total earth care

Georges River Biodiversity Study

Volume 1

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Quality Control

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REV 3 DRAFT	27/04/2021	Sensitive ecological features removed for public access.
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EXECUTIVE SUMMARY

Total Earth Care was commissioned by Georges River Council to undertake a Biodiversity Study of the Georges River LGA. The Biodiversity Study aimed to identify the key biodiversity values within the LGA by assessing the diversity of flora and fauna present, analysing historical changes and identifying key opportunities to protect and conserve biodiversity. The Biodiversity Study comprises a desktop assessment, field surveys at 27 sites across the LGA as well as community and stakeholder consultation.

The Biodiversity Study is reported in two volumes. Volume 1 comprises an overview of the biodiversity values in the LGA. It provides the project background, aims, strategic and legislative context, methods, synthesis of results and further recommendations. Volume 2 provides detailed results of the surveyed sites including comprehensive inventories, conservation significance and site specific recommendations.

The desktop assessment reviewed numerous existing data sources and literature to develop a comprehensive understanding of existing and historical biodiversity values in the LGA. Field surveys were undertaken in 27 Council managed parks and reserves and across 29km of street tree corridors to assess various biodiversity values such as species diversity, conservation significance and habitat connectivity. Additionally, various community and stakeholder consultation activities provided further information and data which supported the outcomes of the desktop assessment and field surveys.

Key findings of the Biodiversity Study are summarised as follows:

Vegetation communities:

- There are 21 vegetation communities within the LGA, covering approximately 724ha. This includes 17 native vegetation communities covering approximately 389ha (54%) and four urban / non-native communities covering approximately 335ha (46%).
- The most common native vegetation type is 'Coastal Enriched Sandstone Dry Forest' which covers approximately 174ha (24%) of the LGA. This is a dry open forest community that provides the most abundant native habitat type for flora and fauna.
- There are seven Threatened Ecological Communities (TECs) within the LGA, one of which is aquatic (seagrass meadows).

Fauna:

- 127 fauna species were recorded during the field surveys This includes 113 native species (89%) and 14 exotic species (11%).
- The most diverse fauna group were birds, of which 87 species were recorded.
- 8 threatened fauna species were recorded during the surveys, three of which have never been previously recorded in the LGA.
- A Grey-headed Flying-fox (*Pteropus poliocephalus*) camp is located in Oatley, within Myles Dunphy Reserve, as such this threatened species is frequently observed across the LGA.
- The LGA has various habitat types present including dry and moist forests, intertidal areas and wetlands. The location of the LGA along the Georges River and Salt Pan Creek is important in supporting the diversity of habitat types.
- The diversity of fauna species has generally decreased over time, this is likely due to increased development and pressures of introduced predatory species.

Flora:

- 460 flora species were recorded during the field surveys including 322 native species (70%) and 138 exotic species (30%).
- These species encompass 116 different plant families. The most diverse plant family is the grasses (Poaceae) of which 46 species were recorded.
- One threatened flora species and one threatened flora population were recorded during the field surveys.
- Diversity of flora species has generally decreased over time, this is likely due to extensive vegetation clearing in the early 20th century, particularly in areas with shale influence soils, as well as the invasion of weed species.

Weeds and pests:

- 139 weed species were recorded during the field surveys, several of which are priority weeds within NSW and / or Weeds of National Significance.
- Most weed species were recorded in riparian areas and in highly disturbed areas.
- Foxes (*Vulpes vulpes*) and cats (*Felis catus*) were frequently observed. These species are a major threat to the survival of many native fauna species due to direct predation.
- Noisy Miners (*Manorina melanocephala*) are prevalent across the LGA, particularly in urban areas and in adjacent woodlands. The species is a native aggressive honeyeater species that can often exclude other bird species in an area.

Connectivity

- Green corridors and habitat connectivity is most prevalent along the foreshore areas, particularly in the south and west of the LGA.
- Large parks and reserves, such as Georges River National Park, Gannons Park and Oatley Park provide important habitat refuges and support connectivity within the LGA and between the large areas outside the LGA such as Holsworthy Military Reserve and the Georges River National Park to the west, and the Royal National Park to the south.
- Some street tree corridors and vegetation within private property provide important green corridors between larger parks and reserves.

Community and stakeholder engagement:

- The public, 18 key stakeholders and community groups were engaged through various activities and platforms including a webinar, a questionnaire and a fieldwork day.
- The community identified various species, vegetation communities and environmental risks of local importance, in summary:
  - 136 fauna species were reported
  - 7 threatened and / or migratory species, four of which were not recorded in the Biodiversity Study.

The outcomes of this Biodiversity Study have been used to develop numerous LGA-wide and site specific recommendations to manage, preserve and improve biodiversity values within the LGA over the next decade. These recommendations address key issues threatening biodiversity such as weed and pest invasion, climate change and vegetation clearing. The recommendations include various approaches to address the issues such as bush regeneration works, community engagement, public education and Council policy development.

Acronyms and Abbreviations

Term	Definition
BAM	Biodiversity Assessment Method
BC Act	NSW *Biodiversity Conservation Act 2016*
Biosecurity Act	*Biosecurity Act 2015*
CMA	Catchment Management Authority
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FAIP	Foreshore Access and Improvement Plan
FM Act	*Fisheries Management Act 1994*
GRC	Georges River Council
KTP	Key Threatening Processes
LEP	Local Environmental Plan
LGA	Local Government Area
LSPS	Local Strategic Planning Statement
NPWS	National Parks and Wildlife Service
MNES	Matters of National Environmental Significance
PCT	Plant Community Type
Coastal Management SEPP	*State Environmental Planning Policy (Coastal Management) 2018*
TEC	Threatened Ecological Community
WoNS	Weeds of National Significance

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1 INTRODUCTION

1.1 Background

Total Earth Care were commissioned by Georges River Council to undertake the Biodiversity Study of the Georges River Local Government Area (LGA). The Biodiversity Study provides an encompassing assessment of the current biodiversity values, locations and opportunities across the entire LGA. It incorporates and elaborates on previous studies in the former Hurstville and Kogarah LGAs and provides a foundation for the further development of a LGA-wide Biodiversity Strategy. It also provides data and recommendations to support sustainable future development and environmental management of the LGA.

Georges River Council has developed the *Local Strategic Planning Statement 2040* (LSPS) (GRC 2020) which creates a land use vision for the future of the LGA that recognises the character of the suburbs and builds on the Georges River community's social, environmental and economic values and strengths. The Biodiversity Study will support the LSPS by providing data and opportunities in meeting the priorities for the environment and open space. This includes the opportunity of protecting important areas of biodiversity value and enhancing green corridors.

1.2 Project aims

The key aims of the Biodiversity Study were as follows:

- Identify the native and exotic flora and fauna present in the LGA
- Analyse changes in biodiversity
- Identify key opportunities to protect and conserve biodiversity
- Investigate options to enhance green corridors
- Identify areas of high biodiversity values across the LGA
- Validate areas on the NSW Biodiversity Values Map on public land and identify any additional areas.

1.3 Study area

The study area comprises the extent of the Georges River LGA (Figure 1-1). It is located approximately 17km to the south west of the Sydney Central Business District (CBD) and covers an area of approximately 38km^2. The study area is bounded by City of Canterbury-Bankstown LGA to the north, Bayside LGA to the east, the Georges River to the south and Salt Pan Creek to the west.

Georges River LGA currently has 266 Council parks covering 477ha (GRC 2020a). Over one fifth of the open spaces are bushland. There is generally greater biodiversity in the south western suburbs of the LGA and less in the northern more urbanised suburbs. This is predominantly due to the historical urbanisation and fewer bushland areas.

For the purposes of the Biodiversity Study, the LGA has been split into 'Level 1', 'Level 2' and 'Level 3' sites based on biodiversity values that were identified during the desktop assessment (refer to Section 3). These 'Levels' reflect the degree of assessment that was undertaken for the Biodiversity Study. Level 1 sites were assessed by desktop assessment only. Level 2 and Level 3 sites were assessed by field surveys, with the latter receiving a more comprehensive assessment (refer to Section 3).

1.4 Report structure

This Biodiversity Study is divided into two volumes and are structured as follows.

1.4.1 Volume 1

Volume 1 (this report) provides generic information that is applicable to the whole Biodiversity Study. It provides background information, methodology and outlines the key biodiversity values and issues across the LGA. Volume 1 is structured as follows:

- Section 1: Introduction
- Section 2: Legislative context and policy

- Section 3: Methods
- Section 4: Literature review
- Section 5: Biodiversity values
- Section 6: Community and stakeholder engagement
- Section 7: Recommendations and opportunities
- Section 8: Conclusion.

1.4.2 Volume 2

Volume 2 provides the specific detail of the surveyed sites including species inventories and detailed maps. Volume 2 is structured as follows:

- Section 1: Introduction
- Section 2: Field survey results.

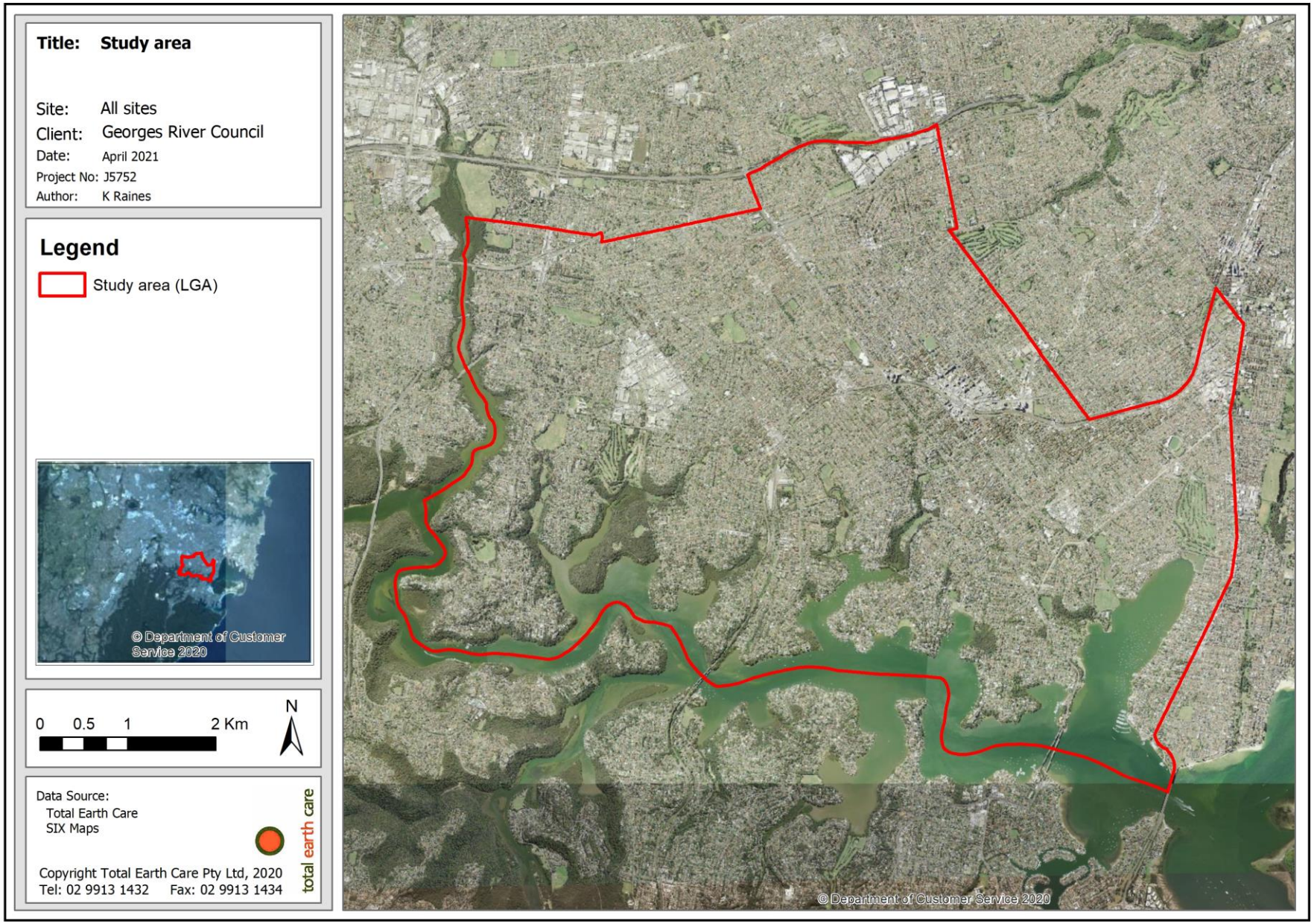

Figure 1-1. Study area

2 STRATEGIC AND LEGISLATIVE CONTEXT

Relevant legislation, planning policies and local plans were reviewed and summarised. Their relevance to the Biodiversity Study is outlined in the following sections.

2.1 Strategic context and policy

2.1.1 Georges River Local Strategic Planning Statement 2040 (GRC 2020a)

Georges River Council has developed the *Local Strategic Planning Statement 2040* (LSPS) (GRC 2020a) which creates a land use vision for the future of the LGA that recognises the character of the suburbs and builds on the Georges River community's social, environmental and economic values and strengths. The LSPS describes the vision of the LGA to 2040 and identifies actions that will be taken to contribute to this longer-term land use vision.

Theme 5 of the LSPS outlines the visions for 'Environment and Open Space' which includes five Local Planning Priorities. This Biodiversity Study provides data and recommendations to assist in reaching several of these Local Planning Priorities. The relevant Local Planning Priorities and their relevance to the Biodiversity Study are outlined in Table 2-1.

Table 2-1. Relevant Local Planning Priorities in the LSPS

Local Planning Priority	Key Actions	Timeframe	How addressed
P17. Tree canopy, bushland, landscaped settings and biodiversity are protected, enhanced and promoted	**A90.** Develop a Biodiversity Strategy informed by the LGA-wide biodiversity study	Medium Term	The outcomes of this Biodiversity Study will inform the Biodiversity Strategy.
P18. An environmentally friendly approach is applied to all development	**A91.** Provide provisions in Council's LEP 2020 to ensure development in business, industrial and high density residential zones is consistent with principles of sustainable practice and environmentally sensitive design.	Short term	The outcomes of this Biodiversity Study will inform developments of provisions in the LEP 2020.
P19. Everyone has access to quality, clean, useable, passive and active open and green spaces and recreation places.	**A100.** Investigate options to deliver Green Grid connections across the LGA.	Short to Medium Term	This Biodiversity Study will explore opportunities to extend and develop connectivity corridors across the LGA.
	A102. Prepare required new plans of management for Council-managed parks and reserves that guide the development and embellishment of open space to support a variety of uses and changing needs	Short Term	This Biodiversity Study will provide recommendations for targeted management measures to be actioned over 10 years focusing on individual parks and reserves. This will inform the future development of plans of management.

The Biodiversity Study also identifies areas to be protected and enhanced, including parks, reserves and street tree corridors, to assist in reaching the target of increasing the tree canopy cover to 40% by 2038 (baseline of 29.17% in 2018).

2.1.2 Georges River Foreshore Access and Improvement Plan – Draft (GRC 2020b)

The *Foreshore Access and Improvement Plan* (FAIP) (GRC 2020b) has been developed to assist in developing resilient estuarine ecosystems and vibrant communities along the foreshore areas of the

Georges River within the Georges River LGA. The FAIP primarily focuses on foreshore parks and reserves on public land.

The FAIP includes four technical reports that focus on specific attributes of the foreshore area. These are summarised in the flowing sections.

2.1.2.1 Assets, access and amenity

Most of the parks and reserves on the foreshore have informal public access (EMM 2019a). Several of the larger parks also have formalised access such as stairs, jetties and pontoons. The report found that there are opportunities for new infrastructure at several parks and reserves. Large scale projects for formal access improvements were identified at the following parks:

- Salt Pan Creek parks between Riverwood Park and Clarendon Road Reserve
- Kogarah Bay parks between Carss Bush Park and Tom Uglys Point
- Gannons Park to Oatley Park.

2.1.2.2 Riparian vegetation

This report comprised a riparian vegetation survey along the foreshore (EMM 2019b). This included reviewing previous vegetation mapping, field assessment via transects, recording of broad vegetation communities and ranking ecological condition, threats and vulnerability.

The habitats present in the foreshore areas include dry sclerophyll forest, wet sclerophyll forest, swamp oak forest, reedlands, wetlands, mangroves and saltmarsh. There is a small area of Littoral Rainforest in Banksia Place Reserve, Lugarno. Three Endangered Ecological Communities (EECs) are present including swamp oak forest, mangroves and saltmarsh.

Threats to the riparian vegetation include:

- Limits to capacity for EECs (and other ecological communities) to migrate in response to sea level rise where hard barriers (seawalls or natural rock face) limit available landward habitat
- Weed infestation
- Water-borne litter and waste deposited via stormwater or diffuse disposal and dumping
- Clearing, trampling and soil erosion due to informal pathway use.

2.1.2.3 Seagrass survey

The study found that changes to seagrass species composition and distribution has occurred since a previous study in 2009 (Cardno 2019). Halophila (*Halophila spp.*) is now the most abundant seagrass genus recorded in the LGA which has replaced Zostera (*Zostera muelleri subsp. capricorni*) as the most abundant genus from the 2009 study. Zostera abundance has now reduced and / or is present in fragmented meadows, which in many cases contain areas of interspersed Halophila. A small patch of *Posidonia spp*. was recorded at the eastern end of Kogarah Bay which is a protected species.

Changes in seagrass may be due to alterations to water and sediment quality from catchment discharge and runoff, incidental loss from recreational activities, shoreline stabilisation works and other pressures from development and industry.

2.1.2.4 Coastal hazards and foreshore improvements

This report provided an analysis of the coastal processes and the current and future hazards (over the next 100 years) confronting the foreshore. It determines specific areas or types of vulnerability and ranks those risks to identify the optimal response (Royal Haskoning DHV 2019). The coastal hazards relevant to foreshore include shoreline recession, coastal inundation (by both still water and waves) and tidal inundation.

Several parks and reserves were found to have erosions and shoreline regression. This can result in loss of habitat. Coastal inundation currently impacts five parks and the vulnerability increases over time (up to 15 parks in 2100 without intervention).

From the four reports, the FAIP summarises the recommended management actions required at each park and reserve. In relation to riparian vegetation, ‘Major intervention’ is recommended at the following parks, primarily due to the presence of EECs:

- Kyle Williams Reserve
- Myles Dunphy Reserve
- Freeman Avenue Reserve

- Salt Pan Creek Reserve
- Belmore Road Reserve South
- Belmore Road Reserve Middle
- Belmore Road Reserve North
- Riverwood Park.

The FAIP further comments on planned and progressing improvement projects for the foreshore. In relation to biodiversity, several of the projects would improve native vegetation (including EECs) and habitat by minimising erosion, stabilising shorelines and managing weeds.

The Biodiversity Study has utilised the information provided in the FAIP to inform understanding approximately the existing environmental constraints across the LGA. It has also been considered in identifying areas for field surveys (refer to Section 3.3.3).

2.1.3 Georges River Community Strategic Plan 2018 - 2028 (GRC 2018)

Georges River Community Strategic Plan represents the community's aspirations for the next decade. The development of the plan incorporated extensive community consultation and drew on social justice principles of equity, access, participation and rights. The plan has six pillars which comprise:

- Pillar 1: A protected environment and green open spaces
- Pillar 2: Quality, well planned development
- Pillar 3: Active and accessible places and spaces
- Pillar 4: A diverse and productive economy
- Pillar 5: A harmonious and proud community with strong social services and infrastructure
- Pillar 6: Leadership and transparency.

Pillar 1, 'A protected environment and green open spaces', generally focuses on bushland reserves, river health, waste and recycling management and better facilities in parks and reserves. To address these, there are four main goals:

- Council's environmentally sustainable practices inspire everyone to protect and nurture the natural environment
- The LGA's waterways are healthy and accessible
- Everyone has access to beautiful parks and open spaces
- Local heritage is protected and promoted.

The Biodiversity Study helps to meet these goals by providing data and recommendations on the biodiversity values of the LGA (refer to Section 7).

2.1.4 Australian Weeds Strategy 2017–2027 (Cwth)

The *Australian Weeds Strategy* provides national guidance on best practice weed management. It aims to guide coordination of effort across all jurisdictions and affected stakeholders and to inform plans and actions by state and territory governments, local governments, regional natural resource management (NRM) agencies, as well as by industry, landholders and the wider community.

The strategy lists Weeds of National Significance (WoNS) and provides national goals and priorities for their management. Several WoNS have been recorded within the LGA (refer to Section 5.5).

2.2 Relevant legislation and policies

2.2.1 Environment Protection and Biodiversity Conservation Act 1999 (Cwth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places defined in the Act as Matters of National Environmental Significance (MNES). Under the EPBC Act, approval is required for actions that have, will have, or are likely to have a significant impact on MNES.

Several MNES are within the LGA, have potential habitat within the LGA, or are in close proximity (refer to Section 5). These include:

- One Wetland of National Importance – Towra Point Nature Reserve, located approximately 2km to the east

- 10 Threatened Ecological Communities (TECs)
- 86 threatened species
- 76 migratory species.

Of these, six TECs listed under the EPBC Act are known to be within the LGA and numerous threatened and migratory species have been recorded, or have potential habitat (refer to Section 5).

Nine Key Threatening Processes (KTPs) listed under the EPBC Act currently impact the LGA (refer to Section 5.10).

2.2.2 Biodiversity Conservation Act 2016 (NSW)

The *Biodiversity Conservation Act 2016* (BC Act) seeks to conserve biological diversity and promote ecologically sustainable development, to prevent extinction and promote recovery of threatened species, populations and ecological communities and to protect areas of outstanding biodiversity value.

Several TECs and species listed under the BC Act are known to occur within the LGA (refer to Section 5). There are 16 KTPs listed under the BC Act that likely impact the LGA (refer to Section 5.10).

Additionally, several locations are on the Biodiversity Values Map. Areas on this map are described under clause 7.3(3) of the *Biodiversity Conservation Regulation 2017* and includes areas of high biodiversity value that is particularly sensitive to impacts from development and clearing.

The surveyed sites that are mapped within the Biodiversity Values Map were validated. This is detailed in Section 3.3.8 and in Volume 2 for each of the surveyed sites.

2.2.3 Fisheries Management Act 1994 (NSW)

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fisheries resources of the State for the benefit of present and future generations.

The Georges River is mapped as Key Fish Habitat under the FM Act. There is a small area of the *Posidonia australis* seagrass within the Georges River (Cardno 2019) which is listed as an endangered population under the FM Act. There are also three KTPs listed under the FM Act that currently impact the LGA (refer to Section 5.10).

The Biodiversity Study does not directly assess aquatic species, however a visual assessment of waterways was undertaken at several key waterways (refer to Section 5.6 and Volume 2).

2.2.4 Biosecurity Act 2015 (NSW)

The *Biosecurity Act 2015* (Biosecurity Act) and its regulations provide requirements for State level priority weeds. The Biosecurity Act regulates all plants, with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Several weeds listed under the Biosecurity Act are known to occur within the LGA.

Several priority weeds managed under the Biosecurity Act were recorded within the LGA (refer to Section 5.5). The Biodiversity Study also provides recommendations to minimise the impact of weed species (refer to Section 7).

2.2.5 Coastal Management Act 2016 and the State Environmental Planning Policy (Coastal Management) 2018 (NSW)

The *Coastal Management Act 2016* (Coastal Management Act) sets out the objectives for the management of the coastal zone, provides development controls and management outcomes for four zones and also provides for the preparation of coastal management programs. The *State Environmental Planning Policy (Coastal Management) 2018* (Coastal Management SEPP) defines the areas of each zone and provides development controls.

Two of the four zones relate to the protection of biodiversity, these are ‘coastal wetlands’ and ‘littoral rainforest’. Several areas of coastal wetlands and littoral rainforest are present in the LGA (refer to Section 5.6).

3 METHODS

3.1 Literature review

Previous reports relating to biodiversity were reviewed to develop a comprehensive understanding of existing biodiversity values in the LGA and previous studies undertaken. These include:

- Hurstville Council Biodiversity Study (Eco Logical 2014)
- Kogarah City Council Fauna Biodiversity Study (Total Earth Care 2012)
- Kogarah City Council Flora Biodiversity Study (Total Earth Care 2009)
- Hurstville Street Tree Management Study (Eco Logical 2015)
- Vegetation Mapping Report (Cardno 2018)
- Neverfail Bay and Oatley Point Reserve Fauna Study (Biosphere Environmental Consultants 2010)
- Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area (DECC 2008)
- Herpetofaunal community of the constructed Lime Kiln Bay Wetland, South Sydney, New South Wales (Mo 2015)
- Myles Dunphy Reserve and Wetland Plan of Management (Hurstville City Council 2013)
- Terrestrial Fauna of Conservation Concern and Priority Pest Species (DECC 2007)
- Fauna Survey of the Bushland Reserves of Kogarah (Biosphere Environmental Consultants 1998)
- Kogarah Bushland Survey (The National Trust 1979).

3.2 Desktop assessment

A desktop assessment was conducted to review existing data and databases (at a 5km radius where appropriate), to develop a comprehensive understanding of the existing environment and historical changes in the LGA. These sources included:

- NSW Bionet Atlas (DPIE 2020a)
- Commonwealth Protected Matters search tool (DAWE 2020a)
- The Native Vegetation of the Sydney Metropolitan Area (OEH 2016)
- Key Fish Habitat Maps – Sydney area (DPI 2020a)
- Fisheries Spatial Data Portal (DPI 2020b)
- Biodiversity Values Map (DPIE 2020b)
- NSW Weed Wise- Priority weeds for the Greater Sydney (DPI 2020c)
- Greater Sydney Regional Strategic Weed Management Plan 2017-2022 (LLS 2019)
- National Flying-fox monitoring viewer (DAWE 2020b)
- Heritage NSW (DPC 2020)
- eSPADE (DPIE 2020c)
- eBird (Cornell Lab of Ornithology 2021)
- Aerial imagery.

Information was also derived from the literature review (refer to Section 3.1).

3.2.1 GIS analysis

GIS analysis was undertaken to identify the priority sites for field assessment. This included analysing various spatial data layers in ArcGIS to generate the following areas of importance:

- **'Level 3'**: areas of high importance to be focused on for targeted field surveys
- **'Level 2'**: areas of moderate importance to be visited with no targeted surveys
- **'Level 1'**: areas of low importance for desktop assessment only
- **Street tree green corridors**: street trees that form notable existing green corridors.

Each of the sites were generally identified by having one or more of the following features and being within a Council park or reserve. Private properties were not considered for field assessment due to small lot sizes, and as such lower likelihood of biodiversity, as well as access issues:

Level 3

- Within Georges River National Park
- On the Biodiversity Values Map
- Within an area mapped as TECs
- Within a foreshore vegetation community that is not a TEC*
- Having a recent threatened flora species record (since 2000)
- Being within Coastal Wetlands or Littoral Rainforest (Coastal Management SEPP).

*foreshore vegetation communities include 'Estuarine Mangrove Forest', 'Sydney Foreshores Shale Forest', 'Coastal Sandstone Foreshores Forest' and 'Coastal Sandstone Riparian Forest' (refer to Section 5.2 and Appendix E).

Level 2

- Other Council parks and reserves located adjacent to Georges River
- Other Council parks and reserves with over 20% canopy coverage or native vegetation present
- Was assessed in a previous study (Total Earth Care 2009, Total Earth Care 2012, Eco Logical 2014) and does not meet the criteria for Level 3.

Level 1

- All remaining areas of the LGA.

Street tree green corridors

- Potential green corridors were identified by vegetation spatial data and aerial imagery. These areas are across both public and private land
- Streets identified in the *Vegetation Mapping Report* (Cardno 2018) as areas to enhance vegetation connectivity
- Outcomes and recommendations of corridors from the community consultation process.

Some general exceptions to the above features are as follows:

- Where Level 2 Council parks and reserves which were located adjacent to a Level 3, they were integrated into the Level 3 site except where they comprise urban / non-native vegetation communities
- Level 3 sites that were less than 0.5ha were downgraded to Level 2 sites.

3.2.2 Gap analysis

A gap analysis was undertaken to consider all the reviewed documents and data. It was used to identify limitations and opportunities to inform the field surveys and development of recommendations. It states issues that were noted during the desktop assessment and developed approaches to fill the gaps in knowledge.

3.3 Field survey

3.3.1 General approach

The survey methodology was developed to collect standardised and measureable data across the LGA. The NSW Biodiversity Assessment Method (BAM) (DPIE 2020d) was used as a basis for the methodology as it is currently the standard for comprehensive biodiversity assessment in NSW.

The BAM is part of the Biodiversity Offsets Scheme (BOS). The BOS is a legislated framework that is required when addressing impacts on terrestrial biodiversity from development and clearing. It also ensures that land used to offset impacts is secured in the long term. The BAM provides a consistent method to assess impacts on biodiversity values from a proposed development (including major projects), clearing or biodiversity certification as well as improvements in biodiversity values from management actions undertaken at a stewardship site.

As the purpose of the Biodiversity Study was to develop a broad assessment of the current biodiversity values, conditions, locations and opportunities across the entire LGA, not to inform development, the complete application of the BAM is impracticable and excessive as it would have require significantly more resources and time to complete. As such, the BAM was been used to guide the development of the methodology with several features utilised in the design. These include using 'BAM plots' for

assessing vegetation type within 'Level 3' areas. The methods and timing for surveying specific species has also been derived from the BAM. These are detailed in Sections 3.3.5 and 3.3.7.

Targeted field survey methodologies were focused on threatened species that were identified as having a high or moderate likelihood of occurring in the LGA (refer to Sections 3.3.5 and 3.3.7, and Appendix C). Threatened species were the focus as they are typically more cryptic or rare, require more protective measures and have recommended survey methods under the BAM. These methods capture other non-threatened species as the key species groups are generally targeted (i.e. birds, owls, and amphibians). Survey guidelines utilised or considered in the development of the methodology include:

- *Biodiversity Assessment Method - Part 1 and Part* 2 (DPIE 2020d)
- *Surveying threatened plants and their habitats* (DPIE 2020e)
- *NSW Survey Guide for Threatened Frogs* (DPIE 2020f)
- '*Species credit' threatened bats and their habitats* (DPIE 2018)
- *Working Draft Threatened Biodiversity Survey and Assessment Guidelines* (DEC 2004)
- *Threatened species survey and assessment guidelines: field survey methods for fauna* (DECC 2009)
- *Survey guidelines for Australia's threatened birds* (DEWHA 2010).

In order to provide a standardised and repeatable survey of vegetation condition in all vegetation types across the LGA, the methodology incorporated several other unique approaches that were not derived from the BAM due to time and practicality constraints. These included the development of a rapid point condition survey for all Level 3 and Level 2 sites.

Street trees in areas identified as street tree green corridors were also assessed in a rapid assessment (refer to Section 3.3.11).

3.3.2 Low impact surveying

It is recognised that fauna surveying utilising minimal disturbance and low impact is of importance to ensuring the long term viability of fauna residing in the LGA. Consequently, minimal disturbance survey techniques were used as a priority over more invasive techniques. Efforts were made to not induce undue stress to fauna. As such, passive survey techniques including the use of ultrasonic call recorders (Anabats) and remote infrared cameras were used over more invasive methods such as elliot trapping and hair tubes.

3.3.3 Surveyed sites

As described in Section 3.2.1, Level 3 and Level 2 sites were targeted for field surveys. Additionally, approximately 29km of streets were surveyed.

A list of the survey sites is provided in Table 3-1. The locations of the surveyed sites and street tree corridors are shown in Figure 3-1 to Figure 3-9.

