Start time	End time	Temperature during survey (°C)	Maximum daily temp (°C)	Rainfall 24hrs (mm)	Rainfall 7 days (mm)	Rainfall month (mm)	Humidity (%)	Barometric pressure (hPa)	Wind (km/h)	Cloud cover %	Moon phase
2 February 2024 (reference population check)	19:55	-	27.6	33.0	0	32.6	560.3	79.6	-	-	-	Waning gibbous
5 February 2024	20:13	21:51	26.5	31.3	8	22.6	525.3	80.7	-	-	25	Waning crescent
6 February 2024	20:12	21:55	25.0	32.5	0.2	18.7	525.5	-	-	-	-	Waning crescent
13 March 2024	18:45	19:00	22.3	29.0	2.6	19.9	58.9	80.4	1,005.8	Calm	-	Waxing crescent
24 March 2024	18:56	21:12	20.1	22.1	0.4	39.8	76.1	95.8	1,010.4	Calm	-	Full moon
25 March 2024	19:00	20:56	21.1	24.2	8.9	40.2	76.5	99.7	1,010	Calm	-	Waning gibbous
26 March 2024	18:56	20:47	21.0	23.2	1.6	22.3	73.0	99.0	1,009	Calm	-	Waning gibbous
31 March 2024	18:56	22:10	22.0	28.0	0	48.6	110.3	88.7	1,011.5	Calm	-	Waning gibbous

E.1.2 Bats

In accordance with 'Species credit' bats and their habitats (OEH, 2018a), meteorological conditions are required to be documented, including:

- minimum and maximum temperature (°C) for each night of the survey
- rainfall (mm) for each night of survey.

Table E.2 provides an overview of the meteorological conditions during targeted bat surveys.

Table E.2 Meteorological conditions during bat surveys

Survey technique	Date	Min temp (°C)	Max temp (°C)	Rainfall (mm)
• Acoustic detection • Harp Trapping	21 November 2016 - 18 January 2017	14.0–24.7	25.3–37.4	253.3
• Acoustic detection • Harp Trapping	30 November 2020	19.5	29.5	0
	1 December 2020	22.0	31.4	0
	2 December 2020	22.4	34.5	0
	3 December 2020	22.4	28.7	0
	4 December 2020	22.3	35.8	0.6

E.1.3 Reptiles

In accordance with Appendix D of the Threatened reptiles – Biodiversity Assessment Method survey guide (DPE, 2022), meteorological conditions are required to be documented, including:

- rainfall (mm) for the two days prior to survey
- rainfall (mm) for each day or night of survey
- minimum and maximum temperature (°C) for each day or night of the survey
- relative humidity (%) for each day or night of the survey
- mean wind speed (km/h), for each day or night of the survey
- cloud cover (oktas) for each day of the survey
- moon phase for each night of the survey.

Table E.3 provides an overview of the meteorological conditions during targeted reptile surveys.

Table E.3 Meteorological conditions during reptile surveys

Date	Min temp range (°C)	Max temp range (°C)	Rainfall (mm)	Relative humidity (%)	Mean wind speed (km/h)	Cloud cover (oktas)
21 November 2016—18 January 2017	14.0–24.7	25.3–37.4	253.3	-	-	-

E.1.4 Forest owl surveys

In accordance with the TBDC (DCCEEW, 2024a), surveys for forest owls should be conducted during calm and dry conditions.

Table E.4 provides an overview of the meteorological conditions during targeted forest owl surveys.

Table E.4 Meteorological conditions during nocturnal bird surveys

Survey Technique	Date	Min temp (°C)	Max temp (°C)	Total rainfall (mm)	Wind (km/h)
Breeding habitat survey for nocturnal species	9 March 2020	19.9	22.3	2.9	-
	10 March 2020	18.3	24.5	44.0	-
	11 March 2020	19.5	26.4	25.0	-
	12 March 2020	17.8	24.4	1.1	-
	13 March 2020	17.1	27.0	9.2	-
Call playback and spotlighting for nocturnal species	21 July 2020	-	20.1	0	-
	22 July 2020	10.2	16.9	0	-
	23 July 2020	11.3	18.1	0	-
	24 July 2020	14.0	18.0	7.0	-

Appendix F

Expert report for Mitchell's Rainforest Snail

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CLARRIE HALL DAM RAISING PROJECT

EXPERT REPORT IN RELATION TO THE DISCOVERY OF MITCHELL'S RAINFOREST SNAIL (*THERSITES MITCHELLAE*) OCCURING WITHIN THE PROPOSED INUNDATION FOOTPRINT

Prepared by Dr John Stanisic OAM
Honorary Research Fellow, Queensland Museum
for Eco Logical Australia

Mitchells Rainforest Snail, *Thersites mitchellae* (Cox, 1864)

Brisbane

June 2021

INTRODUCTION

Thersites mitchellae (Cox, 1864) [Mitchell's Rainforest Snail] is listed under the New South Wales *Biodiversity Conservation Act, 2016* (**BC Act**) as an endangered species and on the Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999* (**EPBC Act**) as critically endangered.

M MRS have been identified by Eco Logical Australia (ELA) within the Clarrie Hall Dam development site within a patch of Bangalow Palm forest in the south-east of the development site. In order to assist in refining the mapping of potential habitats available to this species, I was engaged by ELA to assist in refining Mitchell's Rainforest Snail species polygons by:

- Undertaking a site inspection of the known habitats for this species
- Visiting other habitats present within the development site to determine their habitat value for Mitchell's Rainforest Snail
- Advising the accredited assessor on the extent of habitats present.

As the species has been detected within the development site, this expert report is not required to be used in lieu of a site survey. Instead, this expert report describes the habitat preferences of MRS and assists the refining of potential habitats within the development site.

MITCHELL'S RAINFOREST SNAIL IN NORTH-EASTERN NEW SOUTH WALES

Historically Mitchell's Rainforest Snail occurred in coastal lowland sub-tropical rainforest (LSTR) in an area ranging from the Richmond River to the Tweed River, northeastern New South Wales. Subsequently, much of this rainforest community was cleared for farming activities and more recently for urban development. A survey for Mitchell's Rainforest Snail conducted by the author for the New South Wales National Parks and Wildlife Service established the presence of Mitchell's Rainforest Snail throughout the snail's original range (Stanisic 1998). However, the survey found that the overall range of the species was very much reduced, and Mitchell's Rainforest Snail was only found in very low numbers in small pockets of remaining LSTR and in the warm temperate rainforest (WTR) of the New South Wales North Coast Bioregion. This survey did not sample all the forest types in the wider survey area and concentrated on remnant rainforest patches and adjacent swamp forest. Drier forest was considered unsuitable for Mitchell's Rainforest Snail occupancy. Mitchell's Rainforest Snail discoveries since have consistently reinforced the habitat preferences displayed by Mitchell's Rainforest Snail on that survey.

The removal of most of the LSTR community in the late 1800s and early 1900s has isolated Mitchell's Rainforest Snail in the perennially wet habitats of WTR and swamp forest. Mitchell's Rainforest Snail has and will continue to be discovered in these small pockets of remnant vegetation as development in this area of northeastern New South Wales proceeds into the future.

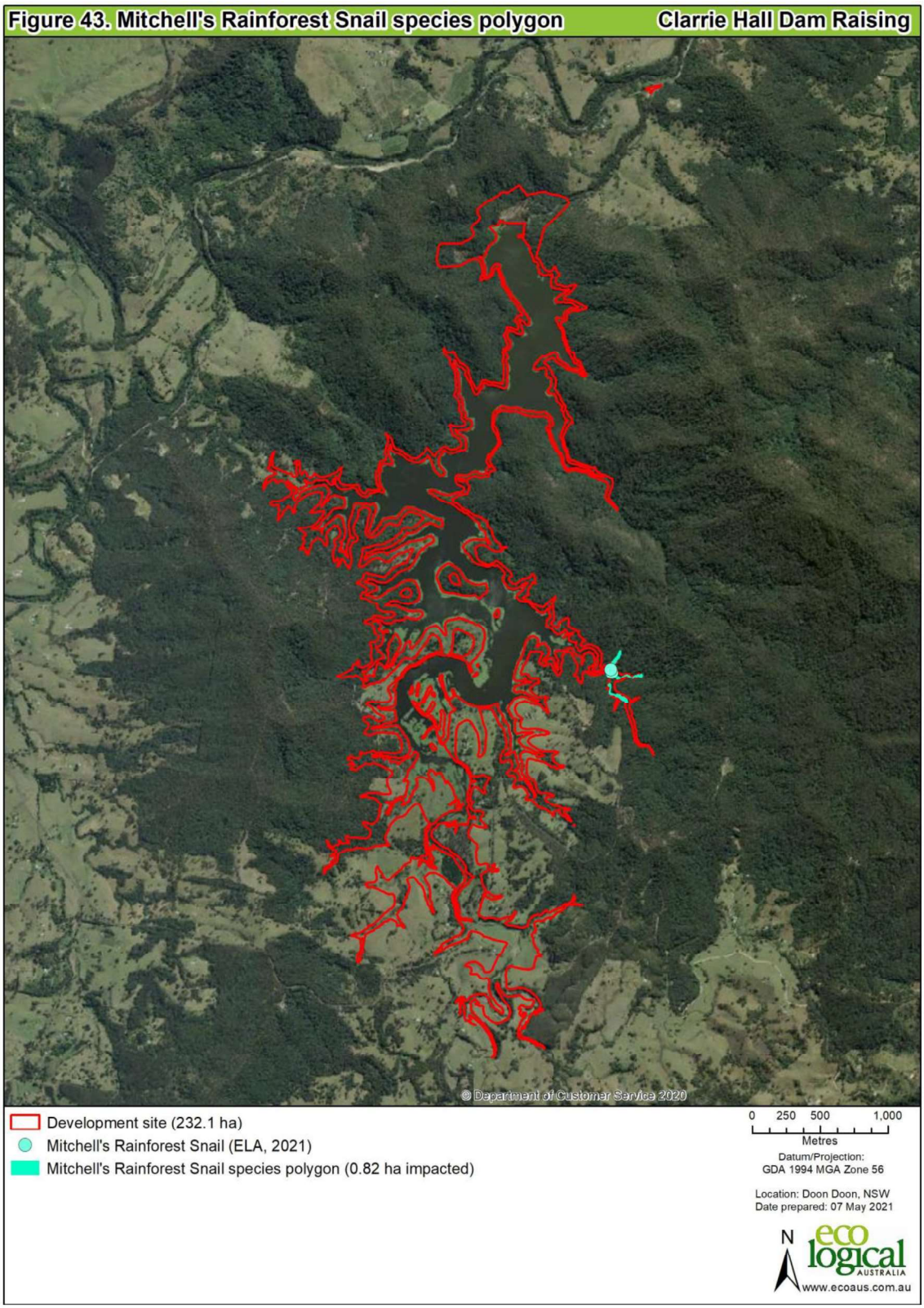

Figure 1. Site map showing Mitchell's Rainforest Snail polygon within the development site.

The microhabitat of the species comprises forest debris such as rotting logs and discarded palm fronds that provide shelter and feeding sites for the species. Mitchell's Rainforest Snail is a fungal feeder and prefers humid moist, but not overly wet, crawl space. Mitchell's Rainforest Snail is a terrestrial snail that can only withstand limited inundation. The species is nocturnal and is usually active in the humid periods of the early evening and especially on humid wet nights. During periods of sustained rain Mitchell's Rainforest Snail may climb trees to escape inundation. However, the species still needs to return to the ground for feeding, mating and egg laying. Personal experience has shown night survey is not considered essential for locating the species.

It is important to note that Mitchell's Rainforest Snail is an invertebrate with low vagility and constrained in its movements by inherent traits peculiar to snails such as acute moisture dependence. Hence, Mitchell's Rainforest Snail is only able to occupy a small part of a landscape unlike more mobile vertebrates that have the adaptability to wander far and wide. Hence, the distribution of Mitchell's Rainforest Snail cannot be measured in terms of broadacre polygons but in the availability of suitable, often small pockets of habitat and microhabitat.

SCOPE

The purpose of this report is to:

a) detail the survey effort, methods and findings of the site survey;
b) provide an accurate map of known and likely Mitchell's Rainforest Snail habitats within the inundation footprint;
c) address BAM criteria regarding Mitchell's Rainforest Snail; and,
d) propose mitigation measures that can be implemented to ameliorate impacts on Mitchell's Rainforest Snail that are likely to result from the project.

SURVEY

A site survey was conducted over two days with Alex Pursche (Eco Logical Australia), Lorelle Stanisic (Queensland Museum land snail researcher) and staff of the Tweed Shire Council on 7th and 8th April 2021. Several sites were inspected by foot and some by boat. At each site visited microhabitats favourable for Mitchell's Rainforest Snail occupancy were searched. Searching included looking inside discarded palm fronds, under woody debris and rocks and inside rotting logs.

Mitchell's Rainforest Snail was discovered at only one site, that being the one in which the species was originally discovered by Eco Logical, Australia (Figs. 2-4). A single individual was found inside a rotting log (Fig. 5). The lack of dead shells was an indication that the species was present in the site in very low numbers. The discovery of Mitchell's Rainforest Snail in rainforest in the upper Tweed River drainage is not surprising. The Plant Community Type (PCT) in which Mitchell's

Rainforest Snail was discovered is classified as WTR, and together with LSTR, is scattered in remnant pockets throughout the entire range of the species.

The location of confirmed specimens of Mitchells Rainforest Snail includes bungalow palm microhabitats within a patch of PCT1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (Figs 2-4).

Figure 2a. Habitat at Mitchell's Rainforest Snail site.

Figure 2b. Habitat at Mitchell's Rainforest Snail site.

Figure 3. Microhabitat at Mitchell's Rainforest Snail site.

Figure 4. Mitchell's Rainforest Snail found under rotting log.

The previous discovery by ELA of a sub-adult Mitchell's Rainforest Snail indicated that this is a breeding population.

The site and surrounding rainforest most probably support a small but significant number of Mitchell's Rainforest Snail individuals. Unfortunately, it is impossible to put a number on the population, but a ballpark estimate would be less, and maybe very much less, than 100 individuals.

Other species recovered at the site, and co-occurring with Mitchell's Rainforest Snail throughout its distribution in north-eastern New South Wales, were *Ramogenia challengeri* (Challenger's Bristle Snail) and *Macularion aquila* (Black-spotted Semi-slug) both known co-habitants of Mitchell's Rainforest Snail throughout its range. While the former is a commonly encountered species the latter is considered an indicator of preferred Mitchell's Rainforest Snail habitat.

