ARCADIS Design & Consultancy for natural and built assets

BIODIVERSITY ASSESSMENT OF DEFERRED LANDS

Stage 1: Review of Existing Information –DRAFT

22 JUNE 2021

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NORTHERN BEACHES COUNCIL

Biodiversity Assessment of Deferred Lands

Review of Existing Information

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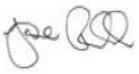
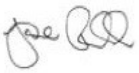
Checker	Jane Rodd	
Approver	Jane Rodd	

Report No 1
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REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	10/12/2020	Biodiversity Assessment of Deferred Lands Stage 1: Review of Existing Information – Draft	JRk, JRd, EL	EC
B	0605/2021	Biodiversity Assessment of Deferred Lands Stage 1: Review of Existing Information – Draft 2 (respond to NB Council Comments)	JRk, , EL	JRd
C	22/06/21	Biodiversity Assessment of Deferred Lands Stage 1: Review of Existing Information – Draft 3 (minor corrections)	EL	JRd

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GLOSSARY AND ACRONYMS

The table below provides a glossary for the key acronyms used within this report.

Term	Meaning
Acronyms	
BAM	NSW Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
BOM	Bureau of Meteorology
Council	Northern Beaches Council
DCP	Development Control Plan
DoEE	Commonwealth Department of Environment and Energy
DPI	NSW Department of Primary Industries
DPIE (EES)	NSW Department of Planning, Industry and Environment (Environment, Energy and Science)
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
IBRA	Interim Biogeographically Regionalisation of Australia
LEP	Local Environmental Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NSW	New South Wales
OEH (now DPIE (EES))	NSW Office of Environment and Heritage
PCT	Plant Community Type
SEPP	State Environmental Planning Policy
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened Ecological Community
VIS	Vegetation Information System
The deferred lands area	Covers the Northern Beaches Deferred Lands area (**Figure 1**)

EXECUTIVE SUMMARY

This review of existing information report is focused on the deferred lands area of the Northern Beaches Council Local Government Area, formerly part of the Warringah Shire Council. The deferred lands cover approximately 1,400 hectares, with around 1,143 hectares of native vegetation. They are adjacent to Garigal National Park to the north and west, and are bounded by the suburbs of Cromer, Narraweena, Beacon Hill, Oxford Falls, Frenchs Forest, Belrose and Belrose North.

Northern Beaches Council is currently midway through a three-year strategic land-use planning program to prepare a single Local Environmental Plan and Development Control Plan for the Northern Beaches Council area. Input on the ecological values of the deferred lands is a critical component to progressing this strategic land-use planning program.

Arcadis Australia Pacific Pty Ltd have been engaged by Northern Beaches Council to provide an assessment of the ecological value of the deferred lands, using a combination of desktop and field assessment. This report is Stage 1 of that assessment and focuses on summarising existing ecological information for the deferred lands area.

We reviewed 31 reports relevant to discussing the ecological value and land zoning of the deferred lands and found that there are substantial areas where detailed assessment has occurred and there is often a diversity of threatened species records. These areas are typically associated with proposed developments as the assessments have been completed as a part of the development consent process. There are other areas which have had minimal visitation or targeted surveys but do still have occasional threatened species records, often close to tracks and fire trails throughout the central part of the deferred lands. Reports included data from the mid-1990s to 2020 and varied in the intensity and target species. Older reports provide information on potential habitat for threatened species and provide information on presence (assuming little or no disturbance since the survey), however due to changes to survey guidelines and threatened species listings, absence may not reflect the current situation.

There is also a previous bias within completed surveys when it comes to taxa, with a strong focus on fauna, especially iconic species such as Eastern Pygmy-possum, Red-crowned Toadlet and Powerful Owl. In total, there are seven fauna species recorded within the deferred lands area with more than 15 records from within the past five years, including between 60 and 70 records for Eastern Pygmy-possum, Red-crowned Toadlet and Rosenberg's Goanna. Whilst there is a bias towards threatened fauna species, there are also records of ten threatened flora species within the deferred lands area, with *Tetratheca glandulosa, Grevillea caleyi, Persoonia hirsuta* and *Eucalyptus camfieldii* the most frequently recorded.

The interior of the deferred lands is primarily Metropolitan Local Aboriginal Land Council and Crown Land and has not historically been subject to detailed ecological survey. Tracks through this land do have several species of threatened flora and fauna recorded adjacent to them, but there are large areas of vegetation away from the tracks that have few records, and little evidence of recent survey. These areas have been identified in the report as requiring further field survey.

Sixteen Plant Community Types have been mapped within the deferred lands area, most of which are associated with the dominant sandstone geology of the area. Five Threatened Ecological Communities are mapped within the deferred lands area; of these, two communities – Duffys Forest Ecological Community in the Sydney Basin Bioregion (32.5 hectares) and Coastal Upland Swamp Endangered Ecological Community (18.43 hectares) – have larger areas mapped within the deferred lands area.

The diversity of threatened species records and large areas of relatively undisturbed native vegetation retained on private lands makes the deferred lands area unique within the Sydney catchment area.

STAGE 1: REVIEW OF EXISTING INFORMATION

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1 INTRODUCTION

1.1 Background

Arcadis Australia Pacific Pty Ltd (Arcadis) have been engaged by Northern Beaches Council (Council) to prepare this Review of Existing Information report as a part of a package of works detailed in the *RFQ 2020/102 Review of Existing Information and Biodiversity Survey of the Deferred Lands*. This Stage 1 report and subsequent biodiversity surveys aim to develop a greater understanding of the Threatened Ecological Communities (TECs), threatened species and their habitats present within the area referred to as the 'deferred lands'.

The deferred lands area and surrounding locality represents an important location for regional biodiversity and provides habitat connectivity and wildlife corridors to key conservation areas including Ku-ring-gai Chase and Garigal National Parks. Currently, a growing population in the Northern Beaches is leading to increased pressure for new land releases and development within the deferred lands area.

The challenge Council faces is to maintain and improve threatened species and ecological communities amidst these pressures. Consequently, detailed information regarding areas of high ecological value within the deferred lands area is critical to prioritising areas of high biodiversity value for conservation during land use planning.

Council is currently midway through a three-year strategic land-use planning program to prepare a single Local Environmental Plan (LEP) and Development Control Plan (DCP) for the Northern Beaches Council area. Input on the ecological values of the deferred lands is a critical component to progressing this strategic land-use planning program.

This report is designed to review and summarise existing information and identify knowledge gaps on the ecological value of the area. It is the first of two stages in the development of the biodiversity survey of the deferred lands. The second stage is field surveys designed to fill gaps in knowledge of ecological values present within the area.

1.2 Study area

The deferred lands, formerly part of the Warringah Local Government Area (LGA) (now amalgamated into the Northern Beaches Council) cover an area approximately 1,400 hectares (ha) in size (**Figure 1**). The lands lie adjacent to Garigal National Park to the north and west, and are bounded by the suburbs of Cromer, Narraweena, Beacon Hill, Oxford Falls, Frenchs Forest, Belrose and Belrose North.

The landscape of the deferred lands is categorised by rugged, rolling to very steep hills on Hawkesbury sandstone with areas of hanging valleys and sandstone plateaus. A variety of soil landscapes occur within the deferred lands area, including Gymea, Lambert, Oxford Falls, Somersby, Lucas Heights, Hornsby, Hawkesbury and Disturbed Terrain. Vegetation is typical of sclerophyll forest, eucalypt woodland and heathland, which exist in varying conditions and patch sizes across the area. Current land use within the deferred lands is predominantly urban residential, with a large area of remnant native vegetation (connected to Garigal and Ku-ring-gai Chase National Parks) used for public recreation (e.g. hiking).

The deferred lands area contains several major creeks and their tributaries, including Deep Creek, Snake Creek, Oxford Creek, Middle Creek and Wheeler Creek. Most of these creeks and their tributaries have been assessed as fair, very good or excellent based on their water quality, macroinvertebrate assemblage, in-stream features and geomorphology (Office of Environment and Heritage, 2016).

1.3 Objectives

Existing information on the deferred lands, including relevant biodiversity studies, databases and mapping have been reviewed to obtain the following:

- The ecological and/or conservation value of the deferred lands (including presence or potential habitat for threatened flora, fauna and ecological communities etc.)
- The relevance, adequacy, and validity of existing information and data (including mapping data, survey effort for threatened species and ecological communities etc.)
- An understanding of any gaps and/or limitations in existing information (including gaps in threatened species records, mapping uncertainties etc.)
- An understanding of land zoning definitions and the adequacy and relevance of existing information for land zoning of the deferred lands.

The purpose of understanding the gaps in existing data is to guide the scope of the detailed field surveys which are part of Stage 2 of this project. This will assist in focusing efforts in areas with previous low survey effort and/or that are likely to contain biodiversity values. In addition, two inter-linked web portals have been set-up to summarise spatial data and allow the results of this report and field data to be readily updated and easily accessed by Council.

1.4 Report structure

The structure of this report has been included below in **Table 1-1** to help meet project objectives (as outlined above in Section 1.3).

Table 1-1: Report structure

Main content	Cross-references
Methodologies for Stage 1	**Chapter 2**
Review of existing information: reports	**Chapter 3** **Figure 2, Figure 3**
Review of existing information: native vegetation	**Section 3.2** **Figure 4, Figure 5**
Review of existing information: threatened flora	**Section 3.3** **Figure 4, Figure 5**
Review of existing information: threatened fauna	**Section 3.4** **Figure 4, Figure 6**
Review of existing information: other biodiversity values	**Section 3.5, Section 3.6** **Figure 6**
Analysis: gaps and limitations	**Section 4.1** **Figure 4**
Analysis: conservation value of land	**Section 4.2**
Analysis: land zoning	**Section 4.3**
Recommendations for Stage 2	**Chapter 5**

Main content	Cross-references
Conclusion	**Chapter 6**
References	**Chapter 7**
Appendices	**Appendix A, Appendix B, Appendix C**

Northern Beaches Council

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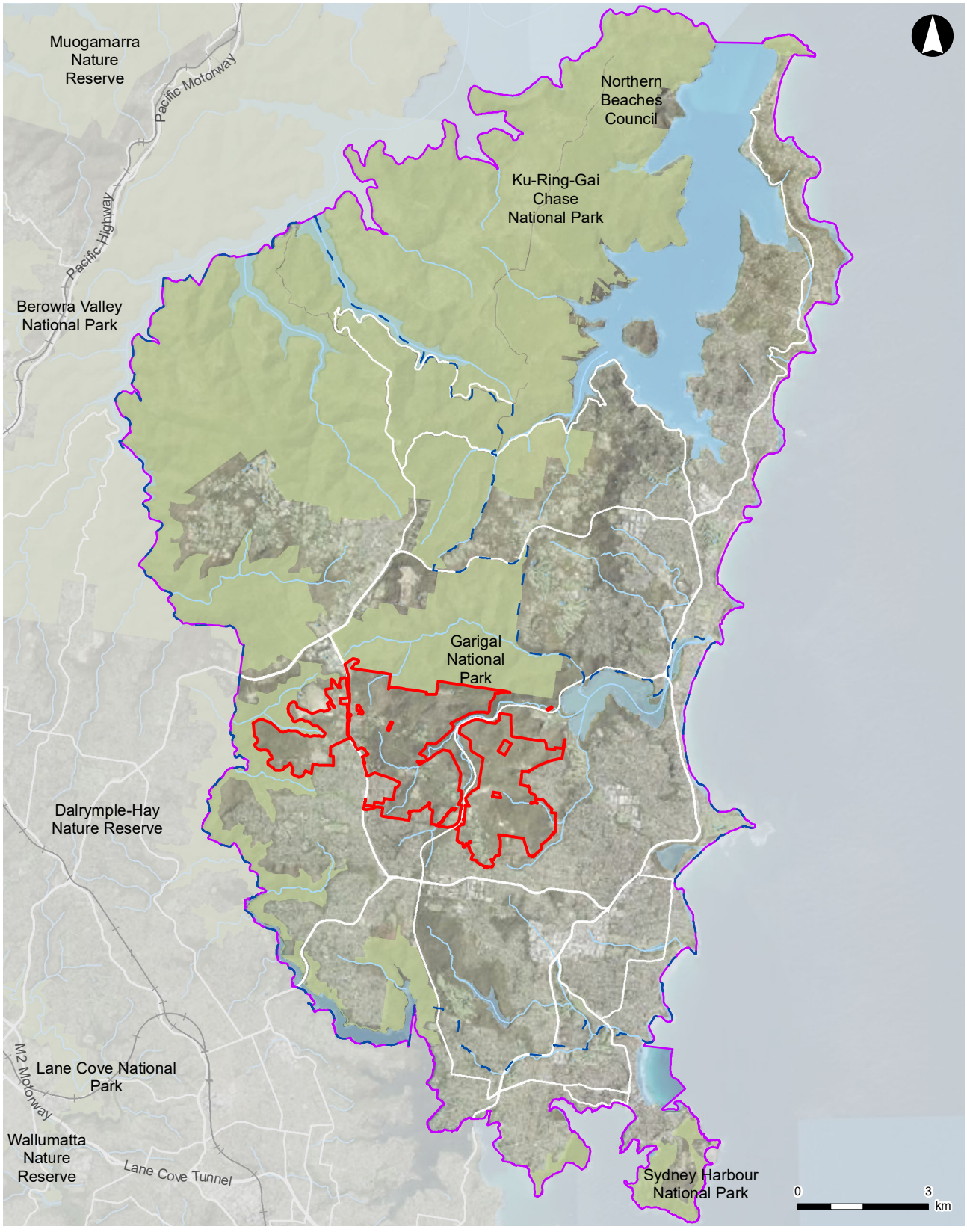

LEGEND

- Deferred lands
- Local Government Area boundary
- Historical Warringah Local Government Area boundary
- NPWS Reserve
- Railway
- Watercourse

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Date issued: March 15, 2021

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Figure 1: Location of the deferred lands area

2 METHODS

2.1 Data sources

A total of 31 documents were sourced and considered as part of this assessment and are included within the References section of this report. Key documents pertaining to the deferred lands area included assessments and surveys of catchment areas (Kavanagh, Law, Lemckert, & Stanton, 2015) (Department of Environment and Climate Change, 2008), surveys of natural areas within the former Warringah LGA (PJ Smith Ecological Consultants, 2000, 2005, 2009) and several ecological assessments within the deferred lands (detailed in **Table 3-1** below). The following data sources were also reviewed:

- Biodiversity Values Map
- BioNet Threatened Biodiversity Data Collection (TBDC)
- Fisheries NSW Spatial Data Portal
- Directory of Important Wetlands of Australia
- BOM Atlas of Ground Water Dependent Ecosystems
- Atlas of Living Australia.

In addition, databases were queried to identify important ecological information, including State and Commonwealth records of threatened entities and Commonwealth Matters of National Environmental Significance (MNES) that occur or have the potential to occur within 10 kilometres of the deferred lands area. Databases and reports interrogated for this purpose are listed below in **Table 2-1**.

Table 2-1: Database searches conducted by Arcadis in October 2020

Database	Purpose of search	Date of database search
NSW BioNet Wildlife Atlas *Managed by the NSW Department of Planning, Industry and Environment (DPIE) Environment, Energy and Science (EES) branch (formerly the Office of Environment and Heritage (OEH))*	Used to compile a list of threatened species records listed under the BC Act and EPBC Act to within 10 kilometres of the deferred lands area.	26 October 2020
Protected Matters Search Tool (PMST) *Managed by the Commonwealth Department of the Environment and Energy (DoEE)*	Used to compile a list of potentially occurring MNES listed under the EPBC Act to within 10 kilometres of the deferred lands area.	26 October 2020
NSW BioNet Vegetation Information System (VIS) Classification database *Managed by DPIE (EES)*	Provides information on Plant Community Types (PCTs) and their relationship to a vegetation formation and vegetation class.	26 October 2020
NSW BioNet Threatened Species Data Collection *Managed by DPIE (EES)*	Contains information for all listed threatened species, populations and communities.	26 October 2020
NSW WeedWise *Managed by NSW Department of Primary Industries (DPI)*	Identifies species listed as priority weeds for a LGA and their control requirements.	26 October 2020

3 EXISTING INFORMATION

3.1 Overview

In total, 31 publicly available and/or unpublished documents were reviewed. Of the reviewed documents, 12 comprised biodiversity assessments (including impact assessments and associated documentation), 10 reports were considered planning reviews, six were detailed vegetation and/or habitat assessments, and three were scientific publications and/or guidance papers (**Figure 2**). The sub-sections below provide a brief discussion of the relevance, adequacy and validity of existing information and data relevant to the deferred lands.

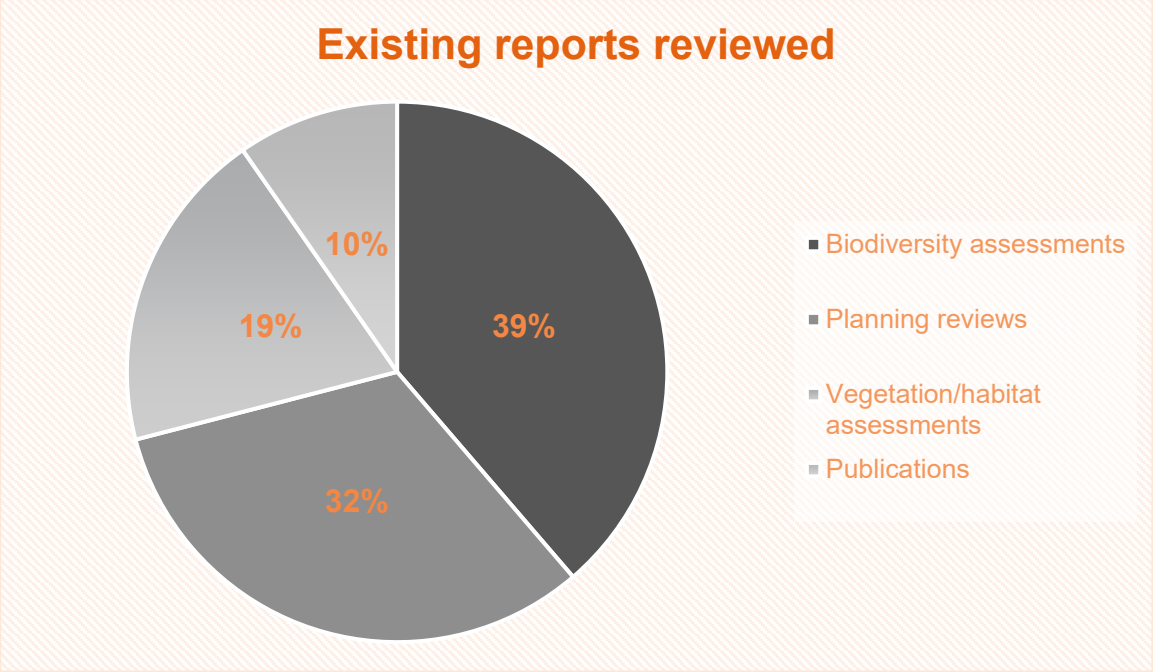

Figure 2: Existing reports comprising Biodiversity assessments (39%), Planning reviews (32%), Vegetation/habitat assessments (19%), and Publications (10%)

3.1.1 Relevance

Of the 31 reports reviewed, 14 were conducted between the year 2000 and up to and including the year 2010. The remaining 17 reports were dated between 2013 and 2020 (**Figure 3**). Of the 12 biodiversity assessments, 50 per cent (%) were conducted between 2005 and 2010, with the remaining 50 % dated between 2013 and 2020. All six vegetation and habitat assessments were conducted between the years 2000 and 2009, while two planning reviews were between 2001 and 2009 (20 %), with the remaining eight dated between 2013 and 2020 (80 %). All three publications were undertaken in more recent years, dated from 2012, 2013 and 2018 (**Figure 3**).

A majority of locations referenced in the existing reports are within the deferred lands area, with a focus on the former Warringah LGA and Narrabeen Lagoon Catchment Area, and in the suburbs of Cromer, Oxford Falls, Belrose and Beacon Hill.

Figure 4 illustrates the general location of previous studies conducted within the deferred lands area and provides an overview of survey effort.

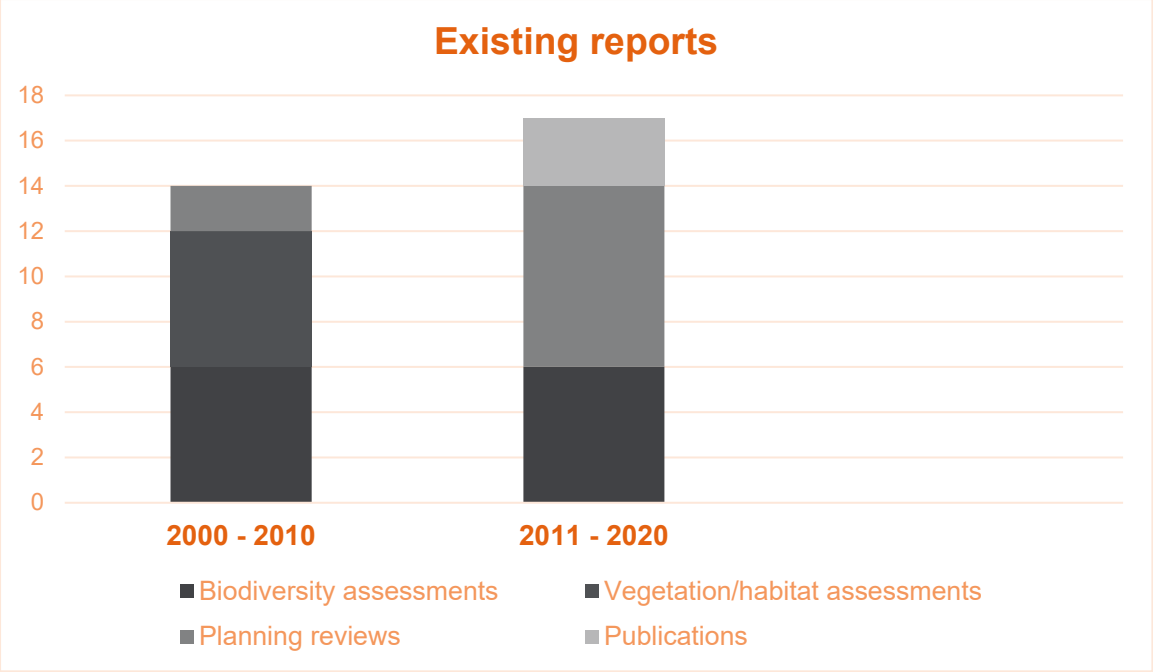

Figure 3: Existing reports dated between 2000 and 2010 (45%) and 2011 and 2020 (55%) and the composition of report types for each period

3.1.2 Adequacy and validity

The sections below present a summary of the adequacy and validity of the reports reviewed.

Reports reviewed were from 1998 onwards, representing more than two decades of data collection. Older reports still provide valuable data on the presence of species, but absence cannot be assumed due to regular changes to legislation, survey guidelines and research.