Table 3-1. Surveyed sites

Level 3 sites		Level 2 sites	
Site name	***Approximate size (ha)***	***Site name***	***Approximate size (ha)***
Bald Face Reserve	1.3	Arrowsmith Park	0.8
Carss Bush Park	16.6	Beverley Hills Golf Course, Claydon Reserve, Spooner Park	34.2
Cedar Street Reserve	2.3	Church Street Reserve	1.5
Clarendon Road Reserve and Ogilvy St Reserve	2.4	Donnelly Park	2.6
H.V. Evatt Park	28.3	Hurstville Golf Course	35.2
Gannons Park and Heinrick Reserve	38.8	Letitia Street Reserve	0.5
Kyle William Reserve	5.75	Lugarno Parade Reserve and Edith Bay Wetlands	3.2
Moore Reserve	14.65	Oatley Memorial Gardens and Oatley Park (Oatley Embankment)	3.1
Myles Dunphy Reserve	11.56	Oatley Pleasure Grounds	3.3
Neverfail Bay Reserve	4.2	Ray Street	0.7
Oatley Park and Lime Kiln Bay Reserve	64.3	Yarran Road Reserve	1.4

Level 3 sites		Level 2 sites	
Site name	***Approximate size (ha)***	***Site name***	***Approximate size (ha)***
Oatley Point Reserve	2.6		
Peakhurst Foreshore Reserve and Jinna Road Reserve	6.5		
Poulton Park, Redin Place Reserve and Quarry Reserve	23.6		
Riverwood Park and Basil Street Reserve	9.4		
Shipwrights Bay Reserve	5.4		
Total	**237.66**	Total	**86.5**
			Total: 324.16

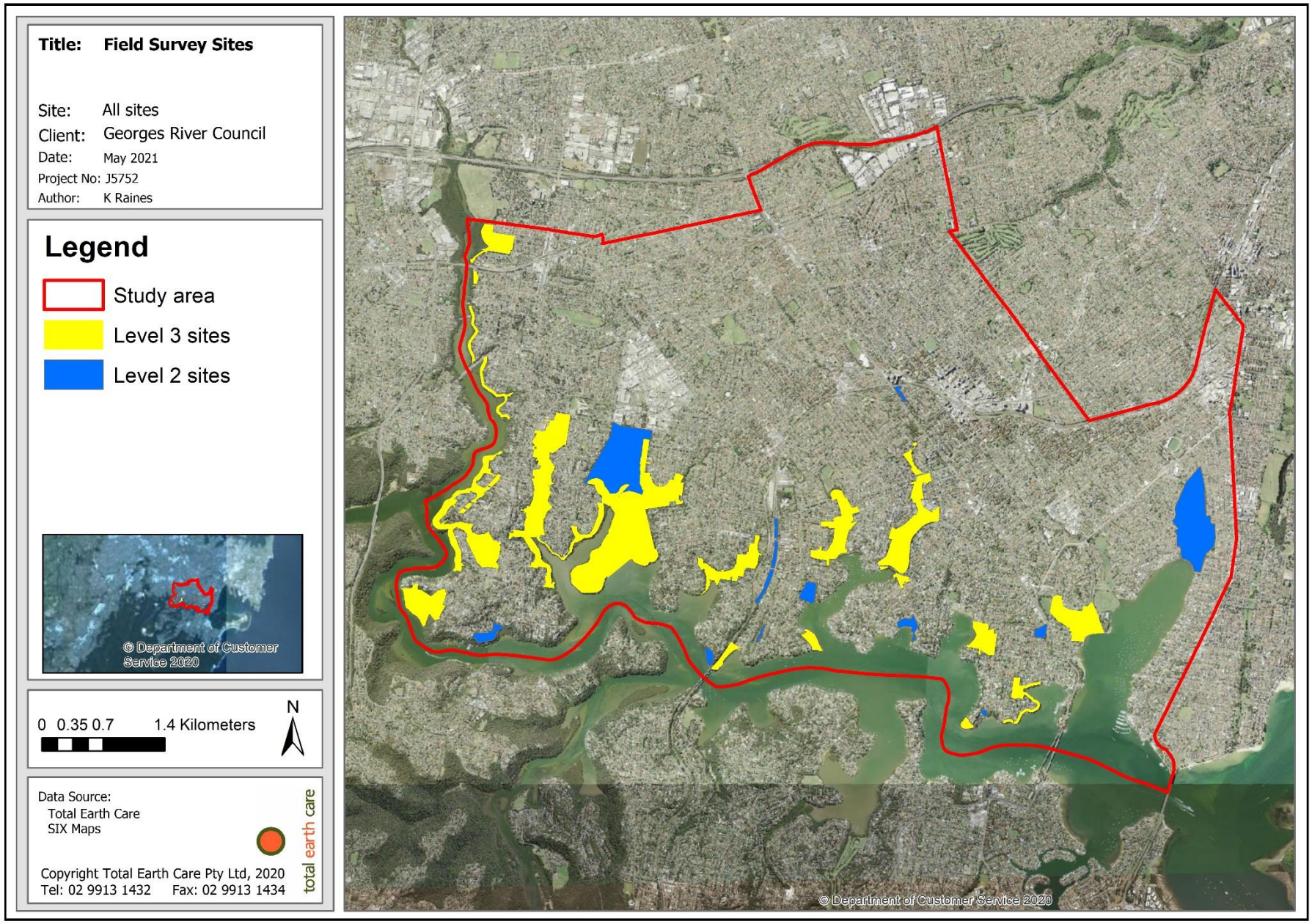

Figure 3-1. Field survey areas

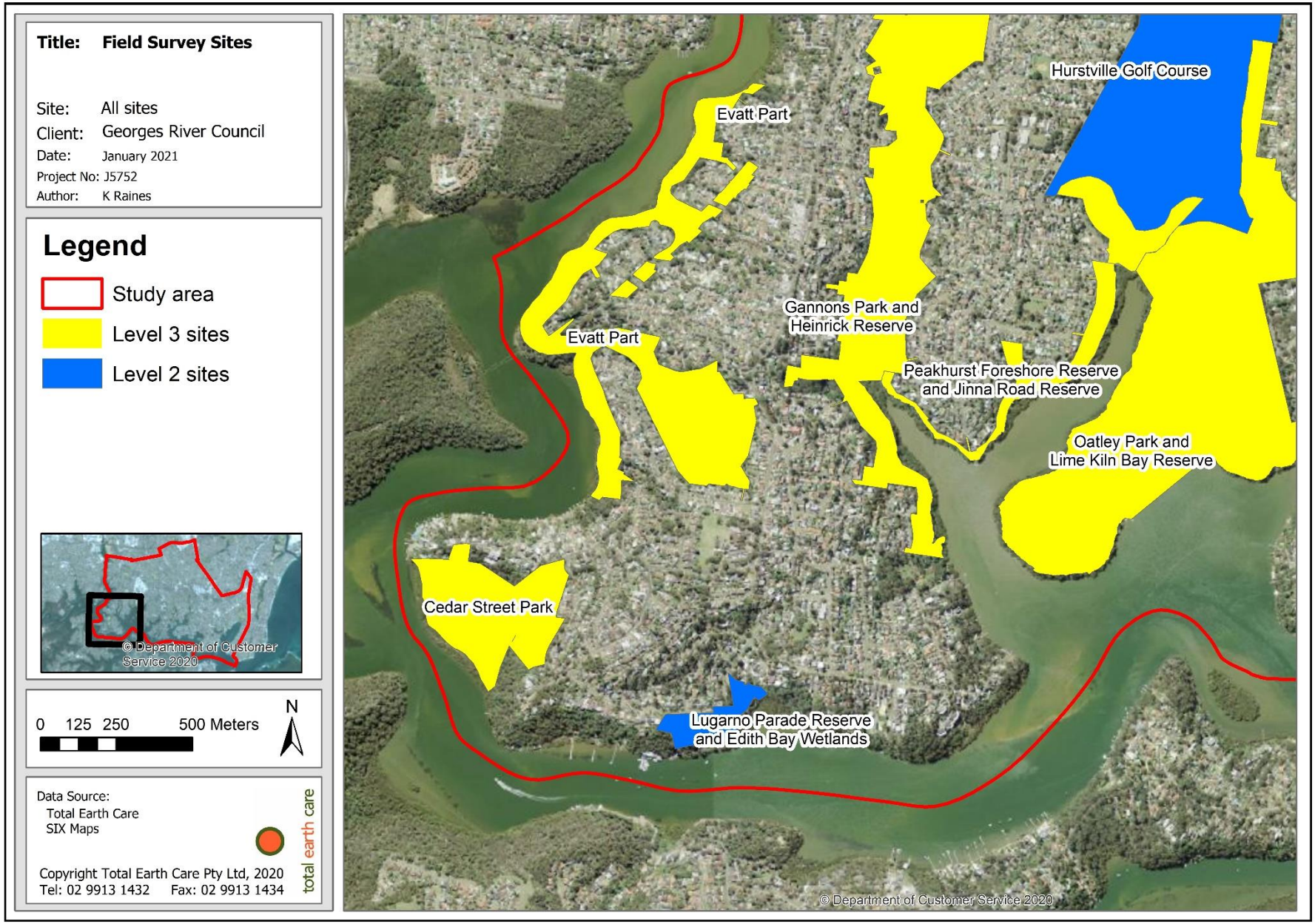

Figure 3-2. Field survey areas

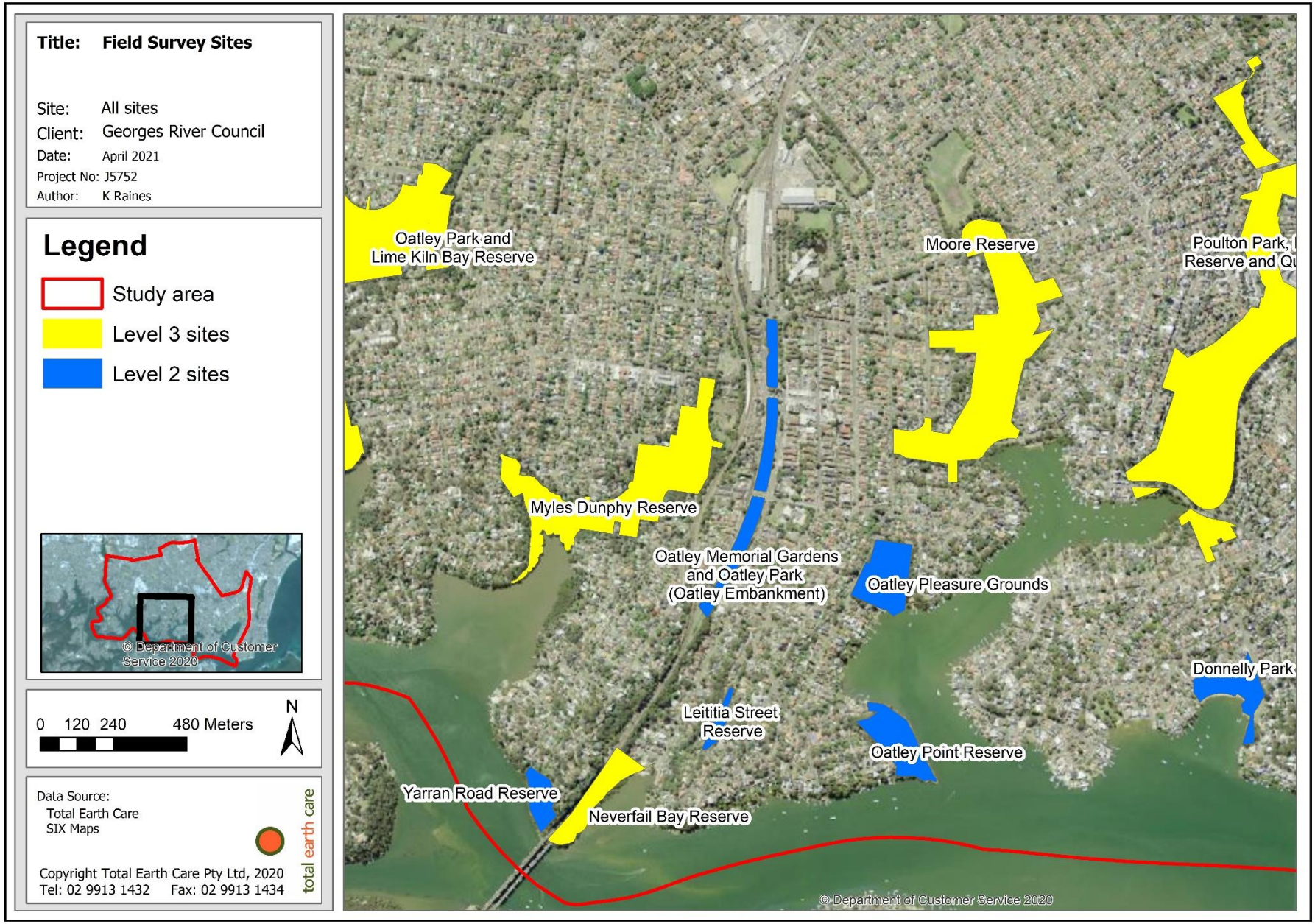

Figure 3-3. Field survey areas

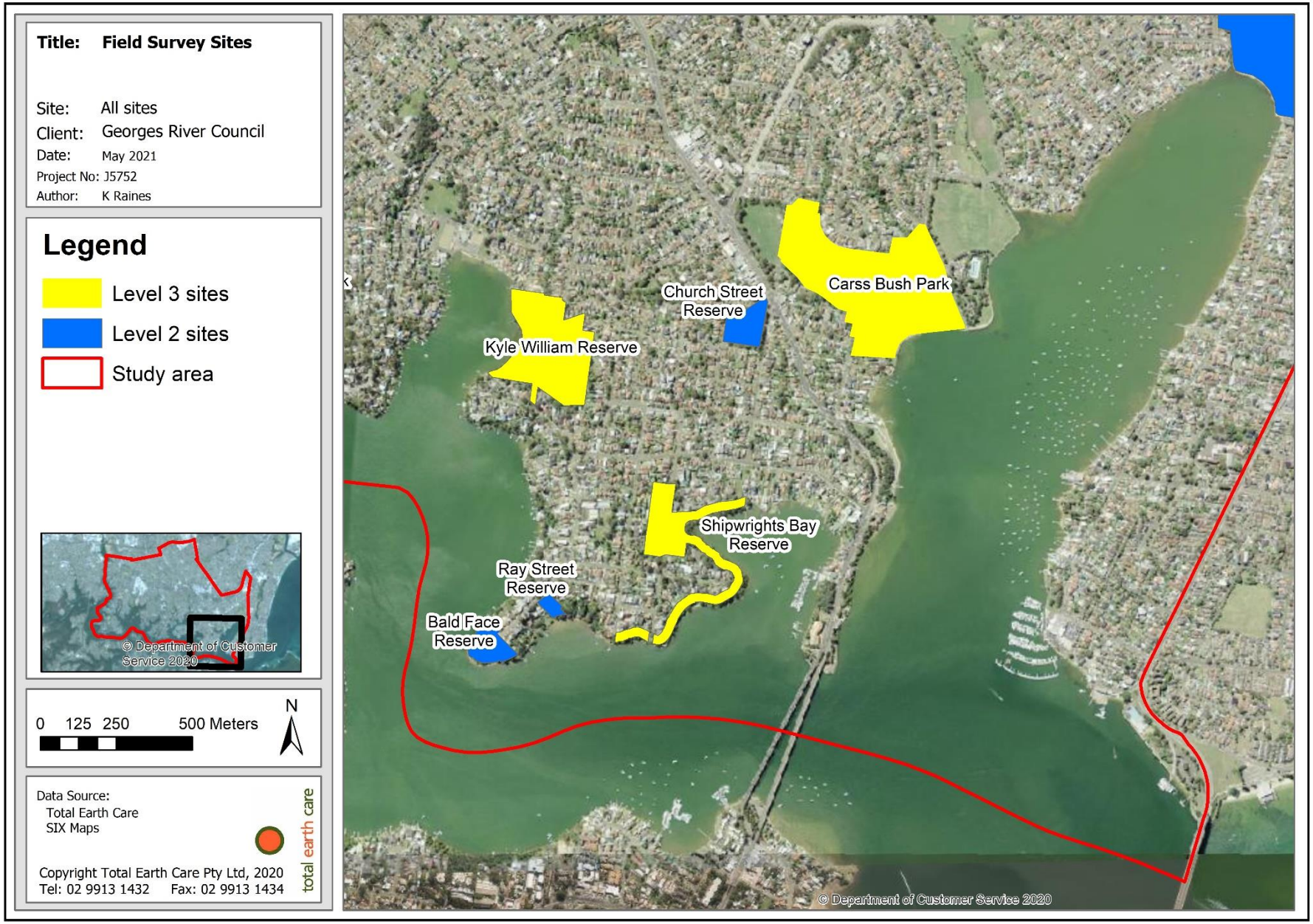

Figure 3-4. Field survey areas

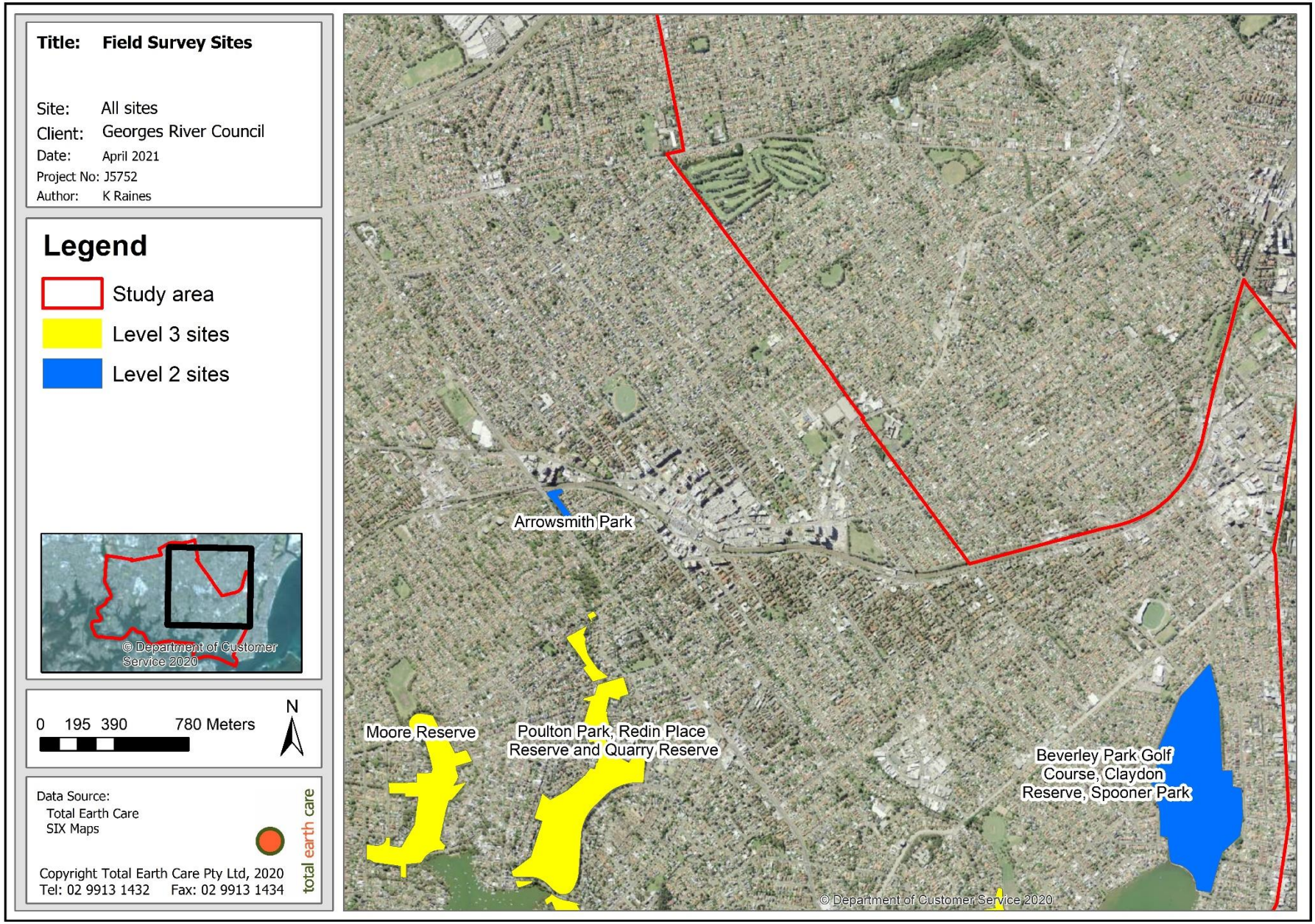

Figure 3-5. Field survey areas

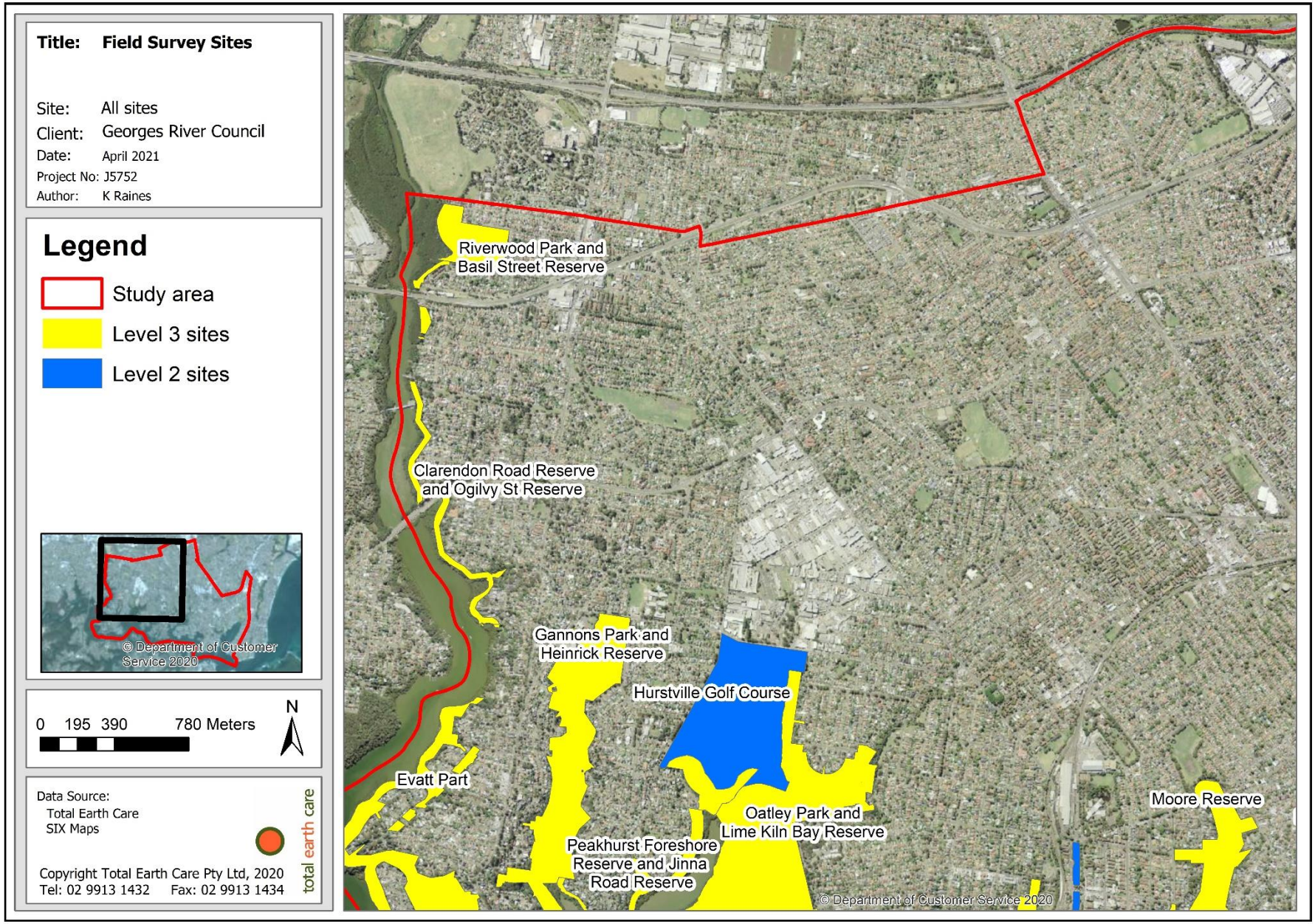

Figure 3-6. Field survey areas

Figure 3-7. Street tree green corridors

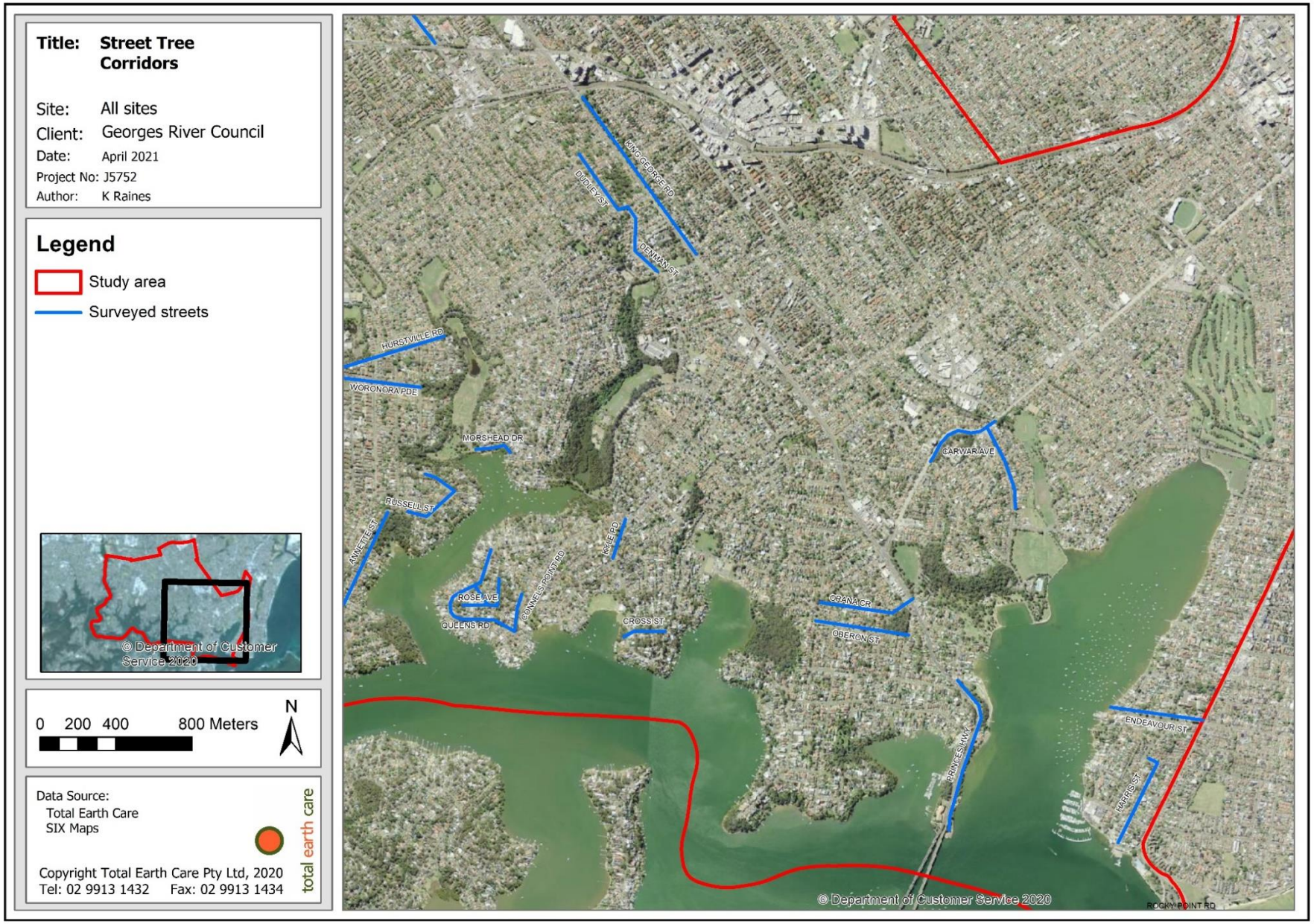

Figure 3-8. Street tree green corridors

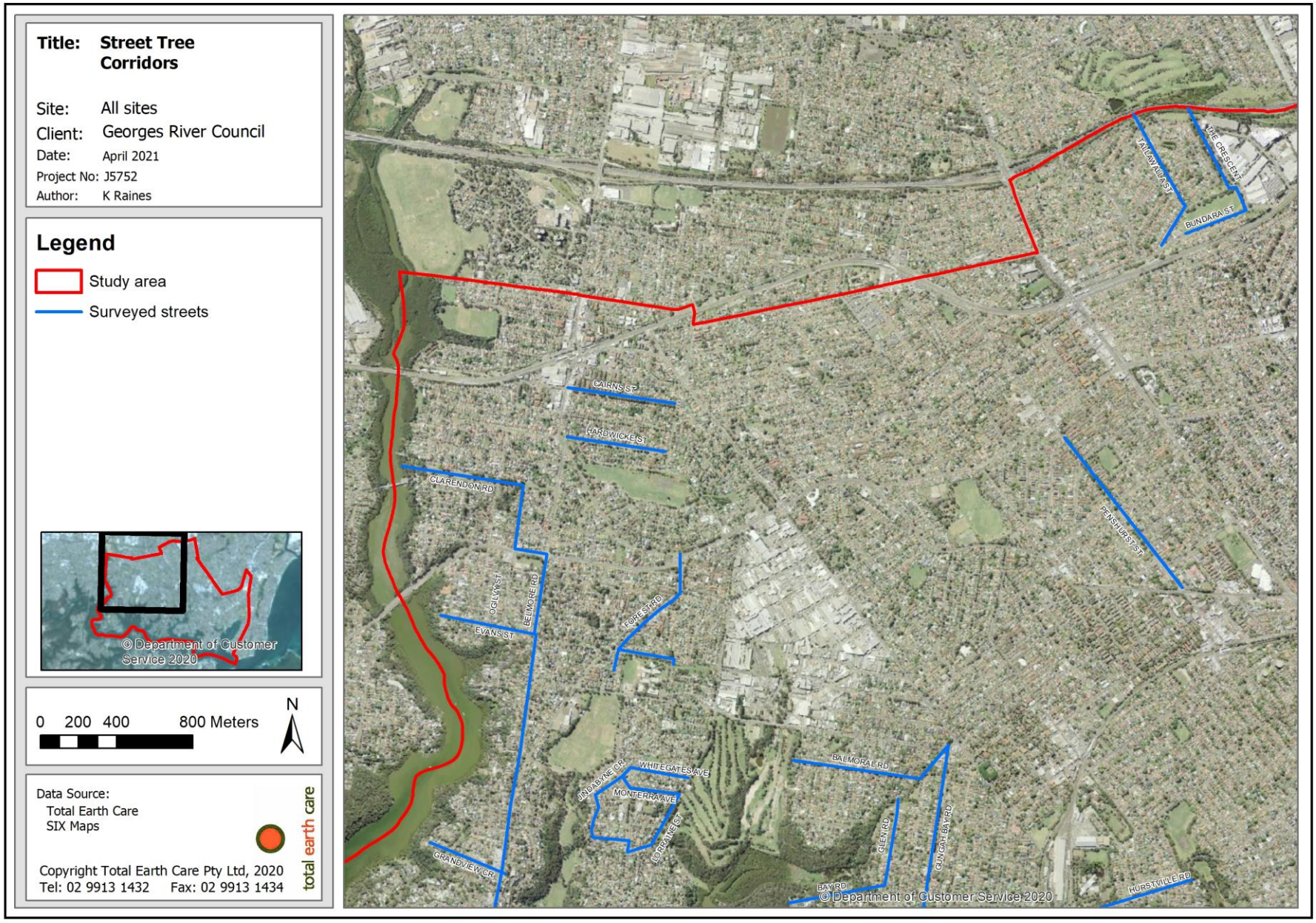

Figure 3-9. Street tree green corridors

3.3.4 Vegetation surveys

3.3.4.1 Stratification

Sites were separated by geographic isolation and coupled with adjacent parks and reserves (refer to Section 3.2.1). Separate vegetation surveys were generally undertaken for each Plant Community Type (PCT) at each site.

3.3.4.2 Vegetation type and species composition

PCTs were confirmed by collecting species composition data in each PCT patch. In Level 3 sites, standardised BAM plots were undertaken to confirm PCTs in dominant vegetation communities. These involved a 20 x 20m plot with a record of all species collected within the plot. In Level 2 sites, and smaller patches within Level 3 sites, detailed flora species lists were collected at each site by a random meander survey (Cropper 1993).

3.3.4.3 Condition assessment

Vegetation condition was assessed by a rapid point condition survey at all Level 2 and Level 3 sites. These were undertaken for each stratification unit or where there was a noticeable visual change in condition. The rapid point condition survey generally included the following features:

- Vegetation structure
- Key native species
- Native species diversity
- Weed species cover
- The degree of:
  - Natural regeneration
  - Fallen log / timber
  - Rocky outcrops / surfaces
  - Cryptograms
  - Litter cover
  - Mistletoe
  - Presence of hollow bearing trees
  - Grazing
  - Signs of erosion
  - Fire / flood damage.

3.3.5 Flora surveys

Comprehensive lists of flora species were collected during the vegetation assessment (refer to Section 3.3.4). Native and exotic species were recorded in accordance with the following resources:

- *Field Guide to the Native Plants of Sydney* (Robinson 2003)
- *Weeds of the south-east: an identification guide for Australia* (Richardson *et al.* 2006)
- *PlantNET* (Botanic Gardens Trust 2020), with reference to recent taxonomic changes.

3.3.6 Threatened species and populations

All known recent records (recorded since 2000) of threatened flora species were investigated. All new observations were recorded by GPS.

Targeted surveys for threatened flora species identified as having a high and moderate likelihood of occurrence (refer to Table 3-2 and Appendix C) were undertaken during the vegetation surveys by random meander. The locations where known records are were visited (where accessible) early in the field surveys to utilise as reference sites. The methodology for targeted surveys at specific sites are outlined in Table 3-2.

Table 3-2. Targeted flora surveys

Species	Ideal survey timing*	Methodology	Locations
Known or high likelihood of occurring			
Gosford Wattle, Hurstville and Kogarah Local Government Areas (*Acacia prominens)*	All year	Random meander during vegetation surveys. Identification of existing records.	All sites
Magenta Lilly Pilly (*Syzygium paniculatum)*	April – June**	Random meander during vegetation surveys Identification of existing records.	All sites
Moderate likelihood of occurring			
Downy Wattle (*Acacia pubescens*)	All year	Random meander during vegetation surveys	All sites
Sunshine Wattle (*Acacia terminalis subsp. terminalis*)	May - July	Random meander during vegetation surveys	All sites
Small Pale Grass-lily (*Caesia parviflora var. minor*)	October – February	Random meander during vegetation surveys	All sites
Hairy Geebung (*Persoonia hirsuta*)	All year	Random meander during vegetation surveys	All sites
Narrow-leafed Wilsonia (*Wilsonia backhousei*).	All year	Random meander during vegetation surveys	All sites

*As stated by DPIE (2020a).
***Syzygium paniculatum* was in flower during the survey period and easily identifiable.