Ground searches of a number of other sites in the northern part of the proposed inundation zone were unsuccessful in locating Mitchell's Rainforest Snail, either as live individuals or dead shells. These sites were characterised by sloping topography which is regarded as being unfavourable to Mitchell's Rainforest Snail occupancy even though the PCT may fall within its preferred range of vegetation. Mitchell's Rainforest Snail seems to prefer flat terrain. The absence of Mitchell's Rainforest Snail in sites, especially the lack of any dead shells, would indicate an historical absence of the species. Other species recovered (but in low numbers) from these sites comprised *Ramogenia challengeri*, the large and common Fraser's Banded Snail, *Sphaerospira fraseri* and the Giant panda Snail, *Hedleyella falconeri*. The overall lack of snails and their dead shells in the survey seems to be a recent event affecting snail collecting in east Australian rainforests. This phenomenon may be the result of the lingering drought which has beleaguered the region for many years. The comparatively disproportionate number of juvenile and sub-adult snails encountered suggests that the snail communities are on a rebound.

HABITAT SUITABILITY WITHIN THE DEVELOPMENT SITE

Seven Plant Community Types contained within the development footprint were assessed for habitation suitability by Mitchell's Rainforest Snail (Table 1). These were characterised by moist rainforest or moist open forest. Past snail surveys of these Plant Community Types within the historical range of Mitchell's Rainforest Snail (by myself and others over many years), have failed to establish the presence of Mitchell's Rainforest Snail in open forests usually with a leading eucalypt species (e.g. Tallowwood, Flooded Gum), warm temperate rainforest with Coachwood, lowland rainforest dominated by Giant Stinging Trees and drier rainforest with Hoop Pine emergents. Consequently, PCTs 770, 827, 1073, 1068, 812, 887 were considered unsuitable habitat for the species.

Bangalow palm-dominated lowland subtropical rainforest on mainly flat terrain seems, very selectively, to be the primary habitat of the species. In these situations,

the species has also been recorded from adjacent 'swamp forest' characterised by *Eucalyptus robusta* and *Melaleuca quinquenervia.*

In this case the habitat in which the snail was found is included as part of PCT 1302. This is mapped as the species polygon and occupies a total area of 0.82 ha (Fig. 1).

PCT ID	PCT Name	Suitability for Mitchells Rainforest Snail
770	Coachwood – Soft Corkwood – Crabapple warm temperate rainforest of the NSW North Coast Bioregion	Not suitable
827	Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast	Not suitable
1073	Pink Bloodwood – Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion	Not suitable
1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	Suitable
1068	Pepperberry - Giant Stinging Tree - Fig lowland rainforest in the NSW North Coast Bioregion	Not suitable
812	Dunn's White Gum tall open forest of the ranges of the northern NSW North Coast Bioregion	Not suitable
887	Hoop Pine - Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion	Not suitable
Paddocks and cleared land		Not suitable

Table 1. Plant Community Types contained within the development footprint assessed for Mitchell's Rainforest Snail habitation suitability.

ASSESSMENT OF POTENTIAL IMPACTS

The flat rainforest areas preferred by Mitchell's Rainforest Snail that historically occurred in the wider Doon Doon Creek environs would have been removed by the early clearing of the valley for farming and later by the damming of Doon Doon Creek for the current Clarrie Hall Dam. The proposed project will lead to further inundation of rainforest gullies and unfavourable drier sclerophyll forest. This will result in the further loss of Mitchell's Rainforest Snail habitat, but survey results indicate that the

project will only impact a single population of Mitchell's Rainforest Snail within the inundation zone. Suitable habitat does not necessarily indicate habitation that can only be confirmed by survey.

The proposed raising of the dam wall by 8.5 metres will result in the loss of both Mitchell's Rainforest Snail habitat and Mitchell's Rainforest Snail snails. The conservation status of Mitchell's Rainforest Snail on both the BC and EPBC Acts makes it mandatory that mitigation proposals be developed which hopefully will minimise the impacts of the project on the snail. As stated previously, Mitchell's Rainforest Snail has been shown to occur in mostly small numbers in suitable habitat, albeit remnant, throughout its historical range.

MITIGATION MEASURES

In my expert option I feel that mitigating the impacts of the proposed 8.5m dam raising on this single Mitchell's Rainforest Snail population can be only be achieved by translocating individuals of the Mitchell's Rainforest Snail population to elsewhere in the Tweed River drainage footprint.

Collecting of Mitchell's Rainforest Snail individuals for translocation would require a concentrated effort conducted over several nights in and around wet weather. Translocation would be to similar habitat/microhabitat within the Tweed River drainage. I would propose the covenanted area in Kingscliff where I have been managing a Mitchell's Rainforest Snail population for the past five years as first choice (Stanisic 2020). But there are others.

This option would not save all the Mitchell's Rainforest Snail individuals from drowning. Unlike more agile vertebrates, land snails hide and shelter under forest debris. They are not liable to move rapidly from these hideouts and will become trapped by the rising water and eventually die from lack of oxygen and immersion. However, translocation would significantly reduce the impact of the dam raising on Mitchell's Rainforest Snail and also and benefit the continued existence of Mitchell's Rainforest Snail in the Tweed River drainage.

A detailed relocation plan would be required for this species.

CONCLUSION

It is my opinion that the Clarrie Hall Dam project must minimise the impact on Mitchell's Rainforest Snail population discovered within the inundation footprint. This can best be achieved by translocating as many of the Mitchell's Rainforest Snail individuals considered at risk which will have a continuing benefit for Mitchell's Rainforest Snail in the Tweed River drainage.

REFERENCES

Stanisic, J. 1998. Survey for the land snail *Thersites mitchellae* in northern New South Wales. For the New South Wales National Parks and Wildlife Service. (Queensland Museum: Brisbane).

Stanisic, J. 2020. Final report on conservation efforts for Mitchell's Rainforest Snail (*Thersites mitchellae*) on part of Lot 13 DP 871753, Kingscliff, New South Wales 2017-2018. Report for the Tweed Shire Council. (Brisbane).

ADDRESSING BAM CRITERIA

As part of this expert report a number of mandatory criteria need to be addressed. Some of these have been incidentally covered in the report but more specific reference is given below.

(a) Identify the relevant species or population.

A small population of Mitchell's Rainforest Snail, *Thersites mitchellae* (Cox, 1868) living in the proposed inundation footprint resulting from the Clarrie Hall Dam raising (the project).

(b) provide a justification for the use of an expert report.

Mitchell's Rainforest Snail (hereafter Mitchell's Rainforest Snail) is listed under the New South Wales *Biodiversity Conservation Act, 2016* (**BC Act**) as an endangered species and on the Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999* (**EPBC Act**) as critically endangered. The project will impact the population of Mitchell's Rainforest Snail and expert mitigation advice is required in order to comply with legislative requirements.

(c) indicate and justify the likelihood of presence of the species or population and prepare a species polygon showing the location and area of the species polygon.

A population of Mitchell's Rainforest Snail was found in bangalow palm-dominated rainforest within the inundation footprint of the project occupying a polygon (0.82 ha) as shown in Fig. 1.

(d) estimate the area of habitat for the subject land, or
(e) estimate the number of mature individuals for the subject land and provide evidence for these estimations.

The area of habitat occupied by Mitchell's Rainforest Snail is estimated as 0.8 hectares based on the size of the rainforest patch. Unfortunately, it is impossible to put a hard number on the population of mature individuals, but a ballpark estimate would be less, and maybe very much less, than 100 individuals. Most significantly, the discovery of a sub-adult Mitchell's Rainforest Snail indicates that it is a viable and breeding population.

(f) include the information in relation to the determination made in the report.

The determination made in this report is based on information contained in:

NSW NPWS. 2001. *Mitchell's Rainforest Snail Thersites mitchellae (Cox, 1864) Recovery Plan*. New South Wales National Parks and Wildlife Service. Hurstville, NSW.

Parkyn, J, L. 2013. *Studies on the ecology of the endangered camaenid land snail Thersites mitchellae (Cox, 1864)*. Unpublished PhD thesis. Southern Cross University, Lismore.

Stanisic, J. 1998. Survey for the land snail *Thersites mitchellae* in northern New South Wales. For the New South Wales National Parks and Wildlife Service. (Queensland Museum, Brisbane).

Stanisic, J. 2000. Survey for land snail *Thersites mitchellae* in Northern New South Wales-Investigation of Stotts Island locality. Unpublished report for New South Wales National Parks and Wildlife Service. (Queensland Museum, Brisbane).

Stanisic, J. 2020. Final report on conservation efforts for Mitchell's Rainforest Snail (*Thersites mitchellae*) on part of Lot 13 DP 871753, Kingscliff, New South Wales 2017-2018. Report for the Tweed Shire Council. (Brisbane).

As well as several other unpublished reports dealing with the management of Mitchell's Rainforest Snail in north-eastern New South Wales that are highlighted in the attached CV.

These reports established the habitat preference of Mitchell's Rainforest Snail as moist lowland subtropical rainforest with bangalow palms and figs. The species also occurs in adjacent swamp forest dominated by *Eucalyptus robusta* and *Melaleuca quinquenervia.* Lowland subtropical rainforest in north-eastern New South Wales has largely been cleared for farming and other developments, but Mitchell's Rainforest Snail has managed to survive in the many small patches that remain.

(g) identify the expert and provide evidence of their credentials.

See 'Attachments' for author's BAM expert accreditation for Mitchell's Rainforest Snail and a detailed CV.

DR JOHN STANISIC OAM

Date and place of Birth:
16 December 1950, Australia.

Positions Held:
Honorary Research Fellow, Queensland Museum;
Honorary Research Associate, Australian Museum, Sydney;
Editorial Board, Molluscan Research.

Professional Qualifications
1972: Batchelor of Science (Honours), University of Sydney. [Thesis: Preliminary investigation into the ecology of Picton Lakes with particular reference to the occurrence of the freshwater sponge *Radiospongilla sceptroides* (Haswell]
1978: Master of Science, University of Sydney. [Thesis: Studies on the freshwater sponge *Radiospongilla sceptroides* Haswell, 1882) (Porifera: Spongillidae)
1988: Doctor of Philosophy (Zoology), University of Queensland. [Thesis: Systematics and biogeography of species of east Australian Charopidae (Mollusca, Pulmonata, Charopidae).

Specialist Expertise
John is Honorary Research Fellow at the Queensland Museum and is Australia's foremost scientific expert on land snails having published on the systematics, distribution and biogeography of land snails and on their associations with rainforest and limestone. He has considerable field experience having surveyed more than 2000 terrestrial sites in eastern Australia. His central focus of research is terrestrial invertebrate biodiversity and the potential use of invertebrates as environmental indicators in regional ecosystem management and more recently has managed large scale invertebrate surveys for the Brisbane City Council, Department of Environment and Heritage and Consolidated Rutile Ltd, and URS Australia Pty Ltd. John has undertaken invertebrate faunal consultancies for numerous organisations including the Australian National Parks and Wildlife Service, Department of Environment Water, Heritage and the Arts, New South Wales National Parks and Wildlife Service, Wet Tropics Management Authority, Australian Quarantine and Inspection Service, Australian Pesticides and Veterinary Medicines Authority and URS Australia Pty Ltd. John also has considerable experience in freshwater ecology and has undertaken the sorting and identification of freshwater macro-invertebrates for Golder Associates, Australasian Resource Consultants Pty Ltd, Hydrobiology and Sinclair Knight Merz Pty Ltd (Brisbane). He is also a consultant for the use of molluscs as environmental indicators in archaeology. He is the lead author of two significant award winning field guides documenting more than 1500 species of Australian land snails.

Affiliations
Member IUCN SSC Group
Associate Editor, Molluscan Research
Assistant Editor, Journal of Archaeology
2011-2015 Adjunct Professor, Southern Cross University
2009-2015 Certified Environmental Practitioner [Environment Institute of Australia and New Zealand].

Awards
2010 EIANZ Environmental Practitioner of the Year
2011 Queensland Museum Medal
2011 Whitley Medal
2018 Paul Harris Fellow
2018 Queensland Natural History Award
2018 Whitley Medallion
2020 Order of Australia Medal

Professional Experience

1973-1977: Part-time tutor and demonstrator in vertebrate and invertebrate zoology in the School of Biological Sciences at Sydney University. **Functions**: Demonstrating vertebrate and invertebrate zoology (morphology, systematics and diversity) to second year undergraduate students; leading tutorials; arranging audio-visual material; leading field courses.

1977: Curator of the Haswell Museum, Department of Zoology, Sydney University. **Functions**: Curation and maintenance of biological specimens for use in undergraduate teaching; arranging audio-visual display units for weekly classes; setting up of teaching displays in the Macleay Museum at Sydney University.

1978-1979: Technical Assistant in the Department of Malacology, Australian Museum, Sydney. **Functions**: Curation of land and freshwater mollusc collections; identifications; public enquiries; field trips; assisting in the organisation of the 1979 International Symposium on the Biology and Evolution of the Mollusca at the Australian Museum.

1980-2006: Curator (Senior Curator as from 16.12.1988), Malacology Section, Queensland Museum**. **Functions**: Curation of the mollusc collections; research, dissemination of information to the public through displays, enquiries and publications; field work; environmental consultancy.

2006- 2014: Principal Biodiversity Scientist and Director, Biodiversity Assessment and Management Pty Ltd (BAAM); **Functions**: Freshwater and terrestrial invertebrate survey including fieldwork, identification and reporting; establish an invertebrate survey division within BAAM; Board of Directors chairperson.

2006-: Honorary Research Fellow, Queensland Museum. **Functions**: Research on land snails; dissemination of information to the public through displays, enquiries and publications; field work; environmental consultancy.

2006-: Research Associate, Australian Museum. **Functions**: Research on land snails; dissemination of information to the public through displays, enquiries and publications; field work; environmental consultancy.

Field Experience

General

1972-1978
Freshwater sponge collecting and ecological survey of Thirlmere Lakes, Sydney.
1977
Deep water dredging for marine molluscs off the coast of Queensland in association with staff of the Australian Museum.