For example, species assemblages and records could be subject to change as a result of ongoing clearing, disturbance, fire, climate change etc. In addition, due to increased survey effort in the area, additional contextual information may now be available. Further, due to advances in technology and additional research, survey methods documented in the reviewed reports may be antiquated.

Fauna survey

The presence and abundance of threatened fauna has been well documented within many parts of the deferred lands, ranging from results of focused impact assessments to wide-ranging and detailed fauna surveys (e.g. Kavanagh *et al*. (2015) and DECC (2008)) (summarised in **Table 3-1** and further detailed in Appendix A). Multiple survey methods have been used across the existing studies, including:

- Nocturnal spotlighting and listening surveys
- Stag-watching surveys
- Call play-back surveys
- Diurnal bird census
- Microchiropteran bat (microbat) ultrasonic bat detecting (e.g., Anabat)
- Mammal trapping (e.g., harp traps, mist nets, cage and Elliot traps, hair tubes, baited camera traps)
- Fauna habitat assessments
- Active searches (diurnal and nocturnal) for signs of fauna.

Overall, the majority of surveys undertaken within the deferred lands area have been undertaken in suitable times (e.g. surveys for microbats in Summer months) and have met minimum effort requirements (e.g. aural-visual surveys for threatened amphibians) (see Appendix A and Appendix B). While some individual surveys were undertaken in sub-optimal conditions (e.g. not within one week of heavy rainfall for threatened frogs), the combined survey effort of studies undertaken within and across the deferred lands area is likely to have increased the probability of species detection.

Several studies, namely Kavanagh *et al*. (2015), DECC (2008), and Travers Bushfire & Ecology (2017) utilised a range of ecological experts (such as government scientists, leading consultant ecologists and species experts) to extensively survey the deferred lands area across multiple years (e.g. 2010 – 2013 (Kavanagh *et al*., 2015), 2008 – 2016 (Travers Bushfire & Ecology, 2017)). Such specialist studies are likely to have increased the survey rigour of the deferred lands area.

A majority of existing surveys of the deferred lands area have focused on detection of significant species (e.g. threatened species for impact assessments). Therefore, vagrant or historical records of species have largely been overlooked in most studies (e.g. Scarlet Robin, Sooty Owl). In addition, by focusing on presence/absence and generalised habitat types, a majority of existing studies have not located or considered significant breeding habitat within the deferred lands area (e.g. breeding hollows for owls and/or cockatoos).

To avoid gaps in threatened species data, it is suggested that both individual reports and BioNet records (Department of Planning, Industry and Environment, 2020) are reviewed to adequately consider the presence and abundance of threatened fauna species within the deferred lands area.

Flora and Vegetation

Of the 18 biodiversity and/or habitat assessments undertaken within the deferred lands area, only 10 mentioned flora and/or native vegetation, with a majority focused on threatened fauna and their habitats. Of these 10 reports, there are minimal references to targeted surveys conducted for threatened flora species (see **Table 3-1** below). Threatened flora species records across the deferred lands area reflect surveys conducted for development proposals, with some additional opportunistic records along tracks and vegetation edges. The majority of the deferred lands area has not been subject to intensive threatened flora surveys.

To avoid gaps in threatened species data, it is suggested that both individual reports and BioNet records (Department of Planning, Industry and Environment, 2020) are reviewed to adequately consider the presence and abundance of threatened flora species within the deferred lands area.

Table 3-1: Summary of key reports reviewed and key findings (full list of reports and further information in Appendix A)

Title	Year	Author(s)	Report type	Study area	Threatened species identified*	Summary
Flora and Fauna Assessment for Proposed Rezoning for Cromer Golf Club Draft Report	2013	Cumberland Ecology	Biodiversity assessment	Lot 2 DP 525492, Lots 859, 860 and 861 DP 752038 and Lot 22 DP 859782, Cromer Road, Cromer	• No threatened species or TECs recorded • Glossy Black-Cockatoo, Eastern Pygmy-possum and Red-crowned Toadlet considered likely to occur • Further targeted surveys by Council recorded Red-crowned Toadlet, Eastern Pygmy-possum and Rosenberg's Goanna (Council *pers. comm.*, 2021).	• Flora and fauna assessment for proposed rezoning at Cromer Golf Course • Rezoning site to R2 Low Density Residential • Re-zoning and development would result in impacts to 4.5ha of native vegetation (8.5ha retained) • Proposal was not considered to have a significant impact on threatened species or ecological communities.
Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area	2008	Department of Environment and Climate Change	Vegetation/habitat assessment	Sydney Catchment Area	• Site 6: 230 vertebrate fauna species (excluding fish) in the last 10 years: three endangered and 14 vulnerable species • Site 15: 207 vertebrate fauna species (excluding fish) in the last 10 years: two endangered and 11 vulnerable species • EECs or threatened flora were not considered for this assessment.	• Widespread habitat assessment assisting with the conservation of native fauna by supporting management plans, recovery actions and investment strategies • Site 6 (Middle Harbour Valley) (western area of deferred lands) ranked 'Highest' (6th highest out of 50 sites) for habitat value. Contains a high fauna diversity, heath and bushland, Flying-fox camp, and presence and habitat for Southern Brown Bandicoot • Site 15 (Garigal-Oxford Falls) (central and eastern areas of the deferred lands) ranked 'Very High' (15th highest out of 50 sites) for habitat value. Contains a high fauna diversity, heath and bushland, and presence and habitat for threatened frogs and Southern Brown Bandicoot • Both sites provide important habitat connectivity for fauna and must be maintained to keep the current biodiversity values of the area.

Title	Year	Author(s)	Report type	Study area	Threatened species identified*	Summary
Oxford Falls Valley and Belrose North Strategic Review (Draft)	2013	Department of Planning and Infrastructure	Planning review	1,341ha Warringah LGA	Not a targeted biodiversity assessment. Strategic assessment of land zoning due to the deferment of Oxford Falls Valley and Belrose North from the Warringah LEP 2011. The Warringah biodiversity study was not used in the review. However, the most recent available data was used to determine the primary and secondary environmental constraints affecting the area.	• Review in response to stakeholder concern regarding the adequacy of consultation during preparation of the Warringah LEP 2011 • Informed by stakeholder consultation and a wide range of reviews focusing on existing information, planning legislation and land use controls • Draft findings do not significantly change urban development potential of land in Oxford Falls Valley and Belrose North. Overall, the E3 zone is the best fit for the majority of the study area.
Balise Eco Village Species Impact Statement	2010	Eco Logical Australia	Biodiversity assessment	Lots 808, 809, 812, 813 and 817 DP 752038 Willandra Road, Beacon Hill	• Red-crowned Toadlet, Rosenberg's Goanna and Eastern Bent-winged Bat recorded • Glossy Black-Cockatoo and Powerful Owl considered likely to occur, and suitable habitat present for a further four threatened fauna species • No threatened flora species or TECs recorded • Further targeted surveys by Council recorded *Tetratheca glandulosa* (Council *pers. comm.*, 2021).	• Historical proposal for the Independent Seniors Living Retirement Village facility at Beacon Hill in the Warringah LGA • Development would result in the removal of 4.02ha of remnant vegetation (23% of the total land holding), modification of 4.00ha (23% of the total land holding) for the Asset Protection Zone (APZ), and retention of 9.44ha of native vegetation (54% of the land holding) • Proposal was not considered to have a significant impact on threatened species or ecological communities.
Biobank Credit Assessment Report: Wheeler Creek Valley Biobank Site	2010	Eco Logical Australia	Biodiversity assessment	Lots 816, 818, 819, 824, 825, 826, 827, 828, 829, 830, 2012 DP 752038; Lot 7034, 7035 and 7036 DP 93795, Oxford Falls	• Red-crowned Toadlet, Rosenberg's Goanna, *Persoonia hirsuta* subsp. *hirsuta, Pimelea curviflora* and *Tetratheca glandulosa* recorded.	• Biobanking assessment for 14 land parcels on Crown Land in the Warringah LGA at Oxford Falls • In total, 454 ecosystem credits were generated and 433 species credits (673 including indicative assessments for *Pimelea curviflora* and *Tetratheca glandulosa*)

Title	Year	Author(s)	Report type	Study area	Threatened species identified*	Summary
						• The site has high habitat connectivity and biodiversity values and supports a mosaic of sandstone vegetation communities.
Flora and Fauna Assessment Little Willandra Road, Cromer	2017	Eco Logical Australia	Biodiversity assessment	Lot B2 DP 358165, 53 Little Willandra Road, Cromer	• Powerful Owl, Red-crowned Toadlet and Eastern Bent-winged Bat recorded • Eastern Pygmy-possum, Rosenberg's Goanna and Varied Sittella considered likely to occur • No threatened flora species or EECs identified.	• Flora and fauna assessment for the proposed construction of a Seniors Living development in Cromer/Oxford Falls covering 1.16ha • In addition to threatened fauna species, a range of key fauna habitat were identified on site including 23 hollow-bearing trees (total of 65 hollows).
Threatened Fauna of the Narrabeen Lagoon Catchment: Surveys and status of threatened species	2015	Kavanagh, R., Law, B., Lemckert, F., & Stanton, M.	Biodiversity assessment	Narrabeen Lagoon Catchment (within Warringah LGA)	• Red-crowned Toadlet, Giant Burrowing Frog, Rosenberg's Goanna/Heath Monitor, Black Bittern, Eastern Osprey, Glossy Black-Cockatoo, Little Lorikeet, Scarlet Robin, Swift Parrot, Varied Sittella, Barking Owl, Powerful Owl, Sooty Owl, Eastern Pygmy-possum, Eastern Coastal Free-tailed Bat, Greater Broad-nosed Bat, Southern Myotis, Large-eared Pied Bat, Eastern Bent-winged Bat, Little Bent-winged Bat, Grey-headed Flying Fox recorded • No threatened flora or ecological communities assessed.	• Report documenting the presence and abundance of threatened fauna within the Warringah LGA • Specialist surveys undertaken across three years by expert scientists and ecological consultants • The area contains one of the most significant remnants of rainforest, forest, woodland, wetlands and heath in the Sydney metropolitan area (that is not a listed National Park or Reserve) • If further urban encroachment is minimised, and active management pursued, the threatened species present could persist, and habitat improved for threatened and non-threatened fauna • The area provides significant habitat for the Giant Burrowing Frog, Rosenberg's Goanna, Powerful Owl, Eastern Pygmy-possum, Large-eared Pied Bat, Southern Myotis and Eastern Bent-winged Bat.
Warringah Natural Area Surveys	2005 – 2009	P&J Smith Ecological Consultants	Biodiversity assessment	Warringah LGA outside Ku-ring-gai Chase and	• A total of 408 native fauna species have been recorded in the Warringah LGA outside the national parks, including 56 threatened	• Natural area surveys of the Warringah LGA, including assessment of existing publications, to compile a comprehensive list of native fauna and flora in the

Title	Year	Author(s)	Report type	Study area	Threatened species identified*	Summary
				Garigal National Parks	species listed under the BC/EPBC Act • A total of 914 native plant species, subspecies, varieties and forms have been recorded in the Warringah LGA outside the national parks, including 19 threatened species listed under the BC/EPBC Act • A majority of species have not been recorded in either Ku-ring-gai Chase or Garigal National Parks and are considered biogeographically significant.	Warringah LGA and outside of surrounding National Parks • A high proportion of flora and fauna species recorded in the Warringah LGA have not been recorded in the surrounding National Parks, making the area biologically significant • Mapping of 11 native vegetation types (37 vegetation communities) in the Warringah LGA in 1750 and 2000 (two derived and one aquatic community not included) • An estimated 41% of the native vegetation of the Warringah LGA has been lost since 1750, with 15 of the 37 vegetation communities cleared to less than 30% of their original area • Twenty-two of the 37 vegetation communities are poorly represented in reserves, with less than 15% of their estimated area in 1750 reserved in national parks or other reserves, or else with a reserved area of less than 5ha.
Review of Four Sites Within Oxford Falls Valley for Urban Development	2009	Planning Assessment Commission	Planning review	Lizard Rock, Cromer Golf Course, Oxford Falls West and Red Hill	Not a targeted biodiversity assessment. The most recent available data was used to identify potential flora and fauna constraints affecting the area.	• A review of the suitability of four sites in Oxford Falls Valley for future urban development • Recommended major studies include transport and accessibility, management of bushfire hazards, aquatic studies, flora and fauna protection, visual analysis and satellite communication buffer zones.
NBH CaNE Biodiversity Offset Package Stage 3 Final Report	2020	SMEC	Biodiversity assessment	Lot 100 DP874509 and Lot 2116 DP752038	• *Grevillea* caleyi and Duffys Forest EEC recorded • Suitable habitat for Red-crowned Toadlet also identified but no individuals recorded.	• Identifying and securing suitable biodiversity offsets for impacts from the Northern Beaches Hospital Connectivity and Network Enhancements Project (NBH CaNE)

Title	Year	Author(s)	Report type	Study area	Threatened species identified*	Summary
						• Potential offset site identified north of Belrose (10.7ha area) comprising intact native vegetation in moderate/good condition, an endangered ecological community, threatened species and threatened species habitat.
Ecological Assessment Planning Proposal for Lot 1 DP 1139826 Ralston Avenue, Belrose	2017	Travers Bushfire & Ecology	Biodiversity assessment	Lot 1 DP 1139826 Ralston Avenue, Belrose	• Giant Burrowing Frog, Red-crowned Toadlet, Rosenberg's Goanna, Powerful Owl, Little Lorikeet, Glossy Black-Cockatoo, Eastern Pygmy Possum, Grey-headed Flying-fox, Little Bent-winged Bat and Large Bent-winged Bat recorded • *Tetratheca glandulosa* and *Grevillea caleyi* recorded • Coastal Upland Swamp and Duffys Forest endangered ecological communities recorded.	• Numerous expert studies (constraints assessments, bushfire and extensive ecological surveys) undertaken in over 138.26ha of lands (focused on 23ha for a proposed development precinct) between 2008 and 2016 • The site supports numerous threatened species and ecological communities and has been determined to be an ecologically sensitive area • The site also contains important local populations of threatened species (e.g. Red-crowned Toadlet) and provides important habitat connectivity to surrounding areas (e.g. Garigal National Park).

* Identified within individual reports. To avoid gaps in threatened species data, it is suggested that both individual reports and BioNet records (Department of Planning, Industry and Environment, 2020) are reviewed to adequately consider the presence and abundance of threatened flora species within the deferred lands area (see **Table 3-4**, **Table 3-5**).

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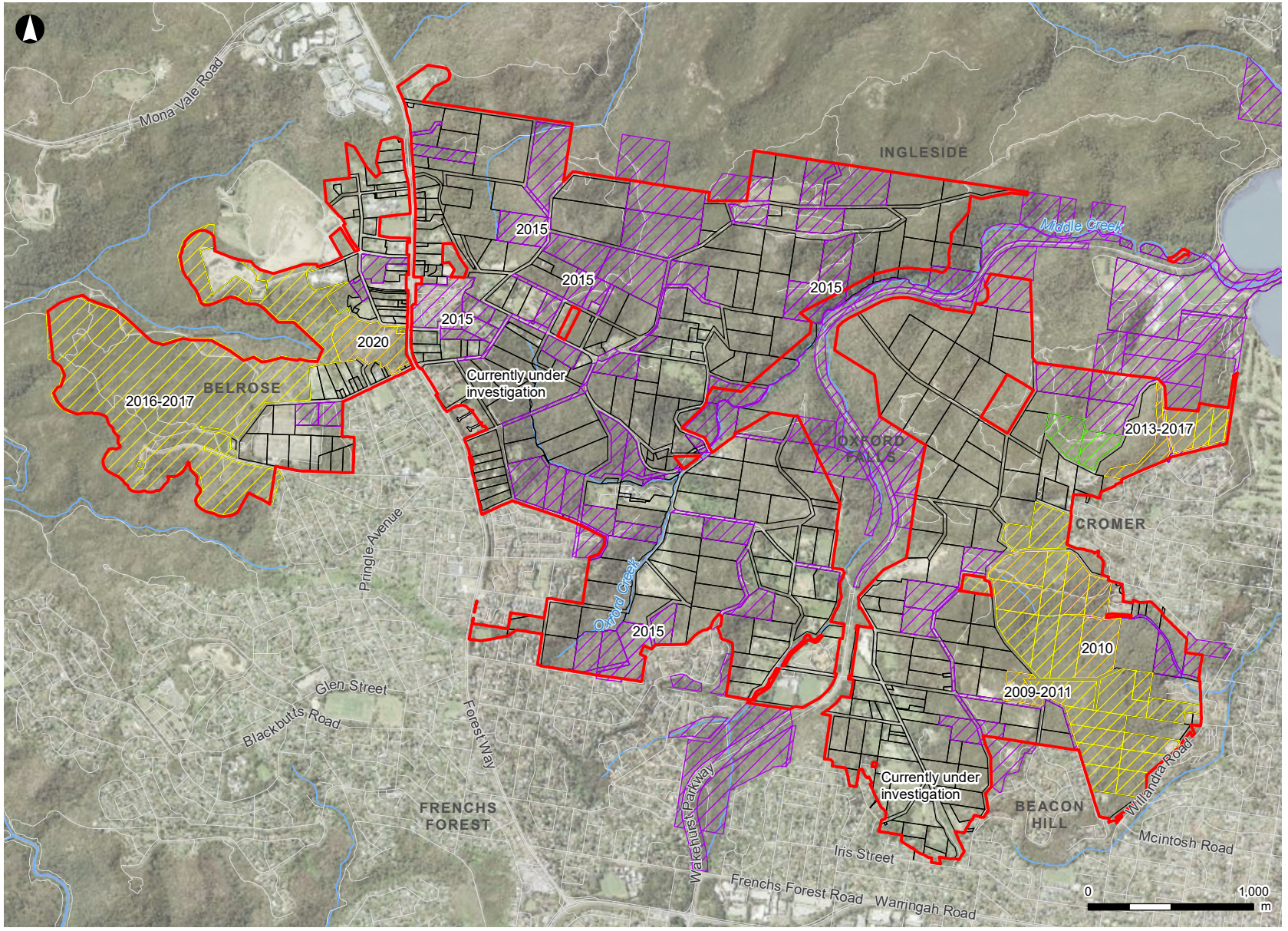

LEGEND

- Lots within deferred lands
- Roads and tracks
- Watercourse

Survey type

- Fauna
- Flora
- Flora and fauna

1:35,000 at A4

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Coordinate System: GDA 1994 MGA Zone 56
Date issued: March 15, 2021
Aerial imagery supplied NSW LPI

Figure 4: Previous locations and survey effort of studies within the deferred lands area

Date: 15/03/2021 Path: \\hc-aus-ns-fs-01\jobs\30060643\L-GIS\A_Current\B_Maps\G30060643_ECO_002_PreviousSurveyEffort_A4L_v6.mxd
Created by : GC Updated by : EH QA by : GC

3.2 Native Vegetation

3.2.1 Plant Community Types

Smith and Smith (2005) identified, described and mapped the native vegetation communities of the Warringah LGA. The vegetation classification and mapping used the vegetation map units described by Benson and Howell (1994) as a starting point, subdividing these into vegetation communities based on subjective assessment of floristic composition patterns. The distribution of communities was mapped with reference to aerial photographs dated from 1996 and using extensive field checking. A total of 40 native vegetation communities were identified, including 38 intact communities and two derived communities.

OEH (2016) mapped the vegetation of the Sydney Metropolitan Catchment Management Area (CMA) area, which encompasses the deferred lands area. Sixteen Plant Community Types (PCTs) were mapped by OEH (2016) within the subject land, as listed in **Table 3-2** and shown in **Figure 5**.

Table 3-2: Map units and corresponding PCTs mapped by OEH (2016) within the deferred lands area

OEH (2016) map unit code	OEH (2016) map unit name	PCT number	PCT name	Area (ha) within deferred lands area
S_FrW03	Coastal Freshwater Wetland	781	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	0.13
S_HL09	Coastal Sandstone Rock Plate Heath	881	Hairpin Banksia - *Kunzea ambigua* - *Allocasuarina distyla* heath on coastal sandstone plateaux, Sydney Basin Bioregion	16.24
S_RF03	Coastal Warm Temperate Rainforest	905	Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion	0.40
S_DSF09	Coastal Sandstone Gully Forest	1250	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	306.38
S_DSF04	Coastal Enriched Sandstone Dry Forest	1776	Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast	0.89
S_DSF08	Coastal Sandstone Riparian Forest	1780	Sydney Peppermint / Coachwood - Water Gum open forest in protected sandstone gullies around Sydney and the Central Coast	21.28
S_DSF11	Sydney North Exposed Sandstone Woodland	1783	Red Bloodwood - Scribbly Gum / Old-man Banksia open forest on sandstone ridges of northern Sydney and the Central Coast	394.23

OEH (2016) map unit code	OEH (2016) map unit name	PCT number	PCT name	Area (ha) within deferred lands area
S_DSF14	Sydney Ironstone Bloodwood-Silvertop Ash Forest	1786	Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region	32.50
S_FoW01	Coastal Alluvial Bangalay Forest	1794	Bangalay - Smooth-barked Apple / She-oak open forest on sandy alluvium in coastal parts of the Sydney region	0.41
S_FoW02	Coastal Flats Swamp Mahogany Forest	1795	Swamp Mahogany / Cabbage Tree Palm - Cheese Tree - Swamp Oak tall open forest on poorly drained coastal alluvium in the Sydney basin	0.14
S_FrW01	Coastal Upland Damp Heath Swamp	1803	Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin	18.43
S_FrW02	Coastal Upland Wet Heath Swamp	1804	Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin	1.08
S_HL08	Coastal Sandstone Heath-Mallee	1824	Mallee - Banksia - Tea-tree - Hakea heath-woodland of the coastal sandstone plateaus of the Sydney basin	334.78
S_RF02	Coastal Sandstone Gallery Rainforest	1828	Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin	0.52
S_WSF02	Coastal Enriched Sandstone Moist Forest	1841	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	13.34
S_WSF06	Coastal Shale-Sandstone Forest	1845	Smooth-barked Apple - Red Bloodwood - Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney	2.89
Total				**1,143.64**

3.2.2 Threatened Ecological Communities

Six of the mapped PCTs are associated with five different Threatened Ecological Communities (TECs) listed under the BC Act (**Table 3-3**). Two PCTs are associated with one TEC listed under the EPBC Act: Coastal Upland Swamp in the Sydney Basin Bioregion (**Table 3-3**).

Table 3-3: TECs mapped by OEH (2016) within the deferred lands area

PCT number	PCT name	Corresponding TEC	BC Act Status	EPBC Act status	Area (ha) within deferred lands area
781	Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	-	0.13
1786	Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region	Duffys Forest Ecological Community in the Sydney Basin Bioregion	E	-	32.50
1794	Bangalay - Smooth-barked Apple / She-oak open forest on sandy alluvium in coastal parts of the Sydney region	Riverflat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	CE	0.41
1795	Swamp Mahogany / Cabbage Tree Palm - Cheese Tree - Swamp Oak tall open forest on poorly drained coastal alluvium in the Sydney basin	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	-	0.14
1803	Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin	Coastal Upland Swamp in the Sydney Basin Bioregion	V	E	18.43
1804	Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin	Coastal Upland Swamp in the Sydney Basin Bioregion	V	E	1.08
Total					**52.69**

E = Endangered, CE = Critically Endangered, V = Vulnerable

Three of the mapped TECs (Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, Riverflat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions and Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions) occur as small fragments at the edges of the deferred lands. These TECs are not considered further in this section.