3.3.7 Fauna surveys

All observed fauna species were recorded, this included visual and auditory observations as well as signs such as scats and scratches. All native and non-native species were recorded.

3.3.7.1 Stratification

The stratification units for the targeted fauna surveys were the boundaries of the sites as described in Section 3.3.3. The survey effort at each site was dependent on the size and complexity of the site.

3.3.7.2 Habitat assessment

For each site, a fauna habitat assessment was undertaken during the vegetation survey with the following data recorded:

- Leaf litter
- Hollow bearing trees / stags
- Rock shelves / bush rock
- Water within 100m
- Man-made structures
- Indirect evidence of fauna (i.e. scratchings, scats etc.).

3.3.7.3 Threatened and migratory species and populations

All observations of threatened and / or migratory species and populations observations were recorded by GPS. Targeted field surveys for threatened and migratory fauna species identified as having a high and moderate likelihood of occurrence (refer to Table 3-3 and Appendix C) were undertaken during the methods outlined in Table 3-3.

The types of survey methods were chosen depending on the landscape and habitat features of the sites (i.e. surveys for amphibians were only undertaken where water (permanent or ephemeral) was present. Further details on methodology is provided in the following sections.

Table 3-3. Targeted fauna surveys

Species	Ideal survey timing	Methodology
Glossy Black-Cockatoo *(Calyptorhynchus lathami)*	April – August**	Diurnal searches via random meander coupled with vegetation surveys. Identification of suitable habitat and chewed cones.
*Latham's Snipe (*Gallinago hardwickii*)	August - April	Diurnal searches in shoreline survey.
Little Lorikeet *(Glossopsitta pusilla)*	All year	Diurnal searches via random meander coupled with vegetation surveys.
White-bellied Sea-Eagle *(Haliaeetus leucogaster)*	July - December	Diurnal searches via random meander coupled with vegetation surveys.
Little Eagle *(Hieraaetus morphnoides)*	August – October**	Diurnal searches via random meander coupled with vegetation surveys.
*Common Sandpiper (*Actitis hypoleucos*)	August - April	Diurnal searches in shoreline survey.
*Sharp-tailed Sandpiper (*Calidris acuminata*)	August - April	Diurnal searches in shoreline survey.
Pied Oystercatcher (*Haematopus longirostris)*	All year	Diurnal searches in shoreline survey.
*White-throated Needletail *(Hirundapus caudacutus)*	September - December	Diurnal searches via random meander coupled with vegetation surveys.
Black Bittern (*Ixobrychus flavicollis)*	All year	Diurnal searches in shoreline survey.
Bar-tailed Godwit (bauera) *(Limosa lapponica baueri)*	August - April	Diurnal searches in shoreline survey.
Square-tailed Kite *(Lophoictinia isura)*	September - January	Diurnal searches via random meander coupled with vegetation surveys.
Eastern Coastal Free-tailed Bat *(Micronomus norfolkensis)*	All year	Habitat assessment and acoustic detection.
Little Bent-winged Bat *(Miniopterus australis)*	December - February	Habitat assessment and acoustic detection.
Large Bent-winged Bat *(Miniopterus orianae oceanensis)*	December - February	Habitat assessment and acoustic detection
Southern Myotis *(Myotis macropus)*	October - March	Habitat assessment and acoustic detection.
Yellow-bellied Sheathtail-bat *(Saccolaimus flaviventris)*	All year	Habitat assessment and acoustic detection.
Greater Broad-nosed Bat *(Scoteanax rueppellii)*	All year	Habitat assessment and acoustic detection.
*Black-faced Monarch *(Monarcha melanopsis)*	September - March	Diurnal searches via random meander coupled with vegetation surveys.
*Satin Flycatcher *(Myiagra cyanoleuca)*	October - March	Diurnal searches via random meander coupled with vegetation surveys.
Powerful Owl *(Ninox strenua)*	May – August**	Call play back, nocturnal spotlighting
Sooty Owl *(Tyto tenebricosa)*	April – August**	Call play back, nocturnal spotlighting
Eastern Osprey *(Pandion cristatus)*	April – November	Diurnal searches via random meander coupled with vegetation surveys.
Red-crowned Toadlet *(Pseudophryne australis)*	All year	Aural-visual surveys, call playback.

Species	Ideal survey timing	Methodology
Grey-headed Flying-fox *(Pteropus poliocephalus)*	October - December	Diurnal searches via random meander coupled with vegetation surveys and visit camp location. Nocturnal surveys to observe feeding locations.
*Grey-tailed Tattler *(Tringa brevipes)*	September - April	Diurnal searches in shoreline survey.
*Common Greenshank (*Tringa nebularia*)	September - April	Diurnal searches in shoreline survey.
Australasian Bittern (*Botaurus poiciloptilus*)	All year	Diurnal searches in shoreline survey.
Bush Stone-curlew (*Burhinus grallarius*)	All year	Call play back, nocturnal spotlighting.
*Red Knot *(Calidris canutus)*	September - April	Diurnal searches in shoreline survey.
Curlew Sandpiper *(Calidris ferruginea)*	September - April	Diurnal searches in shoreline survey.
*Pectoral Sandpiper *(Calidris melanotos)*	September - April	Diurnal searches in shoreline survey.
Eastern False Pipistrelle *(Falsistrellus tasmaniensis)*	All year	Habitat assessment and acoustic detection.
Giant Burrowing Frog *(Heleioporus australiacus)*	September - May	Aural-visual surveys.
Swift Parrot *(Lathamus discolor)*	March – September**	Diurnal searches via random meander coupled with vegetation surveys.
Green and Golden Bell Frog *(Litoria aurea)*	November - March	Aural-visual surveys and call playback.
Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis)*	All year	Diurnal searches via random meander coupled with vegetation surveys.
Barking Owl *(Ninox connivens)*	May – December	Call play back, nocturnal spotlighting.
Eastern Curlew *(Numenius madagascariensis)*	All year	Diurnal searches in shoreline survey.
*Whimbrel *(Numenius phaeopus)*	August - March	Diurnal searches in shoreline survey.
Superb Fruit-Dove *(Ptilinopus superbus)*	All year	Diurnal searches via random meander coupled with vegetation surveys.
*Common Tern *(Sterna hirundo)*	September - March	Diurnal searches in shoreline survey.
Little Tern *(Sternula albifrons)*	September - March	Diurnal searches in shoreline survey.
*Crested Tern *(Thalasseus bergii)*	September - March	Diurnal searches in shoreline survey.
Masked Owl *(Tyto novaehollandiae)*	May - August	Call play back, nocturnal spotlighting.
Terek Sandpiper *(Xenus cinereus).*	September - March	Diurnal searches in shoreline survey.

*indicates non-threatened migratory species.
**Due to survey timing constraints, some species could not be surveyed during the ideal period, however habitat assessment were undertaken to identify suitable habitat.

3.3.7.4 Diurnal surveys

3.3.7.4.1 Birds

Visual and aural identification of birds were conducted at dawn or dusk for one hour when overall activity is generally the highest. Where possible, surveys were not conducted during adverse hot, wet, or windy weather. Walking through potential habitat was used to flush out cryptic species. Opportunistic sightings were also recorded during vegetation surveys and fauna survey work.

3.3.7.4.2 Mammals and reptiles

Identification of diurnal mammals and reptiles was undertaken including active searches for mammal scats, scratches and tracks as well as overturning rocks, logs and man-made materials (i.e. rubbish, small structures) for reptiles.

Motion-detection cameras were set up at suitable locations at Level 3 sites.

3.3.7.5 Migratory and shore bird surveys

Migratory and coastal bird species were targeted at sites where wetlands, coast saltmarsh, mangroves occur, or where the site is adjacent to water. Bird observations were undertaken at dawn or dusk for natural wetlands. Seasonal constraints are an important factor in identifying migratory birds present. Species known to occur in the area, and / or listed as threatened were targeted during the surveys.

3.3.7.6 Nocturnal surveys

3.3.7.6.1 Nocturnal birds

Nocturnal birds were surveyed using call identification, call playback and spotlighting at night. Call playback was not undertaken during times when targeted species may be negatively affected by disturbance. For owl species, call playback was played intermittently for five minutes followed by 10 minute listening. After all calls were played, spotlighting was undertaken for a further 10 minutes.

3.3.7.6.2 Mammals and reptiles

Nocturnal arboreal and ground dwelling mammals as well as reptiles were targeted via spotlighting. Surveying was undertaken during the night at the identified locations.

3.3.7.6.3 Amphibians

Surveying was focused on nocturnal techniques, with less emphasis on diurnal census although this was used as an additional technique targeting basking frogs. Daytime survey effort was undertaken within areas considered suitable habitat. Any watercourses that are present, and its surrounding habitat, were searched. Nocturnal surveying involved call identification, call playback, and spotlighting at night.

Any observance of *Gambusia holbrooki* (a fish predator to amphibian species) was recorded.

3.3.7.7 Microchiroptera (Microbat) and Megachiroptera (Megabat) Bat Species

Ultrasonic echolocation detection was undertaken over multiple nights using an 'Anabat' call detectors at suitable sites. All Anabat data recordings were analysed by a specialist. Trapping of microbats were not undertaken due to the greater potential for impact to individuals.

Surveying for megabats (i.e. Grey-headed Flying-fox) included a combination of spotlighting and call identification. The known camp at Myles Dunphy Reserve was visited. Targeted searches for bat guano and evidence of foraging was undertaken during the habitat survey. An analysis of the foraging resources available, such as identification of preferred food species was also undertaken.

3.3.8 Biodiversity Values Map

At all surveyed sites, areas mapped on the Biodiversity Values Map (October 2020 edition) were validated by ground truthing. Where relevant, areas for re-mapping were proposed.

3.3.9 Waterways assessment

Visual surveys of waterway habitat at major creeks were undertaken, where possible. This generally included an assessment of the following features:

- Riparian vegetation
- Waterway movement
- Presence of pools / riffles
- Water colour
- Water turbidity
- Instream vegetation / weeds
- Presence of aquatic fauna
- Bank erosion and stability.

3.3.10 Weed infestations

Any weed infestations of species listed on the *Greater Sydney Regional Strategic Weed Management Plan 2017-2022* (LLS 2019) were recorded. Weed infestations were defined as areas where weeds make up >80% percentage foliage cover. Any individual Weeds of National Significance (WoNS) were also noted.

3.3.11 Street tree green corridors

Approximately 29km of street trees in areas identified as street tree green corridors (refer to Section 3.2.1) were assessed by a rapid assessment. This assessment method was developed with consideration of the field methodology in the *Hurstville Street Tree Management Study* (Eco Logical 2015). The assessment generally recorded the key species, tree corridor health, the provision of fauna habitat and approximate canopy coverage for each street corridor. The assessment considered other features of the street that provide opportunities and constraints for increasing the corridor including the presence of:

- Constructed footpaths on one or both sides of the street
- Overhead powerlines
- Large shadow from buildings that would limit growth
- Slope of the street
- General level of vegetation in adjoining properties.

A combination of driving (at a low speed) and walking the streets was undertaken depending on the active traffic on the streets and visibility of vegetation. The suitability of fauna habitat was noted and any species observed were recorded.

3.3.12 Mapping

GPS field data was digitised into polygons and points over a base aerial image. Significant habitat features and locations of threatened species were marked using a GPS. Data recorded in the field was uploaded to the ESRI ArcView (Version 10.2.1) GIS running on Windows 10.

Maps for each site were developed to display key features including vegetation communities, waterways, habitat features and significant species, as relevant.

3.4 Community and stakeholder engagement

Community and stakeholder engagement was undertaken throughout the project. Key community and stakeholder groups include:

Key stakeholders:

- Youth Advisory Committee
- Aboriginal Advisory Committee
- Oatley Flora and Fauna Conservation Society
- Climate Citizens Lobby, Australia, Sydney City Group.

Local resident action community groups:

- Lugarno Progress Association
- St George District Residents Association
- South Hurstville Residents Association
- Beverly Hills Owners Association
- Kogarah Residents Association
- Penshurst Action Group.

Environmental groups / agencies

- Bushcare groups
- Georges River Environmental Alliance
- Cooks River Alliance
- Georges Riverkeeper
- Streamwatch & Landcare (combined)

- The Department of Planning, Industry and Environment (DPIE) Environment, Energy and Science (EES) division
- National Parks and Wildlife Service (NPWS)
- Powerful Owl Project.

3.4.1 Community engagement activities

Key community engagement activities that were undertaken are outlined in

Table 3-4.

Table 3-4. Key community engagement activities

Activity	Groups engaged	Timing
Post on the Georges River Council website 'YourSay' page.	Open to public.	Throughout project
Questionaries and interactive map posted on Georges River Council website 'YourSay' page	Open to public.	12th November to 11th December 2020
Invitation email to join to webinar and share information and data. Key stakeholders were invited to speak at the webinar.	Key stakeholders, Local resident action community groups and Environmental groups / agencies	13th November 2020
Webinar (1 hour)	Key stakeholders, Local resident action community groups and Environmental groups / agencies	26th November 2020
Field day	Volunteers of Oatley Flora and Fauna Conservation Society	9th February 2021
Webinar (2 hour)	Open to public.	Indicatively scheduled for August 2021

The outcomes of the community and stakeholder engagement activities are outlined in Section 6.

3.5 Limitations

Due to the large size of the LGA and timeframe constraints, the whole LGA was assessed during the desktop assessment stage. As it was not achievable to assess the whole LGA via field based surveys, a specific methodology was developed to generally target larger patches of bushland, streets with important connectivity values and areas of high conservation value which had a higher likelihood of identifying biodiversity within the study area (i.e. Level 2 and Level 3 sites). As such, biodiversity in more urban and developed areas may be under represented as the remaining areas (Level 1 areas) were subject to a desktop assessment. Private properties were also not considered for field assessment due to small lot sizes, and as such lower likelihood of biodiversity, as well as access issues.

Field surveys were generally consistent with the recommended methods in the most recent guidelines (refer to Section 3.3.1), however some survey effort and locations were tailored when in the field due to access constraints, safety and prioritisation. Where vegetation types could not be directly surveyed, visual assessments were undertaken. The outcomes of the visual assessment, in conjunction with information collected in the desktop assessment, were used to describe these areas.

Due to the brevity of the survey and its timing during one season (Summer 2020-21), the full spectrum of species likely to occur in the LGA cannot be fully quantified or described in this Biodiversity Study. As stated by the DEC (2004) '*The absence of a species from survey data does not necessarily mean it does not inhabit the survey area. It may simply mean that the species was not detected at that time with the survey method adopted and the prevailing seasonal or climatic conditions.'* Additionally, not all habitat features have been recorded (i.e. hollow bearing trees) by GPS, however they were considered in the habitat assessment.

Species of microbats (Microchiroptera) were captured by ultrasonic echolocation detection. Due to the nature of the analysis, some species cannot be distinguished due to highly similar call signatures. As such, some microbat species are identified as being 'possible' where the distinction between two species could not be confirmed.

Fieldwork planning endeavoured to undertake surveys during optimal conditions (i.e. weather, time of day, tidal level) for the majority of species, however this was not always possible due to long periods of inclement weather (i.e. heavy rainfall throughout the season) and project time frames. As such, some groups of species may have been less detectable (i.e. nocturnal and diurnal birds, arboreal mammals and reptiles are typically less detectable during rainfall). Furthermore, survey methods were not focused on invertebrates, therefore records of these species are low or absent. This was undertaken intentionally as these species are typically not protected under legislation.

The street tree corridor assessment does not provide a comprehensive inventory of all trees along the surveyed corridors. This is due to the goals of the survey to assess the biodiversity values, current connectivity and identify opportunities for enhancement. The species lists provides an overview of the key species in each street corridor.

Several waterways were not able to be assessed due to being highly modified (i.e. channelised stormwater, diverted underground). Where possible, assessments of the artificial wetlands at applicable sites were undertaken. This captured similar data in regard to the habitat values provided by the waterbodies.

Some threatened species records are considered sensitive, and their locations have been 'denatured' (i.e. the locations moved) to preserve the safety of the records. Depending on the sensitivity of the species, the locations may be denatured between 1km and 10km from the actual recorded location. As such, in this Biodiversity Study the locations of species records may appear in unusual locations on maps, or not be represented on maps. However, the assessment of species are based on more specific records. The species in which the locations have been denatured are listed in Table 3-5.

Table 3-5. Threatened species which locations are denatured.

Scientific name	Common name	Scientific name	Common name
Fauna		**Flora**	
Lophoictinia isura	Square-tailed Kite	*Caladenia tessellata*	Thick Lip Spider Orchid
Pandion cristatus	Eastern Osprey	*Persoonia hirsuta*	Hairy Geebung
Callocephalon fimbriatum	Gang-gang Cockatoo		
Lophochroa leadbeateri	Major Mitchell's Cockatoo		
Lathamus discolor	Swift Parrot		
Ninox strenua	Powerful Owl		

4 LITERATURE REVIEW

4.1 Vegetation Mapping Report (Cardno 2018)

The study comprised a comprehensive survey of existing tree cover across the Georges River LGA. The study utilised GIS analysis of satellite imagery and ground-truthing to estimate vegetation cover and canopy height.

The average percentage canopy cover was 29-33%. The highest average values located within the bushland areas (79%), decreasing progressively in the open space (26%), low density (16%), medium density (13%) and high density (12%) land use. Canopy height in bushland areas was found to mostly be over 15m high. Estuarine areas were typically shorter, with a canopy height of approximately 5-10m.

The report concluded that reaching a revegetation target of 40.4% by 2038 is achievable. It provided recommendations for revegetation works in each land use zone. Open space, low density and medium density land use zones were identified as having the greatest potential for improvement as well as for contributing to the enhancement of existing and the creation of new wildlife corridors between areas of remnant bushland.

4.2 Hurstville Street Tree Management Study (Eco Logical 2015)

The study documented street trees across the entire former Hurstville LGA. It identified key characteristics of the species including species, location, damage, tree health and age.

Across the former Hurstville LGA 14,819 trees were recorded comprising 104 genera. The most common species were *Lophostemon confertus* (Brush box) and *Callistemon spp.* (Bottlebrushes) which made up approximately 48% of all trees. Other common species comprised *Eucalyptus microcorys, Melaleuca quinquenervia* and *Tristaniopsis laurina*.

Rare species included *Araucaria bidwillii* (one plant), *Koelreuteria elegans* (one plant), *Thevetia peruviana* (one plant), *Laurus nobilis* (three plants) and *Omalanthus populifolius* (two plants). These species are likely to have been planted by local residents.

Approximately 96% of trees were found to be in good condition. Management measures were provided for the maintenance and removal of some poor condition trees.

The study notes that some street trees provide habitat for fauna species such as the Glossy Black Cockatoo (a threatened species in NSW). However, it was not specifically stated if the species was observed during the survey.

4.3 Herpetofaunal Community of the Constructed Lime Kiln Bay Wetland, South Sydney, New South Wales (Mo 2015)

This paper provides a detailed description of the herpetofaunal assemblages at Lime Kiln Bay Wetland collected between 2006 and 2014. The wetland was constructed by 2001 and now provides habitat for various species. The paper states that 23 species were detected by incidental observations and targeted surveys including six frogs, one freshwater turtle, 12 lizards and four snakes.

4.4 Hurstville Council Biodiversity Study (Eco Logical 2014)

A study was undertaken to report on the biodiversity location, condition and protection measures across the former Hurstville LGA. The desktop review generally found that:

- Approximately 216 .6 ha, or 9.6%, of the pre 1750 original extent of remnant vegetation was still present in the Hurstville LGA.
- There were 15 separate vegetation communities mapped within the LGA, seven of which conform to EECs.
- Approximately 13.8 ha (or 6% of Hurstville's remnant vegetation) was classified as an EEC under the then *Threatened Species Conservation Act 1995* (TSC Act) (now replaced by the BC Act).

- Since 1980 there have been seven records of threatened flora species and 13 records of threatened fauna protected under the NSW TSC Act recorded in the Hurstville LGA.
- Several KTPs under State and / or Commonwealth legislation were present.
- Most habitat corridors were identified along waterways and the foreshore of the Georges River.

The field studies were undertaken by two ecologists over approximately five days at five key locations which covered approximately 98ha. Vegetation condition was identified in a 5-level ranked system (red as the worst, to green as the best condition) provided by Council. The key sites comprised:

- Oatley Park
- H. V. Evatt Park and Lugarno Park
- Lime Kiln Bay and Lime Bay Reserve
- Gannons Park
- Riverwood Park.

Each of the sites had high biodiversity values due to the presence of relatively intact natural vegetation, EECs, a variety of fauna habitat elements and habitat for threatened fauna species.

In general, the existing vegetation mapping (OEH 2013) was to a high accuracy. Only minor changes were made to the mapped community extent and in a few locations the vegetation community type. Ten vegetation communities were present in the survey areas including five TECs, these comprised:

- *River-flat Paperbark Swamp Forest* – Endangered under the BC Act
- *Coastal Freshwater Wetlands* – Endangered under the BC Act
- *Swamp Oak Forest* – Endangered under the BC Act and EPBC Act
- *Coastal Saltmarsh* – Endangered under the BC Act and Vulnerable under the EPBC Act
- *Littoral Rainforest* – Endangered under the BC Act and Critically Endangered under the EPBC Act.

Vegetation was generally in moderate to good condition, however there were some areas affected by serious weed invasion and highly invasive weeds (i.e. *Alternanthera philoxeroides* (Alligator Weed)). A total of 29 weed species, including seven priority weeds were recorded, three of which are WoNS.

Two threatened species and a threatened population was recorded during the site visit including a Powerful Owl (*Ninox strenua*) at Gannons Park, an incidental observation of an Eastern Osprey (*Pandion cristatus*) and a number of *Acacia prominens* (Gosford Wattle) (part of an endangered population) at Oatley Park, Gannons Park, H.V. Evatt Park / Lugarno Reserve and Riverwood Park.

4.5 Myles Dunphy Reserve and Wetland Plan of Management (Hurstville City Council 2013)

Hurstville City Council developed the Plan of Management (the plan) of Myles Dunphy Reserve and Wetland to guide the management of the reserve. The plan addresses various characteristics of the reserve including the history, land use, hydrology, fire regime, visual elements, built structures and legislative provisions.

The plan states that prior to 1788 the northern part of the reserve would have been covered in Turpentine Ironbark Forest in the sheltered gullies. Closer to Georges River there would have been a mix of Paperbarks (*Melaleuca spp.*) in the riparian zone and reeds (*Phragmites spp*.) on the stream edge. Mangroves would have populated the tidal areas.

Currently, there are seven native vegetation communities and one non-native community known within the reserve. Most of the vegetation by the river comprises mangroves transitioning to dryer communities at high elevations. Sydney Turpentine Ironbark Forest (Critically Endangered under the BC Act and EPBC Act) is found in small patches near the north eastern boundaries, especially south of Mulga Road.

The various vegetation communities and habitat features including drainage lines, wetlands, the estuary, woodlands, and rock shelves and boulders provide habitat for numerous fauna species.

Weeds have had a major impact on plant community health, especially adjacent to the drainage lines. Areas previously dominated by *Casuarina glauca* (Swamp Sheoak) are now dominated by a range of

woody weeds. In some cases, for example, the Coastal Freshwater Reedland, the native community is almost completely dominated by weeds. Listed weeds found within the park include *Lantana camara* (Lantana), *Chrysanthemoides monilifera ssp. rotundata* (Bitou Bush), *Chrysanthemoides monilifera subsp. monilifera* (Boneseed), and *Olea europaea. cuspidata* (African Olive), *Asparagus spp*. (Asparagus Fern) and *Anredera cordifolia* (Madeira Vine).

The key recommendations of the plan relating to biodiversity were to:

- Stabilise banks and address soil erosion and sedimentation
- Undertake flora and fauna surveys and publish the results for community information
- Continue bush regeneration and support of Bushcare groups
- Manage the informal Grey-headed Flying-fox camp
- Remove and enforce encroachments.

4.6 Kogarah City Council Fauna Biodiversity Study (Total Earth Care 2012)

A study was undertaken to report on the local fauna across the former Kogarah LGA. The study included a comprehensive desktop assessment to identify potential fauna in the area and a field survey focussing on seven parks and reserves covering approximately 43ha.

Field surveys were conducted in spring and summer of 2011 / 12 and comprised of targeted surveys for the various fauna species. The surveys identified 78 fauna species including six species listed as threatened or migratory under the NSW and / or Commonwealth legislation as well as pest species. These include:

Threatened species:

- Little Lorikeet (*Glossopsitta pusilla*) – recorded at Moore Reserve
- Powerful Owl (*Ninox strenua*) – recorded at Poulton Park
- Grey Headed Flying-fox (*Pteropus poliocephalus*) – recorded at Poulton Park, Carss Bush Park, Moore Reserve, Kyle Williams Reserve, Shipwrights Reserve, Bald Face Reserve and Oatley Pleasure Grounds
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) – recorded at Poulton Park, Moore Reserve, Shipwrights Reserve, Carss Bush Park, Bald Face Reserve and Oatley Pleasure Grounds
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) – recorded at Kyle Williams Reserve
- Red-crowned Toadlet (*Psedophryne australis*) – recorded at Kyle Williams Reserve.

Migratory species:

- Latham's Snipe (*Gallinago hardwickii*) – recorded at Moore Reserve.

Pest species:

- Rock Dove (*Columba livia*)
- Spotted Turtle-Dove (*Streptopelia chinensis*)
- Fox (*Vulpes vulpes*)
- Black Rat (*Rattus rattus*).

4.7 Neverfail Bay and Oatley Point Reserve Fauna Study (Biosphere Environmental Consultants 2010)

This report outlined the results of a fauna survey conducted at two bushland reserves in Kogarah LGA, Neverfail Bay and Oatley Point Reserve. An assessment was undertaken on vertebrate fauna present within the reserves and data was compared with results from a previous study (Biosphere Environmental Consultants 1998, see below). Recommendations were provided for the two reserves based on the results. The main findings of the report regarding fauna species recorded within the study are as follows:

- The fauna at the two reserves displayed similar results in that both had low numbers of terrestrial and frog fauna, lacked large reptiles and contained high numbers of exotic animals. In addition, both reserves contained possums, native birds and skinks.

- The low number of terrestrial mammals within the two reserves was thought to mainly be due to predation, as cats were detected hunting in both of the reserves. Both reserves lacked creeks and drainage areas which were determined to be the cause of such low numbers of frogs within the reserves.
- Comparisons between studies previously conducted within the reserves (1998) showed several trends:
    - There was an increase in the number of possums and native birds that utilised both reserves
    - Bats continued to use the reserves
    - Some species appeared to have been lost from the reserves (i.e. no sugar gliders were detected in 2010 study)
    - Feral animals continued to be present within both reserves.

4.8 Kogarah City Council Flora Biodiversity Study (Total Earth Care 2009)

A study was undertaken to report on the floral biodiversity across the former Kogarah LGA. The study was undertaken to identify plant communities, undertake vegetation mapping, develop species inventories and identify significant flora such as TECs.

The study focused on 14 key parks and reserves which covered approximately 53ha. Field surveys were conducted in autumn and winter 2009 and generally comprised a random meander methodology.

Seven vegetation communities were present in the survey areas including four TECs including, these comprised:

- *Sydney Turpentine Ironbark Forest* – Critically Endangered under the BC Act and EPBC Act
- *Southern Sydney Sheltered Forest on Transitional Sandstone Soils* – Endangered under the BC Act
- *Coastal Saltmarsh* – Endangered under the BC Act and Vulnerable under the EPBC Act
- *Swamp Oak Forest* – Endangered under the BC Act and EPBC Act.

One threatened species and one threatened population was recorded during the site visit including a Magenta Lilly Pilly (*Syzygium paniculatum)* recorded at Moore Reserve and a number of Gosford Wattle (*Acacia prominens*) endangered population at Poulton Park, Carss Bush Park, Moore Reserve, Shipwrights Bay Reserve and Letitia Street. Additionally, the Rare or Threatened Australian Plant (ROTAP) species (as described in Briggs and Leigh 1996) *Tetratheca neglecta* and *Hibbertia nitida* were recorded in Poulton Park.

4.9 Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area (DECC 2008)

The study provides a collection of vertebrate fauna data in the Sydney Metropolitan Catchment Management Authority (CMA) area. The study collects data from public sources and community groups and identifies key species of conservation value in various areas of the CMA area.

The study identifies the Lower Georges River area (comprising the Bankstown, Sutherland and former Hurstville LGA) as having high biodiversity value. This is due to the high faunal diversity, estuarine areas, wetlands, bushland and migratory waders.

The Lower Georges River area is noted to have high quality habitat remnants including features of habitat connectivity, fauna habitat, trees hollows and threatened species.

4.10 Terrestrial Fauna of Conservation Concern and Priority Pest Species (DECC 2007)

This report provides a large scale review of the fauna found across greater Sydney, their habitats and conservation significance. The report mentions several species that are known from the Georges River area, these include the following threatened species:

- Green and Gold Bell Frog (*Litoria aurea*) – an extremely rare resident and declining
- Australasian Bittern (*Botaurus poiciloptilus*) – a rare visitor and declining
- Black-chinned Honeyeater (*Melithreptus gularis gularis*) – rare resident and declining
- Squirrel glider (*Petaurus norfolcensis*) (at the time of this report it was not listed as threatened) – extremely rare resident and probably declining
- Southern Myotis (*Myotis macropus*) (formerly known as the Large-footed Myotis (*Myotis adversus*) at the time of this report in which time it was not listed as threatened) – rare resident and probably declining.

And non-threatened species:

- Satin bowerbird (*Ptilonorhynchus violaceus*) – common resident.

4.11 Fauna Survey of the Bushland Reserves of Kogarah (Biosphere Environmental Consultants 1998)

This report outlines the results of a twelve month fauna survey conducted across fourteen reserves in the former Kogarah LGA. The fauna survey involved undertaking assessments within each reserve to identify the extent of mammal, bird, reptile and frog species present. The results from the fauna survey were to be used, in combination with floristic data from the reserves, to determine the conservation values of the reserves and identify management issues relating to the fauna and habitat requirements and land use of reserves. The main findings of the fauna study are outlined below.

- Terrestrial mammals and frogs occurred in considerably low numbers across the reserves. The majority of terrestrial mammals identified within the reserves were introduced, only one species, the Brown Antechinus (*Antichinus stuarti*), out of the seven observed within the reserve was native.
- Frogs were uncommon within the reserves, with only four species being recorded. Frogs were completely absent at six of the fourteen reserves.
- Reptiles, arboreal and flying mammals were slightly more diverse. Three species of arboreal mammals were observed, all of which were native, five species of bat, and eleven species of reptile (ten lizards, one snake).
- The Kogarah reserves contain a high diversity of bird life with a total of sixty five species of bird being recorded during the survey.
- The reserves that were larger in size contained a higher number of species. Poulton Park resulted in the highest fauna diversity and was considered the highest conservation value. No threatened species were recorded within any of the reserves.
- Suggested management for the reserves include bush regeneration, feral animal control, protection of waterways, resolution of conflicting land use and public education.

4.12 Kogarah Bushland Survey (The National Trust 1979)

The Kogarah Bushland Survey outlines the results of flora surveys conducted across sixteen reserves in the former Kogarah LGA by the National Trust of Australia. The general condition of each reserve was assessed and recommendations regarding weed control were described accordingly. The main findings of the report regarding flora species are summarised below.

- *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple) were the most frequently occurring canopy species across the LGA.
- The most commonly recorded trees and large shrubs of the understorey included *Banksia integrifolia* (Coast Banksia), *Banksia serrata* (Old-man Banksia), *Kunzea ambigua* (Tick Bush) and *Pittosporum undulatum* (Sweet Pittosporum).

- The most abundant ground layer species included *Calochlaena dubia* (Soft Bracken), *Lomandra longifolia* (Spiny-headed Mat-rush), *Polyscias sambucifolia* (Elderberry Panax), *Pteridium esculentum* (Common Bracken) and *Themeda triandra* (Kangaroo Grass) (formerly known as *Themeda australis* at the time of this study).
- Common exotic species recorded included *Lantana camara* (Lantana), *Asparagus aethiopicus* (Asparagus fern), *Ligustrum sinense* (Small-leaved Privet), while introduced groundcover species included *Tradescantia fluminensis* (Wandering Jew), *Ageratina Adenophora* (Crofton Weed), *Pennisetum clandestinum* (Kikuyu) and *Ochna serrulate* (Mickey Mouse Plant).

The report also noted the key threats in the area were generally:

- Residential use and gardening including intrusion of gardens into public land and dumping of garden waste
- Overuse and trampling of bushland
- Weed infestations.

5 BIODIVERSITY VALUES

5.1 Overview

5.1.1 Biodiversity values

The 'Biodiversity values' of the Georges River LGA include the natural variety and variability of all living organisms, and the ecological and environmental complexes in which they occur. It incorporates multiple levels of complexity including diversity of genetics, species and ecological communities as well as the ecological services provided by the biodiversity (i.e. pollination, regulation of climate, nutrient cycling). Biodiversity values also include social, economic, ethical and aesthetic features of the environment and are interconnected with human health and wellbeing.

There is no single measure of biodiversity. The area and condition of native vegetation and diversity of species is commonly regarded as a general measure of ecological integrity and biodiversity function. As such, various features of biodiversity are considered in this Biodiversity Study to describe the biodiversity values of the LGA.