Land snail Collecting

1979
Limestone areas of the Jenolan region, New South Wales (1 week).
Rainforests of northern New South Wales (1 week).
1980
Subtropical rainforests of SEQ. (2 weeks).
Tropical rainforests of NEQ. (3 weeks).
1981
Subtropical rainforests of northern New South Wales and SE Queensland (2 weeks).
Bellenden Ker Expedition An altitudinal transect of the invertebrates of the Bellenden Ker Range, North Queensland (4 weeks).
1982
Sub-tropical rainforests of south-east Queensland (2 weeks).
Sub-tropical rainforests of mid-east Queensland (2 weeks).
1983
Rainforests of Cape York Peninsula (6 weeks).
Sub-tropical rainforests of northern New South Wales (2 weeks).
Sub-tropical rainforests of south-east Queensland (4 weeks).
Sub-tropical rainforests of south-east Queensland (4 weeks).
1985
Torres Straits Islands (2 weeks).
1986
Border Ranges rainforests (2 weeks).
1987
Sub-tropical rainforests of north New South Wales (2 weeks).
Mid-east Queensland rainforests (1 week).

1988
Rainforests of Cape York Peninsula, Cooktown and Townsville (7 weeks).
Rainforests of south-east Queensland (1 week).
1989
Rainforests of south-east Queensland including Carnarvon Gorge (2 weeks).
Rainforests of northern New South Wales (1 week).
1990
Rainforests and limestone areas of southern New South Wales (3 weeks).
Rainforests of mid-east Queensland (4 weeks).
Rainforests of south-east Queensland (1 week).
1991
Rainforests and limestone areas of central New South Wales (3 weeks).
Rainforests of northern New South Wales (1 week).
1992
Rainforests and limestone areas of mid-coast New South Wales (2 weeks).
Vine thickets of south-central Queensland (2 weeks).
Rainforests and limestone areas of southern and mid-coast New South Wales (3 weeks).
1993
Rainforests and limestones of central New South Wales (2 weeks).
Vine thickets of the Central Highlands, Queensland (4 weeks).
1994
Rainforests and limestones of northeastern New South Wales (3 weeks).
Mt Mulligan and the vine thickets of Chillagoe and the Central Highlands, Queensland (4 weeks).
1995
Rainforests and limestones of northeastern New South Wales (3 weeks).
Boggomoss environments of Taroom (1 week).
Mt Mulligan and mideastern Queensland (3 weeks).
1996
Rainforests and limestones of northeastern New South Wales (2 weeks).
Boggomoss environments of Taroom (2 weeks).
Palmerville limestones and tropical rainforests of northeastern Queensland (4 weeks).
1997
Rainforests and limestones of northeastern New South Wales (2 weeks).
Boggomoss environments of Taroom (1 week).
Mt Mulligan and the vine thickets of Chillagoe and the Central Highlands, Queensland (4 weeks).
1998
Rainforests and limestones of eastern Victoria (2 weeks).
Vine thickets of the Monto-Marlborough area, Qld (1 week).
Vine thickets opf mideastern Queensland (2 weeks).
Vine thickets of the Callide and Boyne Ranges, Qld (1 week).
Rainforests of northeastern New South Wales (1 week).
1999
Vine thickets of southeastern Queensland (1 week).
Vine thickets of the Rockhampton area, Qld (1 week).
Vine thickets of Whitsunday Island, Qld (1 week).
Vine thickets of Townsville -Cairns hinterland (2 weeks).
2000
Stotts Island rainforests, Tweed River, NE New South Wales (1 week).
Littoral rainforests of the New South Wales central and north coast (2 weeks).
2001
Rainforests of NSW/Qld border region (1 week).
Rainforests of central eastern Queensland and off-lying islands (1 week).
2003
Rainforests of the Rockhampton region (1 week).
Rainforests of the Townsville region (1 week).
2004
Eucalypt forests and limestone outcrops of south-west Western Australia (1 week).
Rainforests and limestone outcrops of the Macleay Valley, NSW (1 week).
Rainforests of Mua Island, Torres Strait (1 week).
2004-5
Remnant bushland patches of Brisbane City (4 weeks).

2006
Vine thickets of the Peak Range, central Queensland (1 week).
Lamington rainforests (IBISCA) (1 week)
2007
Vine thickets of the Great Basalt Wall, central Queensland (1 week).
2007-8
Stuart and McFarlane oil shale deposits, southern and central eastern Queensland (6 weeks).
2008-9
Redland City bushland (Eprapah Creek) (2 weeks)
Taroom boggomosses and vine thickets (3 weeks)
Redland City bushland (Hilliards Creek) (2 weeks)
2009
Rainforest, northern NSW (1 week)
Riparian environments, Taroom-Theodore (1 week)
Remnant brigalow/vine thicket patches, Dalby-Roma, Qld (2 weeks)
Taroom boggomosses and vine thickets (2 weeks).
2010
Ned's Corner Reserve, Victoria. (1 week).
2012
Taroom boggomosses and vine thickets (1 week).
Gawler Ranges, South Australia (1 week).
Larcom Creek, SE Qld (1 week).
2013
Carnarvon Station Reserve, central Queensland. (1 week).
2014
Carnarvon Station Reserve, central Queensland. (1 week).
Rainforests of Eungella (1 week)
2015
Olkola Country Bush Blitz, Cape York Peninsula, (1 week).
Part of Lot 13 DP 871753, Kingscliff, New South Wales (2 days).
2016
Rainforests of south-east Queensland (1 week).
Part of Lot 13 DP 871753, Kingscliff, New South Wales (2 days).
2017
Rainforests of the Central Mackay Coast Bioregion (1 week)
Quinkan Country Bush Blitz, Cape York Peninsula (2 weeks),
Part of Lot 13 DP 871753, Kingscliff, New South Wales (2 days).
2018
Rainforests of south-east Queensland (1 week).
Part of Lot 13 DP 871753, Kingscliff, New South Wales (2 days).
2019
Rainforests of south-east Queensland (1 week).
Part of Lot 13 DP 871753, Kingscliff, New South Wales (2 days).
2020
Rainforests of south-east Queensland (1 week).
Mt Kaputar Snail and Slug Threatened Ecological Community (2 weeks)
Rainforests of north-eastern New South Wales (1 week).

Publications

Journal Articles

Stanisic, J. 1979.Freshwater sponges from the Northern Territory (Porifera: Spongillidae). *Proceedings of the Linnean Society of New South Wales* 103(2): 123-130.
Stanisic, J. 1981. The land Mollusca of Lord Howe Island. *Occasional Papers of the Australian Museum* 1: 43.
Stanisic, J. 1981. *Helix parramattensis* Cox, 1864: A synonym of *Euconulus (Euconulus) fulvus* (Muller, 1774) (Pulmonata: Euconulidae). *Journal of the Malacological Society of Australia* 5(1-2): 81-83.
Stanisic, J. 1981. The carnivorous land snail, *Gulella (Huttonella) bicolor* (Hutton, 1834) in Australia (Pulmonata: Streptaxidae). *Journal of the Malacological Society of Australia* 5(1-2): 84-86.
Simpson, R.D. & **Stanisic, J**. 1986. Faunal survey of New England. II. The distribution of gastropod molluscs. *Memoirs of the Queensland Museum* 22(2): 115-139.

Stanisic, J. 1987. Studies on the Charopidae of tropical and subtropical Australia. I. *Oreokera*: A primitive genus from the high mountains of north Queensland (Mollusca: Pulmonata: Charopidae*). Journal of the Malacological Society of Australia* 8: 1-21.
Stanisic, J. 1988. A re-evaluation of the relationships of *Helix (Thalassia) gayndahensis* Brazier, 1875 (Mollusca, Pulmonata, Helicarionidae). *Memoirs of the Queensland Museum* 25(2): 475-479.
Stanisic, J. 1990. Systematics and biogeography of eastern Australian Charopidae (Mollusca, Pulmonata) from subtropical rainforests. *Memoirs of the Queensland Museum* 30(1): 1-241.
Ponder, W.F. & **Stanisic, J**. 1990. Obituary - G. Alan Solem, An Australian perspective. *Journal of the Malacological Society of Australia* 11: 1-7.
Stanisic, J. 1991. The Colliver shell collection. *The Queensland Naturalist* 31(3-4): 54-57.
David, B. & **Stanisic, J**. 1991. Land snails in Australian archaeology. *The Artefact* 14: 19-24.
Stanisic, J. 1993. The identity of *Helicarion semoni* Marten, 1894: a large semi-slug from the Wet Tropics, northeastern Queensland (Pulmonata: Helicarionidae). *Memoirs of the Queensland Museum* 34(1): 1-9.
Stanisic, J. 1993. *Danielleilona* gen. nov., from the Wet Tropics, northeastern Queensland (Pulmonata: Charopidae). *Memoirs of the Queensland Museum* 34(1): 11-20.
Stanisic, J. 1993. *Lenwebbia paluma* sp. nov., from the Wet Tropics, northeastern Queensland (Pulmonata: Charopidae). *Memoirs of the Queensland Museum* 34(1): 21-26.
Stanisic, J. 1993. *Eungarion mcdonaldi* gen. et sp. nov., a montane semi-slug from mideastern Queensland rainforests (Pulmonata: Helicarionidae). *Memoirs of the Queensland Museum* 34(1): 27-34.
Healy, J.M., Lamprell, K.L. & **Stanisic, J**. 1993. Description of a new species of *Chama* from the Gulf of Carpentaria with comments on *Pseudochama* Odhner (Mollusca: Bivalvia: Chamidae). *Memoirs of the Queensland Museum* 33(1): 211-216.
Stanisic, J. 1994. An ecologic and biogeographic study of a new Tertiary land snail from mideastern Queensland. *Memoirs of the Queensland Museum* 35(1): 241-247.
Stanisic, J. 1994. The distribution and patterns of species diversity of land snails in eastern Australia. *Memoirs of the Queensland Museum* 36(1): 207-214.
Stanisic, J. 1996. New land snails from boggomoss environments in the Dawson Valley, southeastern Queensland (Eupulmonata: Charopidae and Camaenidae). *Memoirs of the Queensland Museum* 39(2): 343-354.
Stanisic, J. 1996. A new camaenid land snail from the Wet Tropics Biogeographic Region, northeastern Queensland (Eupulmonata: Camaenidae). *Memoirs of the Queensland Museum* 39(2): 355-363.
David, B., Barbetti, M., Bekessy, R., Bekessy, L., Bultitude, R., Butler, D., Clarkson, C., Clarkson, J., Conn, C., Dredge, M., Eyre, T., Fullagar, R., Goodall, R., Hall, L.,Head, J., Hua, Q., Ingram, G., Jones, R., Lawson, E., Lourandos, H., Loy, T., Macrokanis, C., McNiven, I., Murray, C., Ogleby, C., Osborne, M., Pole, M., Roberts, R., Schulz, M., Spate, A., **Stanisic, J**., Summerhayes, G., Taylor, C., Tuniz C. & Whittier J. 1996. The Ngarrabullgan Homeland Project: current research in Kuku Djungan country, north Queensland. *Australian Archaeology* 43: 32-36.
Lamprell, K.L. & **Stanisic, J**. 1996. *Callista, Lioconcha and Pitar* in New Caledonia and adjacent waters (Mollusca, Veneridae). *Molluscan Research* 17: 27-48.
Stanisic, J. 1997. An area of exceptional land snail diversity: The Macleay Valley, northeastern New South Wales. *Memoirs of the Museum of Victoria* 56: 441-448.
Lamprell, K.L. & **Stanisic, J**. 1997. Myidae from Australian waters (Mollusca, Bivalvia). Molluscan Research 19: 1-9.
Stanisic, J. 1998. A new semi-slug from Tamborine Mountain, southeastern Queensland (Mollusca: Eupulmonata: Helicarionidae. *Memoirs of the Queensland Museum* 42: 597-603.
Stanisic, J. 1998. *Temporena* Iredale, 1933 unravelled. Memoirs of the Queensland Museum 42: 604.
Stanisic, J. 2000. Taxonomy of the Australian rainforest snail *Helix bellendenkerensis* Brazier, 1875 (Mollusca: Eupulmonata: Camaenidae). *Memoirs of the Queensland Museum* 46: 337-348.
Lamprell, K., **Stanisic, J**. & Clarkson, P. 2001. Spondylids from the Mediterranean Sea and Atlantic Ocean (Mollusca: Bivalvia: Spondylidae). *Memoirs of the Queensland Museum* 46: 611-622.
Lamprell, K., **Stanisic, J**. & Clarkson, P. 2001. Some spondylids from the Pacific Ocean. (Mollusca: Bivalvia: Spondylidae). *Memoirs of the Queensland Museum* 46: 623-628.
Moritz, C., Richardson, K.S., Ferrier, S., Monteith, G., **Stanisic, J**., Williams, S.E. & Whiffin, T. 2001. Biogeographical concordance and efficiency of taxon indicators for establishing conservation priority in a tropical rainforest biota. *Proceedings of the Royal Society of London B*. 268: 1875-1881.
Rowe, C., **Stanisic, J**., David, B. & Lourandos, H. 2001. The helicinid land snail *Pleuropoma extincta* (Odhner, 1917) as an environmental indicator in archaeology. *Memoirs of the Queensland Museum* 46: 741-770.
Hugall, A., Moritz, C., Moussalli, A. & **Stanisic, J**. 2002. Reconciling palaeodistribution models and comparative phylogeography in the Wet Tropics rainforest land snail *Gnarosophia bellendenkerensis* (Brazier, 1875). *Proceedings of the National Academy of Sciences (Philadelphia)* 99: 6112-6117.
Hyman, I.T. & **Stanisic, J**. 2005. New charopid land snails chiefly from limestone outcrops in NSW (Eupulmonata: Charopidae). *Memoirs of the Queensland Museum* 50: 219-302.

Stanisic, J., Cameron, R.A.D., Pokryszko, B.M. & Nekola, J.C. 2007. Forest snail faunas from south-east Queensland and north-east New South Wales (Australia): patterns of local and regional richness and differentiation. *Malacologia* 49: 445-462.

David, B., Fairbairn, A., Aplin, K., Green, M., **Stanisic, J**., Weisler, M., Murepe, L., Simala, D., Kokents, T. & Dop, J. 2007. OJP, a terminal Pleistocene site in the Gulf Province lowlands, Papua New Guinea. *Archaeology in Oceania* 42: 31-33.

McNiven, I.J., Crouch, J., Weisler, M., Kemp, N., Martinez, L.C., **Stanisic, J**., Orr, M., Brady, L., Hocknull, S. & Boles, W. 2008. Tigershark Rockshelter (Baidamau Mudh): seascape and settlement reconfigurations on the Sacred Islet of Pulu, western Zenadh Kes (Torres Strait). *Australian Archaeology* 66: 15-32.

Stanisic, J. 2008. Land snails of Mua island, Torres Strait. *Memoirs of the Queensland Museum, Cultural Heritage Series* 4:1-4.