Duffys Forest Ecological Community in the Sydney Basin Bioregion

OEH (2016) mapped 32.50 hectares of Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region (PCT 1786) within the deferred lands area. PCT 1786 forms the TEC Duffys Forest Ecological Community in the Sydney Basin Bioregion (hereafter referred to as 'Duffys Forest TEC'). The majority of the mapped PCT within the deferred lands area is located in the north-west of the area, on the ridges adjoining both sides of Forest Way. The remainder of the mapped

Duffys Forest TEC consists of two large patches in the centre and south-east of the deferred lands (**Figure 5**).

Smith and Smith (2005) also map Duffys Forest along the plateau adjoining Forest Way, but not in the same areas mapped by OEH (2016) in the centre and south-east of the deferred lands, which are mapped as Sydney Sandstone Ridgetop Forest and Coastal Sandstone Heath. There is an additional area of Duffys Forest mapped in the deferred lands by Smith and Smith (2005), between Middle Creek and Garigal National Park. This patch is described by Smith and Smith (2005) as Angophora-White Mahogany Forest, an unusual variant of Duffys Forest restricted to this single site. OEH (2016) mapped this area as PCT 1845: Smooth-barked Apple - Red Bloodwood - Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney.

Coastal Upland Swamp in the Sydney Basin Bioregion

OEH (2016) mapped 18.43 hectares of Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin (PCT 1803) and 1.08 hectares of Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin (PCT 1804) within the deferred lands area. Both PCTs 1803 and 1804 form part of the TEC Coastal Upland Swamp in the Sydney Basin Bioregion (hereafter referred to as 'Coastal Upland Swamp TEC'). Areas of Coastal Upland Swamp TEC are mapped as scattered patches across the deferred lands area, with larger patches located in the central northern section between the Slippery Dip Trail and Middle Creek, and in the south-east adjoining Lady Penrhyn Drive (**Figure 5**).

3.3 Threatened Flora

A review of the NSW BioNet Wildlife Atlas (Department of Planning, Industry and Environment, 2020) and PMST (Department of the Environment and Energy, 2020) identified 61 threatened flora species recorded within 10 kilometres of the deferred lands area from 1916 and as of October 2020 (Appendix C).

Records of ten threatened flora species occur within the deferred lands area (**Table 3-4**); of these, seven threatened species can be confirmed as naturally occurring in the area through reference to other sources, and two have a moderate likelihood of occurrence due to the presence of associated vegetation types that form potential habitat for the species. None of the threatened flora species have been recorded in high numbers, however, the species most commonly encountered include:

- *Tetratheca glandulosa*
- *Grevillea caleyi*
- *Persoonia hirsuta*
- *Eucalyptus camfieldii*
- *Pimelea curviflora* var. *curviflora*.

An additional 12 threatened flora species are considered to have a moderate to high likelihood of occurrence in the deferred lands area, based on the presence of recent records in the locality and associated vegetation types within the deferred lands that form suitable potential habitat for the species (Appendix C).

A comparison of records of threatened flora and threatened fauna reflects the findings of the review of relevant reports, which indicates that threatened flora surveys have not been conducted to the same level as threatened fauna assessment.

Table 3-4: Threatened flora species previously recorded within the deferred lands area

Name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (TBDC)	Number of records (BioNet) within deferred lands area (year)*	Number of records (BioNet) within 10km (year)*	Species records and distribution in the deferred lands area
Acacia terminalis subsp. *terminalis* Sunshine Wattle	E	E	881, 1250, 1824	Coastal scrub and dry sclerophyll woodland on sandy soils.	1 (2002)	228 (2020)	The single BioNet record within the deferred lands area appears to be inaccurate; the location description states 'Chowder Bay Road, Middle Head' and the accuracy is 2000m. There may be some potential habitat for the species in the deferred lands area.
Eucalyptus camfieldii Camfield's Stringybark	V	V	881, 1250	Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges.	12 (2018)	110 (2019)	All records are located in the north-east of the deferred lands area, on ridgetops and upper slopes. All records in the deferred lands area are located between 120m and 134m ahd, in areas mapped as PCTs 1783 and 1824.
Genoplesium baueri Bauer's Midge Orchid	E	E	881, 1803, 1824	Grows in dry sclerophyll forest and moss gardens over sandstone.	2 (2017)	64 (2020)	This is a Class 2 sensitive species, and records cannot be published. There is one record of the species in the north of the deferred lands area, located within PCT 1824.
Grevillea caleyi Caley's Grevillea	CE	CE	1786, 1845	All sites occur on the ridgetop between elevations of 170 to 240m asl, in association with laterite soils and a vegetation community of open forest,	62 (2016)	810 (2019)	All records located in the west of the deferred lands area, associated with the plateau adjoining Forest Way.

Name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (TBDC)	Number of records (BioNet) within deferred lands area (year)*	Number of records (BioNet) within 10km (year)*	Species records and distribution in the deferred lands area
				generally dominated by *Eucalyptus sieberi* and *Corymbia gummifera*.			Records of the species within the deferred lands area are mapped between about 108m and 200m ahd, with an average asl of 175m ahd. Most records are located within areas mapped as PCT 1786, but others are located in areas mapped as PCTs 1783, 1824, and 1250.
Microtis angusii Angus's Onion Orchid	E	E	1786	Occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils that support the Duffys Forest TEC.	8 (2018)	93 (2018)	This is a Class 2 sensitive species, and records cannot be published. There are several records located within an area of PCT 1824 in the west of the deferred lands area.
Persoonia hirsuta	E	E	881, 1250, 1786, 1824, 1845	Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	21 (2007)	36 (2007)	All records located in the south-east of the deferred lands area, within areas mapped as PCTs 1783 and 1824. Saving our Species conservation site identified in this area.
Pimelea curviflora subsp. curviflora	V	V	1776, 1786	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	12 (2017)	83 (2020)	All records located in the south-east of the deferred lands area, with one record in the north-west, which is described as a 'single plant in mound of fill'.
Prostanthera marifolia	CE	CE	1786	Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community.	1 (2002)	173 (2016)	One record within the deferred lands area. This record appears to be incorrect (geographic co-ordinates

Name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (TBDC)	Number of records (BioNet) within deferred lands area (year)*	Number of records (BioNet) within 10km (year)*	Species records and distribution in the deferred lands area
							have been entered incorrectly). There is potential habitat in patches of Duffys Forest, however the deferred lands appear to be outside the current known distribution of the species.
Syzygium paniculatum	E	V	1794, 1828, 1841	Occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	1 (2016)	87 (2019)	One record within the deferred lands area, adjoining Forest Way. This specimen is likely to be planted.
Tetratheca glandulosa	V	-	881, 905, 1250, 1786, 1845	Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, Occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest.	97 (2019)	461 (2020)	Scattered records across the deferred lands; this species has by far the most records within the deferred lands and occurs in a range of PCTs, but the two in which it is most frequently recorded are PCTs 1783 and 1824.

V = Vulnerable, E = Endangered, CE = Critically Endangered

* Number of records does not correspond to the number of individuals present. One record may contain multiple individuals.

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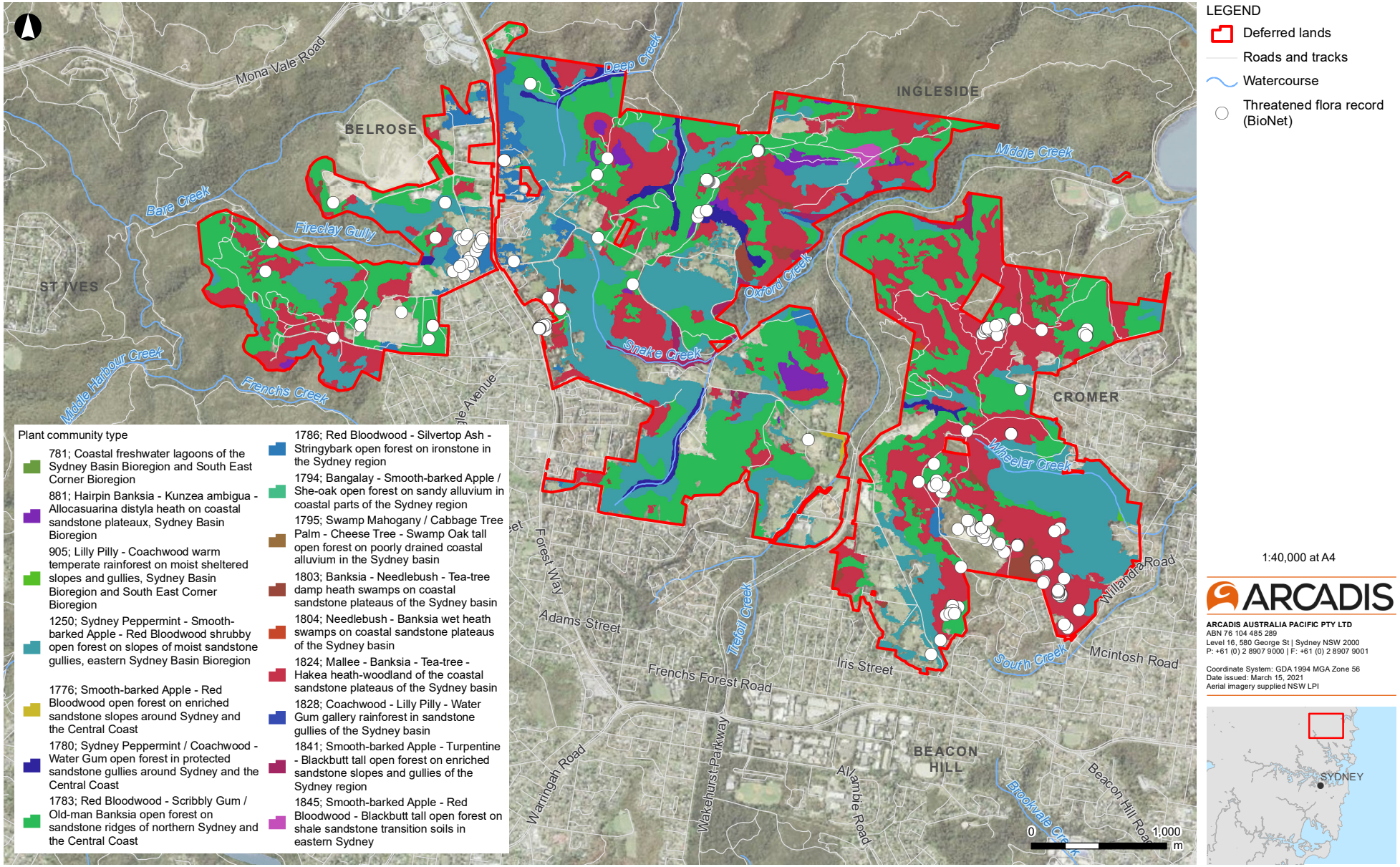

Figure 5: Flora constraints identified within the deferred lands area

3.4 Threatened Fauna

A review of the NSW BioNet Wildlife Atlas (Department of Planning, Industry and Environment, 2020) and PMST (Department of the Environment and Energy, 2020) identified 210 threatened and/or migratory fauna species recorded within 10 kilometres of the deferred lands area from 1963 and as of October 2020. A total of 22 threatened fauna species have been recorded within the deferred lands area between 1984 and 2020. Records clipped to the deferred lands area are shown in **Figure 6**.

Of the fauna species recorded within a 10-kilometre radius, 142 were marine species (i.e. pelagic birds, fish and mammals) and were excluded from assessment due to the distance of the deferred lands area from the ocean, and the consequent lack of marine habitat within the area. Of the remaining 68 species, 38 were birds, 13 were mammals, nine were microchiropteran bats (microbats), five were amphibians, two were reptiles, and one was an invertebrate (snail) (Appendix C).

The study area is known and potentially important habitat for up to 35 species of threatened fauna. Of these species, 22 have been recorded within the deferred lands area since 1984 and up until 2020. An additional 13 species have habitat present within the deferred lands area and have been recorded within the surrounding area, with records as recent as 2020. The deferred lands area is considered significant for species such as the Eastern Pygmy-possum, Red-crowned Toadlet and Rosenberg's Goanna, which are commonly recorded and appear well established due to large areas of intact bushland and important habitat features present within the deferred lands area. Other species, such as the Masked Owl, New Holland Mouse and Large-eared Pied Bat, have fewer records but have been detected recently within the past three years. For these species, further survey and mapping of habitat is likely to provide a better understanding of the distribution and importance of habitat compared with the more regularly recorded threatened fauna. **Table 3-5** below summarises threatened fauna within and surrounding the deferred lands area, including associated PCTs present within the deferred lands and a description of preferred habitat.

Table 3-5: Threatened fauna species recorded within and around the deferred lands area and their habitat present within the deferred lands

Common name	**Scientific name**	**Status (BC Act)**	**Status (EPBC Act)**	**Associated PCTs within the deferred lands area**	**Habitat description** (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	**Number of records (BioNet) within the deferred lands area (year)***	**Number of records (BioNet) within 10km (year)***
Barking Owl	*Ninox connivens*	V	-	905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1828, 1841, 1845	The Barking Owl has declined greatly in southern Australia and occurs in a wide but sparse distribution in NSW. Recent bushfires have further reduced available habitat. Inhabits woodland and open forest, preferentially hunting small arboreal mammals (e.g. Common Ringtail Possum). Requires large, permanent territories up to 6,000ha containing high prey density. Hollows in large, old trees (preferably living eucalypts) are used for breeding.	1 (2017)	56 (2019)
Beach Stone-curlew	*Esacus magnirostris*	CE	-	None	The Beach Stone-curlew is considered a vagrant species south of the Manning River in NSW. It is found exclusively along the coast in a wide variety of coastal habitats including beaches, estuaries and mangroves. The species forages on marine invertebrates in the intertidal zone and breeds in shallow nests above the littoral zone at the backs of beaches, among low vegetation or on sandbanks.	1 (1985)	2 (2013)
Black Bittern	*Ixobrychus flavicollis*	V	-	781, 1250, 1780, 1794, 1795, 1828	Within NSW, the Black Bittern is rarely recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands generally in areas with permanent water and dense vegetation. The species forages on a variety of species (including frogs, reptiles and fish) and nests on a bed of sticks in vegetation overhanging water.	None	37 (2019)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Dusky Woodswallow occurs throughout most of NSW but predominantly breeds on the western slopes of the Great Dividing Range. In NSW, it is largely migratory moving out of the State post breeding. Primarily inhabits dry, open eucalypt forests and woodlands with an open or sparse understorey, foraging on invertebrates and nesting in shrubs or low trees.	5 (1984)	21 (2012)
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V	-	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Eastern Coastal Free-tailed Bat is found along the east coast from south Queensland to southern NSW. The species occurs in dry sclerophyll forest, woodland, swamp and mangrove forests east of the Great Dividing Range. Roosts predominately in tree hollows but will also use bark and man-made structures.	2 (2009)	50 (2019)
Eastern Osprey	*Pandion cristatus*	V	-	781, 881, 1250, 1776, 1783, 1794, 1795, 1841	Eastern Ospreys occur widely along the Australian coastline, especially on rocky shorelines, islands and reefs. The species is uncommon from closely settled parts of south-eastern Australia, however, is known from north Sydney. Favours mouths of rivers, lagoons and lakes feeding on fish. Nests within 1km of the coast in a large stick nest made up high in dead or exposed trees or man-made structures (e.g. telegraph poles).	None	48 (2020)
Eastern Pygmy-possum	*Cercartetus nanus*	V	-	881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795,	In NSW, the Eastern Pygmy-possum occurs along the coast and inland as far as the western slopes. The species prefers heath and woodland containing high densities of *Banksia*, eucalypts and	70 (2020)	1,045 (2020)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
				1803, 1804, 1824, 1828, 1841, 1845	bottlebrushes for foraging. Stands of eucalypts with tree hollows and bark, or stumps and/or abandoned nests/dreys (i.e. bird and Ringtail Possum) are used for shelter.		
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V EP	-	881, 905, 1250, 1776, 1780, 1783, 1786, 1803, 1804, 1824, 1828, 1841, 1845	In NSW, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter and inland to the south-west slopes. A small, endangered population occurs in the Hornsby and Ku-ring-gai LGAs. Generally found in tall woodlands, particularly heavily timbered wet sclerophyll forest, favouring old growth forest for nesting and roosting.	None	93 (2016)
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The northern population of the Giant Burrowing Frog is confined to the sandstone geology of the Sydney Basin, extending as far south as Ulladulla. The species prefers heath, woodland and open dry sclerophyll forest and is found within 300m of breeding habitat burrowed in soil, under vegetation or rocks. Requires soaks, pools or seepage lines for breeding.	11 (2017)	74 (2020)
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	-	881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1824, 1828, 1841, 1845	In NSW, the species is widespread but uncommon occurring in open forests and woodlands where stands of Sheoak are present. *Allocasuarina littoralis* and *Allocasuarina torulosa* are important foraging resources. The species is also dependent on large hollow-bearing eucalypts for nest sites.	26 (2018)	242 (2020)
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	781, 881, 905, 1250, 1776, 1780,	The Greater Broad-nosed Bat is predominately found in gullies and river systems of the Great	None	23 (2020)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
				1804, 1824, 1828, 1841, 1845	Dividing Range and in NSW, is widespread on the New England Tablelands below 500m. The species utilises a variety of habitats roosting in tree hollows (sometimes buildings) and foraging mainly on invertebrates. Maternity roosts in tree hollows are used for breeding.		
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Grey-headed Flying-fox is generally found within 200km of the east coast, occurring mainly in subtropical and temperate rainforests, tall sclerophyll forests, woodlands and heath. Roosts and breeds in camps within 20km of regular resources and travels up to 50km from camps to forage (predominately on nectar and pollen of eucalypts, *Melaleuca* and *Banksia*).	25 (2018)	2,154 (2020)
Koala	*Phascolarctos cinereus*	V	V	905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Koala has a fragmented distribution that has further been reduced due to recent bushfires and urban developments. The species inhabits eucalypt woodlands and forests feeding on specific tree species. Home range size varies with quality of habitat.	None	143 (2020)
Large Bent-winged Bat (formerly the Eastern Bentwing-bat)	*Miniopterus orianae oceanensis*	V	-	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Large Bent-winged Bat occurs along the east and north-west coasts of Australia. The species hunts for flying insects in forested areas, dispersing within 300km of maternity caves (used for breeding). Caves are also used primarily for roosting and hibernation, but they also use derelict mines, storm-water tunnels, buildings or other man-made structures.	33 (2018)	450 (2020)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1824, 1828, 1841, 1845	The Large-eared Pied Bat has a rare and patchy distribution in NSW. The species hunts for flying insects in well-timbered areas containing gullies, and in areas with extensive cliffs and caves. Roosts in caves, cliff crevices, old mine workings and in disused Fairy Martin nests. Breeds in sandstone caves and overhangs.	None	29 (2020)
Little Bent-winged Bat	*Miniopterus australis*	V	-	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Little Bent-winged Bat occurs along the east coast and ranges from Cape York in Queensland to Wollongong in NSW. Inhabits a variety of forests and scrub, but in generally found in well-timbered areas. The species roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and other man-made structures and forages for small insects in densely vegetated habitats. Uses maternity colonies, often associated with the Large Bent-winged Bat, for breeding (only five are known across Australia).	5 (2019)	136 (2020)
Little Eagle	*Hieraaetus morphnoides*	V	-	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Little Eagle is found throughout Australia in open eucalypt forests and woodlands. The species preys on birds, reptiles and mammals and nests in tall, living trees within remnant patches of bushland.	None	22 (2020)
Little Lorikeet	*Glossopsitta pusilla*	V	-	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804,	The Little Lorikeet is distributed widely with nomadic movements common (influenced by season and food availability). The species forages primarily in open forest and woodland on nectar and pollen and	1 (2011)	37 (2020)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
				1824, 1828, 1841, 1845	nests in proximity to feeding areas in hollows of smooth-barked eucalypts. Nests sites are repeatedly used, suggesting preferred sites are limited.		
Long-nosed Bandicoot (North Head)	*Perameles nasuta*	EP	-	881, 905, 1250	The North Head population of the Long-nosed Bandicoot is restricted to North Head. The species occupies a variety of habitats on North Head, sheltering in shallow holes lined with leaves, grass and debris and foraging at dusk digging conical holes for invertebrates, fungi and tubers.	None	2,295 (2020)
Masked Owl	*Tyto novaehollandiae*	V	-	905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1824, 1828, 1841, 1845	The Masked Owl is most abundant along the coast of NSW. It inhabits dry eucalypt forests and woodlands hunting mammals in forests and along edges (including roadsides). Pairs have large home ranges up to 1,000ha and breed in large tree-hollows typically in moist, eucalypt forested gullies. The species occasionally roosts in caves.	None	15 (2020)
New Holland Mouse	*Pseudomys novaehollandiae*	-	V	881, 1250, 1776, 1783, 1786, 1794, 1803, 1804, 1824, 1845	The New Holland Mouse has a fragmented distribution which is likely smaller than current estimates, particularly due to recent bushfires and developments impacting upon available habitat. The species inhabits open heathland, woodland and forest with vegetated sand dunes and a heathy understorey. Lives predominantly in burrows shared with other individuals. Peaks in abundance occur during early to mid-stages of vegetation succession (typically induced by fire).	1 (2017)	12 (2017)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
Powerful Owl	*Ninox strenua*	V	-	905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1828, 1841, 1845,	The Powerful Owl is widely distributed, but exists in low densities, in NSW throughout eastern forests along the coast and inland to the tablelands. The species inhabits a range of vegetation types but requires large tracts of woodland for breeding and hunting (foraging on medium-sized arboreal marsupials). The species roosts in dense vegetation and requires large tree hollows (at least 0.5m deep, 80cm+ wide) for breeding.	29 (2018)	1,145 (2020)
Red-crowned Toadlet	*Pseudophryne australis*	V	-	881, 905, 1250, 1776, 1780, 1783, 1786, 1803, 1804, 1824, 1828, 1841, 1845	The Red-crowned Toadlet is confined to the Sydney Basin, occupying open forests on Hawkesbury and Narrabeen sandstones. It inhabits periodically wet drainage lines below sandstone ridges (often with shale lenses or cappings) and breeds in non-polluted waters within a pH range of 5.5 to 6.5. Shelters under rocks and dense leaf litter within 300m of breeding sites.	66 (2018)	374 (2020)
Regent Honeyeater	*Anthochaera phrygia*	V	-	881, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1841, 1845	The Regent Honeyeater's range has dramatically reduced in the last 30 years, occupying temperate woodlands and open forests of the inland slopes of south-east Australia, confined to three known breeding ranges (two in NSW: Capertee Valley and Bundarra-Barraba region). The species inhabits woodlands that support a significantly high abundance and species richness of bird species, with large numbers of mature trees, high canopy cover and abundance of mistletoes.	None	52 (2017)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
Rosenberg's Goanna (known also as Heath Monitor)	*Varanus rosenbergi*	V	-	881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841	Rosenberg's Goanna occurs on Sydney sandstone from north-west Sydney, around the ACT and as far south as Cooma. The species is found in heath, open forest and woodland and requires large areas of habitat with a high density of termite mounds. Shelters in hollow logs, rock crevices and burrows and feeds on carrion, birds, reptiles, mammals and eggs.	60 (2020)	208 (2020)
Southern Brown Bandicoot (eastern)	*Isoodon obesulus obesulus*	E	E	881, 1250, 1780, 1783, 1786, 1803, 1804, 1824, 1828, 1845	The Southern Brown Bandicoot has a patchy distribution. The species inhabits heath or open forest with a heathy understorey on sandy or friable soils. Nests during the day in shallow depressions covered by litter or grass, usually under brushes, shrubs or small trees, and forages at dusk and/or before dawn creating distinctive conical holes while searching for invertebrates and fungi.	12 (2005)	386 (2020)
Southern Myotis (formerly the Large-footed Myotis)	*Myotis macropus*	V	-	781, 881, 905, 1250, 1776, 1780, 1783, 1794, 1795, 1804, 1828, 1841, 1845	The Southern Myotis is found along within 100km of the east coast. The species hunts over streams and pools catching insects and small fish. Roosts in small groups close to water in caves, mine shafts, hollow-bearing trees, storm-water channels, buildings, under bridges and in dense foliage.	None	109 (2020)
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804,	The range of the Spotted-tailed Quoll has contracted significantly since European settlement and only in Tasmania is it considered relatively common. The species has been recorded across a range of habitat types, using hollow-bearing trees, logs, burrows, caves and rocky outcrops as den	3 (2018)	42 (2018)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
				1824, 1828, 1841, 1845	sites. Use common latrine sites often on flat surfaces. Consumes a variety of prey and occupies ranges up to 4,000ha. Known to traverse along densely vegetated creeklines.		
Square-tailed Kite	*Lophoictinia isura*	V	-	781, 881, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1845	The Square-tailed Kite ranges along coastal and subcoastal areas. In NSW, there are scattered records throughout the State, but is more regularly known from major river systems. It is a summer breeding migrant to the NSW south-coast, arriving in September and leaving by March. The species is found in a variety of timbered habitats, particularly near watercourses. It hunts on passerines, especially honeyeaters, and occupies large ranges of more than 100km^2. The species nests in large stick nests located along or near watercourses in forks or on horizontal tree limbs.	None	26 (2020)
Swift Parrot	*Lathamus discolor*	E	CE	881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804,1824, 1828, 1841, 1845	The Swift Parrot migrates in the autumn and winter months to forage in south-eastern Australia. In NSW, it mostly occurs on the coast and south-west slopes. On the mainland, the Swift Parrot occurs in areas where eucalypts are flowering profusely or where there are abundant lerp infestations. Following winter, they return to Tasmania to breed.	1 (2009)	49 (2019)
Turquoise Parrot	*Neophema pulchella*	V	-	881, 1250, 1776, 1780, 1783, 1803, 1804, 1824, 1845	The Turquoise Parrot ranges from southern Queensland to northern Victoria. The species inhabits edges of eucalypt woodlands, adjoining clearings, timbered ridges and farmland. Forages	1 (2017)	2 (2017)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
					on seeds, grasses and plant material and nests in tree hollows, logs or posts.		
Varied Sittella	*Daphoenositta chrysoptera*	V	-	881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The Varied Sittella is sedentary and is distributed widely in NSW. However, population sizes in NSW are uncertain, and it's believed they've undergone a reduction in recent years. The species inhabits eucalypt forests and woodlands, particularly those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Forages on arthropods and builds a nest in tree forks high in the tree canopy.	2 (2011)	11 (2018)
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	-	781, 881, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824	The White-bellied Sea-Eagle is distributed around the Australian coastline. In NSW, it is widespread along the east coast and inland waterways. Habitats are characterised by the presence of large areas of open water, with foraging and breeding sites occurring within proximity to water. Hunt mainly on fish, and nest in large stick nests in large eucalypts, often with emergent dead branches.	None	126 (2020)
White-throated Needletail	*Hirundapus caudacutus*	-	V	781, 881, 905, 1250, 1776, 1780, 1783, 1786, 1794, 1795, 1803, 1804, 1824, 1828, 1841, 1845	The White-throated Needletail is a non-breeding migrant in Australia, present between late spring and early autumn. They're often observed flying high in the sky catching insects. The species roosts typically along ridgelines in tall trees.	1 (2018)	82 (2019)