5.1.2 Landscape features

5.1.2.1 Soils and geology

The soil types are important in describing the landscape and supporting different vegetation types. The LGA is generally located across two geologies. Triassic aged sandstone is located along the south east of the LGA and along the waterways and late-Triassic aged Wianamatta group shales in the northern sections of the LGA (DPIE 2020c).

There are numerous soil landscapes across the study area (Figure 5-1). Typically, 'Hawkesbury', 'Lucas Heights' and 'Gymea' soil landscapes are located in the southern and eastern half of the LGA. To the north of the LGA, 'Glenorie' and 'Blacktown' soil landscapes are more common on the shale geologies.

5.1.2.2 Climate and bioregion

The climate across the LGA is typical of central Sydney with average summer temperatures of approximately 26ºC and winter averages of approximately 17ºC (BOM 2021). Annual average rainfall is approximately 912mm with the highest rainfall typically in the autumn months.

The local climate is influenced by the coastal winds, the close proximity to the Georges River as well as heat islanding pressures of highly developed areas.

Under the Interim Biogeographic Regionalisation for Australia (IBRA), the LGA is located within the 'Sydney Basin' region and 'Sydney Cataract' subregion (DAWE 2021). The subregion typically comprises sandstone geologies with quaternary sands and muds along the Georges River. The landscape encompasses sandstone plateaus and low hills with shallow creeks leading down to larger rivers (DPIE 2021).

Figure 5-1 Soils landscapes

5.2 Vegetation communities

There are approximately 21 vegetation communities within the LGA (OEH 2016). This includes 17 native vegetation communities and four urban / non-native communities. The extent of these communities are outlined in Table 5-1 and their general locations shown in Figure 5-2 to Figure 5-6.

In total, the mapped vegetation covers approximately 724ha of the LGA, 389ha (54%) of this comprises native communities. Approximately 286ha (40%) of all vegetation and 188ha (48%) of all native vegetation is within public areas. The most extensive native plant community is 'Coastal Enriched Sandstone Dry Forest' which cover approximately 174ha (24%) of the mapped vegetation in the LGA (OEH 2016). The most extensive community is the non-native community 'Urban Exotic / Native' which covers approximately 313ha (43%) of the LGA. Most of the Urban Exotic / Native is mapped in areas of street vegetation in the more developed areas of the LGA.

Table 5-1. Mapped vegetation communities in the study area (OEH 2016)

Plant Community Common Name	BC Act TEC	EPBC Act TEC	Approx. area	% of all vegetation in LGA	Mapping code (OEH 2016)	PCT
Native vegetation communities						
Coastal Enriched Sandstone Dry Forest			174 ha	24%	S_DSF04	1776
Estuarine Mangrove Forest			64 ha	8.8%	S_SW01	952
Sydney Hinterland Exposed Sandstone Woodland			56 ha	7.7%	S_DSF15	1787
Sydney Hinterland Apple-Blackbutt Gully Forest			30 ha	4.1%	S_DSF17	1789
▲Seagrass Meadows		**Posidonia australis* seagrass meadows (E)	21 ha	2.9%	S_SW03	1913
Coastal Shale-Sandstone Forest			11 ha	1.5%	S_WSF06	1845
Sydney Turpentine-Ironbark Forest	Sydney Turpentine Ironbark Forest (CE)	Turpentine Ironbark Forest (possible) (CE)	7 ha	1%	S_WSF09	1281
Estuarine Swamp Oak Forest	Swamp Oak Floodplain Forest (E)	Coastal Swamp Oak (*Casuarina glauca*) Forest (E)	6 ha	0.8%	S_FoW08	1234
Coastal Enriched Sandstone Moist Forest			5 ha	0.7%	S_WSF02	1841
Sydney Foreshores Shale Forest			4 ha	0.5%	S_WSF08	1847
Coastal Sandstone Foreshores Forest			2.8 ha	0.4%	S_DSF06	1778
Riverflat Paperbark Swamp Forest	Swamp Sclerophyll Forest on Coastal Floodplains (E)		2.3 ha	0.3%	S_FoW05	1798
Coastal Saltmarsh	Coastal Saltmarsh (E)	Subtropical and Temperate Coastal Saltmarsh (possible) (V)	1.2 ha	0.2%	S_SW02	1126
Coastal Sandstone Riparian Forest			0.7 ha	0.1%	S_DSF08	1780
Estuarine Reedland	Swamp Oak Floodplain Forest (E)	Coastal Swamp Oak (*Casuarina glauca*) Forest (E)	0.7 ha	0.1%	S_FrW06	1808
Coastal Freshwater Wetland	Freshwater Wetlands on Coastal Floodplains (E)		0.6 ha	0.1%	S_FrW03	781

Plant Community Common Name	BC Act TEC	EPBC Act TEC	Approx. area	% of all vegetation in LGA	Mapping code (OEH 2016)	PCT
Coastal Escarpment Littoral Rainforest	Littoral Rainforest (E)	Littoral Rainforest and Coastal Vine Thickets (possible) (CE)	0.2 ha	0.03%	S_RF07	1833
Urban / Non-native communities						
Urban Exotic / Native			313ha	43%	Urban_E/N	-
Weeds and Exotics			15 ha	2.1%	Weed_Ex	-
Plantation (native and / or exotic)			5 ha	0.7%	Plant_n	-
Artificial Wetland			1.9 ha	0.3%	Art_WL	-

TEC: Threatened Ecological Community, PCT: Plant Community Type, (E): endangered, (V): vulnerable, (CE): critically endangered

*Includes only a 2.6m^2 section of the *Posidonia australis* seagrass meadows TEC

▲ the small section of *Posidonia australis* is also listed under the FM Act as the endangered population *Posidonia australis Hook.f. (1858), seagrass, Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie populations* (Refer to Section 5.6).

Descriptions of each native vegetation type are provided in Appendix E. Further details of the vegetation communities at each of the surveyed sites is provided in Volume 2.

5.2.1 Conservation significance

5.2.1.1 Threatened ecological communities

Several of the native communities are consistent with various TECs listed under the BC Act and / or EPBC Act, including:

- Coastal Saltmarsh, listed as Endangered under the BC Act
- Freshwater Wetlands on Coastal Floodplains, listed as Endangered under the BC Act
- Littoral Rainforest, listed as Endangered under the BC Act and Critically Endangered under the EPBC Act, respectively
- Swamp Oak Floodplain Forest, listed as Endangered under the BC Act and EPBC Act
- Swamp Sclerophyll Forest on Coastal Floodplains, listed as Endangered under the BC Act
- Sydney Turpentine Ironbark Forest, listed as Critically Endangered under the BC Act and EPBC Act.
- Seagrass Meadows (aquatic), listed as Endangered under the EPBC Act.

The TECs within the LGA are typically associated with sandstone geology in coastal areas, most of which are within Council parks and reserves. Many of these patches of TECs are small and restricted in extent by residential developments along foreshore areas. Weeds are also frequent, particularly within the understory of the patches of Estuarine Swamp Oak Forest, which is frequently dominated of *Tradescantia fluminensis* (Wandering Jew) and / or *Asparagus spp.* (Asparagus fern).

There is only one confirmed patch of Littoral Rainforest within the LGA which is located in H.V. Evatt Park. This TEC is of high significance due to its rarity both within the LGA and within Sydney.

The remaining patches of Sydney Turpentine Ironbark Forest are located on shale influenced soils on higher groundwithin the LGA. As such, these patches are in more urban areas and at risk from encroachment of surrounding development.

5.2.1.2 Other conservation significant communities

Most of the vegetation remaining in the LGA is on sandstone geology around the foreshore area. There is little shale influenced vegetation remaining as areas with this geology are mostly developed urban areas on the plateaus of headlands and the northern section of the LGA. As such, the few patches of

the shale influenced community Coastal Shale-Sandstone Forest, at Oatley Point Reserve, is of local conservation significance.

5.2.1.3 Resilience

The large size and lack of historical disturbance of several parks and reserves within the LGA supports resilience of the vegetation and residing species. Large patches of vegetation are typically more resilient as they are less impacted by fragmentation and edge effects (i.e. noise and light pollution, weed encroachment, changes in microclimate). As such, the diversity and abundance of species within the large patches are typically higher.

For example, Oatley Park and Lime Kiln Bay cover a huge 64.3ha area and comprise seven key native vegetation communities. The large size of the area, lack of historical disturbance and existing management support the resilience in the biodiversity and thus enables the persistence of native diversity and minimisation of environmental degradation.

5.2.2 Comparison and changes

5.2.2.1 Historical vegetation extents

The estimated pre-1755 vegetation mapping covers the area within the Georges River Catchment (DPIE 2015). The catchment comprises the southern two thirds of the LGA (refer to Section 5.6). Within this area, existing vegetation (OEH 2016) covers approximately 646ha (18%) of the area covered by pre-1755 vegetation (Figure 5-7).

Small patches of the pre-1755 vegetation is likely remnant. However, most areas that have native vegetation have experienced some clearing and regeneration since European settlement. The extent of this clearing is discussed for each of the surveyed sites in Volume 2.

The extent of most patches of Estuarine Mangrove Forest have expanded in the past 50 years. This is likely due to sedimentation from upstream developments and climate change impacts. At most of the surveyed sites which have mangroves, the expansion of mangroves are threatening other communities including TECs (i.e. Estuarine Swamp Oak Forest, Estuarine Saltmarsh).

5.2.2.2 Changes to vegetation mapping

During the field surveys, three previously mapped vegetation communities (OEH 2016) were identified to be incorrect. These areas have been re-mapped to reflect the ground-truthed vegetation communtities. These vegetation communities are summarised below with detailed descriptions provided for each location in Volume 2.

- Coastal Flats Swamp Mahogany Forest (PCT 1795): previously mapped at Carss Bush Park (OEH 2016)
- Southern Sydney Sheltered Forest (PCT 1785): previously mapped at Carss Bush Park and Kyle Williams Reserve (Total Earth Care 2009)
- Cumberland Riverflat Forest (PCT 835): previously mapped at Riverwood Park (Eco Logical 2014).

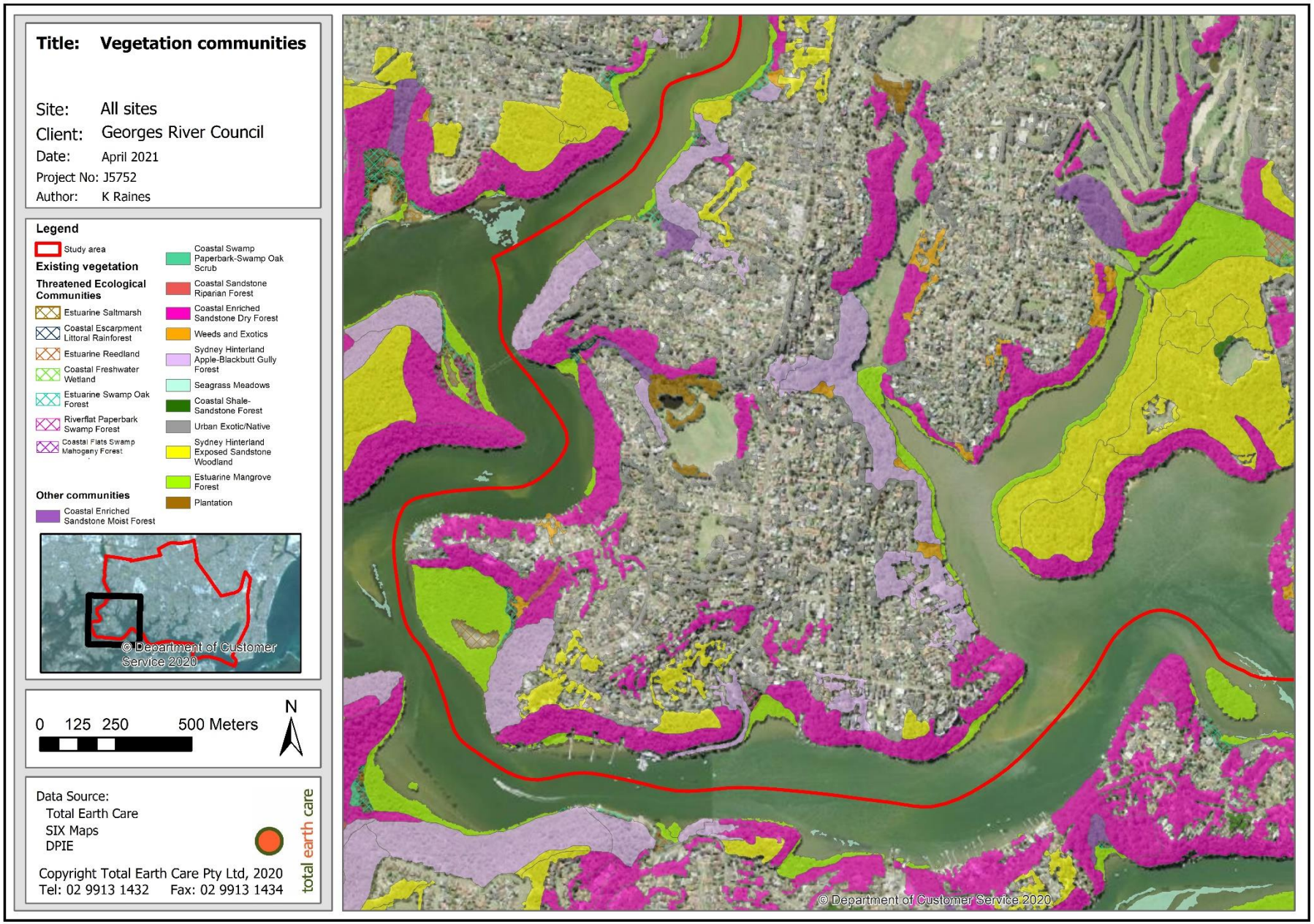

Figure 5-2 Vegetation communities

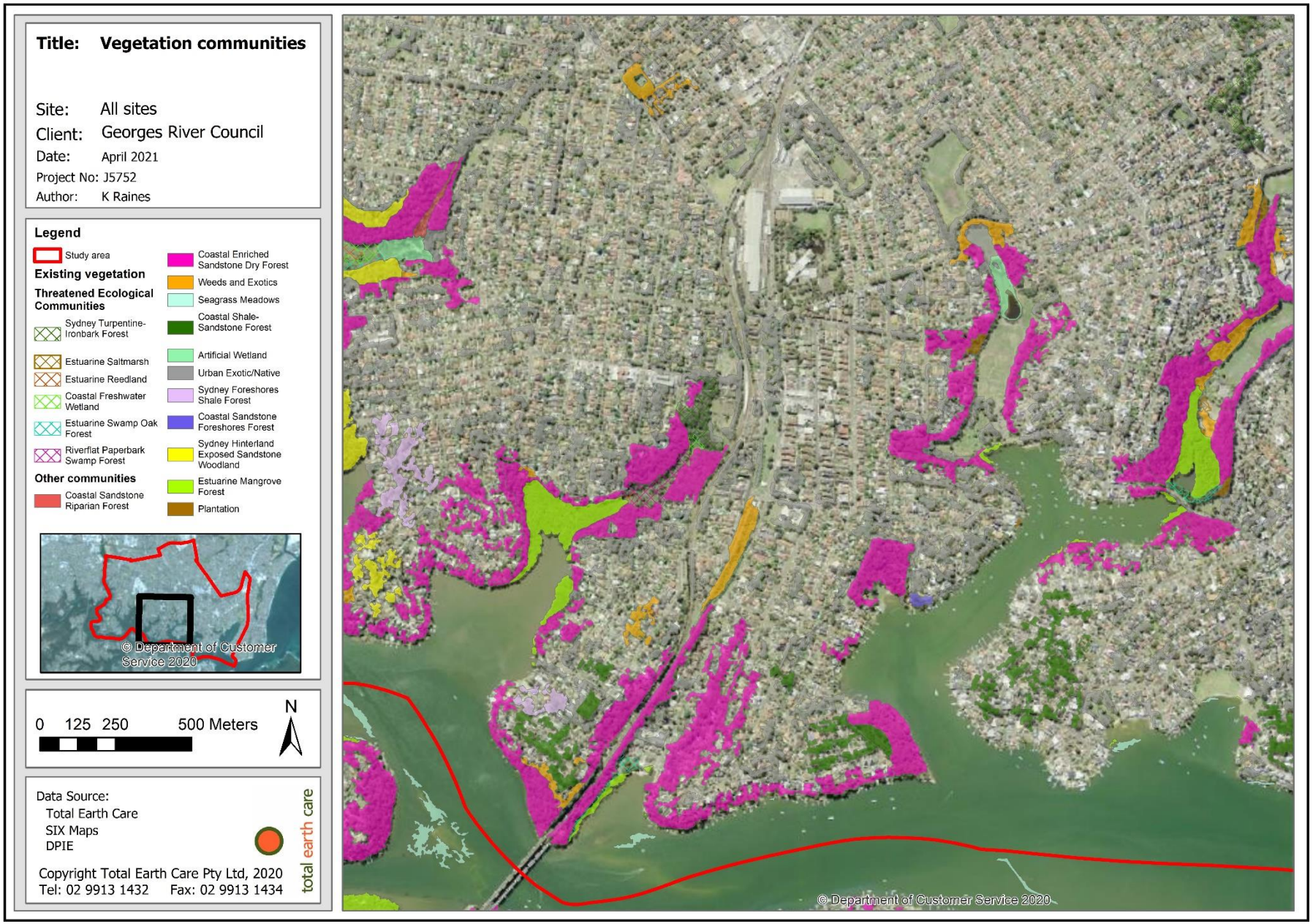

Figure 5-3 Vegetation communities

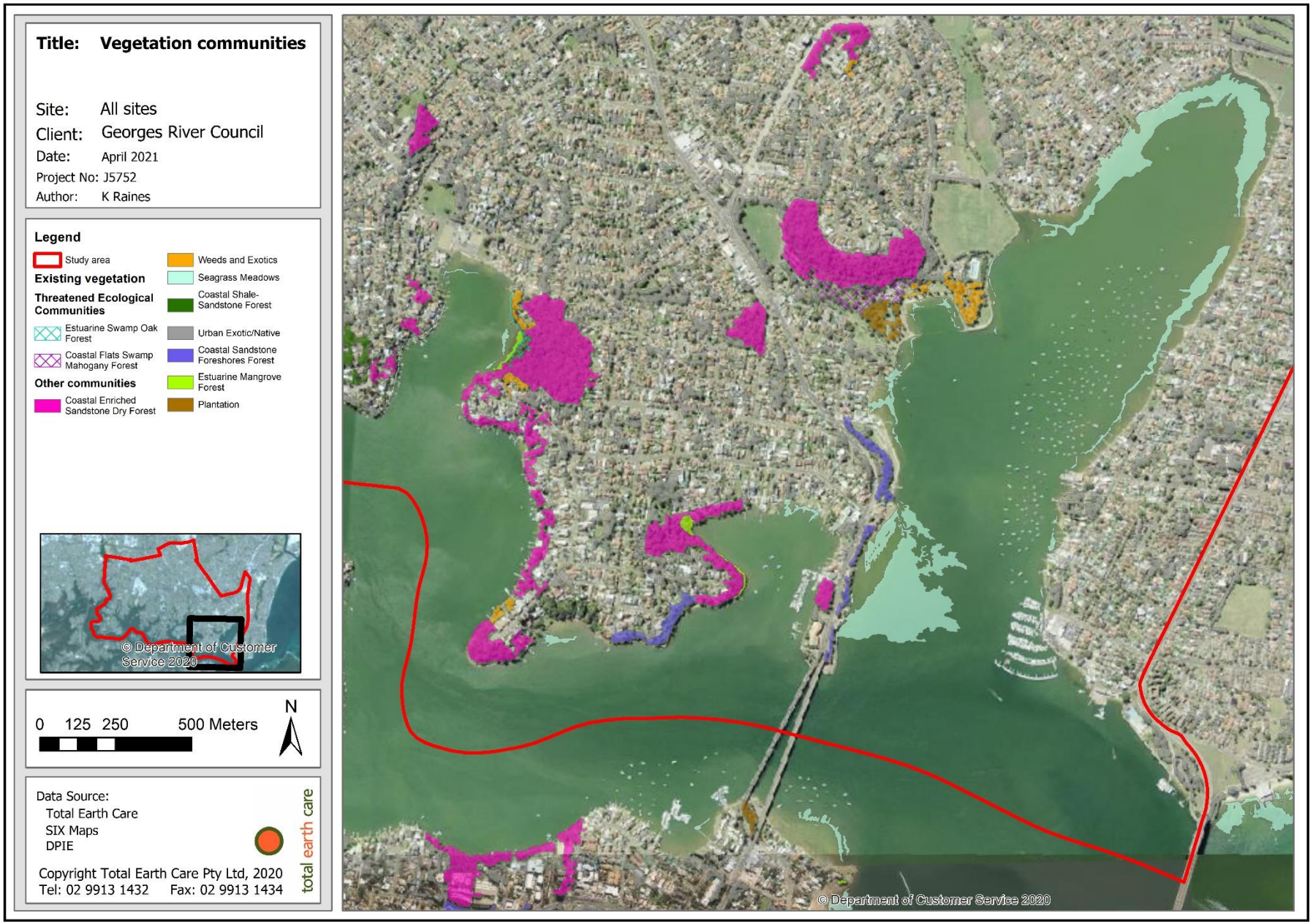

Figure 5-4 Vegetation communities

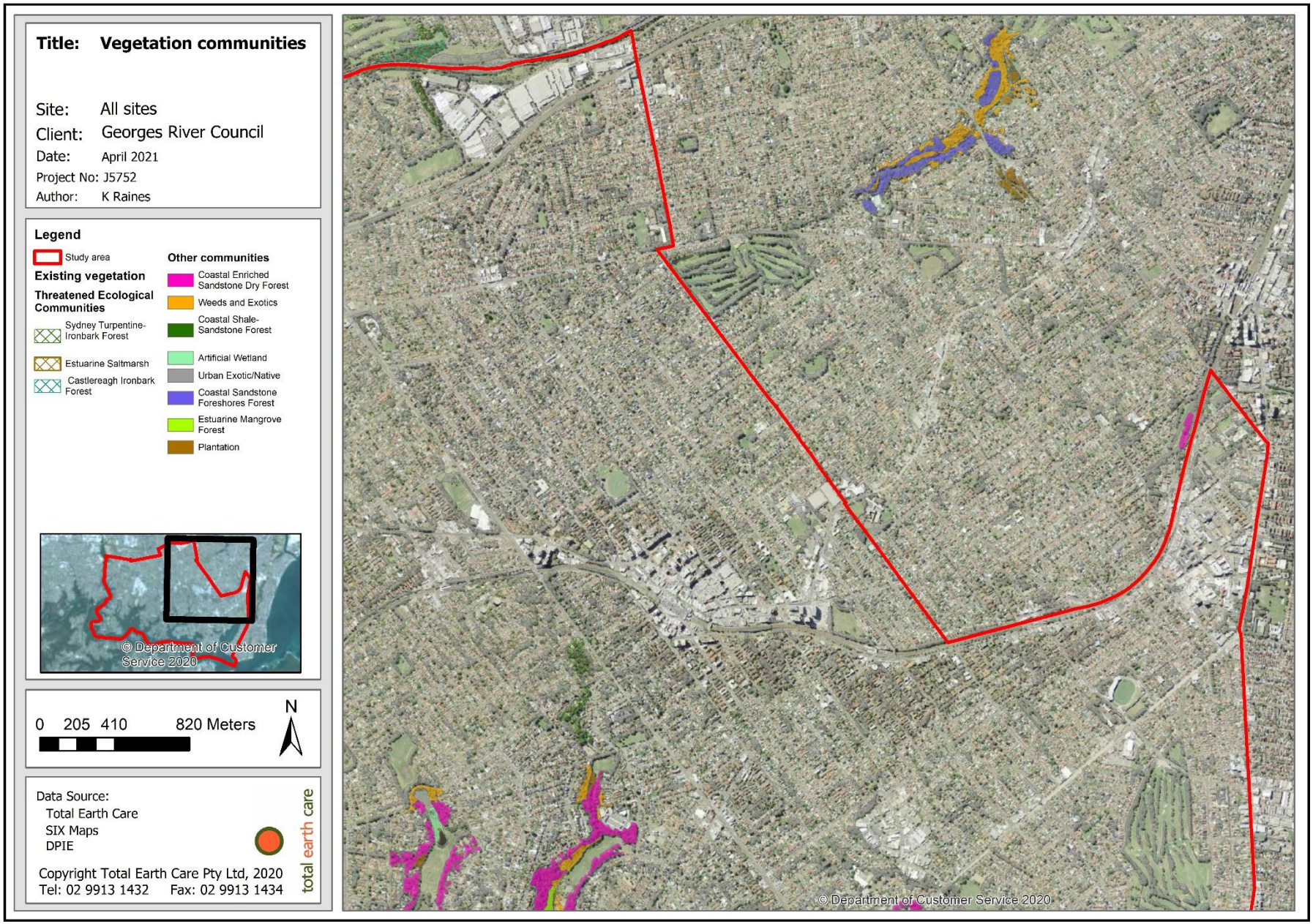

Figure 5-5 Vegetation communities

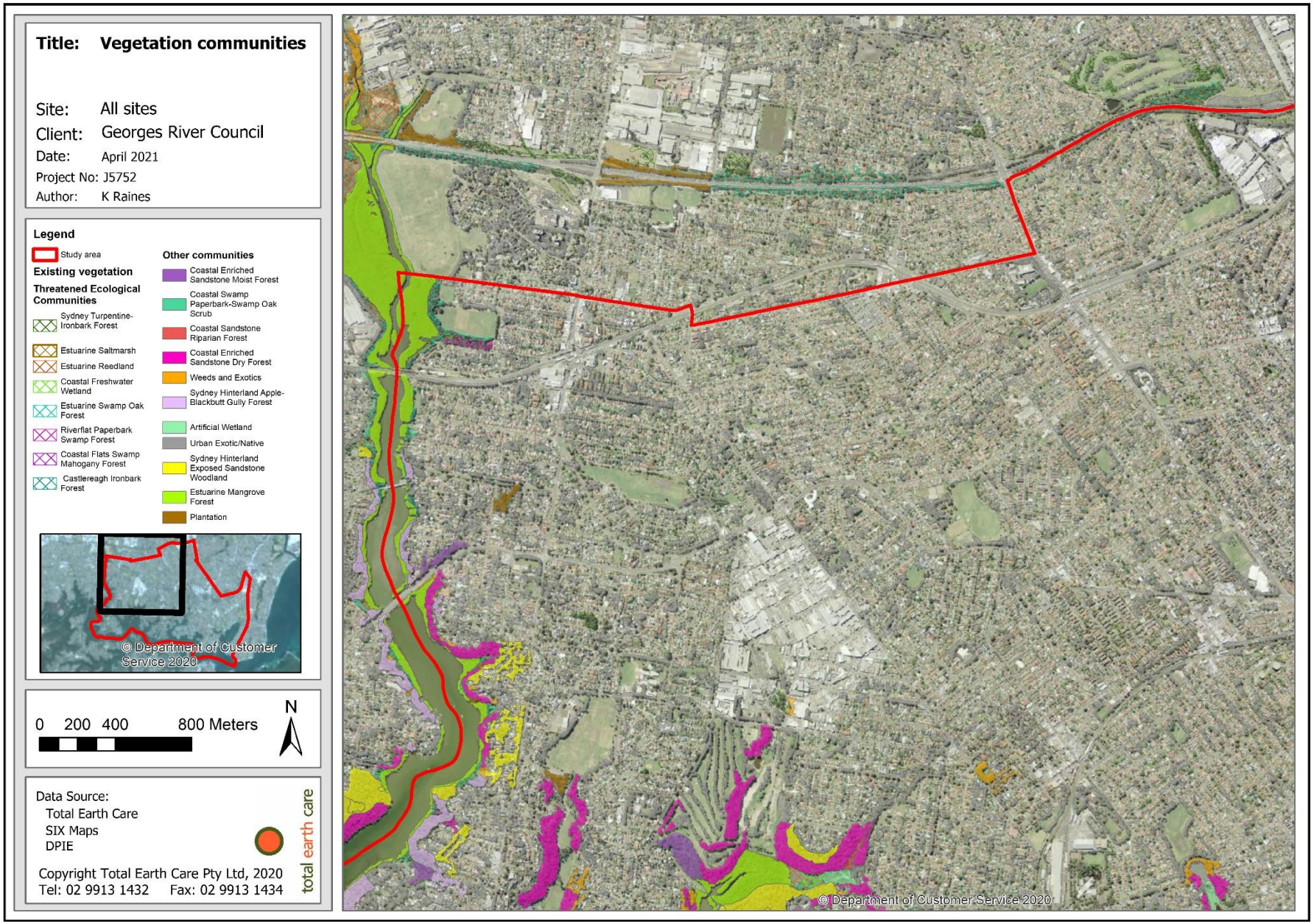

Figure 5-6 Vegetation communities

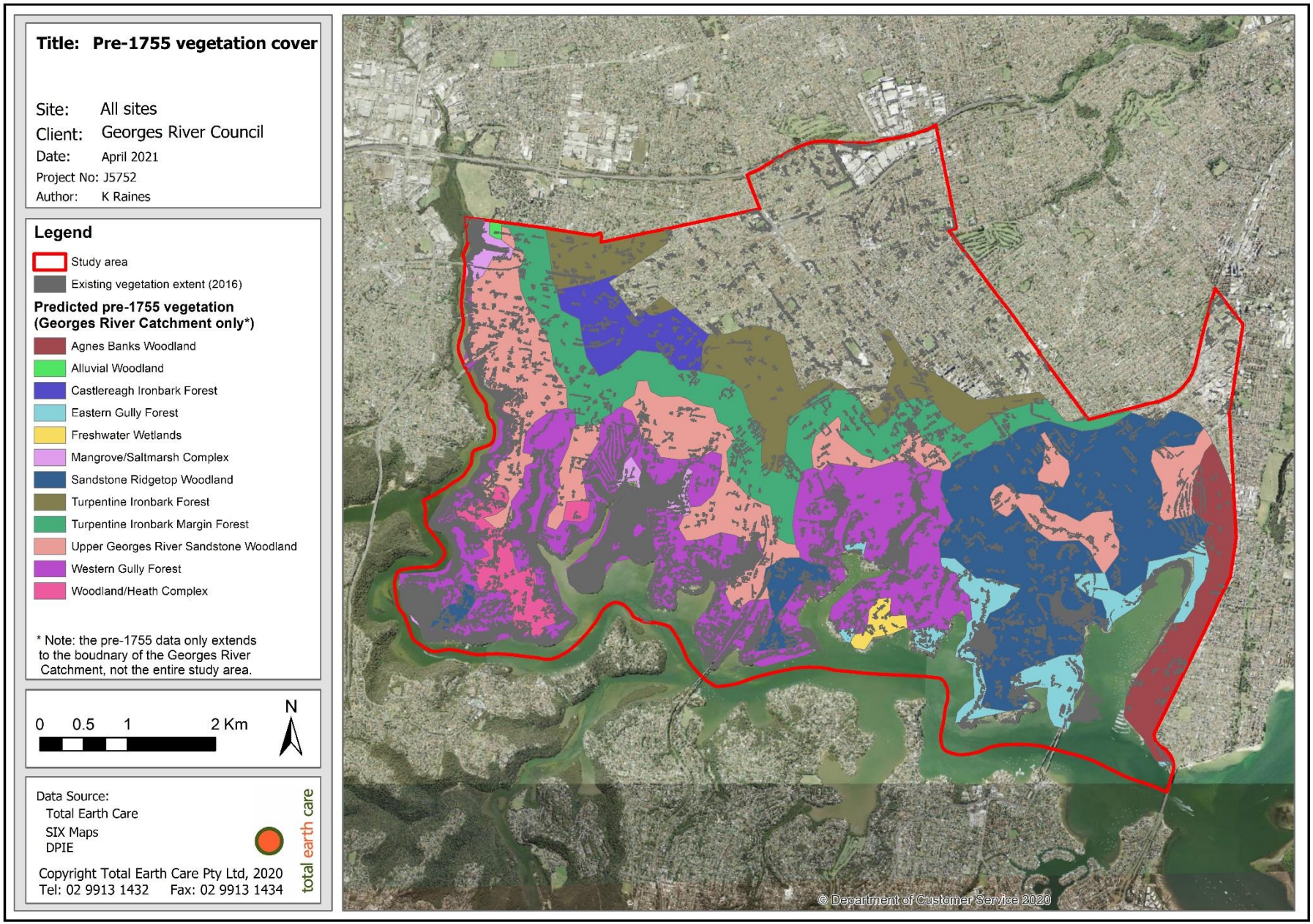

Figure 5-7 Estimated pre-1755 vegetation extent

5.3 Fauna

A total of 259 fauna species have been previously recorded within the LGA (DPIE 2020a). This includes 238 native species (92%) and 22 exotic species (8%). However, only 126 of these species have been recorded in the past decade (DPIE 2020a).

During the Biodiversity Study, 127 terrestrial species were recorded during the field surveys. This includes 113 native species (89%) and 14 exotic species (11%) from the following groups:

- 87 bird species (69%), 81 of which are native (93% of all bird species)
- 23 mammal species (18%), 18 of which are native (% of all mammal species)
- 6 reptile species (5%), all of which are native
- 5 amphibian species (4%), all of which are native
- 3 fish species (2%), 2 of which are native (50% of all fish species)*
- 3 invertebrate species (2%), 2 of which are native (66% of all invertebrate species)*.