Osborn, A.W, Forteath, G.N.R. & **Stanisic, J**. 2008. A new species of freshwater sponge (Porifera:Spongillidae) of the genus *Radiospongilla* from lake Pedder in Tasmania. *Papers and Proceedings of the Royal Society of Tasmania* 142: 39-44.

Stanisic, J. 2009. *Crikey steveirwini* gen. et sp. nov. from montane habitats in the Wet Tropics of northeastern Queensland, Australia (Eupulmonata: Camaenidae). *Zootaxa* 2206: 62-68.

David, B., D., Geneste, J-M., Aplin, K., Delannoy, J-J., Araho, N., Clarkson, C., Connell, K., Haberle, S., Barker, B., Lamb, L., **Stanisic, J.** Fairbairn, A. & Skelly, R. 2010. The Emo Site (OAC), Gulf Province, Papua New Guinea: resolving long-standing questions of antiquity and implications for the history of the ancestral *hiri* trade. *Australian Archaeology* 70: 1-30.

Hugall, A. F. & **Stanisic, J**. 2011. Beyond the prolegomenon: a molecular phylogeny of the Australian camaenid land snail radiation. *Zoological Journal of the Linnean Society* 161: 531-572.

Shea, M., Colgan, D. & **Stanisic, J**. 2012. Systematics of the land snail genus *Gyrocochlea* and its relatives. (Mollusca: Charopidae). *Zootaxa* 3585: 1-109.

Petchey, F., Ulm, S., David, B., McNiven, I.J., Asmussen, B., Tomkins, H., Richards, T., Rowe, C., Leavesley, M., Mandui, M.& **Stanisic, J.** 2012. ^{14}C Marine reservoir variability in herbivores and deposit-feeding gastropods from an open coastline, Papua New Guinea. *Radiocarbon* 54: 1-12.

Stanisic, J. 2013. A new genus, *Denhamiana* gen. nov., and two new species of land snail from inland central Queensland (Eupulmonata, Camaenidae). *Memoirs of the Queensland Museum-Nature* 58: 367**–**374.

Stanisic, J. 2015. *Pallidelix simonhudsoni* sp. nov.: a new land snail from the central highlands of inland southern Queensland, Australia (Gastropoda: Eupulmonata: Camaenidae). *Memoirs of the Queensland Museum-Nature* 59: 55-60.

McNiven, I,J., Wright, D., Sutton, S., Weisler, M., Hocknull, S. & **Stanisic, J**. 2015. Midden formation and marine specialisation art Goemu village, Mabuyag, Torres Strait, before and after European contact. *Memoirs of the Queensland Museum-Culture* 8: 377-475.

Stanisic, J. 2016: Two new species of Pinwheel Snail from contrasting Queensland habitats and a redescription and generic re-assignment of *Gyrocochlea myora* Stanisic, 2010 (Gastropoda: Eupulmonata: Charopidae). *Memoirs of the Queensland Museum-Nature* 60: 1-12.

Stanisic, J. 2016. A new genus and two new species of land snail from geographically remote lithorefugial habitats in Queensland including a remarkable range extension for *Quistrachia* Iredale, 1939 (Gastropoda: Eupulmonata: Camaenidae). *Memoirs of the Queensland Museum-Nature* 60: 43-51.

Stanisic, J. 2018. Revision of *Pallidelix* Iredale, 1933 with the description of new species from central Queensland (Mollusca: Eupulmonata: Camaenidae). *Memoirs of the Queensland Museum-Nature* 60: 193-226.

Stanisic, J. 2018. Description of a new species of semi-slug, *Fastosarion comerfordae* sp. nov. from Eungella National Park, mid-eastern Queensland (Gastropoda: Eupulmonata: Helicarionidae). *Memoirs of the Queensland Museum-Nature* 61: 43-51.

Stanisic, J. 2018. *Helix namoiensis* Cox, 1868: a synonym of the North American zonitid *Mesomphix* (*Omphalina*) *cupreus* (Rafinesque, 1831). *Memoirs of the Queensland Museum-Nature* 61: 154.

Holcroft, L. & **Stanisic, J**. 2018. Thirteen new charopid land snails from mid-eastern Queensland rainforests (Gastropoda: Eupulmonata: Charopidae). *Memoirs of the Queensland Museum-Nature* 61: 155-186.

Mc Niven, I.J., Crouch, J., Bowler, J.M., Sherwood, J.E., Dolby, N., Dunn, J.E. & **Stanisic, J.** 2018. The Moyjil site, south-west Victoria, Australia: excavation of a last intergalcial charcoal and burnt stone feature-is it a hearth? *The Royal Society of Victoria* 130: 94-116

Stanisic, J. 2018. Addendum to '*Australian Land Snails Volume 2, A Field Guide to Southern, Central and Western Species'* by Stanisic, J., Shea, M., Potter, D. and Griffiths. O. 2017. (Bioculture Press: Mauritius). xiv+594pp. *Memoirs of the Queensland Museum-Nature* 61: 192.

Stanisic, J. & E. Window. 2020. Land snails of the Eungella plateau and environs, Clarke Range, Mid-eastern Queensland. *Proceedings of the Royal Society of Queensland* 125: 23-31.

Stanisic, L. & **Stanisic, J.** 2020. On the identity of several Queensland camaenids: a reappraisal of their type specimens, accuracy of type localities and their associaition with extant populations (Eupulmonata: Camaenidae: *Figuladra*). *Memoirs of the Queensland Museum-Nature* 62: 133-156.

Stanisic, J. 2020. New species and genera of Pinwheel Snails from the brigalow lands of south central Queensland (Gastropoda: Eupulmonata: Charopidae). *Memoirs of the Queensland Museum-Nature* 62: 157-185.
Stanisic, J. In prep. Revision of *Mussonena* Iredale, 1933 (Mollusca: Eupulmonata: Camaenidae) and the description of new species from Carnarvon Station and south-eastern Queensland. *Memoirs of the Queensland Museum-Nature.*
Stanisic, J. In prep. Three new pinwheel snails from Queensland and the designation of a lectotype for *Helix iuloidea* Forbes, 1852 (Eupulmonata: Charopidae). *Memoirs of the Queensland Museum-Nature*.

Peer-reviewed books introducing new species and genera of land snails
Stanisic, J., Shea, M., Potter, D. & Griffiths, O. 2010. *Australian land snails. Volume 1. A field guide to eastern Australian species*. (Bioculture Press: Mauritius). xii+591pp.
Stanisic, J., Shea, M., Potter, D. & Griffiths, O. 2018. *Australian land snails. Volume 2. A field guide to southern, central and western species.* (Bioculture Press: Mauritius). xiv+594pp.

Book Articles
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Survey for the land snail *Thersites mitchellae* (Mitchell's Rainforest Snail). Pacific Highway Upgrade, Brunswick Heads to Yelgun. (For Connell Wagner Pty Ltd).
Review of Environmental Factors: Waterford-Tamborine Rd, Williamson Rd to Yore Rd, Tamborine. Terrestrial Invertebrates and Freshwater Macro-invertebrates. (For BAAM Pty Ltd).

2003

Terrestrial Invertebrate Status Review, Brisbane City Field Survey. (For Brisbane City Council). [in conjunction with Drs C. Burwell, R.Raven, G. Monteith and B. Baehr, Queensland Centre for Biodiversity].
Survey for the Giant African Snail (GAS) on Queensland military bases. (For the Australian Quarantine and Inspection Service).
Review of "Survey for land snail *Thersites mitchellae* in Kingscliff, northern New South Wales'. (For Planit Consulting

Pty Ltd).
Survey for the land snail *Thersites mitchellae* (Mitchell's Rainforest Snail). Bottlebrush Crescent, Suffolk Park. (For James Warren and Associates).
Management of *Thersites mitchellae* (Mitchell's Rainforest Snail) on Gales Holdings, Kingscliff: relocation of drain on Part Lot 13. (For Gales Holdings Pty Ltd).
Survey for the land snail *Thersites mitchellae* (Mitchell's Rainforest Snail). Greenfield Road, Lennox Head). (For Aspect North).
Assessment of the potential development impacts on the land snail *Thersites mitchellae* in SEPP 14 wetland. Jonson St/Constellation Close, Byron Bay. (For Bayview Land Development Pty Ltd).

2004

Terrestrial Invertebrate Status Review, Brisbane City Field Survey. (For Brisbane City Council). [in conjunction with Drs C. Burwell, R.Raven, G. Monteith and B. Baehr, Queensland Centre for Biodiversity].
Survey for the Giant African Snail (GAS) on Queensland military bases. (For the Australian Quarantine and Inspection Service).
Survey of the macroinvertebrates and fish of the Goondicum Waterholes. (For Monto Minerals).
Survey for the land snail *Thersites mitchellae* (Mitchell' Rainforest Snail). Banora Point, New South Wales. (For Parsons Brinckerhoff Australia Pty Ltd).
Sorting and identification of freshwater macroinvertebrates from Cloncurry, NW Qld. (For Australasian Resource Consultants Pty Ltd).
Survey, sorting and identification of the aquatic fauna of the Nogoa River and associated waterholes, Ensham Central development. (For BAAM Pty Ltd).

2005

Survey for the Giant African Snail (GAS) on New South Wales military bases. (For the Australian Quarantine and Inspection Service).
Review of efficacy and safety data. Multicrop Multiguard snail and slug killer. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Recovery Plan for the Boggomoss Snail*, Adclarkia dawsonensis*. (For the Queensland Parks and Wildlife Service, Brisbane).
Sorting and identification of freshwater macroinvertebrates from Cloncurry, NW Qld. (For Australasian Resource Consultants Pty Ltd).
Sorting and identification of freshwater macroinvertebrates from Norwich Park, central ME Qld. (For Australasian Resource Consultants Pty Ltd).
Sorting and identification of freshwater macroinvertebrates from the Mackenzie River region, central ME Qld. (For Sinclair Knight Merz Pty Ltd).

2006

Survey, sorting and identification of freshwater macroinvertebrates from Scrubby Creek, Wembley Rd, Springwood, SE Qld. (For BAAM Pty Ltd).
Terrestrial invertebrate survey of the Peak Range, central Queensland. (For the Department of Environment and Heritage). [in conjunction with Drs C. Burwell, R. Raven, G. Monteith and B. Baehr, Queensland Centre for Biodiversity].
Survey of the fish and aquatic macroinvertebrates of the Ella Bay Integrated Resort Project, NE Qld. (For John Holland Services Pty Ltd).

2007

Terrestrial invertebrate survey of the Great Basalt Wall, central Queensland. (For the Department of Environment and Heritage). [in conjunction with Drs C. Burwell, R. Raven, G. Monteith and B. Baehr, Queensland Centre for Biodiversity].
Terrestrial invertebrate survey of the Stuart oil shale deposit, south-east Queensland. (For URS Australia Pty Ltd).
Review of efficacy and safety data. Mesurol 500SC Bird Repellent and Snail and Slug Spray. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).

2007-2008

Terrestrial invertebrate survey of the McFarlane oil shale deposit, mid-east Queensland. (For URS Australia Pty Ltd).

2008

Review of efficacy and safety data. Label variation of Metarex Slug and Snail Bait. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Review of efficacy and safety data. Meta Slug and Snail Pellets. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Review of efficacy and safety data. Slime Snail and Slug Bait. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Review of efficacy and safety data. Delicia Suggoff Lentils. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Sorting and identification of freshwater macroinvertebrates from Dysart, central ME Qld. (For Sinclair Knight Merz

Pty Ltd).
Sorting and identification of freshwater macroinvertebrates from the Daunia coal development, central ME Qld. (For Sinclair Knight Merz Pty Ltd).
Boggomoss Snail Survey (For SunWater, Queensland)

2008-2009

Review of efficacy and safety data. Label variation of Slugout All Weather Snal and Slug Bait. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Review of efficacy and safety data. Label variation of Metarex Slug and Snail Bait. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Sorting and identification of freshwater macroinvertebrates from Coonoon Gibber Creek, SE Qld. (For Sinclair Knight Merz Pty Ltd).
Hilliards Creek Invertebrate Survey (For Redland City Council) [in conjunction with Drs C. Burwell, R. Raven, G. Monteith and B. Baehr, Queensland Centre for Biodiversity].
Boggomoss Snail Survey, Nathan Dam Project, Taroom. (For SunWater, Queensland).

2009

Boggomoss Snail Survey, Nathan Dam Project, Taroom. Survey 2. (For SunWater, Queensland).

2010-2012

Updating Australian Faunal Directory: (AFD) Mollusca, Pulmonata. (For Department of Environment, Heritage, Water and the Arts, Canberra).
Bush Blitz Biodiversity Survey. Ned's Corner Reserve, Victoria. (For Department of Sustainability, Environment, Water, Population and Communities, Canberra).

2012

Sorting and identification of freshwater fish and macroinvertebrates from Abbot Point, NE Qld. (For North Queensland Bulk Ports).
Boggomoss Snail Survey, Nathan Dam Project, Taroom..(For Wildlife Preservation Society of Queensland).
Review of efficacy and safety data. Imtrade Slug and Snail Bait. (For the Australian Pesticides and Veterinary Medicines Authority, Canberra).
Bush Blitz Biodiversity Survey. Gawler Ranges, South Australia. (For Department of Sustainability, Environment, Water, Population and Communities, Canberra).
Survey, sorting and identification of freshwater macroinvertebrates from Larcom Creek, SE Qld. Survey 2. (For Groundwork Plus).

2013

Updating Australian Faunal Directory: (AFD) Mollusca, Pulmonata. (For Department of Sustainability, Environment, Water, Population and Communities, Canberra).

2014

Bush Blitz Biodiversity Survey. Carnarvon Station Reserve, central Queensland. (For Department of Environment, Canberra).

2015

Bush Blitz Biodiversity Survey. Olkola Country, Cape York Peninsula, Queensland. (For Department of Environment, Canberra).
Survey and management of Mitchell's Rainforest Snail (*Thersites mitchellae*) on part of Lot 13 DP 871753, Kingscliff, New South Wales. (For Gales Holdings).

2016

Survey and management of Mitchell's Rainforest Snail (*Thersites mitchellae*) on part of Lot 13 DP 871753, Kingscliff, New South Wales. (For Gales Holdings).

2017

Bush Blitz Biodiversity Survey. Quinkan Country, Cape York Peninsula, Queensland. (For Department of Environment, Canberra).
Biosecurity Australia workshops in snail detection and identification at Port Darwin and Port of Brisbane (For the Department of Agriculture and Water Resources, Canberra).
Survey and management of Mitchell's Rainforest Snail (*Thersites mitchellae*) on part of Lot 13 DP 871753, Kingscliff, New South Wales. (For Gales Holdings).