Common name	Scientific name	Status (BC Act)	Status (EPBC Act)	Associated PCTs within the deferred lands area	Habitat description (Department of Planning, Industry and Environment (Environment, Energy and Science), 2020)	Number of records (BioNet) within the deferred lands area (year)*	Number of records (BioNet) within 10km (year)*
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	781, 881, 905, 1250, 1795, 1841, 1845	The Yellow-bellied Sheathtail-bat is a wide-ranging species recorded in NSW commonly from the New England Tablelands and North West Slopes. The species forages for insects in a variety of habitats, and roosts in tree hollows, buildings and mammal burrows.	1 (2018)	9 (2018)

V = Vulnerable, E = Endangered, CE = Critically Endangered, EP = Endangered Population

* Number of records does not correspond to the number of individuals present. One record may contain multiple individuals.

3.4.1 Fauna habitat

Overview

As a result of the varied geomorphology of the deferred lands, a variety of vegetation communities occur. As part of the analysis for this report and for preparation of upcoming field surveys, these have been classified into five broad fauna habitat types (stratified from PCTs present within the deferred lands and based on previous stratification (Department of Environment and Climate Change, 2008)). These habitat types include Freshwater Wetlands, Rainforest, Heath, Ridgetop Woodland and Riparian Forest (**Figure 6**). These units are grouped based on geology, vegetation structure and likely resources for fauna. These stratifications will be ground-truthed as part of Stage 2 of the project. Most of the deferred lands area is one of three stratification units: Heath, Ridgetop Woodland or Riparian Forest (**Table 3-6**). While the deferred lands support large areas of intact bushland, existing linear infrastructure, such as Wakehurst Parkway and Forest Way, form barriers which lower its habitat connectivity value.

Table 3-6: Proposed fauna habitat stratification units

Fauna stratification unit	Area (ha) within the deferred lands area
Freshwater Wetlands	0.13
Heath	370
Rainforest	0.92
Ridgetop Woodland	430
Riparian Forest	341
Total	**1,143**

Habitat for species recorded within proximity to the deferred lands area

As discussed above in Section 3.4, a total of 22 threatened fauna species have been recorded within the deferred lands area, with an additional 13 threatened fauna recorded within close proximity. The deferred lands contain some suitable habitat for these 13 species (see **Table 3-5**), and further survey and habitat mapping is likely to likely to provide a better understanding of the distribution and importance of habitat compared with the more regularly recorded threatened fauna.

For example, there are 143 records of the Koala (the most recent from 2020) within 10 kilometres of the deferred lands area. However, the Koala has not been recorded within the deferred lands. The deferred lands are included within the Central Coast Koala Management Area (KMA 2) (Office of Environment and Heritage, 2018) and contain a number of *Eucalyptus* species listed under KMA 2, including Grey Gum (*Eucalyptus punctata*), a known regional high-use species for the Koala. Further, the deferred lands area contains 16 PCTs, of which 14 contain suitable habitat for the Koala (all but PCT 781 and PCT 881; see **Table 3-7**). While the deferred lands are unlikely to sustain a large breeding population of Koalas (due to the absence of records), nearby records and the presence of suitable habitat indicate that it may be used as a transitory area or for dispersal. The deferred lands area may become increasingly important habitat for species such as the Koala, considering impacts of bushfire and development within the surrounding environment.

Table 3-7: PCTs and associated feed trees that comprise potential habitat for the Koala within the deferred lands area

PCT within the deferred lands area	PCT name	Associated feed trees (listed in order of dominance within PCT)
905	Lilly Pilly - Coachwood warm temperate rainforest on moist sheltered slopes and gullies, Sydney Basin Bioregion and South East Corner Bioregion	None listed (Koala are known from PCT 905 but it does not contain any feed trees listed within KMA 2 and provides marginal habitat for the Koala)
1250	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	*Eucalyptus piperita*, *Angophora costata*, *Corymbia gummifera*
1776	Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast	*Angophora costata*, *Corymbia gummifera*, *Eucalyptus piperita*, *Eucalyptus pilularis*, *Eucalyptus umbra*, *Syncarpia glomulifera*, *Allocasuarina littoralis*
1780	Sydney Peppermint / Coachwood - Water Gum open forest in protected sandstone gullies around Sydney and the Central Coast	*Eucalyptus piperita*
1783	Red Bloodwood - Scribbly Gum / Old-man Banksia open forest on sandstone ridges of northern Sydney and the Central Coast	*Corymbia gummifera*, *Eucalyptus haemastoma*, *Corymbia eximia*
1786	Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region	*Corymbia gummifera*, *Eucalyptus haemastoma*, *Eucalyptus sieberi*, *Eucalyptus capitellata*, *Eucalyptus oblonga*
1794	Bangalay - Smooth-barked Apple / She-oak open forest on sandy alluvium in coastal parts of the Sydney region	*Eucalyptus botryoides*, *Angophora costata*, *Allocasuarina torulosa*
1795	Swamp Mahogany / Cabbage Tree Palm - Cheese Tree - Swamp Oak tall open forest on poorly drained coastal alluvium in the Sydney basin	*Eucalyptus robusta*, *Casuarina glauca*
1803	Banksia - Needlebush - Tea-tree damp heath swamps on coastal sandstone plateaus of the Sydney basin	None listed (Koala are known from PCT 1803 but it does not contain any feed trees listed within KMA 2)
1804	Needlebush - Banksia wet heath swamps on coastal sandstone plateaus of the Sydney basin	None listed (Koala are known from PCT 1804 but it does not contain any feed trees listed within KMA 2)
1824	Mallee - Banksia - Tea-tree - Hakea heath-woodland of the coastal sandstone plateaus of the Sydney basin	*Corymbia gummifera*, *Eucalyptus haemastoma*
1828	Coachwood - Lilly Pilly - Water Gum gallery rainforest in sandstone gullies of the Sydney basin	*Syncarpia glomulifera*, *Eucalyptus piperita*
1841	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched	*Angophora costata*, *Syncarpia glomulifera*, *Eucalyptus piperita*, *Eucalyptus pilularis*,

PCT within the deferred lands area	PCT name	Associated feed trees (listed in order of dominance within PCT)
	sandstone slopes and gullies of the Sydney region	*Eucalyptus saligna*, *Eucalyptus botryoides*, *Allocasuarina torulosa*
1845	Smooth-barked Apple - Red Bloodwood - Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney	*Angophora costata*, *Corymbia gummifera*, *Eucalyptus pilularis*, *Syncarpia glomulifera*, *Eucalyptus resinifera*, *Allocasuarina littoralis*

Importance of fauna habitat within the deferred lands area

The deferred lands area has been recognised by a range of independent studies to contain important habitat for threatened and non-threatened fauna. For example, the findings of the DECC (2008) report determined that the western extent of the deferred lands area was ranked 6th highest, and the central and eastern extents the 15th highest, of 50 sites in the Sydney Metropolitan Catchment Management Authority (CMA) area for fauna habitat value.

In addition, and among other studies, Kavanagh *et al*. (2015) and Travers Bushfire & Ecology (2017) reported that the deferred lands area is ecologically sensitive and provides significant habitat for a range of threatened fauna species. Further, Kavanagh *et al*. (2015) determined that the deferred lands area contains one of the most significant remnants of rainforest, forest, woodland, wetlands and heath in the Sydney metropolitan area that is not a listed National Park or Reserve, making it both biologically and biogeographically significant.

Furthermore, areas of 'High Environmental Value' (HEV), containing significant biodiversity values (e.g. areas protected for conservation, vegetation and habitat of high conservation value), have been developed and mapped by OEH (Office of Environment and Heritage, 2015). Based on this report, and additional investigations commissioned by the Office of the Government Architect for the Department of Planning and Environment (DPE), a majority of the deferred lands area is mapped as HEV or 'High Environmental Lands' in *Sydney Green Grid: Spatial Framework and Project Opportunities. North District* (TyrrellStudio, 2017). The protection of these areas is considered to provide a range of environmental, social and economic benefits (TyrrellStudio 2017).

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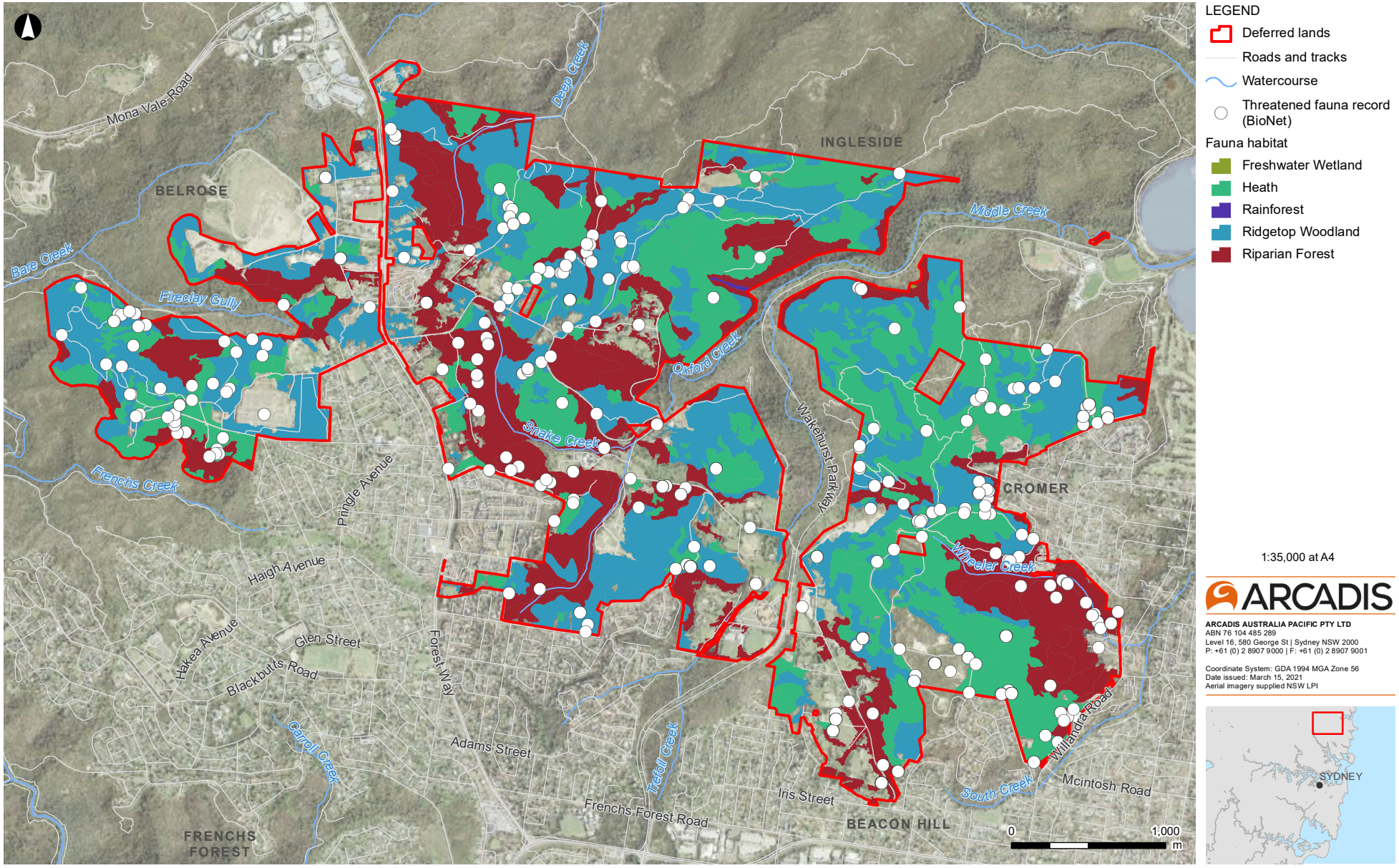

Figure 6: Fauna constraints identified within the deferred lands area

3.5 Core Habitat and Biodiversity Corridors

Northern Beaches Council Biodiversity Planning Review – Draft for Consultation (SMEC 2020) provides core habitat and wildlife corridor mapping of the Northern Beaches LGA, building on work completed by P&J Smith Ecological Consultants (2009).Core habitat was mapped throughout the deferred lands area, including much of the intact vegetation. Fragments of corridor habitat are also mapped on the edges and just within boundaries of lower density residential areas within the deferred lands area.

For the purposes of their report, SMEC (2020) defined core habitat as:

- Primarily consisting of native vegetation
- Large enough to provide significant habitat resources to a variety of native flora and fauna, at least 4 hectares is preferable (refer discussion in P&J Smith Ecological Consultants (2009)
- Cleared areas within core habitat should not comprise the integrity of the patch
- Core areas should be contiguous, and not bisected by busy roads or major watercourses that may disrupt fauna movement.

This report considered the entire LGA and as such, it is necessarily high level for the deferred lands. Almost all of the native vegetation is mapped as core habitat within the deferred lands, with only small strips of areas between tracts of native vegetation and development mapped as corridors. This pattern is also reflected in the Southern Organisation of Regional Councils data on wildlife corridor habitat, which shows most of the area as priority habitat, with only small areas of mainly disturbed land as supporting habitat (**Figure 7**). Note that this report is currently being revised.

3.6 Biodiversity Values Map

The Biodiversity Values Map, published and maintained by DPIE, identifies land with high biodiversity values that would be sensitive to impacts from development and clearing. Two different biodiversity values were mapped within the deferred lands area (online map accessed 7 December 2020 and 10 March 2021):

- Protected Riparian Land adjoining Deep Creek, Snake Creek, Oxford Creek and Wheeler Creek
- Threatened species or communities with potential for serious and irreversible impacts, comprising patches of Duffys Forest and/or threatened species populations mapped along Forest Way, with isolated patches mapped in the central and southern parts of the deferred lands area. Threatened species subject to serious and irreversible impacts and recorded within the deferred lands area include:
    - Beach Stone-curlew
    - *Genoplesium baueri*
    - *Grevillea caleyi*
    - Large Bent-winged Bat
    - Large-eared Pied Bat
    - Little Bent-winged Bat
    - *Persoonia hirsuta*
    - *Prostanthera marifolia*
    - Regent Honeyeater
    - Sooty Owl
    - Swift Parrot.

Table 3-4 and **Table 3-5** provide further details about the number of records and habitat present for these species within the deferred lands area.

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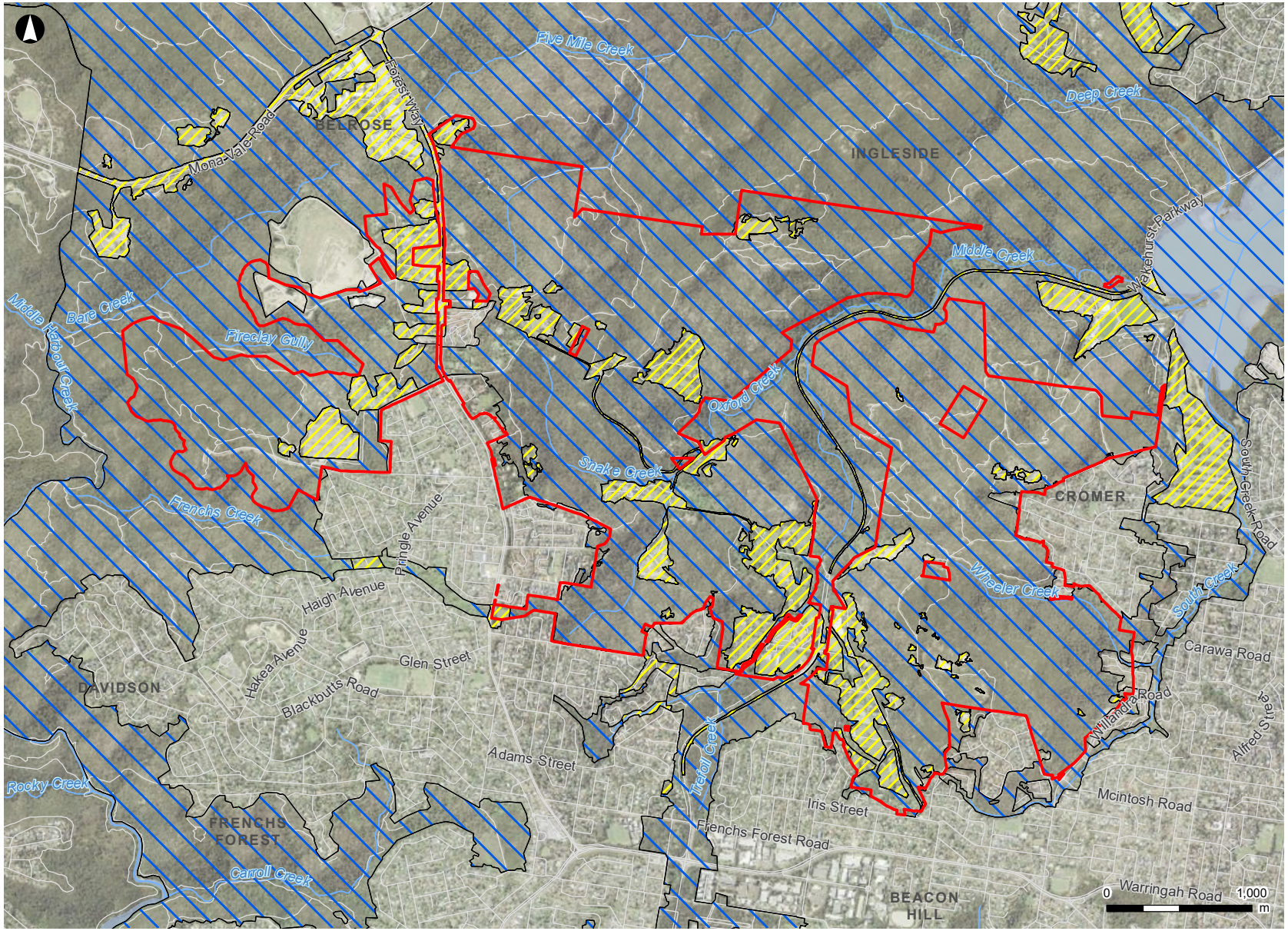

LEGEND

- Deferred lands

SSROC area/habitat

- Priority habitat
- Supporting area
- Roads and tracks
- Watercourse

1:40,000 at A4

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Coordinate System: GDA 1994 MGA Zone 56
Date issued: March 15, 2021
Aerial imagery supplied NSW LPI

Figure 7: Biodiversity corridors and core habitat

4 DATA ANALYSIS

4.1 Gaps and limitations

Pockets of the deferred lands have been surveyed intensively, usually as part of preparation of development applications or other planning proposals (**Table 3-1**, Appendix A). In addition, studies such as Kavanagh *et al*. (2015) have conducted extensive surveys covering a majority of the deferred lands area. However, a majority of studies contain gaps and limitations. For example, most studies are concentrated in the periphery of the deferred lands area, which have historically been subject to the greatest development pressure (**Figure 4**). In addition, many threatened species records are located along tracks (e.g. Slippery Dip Trail, Five Mile Trail), as they are regularly used by the public for recreation activities and are more accessible than other parts of the deferred lands area.