*note: the Biodiversity Study focused on terrestrial biodiversity, as such the records of aquatic and invertebrate species are low and not well represented in the data.

The most common native species are typically urban bird species including the Sulphur-crested Cockatoo (*Cacatua galerita*), Noisy Miner (*Manorina melanocephala*) Rainbow Lorikeet (*Trichoglossus haematodus*). Other frequently recorded species included the Common Brushtail Possum (*Trichosurus vulpecula*), Common Ringtail Possum (*Pseudocheirus peregrinus*) as well as the Grey-headed Flying-fox (*Pteropus poliocephalus*) which is a threatened species.

Notable species include the Sugar Glider (*Petaurus brevicep*) which was recorded at several sites on the western side of the LGA. There have previously only been two records (in 2014 and 2018) of the species in the LGA.

Exotic and pest fauna species common in the LGA comprise various bird, mammal and fish species including the Spotted Turtle-Dove (*Streptopelia chinensis*), Common Myna (*Sturnus tristis*), Fox (*Vulpes vulpes*), Cat (*Felis catus*) and Mosquito Fish (*Gambusia holbrooki*). These species pose threats to native fauna across the LGA (refer to Section 5.10).

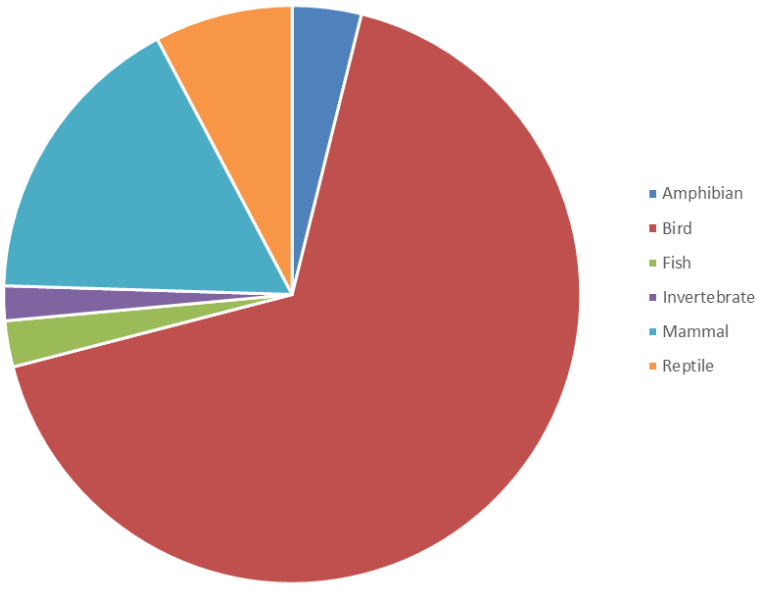

Figure 5-8. Fauna species group diversity, data collected during the Biodiversity Study

5.3.1 Conservation significance

During the Biodiversity Study, 8 threatened fauna species were recorded, these are as follows:

- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), listed as Vulnerable under the BC Act
- Greater Broad-nosed Bat (*Scoteanax rueppellii*), listed as Vulnerable under the BC Act.
- Grey-headed Flying-fox (*Pteropus poliocephalus*), listed as Vulnerable under the BC Act and EPBC Act
- Little Bent-winged Bat (*Miniopterus australis*), listed as Vulnerable under the BC Act
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*), listed as Vulnerable under the BC Act
- Powerful Owl (*Ninox strenua*), listed as Vulnerable under the BC Act
- Southern Myotis (*Myotis macropus*), listed as Vulnerable under the BC Act
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*), listed as Vulnerable under the BC Act.

Thirty-three conservation significant (threatened and / or migratory) species have been previously recorded within the study area (DPIE 2020a), however only 16 of these have been recorded in the past decade. These species are listed in Table 5-2 and shown in Figure 5-9 to Figure 5-13.

Table 5-2. Conservation significant fauna species previously recorded within the LGA (DPIE 2020a, Total Earth Care 2012)

Scientific name	Common name	BC Act	EPBC Act	Count of historical records in LGA	Most recent record (DPIE 2020a)	Recorded during the surveys
Actitis hypoleucos	Common Sandpiper	P	C,J,K	1	1991	No
Anthochaera phrygia	Regent Honeyeater	CE	CE	3	1984	No
Ardenna tenuirostris	Short-tailed Shearwater	P	C,J,K	1	2013	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V		3	1991	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		1	2014	No*
Cuculus optatus	Oriental Cuckoo	P	C,J,K	3	1984	No
Ephippiorhynchus asiaticus	Black-necked Stork	E		1	2005	No
Gallinago hardwickii	Latham's Snipe	P	C,J,K	1	2012[+]	No
Glossopsitta pusilla	Little Lorikeet	V		1	2012[+]	No
Haematopus longirostris	Pied Oystercatcher	E		2	1998	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V		8	2012	**Yes**
Hirundapus caudacutus	White-throated Needletail	P	V,C,J,K	1	2014	No
Hieraaetus morphnoides	Little Eagle	V		2	2017	No
Ixobrychus flavicollis	Black Bittern	V		0	N/A	No*
Lathamus discolor	Swift Parrot	E	CE	2	1991	No
Limosa lapponica	Bar-tailed Godwit	P	C,J,K	523	2020	No*
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V		2	1998	No
Lophoictinia isura	Square-tailed Kite	V		4	2016	No
[▲]Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V		0	N/A	**Yes**
Miniopterus australis	Little Bent-winged Bat	V		1	2013	**Yes**
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		2	2012	**Yes**
Myotis macropus	Southern Myotis	V		0	N/A	**Yes**
Ninox strenua	Powerful Owl	V		32	2017	**Yes**

Scientific name	Common name	BC Act	EPBC Act	Count of historical records in LGA	Most recent record (DPIE 2020a)	Recorded during the surveys
Numenius madagascariensis	Eastern Curlew	P	CE,C,J,K	10	2005	No
Numenius phaeopus	Whimbrel	P	C,J,K	1	1999	No
Pandion cristatus	Eastern Osprey	V		10	2015	No*
Phascolarctos cinereus	Koala	V	V	1	1989	No
Pseudophryne australis	Red-crowned Toadlet	V		1	2015	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	287	2015	**Yes**
Ptilinopus superbus	Superb Fruit-Dove	V		2	1996	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V		1	2012[+]	No
[▲]***Scoteanax rueppellii***	Greater Broad-nosed Bat	V		0	N/A	**Yes**
Thalasseus bergii	Crested Tern	P	J	3	1999	No
Tringa brevipes	Grey-tailed Tattler	P	C,J,K	1	2004	No

CE: critically endangered species, E: endangered species, V: vulnerable species, C: CAMBA, J: JAMBA, K: ROCKAMBA.
Note: Pelagic and marine species were not included in this list.
Note: two records of the Eastern Pygmy-possum *(Cercartetus nanus)* are also within the study area, however the records are from wildlife rescue. It is likely the species was rescued from outside the LGA.
*Species identified by community members during the community consultation, refer to Section 6. .
[▲]It is a likely this species, however the call signature identified during the echolocation recordings cannot be certain as it is highly similar to another closely related species.
[+]The species was recorded by Total Earth Care (2012).

The records of the Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), *Scoteanax rueppellii* (Greater Broad-nosed Bat) and Southern Myotis (*Myotis macropus*) collected during this study are the first within the LGA. Nevertheless, they have been previously recorded within 5km of the LGA and are all cryptic species that are difficult to identify.

There is a Grey-headed Flying-fox (*Pteropus poliocephalus*) camp located in Oatley, within Myles Dunphy Reserve (Figure 5-10). The last available data is from January 2021 in which 4,905 individuals were recorded flying out (n.a. 2021). As such, they are abundant within the LGA and frequently seen flying overhead at dusk.

The White-bellied Sea-Eagle (*Haliaeetus leucogaster*) was observed flying overhead during the survey, as such it is possible the species is using area of the LGA for foraging habitat, however may not be breeding within the LGA. This may be similar for other large seabirds, for example, the Eastern Osprey (*Pandion cristatus*), although not recorded during the Biodiversity Study, it has been recorded in the LGA in recent years by the community and in other studies (DPIE 2020a, Cornell Lab of Ornithology 2020). Additionally, a known breeding pair are present in the Sutherland Shire LGA, south of the Georges River.

Although not recorded in the LGA, there is potential that the following conservation significant species may utilise the LGA. These species were identified as having a moderate or high likelihood of occurrence in addition to those listed in Table 5-2 (refer to Appendix C).

- *Sharp-tailed Sandpiper *(Calidris acuminata)*
- *Black-faced Monarch *(Monarcha melanopsis)*
- *Satin Flycatcher *(Myiagra cyanoleuca)*
- Sooty Owl *(Tyto tenebricosa)*
- *Grey-tailed Tattler *(Tringa brevipes).*

*indicates non-threatened migratory species.

5.3.2 Fauna habitat

The LGA has various types of species habitat, particularly due to the large amount of coastline and steep sandstone banks. The habitat types present in the LGA can generally be summarised as follows:

- Dry open forest
- Moist gully forests and riparian areas
- Foreshore intertidal zones
- Wetlands
- Weedy thickets
- Open grasslands.

5.3.2.1 Dry open forest

Across the LGA, dry open forests are typically found on upper sandstone slopes and dry gullies. They typically have a canopy of eucalypt species with an understorey of dry sclerophyll shrubs with ferns and forbs amongst the ground cover. Typical dominant species include Sydney Red-gum (*Angophora costata*), Red Bloodwood (*Corymbia gummifera*), Blackbutt (*Eucalyptus pilularis*) and Sweet Pittosporum (*Pittosporum undulatum*).

Dry open forest includes areas of the Coastal Enriched Sandstone Dry Forest vegetation community which is the most common across the LGA (covering approximately 24% of all the vegetated areas). Other dry open forest vegetation communities such as Coastal Enriched Sandstone Dry Forest, Sydney Hinterland Exposed Sandstone Woodland, Sydney Hinterland Apple-Blackbutt Gully Forest and Coastal Sandstone Foreshores Forest covers approximately 263 ha of the LGA which is approximately 36% of all the vegetated areas (refer to Section 5.2).

In the lower slopes of these communities, there is typically an ecotone into coastal moist communities. Up slope from the gullies to the ridges, the escarpments typically become drier. More light penetrates the canopy as the trees are less dense and the ground and leaf litter dries quickly.

Open dry forests often provide tree hollows, typically forming in Sydney Red-gums (*Angophora costata*), and an abundance of leaf litter and rocky outcrops on the sandstone slopes. These habitat features are important for hollow nesting birds, arboreal mammals, reptiles, microbats and invertebrates. Additionally, numerous arboreal termite mounds were observed within the canopy of these habitat types. Arboreal termite mounds, provide food and sheltering resources for reptile and bird species.

5.3.2.2 Moist gully forests and riparian areas

Several moist gullies and riparian areas are present in the LGA. They typically support taller forests with a closed canopy. These habitats can be found in vegetation communities including Coastal Escarpment Littoral Rainforest, Sydney Turpentine Ironbark Forest and Coastal Enriched Sandstone Moist Forest. These communities are typically found along drainage lines leading down to the Georges River. They are on lower sandstone slopes and / or on areas with shale influence geology.

These habitats typically provide a moist and cool microclimate and include typical species of Turpentine (*Syncarpia glomulifera*), Port Jackson Fig (*Ficus rubiginosa*), Cheese Tree (*Glochidion ferdinandi*) and Coachwood (*Ceratopetalum apetalum*).

Hollow development in the old growth trees is important nesting habitat for many species, including possums, cockatoos, parrots and the Powerful Owl (*Ninox strenua*). Rotting fallen timber and moist leaf litter provides potential shelter for amphibians, reptiles and invertebrates. Fleshy fruiting species (i.e. figs) are an important seasonal food source that attracts migratory birds including the Channel-billed Cuckoo (*Scythrops novaehollandiae*) and Eastern Koel (*Eudynamys orientalis*), as well as large numbers of the Grey-headed Flying-foxes (*Pteropus poliocephalus*).

The corridors within the closed canopy and the provision of water provide suitable habitat for many microbat species such as the threatened Southern Myotis (*Myotis macropus*) and aquatic fauna. Some steeper waterways also provide rocky rifles and pools which is important in facilitating healthy waterways and provides potential habitat for amphibians, fish and feeding resources for reptiles and mammals.

5.3.2.3 Foreshore tidal influence zones

The LGA has an extensive coastline with the Georges River to the south and Salt Pan Creek to the west. This habitat type comprises several coastal vegetation communities with saline tidal influence. The foreshore tidal influence zones generally include the Estuarine Mangrove Forest, Estuarine Swamp Oak Forest, Riverflat Paperbark Swamp Forest, Estuarine Reedland and Coastal Saltmarsh communities.

Estuarine Mangrove Forest and mudflats cover much of the foreshore areas, however some smaller areas of natural shorelines of bare weathered sandstone, sandy or gravel beaches occur. The intertidal

vegetation and mud flats provide important foraging habitat for shoreline wading and migratory birds such as the Bar-tailed Godwit (*Limosa lapponica*) as well as nurseries for breeding fish.

5.3.2.4 Wetlands

There are several natural and artificial wetlands across the LGA. Natural wetlands typically comprise areas of the vegetation communities Coastal Freshwater Wetland and Estuarine Reedland which are in freshwater of transitional areas near the coastline. Several artificial wetlands have been constructed across the LGA, notably at Gannons Park, Moore Reserve and Lime Kiln Bay.

These wetlands provide important foraging, sheltering, and breeding habitat for wetland birds and amphibians such as the Royal Spoonbill (*Platalea regia*), Little Black Cormorant (*Phalacrocorax sulcirostris*), Intermediate Egret (*Ardea intermedia*) and Brown-striped Frog (*Limnodynastes peronii*).

5.3.2.5 Weedy thickets

A sizeable proportion of the vegetation within some of the reserves surveyed is weedy thickets and garden escapes consisting of species such as *Lantana camera* (Lantana), *Ligustrum* spp. (Privet species), *Erythrina x sykesii* (Coral tree) and *Olea europaea* (Common Olive).

Although these weed species are a risk to native vegetation they also provide habitat resource for small birds, possums and reptile species as it offers protection from predators. Common Ringtail Possums (*Pseudocheirus peregrinus*) construct dreys and small birds such as wrens and finches often use weedy thickets as nesting, foraging, sheltering and roosting habitat. Consequently, removal of weedy thickets should be gradual with revegetation occurring as soon as possible to ensure that the lost habitat is replaced.

5.3.2.6 Open grasslands

The majority of larger Council parks and reserves include both bushland for conservation and parkland for recreation. Additionally, private properties often have gardens with open lawn areas. Whilst artificial, these grassy open areas provide habitat for species that do not favour bushland, for example Masked Lapwing (*Vanellus miles*) and Magpie-larks (*Grallina cyanoleuca*).

5.3.3 Comparison and changes

5.3.3.1 Species diversity

Through the analysis of the data and feedback from community consultation, it has been noted that there has generally been a reduction in species diversity over the past century. Several species have not been recorded since the mid to late 20th century, for example the Red-naped Snake (*Furina diadema*) (1954), Common Scaly-foot (*Pygopus lepidopodus*) (1959), Koala (*Phascolarctos cinereus*) (1989), Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) (1998) and Regent Honeyeater (*Anthochaera phrygia*) (1984). As such, it is likely many species are now extinct from the LGA.

Several community members also mentioned that there are less sightings of woodland and wader birds as well as amphibians in the past decades. The data collected during this Biodiversity Study supports this, with few records of shoreline wading species. For example, the Pied Oystercatcher (*Haematopus longirostris*) or Latham's Snipe (*Gallinago hardwickii*) were not recorded during the field surveys. However, surveys as part of the Biodiversity Study only captured isolated locations within one season.

5.3.3.2 Fauna habitat

A review of historical aerial imagery has demonstrated that there was significant development in the late 19th to mid-20th century. During this time, many areas of remnant vegetation were cleared. As such, much remnant vegetation, including important habitat features (i.e. hollow bearing trees, bush rock) have been lost. Several foreshore areas and waterways were modified including the redirection of waterways and infilling of marshy areas.

Much of the native bushland that now exists in the LGA is regrowth and only has trees that are approximately half a century old. Nevertheless, patches of important remnant bushland occur in well preserved patches, including Oatley Park and southern sections of Gannons Park.

Open grassy areas now dominate large areas of the landscape for recreational spaces. These areas often fragment nearby patches of native vegetation, for example at Gannons Park and Moore Reserve.

5.4 Flora

Within the LGA, a total of 841 flora species have been previously recorded (DPIE 2020a). This includes 592 native species (70%) and 249 exotic species (30%). However, only 415 of these species have been recorded in the past decade (DPIE 2020a).

During the Biodiversity Study, 460 species were recorded during the field surveys including 322 native species (70%) and 138 exotic species (30%). These species encompass 116 different plant families. The most diverse plant families recorded are as follows:

- 46 species (10%) within Poaceae (grasses family), 29 of which are native (63% of Poaceae species)
- 43 species (9%) within Myrtaceae (myrtle family), all of which are native
- 38 species (8%) within Fabaceae (pea family), 31 of which are native (82% of all Fabaceae species).

Flora species diversity varies between plant communities where are typically determined by abiotic factors such as geology, aspect, slope, hydrology and climate (refer to Section 5.2). The most frequently recorded flora species were those associated with the abundant Coastal Enriched Sandstone Dry Forest vegetation community. This includes species such as *Angophora costata* (Sydney Red Gum), *Eucalyptus pilularis* (Blackbutt), *Lomandra longifolia* (Spiny-headed Mat-rush) and *Pittosporum undulatum* (Sweet Pittosporum) which were recorded at most surveyed sites.

Coastal areas with tidal influences are typically dominated by communities such as Estuarine Mangrove Forest and Estuarine Swamp Oak Forest. These communities have smaller diversity of flora as they are located in harsher environments. Typical flora species include *Avicennia marina subsp. australasica* (Grey Mangrove), *Casuarina glauca* (Swamp Oak) and *Melaleuca decora* which can tolerate saline soils and inundation.

Notable species include ground and tree orchids including *Dendrobium linguiforme* (Tounge Orchid) and *Cryptostylis erecta* (Tartan Tongue Orchid) as well as iconic species such as the cycad *Macrozamia spiralis* and tree fern *Cyathea australis* (Rough Treefern).

Exotic species common in the LGA include weedy species, ornamental species and garden escapes including *Lantana camera* (Lantana), *Ligustrum* spp. (Privet species), *Olea europaea* (Common Olive), *Camellia spp.* (Camellia), *Celtis sinensis* (Japanese Hackberry), *Cocos nucifera* (Coconut Palm) and *Jacaranda mimosifolia* (Jacaranda). Numerous weed species are listed as Weeds of National Significance (WoNS) and State priority weeds (LLS 2019) (refer to Section 5.5).

5.4.1 Conservation significance

During the Biodiversity Study, one threatened flora species and one threatened flora population were recorded, these are as follows:

- *Syzygium paniculatum* (Magenta Lilly Pilly), listed as an Endangered under the BC Act and Vulnerable under the EPBC Act
- *Acacia prominens* (Gosford Wattle), listed as an endangered population listed under the BC Act.

Nine conservation significant species (threatened species / population) have been previously recorded within the LGA (DPIE 2020a), however only the two species identified during the survey have been recorded in the past decade. These species are listed in Table 5-3 and shown in shown in Figure 5-9 to Figure 5-13. Note that the locations of some species records in Figure 5-9 to Figure 5-13 have been denatured to due sensitivity.

Table 5-3. Conservation significant flora species previously recorded within the LGA (DPIE 2020a, Total Earth Care 2012)

Common name	Scientific name	BC Act Status	EPBC Act Status	Count of historical records in LGA	Most recent record	Recorded during the surveys
Gosford Wattle, Hurstville and Kogarah Local Government Areas	*Acacia prominens*	EP		**15**	**2016**	**Yes**
Magenta Lilly Pilly	*Syzygium paniculatum*	E	V	**3**	**2015**	**Yes**
Downy Wattle	*Acacia pubescens*	V	V		1997	No
Hairy Geebung	*Persoonia hirsuta*	E	E		1988	No
	Maundia triglochinoides	V			1903	No
Thick Lip Spider Orchid	*Caladenia tessellata*	E	V		1901	No
Deane's Paperbark	*Melaleuca deanei*	V	V		1899	No
Scrub Turpentine	*Rhodamnia rubescens*	CE			1899	No
Bynoe's Wattle	*Acacia bynoeana*	E	V		1898	No
Black-eyed Susan	*Tetratheca juncea*	V	V		1893	No
	Posidonia australis	EP*			2019	No**

CE: critically endangered species, E: endangered species, V: vulnerable species, EP: endangered population.
*Listed under the FM Act.
** *Posidonia australis* was not surveyed as it is a seagrass and the Biodiversity Study is a terrestrial study only.

A small patch (2.6m^2) of *Posidonia australis* is present at the eastern end of Kogarah Bay (Cardno 2019). This species is listed as an endangered population under the FM Act and also an Endangered Ecological Community under the EPBC Act (refer to Section 5.6).

5.4.2 Comparison and changes

5.4.2.1 Species diversity

Historical changes in species diversity over time can largely be attributed to the removal of large tracts of bushland and the alteration of vegetation types (i.e. to planted urban and exotic areas) and changed hydrology. Most of the remaining habitat for flora is along the foreshore area on sandstone geology. Much of the vegetation to the north of the LGA, which is mostly on shale geologies, have been cleared prior to the 20th century. As such, much of habitat for species requiring shale derived soils is absent.

Through the analysis of the data and feedback from community consultation, it has been noted that there has generally been a reduction in species diversity over the past century. Several species, have not been recorded since the turn of the 20th century, for example *Aphanopetalum resinosum* (Gum Vine) (1893), *Coronidium scorpioides* (Button Everlasting) and the threatened species *Tetratheca juncea* (Black-eyed Susan) (1983) and *Caladenia tessellata* (Thick Lip Spider Orchid) (1901). As such, it is likely many species are now extinct from the LGA, however some may persist in cryptic locations and have not been recorded.

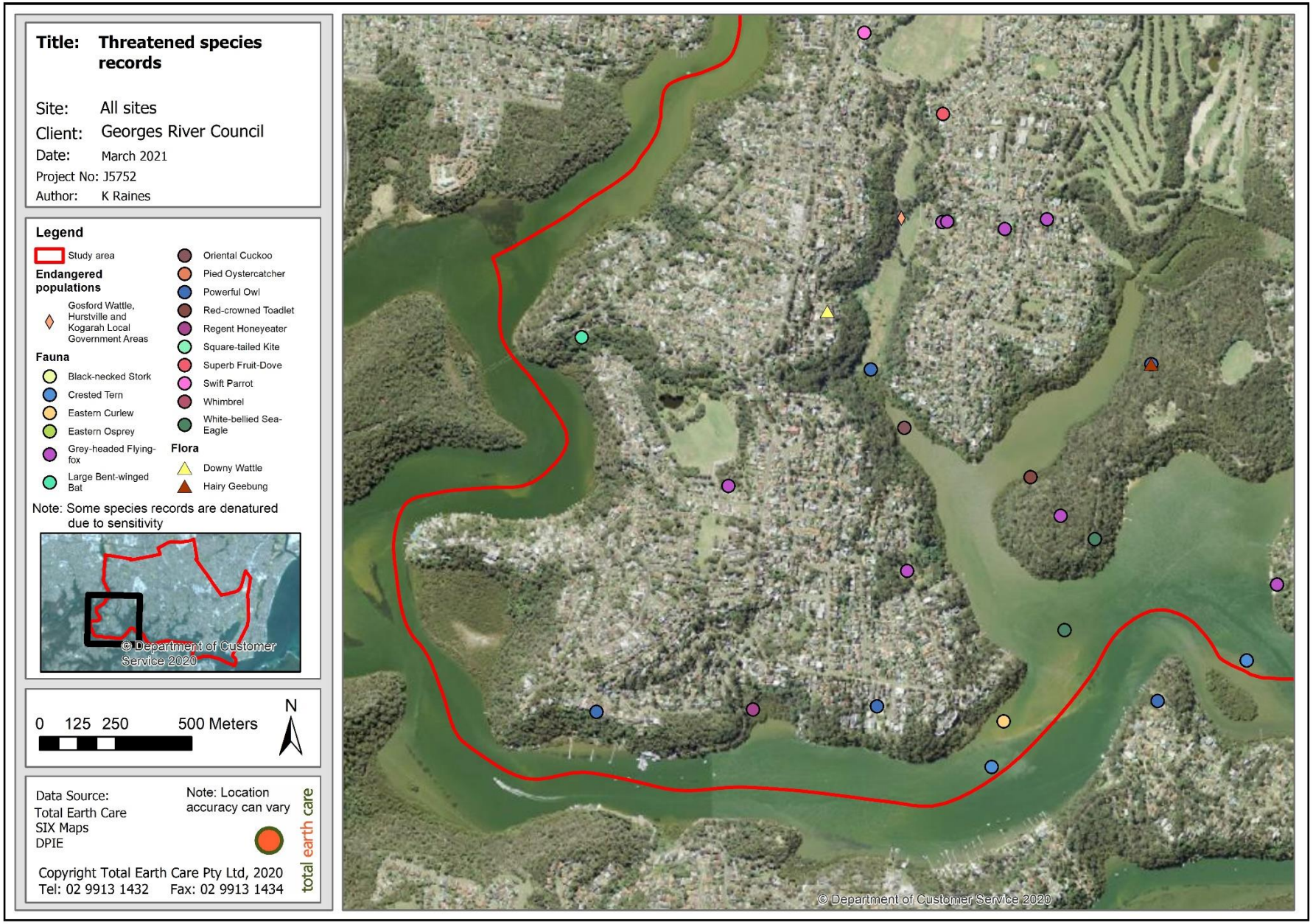

Figure 5-9 Threatened species records

Figure 5-10 Threatened species records

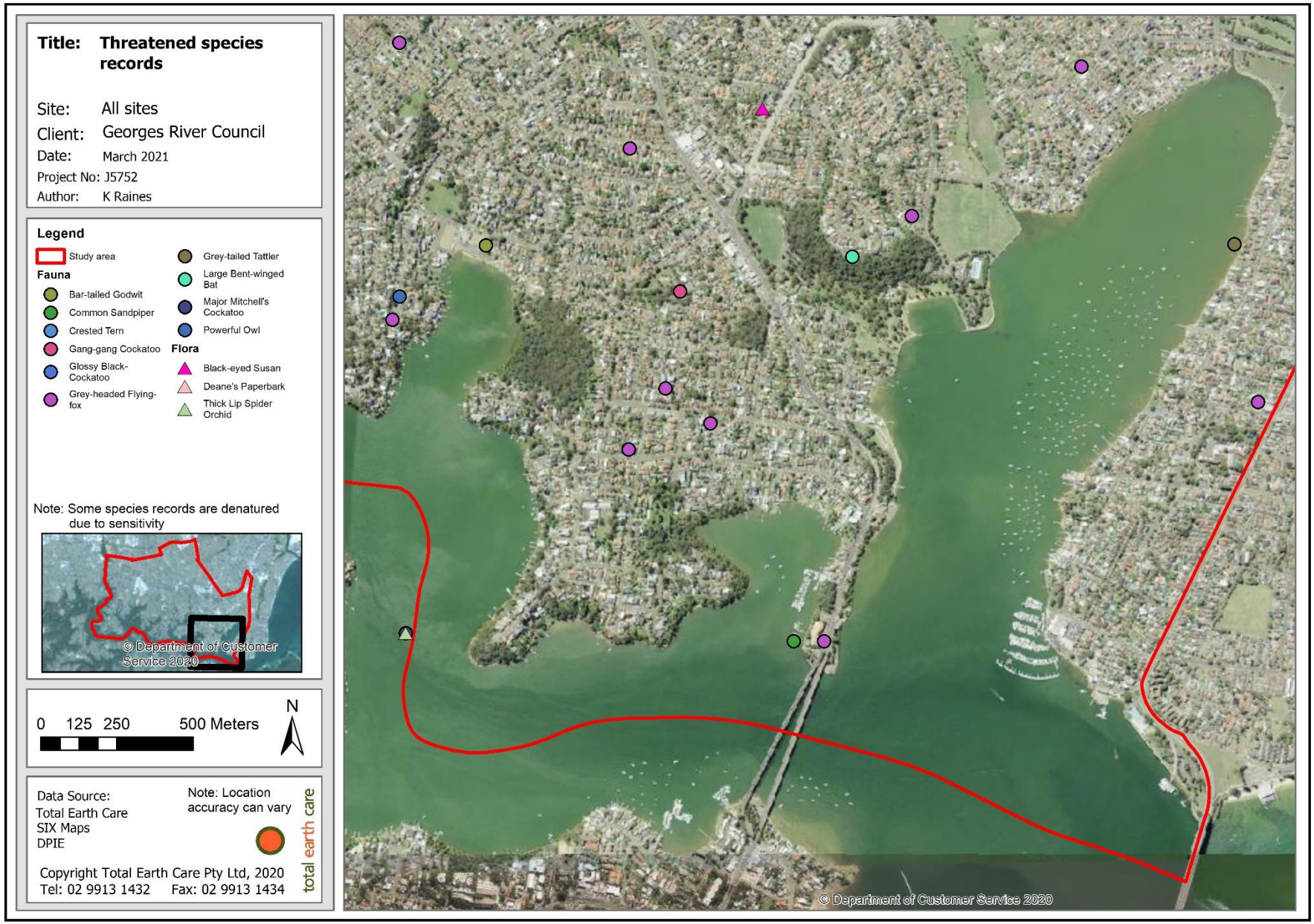

Figure 5-11 Threatened species records

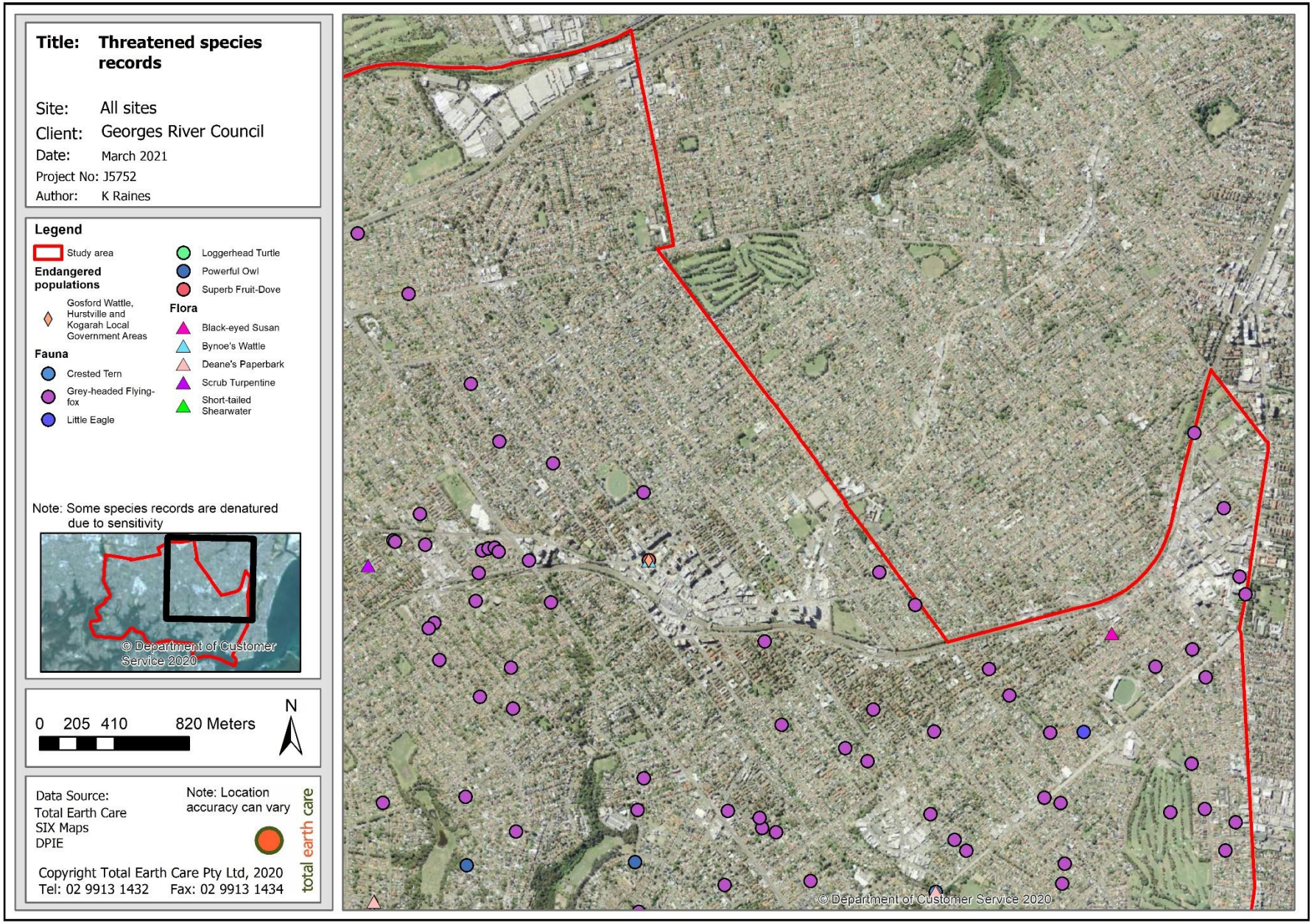

Figure 5-12 Threatened species records

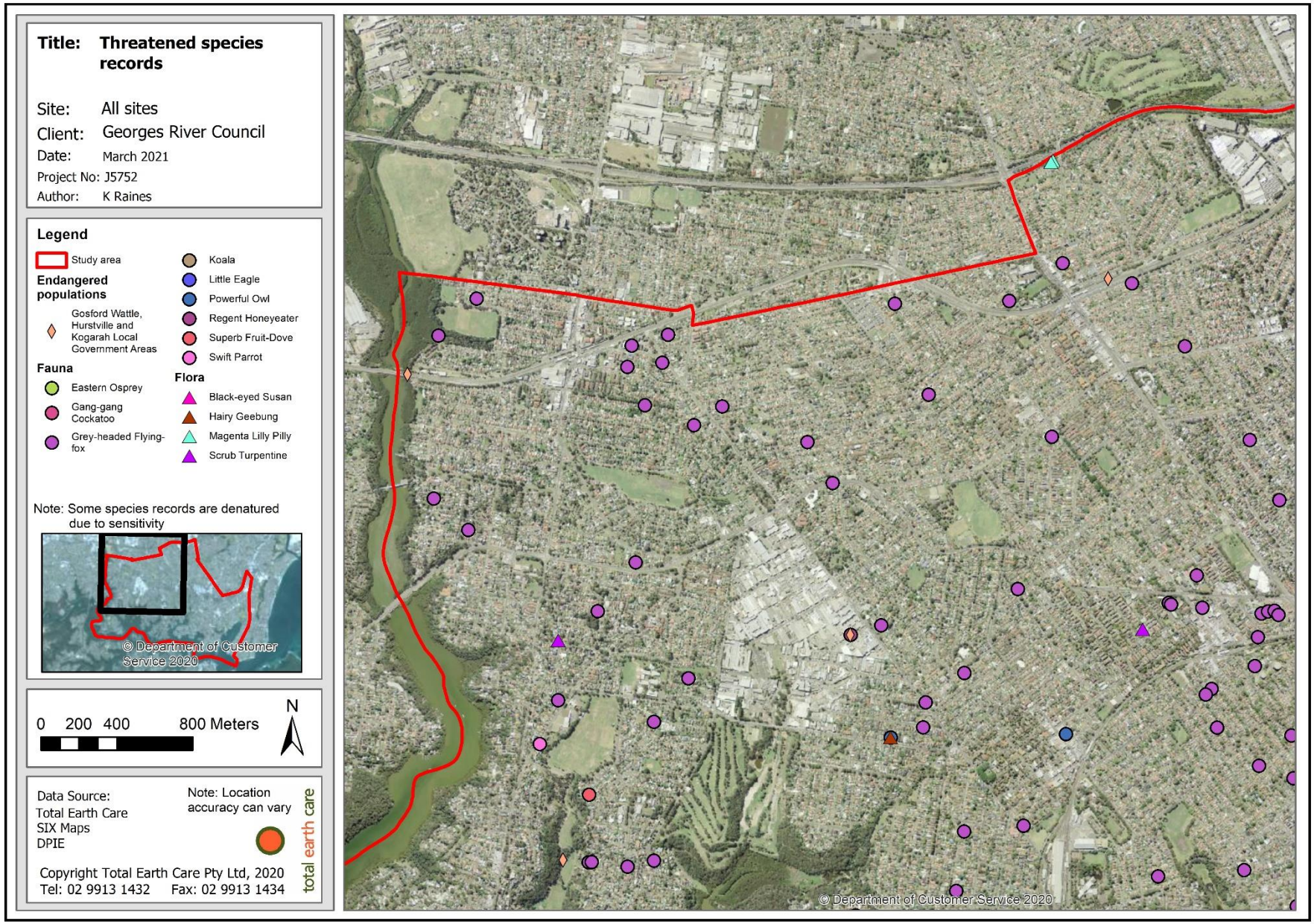

Figure 5-13 Threatened species records

5.5 Weeds

Within the LGA, a total of 249 exotic species have been previously recorded (DPIE 2020a). During the Biodiversity Study, 139 weed species were recorded during the field surveys. Several recorded weed species are listed as priority weeds within NSW (LLS 2019) and / or Weeds of National Significance (WoNs), including:

- *Alternanthera philoxeroides* (Alligator Weed)
- *Anredera cordifolia* (Madeira Vine)
- *Arundo donax* (Giant Reed)
- *Asparagus aethiopicus* (Asparagus Fern)
- *Asparagus asparagoides* (Bridal Creeper)
- *Asparagus plumosus* (Climbing Asparagus Fern)
- *Cestrum parqui* (Green Cestrum)
- *Lantana camara* (Lantana)
- Olea europaea subsp. Cuspidate (African Olive)
- *Rubus fruticosus aggregate* (Blackberry)
- *Salix sp*. (Willow)
- *Senecio madagascariensis* (Fireweed).