2018

Survey and management of Mitchell's Rainforest Snail (*Thersites mitchellae*) on part of Lot 13 DP 871753, Kingscliff, New South Wales. (For Gales Holdings).

2019

Survey and management of Mitchell's Rainforest Snail (*Thersites mitchellae*) on part of Lot 13 DP 871753, Kingscliff, New South Wales. (For Gales Holdings).

2020

Survey of Mt Kaputar Snail and Slug Threatened Ecological Community (For NSW Parks and Wildlife Service)

Expert Panels

2015

Biodiversity Planning Assessment, South-East Queensland Bioregion. (Venue: Brisbane for Queensland Department of Environment).

2017

Biodiversity Planning Assessment, Brigalow Lands South Bioregion. (Venue: Toowomba for Queensland Department of Environment).

Biodiversity Planning Assessment, Brigalow Lands North Bioregion. (Venue: Rockhampton for Queensland Department of Environment).

2018

Biodiversity Planning Assessment, Wet Tropics Bioregion. (Venue: Cairns for Queensland Department of Environment).

Grants Held

Bush Blitz TTC214-54: 2015 Revision of *Mussonena* Iredale, 1933 (Mollusca: Eupulmonata: Camaenidae) and the description of new species from Carnarvon Station and south-eastern Queensland.

Bush Blitz TTC214-55: 2015 Revision of *Pallidelix* Iredale, 1933 (Mollusca: Eupulmonata: Camaenidae) with the description of 4 new species from central Queensland.

Bush Blitz TTC216-13: 2017 Description of 16 new species and 5 new genera of Charopidae from Carnarvon Station Reserve, Qld and surrounding areas (Gastropoda: Eupulmonata: Charopidae).

Bush Blitz TTC217-04: 2018 Description of new species of Pupinidae and Rhytididae from Quinkan Country and a new species of Camaenidae from Olkola Country (Gastropoda: Eupulmonata).

Appendix G
Credit reports

EMM
creating opportunities

BAM Credit Summary Report

Proposal Details

Assessment Id
00037938/BAAS17037/23/00037939

Proposal Name
Clarrie Hall Dam Raising

BAM data last updated *
14/03/2024

Assessor Name
Eugene

Report Created
10/09/2024

BAM Data version *
67

Assessor Number
BAAS17009

BAM Case Status
Finalised

Date Finalised
10/09/2024

Assessment Revision
4

Assessment Type
Major Projects

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

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

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast												
1	827_Burnt	Not a TEC	92.3	92.3	19	PCT Cleared - 55%	High Sensitivity to Gain			1.75		769

2	827_Derived_sedgeland	Not a TEC	1.1	1.1	4.6	PCT Cleared - 55%	High Sensitivity to Gain			1.75		0
3	827_Grassland	Not a TEC	6.2	6.2	64.1	PCT Cleared - 55%	High Sensitivity to Gain			1.75		0
4	827_High	Not a TEC	68.9	68.9	72.1	PCT Cleared - 55%	High Sensitivity to Gain			1.75		2173
5	827_Low	Not a TEC	56.1	56.1	25.5	PCT Cleared - 55%	High Sensitivity to Gain			1.75		626
6	827_Mod	Not a TEC	60.5	60.5	31.3	PCT Cleared - 55%	High Sensitivity to Gain			1.75		827
7	827_Planted	Not a TEC	84.3	84.3	5.1	PCT Cleared - 55%	High Sensitivity to Gain			1.75		187
											Subtotal	**4582**
Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the NSW North Coast Bioregion												
8	1073_High	Not a TEC	79.5	79.5	2.7	PCT Cleared - 40%	High Sensitivity to Gain			1.50		80
											Subtotal	**80**

White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion												
9	1302_High	Lowland Rainforest of Subtropical Australia	63.7	63.7	5.8	Environment Protection and Conservation Act listing status	High Sensitivity to Gain	Not Listed	Critically Endangered	2.50		230
10	1302_Mod	Lowland Rainforest of Subtropical Australia	54.7	54.7	3	Environment Protection and Conservation Act listing status	High Sensitivity to Gain	Not Listed	Critically Endangered	2.50		102
											Subtotal	**332**
											Total	**4994**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Assa darlingtoni / Pouched Frog (Fauna)									
827_High	68.9	68.9	23.4	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Vulnerable	Vulnerable	False	805

1302_High	63.7	63.7	5.8	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Vulnerable	Vulnerable	False	184
1302_Mod	54.7	54.7	3	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Vulnerable	Vulnerable	False	82
								Subtotal	**1071**
Carterornis leucotis / White-eared Monarch (Fauna)									
827_High	68.9	68.9	72.1	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	2483
827_Mod	60.5	60.5	31.3	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	945
827_Burnt	92.3	92.3	19	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	879

827_Low	56.1	56.1	25.5	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	715
827_Planted	84.3	84.3	5.1	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	214
1073_High	79.5	79.5	2.7	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	106
1302_High	63.7	63.7	5.8	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	184
1302_Mod	54.7	54.7	3	Biodiversity Conservation Act listing status	Ecology or response to management is poorly known	Vulnerable	Not Listed	False	82
								Subtotal	**5608**
Corokia whiteana / Corokia (Flora)									
827_High	N/A	N/A	6	Population size	Seedbank Persistence	Endangered	Endangered	True	18

1302_High	N/A	N/A	6	Population size	Seedbank Persistence	Endangered	Endangered	True	18
								Subtotal	**36**
Desmodium acanthocladum / Thorny Pea (Flora)									
827_Mod	60.5	60.5	2.2	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	67
								Subtotal	**67**
Drynaria rigidula / Basket Fern (Flora)									
827_Low	56.1	56.1	0.5	Geographic Distribution	Age at First Significant Flowering	Endangered	Not Listed	True	21
								Subtotal	**21**
Endiandra hayesii / Rusty Rose Walnut (Flora)									
827_High	N/A	N/A	7	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	14
827_Mod	N/A	N/A	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	6

827_Burnt	N/A	N/A	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	6
1302_High	N/A	N/A	36	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	72
1302_Mod	N/A	N/A	1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	2
								Subtotal	**100**
Endiandra muelleri subsp. bracteata / Green-leaved Rose Walnut (Flora)									
827_High	N/A	N/A	231	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	693
827_Mod	N/A	N/A	51	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	153
827_Burnt	N/A	N/A	77	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	231

827_Low	N/A	N/A	3	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	9
827_Planted	N/A	N/A	4	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	12
1073_High	N/A	N/A	1	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	3
1302_High	N/A	N/A	61	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	183
1302_Mod	N/A	N/A	29	Rate of decline	Ability to colonise improved habitat	Endangered	Not Listed	True	87
								Subtotal	**1371**
Grammitis stenophylla / Narrow-leaf Finger Fern (Flora)									
827_High	68.9	68.9	0.34	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	12

827_Mod	60.5	60.5	0.12	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	4
1302_High	63.7	63.7	0.57	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	18
								Subtotal	**34**
Haliaeetus leucogaster / White-bellied Sea-Eagle (Fauna)									
827_High	68.9	68.9	14.4	Biodiversity Conservation Act listing status	Fecundity – age at which females first produce	Vulnerable	Not Listed	False	494
827_Low	56.1	56.1	1.3	Biodiversity Conservation Act listing status	Fecundity – age at which females first produce	Vulnerable	Not Listed	False	36
827_Mod	60.5	60.5	4.4	Biodiversity Conservation Act listing status	Fecundity – age at which females first produce	Vulnerable	Not Listed	False	132
								Subtotal	**662**

Hicksbeachia pinnatifolia / Red Boppel Nut (Flora)									
827_Planted	N/A	N/A	4	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	8
								Subtotal	**8**
Lepiderema pulchella / Fine-leaved Tuckeroo (Flora)									
827_Low	N/A	N/A	5	Population size	Effectiveness of management in controlling threats	Vulnerable	Not Listed	True	15
827_Planted	N/A	N/A	10	Population size	Effectiveness of management in controlling threats	Vulnerable	Not Listed	True	30
								Subtotal	**45**
Macadamia tetraphylla / Rough-shelled Bush Nut (Flora)									
827_High	N/A	N/A	1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	2

827_Mod	N/A	N/A	6	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	12
827_Burnt	N/A	N/A	1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	2
827_Low	N/A	N/A	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	6
827_Planted	N/A	N/A	1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	2
								Subtotal	**24**
Marsdenia longiloba / Slender Marsdenia (Flora)									
827_High	68.9	68.9	59.9	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	2063

827_Mod	60.5	60.5	1.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	33
827_Burnt	92.3	92.3	12.5	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	579
827_Low	56.1	56.1	0.86	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	24
1073_High	79.5	79.5	1.3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	50
1302_High	63.7	63.7	3.3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	104
								Subtotal	**2853**

Menura alberti / Albert's Lyrebird (Fauna)									
827_High	68.9	68.9	11.5	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Vulnerable	Not Listed	False	396
1302_High	63.7	63.7	3	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Vulnerable	Not Listed	False	95
								Subtotal	**491**
Mixophyes iteratus / Giant Barred Frog (Fauna)									
827_High	68.9	68.9	1.7	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	60
827_Mod	60.5	60.5	0.66	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	20
827_Low	56.1	56.1	0.27	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	8

1302_High	63.7	63.7	2.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	70
1302_Mod	54.7	54.7	1.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Vulnerable	False	33
								Subtotal	**191**
Myotis macropus / Southern Myotis (Fauna)									
827_High	68.9	68.9	61.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	2130
827_Mod	60.5	60.5	27.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	841
827_Burnt	92.3	92.3	15.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	714
827_Low	56.1	56.1	19	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	533

827_Planted	84.3	84.3	4.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	201
1073_High	79.5	79.5	0.66	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	26
1302_High	63.7	63.7	3.7	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	117
1302_Mod	54.7	54.7	2.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	80
								Subtotal	**4642**
Phascolarctos cinereus / Koala (Fauna)									
827_High	68.9	68.9	72.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	2483
827_Mod	60.5	60.5	27.5	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	833

827_Burnt	92.3	92.3	19	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	879
827_Low	56.1	56.1	24.5	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	687
827_Planted	84.3	84.3	5.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	214
1073_High	79.5	79.5	2.7	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	106
1302_High	63.7	63.7	5.8	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	184
1302_Mod	54.7	54.7	3	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	82

								Subtotal	**5468**
Philoria loveridgei / Loveridge's Frog (Fauna)									
1302_High	63.7	63.7	0.16	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	5
								Subtotal	**5**
Phyllodes imperialis southern subspecies / Southern Pink Underwing Moth (Fauna)									
827_High	68.9	68.9	0.04	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	1
1302_Mod	54.7	54.7	0.05	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Endangered	False	1
								Subtotal	**2**
Rhodamnia rubescens / Scrub Turpentine (Flora)									
827_High	N/A	N/A	406	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	1218

827_Mod	N/A	N/A	131	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	393
827_Burnt	N/A	N/A	47	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	141
827_Low	N/A	N/A	87	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	261
827_Planted	N/A	N/A	22	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	66
1073_High	N/A	N/A	2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	6
1302_High	N/A	N/A	10	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	30

1302_Mod	N/A	N/A	4	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	12
								Subtotal	**2127**
Rhodomyrtus psidioides / Native Guava (Flora)									
827_High	68.9	68.9	60.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	3110
827_Mod	60.5	60.5	16.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	734
827_Burnt	92.3	92.3	15.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	1056
827_Low	56.1	56.1	2.6	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	111

827_Planted	84.3	84.3	1.2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Critically Endangered	Critically Endangered	True	79
								Subtotal	**5090**
Syzygium hodgkinsoniae / Red Lilly Pilly (Flora)									
827_High	N/A	N/A	6	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	12
827_Burnt	N/A	N/A	8	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	16
1302_High	N/A	N/A	91	Geographic Distribution	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	182
								Subtotal	**210**
Syzygium moorei / Durobby (Flora)									
827_Low	N/A	N/A	2	Rate of decline	Ability to colonise improved habitat	Vulnerable	Vulnerable	True	6

827_Planted	N/A	N/A	14	Rate of decline	Ability to colonise improved habitat	Vulnerable	Vulnerable	True	42
								Subtotal	**48**
Thersites mitchellae / Mitchell's Rainforest Snail (Fauna)									
827_High	68.9	68.9	2	Environment Protection and Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Critically Endangered	True	103
1302_High	63.7	63.7	0.21	Environment Protection and Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Critically Endangered	True	10
								Subtotal	**113**
Tyto novaehollandiae / Masked Owl (Fauna)									
827_High	68.9	68.9	35.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1222
827_Mod	60.5	60.5	3.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	106

827_Burnt	92.3	92.3	12.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	560
1073_High	79.5	79.5	0.21	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	8
1302_High	63.7	63.7	1.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	42
								Subtotal	**1938**
Tyto tenebricosa / Sooty Owl (Fauna)									
827_High	68.9	68.9	35.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	True	1833
827_Mod	60.5	60.5	3.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	True	159
827_Burnt	92.3	92.3	12.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	True	840

1073_High	79.5	79.5	0.21	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	True	13
1302_High	63.7	63.7	1.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	True	63
								Subtotal	**2908**