Further, most existing surveys of the deferred lands area have focused on the detection of threatened fauna species with a high local significance, such as Red-crowned Toadlet, Eastern Pygmy-possum and Rosenberg's Goanna. As such, there are gaps in knowledge of vagrant or historically significant species such as the Scarlet Robin and Sooty Owl. In addition, by focusing on presence/absence and generalised habitat types, a majority of existing studies have not located or considered significant breeding habitat within the deferred lands area (e.g. breeding hollows for owls and/or cockatoos). Whether an area provides both breeding and foraging habitat, or foraging habitat only, is an essential determinant of the importance of threatened fauna habitat.

The PCT mapping by OEH (2016) appears to be relatively accurate across much of the deferred lands area, given most areas are mapped as sandstone communities defined by topography. However, there may be some errors in the mapping of Coastal Upland Swamps, which have been identified based on consistent photo patterns rather than ground-truthed information. Coastal Upland Swamp can be difficult to map at larger scale, as some areas of sandstone heath regrowth, particularly in damper areas, can have similar patterns to Coastal Upland Swamp on aerial photographs. Some areas of potential additional Duffys Forest need to be investigated, particularly the area between Middle Creek and Garigal National Park mapped as a Duffys Forest variant by Smith and Smith (2005).

Threatened flora species records across the deferred lands area reflect surveys conducted for development proposals, with some additional opportunistic records along tracks and vegetation edges. The majority of the deferred lands area has not been subject to targeted threatened flora surveys. The extent of potential habitat that has not been systematically surveyed, along with the steep topography of the deferred lands area, presents a challenge as most threatened flora survey guidelines (for instance DPIE (EES), 2020) require intensive searching, even for large areas. Some of the threatened flora species most likely to occur within the deferred lands area, such as *Tetratheca glandulosa* and *Pimelea curviflora* var. *curviflora,* are relatively small forbs that are cryptic when not in flower and difficult to find in the ground layer, making detection in large scale surveys less likely.

Figure 4, **Figure 5** and **Figure 6** indicate gaps in survey and threatened species records, particularly in the more intact areas in the centre of the deferred lands, owned by the Metropolitan Local Aboriginal Land Council (MLALC). This area comprises similar habitat to the surrounding areas but does not have a comparable number of threatened flora and fauna records. Consequently, these are areas that require further assessment in order to determine ecological value.

4.2 Conservation value of land

Globally, the concept of preserving areas of high conservation value is a fundamental principle for conserving biodiversity in landscapes with competing social, economic and environmental requirements (Te´donzong, et al., 2018). Methods for determining high conservation value areas are highly variable and make comparison and consistent determination difficult (Neugarten & Savy, 2012). This section reviews some of the key factors that determine areas of high conservation value and how this might apply to the deferred lands area. This information is summarised in **Table 4-1**. For the Sydney region, the Office of Environment and Heritage, currently Environment, Energy and Science

(EES) team within DPIE released the *Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area* (Department of Environment and Climate Change, 2008) which focussed on fauna habitat quality. Overall conservation values are mapped in *Developing Maps of High Environmental Value for Strategic Planning – Mapping and Governance Guide* (Office of Environment and Heritage, 2015) and specifics from this report for the study area are discussed in Section 3.4.1

Table 4-1: Summary of contributing factors to high conservation value determinations and discussion on pros and cons

High value conservation criteria	Reference	Applicability to the deferred lands area	Comments
Areas protected for conservation			
Protected areas	OEH (2015)	No gazetted areas protected for conservation are declared within the deferred lands, but Garigal National Park occurs on the border to the west and north and Oxford Falls Park along Wakehurst Parkway which bisects the deferred lands (**Figure 1**).	Criteria for national parks and reserves as determined in the *National Parks and Wildlife Act 1974*. Proximity of areas of the deferred lands to protected areas are likely to significantly increase the value of those areas. This is due to the value of the area as a wildlife corridor and the minimal likely edge effects which bring disturbance to areas that are bordered by other land uses. This protection increases resilience of the vegetation and provides habitat for species that may require larger home ranges or mosaic habitats not completely provided by the deferred lands. Sometimes protected areas have variable levels of management which may not promote the greatest biodiversity. Differences in management practices may influence adjacent areas of the deferred lands, either positively or negatively.
Vegetation			
Threatened Ecological Communities (TECs)	OEH (2015)	Small areas of TECs including Duffys Forest and Coastal Upland Swamp are mapped within the deferred lands area. Coastal Upland Swamp is listed as a TEC under the EPBC Act.	Naturally rare, or vegetation that has been heavily reduced and disturbed since European habitation provides often supports rare species or provides unusual assemblages and requires special protection. Areas confirmed to be TECs, especially those listed under the EPBC Act should be considered for high value conservation status. The size and condition of the TEC will also influence the contribution that it makes to the ecological value of the area.
Over-cleared vegetation types	OEH (2015) BAM (DPIE (EES) 2020)	PCTs with a high percentage of clearing when compared to their pre-European settlement extent. Three PCTs in the deferred lands area have a percent cleared value over 70%: 781 Coastal freshwater wetland (74% cleared);	Under the BAM, PCTs with a percent cleared value of 70% to 90% are considered to have a high sensitivity to loss, and PCTs with a percent cleared value of over 90% are considered to have a very high sensitivity to loss. Over-cleared vegetation types largely overlap with TECs, but TECs include

High value conservation criteria	Reference	Applicability to the deferred lands area	Comments
		1786 Red Bloodwood - Silvertop Ash - Stringybark open forest on ironstone in the Sydney region (71% cleared) and 1845 Smooth-barked Apple - Red Bloodwood - Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney (92% cleared).	naturally rare communities, as well as over-cleared ones.
Biodiversity Values Map	BAM (DPIE (EES) 2020)	There are two key areas mapped on the Biodiversity Values map for the deferred lands: threatened ecological communities and riparian vegetation.	See Section 3.6 of discussion of what is mapped within the Deferred lands on the Biodiversity Values Map. The two types of Biodiversity Values mapped within the Deferred Lands include: • Threatened species or communities with potential for serious and irreversible impacts • Protected Riparian Land
Relevant SEPP – Coastal, Rainforest and Koala	OEH (2015)	Does not apply to the deferred lands, due to their geography. Nearby areas contain land within the Coastal SEPP definition, but not the deferred lands area. Koala habitat may apply.	Coastal Management SEPP has now replaced SEPP 14 Coastal Wetlands and SEPP 26 Littoral Rainforest. These could represent high conservation values in more coastal areas. The Koala SEPP in NSW is currently being revised.
Patch size	DECC (2008) SMEC (2020) DPIE (2020)	Patch size of native vegetation varies across the deferred lands, with many large patches still present.	A diverse range of fauna species require certain size areas of contiguous vegetation to survey (e.g. forest owls, pygmy possums), others require multiple patches of habitat as a mosaic (e.g. Angold *et. al*., 2006). Patch size alone does not determine an areas conservation value, but rather the size of individual patch sizes in combination with the number of interconnected patches, as well as variation in density of threatened species depending on the biology of those species. Overall patch size is often correlated with higher biodiversity for a group of animals (e.g mammals) (Lindenmeyer et. al., 2000), however landscape mosaics (where there is a collection of patches of different vegetation types), have also been shown to create biodiversity of species, but often at the expense of particular groups (e.g hollow nesting specialists)
Fauna Habitat			
Old growth forest	OEH (2015)	Small areas, especially in riparian locations may have	This is usually featured in identified High Conservation Value areas in State Forests

High value conservation criteria	Reference	Applicability to the deferred lands area	Comments
		forests that constitute old growth, as well as areas that are relatively inaccessible and have not been disturbed since European occupation.	when logging is planned. It is usually defined as mature forests where the effects of previous disturbance are now negligible. It is related to the presence of tree hollows.
Tree hollows	OEH (2015); DECC (2008)	This is relevant to the woodlands and forests, more than heathlands (although old *Banksia* trees can produce hollows. Hollow-dependent fauna occurs across the deferred lands site.	Hollows are increasingly rare in most habitats, and hollow loss has contributed significantly to the reduction in population for raptors, arboreal mammals and other hollow-dependent fauna. Areas with large numbers of hollows of varying sizes are increasingly rare, and therefore valuable for threatened species conservation.
Threatened fauna habitat	OEH (2015) DECC (2008)	There are areas of the deferred lands that multiple threatened species are regularly recorded (e.g. to the east, near the Narrabeen Sports Academy), and there are several species (e.g. Red-crowned Toadlet that are rare in many parts of their range but are commonly encountered in favourable conditions within the deferred lands area. Therefore, significant threatened fauna habitat is present. There are in survey in many parts of the deferred lands as well.	High quality threatened fauna habitat is a feature of the determination of high conservation value land and given the results of previous studies (e.g. Kavanagh *et. al*., 2015) and existing BioNet records is likely to be an important feature of conservation value within the deferred lands are. Habitat condition (measured by weed occurrence, maturity of vegetation etc) will also influence habitat value.
Wildlife Corridors/Habitat connectivity	DECC (2008) SMEC (2020) Biodiversity Conservation Regulation 2017 Section 1.4 Figure 7	The deferred lands are unusual in the quantity of connected habitat that is still present. Much of the remaining native vegetation is still relatively intact and provides an opportunity to preserve corridors and connectivity for the Northern Beaches region.	Many fauna species require large areas of connected habitat to move within to forage and breed. Many species become locally extinct due to the fragmentation of habitat. As such, this is ann important criterion for conservation value.
Wetlands			
Ramsar Wetlands	OEH (2015)	Not applicable. Closest Ramsar wetland is at Towra Point in southern Sydney.	Not applicable
Riparian areas/water sustainability	DECC (2008), Biodiversity	As well as providing valuable water resources for flora and fauna, riparian	Provide numerous conservation values for native flora and fauna within an area. These are included on the Biodiversity

High value conservation criteria	Reference	Applicability to the deferred lands area	Comments
	Conservation Regulation 2017, Section 1.4	vegetation is often less subject to destructive storms and can be more immune to fire. For this reason, hollow-bearing trees are more prolific, especially the Coachwoods of the area that provide suitable large hollows for hollow-dependent fauna (Kavanagh *et. al.*, 2015)	Values Map (Section 3.6) and are detailed in BMT (2021)
Geological significance			
Geology		The geology of the area is the primary basis of the vegetation formations and provides habitat for fauna. The geology of the area is an important component of determining conservation significance within the area but is not part of the scope of this report.	Geological significance should be a part of determining high conservation value areas, but is not further considered in this study, other than commenting of features relevant to biodiversity habitat.
Cultural significance			
Indigenous historical significance	(Neugarten & Savy, 2012)	There are many areas of cultural significance to Indigenous people within the deferred lands and this contributes to those areas' conservation value, however detailed consideration of these values is outside the scope of this report.	Indigenous significance is an important part of determining conservation value of the land and should be part of future land use planning, however it is out of scope for this study.
Ecotourism and Education	(Neugarten & Savy, 2012)	The deferred lands are part of a larger area of urban bushland that is not common in such close proximity to large cities of Australia. It therefore potentially provides extensive opportunities for ecotourism and education, providing for both the protection of the environment and business opportunities for the people of the northern beaches. It is beyond the scope of this report to provide detail on this aspect, but it is included as a consideration for	Attempts to provide consistent criteria for high conservation land at the global scale incorporate a significant section on social value of high conservation land. Consideration of the natural capital, or value of ecosystem services to the Northern Beaches population should be incorporated into any assessment of conservation value during later stages of the planning process. It is acknowledged that this is an important component of an assessment of conservation value of land but is outside the scope of this report which is focussed on biodiversity.

High value conservation criteria	Reference	Applicability to the deferred lands area	Comments
		strategic land use consideration.	

4.2.1 Application to Deferred lands

The deferred lands area is one of the largest areas of native bushland outside of a national park in the greater Sydney region. This scarcity of large tracts of native vegetation in unreserved areas makes the deferred lands potentially valuable to the protection of wildlife, particularly given that they are adjacent to Garigal National Park, a relatively small national park in proximity to suburban environments, subject to the threats to bushland and native species that this can produce (e.g predation of fauna by cats, sediment and pollution run off, edge effects etc).

Maintaining connectivity to Garigal National Park and creating a non-national park buffer to the suburban environment, as well as extending the continuous area of native bushland, is likely to have a greater positive impact on retained areas of native bushland within the deferred lands than retaining patches within the interior of the deferred lands, separated by rural or residential land. In the Stage 2 report for this project, we will be looking at determining high, moderate and low areas of ecological value throughout the deferred lands area and will rely on the factors discussed in **Table 4-1**. Based on our knowledge from this desktop review, we propose the use of five criteria to determine areas of high, moderate and low ecological value during the next stage of the project. The advantages and disadvantages of these criteria are discussed in Table 4-2 and are prioritised and discussed in Section 4.2.2.

Table 4-2 Summary of proposed criteria within the deferred lands to determine conservation value

Conservation value criterion	Advantages	Disadvantages
Protected area proximity/proximity to large tracts of protected bushland	Provides additional areas of habitat for specialist fauna species that rely on this kind of resource (gliders, spotted-tailed quolls etc).	Potentially homogenous areas of habitat can sometimes favour one particular suite of species, whereas mosaic landscapes can promote diversity (discussed in Lindenmeyer 2019)
Riparian land/water sustainability	Riparian areas often have a different microclimate to hillsides and other landforms. They also provide connectivity through the landscape which is important for fauna, including threatened species (refer also to wildlife corridors) Intact riparian vegetation protects water resources, often critical for biodiversity of the area.	These areas are sensitive to pollution, erosion and sedimentation and so the quality may erode more quickly than surrounding areas, reducing the conservation value of the area. May mean other corridors for wildlife are overlooked if they do not contain wetland/riparian areas.
Wildlife Corridors/Habitat connectivity	This value relates to the above two, but is not completely captured in them. Wildlife corridors and the extent of habitat connectivity of an area reflects the ability of fauna to move across the landscape within suitable areas; it also provides resistance/resilience to disturbance, especially from edge	Emphasis on preserving corridors may minimise contribution of smaller areas of habitat, such as “stepping stone” areas of native vegetation. Corridors occur at different scales, depending on the flora or fauna species of interest. Minimum widths are contentious (varying from 30 metres up to 2km, depending on the area and target suite of species

Conservation value criterion	Advantages	Disadvantages
	effects where surrounding areas have been cleared.	(discussed in Beier 2018).Determining the optimal location and size of wildlife corridors can be complex, and regional or sub-regional corridor success is often dependent on the co-operation of numerous landholders and other stakeholders.
Threatened species habitat	A high number of threatened species records is likely to suggest an area has high quality habitat, taking account of survey effort Can be estimated by examining important and potentially scarce habitat features (e.g density of hollow-bearing trees, water sources, diversity of foraging resources etc)	Recording bias and an emphasis on only threatened species may mean other high quality areas are missed. While threatened species habitat is important, habitat for other species should also be considered.
Threatened ecological communities	Threatened ecological communities often overlap with overcleared landscapes (as discussed **Table 4-1**), but also include ecological communities that are naturally rare. Preservation of these communities promotes biodiversity because often these communities contain resources that are scarce or declining in the landscape, this could include threatened flora species.	These communities can sometimes be difficult to quantify and differentiate from other more common communities (e.g Duffys Forest Endangered Ecological Community). They can also be very degraded compared with other more common communities and take a long time and effort to regain their integrity and functionality.

4.2.2 Prioritisation

Summarising the above discussion and our desktop, the following measures of conservation are ranked in order of importance. However, the robustness of this prioritisation will be tested in the Stage 2 report for this project, by testing different weighting of these variables. It is also noted that none of these variables are independent, there is significant overlap with all of them.

- Threatened species habitat (extent and quality)
- Threatened ecological communities (extent and quality)
- Proximity to protected bushland
- Wildlife corridors
- Riparian land/water sustainability

Non-ecological criteria, such as social value including importance to First Nations are also considered to be important but are outside the scope of this report.

4.3 Land zoning

Alongside previous studies, this report will be used to better inform the future zoning of the deferred lands under the Northern Beaches Council LEP (in preparation). In developing the new LEP, Council is considering both the consistency of environmental zones within the amalgamated Warringah, Manly and Pittwater LGAs, as well as identification of suitable environmental protection (and alternative land use) zones within the deferred lands.

Of particular interest within the deferred lands, given the abundance of ecological values, is the protection of environmentally significant areas as environment protection zones. There are four classifications of environmental protection zones in the Standard Instrument:

- E1 - National Parks and Nature Reserves
- E2 - Environmental Conservation
- E3 - Environmental Management
- E4 - Environmental Living.

Further explanation of these categories and their criteria are summarised in **Table 4-3**.

In order to determine the best category for environmental protection of parts of the deferred lands, detailed information on the biodiversity values of these areas is required, as well as an understanding of community requirements and pressures. This report provides summarised information showing that many areas of the deferred lands study area have the kind of values that would make them good candidates for E2 and E3 environment zone protection where the primary use of the land is conservation (Department of Planning and Environment, 2015). Parts of the area have received little, if any targeted survey (summarised in Section 4.1) but information on these areas will be gathered during Stage 2 of this project. The deferred lands are surrounded by National Parks (E1) land, but parts of the deferred lands are contiguous with this area and likely to have similar values, which could be protected by E2 zoning. Areas of significant, but lesser values within the deferred lands area may meet the criteria for E3 or E4 zoning, which provides for low-impact residential development **Table 4-3**.

Parts of the deferred lands form part of the Metropolitan Rural Area (MRA) network that has identified the following types of land within the Greater Sydney region as having special values requiring protection (Clarke 2017). MRA land consists of:

- Public land protected for conservation and other public values (e.g defence etc)
- Peri-urban land used for a range of rural and rural lifestyle purposes
- Rural towns and villages.

Values identified within the MRA have some legislative protection under the Environmental *Planning and Assessment Act 1979* and the *Greater Sydney Commission Act 2015.* This compels councils that have MRA within their LGAs to protect and enhance environmental, social and economic values in rural areas. This also extends to other planning policies such as the Seniors SEPP 2014 which ordinarily allows for greater housing density for seniors living but this does not apply to the MRA.

The MRA is split into five districts, with the deferred lands forming part of the northern district. The MRA in the northern district is comprised primarily of public lands (81%), particularly national parks, including Garigal, Ku-ring-gai Chase, Maramarra and Muogamurra Nature Reserve. Parts of the deferred lands are included within the MRA, but not all of it is covered. The values represented within the deferred lands (primarily biodiversity), differ to those protected in other parts of the MRA, which are more agricultural, rural residential. One of the ways that the MRA plan seeks to meet the objective of minimising impacts on these areas is to facilitate the establishment of biodiversity offsets on private land, offering an opportunity to earn income from the land, other than developing it.

Table 4-3: Environment Protection Zones (from Department of Planning 2009)

Environmental Zone	Title	Objectives	Key criteria and allowable uses	Information required to potentially meet the criteria for this zoning
E1	National Parks and Nature Reserves	Uses as per *National Parks and Wildlife Act 1974*.	For current national parks and nature reserves, new conservation areas only if agreed by EES. Not generally intended for application to Crown land.	• Significant tracts of threatened ecological community in good or above condition • Significant areas of habitat for multiple threatened species that is unusual in the local area • Likely to be combined with significant Indigenous cultural heritage areas.
E2	Environmental Conservation	High ecological, scientific, cultural or aesthetic values outside the national parks and nature reserves system.	Must be backed by appropriate scientific data about the significance of the area. No mandatory permitted uses. Possibly suitable include: • Bed and breakfast accommodation • Ecotourism • Water recreation structure • Wetland rehabilitation. Prohibited uses include industry, service stations, hotel or motel accommodation and seniors housing	• Areas of high ecological significance as determined by; occurrence of TECs, multiple threatened species habitat, especially areas that contain unusual vegetation or habitat features. Within the deferred lands may be core/central areas, areas with upland swamp vegetation and areas with breeding habitat for multiple threatened fauna species. Any areas established as biodiversity offset sites are likely to have this level of protection. Parts of the MRA may fit into this category and/or E3.
E3	Environmental Management	Focused on protecting, managing and restoring areas with special ecological, scientific, cultural or aesthetic values Where rehabilitation and restoration of special environmental qualities are the primary purpose.	Areas of transition between high conservation value land and other lands such as rural or residential. Highly constrained land where elements such as slope, erodible soils or salinity may have an impact on water quality. Limited range of development is permissible, as long as it does not impact on conservation values. Examples of potential uses include: • All permissible E2 activities • Community facilities	• Corridors and buffers between areas of high conservation value (E1 & E2) and areas with other uses (e.g. E4 or rural residential).

Environmental Zone	Title	Objectives	Key criteria and allowable uses	Information required to potentially meet the criteria for this zoning
			• Kiosks and recreation areas.	
E4	Environmental Living	Main objective is to provide for low-impact residential development in areas with special ecological, scientific or aesthetic values.	Applied to existing low impact residential development, may include rural areas that have special conservation values. In addition to what is permissible in E2 and E3 areas, Council may allow the following types of uses in E4 areas: • Caravan parks • Home-based industries, including childcare • Secondary dwellings.	• Only in more disturbed, low ecological value areas, in buffer zones between residential and E3 areas.

5 RECOMMENDATIONS FOR STAGE 2

5.1 Flora

Ground truthing during Stage 2 of the project should focus on areas that have not previously been surveyed in detail, as well as targeting areas of known and potential threatened ecological communities and threatened species habitat.

Priorities for the vegetation mapping should include:

- Confirmation of the current boundary between PCTs and cleared lands, using recent aerial photography
- Verification of mapped PCTs via rapid vegetation point assessments spread evenly across the deferred lands area, as well as at strategically targeted locations
- Focus on confirmation and assessment of areas of TECs, including sampling using BAM plots.

Threatened flora surveys should focus on confirming previous records of threatened species and identifying habitat characteristics for the species, as well as investigation of previously un-surveyed areas. Given that large areas of potential habitat for flora species in the deferred lands, achieving an even geographic spread of survey locations will require a lower intensity of survey effort. A grid-based systematic survey for large areas of suitable habitat, similar to that described in the NSW Flora survey guide for the Biodiversity Assessment Method, *Surveying threatened plants and their habitats* (DPIE (EES) 2020), is recommended. This approach provides broad coverage across areas and allows for simultaneous vegetation sampling using rapid assessment points. It may also be appropriate to conduct parallel transects on smaller sites, if timing allows.