It is likely that the diversity of weed species in the LGA is much larger than recorded in the Biodiversity Study survey. This is due to the survey effort being focused on areas that comprise native vegetation and are of higher condition in an effort to identify more native species diversity.

Most weed species were recorded in riparian areas and in highly disturbed areas. This is typical due to weed species being transported by water and by human movement (i.e. on shoes). Additionally, weed species are frequently transported in the faeces of animals. This can be observed in the highly weedy vegetation at Myles Dunphy Reserve at the Grey-headed Flying-fox (*Pteropus poliocephalus*) camp.

5.6 Waterways and aquatic ecology

The LGA is bounded by the waterways of Georges River to the south and Salt Pan Creek to the west. Some other key waterways flow southwards into Georges River including Boggywell Creek, Dairy Creek, Renown Creek, Poulton Creek and Kogarah Bay Creek (Figure 5-14 to Figure 5-18). At the north of the LGA is the upper reaches of Wolli Creek which drains to the north east.

Some sections of these waterways have been modified by human development. For example, the natural alignment of Renown Creek, which historically ran through Moore Reserve, was altered in the mid-20th century due to land reclamation at the southern end of the site. Much of the natural alignment is now redirected underground in culverts. Nevertheless, the modern development of artificial wetlands across the LGA, like the one at Moore Reserve, have somewhat replaced natural waterways and reinstated aquatic habitats.

The LGA is situated across two catchments including the Georges River Catchment in the south and the Cooks River Catchment in the north. The Georges River Catchment covers approximately two thirds of the LGA and encompasses all waterways except Wolli Creek which is part of the Cooks River Catchment.

The Georges River is mapped as Key Fish Habitat (DPI 2020a). Due to several characteristics including the presence of seagrass, saltmarsh, coastal wetlands and the size of the waterway, it is classified as ‘Type 1’ and ‘Class 1’ Key Fish Habitat (DPI 2013). The freshwater fish community status of the Georges River, which is an indication of the ‘healthiness’ of fish assemblages, is ‘fair’ (DPI 2020b).

Seagrass is present within several bays of the Georges River (GRC 2020b) (refer to Section 2.1.2.3). Approximately 4.8ha of seagrass is present comprising predominantly *Halophila* with smaller areas of *Zostera*. A small patch (2.6m^2) of *Posidonia* is present at the eastern end of Kogarah Bay. This species is listed as an endangered population under the FM Act and an EEC under the EPBC Act.

There are several areas of coastal wetlands and littoral rainforest, as mapped under the Coastal Wetlands SEPP (Figure 5-14 to Figure 5-18) which have important hydrological and floristic characteristics. The areas of coastal wetlands are located incrementally along the foreshore and are predominantly in areas of estuarine mangroves.

5.7 Georges River National Park

Sections of Georges River National Park are located in the western side of the LGA near Lugarno. These sections of the National Park are fragmented in two sections along the boundary of Georges River and Salt Pan Creek and continues along the eastern bank of Salt Pan Creek (Figure 5-14 to Figure 5-18). The National Park extends to the western side of Georges River near the suburbs of Alfords Point and Padstow Heights.

The vegetation community within these sections of the National Park predominantly comprise of Estuarine Mangrove Forest, Coastal Enriched Sandstone Dry Forest and Sydney Hinterland Apple-Blackbutt Gully Forest. These areas have been subject to fire in the past decade (NPWS 2018). The narrow strip of National Park near McGowan Reserve in the north of the LGA was burnt in 2011. The eastern half of the southern section of National Park near Lugarno was subject to a wildfire in 2015.

5.8 Green corridors and connectivity

Green corridors comprise connected areas of vegetation that provide habitat and linkages for the passage of wildlife. The requirement of size of vegetation patches, vegetation structure and composition as well as the distance between patches vary for different species and species groups. For example, wrens (i.e. White-browed Scrubwren (*Sericornis frontalis*)) require closer patches of vegetation with more dense vegetation (i.e. shrubs) to safely move across the landscape. This can be compared to larger sea birds (i.e. White-bellied Sea-Eagle (*Haliaeetus leucogaster*)) which require larger patches of taller canopy trees, however can travel several kilometres between patches. Additionally, more mobile species, such as birds, typically move across a fragmented landscape more easily than less mobile species (i.e. reptiles, amphibians).

Barriers to movement are also frequent within urban areas. Common built barriers include roads, walls, buildings and fences. Fragmentation in vegetation connectivity also forms a barrier to movement on a larger landscape scale.

Within the LGA, green corridors are generally present along the foreshore area from Riverwood Park in the north west of the study area, south to H.V. Evatt Park and the Georges River National Park, then eastwards towards Gannons Park, Oatley Park, Jew Fish Point, Myles Dunphy Reserve, Oatley Pleasure Grounds, Poulton Park, Kyle Williams Reserve and Carss Bush Park.

Some separated patches of vegetation (i.e. parks in higher density urban area) provide some connectivity for more mobile species (i.e. Birds, Common Ringtail Possum) in the form of ‘islands’. Vegetated street corridors, median strip vegetation and backyard gardens provide important connectivity between the larger patches as well as providing feeding and roosting resources to species.

The green corridors within the study area support the larger Sydney Green Grid and provides some connectivity between the large areas of Holsworthy Military Reserve and the Georges River National Park to the west, and the Royal National Park to the south.

Existing green corridors in the western half of the LGA are generally larger and more intact with the Georges River National Park, Gannons Park and Oatley Park as key areas. The northern half, and to a lesser extent the eastern half, of the LGA have narrower green corridors with smaller parks and reserves and larger gaps between them. These areas present opportunities for improvement. Almost all of the green corridors in the northern half of the study area comprise only street trees and are generally not considered large enough to support the movement of fauna species, except some common urban species.

There are numerous parks and reserves within the LGA. These areas have differing degrees of vegetation and open space, both of which can provide habitat for various species. However, canopy cover is key in providing connective corridors and reducing urban heat.

5.9 Heritage values

Several parks and reserves within the LGA are protected under local heritage for their biodiversity and other aesthetic and cultural values. These heritage items with biodiversity values are outlined in Table 5-4.

Table 5-4. Parks and reserve with heritage listings due to biodiversity values

Item	Listing	Description relating to biodiversity
Evatt Park	Local heritage	Open recreational space that forms an important part of the Lugarno cultural and environmental landscape featuring undisturbed natural bushland.
Oatley Park and Baths	Local heritage	Oatley Park is of exceptional local significance as one of few sizeable non-privately owned waterfront land promontory jutting along the banks of Lime Kiln Bay and Jew Fish Bay of Georges River and as one of Sydney's finest areas of natural bushland that remained undeveloped in an urban area. It has a high importance as a recreational and sporting place to the local and wider community.
Oatley Point Reserve	Local heritage	Oatley Point Reserve is significant for its historic, aesthetic and social values. Aesthetically the reserve acts as a natural landmark to the water. Socially, the locality values the site as an area worthy of reclamation, regeneration and retention for social, aesthetic and historic values.
Oatley Pleasure Grounds	Local heritage	Important area of remnant bushland with significant native trees and rock outcrops. Significance compromised by weed infestation.
Moore Reserve	Local heritage	It includes areas of remnant bushland with significant native trees, rock outcrops and watercourse. Significance compromised by weed infestation. Representative of the public parkland created by Council by reclamation. Pockets of locally rare bushland.
Kyle Williams House and Reserve	Local heritage	It is socially significant as it reflects open space along the foreshore which is rare within the locality.
Bald Face Point Reserve	Local heritage	Bald Face Point Reserve is historically and socially significant as it represents rare undeveloped regenerated foreshore land within the Municipality. It reflects the Environmental awareness of the Local Community with the establishment of the Bald Face Point Regeneration Program.
Carss Bush Park	Local heritage	The Park retains remnant vegetation pre-dating European settlement of the area. Subsequent plantings enhance the appearance of the Park, complementing the remnant vegetation.

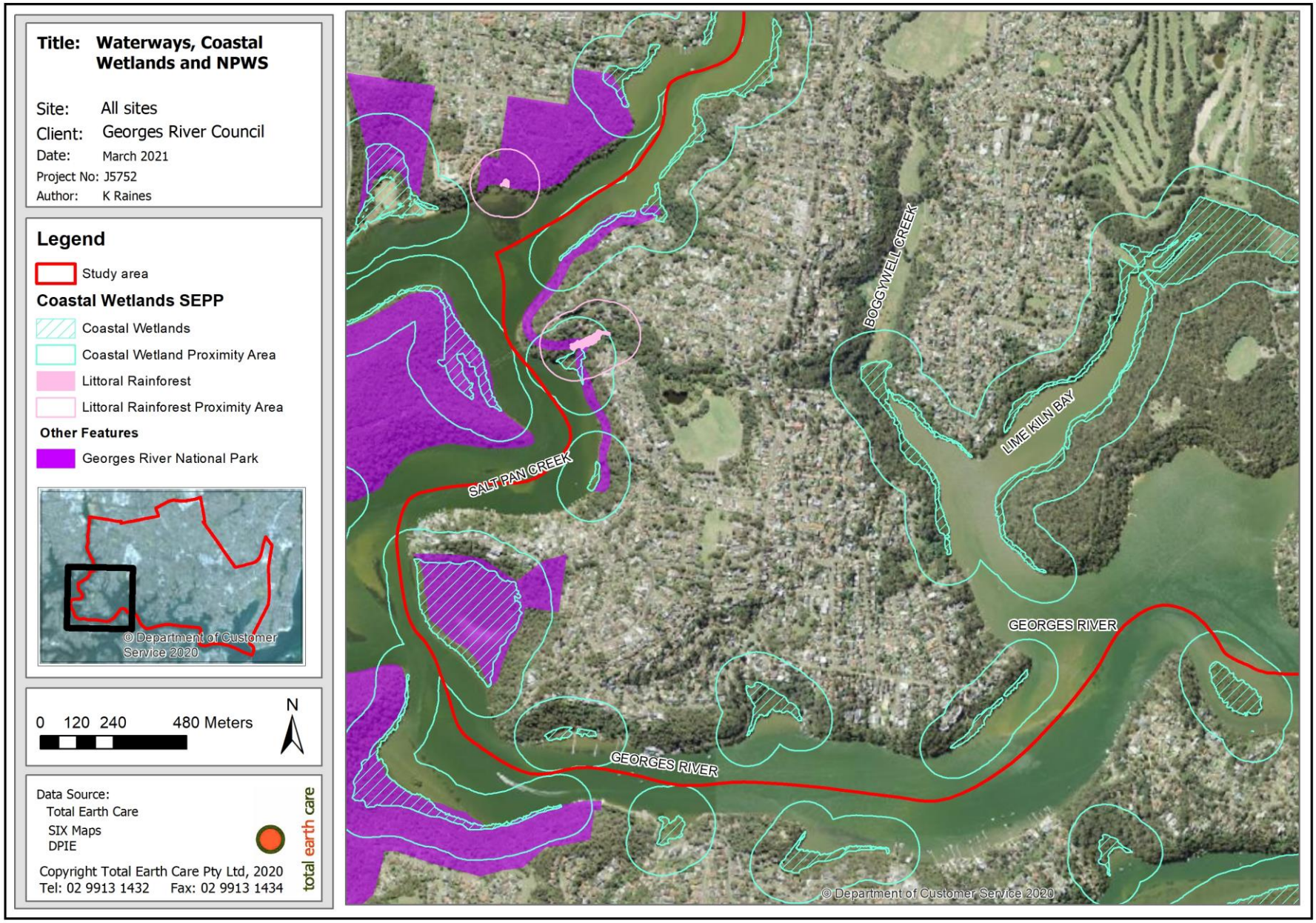

Figure 5-14 Waterways, Coastal Wetlands SEPP and NPWS areas

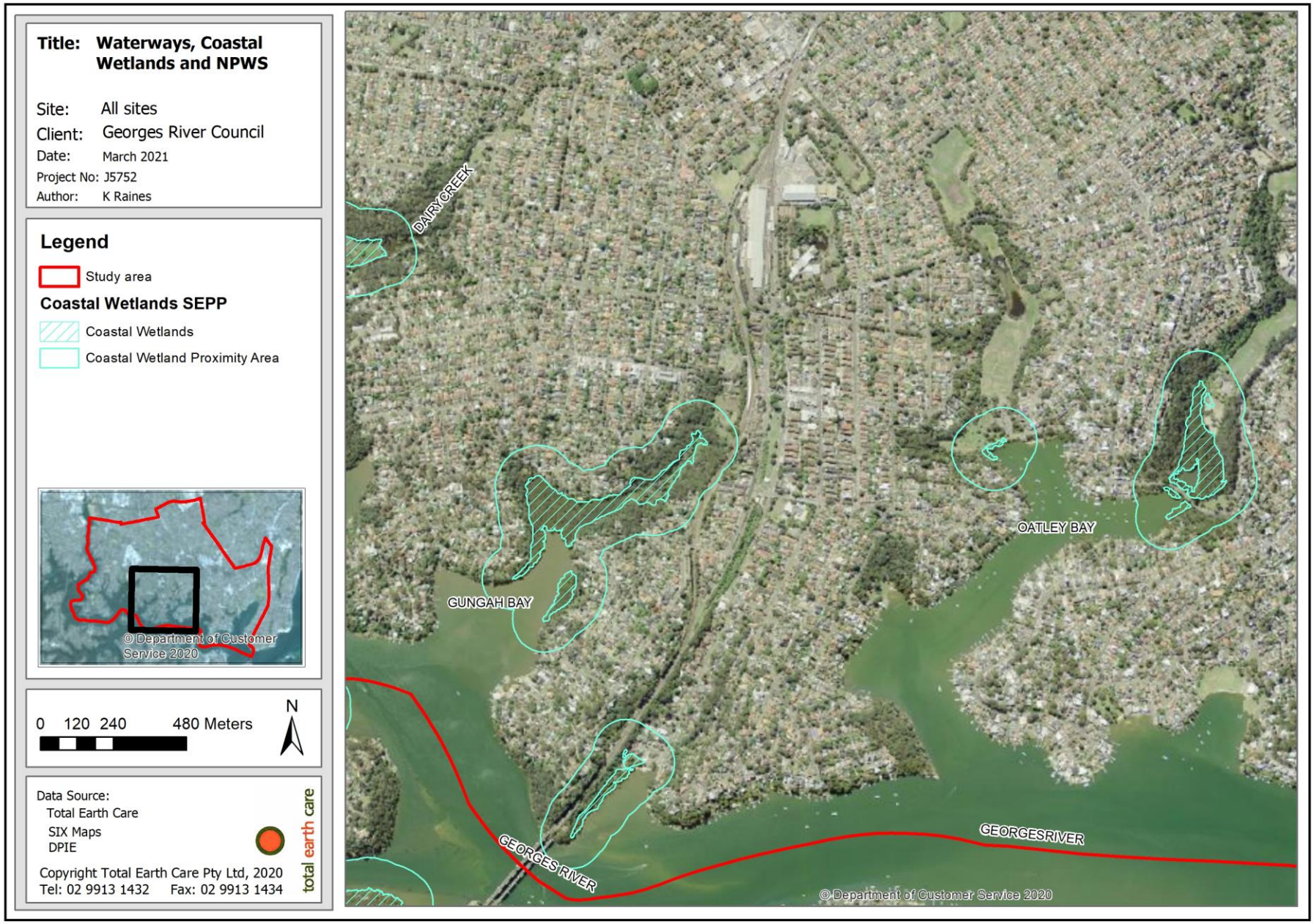

Figure 5-15 Waterways, Coastal Wetlands SEPP and NPWS areas

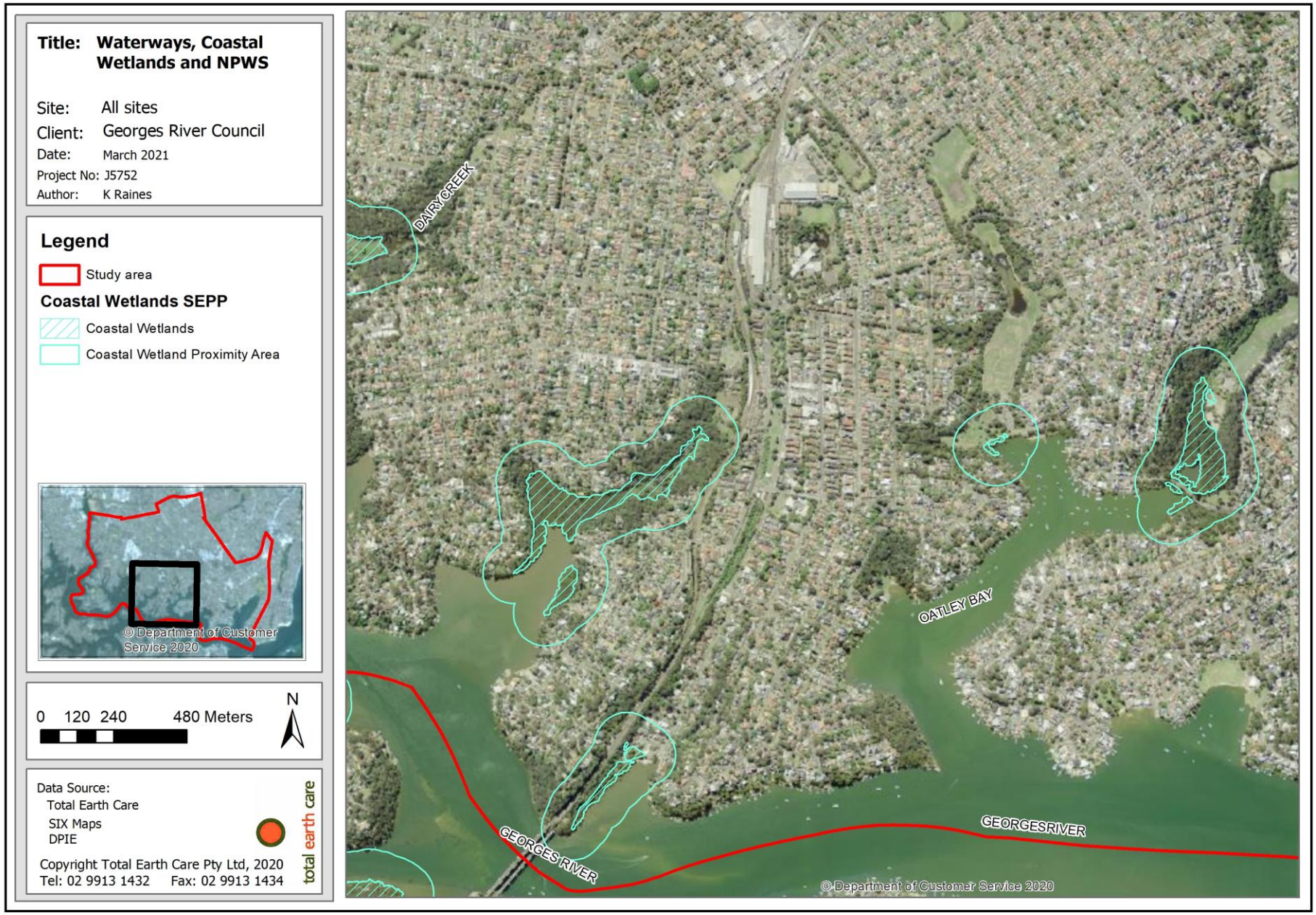

Figure 5-16 Waterways, Coastal Wetlands SEPP and NPWS areas

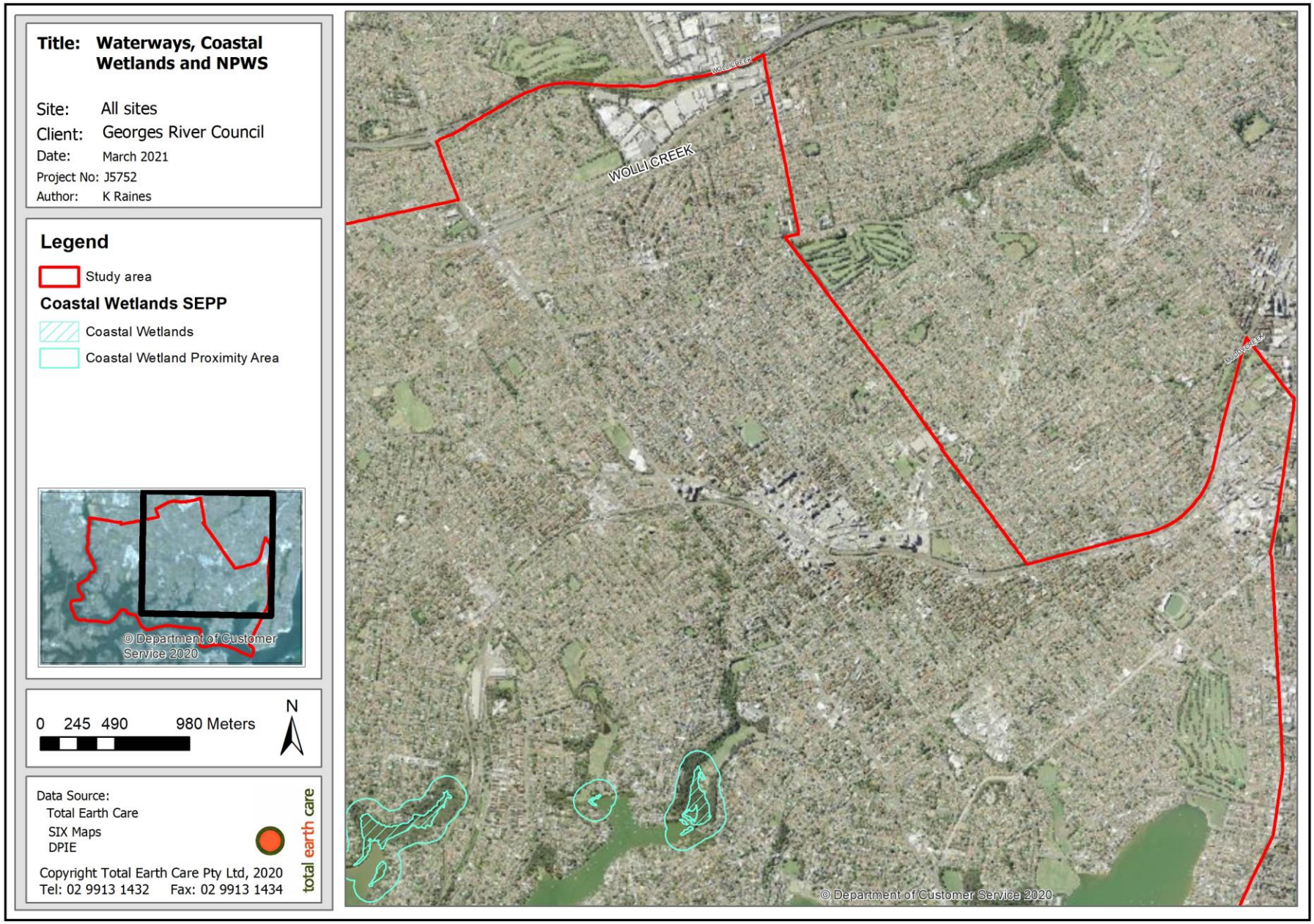

Figure 5-17 Waterways, Coastal Wetlands SEPP and NPWS areas

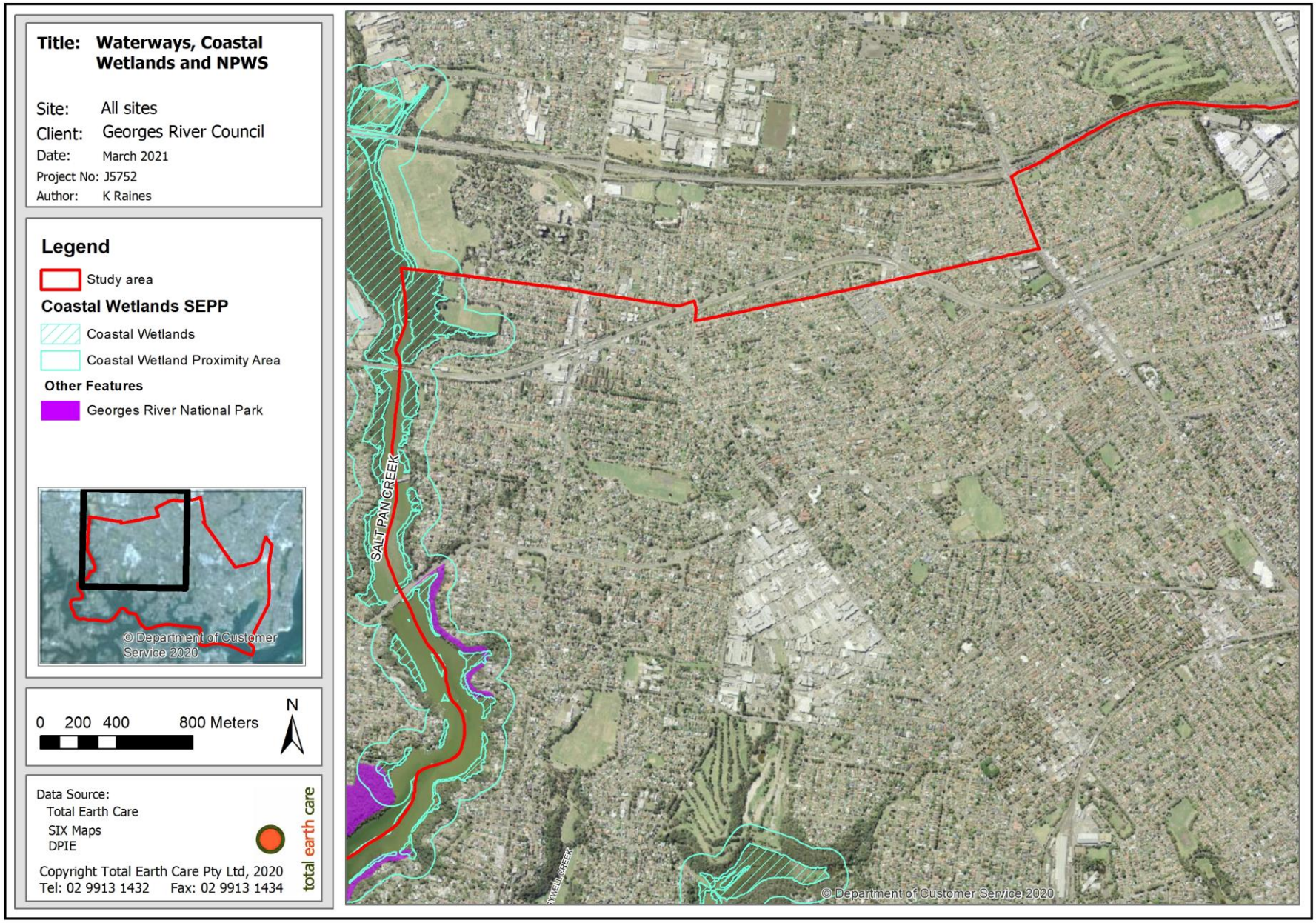

Figure 5-18 Waterways, Coastal Wetlands SEPP and NPWS areas

5.10 Key Threatening Processes

Key Threatening Processes (KTPs) are issues that threaten the survival, abundance or evolutionary development of native species and ecological communities.

The LGA is located within metropolitan Sydney and is subject to various pressures resulting from human activities. Previous studies have noted that some KTPs have been present in the LGA for decades, namely the impacts of vegetation clearing, pest species and weed infestations (refer to Section 4).

During the field surveys, numerous KTPs were noted. State and Commonwealth listed KTPs that impact the LGA are provided in Table 5-5 and the major KTPs are discussed further below.

Table 5-5. Key Threatening Processes impacting the study area

BC Act	FM Act	EPBC Act
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners, *Manorina melanocephala* (Latham, 1802)		Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)
Anthropogenic Climate Change	Human-caused climate change	Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases
Bushrock removal		
Clearing of native vegetation		Land clearance
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis		Infection of amphibians with chytrid fungus resulting in chytridiomycosis
Infection of native plants by *Phytophthora cinnamomi*		Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)
Invasion and establishment of exotic vines and scramblers		Novel biota and their impact on biodiversity
Invasion, establishment and spread of Lantana (*Lantana camara* L. *sens. lat*)		Novel biota and their impact on biodiversity
Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif.		Novel biota and their impact on biodiversity
Invasion of native plant communities by exotic perennial grasses		Novel biota and their impact on biodiversity
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants		Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
Loss of hollow-bearing trees		
Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish) (as described in the final determination of the Scientific Committee to list the threatening process)		Novel biota and their impact on biodiversity
Predation by the European Red Fox *Vulpes vulpes* (Linnaeus, 1758)		Predation by European red fox
Predation by the Feral Cat *Felis catus* (Linnaeus, 1758)		Predation by feral cats
Removal of dead wood and dead trees		
	Degradation of native riparian vegetation along New South Wales water courses	
	Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales	

BC Act: *Biodiversity Conservation Act 2016*, FM Act*: Fisheries Management Act 1994*, EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999 (Cwth)*

Foxes (*Vulpes vulpes*) and cats (*Felis catus*) pose a major threat to the survival of many native fauna species due to direct predation. Ground-nesting birds and small to medium-sized mammals are especially at risk. Foxes and cats were observed in abundance across the LGA. Foxes were typically observed in vegetated areas at night, however on several occasions were recorded traversing streets. All cats observed throughout the study were not wearing bells. Cats were observed at 10 of the 27 surveyed sites and are likely to utilise most of the LGA (refer to Volume 2).