Appendix H
Likelihood of occurrence assessment

EMM
creating opportunities

H.1 Likelihood of occurrence assessment

Table H.1 Likelihood of occurrence assessment for MNES

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Acronychia littoralis	Scented Acronychia	E	E	Y	-	-	-	Scented Acronychia occurs in transition zones between littoral rainforest and swamp sclerophyll forest; between littoral and coastal cypress pine communities; and margins of littoral forest. The species mainly occurs within 2 km from the coast on sandy soil. Two forms of Scented Acronychia exist, one which can produce viable seeds, and one which can only reproduce vegetatively.	Negligible	The subject land does not contain swamp sclerophyll forest, coastal and littoral cypress pine communities or littoral forest to support the species. The subject land is also not within 2 km of the coast. There have been no records of the species within the locality.
Actitis hypoleucos	Common Sandpiper	-	MiW, Ma	Y	-	-	-	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags.	Low	The subject land contains wetland habitat within the Dam; however, the condition of the habitat is suboptimal for the species. The Dam does not contain mangroves, muddy margins or rocky shores to support the species.
Amyema plicatula	null	-	E	Y	-	-	-	Parasitic on mature Rosewood trees, growing on basalt-derived soils where subtropical rainforest would have grown before land-clearing occurred. Occurs at one location within a remnant rainforest fragment on cleared, undulating farmland at the foothills of the Nightcap Range. Flowers in summer.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Anthochaera phrygia	Regent Honeyeater	CE	CE	Y	-	-	-	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany. Other tree species may be regionally important. Flowering of associated species such as Thin-leaved Stringybark *Eucalyptus eugenioides* and other Stringybark species, and Broad-leaved Ironbark. E. fibrosa can also contribute important nectar flows at times. Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres.	Negligible	The subject land does not contain dry forest or woodland to support the species.
Apus pacificus	Fork-tailed Swift	-	Mi	-	Y	5	28/02/1994	They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes.	Low	The subject land does not contain suitable dry, open habitats to support the species. The species is likely to utilise the open farmland habitat in the locality.
Ardenna pacifica	Wedge-tailed Shearwater	-	Mi	-	Y	3	12/05/2022	The Wedge-tailed Shearwater is a pelagic, marine bird known from tropical and subtropical waters. The species tolerates a range of surface-temperatures and salinities but is most abundant where temperatures are greater than 21 °C and salinity is greater than 34.6 %.	Low	The species is a pelagic, marine bird. No marine habitat occurs within the subject land.
Argynnis hyperbius inconstans	Australian Fritillary	-	CE	Y	-	-	-	The Australian fritillary usually occurs around river estuaries or open, swampy coastal regions. They are restricted to areas where its larval food plant, *Viola betonicifolia* (the arrowhead violet), occurs. The Australian fritillary appears to only occupy lower altitude sites (<600 m) (TSSC, 2017).	Low	The subject land does not contain river estuaries or open, swampy coastal habitat. Additionally, no occurrences of *Viola betonicifolia* were recorded on the subject land.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Arthraxon hispidus	Hairy-joint Grass	V	V	Y	Y	2	15/05/2017	Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Assa darlingtoni	Pouched Frog	V	V	Y	Y	239	18/01/2022	Pouched frogs live in cool, moist rainforest, including Antarctic Beech, or moist eucalypt forest in mountainous areas, mostly above 800 m but have been found as low as 300 m. They spend most of the time in damp leaf litter, or under rocks and rotten logs.	Known	The species was incidentally sighted on the subject land during surveys.
Assa wollumbin	Mount Wollumbin Hip-pocket Frog, Wollumbin Pouched Frog	-	CE	Y	-	-	-	The Wollumbin hip-pocket frog is restricted to rainforest and wet sclerophyll forest in or near Wollumbin NP, NSW. The species relies on moist leaf litter, rotting logs, and rocks for shelter and nest sites. Most records here are from elevations of 350–550 m ASL, whereas the pouched frog is usually found at greater than 800m ASL. It is unknown where the divide between the distributions of the Wollumbin hip-pocket frog and the pouched frog occurs, nor whether there is any distributional overlap, but it is suspected that the Tweed River Valley may function as a physical barrier between the two species (DCCEEW, 2023).	Negligible	The species is restricted to Wollumbin National Park and is suspected to not occur south of the Tweed River. The subject land is outside of the known and predicted range of the species and occurs south of the Tweed River.
Atrichornis rufescens	Rufous Scrub-bird	V	E	Y	Y	3	31/12/1990	Rufous Scrub-birds are now confined to high-altitude (above 600 m elevation) subtropical, warm temperate and cool temperate rainforests, and wet sclerophyll forests. The species formerly occurred in some lower altitude forests in far north-eastern NSW but was presumably lost as a result of clearing following European settlement. Rufous Scrub-birds spend most of their time foraging in deep, moist litter beneath a very dense layer of vegetation and/or woody debris. They are active foragers, scuttling through litter using their head and bill to toss leaves aside while searching for food such as small invertebrates (including snails and insects). They breed from early spring to summer but very little is known of their breeding behaviour because they are so shy and cryptic, and their habitat is so dense. Male calling peaks in the breeding season but continues throughout the year. The nest is a domed structure built in dense vegetation on or close to the ground.	Negligible	The subject land occurs below 600 m above sea level, and as such does not contain suitable habitat to support the species.
Baloghia marmorata	Marbled Balogia, Jointed Baloghia	V	V	Y	-	-	-	In NSW, Jointed Baloghia is found in subtropical rainforest, notophyll vine forest and wet sclerophyll forest on soils derived from basalt. Found between 150m and 550m above sea level.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Bosistoa transversa	Three-leaved Bosistoa, Yellow Satinheart	V	V	Y	Y	11	6/06/2015	Three-leaved Bosistoa grows in wet sclerophyll forest, dry sclerophyll forest and rainforest including highly disturbed habitat up to 300 m in altitude. Flowering occurs from January to May. Ripe fruits are present from May to November.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Botaurus poiciloptilus	Australasian Bittern	E	E	Y	-	-	-	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes *Typha* spp. and spikerushes *Eleocharis* spp. Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely vegetated wetlands on a platform of reeds; there are usually six olive-brown eggs to a clutch.	Negligible	The aquatic habitat on the subject land does not contain tall, dense vegetation to support the species.
Bulbophyllum globuliforme	Hoop Pine Orchid	V	V	Y	-	-	-	Grows on Hoop Pines (*Araucaria cunninghamii*) in upland subtropical rainforest. It is usually found on the upper trunk and branches of the Hoop Pines which protrude from the general rainforest canopy. The climate in such situations is cool and wet.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Calidris acuminata	Sharp-tailed Sandpiper	-	V, MiW, Ma	Y	-	-	-	They prefer muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms.	Low	The subject land contains wetland habitat within the Dam, however there is a lack of shallow aquatic habitat with emergent vegetation to support the species.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Calidris ferruginea	Curlew Sandpiper	E	CE, MiW, Ma overfly	Y	-	-	-	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores. Curlew Sandpipers are omnivorous, feeding on worms, molluscs, crustaceans, insects and some seeds. Birds breed at 2 years of age and the oldest recorded bird is 19 years old. Most birds caught in Australia are between 3 and 5 years old.	Low	The subject land does not contain littoral or coastal habitat to support the species.
Calidris melanotos	Pectoral Sandpiper	-	MiW, Ma overfly	Y	-	-	-	The Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. They prefer wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire.	Negligible	The subject land does not contain suitable coastal waterbodies to support the species.
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V	V	Y	Y	71	28/10/2022	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, Allocasuaraina diminuta, and *A. gymnathera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (*Casuarina cristata*). Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	Known	The species was incidentally recorded in the subject land.
Chalinolobus dwyeri	Large-eared Pied Bat	V	E	Y	Y	5	30/04/2019	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in caves, overhangs, mine adits and concrete structures. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.	Known	The species was recorded in the subject land via an acoustic detector in 2020.
Clematis fawcettii	Stream Clematis	V	V	Y	Y	6	19/08/1995	Drier rainforest, usually near streams.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	V	Y	Y	3	17/08/2022	The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding. Hollows in standing dead or live trees and tree stumps are essential for nesting.	Low	The subject land does not contain suitable dry eucalypt woodland to support the species. There is a low number of records in the locality.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	-	E	Y	-	-	-	The ecological community occurs in coastal catchments, mostly at elevations of less than 20 m above sea-level (ASL) that are typically found within 30 km of the coast. On the mid and north coast of NSW the ecological community may also occur up to 50 m ASL on floodplains of, or coastland flats associated with, former or current coastal river systems. Coastal Swamp Oak Forest typically occurs on unconsolidated sediments, including alluvium deposits, and where soils formed during the Quaternary period as a result of sea-level rise during the Holocene period. These are most typically hydrosols, which are saturated with water for long periods of time (typically grey-black clay-loam and/or sandy loam soils). The ecological community can also occur on organosols (peaty soils). The ecological community is typically found where groundwater is saline or brackish but can occur in areas where groundwater is relatively fresh. It is typically found on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. These are typically associated with low-lying coastal alluvial floodplains and alluvial flats.	Negligible	The TEC was not recorded during vegetation mapping nor targeted flora surveys.
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	V	V	Y	Y	3	29/01/1995	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils. The Three-toed Snake-tooth Skink lives in loose soil, leaf litter and rotting logs, and feeds on earthworms and beetle grubs. Garden beds and urban yards under leaf litter on alluvial soils.	Negligible	The species was not recorded on the subject land during targeted surveys.
Coleus nitidus (syn Plectranthus nitidus)	Nightcap Plectranthus, Silver Plectranthus	E	E	Y	-	-	-	Grows on rocky cliff-faces and boulders, in the shelter and shade provided by the adjacent rainforest and dry rainforest. Co-occurs with *Plectranthus graveolens* and Crofton Weed.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Corokia whiteana	Corokia	E	E	Y	Y	146	26/05/2023	The inland populations are found at the boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m.	Known	The species was recorded on the subject land.
Cryptocarya foetida	Stinking Cryptocarya, Stinking Laurel	V	V	Y	Y	1	1/05/2014	Found in littoral, warm temperate and subtropical rainforest, wet sclerophyll forest and Camphor Laurel forest usually on sandy soils, but mature trees are also known on basalt soils. The seeds are readily dispersed by fruit-eating birds, and seedlings and saplings have been recorded from other habitats where they are unlikely to develop to maturity. Though seedlings can be fairly numerous, few mature trees are known.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Y	-	-	-	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*). Little is known about the ecology of the species; being leafless it is expected to have limited photosynthetic capability and probably depends upon a fungal associate to meet its nutritional requirements from either living or dead organic material. In addition to reproducing from seed, it is also capable of vegetative reproduction and thus forms colonies which can become more or less permanent at a site. On the Central Coast of NSW, populations have been recorded in woodland dominated by Scribbly Gum (*Eucalyptus haemastoma*), Brown Stringybark (Eucalyptus capitellata), Red Bloodwood (*Corymbia gummifera*) and also associated with Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*).	Negligible	In NSW, the species northern most records are from the Gibraltor Range National Park, which is located approximately 140 km south of the subject land.
Cuculus optatus	Oriental Cuckoo	-	Mi	-	Y	5	6/09/1998	The species non-breeding habitat consists of monsoonal rainforest, vine thickets, wet sclerophyll forest or open Casuarina, Acacia or Eucalyptus woodlands. The species is frequently at edges or ecotones between habitat types (DoE, 2015).	Low	The species has not been recorded in the locality since 1998.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	CE	CE	Y	Y	5	23/04/1992	Usually recorded from drier rainforests and adjacent wetter eucalypt forest but rarely seen due to its small size and cryptic habits. Also found in the wetter lowland rainforests that are now largely cleared in NSW. The bird shows a decided preference for fig trees, but also feeds on other fruiting rainforest species, lichen, nectar and grubs.	Negligible	The species was not recorded on the subject land during targeted surveys.
Cynanchum elegans	White-flowered Wax Plant	E	E	Y	-	-	-	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (*Leptospermum laevigatum*) – Coastal Banksia (*Banksia integrifolia subsp. integrifolia*) coastal scrub; Forest Red Gum (*Eucalyptus tereticornis*) aligned open forest and woodland; Spotted Gum (*Corymbia maculata*) aligned open forest and woodland; and Bracelet Honeymyrtle (*Melaleuca armillaris*) scrub to open scrub. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific. The fruit can take up to six months to mature. Seed production is variable and unreliable. Seeds are wind dispersed. It is considered to be unlikely that a soil seed bank for this species exists. Plants are capable of suckering from rootstock in response to occasional slashing or grazing. The fire response of the species is unknown although it has been known to reshoot following fire. Annual burning at one site has been shown to result in population decline.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Cyperus semifertilis	Missionary Nutgrass	E	V	-	Y	2	21/03/1996	Occurs in open forest dominated by White Mahogany (*Eucalyptus acmenoides*) and wet sclerophyll forest with Sydney Blue Gum (*Eucalyptus saligna*) and Brush Box (*Lophostemon confertus*).	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Dasyornis brachypterus	Eastern Bristlebird	E	E	Y	Y	3	16/01/1995	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse midstorey near rainforest ecotone; all of these vegetation types are fire prone. Age of habitat since fires (fire-age) is of paramount importance to this species. The Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, habitat in northern NSW requires frequent fires to maintain habitat condition and suitability. Shy and cryptic and rarely flies, although can be seen scampering over the ground; when approached, may move to a lookout perch 1 m or more above the ground, then retreat into dense vegetation. Males are strongly territorial.	Negligible	The subject land has a distinct lack of contiguous, tall, and dense grassy understoreys that would support the species.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Y	Y	34	13/11/2019	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Quolls use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites. Mostly nocturnal, although will hunt during the day; spend most of the time on the ground, although also an excellent climber and will hunt possums and gliders in tree hollows and prey on roosting birds. Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. A generalist predator with a preference for medium-sized (500 g-5 kg) mammals. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, reptiles and insects. Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares. Are known to traverse their home ranges along densely vegetated creek lines.	Negligible	Although the species was not specifically targeted, the terrestrial and arboreal camera trap effort across the subject land is considered sufficient to have captured the species if it were present. No individuals of the species were recorded throughout the surveys.
Davidsonia jerseyana	Davidson's Plum	E	E	Y	Y	12	23/01/2004	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300 m). Many trees are isolated in paddocks and on roadsides in former rainforest habitats.	Negligible	The species was not recorded on the subject land throughout targeted flora surveys.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Davidsonia johnsonii	Smooth Davidson's Plum	E	E	Y	Y	30	31/08/2022	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300 m). Many trees are isolated in paddocks and on roadsides in cleared land.	Negligible	The species was not recorded on the subject land throughout targeted flora surveys.
Delma torquata	Adorned Delma, Collared Delma	-	V	Y	-	-	-	The Collared Delma normally inhabits eucalypt-dominated woodlands and open-forests in Queensland Regional Ecosystem Land Zones. In the eastern parts of the species' range (i.e. the Toowoomba Range), suitable habitats are commonly associated with exposed rocky outcrops on ridges or slopes in vegetation communities dominated by Narrow-leafed Ironbark (*Eucalyptus crebra*). Other vegetation communities in this region are typically dominated by Lemon-scented Gum. The presence of rocks, logs, bark and other coarse woody debris, and mats of leaf litter (typically 30–100 mm thick) appears to be an essential characteristic of the Collared Delma microhabitat and is always present where the species occurs. This may be the limiting factor for the Collared Delma recolonising in recently burnt areas.	Negligible	The subject land does not contain suitable eucalypt-dominated woodlands nor open-forests in QLD RE vegetation zones. The subject land also does not contain exposed rocky outcrops on ridges or slopes in Narrow-leaved Ironbark communities.
Desmodium acanthocladum	Thorny Pea	V	V	Y	Y	49	7/09/2021	Dry rainforest and fringes of riverine subtropical rainforest. On basalt-derived soils at low elevations. Much of its habitat has been cleared for agriculture.	Known	The species was recorded on the subject land.
Diospyros mabacea	Red-fruited Ebony	E	E	Y	Y	39	5/04/2017	Usually grows as an understorey tree in lowland subtropical rainforest, often close to rivers. Soils are generally basalt-derived or alluvial.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Diploglottis campbellii	null	E	E	Y	Y	135	29/05/2023	Confined to the warm subtropical rainforests of the NSW-Queensland border lowlands and adjacent low ranges. The forest types in which the species occurs vary from lowland subtropical rainforest to drier subtropical rainforest with a Brush Box open overstorey. Occurs on basalt-derived soils and also on poorer soils such as those derived from quartz monzonite. Flowering times vary across its range depending on latitude and to some extent annual seasonal variations. Ripe fruits are generally present from January to early April, with peak fruiting during the last week of February and early March. Seed dispersal mechanisms are unclear.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Dunn's white gum (Eucalyptus dunnii) moist forest in north-east New South Wales and south-east Queensland	Dunn's white gum (Eucalyptus dunnii) moist forest in north-east New South Wales and south-east Queensland	-	E	Y	-	-	-	Typically occurs on deep, fertile soils and is largely confined to fertile basaltic derived soils, or fine-grained sediments of colluvium or alluvium depending on upstream environments. Most commonly found at the margins of rainforests in valley bottoms and on lower slopes of hills and escarpments. It may also sometimes occur on upper slopes and basalt ridges however is typically less common on north-western-facing slopes. Mostly occurs at elevations between 400–650 m above sea level (ASL), however can also occur between 200–800 m ASL, and in areas that have an average annual rainfall of 1000-1500 mm.	Negligible	The TEC was not recorded during vegetation mapping.
Eidothea hardeniana	Nightcap Oak	E	CE	-	Y	242	16/01/2019	The species occurs in upland warm temperate rainforest, usually near creeks. Pollen movement is mostly mediated by small nocturnal beetles. Flowering occurs from mid-October to mid-November. The fruit takes over one year to develop and reaches full size in about mid-December. It then changes colour from green to dull yellow over the following two to three months, falling from mid-February to early March. The flesh *of E. hardeniana* fruit is thought to be unpalatable to the local dispersal organisms. Generally, once the fruit falls to the ground, bush rats (*Rattus fuscipes*) chew through the flesh and hard endocarp to feed on the seed.	Negligible	The species has only been recorded within the Nightcap Range which is located approximately 4 km south of the subject land. All of the records in the locality are located within the Nightcap Range, which is located within the 10 km search area undertaken for the desktop searches.
Elaeocarpus sedentarius	Minyon Quandong	E	E	-	Y	833	18/09/2019	Warm temperate or subtropical rainforest, and where rainforest and wet eucalypt forest meet. Often associated with Brush Box.	Negligible	The species was not recorded in the subject land during targeted flora surveys.
Elaeocarpus williamsianus	Hairy Quandong	E	E	Y	-	-	-	Subtropical to warm temperate rainforest, including regrowth areas where it has apparently regrown from root suckers after clearing. Soils are derived from metasediments.	Negligible	The species was not recorded in the subject land during targeted flora surveys.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Endiandra floydii	Crystal Creek Walnut	E	E	Y	Y	2	28/01/1994	Warm temperate, subtropical rainforest or wet sclerophyll forest with Brush Box overstorey, and in and Camphor Laurel forest. The species can occur in disturbed and regrowth sites. The species generally prefers sheltered locations however it has been recorded on ridgelines, slopes, gullies and creek flats. It occurs from sea level up to 430 m above sea level. Flowering has been observed from November to May. Fruit, which has been observed from December to May, is not produced every year, and heavy crops are produced at irregular intervals. Following the severe drought conditions of the 2002 dry season, heavy fruit crops were reported throughout the range of the Crystal Creek Walnut. Seeds germinate readily and rapidly in nursery conditions. From one recorded fire exposure event the species was found to resprout from the root stock following the fire, the main trunk was killed by the fire.	Negligible	The species was not recorded in the subject land during targeted flora surveys.
Endiandra hayesii	Rusty Rose Walnut	V	V	Y	Y	141	18/10/2021	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils. The species occurs in regrowth and highly modified forms of these habitats.	Known	The species was recorded in the subject land.
Erythrotriorchis radiatus	Red Goshawk	E	E	Y	Y	4	6/12/1999	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Adults appear to occupy territories throughout the year and breeding territories are traditionally used from year to year. Adults have large home-ranges, estimated in the Northern Territory to be as great as about 120 km^2 for females and 200 km^2 for males. Red Goshawks usually hunt from concealed or, less often, exposed perches, but also fly close above or through forest or woodland searching for prey. They often hunt from perches early in the morning and late in the day and tend to hunt more on the wing at other times of the day. The breeding behaviour of Red Goshawks is not well known. Breeding is likely to be in spring and summer in southern Queensland and NSW. The birds lay clutches of 1-2 eggs between July and September, in a stick nest in a tall tree (>20 m tall) within 1 km of a watercourse or wetland. Young fledge around November and December. In winter in eastern Australia, the birds appear to move from nesting sites in the ranges to coastal plains, where they are associated with permanent wetlands.	Negligible	The species was not recorded in the subject land during targeted surveys. The species has not been recorded in the locality since 1999.
Falco hypoleucos	Grey Falcon	V	V	Y	-	-	-	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse; peak laying season is in late winter and early spring.	Negligible	The subject land does not contain watercourses with suitable vegetation in arid and semi-arid regions. The species is a vagrant east of the dividing range.
Floydia praealta	Ball Nut	V	V	Y	Y	9	13/11/2020	Riverine and subtropical rainforest, usually on red loam soil on basalt. The Ball Nut inhabits floristically rich, tall, closed riverine to subtropical rainforest or coastal scrub. The species is recorded on gently sloping alluvial levees to moderately sloped foot slopes and hillslopes, as well as steeply sloping scree slopes at altitudes from 50—350 m.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Fontainea australis	Southern Fontainea	V	V	Y	Y	9	6/08/2020	Southern Fontainea is found in lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest in the Nightcap Range.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Gallinago hardwickii	Latham's Snipe	-	V, Mi	Y	Y	23	12/11/2017	Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies).	Known	The species was recorded on the subject land.