5.2 Fauna

Fauna have been more widely and intensively surveyed; therefore Stage 2 should be less focused on presence/absence of threatened fauna with a stronghold in the area, but rather on breeding habitat and on secondary and vagrant species that have been recorded less often (**Table 3-5**) or have been recorded outside of, but in proximity to, the deferred lands area.

In addition, Stage 2 fauna investigations should:

- Prioritise key threats to fauna and their habitats
- Collect detailed field information on fauna habitats to infer higher value areas across the deferred lands area, even when records are not present
- Focus on areas with minimal survey, such as the central area of the deferred lands, adjacent to Garigal National Park
- Prioritise areas that are essential to maintenance of corridors, and appropriate buffers around them, gathering further detail on the quality of corridor habitat.

6 CONCLUSION

Council is currently midway through a three-year strategic land-use planning program to prepare a single LEP and DCP for the Northern Beaches Council area. Input on the ecological values of the deferred lands is a critical component to progressing this strategic land-use planning program. The deferred lands cover more than 1,100 hectares of largely intact vegetation, the largest area outside of national parks and reserves system in the Sydney metropolitan area it also provides connectivity to Kuringai and Garigal National Parks.

Existing information on the ecological value of the deferred lands area is variable, with intensive survey occurring in areas that have previously, or are currently under investigation for potential residential development. This includes areas around the edges of the deferred lands, especially Ralston Avenue, Belrose, Wheeler Creek Valley and Cromer Golf Club.

There is also a previous bias within the surveys done when it comes to taxa, with a strong focus on fauna, especially iconic species such as Eastern Pygmy-possum, Red-crowned Toadlet and Powerful Owl. Within the deferred lands area, there are seven fauna species with more than 15 records, and up to 70 records, from within the past five years. Threatened flora species have been subject to less intensive survey than threatened fauna, however populations of several threatened flora species have been identified within the deferred lands.

While it is important to document the more iconic threatened species, the focus of Stage 2 of this project should be on documenting the habitat that supports these and rarer threatened fauna and filling the gap in vegetation community and threatened flora surveys. The presence and extent of Duffys Forest Ecological Community in the Sydney Basin Bioregion and Coastal Upland Swamps in the Sydney Basin Bioregion, the two TECs that occur most commonly within the deferred lands, should be confirmed.

The interior of the deferred lands is primarily Metropolitan Local Aboriginal Land Council and Crown Land and has not been targeted for detailed ecological survey to date. Tracks through this land do have several species of threatened flora and fauna recorded, but there are large tracts of vegetation away from the tracks that have few records, and little evidence of recent survey. These areas are less likely to suffer from edge effects and may represent good core habitat, however surveys need to be undertaken to confirm this.

SMEC (2020) identified most of the deferred lands as core habitat, with small areas considered to be suitable as biodiversity corridors, where they interfaced with cleared land (e.g. residential). This was a high-level review, and it is recommended that more detailed analysis of the ecological quality of this habitat is determined. This will be provided in the Stage 2 report for this project.

The Stage 2 report will also attempt to characterise the deferred lands area based on conservation value, using the following priorities, developed from this review:

- Threatened species habitat (extent and quality)
- Threatened ecological communities (extent and quality)
- Proximity to protected bushland
- Wildlife corridors
- Riparian land/water sustainability

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APPENDIX A: SUMMARY OF EXISTING FAUNA SURVEY EFFORT IN THE DEFERRED LANDS AREA

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
Flora and Fauna Assessment for Proposed Rezoning for Cromer Golf Club Draft Report	2013	Cumberland Ecology	Biodiversity assessment	Lot 2 DP 525492, Lots 859, 860 and 861 DP 752038 and Lot 22 DP 859782, Cromer Road, Cromer	Habitat assessment (1 day) (May 2005) Aural surveys (3 nights) (May 2005)	Habit assessment	Habitat assessment	Habitat assessment	Habitat assessment	Cage trapping (10 days, 5 trap lines of 5 traps, 25m apart, standard mix) (May/June 2005) Elliott B traps (5 days, 2 trap lines, 10m apart, standard mix) (May/June 2005)	-
Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area	2008	Department of Environment and Climate Change	Vegetation/habitat assessment	Sydney Catchment Area	Diurnal search (50x100m area, 1 hour) Nocturnal search (up to 200m area, 30mins)	Diurnal search (50x100m area, 1 hour)	20min observation and listening search (2ha site)	Call play-back	Spotlighting (200m transect, 30mins)	Diurnal search (50x100m area, 1 hour)	Habitat assessment Harp trapping (1 night per site) Anabat (each site during nocturnal surveys)
Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area: Appendix 4 Site Profiles	2008	Department of Environment and Climate Change	Vegetation/habitat assessment	Garigal to Oxford Falls	No targeted flora and fauna surveys. Results based on Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area						

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
Native vegetation remnants within the Northern Beaches Council LGA area ranked for their habitat value	2008	Department of Environment and Climate Change	Vegetation/habitat assessment	Northern Beaches Council LGA	No targeted flora and fauna surveys. Results based on Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area						
Oxford Falls Valley and Belrose North Strategic Review (Draft)	2013	Department of Planning and Infrastructure	Planning review	1341ha Warringah LGA	No targeted flora and fauna surveys. Threatened species based on BioNet records and potential habitat present						
Greener Places: An urban green infrastructure design framework for New South Wales	2020	Department of Planning, Industry and Environment	Planning review	NSW urban areas	No targeted flora and fauna surveys. Design framework to guide planning, design and delivery of green infrastructure in urban areas						
Balise Eco Village Species Impact Statement	2010	Eco Logical Australia	Biodiversity assessment	Lots 808, 809, 812, 813 and 817 DP 752038 Willandra Road, Beacon Hill	Utilised results of previous site surveys (active searches, spotlighting, aural surveys, tadpole surveys, pitfall trapping, combined at least 42 hours	Utilised results of previous site surveys (habitat assessments, active searches combined at least 64 hours across 21 days, 12 pitfall trap nights, 5	Utilised results of previous site surveys (habitat assessments, opportunistic sightings at least 7 days, observation and listening surveys at least 43 hours across 14	Utilised results of previous site surveys (habitat assessments, diurnal searches, call play-back and spotlighting at least 8 nights) (across 2002	Utilised results of previous site surveys (combined mammal surveys call play-back and spotlighting at least 42 hours across 24 nights, cage traps, baited camera traps, pitfall traps, Elliot traps combined at least at least 938 trap nights, hair tubes at least 1,080 hair tube nights) (across 2002 – 2009 in February, March, September, October, December)	Utilised results of previous site surveys (Anabats at least 25 nights, harp trap at least 11 nights) (across 2002 – 2009 in February, September, December) Additional Anabat surveys

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
					across 14 days, 12 trap nights) (across 2002 – 2009 in January, February, September, December) Additional targeted habitat searches (at least 43 hours, 7 days) (2009 – 2010 in July, August)	camera trap nights) (across 2002 – 2009 in February, March, December) Additional targeted habitat searches (16 hours, 2 days) (October 2009, May 2010)	days) (across 1999 – 2009 in March, April, July October, December)	– 2009 in September and December) Additional targeted habitat searches (at least 4 hours, 1 day) (July 2010)	Additional 630 hair tube nights targeting Southern Brown Bandicoot (July 2010)		(at least 8 nights) (July 2010)
Balise Eco Village Species Impact Statement: Volume 2	2010	Eco Logical Australia	Biodiversity assessment	Lots 808, 809, 812, 813 and 817 DP 752038 Willandra Road, Beacon Hill	No targeted flora and fauna surveys. Results based on Balise Eco Village Species Impact Statement						
Balise Eco Village Environmental Site Management Plan	2010	Eco Logical Australia	Biodiversity assessment	Lots 808, 809, 812, 813 and 817 DP 752038 Willandra Road, Beacon Hill	No targeted flora and fauna surveys. Results based on Balise Eco Village Species Impact Statement						
Biobank Credit Assessment Report: Wheeler Creek	2010	Eco Logical Australia	Biodiversity assessment	Lots 816, 818, 819, 824, 825, 826, 827,	Utilised results of previous site surveys (including diurnal bird census, scat collection, habitat searches, spotlighting, Anabats, call play-back, hair tubes and trapping undertaken in March and September 2001). Additional targeted surveys undertaken in 2009 for Red-crowned Toadlet and Rosenberg's Goanna						

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
Valley Biobank Site				828, 829, 830, 2012 DP 752038; Lot 7034, 7035 and 7036 DP 93795, Oxford Falls							
Biobanking Agreement Credit Assessment Report: Rickards Road Biobank Site	2017	Eco Logical Australia	Biodiversity assessment	240 Rickards Road (Lot 3 DP184056)	No targeted fauna surveys. Threatened fauna species based on BioNet records and potential habitat present						
Flora and Fauna Assessment Little Willandra Road, Cromer	2017	Eco Logical Australia	Biodiversity assessment	Lot B2 DP 358165, 53 Little Willandra Road, Cromer	Call play-back, spotlighting and active searches (2 nights) (March and September 2016)	Habitat assessment, opportunistic sightings	Habitat assessment, opportunistic sightings	Diurnal searches, call play-back, stag-watching, songmeter monitoring and spotlighting (2 nights) (March and September 2016)	Diurnal searches, call play-back, stag-watching, songmeter monitoring and spotlighting (2 nights) (March and September 2016)	Diurnal searches, call play-back, stag-watching, songmeter monitoring and spotlighting (2 nights) (March and September 2016)	Roost searches, stag-watching, Anabats (2 nights) (March and September 2016)
Threatened Fauna of the Narrabeen Lagoon Catchment: Surveys and status of	2015	Kavanagh, R., Law, B., Lemckert, F., & Stanton, M.	Biodiversity assessment	Narrabeen Lagoon Catchment (within Warringah LGA)	Aural surveys, road surveys, tadpole searches, spotlighting, call identification	Diurnal habitat searches, road surveys, spotlighting ((7 sites, 14 surveys, 1-2 hours each)	20min observation and listening search (19 plots, surveyed twice) and opportunistic	Call play-back, spotlighting (16 sites, 13 surveys, May-June 2011; 13 sites, 17	Call play-back, spotlighting (16 sites, 13 surveys, May-June 2011; 13 sites, 17	Nest boxes (7 sites, 30 boxes, 5 surveys each site, May-June 2011; 10 sites, 40 boxes, 2-9 surveys each site, Nov-Dec	Diurnal habitat/roost searches (5 sites, 4.5 hours, Oct 2011, Jan 2012, Apr 2012), Anabats

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
threatened species					(7 sites, 14 surveys, 1-2 hours each) (Oct-Nov 2012, Jan-Jun 2013) Diurnal habitat searches (7 sites, 14 surveys, 1-2 hours each) (Oct 2012, Nov 2012, Jan 2013, Feb 2013, Mar 2013, Jun 2013)	(Oct-Nov 2012, Jan-Jun 2013) Camera traps (27 sites, 479 nights, May-June 2011; 12 sites, 160 nights, Oct-Nov 2011, Jan 2012, May 2012; 20 sites, 382 nights, Mar-Apr 2013)	sightings (5 sites, 34 surveys, 20min/survey) (Oct-Nov 2012)	surveys, Nov 2011 -May 2012)	surveys, Nov 2011 -May 2012)	2011, Jan-May 2012; 4 sites, 20 boxes, 8 surveys, Jan-Jun 2013), camera traps (27 sites, 479 nights, May-June 2011), Elliot traps (7 sites, 125 traps, 9 nights, May 2013)	(5 sites, 14 nights, May 2011; 11 sites, 27 nights, Oct-Nov 2011, Jan 2012, Mar 2012, Apr 2012; 9 sites, 18 nights, Mar 2013), harp traps and mist nets (5 sites, 5 nights, Nov 2012)
Warringah Natural Area Survey: Fauna Species	2005	P&J Smith Ecological Consultants	Biodiversity assessment	Warringah LGA outside Ku-ring-gai Chase and Garigal National Parks	No targeted fauna surveys. Provides a comprehensive (although not complete) annotated list of the native fauna species recorded in the Warringah LGA outside the national parks and identifies the species of special conservation significance at national, state, regional (northern Sydney) and local (Warringah) levels						
Warringah Natural Area Survey: Vegetation Communities and Plant Species	2005	P&J Smith Ecological Consultants	Biodiversity assessment	Warringah LGA outside Ku-ring-gai Chase and Garigal National Parks	No targeted fauna surveys. Report detailing the vegetation communities and flora recorded in the Warringah LGA						
Survey of the Duffys Forest Vegetation Community:	2000	P&J Smith Ecological Consultants	Vegetation/habitat assessment	Warringah LGA	No targeted fauna surveys. Detailed information and review about the Duffys Forest Vegetation Community in the Warringah LGA, including within Ku-ring-gai Chase, Terry Hills, Duffys Forest, Ingleside and Garigal National Park						

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
Report to NSW National Parks and Wildlife Service and Warringah Council											
Warringah Natural Area Survey: Vegetation History and Wildlife Corridors	2005	P&J Smith Ecological Consultants	Vegetation/habitat assessment	Warringah LGA outside Ku-ring-gai Chase and Garigal National Parks	No targeted fauna surveys. Report detailing the identification and mapping of native vegetation communities in the Warringah LGA outside Ku-ring-gai Chase and Garigal National Parks. Key wildlife corridors also mapped, including within Ku-ring-gai Chase National Park, Garigal National Park, Manly Dam Reserve, Jamieson Park, Dee Why Lagoon, Allenby Park, NSW Gun Club, Coast and coastal lagoon vegetation, Duffys Forest linking Ku-ring-gai Chase National Park and dead-end corridors linking smaller areas of bushland with larger areas of bushland						
Warringah Natural Area Survey: Vegetation History and Wildlife Corridors 2009 Update	2009	P&J Smith Ecological Consultants	Vegetation/habitat assessment	Warringah LGA outside Ku-ring-gai Chase and Garigal National Parks	Updates to the Warringah Natural Area Survey: Vegetation History and Wildlife Corridors report, including updated wildlife corridors and vegetation mapping						
Review of Four Sites Within Oxford Falls Valley For Urban Development	2009	Planning Assessment Commission	Planning review	Lizard Rock, Cromer Golf Course, Oxford Falls West and Red Hill	No targeted fauna surveys. Review of the suitability of four sites in Oxford Falls Valley for future urban development						
NBH CaNE Biodiversity Offset Package Stage 3 Final Report	2020	SMEC	Biodiversity assessment	Lot 100 DP874509 and Lot 2116 DP752038	Habitat assessment (1 day) (May 2016) Active searches (6 days) (September,	-	-	-	-	-	-

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
					November, December 2016, March 2017, February 2020)						
Northern Beaches Council Biodiversity Planning Review: Natural Values Mapping Methodology Report (Draft)	2020	SMEC	Planning review	Northern Beaches LGA	Biodiversity planning review. Field validation was undertaken for current edges of Grey-headed Flying-fox colonies. No other targeted threatened fauna species surveys undertaken						
Ecological Assessment Planning Proposal for Lot 1 DP 1139826 Ralston Avenue, Belrose	2017	Travers Bushfire & Ecology	Biodiversity assessment	Lot 1 DP 1139826 Ralston Avenue, Belrose	Specialist report and study by Michael Mahony Opportunistic habitat searches, funnel trapping, spotlighting, call play-back, tadpole searches (at least 21 nights, October 2011, December 2011,	Specialist report and study by Gerry Swan Opportunistic habitat and diurnal searches, funnel trapping, burrow searches (at least 21 days, May 2008, December 2011, October 2012, May	Opportunistic sightings (at least 18 days, May 2008, December 2011, October 2012)	Call play-back and spotlighting (at least 5 nights, May 2008, December 2011, October 2012)	Spotlighting, call play-back, cage trapping, Elliott trapping, hair tubes, hollow searches, denning tubes, camera traps, habitat assessments (at least 84 days, May 2008, December 2011, October 2012, August	Specialist report and study by Ross Goldingay	Anabats (passive and active), spotlighting, harp trapping (at least 11 nights, May 2008, December 2011, October 2012)

Title	Year	Author(s)	Report type	Study area	Amphibians	Reptiles	Diurnal birds	Forest owls	Arboreal mammals	Small mammals	Microbats
					October 2012, April 2013, May 2013, May 2015, March 2017)	2015, March 2017)			2013, May 2015, June 2015, July 2015,)		
Report of Warringah Council Meeting held on 19 June 2001. (pp. 63-140)	2001	Warringah Council	Planning review	No targeted fauna surveys. Findings of transport and water quality studies required by Stage 1 of the Non-Urban Lands Study and recommended actions							

APPENDIX B: FAUNA SURVEY GUIDELINES

Recommended survey effort and timing as per industry guidelines for key threatened fauna groups recorded within the deferred lands area

Fauna group	Minimum survey requirements[1]	Minimum survey effort	Seasonal survey requirements	Recommended conditions	Survey guidelines
Amphibians (e.g., Giant Burrowing Frog, Red-crowned Toadlet)	Aural-visual surveys and/or tadpole searches with a spotlight at night within 300m of suitable breeding habitat (i.e., ephemeral flowing streams with permanent pools, upland swamps)	Aural-visual: 960mins over a 500m transect, 8 repeated surveys (Giant Burrowing Frog); 460mins over a 500m transect, 4 repeated surveys (Red-crowned Toadlet) Tadpole: 10mins/50m^2, 8 repeated surveys	Sep – May (aural-visual) Feb – May (tadpole)	Within one week of heavy rainfall (i.e., >50mm in 24 hours, >100mm over three days) Avoid cold temperatures	(Commonwealth of Australia, 2010) (Department of Planning, Industry and Environment, 2020) (Department of Environment and Conservation, 2004)
Arboreal mammals (e.g., Grey-headed Flying-fox, Koala)	Initial review of data to identify important areas (e.g., camps) and foraging resources (e.g., feed trees). Direct surveys (e.g., nocturnal spotlighting, acoustic surveys) and/or indirect surveys (e.g., scat searches)	Spotlighting: minimum two 200m long transects per 5ha, spaced 100m apart and across two separate nights Scat: identify a central tree important to the species (i.e., feed tree), search under this tree and surround 29 trees for 2mins per tree	Aug – Jan (breeding Koala) Oct – Dec (breeding Grey-headed Flying-fox)	Avoid windy and rainy conditions	(Commonwealth of Australia, 2014) (Commonwealth of Australia, 2010) (Commonwealth of Australia, 2011) (Department of Environment and Conservation, 2004) (Phillips & Callaghan, 2011)
Cockatoos (e.g., Gang-gang Cockatoo, Glossy Black-Cockatoo)	Stag-watching surveys to identify breeding habitat and individuals	Stag-watching at suitable hollow-bearing trees (5-8m above ground, >15cm wide) 30mins prior to sunset and continue 60mins after sunset	Oct – Jan (Gang-gang Cockatoo) Apr – Aug (breeding Glossy Black-Cockatoo)	Avoid windy and rainy conditions	(Department of Environment and Conservation, 2004)
Diurnal raptors (e.g., Eagles, Kites, Ospreys)	Area searches in suitable habitat. Detection by sightings, calls and/or signs of occupancy (i.e., nests, feathers)	Suggested 2ha area search and/or 20min point census	N/A	Avoid windy and rainy conditions Early morning or early evening	(Department of Environment and Conservation, 2004) (Commonwealth of Australia, 2010)

Fauna group	Minimum survey requirements[1]	Minimum survey effort	Seasonal survey requirements	Recommended conditions	Survey guidelines
Microbats	Roost searches, acoustic detection (i.e., Anabats) and/or trapping (e.g., harp trap, mist net) set in woodlands, valley floors, riparian areas and/or fertile parts of the subject land within proximity to habitat resources (e.g., caves, cliffs, waterbodies)	16 total trapping nights (e.g., 4 nights, 4 Anabats)	Nov (mid) – Jan (end)	Avoid windy and rainy conditions Avoid cold temperatures	(Office of Environment and Heritage, 2018) (Commonwealth of Australia, 2010) (Department of Environment and Conservation, 2004)
Migratory birds (e.g., White-throated Needletail)	Area or transect surveys in suitable habitat. Detection by sighting or call	Suggested 2ha area search and/or 20min point census. Tall trees on ridgetops can be targeted for potential roosting habitat	Oct – May	Avoid windy and rainy conditions Early evening (to detect potential roost sites)	(Department of Environment, 2015) (Department of Environment and Conservation, 2004) (Commonwealth of Australia, 2010)
Owls (e.g., Barking Owl, Masked Owl, Powerful Owl)	Stag-watching surveys to identify breeding habitat and individuals	Stag-watching at suitable hollow-bearing trees (>20cm wide) 30mins prior to sunset and continue 60mins after sunset	May – Aug	Avoid windy and rainy conditions	(Department of Environment and Conservation, 2004)
Reptiles (e.g., Rosenberg's Goanna)	Habitat searches targeting important resources (e.g., termite mounds), spotlighting and or/ trapping in suitable habitat	Habitat searches and spotlighting: 30min searches, 2 nights Baited camera trap: set with meat bait, deployed near potential habitat resources (e.g., termite mounds, rocky outcrops, hollow logs)	N/A	Avoid windy and rainy conditions	(Department of Environment and Conservation, 2004)
Small-medium mammals (e.g., Bandicoots, Eastern Pygmy-possum, Spotted-tailed Quoll)	Habitat searches, direct surveys (e.g., nocturnal spotlighting, trapping) and/or indirect surveys (e.g., scat searches)	Hair tubes/baited camera traps: set with standard bait or meat bait, deployed near potential habitat resources (e.g., burrows, shrubs, near diggings or waterbodies) for a minimum of 2 surveys each 14 days duration	Oct – Mar (Eastern Pygmy-possum) Dec – Oct (Spotted-tailed Quoll)	Trapping surveys timed at least one month apart, one following significant rainfall Optimal in autumn	(Commonwealth of Australia, 2011) (Department of Environment and Conservation, 2004)

Fauna group	Minimum survey requirements[1]	Minimum survey effort	Seasonal survey requirements	Recommended conditions	Survey guidelines
		Hair tubes: minimum 20 hair tubes per sampling site. Devices set 20m apart in 2 parallel lines separated by 25m			
Wetland birds (e.g., Black Bittern)	Call play-back in suitable habitat for solicited call responses and sightings. Area searches in suitable habitat for sightings, nests, footprints and/or feathers	Suggested 2ha area search and/or 20min point census	N/A	Avoid windy and rainy conditions Early morning or early evening	(Department of Environment and Conservation, 2004) (Commonwealth of Australia, 2010)
Woodland birds (e.g., Little Lorikeet, Regent Honeyeater, Swift Parrot)	Area or transect surveys in suitable habitat. Detection by sighting or call	20 hours, 8 days	Mar – July (Swift Parrot) May – Mar (peak Sep – Nov; Regent Honeyeater)	Avoid windy and rainy conditions Early morning or early evening Peak blossoming period of known foraging resources	(Commonwealth of Australia, 2010)