Noisy Miners (*Manorina melanocephala*) are prevalent across the LGA, particularly in urban areas and in adjacent woodlands. The species is a native aggressive honeyeater species that can often exclude other bird species in an area. This KTP is typically more prevalent in areas that have been influenced by human pressures such as woodland clearance, fragmentation, reduction in understory vegetation, invasion of exotic grasses and altered fire regimes (DPIE 2017).

Invasion of weed species including *Lantana camara* (Lantana), *Olea europaea subsp. cuspidate* (African Olive), exotic perennial grasses and of exotic vines and scramblers are also prevalent across the LGA. Expansion of these, and other, weed species is most extensive in riparian areas and in highly disturbed areas (refer to Section 5.5). *Lantana camara* and other climbing and trailing weeds such as *Ipomoea indica* (Morning Glory) and *Tradescantia fluminensis* (Wandering Jew) are often dominant in many creekside habitats including some TECs. Managing these weeds is important in sustaining healthy vegetation communities.

The impacts of climate change are increasing and pose a notable risk to the LGA due to the riverside location along the Georges River and Salt Pan Creek. Climate change can have various direct and indirect impacts on biodiversity and can also support other KTPs. Direct impacts include damage to flora and fauna during extreme weather events of storms and heat waves. Sea level rise and the changes of microclimates can result in the migration of vegetation community boundaries. This can be seen at various locations across the LGA with the increasing extent of mangroves and shrinking saltmarsh communities.

Indirect impacts of climate change include the altering of inter-specific interactions such as predation, competition and changes to phenology (timing of annually recurrent biological events, i.e. breeding, pollination, torpor, hatching). The changes in climate as well as human pressures can increase the movement of pathogens and pests.

6 COMMUNITY AND STAKEHOLDER ENGAGEMENT

6.1 Overview

During the community consultation process, the members of the community and stakeholders had the opportunity to share their local knowledge and experience across various platforms. The data collected by the community is summarised as follows:

- 136 fauna species were reported
- 7 threatened and / or migratory species were recorded including:
  - Bar-tailed Godwit (*Limosa lapponica*), listed as migratory under the EPBC Act
  - Eastern Osprey *(Pandion cristatus)*, listed as Vulnerable under the BC Act
  - Glossy Black-Cockatoo (*Calyptorhynchus lathami*), listed as Vulnerable under the BC Act
  - Grey-headed Flying-fox (*Pteropus poliocephalus*), listed as Vulnerable under the BC Act and EPBC Act
  - Black Bittern *(Ixobrychus flavicollis),* listed as Vulnerable under the BC Act
  - Powerful Owl (*Ninox strenua*), listed as Vulnerable under the BC Act
  - White-bellied Sea-Eagle (*Haliaeetus leucogaster*), listed as Vulnerable under the BC Act.
- 71 species that were not recorded in the Biodiversity Study, most of which are invertebrates
- 70 species that have 10 or less historical records in the LGA, most of which are invertebrates.

The full list of species is provided in Appendix D, Table A-8.

Details are provided in the following sections.

6.2 Outcomes of Community Engagement Activities

6.2.1 Outcomes of community questionnaire

The community questionnaire was open to the public between 13th November and 11th December 2020. The questionnaire was available on Councils 'YourSay' Page and included 10 questions which enabled respondents to share knowledge and information approximately biodiversity in the LGA.

Responses from the questionnaire are summarised as follows:

- 56 responses were received
- 33 (58%) of respondents participate in community environmental groups
- 21 (37.5%) respondents engaged in citizen science programs including the Aussie Backyard Bird Count, FrogID, Streamwatch and Pollinator Count.
- The respondents provided data in various forms on six threatened species observed in the recent years including:
  - Grey-headed Flying-fox (*Pteropus poliocephalus*)
  - Glossy Black-Cockatoo *(Calyptorhynchus lathami)*
  - Powerful Owl *(Ninox strenua)* with chicks
  - Eastern Osprey *(Pandion cristatus)*
  - White-bellied Sea-Eagle (*Haliaeetus leucogaster)*
  - Black Bittern (*Ixobrychus flavicollis*) (potential).
- Comments on the general decline in species (predominantly small birds) over the past 40 years.
- The respondents provided data on several TECs and other sensitive vegetation communities including mangroves, salt marsh, seagrass and Sydney Turpentine Ironbark Forest.
- Several hotspots were identified including Oatley Park, Myles Dunphy Reserve, Lime Kiln Bay, Moore Reserve, Gannons Park and Oatley Pleasure Grounds.
- Identification of notable street tree corridors including Kitchener Street, and Douglas Haigh Street, Oatley and Morshead Drive, Connells Point.
- Notable fauna habitat including hollow bearing trees noted at Oatley Park and surrounding streets.

- Both positive and negative comments on the number and activity of the Grey-headed Flying-fox (*Pteropus poliocephalus*) within suburban areas.
- Increases in the number of Noisy Miners (*Manorina melanocephala*) within urban areas.

Several members of the community mentioned spotting Glossy Black-Cockatoos (*Callocephalon fimbriatum*) through early 2020, which are typically rare in metropolitan Sydney. It is possible that these sightings are associated with the displacement of fauna following the 2019 / 2020 bushfires. However, due to the limited suitable habitat, it is unlikely that the LGA would support a persistent population of the species.

6.2.2 Community and Stakeholder Webinar

A Community and Stakeholder Webinar was held on 26th November 2020 in which the eighteen key stakeholders and community groups were invited to join. The webinar provided an overview on the project and provided a platform for open conversation and questions. The webinar was made publicly available on Councils 'YourSay' page on 27th November 2020.

Following the webinar various sources of additional data were contributed to the project from numerous stakeholders and community groups.

6.3 Key Issues Raised

Through the community consultation process the community raised several issues and concerns. These are summarised as follows:

- Respondents wanting more controls to protect native vegetation and species including the habitat for native species and green corridor initiatives.
- Respondents wanting more control of pest (including domestic pet species) and weed species, pollution and the reduction of pesticides.
- A concern that increased development, particularly increasing building density, would negatively impact biodiversity and minimise green space for the community.
- A concern that replacement plantings required following tree and vegetation removal for development are not being implemented.
- Desire for more native plantings to be required to offset development.
- A larger focus on the importance of the environment within the study area in context with other LGAs along and across the Georges River in a regional ecosystem approach.
- An urgency to implement protection of biodiversity and increase Bushcare work to preserve existing biodiversity in the study area
- Concerns of the impacts of climate change on local biodiversity
- Concerns for the infrequency of low intensity hazard reduction burns.

7 RECOMMENDATIONS AND OPPORTUNITIES

The following management actions are recommended to protect, conserve and improve the biodiversity of the LGA. Table 7-2 provides LGA-wide and site-specific management actions for the surveyed sites. For more details of the surveyed sites, refer to Volume 2.

The priorities of the management actions listed in Table 7-2 are as follows:

- **High:** Action required in first two years
- **Moderate:** Action required in first five years.
- **Low:** Action required in 5-10 years.

The surveyed site references are provided in Table 7-1. For details of how the management actions should be applied to each site, refer to the specific site in Volume 2.

Table 7-1. Site references for management actions

Level 3 sites		Level 2 sites	
Site name	***Site reference***	***Site name***	***Site reference***
Bald Face Reserve	1	Arrowsmith Park	17
Carss Bush Park	2	Beverley Hills Golf Course, Claydon Reserve, Spooner Park	18
Cedar Street Reserve	3	Church Street Reserve	19
Clarendon Road Reserve and Ogilvy St Reserve	4	Donnelly Park	20
H.V. Evatt Park	5	Hurstville Golf Course	21
Gannons Park and Heinrick Reserve	6	Letitia Street Reserve	22
Kyle William Reserve	7	Lugarno Parade Reserve and Edith Bay Wetlands	23
Moore Reserve	8	Oatley Memorial Gardens and Oatley Park (Oatley Embankment)	24
Myles Dunphy Reserve	9	Oatley Pleasure Grounds	25
Neverfail Bay Reserve	10	Ray Street	26
Oatley Park and Lime Kiln Bay Reserve	11	Yarran Road Reserve	27
Oatley Point Reserve	12		
Peakhurst Foreshore Reserve and Jinna Road Reserve	13		
Poulton Park, Redin Place Reserve and Quarry Reserve	14		
Riverwood Park and Basil Street Reserve	15		
Shipwrights Bay Reserve	16		

Table 7-2. Recommended management actions

ID	Priority	Action	Site reference
General			
G1	High	Utilise the results of this Biodiversity Study to develop a LGA wide Biodiversity Strategy.	N/A
G2	High	Utilise the results of this Biodiversity Study and principles of Ecologically Sustainable Development to develop biodiversity controls in the Georges River LEP and DCP.	N/A
G3	High	Liaise with NSW DPIE to update any threatened species profiles benefiting from the results of this study.	N/A
G2	Moderate	Develop LGA wide Flora and Fauna Assessment Guidelines to standardise the process and requirements of biodiversity assessments and vegetation management plans relating to development applications.	N/A
G3	Low	By 2030, undertake a new Biodiversity Study. This would compare and assess changes to biodiversity that have occurred in the LGA since 2021 and review the success of the management measures.	N/A
G4	Moderate	Investigate available options and viability for formal in perpetuity protection of Council reserves (i.e. Biodiversity Stewardship Agreements and Conservation Agreement under the *Biodiversity Conservation Act 2016*).	4, 7, 9, 11
G5	Moderate	Implement the results of this Biodiversity Study and the Biodiversity Strategy to review and update plans of management for all Council managed parks and reserves in accordance with the Part 2 Division 2 of the *Local Government Act 1993.* Implement management for current and future risks (i.e. climate change, new weed threats).	All sites.
Vegetation communities			
V1	High	Add / remove additional areas to the Biodiversity Values Map and Sydney metro vegetation mapping (OEH 2016) through consultation with DPIE.	2, 8, 10, 14, 16
V2	High	Undertake ongoing bush regeneration works (via contract and voluntary means) to minimise weed prevalence.	1, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 27
V3	High	Undertake bush regeneration works and replanting to improve the condition of the Sydney Turpentine Ironbark Forest in accordance with the best practice guidelines (DECC 2008).	9, 14
V4	Moderate	Undertake bush regeneration works (via contract and voluntary means) to minimise weed prevalence.	2, 7, 10, 13, 17, 19, 20, 21, 22, 23, 24, 25, 26
V5	Moderate	Implement buffer plantings around Threatened Ecological Communities where possible to reduce edge effects and increase patch resilience.	4, 5, 8, 10, 11, 15, 16
V6	Moderate	Monitor changes to the extent of the Estuarine Saltmarsh community and lobby National Parks and Wildlife Service for management efforts to retain the current extent at Cedar Street Reserve.	3, 10, 14, 15

ID	Priority	Action	Site reference
V7	Moderate	Undertake regular monitoring to detect any incursion of weeds or illegal dumping from neighbouring properties.	4, 12, 16, 19, 26
V8	Moderate	Investigate opportunities to implement and / or increase native vegetated areas and increase native species habitat (i.e. mid-storey vegetation to improve connectivity and to support native woodland birds).	17, 18, 19, 20, 21
V9	Low	Work with local Rural Fire Brigades to undertake more low-moderate intensity hazard reduction burns in areas of vegetation senescence.	11
Fauna and flora			
F1	High	Develop a Plan of Management for the Grey-headed Flying-fox (*Pteropus poliocephalus*) camp at Myles Dunphy Reserve. Minimise community disturbance to the Grey-headed Flying-fox camp through redirecting pedestrian traffic and community engagement activities.	9
F2	High	Protect mature hollow-bearing trees by recommending inclusion on a future Significant Tree Register and continue to retain stagged dead trees for habitat.	2
F3	Low	Harvest the seed from existing individuals of *Acacia prominens* (Gosford Wattle) and *Acacia pubescens* (Downy Wattle) and propagate new plants for use in Council parks and reserves and for sale to the community.	2, 5, 6, 8, 9, 11, 16, 22, 27
Green corridors and connectivity			
GC1	High	Develop a Habitat Connectivity Plan to inform the planning of the Green Grid across the LGA. This would include provisions for connectivity improvements and habitat structures for key species within the LGA (i.e. gliders, possums, birds). It would include consideration of gap-crossing distances, structural connectivity elements and habitat patches (islands) and increasing ground and mid-storey flowering vegetation suitable for small birds and reptiles. The Habitat Connectivity Plan would be developed in collaboration with adjacent Councils and government stakeholders (i.e. National Parks and Wildlife Service) and in consideration of the Street Tree Master Plan.	Whole LGA.
GC2	High	Utilise this data to inform the development of a Street Tree Master Plan for the LGA and implement the plan to improve the urban canopy in streets corridors. Where possible, plant native evergreen species that provide food resources for local fauna throughout the year (i.e. species that flower at different times during the year) and suitable exotic species resilient to effects of climate change including increased extreme heat and bushfire events.	Whole LGA.

ID	Priority	Action	Site reference
GC3	High	Consider the implementation of green cover requirements in new Council assets, new commercial developments and high-density residential buildings such as rain gardens, green roofs and green walls in planning controls	Whole LGA.
GC4	High	Continue to support electricity providers to reduce and/or relocate powerlines in the LGA.	Relevant street tree corridors.
GC5	Moderate	Ensure conservation of the site is prioritised in any future accessibility enhancements as part of the Salt Pan Creek Open Space Corridor. If paths are to permeate the site, elevated boardwalks are to be prioritised over excavated paths.	4, 15
GC6	Moderate	Strengthen vegetation and canopy corridors connecting Kyle Williams Reserve in the west to Carss Bush Park in the east.	7
GC7	Moderate	Establish and maintain regular communication with TfNSW, or equivalent department, to ensure areas of conservation significance are not cleared for potential future road widening works.	17
Pest species and threats			
P1	High	Undertake a fox (*Vulpes vulpes*) control program.	1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 19, 20, 21, 23, 25, 26, 27
P2	High	Classify the site, or sections of the site, as a 'wildlife protection area' as defined under section 30 (b) of the *Companion Animals Act 1998* and undertake appropriate cat control.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 25, 26, 27
P3	High	Manage the spread of *Phytophthora cinnamomi* through appropriate hygiene protocols.	12
P4	Moderate	Implement requirement for soil sampling for *Phytophthora cinnamomi* at relevant locations (i.e. near known areas and along riparian corridors) in planning controls. This would be implemented as a condition of consent in the approval of development applications.	Whole LGA.
P5	Moderate	Maintain ongoing consultation and collaborative work with adjacent Councils and government stakeholders (i.e. National Parks and Wildlife Service, TfNSW, DPI Fisheries) to coordinate management of adjacent land (i.e. National Park land, State road corridors).	3, 4, 5, 10, 15
P6	Moderate	Investigate management options to minimise impacts of sea level rise such as planning controls, soft and hard engineering options.	10
Community engagement and education			
C1	High	Develop ongoing opportunities for community engagement through Bushcare, Georges River Keeper and citizen science initiatives.	Whole LGA.

ID	Priority	Action	Site reference
C2	High	Develop and implement initiatives for private landholders to improve vegetation condition and extent of the tree canopy on private land, especially adjacent to important green corridors.	Whole LGA.
C3	Moderate	Implement interpretive and educational signage regarding threatened species, communities and environmental risks.	14, 23
C4	Moderate	Implement a public education program regarding responsible pet ownership. This would include information approximately the 'wildlife protection areas' (as specified in management action P2), pet registration, collar bells and keeping cats inside at night.	N/A.
C5	Moderate	Utilise and integrate traditional Indigenous knowledge and land management techniques for threatened species recovery and conservation management where available and appropriate.	Whole LGA.
C6	Moderate	Investigate developing a program to encourage and support the community to plant in the road verges adjacent to their properties with mixed-storey plantings.	Whole LGA.
C7	Low	Develop community education materials regarding invasive weed identification, control and notification.	N/A.

8 CONCLUSION

The Georges River LGA is home to a range of biodiversity including numerous species of plants, animals and vegetation communities. The LGA comprises several large Council managed parks and reserves which provides important habitat and connectivity, particularly along the foreshore of the Georges River and Salt Pan Creek.

This Biodiversity Study is comprised of a desktop assessment, field surveys at 27 sites across the LGA as well as community and stakeholder consultation. The outcomes identify various biodiversity values including diverse of flora and fauna species and habitat types, conservation significance, connectivity corridors as well as key threats to biodiversity.

Key features of the LGA which are unique within the Sydney context include the size and condition of several large parks and reserves and the diversity of species and habitat types within them. Nevertheless, there are numerous existing threats to the biodiversity values that, without suitable management, risk the retention and resilience of biodiversity in the LGA. These include weed and pest invasion, climate change, vegetation clearing and increased barriers to connectivity.

This Biodiversity Study provides several recommendations to manage, preserve and improve biodiversity values within the LGA over the next decade. The recommendations include various approaches to address threats and risks to biodiversity such as bush regeneration works, community engagement, public education and Council policy development.

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APPENDIX A – FAUNA DATABASE SEARCH RESULTS

Table A 1. Conservation significant fauna database search results within 5km of the Georges River LGA (DPIE 2020a, DAWE 2020a)

Scientific name	Common name	BC Act	EPBC Act	Records within 5km	Source	Records within the LGA	Most recent record within the LGA
Actitis hypoleucos	Common Sandpiper	P	C,J,K	14	Bionet, EPBC	3	1984
Anthochaera phrygia	Regent Honeyeater	E4A, P	CE	7	Bionet, EPBC	3	1991
Apus pacificus	Fork-tailed Swift	P	C,J,K	1	Bionet, EPBC	0	N/A
Arctocephalus forsteri	New Zealand Fur-seal	V,P		1	Bionet	0	N/A
Arctocephalus pusillus doriferus	Australian Fur-seal	V,P		1	Bionet	0	N/A
Ardenna pacifica	Wedge-tailed Shearwater	P	J	2	Bionet, EPBC	0	N/A
Ardenna tenuirostris	Short-tailed Shearwater	P	C,J,K	10	Bionet, EPBC	0	N/A
Arenaria interpres	Ruddy Turnstone	P	C,J,K	95	Bionet, EPBC	0	N/A
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V,P		6	Bionet	0	N/A
Botaurus poiciloptilus	Australasian Bittern	E1,P	E	8	Bionet, EPBC	0	N/A
Burhinus grallarius	Bush Stone-curlew	E1,P		5	Bionet	0	N/A
Calamanthus fuliginosus	Striated Fieldwren	E1,P		1	Bionet	0	N/A
Calidris acuminata	Sharp-tailed Sandpiper	P	C,J,K	358	Bionet, EPBC	0	N/A
Calidris alba	Sanderling	V,P	C,J,K	3	Bionet, EPBC	0	N/A
Calidris canutus	Red Knot	P	E,C,J, K	33	Bionet, EPBC	0	N/A
Calidris ferruginea	Curlew Sandpiper	E1,P	CE,C, J,K	214	Bionet, EPBC	0	N/A
Calidris melanotos	Pectoral Sandpiper	P	J,K	1	Bionet, EPBC	0	N/A
Calidris ruficollis	Red-necked Stint	P	C,J,K	225	Bionet, EPBC	0	N/A
Calidris subminuta	Long-toed Stint	P	C,J,K	1	Bionet, EPBC	0	N/A
Calidris tenuirostris	Great Knot	V,P	CE,C, J,K	14	Bionet, EPBC	0	N/A
Callocephalon fimbriatum	Gang-gang Cockatoo	V,P, 3		5	Bionet	3	1991
Calyptorhynchus lathami	Glossy Black-Cockatoo	V,P, 2		3	Bionet	1	2014
Caretta caretta	Loggerhead Turtle	E1,P	E	2	Bionet, EPBC	0	N/A

Scientific name	Common name	BC Act	EPBC Act	Records within 5km	Source	Records within the LGA	Most recent record within the LGA
Cercartetus nanus	Eastern Pygmy-possum	V,P		12	Bionet	2	2014
Chalinolobus dwyeri	Large-eared Pied Bat	V,P	V	1	Bionet, EPBC	0	N/A
Charadrius leschenaultii	Greater Sand-plover	V,P	V,C,J, K	5	Bionet, EPBC	0	N/A
Charadrius mongolus	Lesser Sand-plover	V,P	E,C,J, K	5	Bionet, EPBC	0	N/A
Chelonia mydas	Green Turtle	V,P	V	1	Bionet, EPBC	0	N/A
Circus assimilis	Spotted Harrier	V,P		2	Bionet	0	N/A
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V,P		1	Bionet	0	N/A
Crinia tinnula	Wallum Froglet	V,P		1	Bionet	0	N/A
Cuculus optatus	Oriental Cuckoo	P	C,J,K	3	Bionet, EPBC	3	1984
Daphoenositta chrysoptera	Varied Sittella	V,P		4	Bionet	0	N/A
Dasyornis brachypterus	Eastern Bristlebird	E	E	0	EPBC	0	N/A
Dasyurus maculatus	Spotted-tailed Quoll	V,P	E	1	Bionet, EPBC	0	N/A
Diomedea exulans	Wandering Albatross	E1,P	E	4	Bionet, EPBC	0	N/A
Dugong dugon	Dugong	E1,P		3	Bionet	0	N/A
Ephippiorhynchus asiaticus	Black-necked Stork	E1,P		1	Bionet	1	2005
Epinephelus daemelii	Black Rockcod	V	V	0	EPBC	0	N/A
Epthianura albifrons	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	E2,V ,P		41	Bionet	0	N/A
Epthianura albifrons	White-fronted Chat	V,P		41	Bionet	0	N/A
Esacus magnirostris	Beach Stone-curlew	E4A, P		2	Bionet	0	N/A
Falco hypoleucos	Grey Falcon	E	V	0	EPBC	0	N/A
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V,P		1	Bionet	0	N/A
****Gallinago hardwickii***	Latham's Snipe	P	J,K	23	Bionet, EPBC	0	N/A
Gelochelidon nilotica	Gull-billed Tern	P	C	1	Bionet	0	N/A
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V,P, 3		1	Bionet, EPBC	0	N/A
****Glossopsitta pusilla***	Little Lorikeet	V,P		6	Bionet	0	N/A
Grantiella picta	Painted Honeyeater	V	V	0	EPBC	0	N/A
Haematopus fuliginosus	Sooty Oystercatcher	V,P		9	Bionet	0	N/A
Haematopus longirostris	Pied Oystercatcher	E1,P		797	Bionet	2	1998
Haliaeetus leucogaster	White-bellied Sea-Eagle	V,P		70	Bionet	8	2012
Heleioporus australiacus	Giant Burrowing Frog	V	V	0	EPBC	0	N/A
Hieraaetus morphnoides	Little Eagle	V,P		5	Bionet	2	2017

Scientific name	Common name	BC Act	EPBC Act	Records within 5km	Source	Records within the LGA	Most recent record within the LGA
Hirundapus caudacutus	White-throated Needletail	P	V,C,J,K	11	Bionet, EPBC	1	2014
Hoplocephalus bungaroides	Broad-headed Snake	E	V	0	EPBC	0	N/A
Hydroprogne caspia	Caspian Tern	P	J	74	Bionet, EPBC	0	N/A
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E	0	EPBC, EPBC	0	N/A
Ixobrychus flavicollis	Black Bittern	V,P		4	Bionet	0	N/A
Lathamus discolor	Swift Parrot	E1,P,3	CE	6	Bionet, EPBC	2	1991
Limicola falcinellus	Broad-billed Sandpiper	V,P	C,J,K	5	Bionet, EPBC	0	N/A
Limosa lapponica	Bar-tailed Godwit	P	C,J,K	523	Bionet, EPBC	4	2010
Limosa lapponica baueri	Bar-tailed Godwit (baueri)	P	V	1	Bionet, EPBC	1	2020
Limosa limosa	Black-tailed Godwit	V,P	C,J,K	5	Bionet, EPBC	0	N/A
Litoria aurea	Green and Golden Bell Frog	E1,P	V	751	Bionet, EPBC	0	N/A
Litoria raniformis	Growling Grass Frog	E	V	0	EPBC	0	N/A
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V,P,2		3	Bionet	2	1998
Lophoictinia isura	Square-tailed Kite	V,P,3		7	Bionet	4	2016
Macquaria australasica	Macquarie Perch	V	E	0	EPBC	0	N/A
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V,P		2	Bionet	0	N/A
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V,P		3	Bionet	0	N/A
Miniopterus australis	Little Bent-winged Bat	V,P		4	Bionet	1	2013
Miniopterus orianae oceanensis	Large Bent-winged Bat	V,P		36	Bionet	2	2012
Mixophyes balbus	Stuttering Frog	E	V	0	EPBC	0	N/A
Myotis macropus	Southern Myotis	V,P		9	Bionet	0	N/A
Neophema chrysogaster	Orange-bellied Parrot	E	CE	0	EPBC	0	N/A
Neophema pulchella	Turquoise Parrot	V,P,3		1	Bionet	0	N/A
Ninox strenua	Powerful Owl	V,P,3		217	Bionet	32	2017
Numenius madagascariensis	Eastern Curlew	P	CE,C,J,K	444	Bionet, EPBC	10	2005
Numenius minutus	Little Curlew	P	C,J,K	2	Bionet, EPBC	0	N/A
Numenius phaeopus	Whimbrel	P	C,J,K	160	Bionet, EPBC	1	1999
Onychoprion fuscata	Sooty Tern	V,P		2	Bionet	0	N/A
Pandion cristatus	Eastern Osprey	V,P,3		25	Bionet	10	2015

Scientific name	Common name	BC Act	EPBC Act	Records within 5km	Source	Records within the LGA	Most recent record within the LGA
Perameles nasuta	Long-nosed Bandicoot population in inner western Sydney	E2,P		1	Bionet	0	N/A
Petauroides volans	Greater Glider		V	0	EPBC	0	N/A
Petaurus australis	Yellow-bellied Glider	V,P		1	Bionet	0	N/A
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	0	EPBC	0	N/A
Petroica boodang	Scarlet Robin	V,P		1	Bionet	0	N/A
Petroica phoenicea	Flame Robin	V,P		2	Bionet	0	N/A
Petroica rodinogaster	Pink Robin	V,P		2	Bionet	0	N/A
Phascolarctos cinereus	Koala	V,P	V	119	Bionet, EPBC	1	1991
Pluvialis fulva	Pacific Golden Plover	P	C,J,K	70	Bionet	0	N/A
Pluvialis squatarola	Grey Plover	P	C,J,K	5	Bionet, EPBC	0	N/A
Pommerhelix duralensis	Dural Land Snail	E	E	0	EPBC	0	N/A
Prototroctes maraena	Australian Grayling	E	V	0	EPBC	0	N/A
Pseudomys novaehollandiae	New Holland Mouse		V	0	EPBC	0	N/A
Pseudophryne australis	Red-crowned Toadlet	V,P		6	Bionet	1	2015
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V	1726	Bionet, EPBC	287	2015
Ptilinopus superbus	Superb Fruit-Dove	V,P		4	Bionet	2	1996
Rostratula australis	Australian Painted Snipe	E1,P	E	3	Bionet, EPBC	0	N/A
Rostratula australis	Australian Painted Snipe	E	E	0	EPBC	0	N/A
****Saccolaimus flaviventris***	Yellow-bellied Sheathtail-bat	V,P		5	Bionet	0	N/A
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P		5	Bionet	0	N/A
Stagonopleura guttata	Diamond Firetail	V,P		1	Bionet	0	N/A
Sterna hirundo	Common Tern	P	C,J,K	4	Bionet, EPBC	0	N/A
Sternula albifrons	Little Tern	E1,P	C,J,K	1347	Bionet, EPBC	0	N/A
Thalasseus bergii	Crested Tern	P	J	175	Bionet, EPBC	3	2005
Thinornis cucullatus cucullatus	Hooded Plover		V	0	EPBC, EPBC	0	N/A
Thinornis rubricollis	Hooded Plover	E4A, P	V	1	Bionet, EPBC	0	N/A
Tringa brevipes	Grey-tailed Tattler	P	C,J,K	110	Bionet, EPBC	1	2004
Tringa incana	Wandering Tattler	P	J	1	Bionet, EPBC	0	N/A
Tringa nebularia	Common Greenshank	P	C,J,K	131	Bionet, EPBC	0	N/A
Tringa stagnatilis	Marsh Sandpiper	P	C,J,K	1	Bionet, EPBC	0	N/A

Scientific name	Common name	BC Act	EPBC Act	Records within 5km	Source	Records within the LGA	Most recent record within the LGA
Tyto novaehollandiae	Masked Owl	V,P, 3		4	Bionet	0	N/A
Tyto tenebricosa	Sooty Owl	V,P, 3		12	Bionet	0	N/A
Varanus rosenbergi	Rosenberg's Goanna	V,P		4	Bionet	0	N/A
Xenus cinereus	Terek Sandpiper	V,P	C,J,K	41	Bionet, EPBC	0	N/A

BC Act – *Biodiversity Conservation Act 2016* (NSW); EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
E4A – critically endangered; E – endangered species; V – vulnerable. CE - critically endangered; P – protected
C – CAMBA, J – JAMBA, K – ROCKAMBA.
*The species was recorded by Total Earth Care (2012).

APPENDIX B – FLORA DATABASE SEARCH RESULTS

Table A 2. Conservation significant flora database search results within 5km of the Georges River LGA (DPIE 2020a, DAWE 2020a)

Scientific name	Common name	BC Act	EPBC Act	Records within 5km	Source	Records within the LGA	Most recent record within the LGA
Acacia bynoeana	Bynoe's Wattle	E1	V	5	Bionet	1	1989
Acacia prominens	Gosford Wattle, Hurstville and Kogarah Local Government Areas	E2		15	Bionet	15	2016
Acacia pubescens	Downy Wattle	V	V	607	Bionet	1	1997
Acacia terminalis subsp. terminalis	Sunshine Wattle	E1	E	9	Bionet	0	N/A
Allocasuarina diminuta subsp. mimica	Allocasuarina diminuta subsp. mimica population in the Sutherland Shire and Liverpool City local government areas	E2		2	Bionet	0	N/A
Caesia parviflora var. minor	Small Pale Grass-lily	E1		1	Bionet	0	N/A
Caladenia tessellata	Thick Lip Spider Orchid	E1,P,2	V	23	Bionet, EPBC	2	1901
Callistemon linearifolius	Netted Bottle Brush	V,3		12	Bionet	0	N/A
Chamaesyce psammogeton	Sand Spurge	E1		1	Bionet	0	N/A
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	0	EPBC	0	N/A
Deyeuxia appressa		E1	E	2	Bionet	0	N/A
Deyeuxia appressa		E	E	0	EPBC	0	N/A
Epacris purpurascens var. purpurascens		V		6	Bionet	0	N/A
Eucalyptus camfieldii	Camfield's Stringybark	V	V	2	Bionet, EPBC	0	N/A
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	1	Bionet	0	N/A
Genoplesium baueri	Yellow Gnat-orchid	E	E	0	EPBC	0	N/A
Hibbertia puberula		E1		1	Bionet	0	N/A
Hibbertia stricta subsp. furcatula		E1		11	Bionet	0	N/A
Leucopogon exolasius	Woronora Beard-heath	V	V	2	Bionet	0	N/A
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		7	Bionet	0	N/A

Scientific name	Common name	BC Act	EPBC Act	Records within 5km	Source	Records within the LGA	Most recent record within the LGA
Maundia triglochinoides		V		5	Bionet	3	1903
Melaleuca biconvexa	Biconvex Paperbark	V	V	0	EPBC	0	N/A
Melaleuca deanei	Deane's Paperbark	V	V	24	Bionet, EPBC	4	1899
Persicaria elatior	Tall Knotweed	V	V	0	EPBC	0	N/A
Persoonia hirsuta	Hairy Geebung	E1,P,3	E	11	Bionet, EPBC	2	1988
Persoonia nutans	Nodding Geebung	E1,P	E	2	Bionet, EPBC	0	N/A
Pimelea curviflora var. curviflora		V	V	0	EPBC	0	N/A
Pimelea spicata	Spiked Rice-flower	E1	E	1	Bionet, EPBC	0	N/A
Pomaderris prunifolia	P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	E2		2	Bionet	0	N/A
Prostanthera densa	Villous Mint-bush	V	V	3	Bionet	0	N/A
Prostanthera saxicola	Prostanthera saxicola population in Sutherland and Liverpool local government areas	E2		3	Bionet	0	N/A
Pterostylis gibbosa	Illawarra Greenhood	E1,P,2	E	1	Bionet	0	N/A
Pterostylis saxicola	Sydney Plains Greenhood	E1,P,2	E	2	Bionet, EPBC	0	N/A
Pultenaea aristata	Prickly Bush-pea	V	V	1	Bionet	0	N/A
Pultenaea pedunculata	Matted Bush-pea	E1		1	Bionet	0	N/A
Rhizanthella slateri	Eastern Underground Orchid	V	E	0	EPBC	0	N/A
Rhodamnia rubescens	Scrub Turpentine	E4A		5	Bionet	4	1899
Senecio spathulatus	Coast Groundsel	E1		10	Bionet	0	N/A
Syzygium paniculatum	Magenta Lilly Pilly	E1	V	116	Bionet, EPBC	3	2015
Tetratheca juncea	Black-eyed Susan	V	V	20	Bionet	3	2015
Thelymitra kangaloonica	Kangaloon Sun Orchid	CE	CE	0	EPBC	0	N/A
Thesium australe	Austral Toadflax	V	V	0	EPBC	0	N/A
Wahlenbergia multicaulis	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E2		3	Bionet	0	N/A
Wilsonia backhousei	Narrow-leafed Wilsonia	V		6	Bionet	0	N/A

BC Act – *Biodiversity Conservation Act 2016* (NSW); EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
E4A – critically endangered; E – endangered species; V – vulnerable. CE - critically endangered; P – protected
C – CAMBA, J – JAMBA, K – ROCKAMBA.
*The species was recorded by Total Earth Care (2012).