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Gossia fragrantissima	Sweet Myrtle	E	E	Y	Y	1	1/07/2005	Dry subtropical and riverine rainforest. As it can coppice from roots left in the ground when rainforest is cleared, it is found at several sites as isolated plants in paddocks or regrowth.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Grey box-grey gum wet forest of subtropical eastern Australia		-	E	Y	-	-	-	The ecological community typically occurs on escarpment slopes and foothills, on inland hills and ranges between 100 m and 600 m altitude. It is mainly associated with areas where mean annual rainfall exceeds approximately 1000 mm (DECC 2008a) and does not exceed 1260 mm. DPIE 2021). It may occur in areas with somewhat lower or higher rainfall than this where topography or other factors create a suitable microclimate. Soils that support the ecological community are relatively fertile, well drained (NSW TSSC 2011) and are derived mostly from fine-grained sedimentary rocks, sometimes with local volcanic influence. The ecological community may occur on soils derived from other geologies especially where they have fine grained sedimentary or volcanic influence. It does not occur on broader alluvial landforms (including floodplains, alluvial flats, older floodplain terraces and periodically flooded depressions), where it is replaced by other ecological communities such as the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions, but may occur on shallower alluvial soils on the margins of the floodplain and in the smaller narrow alluvial systems (DCCEEW 2022).	Negligible	The TEC was not recorded on the subject land during vegetation mapping.
Hicksbeachia pinnatifolia	Red Boppel Nut	V	V	Y	Y	138	20/05/2020	Subtropical rainforest, moist eucalypt forest and Brush Box forest.	Known	The species was recorded on the subject land.
Hirundapus caudacutus	White-throated Needletail	V	V, Mi	Y	Y	46	16/03/2023	In Australia, the White-throated Needletail is almost exclusively aerial, recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps	High	The subject land has suitable habitat and there is a moderate number of records within the locality. The species may fly over the subject land.
Hirundo rustica	Barn Swallow	-	Mi	-	Y	2	31/05/1993	In Australia, the Barn Swallow is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires (Pizzey 1980; Blakers et al. 1984), and also in or over freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland.	Negligible	The subject land is outside of the known or predicted range for the species.
Isoglossa eranthemoides	Isoglossa	E	E	Y	Y	23	21/01/2019	Understorey of lowland subtropical rainforest, in moist situations on floodplains and slopes. Underlying soils are derived from basalt, metasediments or gabbro.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Lathamus discolor	Swift Parrot	E	CE, Ma	Y	-	-	-	Migrates to the Australian south-east mainland between February and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (Eucalyptus robusta), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Forest Red Gum (*E. tereticornis*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*). Commonly used lerp infested trees include Inland Grey Box (*E. microcarpa*), Grey Box (*E. moluccana*), Blackbutt (*E. pilularis*), and Yellow Box (*E. melliodora*). Return to some foraging sites on a cyclic basis depending on food availability. Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum (*Eucalyptus globulus*).	Negligible	The subject land does not contain any of the listed feed trees for the species. The species is unlikely to forage on the subject land.

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Litoria olongburensis	Olongburra Frog	V	V	Y	Y	3	17/03/2023	The Olongburra Frog is an "acid" frog confined to the coastal sandplain wallum swamps. Their life cycle is adapted to the acidic pH (2.8–5.5) of these wetlands. Frogs are highest in abundance in relatively undisturbed wallum swamps Breeding habitat is characterised by the presence of emergent sedges, with upright species such as *Baumea* spp. and *Schoenus* spp. preferred by adult frogs for perching. Frogs can be found in breeding habitat all year. However, little is known about habitat use when breeding is not occurring and drier areas adjacent to primary habitat may also be utilised. Breeding occurs mainly in spring, summer and autumn after rain. Eggs are laid singly in water at the base of sedges.	Negligible	The subject land does not contain coastal wallum swamps to support the species.
Lowland Rainforest of Subtropical Australia		-	CE	Y	-	-	-	The ecological community occurs on basalt and alluvial soils, including sand and old/elevated alluvial soils as well as floodplain alluvia. It also occurs occasionally on historically enriched rhyolitic soils and basaltically enriched metasediments. Lowland Rainforest mostly occurs in areas <300 m above sea level. Aspect can result in the community being found at >300 m altitude on north-facing slopes, but typically 300 m defines the extent of the lowlands. In addition, Lowland Rainforest typically occurs in areas with high annual rainfall (>1300 mm) (DSEWPaC 2011).	Known	This TEC has been recorded within the subject land in all areas mapped as PCT 1302.
Macadamia integrifolia	Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak	-	V	Y	-	-	-	The Macadamia Nut grows in remnant rainforest, preferring partially open areas such as rainforest edges. However, this habitat is not continuously fit for the species.	Negligible	This species was not recorded during targeted flora surveys.
Macadamia tetraphylla	Rough-shelled Bush-nut	V	V	Y	Y	74	31/08/2022	Found in subtropical rainforest, usually near the coast.	Known	This species was recorded on the subject land during targeted flora surveys.
Marsdenia longiloba	Slender Marsdenia	E	V	Y	Y	9	14/04/2020	Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops. Associated species include *Eucalyptus crebra, E. microcorys, E. acmenoides, E. saligna, E. propinqua, Corymbia intermedia* and *Lophostemon confertus*.	Known	This species was recorded on the subject land during targeted flora surveys.
Melanodryas cucullata cucullata	South-eastern Hooded Robin, Hooded Robin (south-eastern)	E	E	Y	-	-	-	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season.	Negligible	The subject land does not contain suitable lightly wooded, open eucalypt woodland, acacia scrub or mallee to support the species.
Mixophyes balbus	Stuttering Frog	E	V	Y	Y	1	19/04/1992	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Feed on insects and smaller frogs. Breed in streams during summer after heavy rain Eggs are laid on rock shelves or shallow riffles in small, flowing streams. As the tadpoles grow, they move to deep permanent pools and take approximately 12 months to metamorphose.	Negligible	Although the species was not specifically targeted, the survey effort completed for the other amphibian species is considered sufficient to have recorded the species if it was present. The species has not been recorded in the locality since 1992.
Mixophyes fleayi	Fleay's Barred Frog	E	E	Y	Y	531	3/02/2021	Rainforest and wet eucalypt forest of the escarpment and foothills, usually close to gravely streams. The species occurs along stream habitats from first to third order streams (i.e. small streams close to their origin through to permanent streams with grades of 1 in 50) but is not found in ponds or ephemeral pools. A nest is constructed in the shallow running water that occurs between pools in relatively wide, flat sections of the stream. Eggs are deposited in a shallow excavation in the stream bed or pasted directly onto bed rock. Individuals have been found hundreds of metres away from streams.	Negligible	The species was not recorded on the subject land during targeted surveys.

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Mixophyes iteratus	Giant Barred Frog	V	V	Y	Y	83	13/10/2021	Giant Barred Frogs are found along freshwater streams with permanent or semi-permanent water, generally (but not always) at lower elevation. Moist riparian habitats such as rainforest or wet sclerophyll forest are favoured for the deep leaf litter that they provide for shelter and foraging, as well as open perching sites on the forest floor. However, Giant Barred Frogs will also sometimes occur in other riparian habitats, such as those in drier forest or degraded riparian remnants, and even occasionally around dams. Although generally found within about 20 m of the stream, outside the breeding season, the Giant Barred Frog may disperse away from the stream (e.g. 50 m or further).	Known	The species was recorded on the subject land.
Monarcha melanopsis	Black-faced Monarch	-	MiT, Ma overfly	Y	-	-	-	They mainly occur in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.	Moderate	The subject land contains suitable rainforest and vine-thicket habitat to support the species.
Motacilla flava	Yellow Wagtail	-	MiT, Ma overfly	Y	-	-	-	Eucalypt forest and woodlands, at high elevations when breeding. They are particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland types. During migration, habitat preferences expand, with the species recorded in most wooded habitats except rainforests (DoE, 2015).	Negligible	The subject land does not occur at high altitudes required to support this species.
Myiagra cyanoleuca	Satin Flycatcher	-	MiT, Ma overfly	Y	-	-	-	Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. They are mainly recorded in eucalypt forests, especially wet sclerophyll forest, often dominated by eucalypts such as Brown Barrel, *Eucalyptus fastigata*, Mountain Gum, *E. dalrympleana*, Mountain Grey Gum, Narrow-leaved Peppermint, Messmate or Manna Gum, or occasionally Mountain Ash, *E. regnans*.	Low	The habitat on the subject land does not contain the tree species within which the species is mainly recorded in. There are no records in the locality.
Notamacropus parma	Parma Wallaby	V	V	-	Y	5	24/03/1995	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. Typically feed at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas. During the day they shelter in dense cover.	Negligible	The species was not recorded on the subject land during targeted surveys.
Numenius madagascariensis	Eastern Curlew	-	CE, MiW, Ma	Y	-	-	-	It generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. May also roost on wooden oyster leases or other similar structures. Within Australia, immature birds, which do not migrate, move northward in winter.	Negligible	The subject land does not contain suitable littoral, coastal habitat to support the species.
Ochrosia moorei	Southern Ochrosia	E	E	Y	Y	13	20/03/2013	Southern Ochrosia is found in riverine and lowland subtropical rainforest.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Owenia cepiodora	Onion Cedar	V	V	Y	Y	31	30/06/2011	Subtropical and dry rainforest on or near soils derived from basalt.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Ozothamnus vagans	Wollumbin Dogwood	E	V	-	Y	56	1/04/2019	Mostly recorded from open situations on the margins of, or within, wet sclerophyll forest, subtropical rainforest and cool temperate rainforest. *Ozothamnus vagans* is generally associated with rhyolite or basalt soils and occurs at elevations of greater than 500 m. The species prefers areas of disturbance and grows in sunny location son escarpment edges, in large gaps in the rainforest, and along roadsides.	Negligible	The species was not recorded on the subject land during targeted flora surveys.