1. Based on recommended survey guidelines

APPENDIX C: THREATENED FLORA AND FAUNA IDENTIFIED FROM PMST AND BIONET SEARCHES WITHIN 10KM OF THE DEFERRED LANDS AREA AND THEIR LIKELIHOODS OF OCCURRENCE

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
FLORA							
Acacia bynoeana	Bynoe's Wattle	E	V	BioNet, PMST	Occurs from Morisset south to the Southern Highlands and west to the Blue Mountains. It grows mainly in heath or dry sclerophyll forest on sandy soils and seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas.	21 (2008)	Moderate – the only recent records in the locality are at North Turramurra, however there is potential habitat for the species in the deferred lands area.
Acacia pubescens	Downy Wattle	V	V	BioNet, PMST	Distributed within the Bankstown-Fairfield-Rookwood areas and the Pitt Town area. Known from Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland on alluviums, shales and at the intergrade between shales and sandstones.	34 (2018)	Low – although there are recent records of this species at North Turramurra, about 5km west of the deferred lands area, no vegetation types associated with this species are present.
Acacia terminalis subsp. terminalis	Sunshine Wattle	E	E	BioNet, PMST	Grows in scrub and dry sclerophyll woodland on sandy soils in mostly near-coastal area from Botany Bay and the northern foreshore of Port Jackson. Recent collections are mainly from the Quarantine Station, Clifton Gardens, Dover Heights, Parsley Bay, Nielsen	228 (2020)	Moderate – the single BioNet record within the deferred lands area appears to be inaccurate; the location description states 'Chowder Bay Road, Middle Head' and the accuracy is 2000m. There are numerous records of the species in the locality and there may be

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					Park, Cooper Park, Chifley and Watsons Bay.		some potential habitat for the species in the deferred lands area.
Allocasuarina glareicola	-	E	E	PMST	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil in open woodland.	0	Low – the deferred lands area is located outside the species' known distribution, and no suitable habitat is present.
Allocasuarina portuensis	Nielsen Park She-oak	E	E	BioNet, PMST	Known from only a single population within Sydney Harbour National Park. The original habitat is tall, closed woodland. There are no plants left at the original site, however propagated plants have been established at a number of locations at Nielsen Park and nearby areas.	31 1998)	Low – no suitable habitat for the species is present in the deferred lands area.
Asterolasia elegans	-	E	E	BioNet, PMST	Occurs in sheltered forests on mid- to lower slopes and valleys on Hawkesbury Sandstone. Known from only seven populations north of Sydney in the Baulkham Hills. Hawkesbury and Hornsby Local Government Areas. Found in sheltered forests on mid- to lower slopes and valleys.	1 (2014)	Low to Moderate – there is one disjunct record of this species at Bilgola Beach. There are two associated vegetation types for this species (PCTs 1250 and 1780) present in the deferred lands area, and there is a small possibility of it occurring in sandstone gullies in the deferred lands area.
Caladenia tessellata	Thick Lip Spider Orchid	E	V	BioNet, PMST	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the	5 (1945)	Low – the species has not been recorded within the locality since 1945 and is thought to no longer occur within the Sydney region.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					population near Braidwood is in low woodland with stony soil.		
Callistemon linearifolius	Netted Bottle Brush	V	-	BioNet	Occurs chiefly from Georges River to the Hawkesbury River, with recent records for the Sydney area limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest.	31 (2019)	High – there is a record of the species on the boundary of the deferred lands area, and there is extensive potential habitat for the species in the deferred lands area.
Camarophyllopsis kearneyi	-	E	-	BioNet	Known only from the type location in Lane Cove Bushland Park. Found growing under ferns and on creek banks.	1 (1998)	Low – only know from type locality at Lane Cove Bushland Park.
Chamaesyce psammogeton	Sand Spurge	E	-	BioNet	Found sparsely along the coast from south of Jervis Bay to Queensland. Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (Spinifex sericeus).	16 (2019)	Low – this species only occurs in coastal zones (foredunes and strandlines).
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	BioNet, PMST	Recorded from the Gibraltar Range south to Victoria, chiefly in coastal districts but also extends on to tablelands. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland.	1 (1954)	Low – the species has not recently been recorded within the locality. There are some associated vegetation types present.
Cynanchum elegans	White-flowered Wax Plant	E	E	PMST	Restricted to the east coast of NSW, inland to Merriwa. Occurs on margins of dry rainforest, also littoral rainforest, open forest and woodland, and scrub.	0	Low – the species has not been recorded within the locality. There are some small occurrences of associated vegetation types that might provide potential habitat for the species.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Darwinia biflora	-	V	V	BioNet, PMST	Recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas. Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone.	675 (2020)	Low to Moderate – the deferred lands area is outside the known distribution of the species; the closest record is about 2.5km to the west. Some marginal potential habitat for the species occurs in the study area.
Darwinia peduncularis	-	V	-	BioNet	Occurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. Usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone.	5 (1999)	Low – the deferred lands area is outside of the known distribution of the species, with the closest record about 13km to the west.
Deyeuxia appressa	-	E	E	BioNet, PMST	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area, south of Bankstown and in Killara. Has not been collected since and may now be extinct in the wild due to habitat loss and development within these areas. Almost nothing is known of the species' habitat and ecology.	3 (1941)	Low – the deferred lands area is outside of the historical distribution of the species, which has not been recorded for over 75 years.
Diuris bracteata	-	E	X	BioNet	All known extant populations fall within the Gosford and Wyong local government areas, with one historical record from Gladesville in northern Sydney. Occurs in dry sclerophyll woodland and forest with a predominantly grassy understorey.	1 (1999)	Low – the deferred lands area falls outside the species' current known distribution.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Epacris purpurascens var. purpurascens	-	V	-	BioNet	Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts. Found in a range of habitat types, most of which have a strong shale soil influence.	152 (2020)	Moderate – there are numerous records of the species in the locality and some potential habitat for the species in the deferred lands area.
Eucalyptus camfieldii	Camfield's Stringybark	V	V	BioNet, PMST	Occurs in scattered locations within a restricted distribution from Raymond Terrace south to Waterfall. Grows in poor coastal country in shallow sandy soils overlying Hawkesbury Sandstone, in coastal heath mostly on exposed sandy ridges. Occurs mostly in small, scattered stands near the boundary of all coastal heaths and low open woodland of the slightly more fertile inland areas.	110 (2019)	Known – records located in the north-east of the deferred lands area, on ridgetops and upper slopes.
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	BioNet	Occurs from Nundle to north of Tenterfield where it grows in dry grassy sclerophyll woodland on shallow soils of slopes and ridges. Planted as urban trees, windbreaks and corridors.	11 (2009)	Low – not likely to occur naturally as the deferred lands area is outside the species' known natural distribution and no associated vegetation types were recorded within the deferred lands area. Planted individuals are likely to occur.
Eucalyptus scoparia	Wallangarra White Gum	E	V	BioNet	In NSW it is known from only three locations near Tenterfield, including Bald Rock National Park. Found in open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes. Widely	1 (2005)	Low – not likely to occur naturally as the deferred lands area is outside the species' known natural distribution and no associated vegetation types were recorded within the deferred lands area. Planted individuals are likely to occur.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					planted as an urban street tree and in gardens.		
Galium australe	Tangled Bedstraw	E	-	BioNet	Tangled Bedstraw is widespread in Victoria and Tasmania and is also found in South Australia (and ACT Territory in Jervis Bay). Following a taxonomic revision, many recent records in NSW have been re-determined as other species. Tangled Bedstraw has been recorded historically in the Nowra (Colymea) and Narooma areas and is extant in Nadgee Nature Reserve, south of Eden. Records in the Sydney area are yet to be confirmed.	1 (1999)	Low – no vegetation types associated with this species occur in the deferred lands area.
Genoplesium baueri	Bauer's Midge Orchid	E	E	BioNet, PMST	The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Grows	64 (2020)	Known – there are records of this species within the deferred lands.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					is dry sclerophyll forest and moss gardens over sandstone.		
Genoplesium plumosum	Tallong Midge Orchid	CE	E	BioNet	Currently known from only two areas - the village of Tallong and its immediate environs, and a site in Morton National Park south-east of Wingello. Occurs exclusively in heathland on very shallow soils, often with lichens and mosses on sandstone conglomerate rock shelves.	1 (1949)	Low – the deferred lands area is outside of the species known distribution and there are no recent records of the species in the locality.
Grammitis stenophylla	Narrow-leaf Finger Fern	E	-	BioNet	A fern which occurs in coastal regions from Queensland to the NSW south coast. It grows in moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	10 (2019)	Moderate – the species has been recorded within the locality and associated vegetation types that provide habitat for the species occur within the deferred lands area.
Grevillea caleyi	Caley's Grevillea	CE	E	BioNet, PMST	Restricted to an 8 km square area around Terrey Hills, around 20 kilometres north of Sydney. Occurs in three major areas of suitable habitat, namely Belrose, Ingleside and Terrey Hills/Duffys Forest. All sites occur on the ridgetop between elevations of 170 to 240 metres above sea level, in association with laterite soils and a vegetation community of open forest, generally dominated by Eucalyptus sieberi and Corymbia gummifera.	810 (2019)	Known – there are records of this species in the west of the deferred lands area, associated with the plateau adjoining Forest Way.
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	-	BioNet	Endemic to western Sydney. Grows on reddish clay to sandy soils derived from	1 (2003)	Low – the deferred lands area lies outside the current known distribution of the species.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					Wianamatta Shale and Tertiary alluvium.		
Grevillea shiressii	-	V	V	PMST	Known from two populations near Gosford, on tributaries of the lower Hawkesbury River. Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils.	0	Low – the deferred lands area lies outside the current known distribution of the species.
Haloragis exalata subsp. exalata	Square Raspwort	V	V	PMST	Square Raspwort occurs in four widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Requires protected and shaded areas in riparian habitats.	0	Low – the deferred lands area lies outside the current known distribution of the species.
Haloragodendron lucasii	-	E	E	BioNet, PMST	Known locations of this species are confined to a very narrow distribution on the north shore of Sydney. Grows in dry sclerophyll forest; reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. Associated with high soil moisture and relatively high soil-phosphorus levels.	98 (2020)	Moderate – the species has been recorded within the locality and associated vegetation types that provide habitat for the species occur within the deferred lands area.
Hibbertia puberula	-	E	-	BioNet	Widespread, but never common. Extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Favours low	1 (1946)	Moderate – although the species has not been recorded recently within the subject land, vegetation associations representing potential habitat were identified within the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					heath on sandy soils or rarely in clay, with or without rocks underneath.		In addition, recent work on the species has shown the species to be widespread (Toelken and Miller, 2012) although not common.
Hibbertia spanantha	Julian's Hibbertia	CE	CE	BioNet, PMST	Endemic to NSW where it is restricted to four known locations. Grows in forest with canopy species including Eucalyptus pilularis, E. resinifera, Corymbia gummifera and Angophora costata and open understorey. The soil is identified as a light clay occurring on a shale sandstone soil transition.	5 (2018)	Low – the deferred lands area lies outside the current known distribution of the species.
Hibbertia superans	-	E	-	BioNet	Occurs from Baulkham Hills to South Maroota, with 16 known sites, and at one locality at Mount Boss, inland from Kempsey. Occurs on sandstone ridgetops often near the shale/sandstone boundary, in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides.	1 (2008)	Moderate – the species has been recorded within the locality and associated vegetation types that provide potential habitat for the species occur within the deferred lands area.
Hygrocybe anomala var. ianthinomarginata	-	V	-	BioNet	Known from the type locality in Lane Cove Bushland Park with other records from the Royal National Park and the Blue Mountains National Park. Occurs in gallery warm temperate forests associated with alluvial sandy soils. Substrates include soil, humus, or moss.	1 (1998)	Low – the only record in the locality is from Lane Cove Bushland Park. There is no suitable habitat for the species within the subject land.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Hygrocybe aurantipes	-	V	-	BioNet	Known from the type locality in Lane Cove Bushland Park with other records from the Blue Mountains National Park and Hazelbrook. Occurs in gallery warm temperate forests associated with alluvial sandy soils. Substrates include soil, humus, or moss.	1 (1990)	Low – the only record in the locality is from Lane Cove Bushland Park. There is no suitable habitat for the species within the subject land.
Hygrocybe austropratensis	-	E	-	BioNet	Known only from the type locality in Lane Cove Bushland Park. Occurs in gallery warm temperate forests associated with alluvial sandy soils. Substrates include soil, humus, or moss.	1 (1998)	Low – the only record in the locality is from Lane Cove Bushland Park. There is no suitable habitat for the species within the subject land.
Hygrocybe lanecovensis	-	E	-	BioNet	Known only from the type locality in Lane Cove Bushland Park. Occurs in gallery warm temperate forests associated with alluvial sandy soils. Substrates include soil, humus, or moss.	1 (1998)	Low – the only record in the locality is from Lane Cove Bushland Park. There is no suitable habitat for the species within the subject land.
Hygrocybe reesiae	-	V	-	BioNet	Known from the type locality in Lane Cove Bushland Park with other records from the Blue Mountains National Park in Hazelbrook and Tasmania. Occurs in gallery warm temperate forests associated with alluvial sandy soils. Substrates include soil, humus, or moss.	1 (1998)	Low – the only record in the locality is from Lane Cove Bushland Park. There is no suitable habitat for the species within the subject land.
Hygrocybe rubronivea	-	V	-	BioNet	Known from the type locality in Lane Cove Bushland Park with other records from the Blue Mountains and south east	1 (1998)	Low – the only record in the locality is from Lane Cove Bushland Park. There is

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					Queensland. Occurs in gallery warm temperate forests associated with alluvial sandy soils. Substrates include soil, humus, or moss.		no suitable habitat for the species within the subject land.
Kunzea rupestris	-	V	V	BioNet, PMST	Restricted, with most locations in the Maroota - Sackville - Glenorie area and one outlier in Ku-ring-gai Chase National Park. Grows in shallow depressions on large flat sandstone rock outcrops. Characteristically found in short to tall shrubland or heathland.	1 (2007)	Moderate – one recent record in the locality and large areas of associated vegetation types are present within the deferred lands area. Therefore, the species is considered to have potential to occur within the deferred lands area.
Lasiopetalum joyceae	-	V	V	BioNet, PMST	Has restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River; currently known from 34 sites between Berrilee and Duffys Forest. Grows in heath and open woodland in sandy soils on sandstone.	119 (2020)	Moderate – the species has been recorded within the locality and associated vegetation types that provide potential habitat for the species occur within the deferred lands area.
Leptospermum deanei	-	V	V	BioNet, PMST	Occurs in Hornsby, Warringah, Ku-ring-gai and Ryde local government areas in woodland on lower hills and slopes or near creeks, sandy alluvial soil or sand over sandstone. Occurs in riparian scrub and open forest.	40 (2017)	Moderate – the species has been recorded in the broader locality. Associated vegetation types that provide habitat to the species have also been recorded within the deferred lands area.
Melaleuca biconvexa	Biconvex Paperbark	V	V	BioNet, PMST	Occurs as scattered and dispersed populations found in Jervis Bay in the south and the Gosford/Wyong area in the north. Grows in damp places, often near streams, low-lying areas on	2 (2002)	Low – the deferred lands area falls outside of the current known distribution of the species.

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					alluvial soils of low slopes or sheltered aspects.		
Melaleuca deanei	Deane's Paperbark	V	V	BioNet, PMST	Occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas, with more isolated occurrences at Springwood, Wollemi National Park, Yalwal and Central Coast areas. The species occurs mostly in ridgetop woodland, with only five per cent of sites in heath on sandstone.	75 (2020)	Moderate – the species has been recorded within the locality and associated vegetation types that provide potential habitat for the species occur within the deferred lands area.
Microtis angusii	Angus's Onion Orchid	E	E	BioNet, PMST	Currently known from only one site at Ingleside, north of Sydney. Preferred natural habitat of this orchid is not easy to define as the Ingleside location is highly disturbed, with the dominant species introduced weeds. Occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils in the Duffys Forest- Terrey Hills- Ingleside and Belrose areas.	93 (2018)	Known – there are records of this species within the deferred lands.
Persicaria elatior	-	V	V	PMST	Has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace and the Grafton area. This species normally grows in damp places, especially beside streams	0	Low – the species has not been recorded within the locality. Only one associated vegetation type is present within the deferred lands area and is unlikely to provide suitable habitat.

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					and lakes. Occasionally in swamp forest or associated with disturbance.		
Persoonia hirsuta	Hairy Geebung	E	E	BioNet, PMST	Scattered distribution around Sydney, from Singleton in the north to Bargo in the south and the Blue Mountains to the west. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone or very rarely on shale.	36 (2007)	Known – there are numerous records for this species in the south east of the deferred lands area.
Persoonia mollis subsp. maxima	-	E	E	BioNet, PMST	Highly restricted, known from the Hornsby Heights-Mt Colah area north of Sydney. Occurs in sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone.	204 (2018)	Low – the deferred lands area lies outside the species' highly restricted known distribution.
Pimelea curviflora var. curviflora	-	V	V	BioNet, PMST	Confined to the coastal area around the Sydney and Illawarra regions, with populations between northern Sydney and Maroota. Formerly recorded around the Parramatta River and Port Jackson region. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	83 (2020)	Known – there are numerous records for this species in the south-east of the deferred lands area.
Pimelea spicata	Spiked Rice-flower	E	E	PMST	Occurs in two disjunct areas: the Cumberland Plain and Illawarra, where it occurs on well-structured clay soils. On the Cumberland Plain, it is associated with Grey Box communities	0	Low – the species known distribution lies outside the deferred lands area and there are no records of the species in the broader locality.

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					and in the coastal Illawarra it occurs commonly in Coast Banksia open woodland.		
Prostanthera densa	Villous Mintbush	V	V	BioNet	This species has been recorded from the Currarong area in Jervis Bay, Royal National Park (Marley), Cronulla, Helensburgh and Port Stephens (Nelson Bay). Generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea.	1 (2012)	Low – the deferred lands area falls outside of the current known distribution of the species.
Prostanthera junonis	Somersby Mint-bush	E	E	PMST	Has a north-south range of approximately 19 km on the Somersby Plateau in the Gosford and Wyong local government areas. Occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub.	0	Low – the species known distribution lies outside the deferred lands area and there are no records of the species in the broader locality.
Prostanthera marifolia	Seaforth Mintbush	CE	CE	BioNet, PMST	Currently only known from the northern Sydney suburb of Seaforth and has a very highly restricted distribution, fragmented by urbanisation into three small sites. Occurs in localised patches, in or within close proximity to the endangered Duffys Forest ecological community. Located on deeply weathered clay-loam soils associated	173 (2016)	Moderate – the one record within the deferred lands area appears to be incorrect (geographic co-ordinates have been entered incorrectly). There is potential habitat in patches of Duffys Forest, however the deferred lands appear to be outside the current known distribution of the species.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					with ironstone and scattered shale lenses.		
Rhizanthella slateri	Eastern Underground Orchid	V	E	BioNet, PMST	Occurs from south-east Queensland to south-east NSW. Currently known from fewer than 10 locations in NSW. Habitat requirements are poorly understood, and no particular specific vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	1 (2020)	Low – although it is acknowledged that habitat requirements for the species are poorly understood. This species is unlikely to be detected without substantial targeted survey effort using specialised techniques.
Rhodamnia rubescens	Scrub Turpentine	CE	-	BioNet	Occurs in coastal districts north from Batemans Bay in NSW to areas inland of Bundaberg in Queensland. Populations typically occur in coastal regions and occasionally extend inland onto escarpments. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	38 (2019)	Moderate – the species has been recorded within the locality and marginal habitat occurs in the deferred lands area.
Sarcochilus hartmannii	Hartman's Sarcochilus	V	V	BioNet	Distributed from the Richmond River in northern NSW to Gympie in south-east Queensland. Occurs on cliff faces on steep narrow ridges supporting eucalypt forest and clefts in volcanic rock from 500 to 1000 m in altitude.	1 (1940)	Low – the species is not known to occur within the Sydney MCA (OEH, 2017) and has not been recorded recently in the locality (nearest recent record is over 150 kilometres north).
Senecio spathulatus	Coast Groundsel	E	-	BioNet	Occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at	1 (1916)	Low – the species has not recently been recorded within the locality and no associated vegetation types occur in the deferred lands area.

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					Cudmirrah) where it grows on frontal dunes.		
Syzygium paniculatum	Magenta Lilly Pilly	E	V	BioNet, PMST	Found in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	87 (2019)	Known – although the record in the deferred lands area is in a residential garden adjoining Forest Way and is likely to be a planted specimen.
Tetratheca glandulosa	Glandular Pink-bell	V	-	BioNet	Restricted to the Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong local government areas. Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone. Occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam, and may include stony lateritic fragments. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest.	461 (2020)	Known – there are a large number of records for this species across the deferred lands area.
Thesium australe	Austral Toadflax	V	V	PMST	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Grows on coastal headlands or grassland and grassy	0	Low – the species is not currently known from the Sydney Metro CMA, with only a single historic record occurring within the CMA (dated 1803).

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					woodland away from the coast; often found in association with Themeda triandra (Kangaroo Grass).		
FAUNA							
Botaurus poiciloptilus	Australasian Bittern	E	E	BioNet, PMST	Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spike rushes.	6 (2014)	Low – records in the locality are centred around Nareen Wetlands, Narrabeen Lake and Lane Cove National Park. There is minimal suitable habitat present within the deferred lands area.
Ninox connivens	Barking Owl	V	-	BioNet	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils. Roosts in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as *Acacia* and *Casuarina* species. Requires very large permanent territories in most habitats due to sparse prey densities.	56 (2019)	Low to Moderate – records in the locality are centred around Warriewood Wetlands and Narrabeen Lakes. While there is one record of the species (2017) and suitable habitat present within the deferred lands area, there are low numbers of individuals within the locality.
Esacus magnirostris	Beach Stone-curlew	CE	-	BioNet	The Beach Stone-curlew is considered a vagrant species south of the Manning River in NSW. It is found exclusively along the coast in a wide variety of coastal habitats including beaches, estuaries and mangroves. The species forages on marine invertebrates in the	2 (2013)	Known – records in the locality are from Reef Beach and Beacon Hill. There is one historical record (from 1985) from the deferred lands area. While the species has been historically recorded, there is no suitable habitat present within the deferred lands area.

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					intertidal zone and breeds in shallow nests above the littoral zone at the backs of beaches, among low vegetation or on sandbanks.		
Ixobrychus flavicollis	Black Bittern	V	-	BioNet	Has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	37 (2019)	Low – records in the locality are centred around Narrabeen Lagoon, Dee Why Lagoon and Warriewood Wetlands. There is minimal suitable habitat present, and this species has not been previously recorded within the deferred lands area.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	BioNet	Eastern subspecies occurs from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range. Inhabits forests or woodlands dominated by box and ironbark eucalypts where it forages for insects and nectar.	2 (2015)	Low – a small number of records within the surrounding area from Ku-ring-gai Chase National Park. While there is suitable habitat present within the deferred lands area, the species is rare east of the Great Dividing Range and is unlikely to occur.
Monarcha melanopsis	Black-faced Monarch	-	M	PMST	Mainly occurs 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)	0	Low – migratory species, no records, and minimal suitable habitat present within the deferred lands area.

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					rainforest and (occasionally) cool temperate rainforest.		
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	BioNet	Widespread in coastal and subcoastal northern and eastern Australia; in NSW, the species becomes increasingly uncommon south of the Northern Rivers region. Rarely occurs south of Sydney. Found in association with wetlands, swamps, billabongs, estuaries and surrounding vegetation.	1 (2004)	Low – one historical record from North Ryde. There is minimal suitable habitat present, the species rarely occurs in Sydney, and has not been previously recorded within the deferred lands area.
Hoplocephalus bungaroides	Broad-headed Snake	E	V	PMST	The Broad-headed Snake is largely confined to Triassic and Permian sandstones. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring.	0	Low – no records of the species within the deferred lands and surrounding area. While suitable habitat is present, the species is not known from northern Sydney.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	BioNet	The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands. 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.	1 (2018)	Low – one record from Warrimoo Downhill Mountain Bike Track. While there is suitable habitat present within the deferred lands area, this species is rare in Sydney and is unlikely to occur.

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Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	PMST	In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.	0	Low – no records of the species within the deferred lands and surrounding area. While suitable habitat is present, the species is not known from northern Sydney.
Burhinus grallarius	Bush Stone-curlew	E	-	BioNet	Found throughout most of Australia. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber.	19 (2019)	Low to Moderate – records in the locality are centred around Dee Why, Newport and North Head. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are low numbers of individuals within the locality.
Pommerhelix duralensis	Dural Land Snail	E	E	PMST	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark.	0	Low – no records of the species within the deferred lands and surrounding area. No suitable habitat (e.g. Cumberland Plain Woodland) present.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	BioNet	The Dusky Woodswallow occurs throughout most of New South Wales. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest.	21 (2012)	Low to Moderate – records in the locality are centred around North Ryde, Macquarie University and Beacon Hill. While there are five historic records of the species (most recent 1984) and suitable habitat present within the deferred lands area, there are low numbers of individuals within the locality.
Vespadelus troughtoni	Eastern Cave Bat	V	-	BioNet	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. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	2 (2020)	Low to Moderate – a small number of records in the locality centred around Warriewood and Sydney Harbour National Park. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are low numbers of individuals within the locality.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	BioNet	The Eastern Coastal Free-tailed Bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	50 (2019)	Moderate – records in the locality are centred around Warriewood and Turramurra. There are two records of the species (most recent 2009) and suitable habitat present within the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	BioNet	Occurs along the east coast of NSW, where it inhabits tall moist forests. Roosts in hollows of eucalypts, occasionally under loose bark on trees or in buildings.	12 (2019)	Low to Moderate – records in the locality are centred around Warriewood, Pymble ad Lindfield. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are minimal records of the species in the surrounding area.
Pandion cristatus (syn. P. haliaetus)	Eastern Osprey	V	M	BioNet, PMST	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	48 (2020)	Low to Moderate – records in the locality are centred around Narabeen Lagoon, Warriewood Wetlands and Dee Why Lagoon. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are no known nest sites (closest known site is near the Sydney Academy of Sport and Recreation/Narrabeen Lagoon).
Cercartetus nanus	Eastern Pygmy-possum	V	-	BioNet	Found in a broad range of habitats from rainforest through to sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation. Frequently spends time in torpor especially in winter.	1,045 (2020)	Known – a large number (70) of records within the deferred lands area. Suitable habitat (e.g. woodlands, heath, hollow-bearing trees, nectar resources) present throughout the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Apus pacificus	Fork-tailed Swift	-	M	BioNet, PMST	In NSW, the Fork-tailed Swift is recorded in all regions. It is almost exclusively aerial. Occurs over a range of habitats, including inland plains, cliffs and beaches, settled areas (including towns, urban areas and cities), riparian woodland and tea-tree swamps, low scrub, heathland, saltmarsh, grassland and sandplains, rainforests, wet sclerophyll forest or open forest or plantations of pines.	11 (2009)	Moderate – records in the locality are scattered from Wahroongah, to Mount Colah and Long Reef. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are low numbers of individuals within the locality.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	BioNet	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. Favours old growth forest and woodland attributes for nesting and roosting.	93 (2016)	Low to Moderate – records in the locality are centred around the local population in St Ives and Turramurra. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded and are likely to be vagrant within the deferred lands area.
Heleioporus australiacus	Giant Burrowing Frog	V	V	BioNet, PMST	Found on the sandstone geology of the Sydney Basin, and south to Jervis Bay. There is a marked preference for sandstone ridgetop habitat. It occurs in semi-permanent to ephemeral sand or rock-based streams, and infrequently in semi-permanent to permanent	74 (2020)	Known – 11 records of the species within the deferred lands area. Suitable habitat (e.g. soaks/pools/drainage lines with sandy/clay base in sandstone woodland) present within the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					constructed dams with a sandy silt or clay base.		
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	BioNet	Occurs in eucalypt woodland and forest with *Casuarina/Allocasuarina* spp. Nests in large tree hollows.	242 (2020)	Known – a large number (26) of records within the deferred lands area. Suitable habitat (e.g. eucalypt woodland with *Allocasuarina*, hollow-bearing trees) present throughout the deferred lands area.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	BioNet	In NSW it is widespread on the New England Tablelands. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	23 (2020)	Low to Moderate – records in the locality are centred around Warriewood, Turramurra and Lindfield. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area.
Petauroides volans	Greater Glider	-	V	BioNet, PMST	The Greater Glider has restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria, with an elevated range from sea level to 1200m above sea level. The species is largely restricted to eucalypt forests and woodlands. It is found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows and with a diversity of eucalypts.	1 (2004)	Low – one historical record from Lane Cove. While there is suitable habitat present within the deferred lands area, this species is rare in Sydney and is unlikely to occur.
Litoria aurea	Green and Golden Bell Frog	E	V	BioNet, PMST	This species occurs in fragmented patches near coastal locations from VIC to south of the NSW-QLD border. For breeding it uses a wide range of	9 (2002)	Low – historical records from Long Reef Golf Course, Macquarie University and Warriewood escarpment. There is minimal suitable habitat present, and the

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					waterbodies, including both natural and man-made structures, such as marshes, dams, and stream sides, and ephemeral wetlands.		species has not been previously recorded within the deferred lands area.
Falco hypoleucos	Grey Falcon	E	-	PMST	Medium-sized raptor that is generally restricted to grassland and wooded watercourses of the arid and semi-arid areas.	0	Low – no records of the species within the deferred lands and surrounding area. While suitable habitat is present, the species is not known from Sydney.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	BioNet, PMST	Occurs in subtropical and temperate rainforests, tall sclerophyll forest 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.	2,154 (2020)	Known – a large number (25) of records within the deferred lands area. Suitable habitat (e.g. woodlands, heath, nectar resources) present throughout the deferred lands area.
Phascolarctos cinereus	Koala	V	V	BioNet, PMST	In New South Wales, koala populations are found on the central and north coasts, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range. Inhabit eucalypt woodlands and forests.	143 (2020)	Low to Moderate – records in the locality are centred around the local population in St Ives and Turramurra. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded and are likely to be vagrant within the deferred lands area.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	BioNet	The Large Bent-winged Bat forage in forested areas. Caves are the primary roosting habitat, but they also use derelict mines, storm-water tunnels,	450 (2020)	Known – a large number (33) of records within the deferred lands area. Suitable habitat (e.g. woodlands, caves) present throughout the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					buildings and other man-made structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Populations disperse within about 300 km range of maternity caves.		
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	BioNet, PMST	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features.	29 (2020)	Moderate to High – records in the locality are centred around Ingleside, St Ives, and plateaus. While the species has not been previously recorded within the deferred lands area, there is suitable habitat present (e.g. roosting habitat along sandstone ridgetops, foraging habitat around riparian/wetland areas).
Miniopterus australis	Little Bent-winged Bat	V	-	BioNet	The Little Bent-winged Bat is found in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bent-winged Bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. Maternity colonies form in spring and birthing occurs in early summer. Only five nursery sites /maternity colonies are known in Australia.	136 (2020)	Known – a small number (5) of records within the deferred lands area. Suitable habitat (e.g. varying vegetation, hollow-bearing trees, caves) present throughout the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Hieraaetus morphnoides	Little Eagle	V	-	BioNet	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or *Acacia* woodlands and riparian woodlands of interior NSW are also used.	22 (2020)	Moderate to High – records in the locality are centred around headlands (e.g. North Head, Narrabeen and Turimetta Headlands). While the species has not been previously recorded within the deferred lands area, there is suitable habitat present (e.g. eucalypt forests, tall trees for nesting).
Glossopsitta pusilla	Little Lorikeet	V	-	BioNet	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to SA. Forages primarily in the canopy of open *Eucalyptus* forest and woodland, yet also finds food in *Angophora*, *Melaleuca* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	37 (2020)	Known – one record (from 2011) within the deferred lands area. Suitable habitat (e.g. eucalypt woodlands, riparian habitats, hollow-bearing trees) present throughout the deferred lands area.
Litoria littlejohni	Littlejohn's Tree Frog	V	V	PMST	Distributed along the eastern slopes of the Great Dividing Range from Watagan State Forest near Wyong, south to Buchan in north-eastern Victoria. It appears to be restricted to sandstone woodland and heath communities at mid to high altitude. It is not known from coastal habitats.	0	Low – no records of the species within the deferred lands and surrounding area. Limited suitable habitat is present within the deferred lands area, and the species is not known from the locality.
Perameles nasuta	Long-nosed Bandicoot (North Head)	EP	-	BioNet	The North Head population of the Long-nosed Bandicoot is restricted to North Head. The species occupies a variety of habitats on North Head, sheltering in shallow holes lined with leaves, grass	2,295 (2020)	Low to Moderate – records in the locality are from the population in North Head. While there is suitable habitat present within the deferred lands area, the

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					and debris and foraging at dusk digging conical holes for invertebrates, fungi and tubers.		species has not been previously recorded within the deferred lands area.
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE Mainland)	V	V	PMST	In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. Inhabits coastal heaths and dry and wet sclerophyll forests with a dense understorey.	0	Low – no records of the species within the deferred lands and surrounding area. While there is suitable habitat present within the deferred lands area, the species is not known from the locality.
Tyto novaehollandiae	Masked Owl	V	-	BioNet	Occurs from the eastern coast of NSW inland to the western plains. Found in eucalypt forests and woodlands from sea level to 1100 m. Hunts in and along the edges of forests, including roadsides for arboreal and terrestrial mammals. Roosts and nests in large tree hollows within moist eucalypt forested gullies.	15 (2020)	Moderate to High – records in the locality are centred around the Warriewood escarpment, plateaus and Ku-ring-gai Chase National Park. While the species has not been previously recorded within the deferred lands area, there is suitable habitat present (e.g. eucalypt forests and woodlands, hollow-bearing trees).
Pseudomys novaehollandiae	New Holland Mouse	-	V	BioNet, PMST	Distribution is patchy in time and space. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes.	12 (2017)	Known – one record (from 2017) within the deferred lands area. Suitable habitat (e.g. heathlands, woodlands and forests) present throughout the deferred lands area.
Cuculus optatus	Oriental Cuckoo	-	M	BioNet, PMST	The Oriental Cuckoo occur in eastern New South Wales, eastern Queensland and Cape York Peninsula, and top end of Northern Territory. Habitat includes rainforest margins, monsoon forest, vine scrub, riverine thickets, wetter	6 (2014)	Low to Moderate – records in the locality are scattered from St Ives, Newport, Collaroy and Harbord. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					densely canopied eucalypt forest, paperbark swamp, mangroves.		deferred lands area, and there are low numbers of individuals within the locality.
Grantiella picta	Painted Honeyeater	V	V	PMST	The species is nomadic and occurs at low densities throughout its range with the greatest concentrations being on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests.	0	Low – no records of the species within the deferred lands and surrounding area. While there is suitable habitat present within the deferred lands area, the species is not known from the locality.
Macropus parma	Parma Wallaby	V	-	BioNet	Their range is now confined to the coast and ranges of central and northern NSW from the Gosford district to the Queensland border. Prefers moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	1 (2014)	Low – one record from the Wildlife Rehabilitation database. While there is suitable habitat present within the deferred lands area, the species is not known from the locality.
Ninox strenua	Powerful Owl	V	-	BioNet	In NSW, the Powerful Owl is widely distributed throughout the eastern forests from the coast inland to tablelands. It inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest requiring large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of	1,145 (2020)	Known – a large number (29) of records (most recent 2018) within the deferred lands area. Approximately seven pairs believed to occupy the deferred lands area (Kavanagh *et.al*., 2015). Suitable habitat (e.g. varying habitats from woodland to rainforest, hollow-bearing trees) present throughout the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					80-240 cm) that are at least 150 years old.		
Pseudophryne australis	Red-crowned Toadlet	V	-	BioNet	Confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.	374 (2020)	Known – a large number (66) of records (most recent from 2018) within the deferred lands area. Suitable habitat (e.g. wet drainage lines below sandstone ridges) present throughout the deferred lands area.
Anthochaera phrygia	Regent Honeyeater	CE	CE	BioNet, PMST	Occurs mostly in box-ironbark forests and woodland and prefers wet, fertile sites such as along creek flats, broad river valleys and foothills.	52 (2017)	Moderate – records in the locality are scattered around from Ku-ring-gai Chase National Park, Terrey Hills and Ingleside. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are low numbers of individuals within the locality. Breeding habitat is not present within the deferred lands area or the Sydney region.
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	BioNet	Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	5 (2019)	Moderate – records in the locality are scattered around from Mona Vale, Newport, Davidson and North Curl Curl. While the species has not been previously recorded within the deferred lands area, and there are low numbers of individuals within the locality, there is suitable habitat present within the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Varanus rosenbergi	Rosenberg's Goanna	V	-	BioNet	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. It shelters in burrows, hollow logs and rock crevices.	208 (2020)	Known – a large number (60) of records (most recent from 2020) within the deferred lands area. Suitable habitat (e.g. heath, open forest, woodland, termite mounds, rocky outcrops) present throughout the deferred lands area.
Rhipidura rufifrons	Rufous Fantail	-	M	PMST	In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts, usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests.	0	Low – no records of the species within the deferred lands and surrounding area. While there is suitable habitat present within the deferred lands area, the species is migratory and not known from the locality.
Myiagra cyanoleuca	Satin Flycatcher	-	M	PMST	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.	0	Low – no records of the species within the deferred lands and surrounding area. While there is suitable habitat present within the deferred lands area, the species is migratory and not known from the locality.
Petroica boodang	Scarlet Robin	V	-	BioNet	In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	6 (2019)	Known – records in the locality are scattered from Allambie Heights, North Narrabeen, Wahroonga, South Turramurra, Red Hill and Bilgola Plateau. There is one record (from 1986) from the deferred lands area. While the species has not been recently recorded within the deferred lands area, and there are low numbers of individuals within the locality, there is suitable habitat present within the deferred lands area.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Tyto tenebricosa	Sooty Owl	V	-	BioNet	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Nests in very large tree-hollows.	4 (2012)	Known – two records (most recent from 2012) within the deferred lands area. Suitable habitat (e.g. rainforest, moist eucalypt forests, hollow-bearing trees) present throughout the deferred lands area. Potential roost habitat around Oxford Creek and Middle Creek.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	BioNet, PMST	The Southern Brown Bandicoot is generally only found in heath or open forest with a heathy understorey on sandy or friable soils. Nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees *Xanthorrhoea* spp., blackberry bushes and other shrubs, or in rabbit burrows.	386 (2020)	Known – a small number (12) of records (most recent from 2005) within the deferred lands area. Suitable habitat (e.g. heath, open forest) present throughout the deferred lands area. Recent studies suggest that the species may be present in the south-western section of the deferred lands area.
Myotis macropus	Southern Myotis	V	-	BioNet	Southern Myotis 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. They forage over streams and pools catching insects and small fish by raking their feet across the water surface.	109 (2020)	High – records in the locality are scattered around major creeks in the Northern Beaches (e.g. Snake Creek, Deep Creek, Middle Creek). While the species has not been previously recorded within the deferred lands area, several studies (e.g. Kavanagh *et.al.*, 2015) have recorded them in adjacent areas, and there is suitable habitat present within the deferred lands area.
Monarcha trivirgatus	Spectacled Monarch	-	M	PMST	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies	0	Low – no records of the species within the deferred lands and surrounding area. While there is suitable habitat present

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					and waterside vegetation, as well as mangroves.		within the deferred lands area, the species is migratory and not known from the locality.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	BioNet, PMST	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites.	42 (2018)	Known – a small number (3) of records (most recent from 2018) within the deferred lands area. Suitable habitat (e.g. varying habitats for foraging, hollow-bearing trees, logs, caves and rocky outcrops for shelter and breeding) present throughout the deferred lands area.
Lophoictinia isura	Square-tailed Kite	V	-	BioNet	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	26 (2020)	Moderate to High – records in the locality are centred around reserves (e.g. Manly Dam Reserve, Cowan Creek Reserve, Cliff Oval). While the species has not been previously recorded within the deferred lands area, there is suitable habitat present (e.g. eucalypt forests, tall trees for nesting).
Petaurus norfolcensis	Squirrel Glider	V	-	BioNet	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia mid-storey. Requires abundant tree hollows for refuge and nest sites.	7 (2018)	Low to Moderate – records in the locality are scattered from Terry Hills, Warriewood Escarpment, Warriewood and Bayview Heights. While there is suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are low numbers of individuals within the locality.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
Mixophyes balbus	Stuttering Frog	E	V	PMST	Terrestrial species, found in rainforest, Antarctic beech forest or wet sclerophyll forest.	0	Low – no records of the species within the deferred lands and surrounding area. While there is suitable habitat present within the deferred lands area, the species is not known from the locality.
Ptilinopus superbus	Superb Fruit-Dove	V	V	BioNet	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. Inhabits rainforest and similar closed forests.	22 (2017)	Low – records in the locality are scattered from Irrawong Reserve, Manly, Newport, Warriewood and Forestville. While there is marginal suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are low numbers of individuals within the locality.
Polytelis swainsonii	Superb Parrot	V	V	BioNet	Occurs across Riverina area in summer, migrates along Macquarie and Namoi Rivers to northern NSW in winter. Inhabits timbered watercourses and nearby woodlands. Requires deep hollows or hollow limbs for nesting, typically in Red Gums.	1 (1986)	Low – one historical record from Turramurra. While there is marginal suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and the species is not known from the locality.
Lathamus discolor	Swift Parrot	E	CE	BioNet, PMST	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or	49 (2019)	Known – one record (from 2009) within the deferred lands area. While the species has not been recently recorded within the deferred lands area, and there are low numbers of individuals within the locality, there is suitable habitat present within the deferred lands area (e.g. eucalypt woodland). No breeding habitat is present on mainland Australia.

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					where there are abundant lerp (from sap-sucking bugs) infestations.		
Neophema pulchella	Turquoise Parrot	V	-	BioNet	In NSW, occurs from the coastal plains to the western slopes of the Great Diving Range. Found along the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Forages on the ground for seeds and grasses. Nests in a tree hollow, log or post.	2 (2017)	Known – one record (from 2017) within the deferred lands area. While there are low numbers of individuals within the locality, there is suitable habitat present within the deferred lands area (e.g. eucalypt woodland adjoining clearings, creeks, timbered ridges).
Daphoenositta chrysoptera	Varied Sittella	V	-	BioNet	The Varied Sittella inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gum with dead branches, mallee and *Acacia* woodland.	11 (2018)	Known – records in the locality are scattered from Warriewood Wetlands, Cromer Heights, Hornsby Park, St Ives, Clifton Gardens, Gordon and Barwon Road Reserve. There are two records (most recent 2011) from the deferred lands area. While the species has not been recently recorded within the deferred lands area, and there are low numbers of individuals within the locality, there is suitable habitat present within the deferred lands area (e.g. eucalypt woodlands).
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	BioNet, PMST	In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Occurs in coastal areas such as bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps,	126 (2020)	Low – records in the locality are centred on large waterbodies and/or headlands (e.g. Narrabeen Lagoon, Manly Lagoon, Irrawong Reserve, McCarrs Creek Reserve, Sydney Heads). While there are a large number of records in the surrounding area and the species may fly overhead, there is marginal suitable habitat present within the deferred lands

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					lakes, reservoirs, billabongs and saltmarsh.		area, and the species has not been previously recorded within the deferred lands area.
Hirundapus caudacutus	White-throated Needletail	-	V M	BioNet, PMST	In Australia the species is widespread in eastern and south-eastern Australia, from the islands in Torres Strait and the tip of Cape York south to Tasmania. It does not breed in Australia. Occurs in airspace over open forest, rainforest, heathland, farmlands, sandy beaches, mudflats and islands.	82 (2019)	Known – one record (from 2018) within the deferred lands area. Suitable habitat (e.g. tall, open forest, sandstone ridgetops) present throughout the deferred lands area.
Ptilinopus magnificus	Wompoo Fruit-Dove	V	-	BioNet	Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula. It is rare south of Coffs Harbour. Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests.	2 (1985)	Low – records in the locality are centred on Collaroy Plateau. While there is marginal suitable habitat present within the deferred lands area, the species has not been previously recorded within the deferred lands area, and there are only historical records of the species within the locality.
Motacilla flava	Yellow Wagtail	-	M	PMST	This species occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra. In the north of its range, it is also found in large forest clearings.	0	Low – no records of the species within the deferred lands and surrounding area. While there is marginal suitable habitat present within the deferred lands area, the species is migratory and not known from the locality.
Petaurus australis	Yellow-bellied Glider	V	-	BioNet	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest	1 (1999)	Low – one historical record from Lane Cove National Park. While there is marginal suitable habitat present within the deferred lands area, the species has

Scientific name	Common name	Status (BC Act)	Status (EPBC Act)	Source	Habitat description (DPIE (EES), 2020)	Number of records (BioNet) within 10km (year)	Likelihood of occurrence in deferred lands area
					with heath understorey in coastal areas. Prefers mixed species stands with a shrub or *Acacia* mid-storey. Requires abundant tree hollows for refuge and nest sites.		not been previously recorded within the deferred lands area, and there are is only one historical record of the species within the locality.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	BioNet	Occurs throughout tropical and south-east of Australia, excluding Tasmania. Found in a variety of habitat types including wet and dry sclerophyll forest, open woodland, *Acacia* shrubland, mallee, grassland and desert. Forages for insects above the tree canopy. Roost in tree hollows, abandoned sugar glider nests or animal burrows.	9 (2018)	Known – one record (from 2018) within the deferred lands area. Suitable habitat (e.g. woodland, forest, hollow-bearing trees) present throughout the deferred lands area.

V = vulnerable, E = endangered, CE = critically endangered, M = migratory

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