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Pandion haliaetus	Osprey	V	MiW, Ma	Y	-	-	-	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging.	Low	The subject land contains extensive areas of water; however the subject land does not occur in littoral or coastal habitats where the species is most regularly known from. It is considered unlikely that the species would utilise the habitat within the subject land.
Petauroides volans	Southern Greater Glider	E	E	Y	Y	22	17/09/2021	Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha. Usually solitary, though mated pairs and offspring will share a den during the breeding season and until the young are independent. Very loyal to their territory.	Negligible	The species was not recorded on the subject land during targeted surveys.
Petaurus australis	Yellow-bellied Glider	V	V	Y	Y	16	23/11/2022	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Den, often in family groups, in hollows of large trees. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	Negligible	Call playback was conducted during spotlighting surveys, and the survey effort conducted for the other arboreal mammal species is considered sufficient to have recorded the species if it was present. No individuals of the species were detected on the subject land.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Y	Y	2	9/08/2016	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Highly territorial and have strong site fidelity with an average home range size of about 15 ha. Males tend to have larger home ranges than females. The home range consists of a refuge area and a foraging range linked by habitually used commuting routes. Females settle in or near their mother's range, while males mainly disperse between female groups within colonies, and less commonly between colonies. Dominant males associate and breed with multiple females.	Negligible	The subject land has a distinct lack of rocky escarpments, outcrops and cliffs to support the species.
Phaius australis	Lesser Swamp-orchid	E	E	Y	-	-	-	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Phascolarctos cinereus	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	E	E	Y	Y	520	12/09/2023	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than 2 ha to several hundred hectares in size. Generally solitary but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Females breed at two years of age and produce one young per year.	Known	The species was recorded on the subject land.
Phyllodes imperialis southern subspecies	Southern Pink Underwing Moth	E	E	Y	Y	12	8/03/2018	The Southern Pink Underwing Moth is found in subtropical rainforest below about 600 m elevation. Potential breeding habitat is restricted to areas where the caterpillar's food plant, a native rainforest vine, *Carronia multisepalea*, occurs in subtropical rainforest. Adult Southern Pink Underwing Moths require the low light conditions of the rainforest in order to breed.	Known	Whilst larvae and adult moths were not recorded within the subject land, occurences of *Carronia multisepalea* were recorded within the subject land. All occurrences of *Carronia multisepalea* will be assumed as a record of the Southern Pink Underwing Moth.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Plectranthus nitidus	Nightcap Plectranthus	E	E	-	Y	14	17/05/2018	Grows on rocky cliff-faces and boulders, in the shelter and shade provided by the adjacent rainforest and dry rainforest. Co-occurs with *Plectranthus graveolens* and Crofton Weed. Little is known of the ecology of this species. Flowers from February until May.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Potorous tridactylus	Long-nosed Potoroo	V	V	Y	Y	60	5/09/2022	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grasstrees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil. Often digs small holes in the ground in a similar way to bandicoots.; Mainly nocturnal, hiding by day in dense vegetation - however, during the winter months animals may forage during daylight hours. Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2 to 5 ha. Breeding peaks typically occur in late winter to early summer and a single young is born per litter. Adults are capable of two reproductive bouts per annum.	Negligible	The species was not recorded on the subject land during targeted surveys.
Pseudomys novaehollandiae	New Holland Mouse	-	V	Y	Y	1	4/05/2020	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. It is a social animal, living predominantly in burrows shared with other individuals. Distribution is patchy in time and space, with peaks in abundance during early to mid-stages of vegetation succession typically induced by fire.	Negligible	The subject land does not contain suitable open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes to support the species. Low number of records in the locality.
Pseudomys oralis	Hastings River Mouse	E	E	-	Y	1	3/09/2021	A variety of dry open forest types with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops and fallen logs. Nests may be in either gully areas or ridges and slopes. They eat seeds, leaves, insects and fungi. Home range is generally between 0.5 ha and 4 ha and there may be some overlap with other individuals.	Negligible	The subject land does not contain dry open forests to support the species. Low number of records in the locality.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Y	Y	222	5/05/2023	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. Annual mating commences in January and conception occurs in April or May; a single young is born in October or November. Site fidelity to camps is high; some camps have been used for over a century. Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km. Feed on the nectar and pollen of native trees, in particular *Eucalyptus, Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	Known	The species was recorded foraging on the subject land during surveys. No breeding camps are located on the subject land.
Randia moorei	Spiny Gardenia	E	E	Y	Y	4	27/04/2015	Spiny Gardenia occurs in subtropical, riverine, littoral and dry rainforest. In NSW, Hoop Pine and Brush Box are common canopy species. It is found along moist scrubby water courses at altitudes up to 360 m asl, with most records below 100 m asl. Clumps of shrubs and small trees may represent single genetic individuals.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Rhipidura rufifrons	Rufous Fantail	-	MiT, Ma overfly	Y	-	-	-	They mainly inhabit wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E.cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E.regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby understorey often including ferns.	Known	The species was recorded on the subject land.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Rhodamnia maideniana	Smooth Scrub Turpentine	CE	CE	Y	Y	19	5/04/2017	*Rhodamnia maideniana* occurs in subtropical rainforest on basaltic soils, including red-brown loams and clay loams. It can be locally common on slopes and in gullies, growing from 40–900 m above sea level. It often occurs in disturbed fragments and along edges of simple to complex notophyll vineforest, in the ecotone with adjacent wet eucalypt forest. Across its distribution, *R. maideniana* occurs patchily in suitable habitat (TSSC 2023).	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Rhodamnia rubescens	Scrub Turpentine	CE	CE	Y	Y	263	16/09/2022	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	Known	The species was recorded on the subject land during targeted flora surveys.
Rhodomyrtus psidioides	Native Guava	CE	CE	Y	Y	13	21/12/2020	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	Known	The species was recorded on the subject land during targeted flora surveys.
Rostratula australis	Australian Painted Snipe	-	E, Ma overfly	Y	-	-	-	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Incubation and care of young is all undertaken by the male only. Forages nocturnally on mudflats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	Low	The subject land contains wetland habitat within the Dam; however the condition of the habitat is suboptimal for the species. The Dam contains steep margins between aquatic habitat and terrestrial habitat, with a distinct lack of mudflats and shallow water shelves for foraging.
Sarcochilus fitzgeraldii	Ravine Orchid	V	V	Y	Y	11	11/11/1997	The Ravine Orchid grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500–700 m. Occasional clumps are found on the bases of fibrous-barked trees.	Negligible	The subject land occurs below 500 m above sea level. As such, the subject land does not contain suitable habitat to support the species.
Sarcochilus hartmannii		V	V	Y	Y	12	8/10/2012	Favours cliff faces on steep narrow ridges supporting eucalypt forest and clefts in volcanic rock from 500 to 1,000 m in altitude. Also found occasionally at the bases of fibrous trunks of trees, including cycads and grasstrees.	Negligible	The subject land occurs below 500 m above sea level. As such, the subject land does not contain suitable habitat to support the species.
Sophora fraseri	Brush Sophora	V	V	-	Y	1	4/01/1907	Brush Sophora is usually found in wet situations in wet sclerophyll forest or vine forest, often near rainforest. The roots of Brush Sophora contain a number of fungal/mycorrhizal species. Resprouts from fire. Flowers from April until November, fruit occurs from January to November.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Stagonopleura guttata	Diamond Firetail	-	V	Y	-	-	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Usually encountered in flocks of between 5 to 40 birds, occasionally more. Groups separate into small colonies to breed, between August and January. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting. Appears to be sedentary, though some populations move locally, especially those in the south. Has been recorded in some towns and near farmhouses.	Low	The subject land does not contain suitable grassy eucalypt woodland
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions		-	E	Y	-	-	-	The ecological community is found on alluvial landforms, including floodplains, the riparian zones of parent rivers and other order tributaries, alluvial flats, floodplain/alluvial terraces and periodically flooded depressions. It generally occurs below 50 m above sea-level (ASL), although it can occur up to 250 m ASL.	Negligible	This TEC was not recorded during vegetation mapping surveys or targeted flora surveys.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Symplocos baeuerlenii	Small-leaved Hazelwood	V	V	Y	Y	469	20/05/2020	Occurs in sub-tropical and warm temperate rainforest on less fertile soils derived from rhyolite.	Negligible	The species was not recorded on the subject land during targeted flora surveys.
Symposiachrus trivirgatus	Spectacled Monarch	-	MiT, Ma overfly	Y	-	-	-	Dense vegetation, mainly in rainforest but also in moist forest or wet sclerophyll and occasionally in other dense vegetation such as mangroves, drier forest and woodlands.	Moderate	The subject land contains suitable habitat to support the species.
Syzygium hodgkinsoniae	Red Lilly Pilly	V	V	Y	Y	110	10/03/2020	Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soils.	Known	The species was recorded on the subject land.
Syzygium moorei	Durobby	V	V	Y	Y	47	1/07/2020	Durobby is found in subtropical and riverine rainforest at low altitude. It often occurs as isolated remnant paddock trees.	Known	The species was recorded on the subject land.
Thalasseus bergii	Crested Tern	-	Mi	-	Y	3	9/11/2017	The nest is a shallow scrape in bare sand, rock or coral in flat open sites on offshore islands, low-lying coral reefs, sandy or rocky coastal islets, coastal spits, lagoon mudflats or islets in saltpans and sewage works (Commonwealth of Australia, 2020).	Low	The subject land does not contain suitable coastal habitat to support the species.
Thersites mitchellae	Mitchell's Rainforest Snail	E	CE	-	Y	3	1/05/2020	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils. Slightly higher ground around the edges of wetlands with palms and fig trees are particularly favoured habitat. Typically found amongst leaf litter on the forest floor, and occasionally under bark in trees. Active at night and feeds on leaf litter, fungi and lichen.	Known	The species was recorded on the subject land during targeted surveys.
Thesium australe	Austral Toadflax, Toadflax	V	V	Y	-	-	-	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Negligible	The subject does is not located on a coastal headland, nor does it contain grassy woodland habitat to support the species.
Turnix melanogaster	Black-breasted Button-quail	CE	V	Y	Y	13	24/09/1995	Preferred habitat includes drier low closed forests, including dry rainforests, vine forest and vine thickets, often in association with Hoop Pine, and Bottletree scrubs. The understorey may be dense or sparse, but a deep, moist leaf-litter layer, in which the birds forage, is an important component of habitat. Birds have been recorded using Lantana thickets at edges of rainforest or Lantana understorey of forest or rainforest, but it is not known if Lantana associations are suitable for sustaining breeding. During droughts, birds may move into wetter rainforests bordering dry rainforests. In NSW, as well as drier rainforests, may occupy wetter subtropical rainforests, sometimes in association with moist eucalypt forest. Black-breasted Button-quails forage in leaf-litter by pivot-feeding, scratching at the leaf-litter with one leg while pivoting the body on the other, displacing leaves and soil, and exposing invertebrate prey. This method of foraging produces distinctive circular saucer-shaped depressions, often termed platelets, 15-25 cm in diameter. Breeding has been recorded from September to May but it is possible that breeding occurs throughout the year at some sites. Females, which are territorial, are occasionally seen singly.	Negligible	The species was not recorded on the subject land during targeted surveys.
Uromyrtus australis	Peach Myrtle	E	E	Y	Y	305	20/05/2020	Warm temperate rainforest on less fertile soils derived from rhyolite rock. Often associated with Coachwood (*Ceratopetalum apetalum*).	Negligible	The species was not recorded on the subject land during targeted surveys.
Vincetoxicum woollsii (syn Tylophora woollsii)	null	E	E (listed as Tylophora woollsii)	Y	-	-	-	It has been recorded from wet sclerophyll/rainforest margins, Eucalypt dominated open forests and disturbed road verges. It grows on brown clay over metasediments at altitudes between 10–750 m above sea level. Associated species include *Eucalyptus eugenioides, E. microcorys, E. saligna, E. biturbinata, Acacia hakeoides, A. lineate, Myoporum spp*., and *Casuarina spp*. in NSW (DEWHA, 2008).	Negligible	The species was not recorded on the subject land during targeted surveys.

Scientific name	Common name	BC Act	EPBC Act	PMST	BioNet	Number of BioNet records (locality)	Last recorded	Habitat associations (DCCEEW 2023, DPE 2023)	Likelihood of occurrence	Justification
Westringia rupicola	null	-	V	Y	-	-	-	Westringia rupicola grows in crevices in sheer rhyolite cliffs. Associated species include *Plectranthus sp., Leptospermum microcarpum*, and *Callistemon comboynensis*. This species occurs within the South East Queensland Natural Resource Management Region. The distribution of this species overlaps with the "White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland" EPBC Act-listed threatened ecological community (DEWHA, 2008).	Negligible	The subject land does not contain sheer rhyolite cliffs nor any of the associated species. The subject land also does not contain White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland EPBC Act-listed TEC.

Notes: 1. NSW Biodiversity Conservation Act (BC Act) status. CE = Critically Endangered, E = Endangered, V = Vulnerable

2. Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) status. CE = Critically Endangered, E = Endangered, V = Vulnerable, Mi = Migratory, Ma = Marine

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