APPENDIX C – SPECIES LIKELIHOOD OF OCCURRENCE

After reviewing the list of threatened species and migratory species records from the DPIE Wildlife Atlas database (DPIE 2020a) and EPBC Protected Matters Search (DAWE 2020a) (Appendix A and Appendix B), additional matters were considered in assessing which threatened species are likely to occur within the LGA. This included information such as the number of records within the 5 km radius of the site, the dates of these records, the likelihood of detecting the species during a survey, the preferred species habitat requirements and whether the study area contained suitable habitat for the species.

The determination of species for likelihood assessment requires the exclusion of those species that are not relevant to the site including species that either have not been recorded on the study area during the field studies or are unlikely to be present on the site due to the absence of suitable habitats (i.e. Extremely Low category).

Table A 3. Threatened Species Likelihood of Occurrence Matrix

		Likelihood of Occurrence based on further investigations e.g. field survey, up-to-date local monitoring records					
		Species identified and suitable habitat occurs within the Subject Site	**Species not identified but suitable habitat occurs within the Subject Site**	**Species not identified but partially disturbed or degraded habitat occurs within the Subject Site**	**Species not identified and no suitable habitat occurs within the Subject Site**	**Species not identified but suitable habitat occurs within 1 km of the Subject Site**	**Species not identified and suitable habitat occurs > 10 km away from the Subject Site**
Likelihood of Occurrence based on desktop assessments (DPIE 2020a, DAWE 2020a)		1	2	3	4	5	6
Expected to occur during the Project (i.e. high abundance of recent records within 5 km)	1	DOES OCCUR	HIGH	HIGH	MEDIUM	MEDIUM	LOW
Could occur during the Project (i.e. some recent records within 5 km)	2	DOES OCCUR	HIGH	MEDIUM	MEDIUM	LOW	LOW
Possible under exceptional circumstances (i.e. low numbers of recent records within 5 km)	3	DOES OCCUR	MEDIUM	MEDIUM	LOW	LOW	LOW
Unlikely to occur during the Project (i.e. old records but low in numbers)	4	DOES OCCUR	MEDIUM	LOW	LOW	LOW	EXTREMELY LOW
Very unlikely to occur during the Project (i.e. only old records)	5	DOES OCCUR	LOW	LOW	LOW	EXTREMELY LOW	EXTREMELY LOW
Extremely rare or previously unknown to occur (i.e. no records)	6	DOES OCCUR	LOW	LOW	EXTREMELY LOW	EXTREMELY LOW	EXTREMELY LOW

Table A 4. Threatened flora Likelihood of Occurrence

Note: 'recent' records refer to records in the last 20 years.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Acacia bynoeana	Bynoe's Wattle	E1	V	Distribution & Ecology: Found in central eastern NSW from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Currently known from approximately 30 locations with the size of the populations at most locations being very small (1-5 plants). Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Flowering & Reproduction: in summer, from September to March. Seedpods mature from September to January. Notable Threats: browsing by herbivores, habitat disturbance, and catastrophic events triggering localised extinction.	**Low:** There are no records within the study area, there is only one record within 5km.
Acacia prominens	Gosford Wattle, Hurstville and Kogarah Local Government Areas	E2		Occurs at a few sites along the railway line at Penshurst, at Carss Bush Park, Carss Park and there is an unconfirmed siting at Oatley Park, Oatley. Grows in open situations on clayey or sandy soils. Flowers from July to September and pods are produced in September-October.	**High:** There are 15 total records within the study area, four of which are recent. The species was recorded in the 2012 (Total Earth Care) study.
Acacia pubescens	Downy Wattle	V	V	Distribution and ecology: Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Longevity is unknown, but clonal species have been known to survive for many decades. Flowering & Reproduction: Flowers from August to October. Pollination of Acacia flowers is usually by insects and birds. The pods mature in October to December. Recruitment is more commonly from vegetative reproduction than from seedlings. The percentage of pod production and seed fall for this species appears to be low.	**Moderate:** There hundreds of records within 5km of the site and one record within the study area (1997). However, the soil type (shales) in which the species prefers is in areas of high development and little to no remnant vegetation.
Acacia terminalis subsp. terminalis (aka. Acacia terminalis subsp. Eastern Sydney)	Sunshine Wattle	E1	E	Distribution & Ecology: Very limited distribution in the eastern suburbs of Sydney. Occurs in coastal scrub and dry sclerophyll woodland on sandy soils. Habitat is generally sparse and scattered. Most areas of habitat or potential habitat are small and isolated, and disturbed due to surrounding urban development. Flowering & Reproduction: Autumn through to early winter. Pollinated by small birds and bees. Seeds mature in November and are dispersed by ants. Seed viability is high and recruitment occurs mainly after fire. A fire temperature of 60 degrees is required for optimum germination. Although plants are killed by fire, they have been recorded sprouting from the base.	**Moderate:** There are seven recent records within 5km of the site, however no records are within the study area.
Allocasuarina diminuta subsp. mimica	Allocasuarina diminuta subsp. mimica population in the Sutherland Shire and Liverpool City local	E2		The endangered population occurs along sandstone ridges and upper hillsides in the region northwest from Heathcote, towards Menai and Holsworthy, in heathy and low open woodland communities. It is restricted to the Local Government Areas listed in this instance (Sutherland and Liverpool). It is known in Heathy woodland, Heathlands and Low open woodland communities.	**Low:** There is one recent record within 5km of the site (south of Georges River) and none in the study area. There is limited potential habitat for the species.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
	government areas				
Caesia parviflora var. minor	Small Pale Grass-lily	E1		The Small Pale Grass-lily is an inconspicuous herb. The leaves are 2 mm wide and arranged in a rosette at ground level. This variety occurs uncommonly in Tasmania, southern Victoria and south-east South Australia with an outlying population in NSW, in Barcoongere State Forest, between Grafton and Coffs Harbour. Found in damp places in open forest on sandstone.	**Moderate:** There is one record of the species within 5km and none within the study area. There is potential habitat and the study area (Coastal Enriched Sandstone Dry Forest).
Caladenia tessellata	Thick Lip Spider Orchid	E1,P,2	V	Populations at Wyong, Ulladulla and Braidwood in NSW. There are no recent records of the species occurring in the Sydney region. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year. Flowers appear between September and November (but apparently generally late September or early October in extant southern populations).	**Low:** There are two recent record within 5km of the site, however non in the study area. There is limited potential habitat for the species.
Callistemon linearifolius	Netted Bottle Brush	V,3		Distribution & Ecology: Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Grows in dry sclerophyll forest on the coast and adjacent ranges. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park. Flowering & Reproduction: spring – summer. Notable Threats: local extinction due to low population numbers, encroaching development.	**Low:** There are 12 recent records within 5km, however none are within the study area. Very obvious species. The recent records are in urban area and are likely planted.
Chamaesyce psammogeton	Sand Spurge	E1		Sand Spurge is found sparsely along the coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach National Park) to Queensland (and Lord Howe Island). Populations have been recorded in Wamberal Lagoon Nature Reserve, Myall Lakes National Park, Moonee Beach Nature Reserve and Bundjalung National Park. Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (*Spinifex sericeus*) and Prickly Couch (*Zoysia macrantha*)	**Low:** There is only one record within 5km (1933) and non within the study area. There is limited suitable habitat.
^^Cryptostylis hunteriana	Leafless Tongue Orchid	V,P,2	V	Distribution & Ecology: has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It occurs mainly in coastal districts, and known from a range of communities, including swamp-heath and woodland. Flowering & Reproduction: between November and February. In addition to reproducing from seed, it is also capable of vegetative reproduction and thus forms colonies which can become more or less permanent at a site. Notable Threats: urban development, inappropriate fires regimes, trampling.	**Low:** There are no records within 5km and there is limited suitable habitat in the study area.
Deyeuxia appressa		E1	E	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown. Was then collected in 1941 from Killara, near Hornsby. Has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas.	**Low**: Only two records within 5km (1930), the species has not been recorded since. Likely locally extinct.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Epacris purpurascens var. purpurascens		V		Distribution & Ecology: Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence. Flowering & Reproduction: Flowers in Spring. Lifespan is recorded to be 5-20 years, requiring 2-4 years before seed is produced in the wild. Killed by fire and re-establishes from soil-stored seed. Notable Threats: land clearing, human activities causing habitat loss or population damage.	**Low:** There are six records within 5km, one of which is recent. The soil type (shales) in which the species prefers is in areas of high development and little to no remnant vegetation.
Eucalyptus camfieldii	Camfield's Stringybark	V	V	Distribution & Ecology: Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Flowering & Reproduction: A number of stems arise from these lignotubers giving the impression of individual plants. Flowering period is irregular, flowers recorded throughout the year. Poor response to too frequent fires. Population sizes are difficult to estimate because its extensive lignotubers may be 20 m across.	**Low:** Only two records are within 5km (most recent is 1952). Both are within the forested areas of Holsworthy Military Area, south of Gorges River.
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock. Seedling recruitment is common, even in disturbed soils, if protected from grazing and fire. Tends to grow on lower slopes in the landscape. This species is sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield, being most common in central portions of its range. Found largely on private property and roadsides, and occasionally in conservation reserves. Planted as urban trees, windbreaks and corridors.	**Low:** There is only one record within 5km. The local Sydney population is likely to be made up of planted specimens.
^^Genoplesium baueri	Bauer's Midge Orchid	E1,P,2	E	Grows in dry sclerophyll forest and moss gardens over sandstone. Flowers February to March. The species has been recorded from locations between Ulladulla and Port Stephens. Approximately 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.	**Low:** There are no records within 5km. Unlikely to occur due to geographic restriction, however some suitable habitat is present
Hibbertia puberula		E1		Distribution & Ecology: widespread but never common. Extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Prefers low heath on sandy soils or rarely in clay, with or without rocks underneath. Habitats are typically dry sclerophyll woodland communities although heaths are also occupied. One of the recently described subspecies also favours upland swamps. Flowering & Reproduction: time is October to December, sometimes into January. Notable Threats: land clearing and development.	**Low:** One record within 5km (1908), some suitable habitat is present, however it is likely absent from the area.
Hibbertia stricta subsp. furcatula		E1		Hibbertia stricta subsp. furcatula (Hibbertia sp. nov. 'Menai') is known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. The Southern Sydney population occurs on both sides of the Woronora River gorge, near Loftus and in Royal National Park. The southern population is mainly in the vicinity of Nowra.	**Low:** There are nine recent records within 5km, all of which are located within Holsworthy Military Area, south of Georges River. Limited suitable habitat present.
Leucopogon exolasius	Woronora Beard-heath	V	V	Woronora Beard-heath is found along the upper Georges River area and in Heathcote National Park. The common and similar *Leucopogon setiger* has longer flower stalks, a smooth outer surface to the flower tube and shorter, wider leaves.	**Low:** There are two recent records within 5km, one of which is recent, located within Holsworthy Military Area, south of

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
					Georges River. Marginal suitable habitat present.
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		Distribution & Ecology: Grows in vine thickets and open shale woodland. Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. Flowering & Reproduction: Flowers in spring. Has large underground tubers.	**Low:** Seven recent records within 5km within known areas (near Bankstown). The soil type (shales) in which the species prefers is in areas of high development and little to no remnant vegetation. The endangered population does not extend to the Georges River LGA.
Maundia triglochinoides		V		Distribution & Ecology: Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong. Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowering & Reproduction: November-January. Probably wind pollinated. Spreads vegetatively, with tufts of leaves arising along rhizome. Water dispersed. Populations expand following flood events and contract to more permanent wetlands in times of low rainfall.	**Low:** There are five records (1903) in the study area, however the current known distribution is on the Central Coast only. The species is likely extinct form the locality.
Melaleuca biconvexa	Biconvex Paperbark	V	V	Distribution & Ecology: Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Flowering & Reproduction: occurs over just 3-4 weeks in September and October. Resprouts following fire.	**Low:** There are no records within 5km. Although there is some suitable habitat, the study area is outside of its known current range.
Melaleuca deanei	Deane's Paperbark	V	V	The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate. Two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas.	**Low:** There are 24 records within 5km of the site, however only 4 are recent, all of which are located within Holsworthy Military Area, south of Georges River. The records within the site (1899) are old and within urban area.
Persicaria elatior	Tall Knotweed	V	V	Tall Knotweed 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 (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). The species also occurs in Queensland. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	**Low**: There are no records within 5km. There is some suitable habitat (small creeklines are over sandstone bedrock). However the species is likely absent due to geographic isolation.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Persoonia hirsuta	Hairy Geebung	E1,P,3	E	Distribution & Ecology: Has a scattered distribution around Sydney from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. Has a large area of occurrence but occurs in small populations. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations. Flowering & Reproduction: Flowers November to January. It is probably killed by fire (as other Persoonia species are) but will regenerate from seed.	**Moderate:** There are 11 records within 5km, however only three are recent. Two records are within the study area, however old (1988), nevertheless some suitable habitat is present.
Persoonia nutans	Nodding Geebung	E1,P	E	Distribution & Ecology: Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River/Castlereagh Ironbark Forests. Flowering & Reproduction: November to March with sporadic flowering all year round. Seed is likely to be dispersed, after consumption of the fruit, by large birds.	**Low:** Two records are within 5km (1990). Habitat within the study area is not suitable.
Pimelea curviflora var. curviflora		V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Flowers October to May. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots. Likely to be fire tolerant species capable of resprouting following fire due to the presence of a tap root. Seedlings have been observed following fire. Confined to the coastal area of the Sydney and Illawarra regions. Formerly recorded around the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly.	**Low:** There are no records within 5km. The soil type (shales) in which the species prefers is in areas of high development and little to no remnant vegetation.
Pimelea spicata	Spiked Rice-flower	E1	E	Distribution & Ecology: Occurs in two disjunct areas: Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas) and Illawarra (Landsdowne to Shellharbour to northern Kiama). Found on well-structured clay soils. On the Cumberland Plain sites it is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark. Flowering & Reproduction: Mature plants spread over short distances through underground rhizomes, and this can assist them to recover from disturbances like fire and irregular grazing. Flowers may be self-pollinating, although fruit production is variable. Fruit are not dispersed well, with most seedlings germinating close to the adult (within 30cm or so). A soil seedbank develops and is maintained in the presence of a suitable disturbance regime.	**Low:** There is one recent record within 5km. The soil type (clays) in which the species prefers are not present in the study area.
Pomaderris prunifolia	P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	E2		Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It also occurs near Walcha on the New England tablelands and in far eastern Gippsland in Victoria. Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. Flowers appear in September and October. The species has been found in association with *Eucalyptus amplifolia*, *Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua.*	**Low**: There are two records within 5km, one of which is recent (2017). There is limited suitable habitat present, however the endangered population does not extend to the Georges River LGA.
Prostanthera densa	Villous Mint-bush	V	V	Distribution & Ecology: Generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea. This species has been recorded from the Currarong area in Jervis Bay, Royal National Park (Marley), Cronulla, Helensburgh and Port Stephens (Nelson Bay). The Sydney and Royal National Park populations were thought possibly extinct, but the species is now known to occur at Bass and Flinders Point in Cronulla. Flowering & Reproduction: occurs chiefly in spring or from May - December.	**Low**: There are three records of the species within 5km (most recent is 1985). There is no suitable habitat in the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Prostanthera saxicola	Prostanthera saxicola population in Sutherland and Liverpool local government areas	E2		Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Two populations occur within a conservation reserve (Georges River National Park; Scheyville NP). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	**Low**: There are three records of the species within 5km (most recent is 1987). There is limited suitable habitat in the study area. The endangered population does not extend to the Georges River LGA.
Pterostylis gibbosa	Illawarra Greenhood	E1,P,2	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	**Low**: There is one record within 5km (1949). There is li
Pterostylis saxicola	Sydney Plains Greenhood	E1,P,2	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Two populations occur within a conservation reserve (Georges River National Park; Scheyville NP). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	**Low:** Two records within 5km, one of which is recent (2007). The known vegetation communities in which it grows are not within the study area.
Pultenaea aristata	Prickly Bush-pea	V	V	Distribution & Ecology: restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong. Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community, in either dry sclerophyll woodland or wet heath on sandstone. Flowering & Reproduction: has been recorded in winter and spring.	**Low:** There is one record within 5km. There is no suitable habitat within the study area.
Pultenaea pedunculata	Matted Bush-pea	E1		In NSW the species is represented by just three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). The Cumberland Plain occurrences were more widespread (Yennora, Canley Vale and Cabramatta were lost to development) and is now found at Villawood and Prestons, and north-west of Appin between the Nepean River and Devines Tunnel number 2 (Upper Sydney Water Supply Canal). NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area. In the Cumberland Plain the species favours sites in clay or sandy-clay soils (Blacktown Soil Landscape) on Wianamatta Shale-derived soils, usually close to patches of Tertiary Alluvium (Liverpool area) or at or near the Shale-Sandstone interface (Appin). All sites have a lateritic influence with ironstone gravel (nodules) present.	**Low:** There is one record within 5km (1988). The soil type (shales) in which the species prefers is in areas of high development and little to no remnant vegetation.
Rhizanthella slateri	Eastern Australian Underground Orchid	V,P,2	E	In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood, although it is known to occur in sclerophyll forest. Flowers September to November.	**Low:** There are no records within 5km. Limited habitat is present within the study area.
Rhodamnia rubescens	Scrub Turpentine	E4A		Distribution & Ecology: Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	**Low:** Five records are within 5km, all of which are old (1996. Some suitable habitat is present in Coastal Enriched Sandstone Moist Forest (PCT 1841) and

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
				Flowering & Reproduction: late winter to spring. Flowers August to October, fruit October to December. Notable threats: Myrtle Rust (*Austropuccinia psidii*).	Coastal Shale-Sandstone Forest (PCT 1845).
Senecio spathulatus	Coast Groundsel	E1		Coast Groundsel occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). In Victoria there are scattered populations from Wilsons Promontory to the NSW border. Coast Groundsel grows on frontal dunes.	**Low:** Ten records are within 5km, two of which are recent (2011). There is no suitable habitat within the study area.
Syzygium paniculatum	Magenta Lilly Pilly	E1	V	Distribution & Ecology: Naturally found only in NSW in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. On the south coast it 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. Flowering & Reproduction: between November and February, with fruits mature in May. Notable Threats: known low genetic diversity, loss of habitat due to residential development, Myrtle Rust, rising sea levels.	**High:** There are 116 records within 5km, several of which are recent. There are three records within the study area, the most recent from 2015. There is some suitable habitat present.
Tetratheca juncea	Pink Bells (also Black-eyed Susan)	V	V	Distribution & Ecology: Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. Usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. Also recorded in heathland and moist forest, with the majority of populations' occuring on low nutrient soil. Flowering & Reproduction: Usually via underground stems which can be up to 50 cm long. Consequently, individual plants may be difficult to identify. Also reproduces sexually but requires insect pollination.	**Low**: There are 20 records within 5km, three of which are within the study area. However, all records are very old (all form late 1800's). However, some suitable habitat is present.
Thelymitra kangaloonica	Kangaloon Sun Orchid	E4A,P,2	CE	The species is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. These swamps are a part of the ecological community "Coastal Upland Swamp" EEC. The majority of known plants are located on land managed by the Sydney Catchment Authority. One small population is located in Budderoo National Park. It is likely that the number of mature individuals of Thelymitra kangaloonica (Thelymitra sp. Kangaloon) is very low, with less than 250 plants known. It is found in swamps in sedgelands over grey silty grey loam soils. It is thought to be a short-lived perennial, flowering in late October and early November	**Low:** There are no records within 5km. There is no suitable habitat within the study area.
Thesium australe	Austral Toadflax	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. It is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Often found in association with Kangaroo Grass (*Themeda australis*) and often hidden amongst grasses and herbs.	**Low**: There are no records within 5km and there is no suitable habitat.
Wahlenbergia multicaulis	Tadgell's Bluebell in the local government areas of Auburn, Bankstown,	E2		There are 13 known sites, two of which are in northern Sydney (Thornleigh and Mt Ku-Ring-Gai) with the remainder in western Sydney (Rookwood, Chullora, Bass Hill, Bankstown, Georges Hall, Campsie, South Granville and Greenacre). In Western Sydney most sites are closely aligned with the Villawood Soil Series, which is a poorly drained, yellow podsolic extensively permeated with fine, concretionary ironstone (laterite). Found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses	**Low:** There are three records within 5km, two of which are recent (2010). The endangered population does not extend to the Georges River LGA.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
	Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield			and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open.	
Wilsonia backhousei	Narrow-leafed Wilsonia	V		In NSW Narrow-leaf Wilsonia is found on the coast between Mimosa Rocks National Park and Wamberal north of Sydney (Nelson's Lake, Potato Point, Sussex Inlet, Wowly Gully, Parramatta River at Ermington, Clovelly, Voyager Point, Wollongong and Royal National Park). It grows in all southern states. This is a species of the margins of salt marshes and lakes. Flowering occurs in spring and summer.	**Moderate:** There are six records within 5km, three of which are recent (2007- 2010). There is some suitable habitat in the study area near saltmarshes.

Table A 5. Threatened and migratory fauna Likelihood of Occurrence

Note: 'recent' records refer to records in the last 20 years. Pelagic species have not been included.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Actitis hypoleucos	Common Sandpiper	P	C,J,K	Small bicolored sandpiper which often bobs its tail in a distinctively wagtail-like manner. Plain brown with white underparts; distinguished from bulkier and rounder-headed Green Sandpiper by a prominent white spur at the shoulder. Found in a variety of wetland habitats; breeds on stony ground along rivers and lakeshores, with migrants occurring on muddy and rocky substrates from concrete canal banks to channels in tidal mudflats. Mainly found as singles or in small groups, not in flocks or mixed with other species. The Common Sandpiper is migratory, breeding in Eurasia. Most of the western breeding populations winter in Africa and eastern breeding populations' winter in Australia and south Asia to Melanesia. Some birds do not return to Eurasia to breed, but remain in the north of Australia throughout the Australian winter.	**High:** There are 10 records within 5km, nine of which are recent. There is some suitable foraging habitat within the study area
Anthochaera phrygia	Regent Honeyeater	E4A,P	CE	Distribution & Ecology: North-eastern Victoria to south-east Queensland. Mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Also found in drier coastal woodlands and forests. Foraging: A generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Insects make up 15% of diet. Breeding: between July and January. There are only three known key breeding regions remaining: two of which are in NSW at Capertee Valley, and the Bundarra-Barraba region. Nesting: in horizontal branches or forks in tall mature Eucalypts and sheoaks, and also in mistletoe haustoria. Relevant threats: Competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds.	**Low:** There are seven records within 5km, however all of them are old (most recent is 1995). There is no preferred habitat within the study area.
Arctocephalus forsteri	New Zealand Fur-seal	V,P		Occurs in Australia and New Zealand. Reports of non-breeding animals along southern NSW coast particularly on Montague Island, but also at other isolated locations to north of Sydney. Prefers rocky parts of islands with jumbled terrain and boulders. Feeds principally on cephalopods and fish, but also seabirds and occasionally penguins.	**Low:** There is only one record within 5km. There is no preferred habitat within the study area.
Arctocephalus pusillus doriferus	Australian Fur-seal	V,P		Reported to have bred at Seal Rocks, near Port Stephens and Montague Island in southern NSW. Haul outs are observed at isolated places along the NSW coast. Prefers rocky parts of islands with flat, open terrain. They occupy flatter areas than do New Zealand Fur-seals where they occur together.	**Low:** There is only one record within 5km. There is no preferred habitat within the study area.
Ardenna pacifica	Wedge-tailed Shearwater	P	J	Distribution & Ecology: a pelagic, marine bird known from tropical and subtropical waters. It is widespread across the Indian and Pacific Oceans. Breeding: In summer, on the east and west coasts of Australia and on off-shore islands. Common in the Indian Ocean, the Coral Sea and the Tasman Sea. Areas where breeding occurs include islands off the west coast of WA, islands and cays of the Great Barrier Reef (Queensland), and islands along the eastern coast of eastern Australia, including Lord Howe Island and Norfolk Island (NSW). Foraging: have been observed feeding along the junction between inshore and offshore water masses in Australia. In tropical waters, they mainly forage over cool nutrient-rich waters and associated upwellings. Roosting: mainly excavated burrows on flat or flattish areas with dense grassy and tussocky vegetation. This can vary depending on the nature of soil and terrain, as at some sites burrows are below the cover of trees and shrubs. In deep soft soil, burrows can be 2+ metres long. At sites with sandy vegetated screes or stable dunes or on flats of shell grit, burrows are approximately to 1.5 m long, parallel with the surface or steeply dipping).	**Low:** There are two records within 5km, one of which is recent. There is no preferred habitat within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V,P		Distribution & Ecology: Widespread in eastern, southern, and south-western Australia. 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. Also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland. Foraging: Primarily eats invertebrates, which are captured whilst hovering or sallying above the canopy. Breeding: August to January. Generally breed in solitary pairs. Nest is a scanty of twigs, 1-20m high on a horizontal branch/fence post. Relevant threats: Aggressive exclusion by over abundant noisy miners.	**Low:** There are six records within 5km, four of which are recent. There is limited suitable habitat within the study area.
Botaurus poiciloptilus	Australasian Bittern	E1,P	E	Distribution & Ecology: widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. They favour permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleoacharis spp.). Foraging: they hide during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. The species requires shallow water, less than 30 cm deep with medium to low density reeds, grasses or shrubs for foraging. Nesting: needs deeper water, with medium to high density reeds, rushes or sedges for nesting. Nests are built in secluded places in densely-vegetated wetlands on a platform of reeds, with olive-brown eggs. Breeding: occurs in summer from October to January.	**Moderate:** There are eight records within 5km, four of which are recent. There some suitable habitat in the coastal freshwater wetlands.
Burhinus grallarius	Bush Stone-curlew	E1,P		Distribution & Ecology: Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Behaviour: Largely nocturnal, being especially active on moonlit nights. Foraging: Feed on insects and small vertebrates, such as frogs, lizards and snakes. Breeding: August – January on the ground in a scrape or small bare patch.	**Moderate:** There are five records within 5km, two of which are recent. There is limited suitable habitat for the species
Calidris acuminata	Sharp-tailed Sandpiper	P	C,J,K	Distribution & Ecology: spends the non-breeding season in Australia. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal (freshwater and saline) habitats. They are widespread in most regions of New South Wales (NSW) and Victoria, especially in coastal areas. They prefer muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry as well as intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Breeding: May to September in Northern Siberia, in flocks of less than a thousand. The majority of the world population occurs in Australia in the nonbreeding season. Roosting: Roosting occurs at the edges of wetlands, on wet open mud or sand, in shallow water, or in short sparse vegetation, such as grass or saltmarsh. Occasionally, they roost on sandy beaches, stony shores or on rocks in water. They have also been recorded roosting in mangroves. Foraging: at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water. They also forage among inundated vegetation of saltmarsh, grass or sedges. They forage in sewage ponds, and often in hypersaline environments. After rain, they may forage in paddocks of short grass, well away from water. They may forage on coastal mudflats at low tide, and move to freshwater wetlands near the coast to feed at high tide.	**High:** There are 358 records within 5km, several of which are recent. There is suitable habitat for the species within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Calidris canutus	Red Knot	P	E,C,J,K	Distribution & Ecology: Inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps or inland lakes. Foraging: usually in soft substrate near the edge of water on intertidal mudflats or sandflats exposed by low tide. At high tide they may feed at nearby lakes, sewage ponds and floodwaters. They probe rapidly in soft sand and mud for worms, bivalves and crustaceans and also eat spiders, insects, seeds and shoots. They feed by day and night, regulated by the tide. Roosting: on sandy beaches, spits and islets, and mudflats; in open areas far away from potential cover for predators, but close to feeding grounds. Breeding: in the far northern hemisphere, in scattered single pairs. The nest is a shallow depression on open ground, lined with grass and lichen. The eggs are blotched and speckled for camouflage.	**Moderate:** There are 358 records within 5km, several of which are recent. There is suitable habitat for the species within the study area.
Calidris ferruginea	Curlew Sandpiper	E1,P	CE,C,J,K	Distribution & Habitat: Most of the Australian coastline (including Tasmania). Occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration. Generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. Also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. Breeding: In Siberia and migrates to Australia (as well as Africa and Asia) for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April. Foraging: In or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. Omnivorous, feeding on worms, molluscs, crustaceans, insects and some seeds. Roosting: On shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores.	**Moderate:** There are 214 records within 5km, several of which are recent. There is suitable habitat for the species within the study area.
Calidris melanotos	Pectoral Sandpiper	P	J,K	The Pectoral Sandpiper is a wading bird with fairly long bill that has slight downwards curve. The legs are yellowish green and the bill is dark with yellow at the base. Winters in freshwater wetlands, saltwater wetlands, wet grassland, mudflats, and lake shores.	**Moderate:** There is only one record within 5km (1977) There is suitable habitat for the species within the study area.
Callocephalon fimbriatum	Gang-gang Cockatoo	V,P,3		Distribution & Ecology: from southern Victoria through south- and central-eastern New South Wales. In spring and summer, they are 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. Foraging: mainly on seeds of native and introduced trees and shrubs, with a preference for eucalypts, wattles and introduced hawthorns. They will also eat berries, fruits, nuts and insects and their larvae. Breeding: Favours old growth forest and woodland attributes for nesting and roosting. Roosting: Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts. Relevant threats: Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners. Susceptible to Psittacine cirovirus disease spread through contaminated nesting hollows.	**Low**: There are five records within 5km, one of which is recent. The last record within the study area was 1991.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
^^***Calyptorhynchus lathami***	Glossy Black-Cockatoo	V,P,2		Distribution & Habitat: Uncommon, although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Foraging: Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, Allocasuaraina diminuta, and A. gymnathera. Belah (*Casuarina cristata*) is also utilised and may be a critical food source for some populations. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina and Allocasuarina* species), shredding the cones with the massive bill. Orts discarded at base of tree can be an indicator of local populations, with fresh orts a light tan/pale brown and older orts grey. Breeding: A single egg is laid between March and May. Roosting: Dependent on large hollow-bearing eucalypts for nest sites.	**High:** There are three records of the species in 5km of the site, one of which is recent. There is limited suitable habitat within the study area.
Cercartetus nanus	Eastern Pygmy-possum	V,P		Distribution & Ecology: south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Foraging: Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Nesting: Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Breeding: Young can be born whenever food sources are available, however most births occur between late spring and early autumn. Behaviour: Agile climbers, but can be caught on the ground in traps, pitfalls or postholes; generally nocturnal. Frequently spends time in torpor especially in winter, with body curled, ears folded and internal temperature close to the surroundings.	**Moderate**: There are 12 records of the species in 5km of the site, nine of which is recent. There is some suitable habitat within the study area, however it is minimal and fragmented.
Chalinolobus dwyeri	Large-eared Pied Bat	V,P	V	Distribution & Ecology: generally rare with a very patchy distribution in NSW. Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands, and in Found in well-timbered areas containing gullies. Roosting: Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Likely to hibernate through the coolest months. Breeding: It is uncertain whether mating occurs early in winter or in spring. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Foraging: probably for small, flying insects below the forest canopy. Notable Threats: goats, pesticides, land clearing.	**Low:** There is one records within 5km (2005). There is no limited suitable foraging habitat within the study area and no suitable breeding habitat.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Chelonia mydas	Green Turtle	V,P	V	Distribution & Ecology: Widely distributed in tropical and sub-tropical seas. Usually found in tropical waters around Australia but also occurs in coastal waters of NSW, where it is generally seen on the north or central coast, with occasional records from the south coast. Behaviour: Ocean-dwelling species spending most of its life at sea. Diet: Carnivorous when young but as adults they feed only on marine plant material. Breeding: Eggs laid in holes dug in beaches throughout their range, with scattered nesting records along the NSW coast.	**Low:** There is one records within 5km (2007). There is no suitable habitat within the study area.
Cuculus optatus	Oriental Cuckoo	P	C,J,K	The species breeds in northern Eurasia and migrates to eastern Australia in winter. It mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground. It is usually secretive and hard to see.	**Low:** There are three records within 5km (most recent is 1984). There is limited habitat for the species.
Dasyurus maculatus	Spotted-tailed Quoll	V,P	E	Distribution & Ecology: Habitats include: rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites: use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces. Behaviour: Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Large home ranges (Fe up to 750 ha, Ma up to 3,500ha). Known to traverse their home ranges along densely vegetated creeklines. Foraging: generalist predator with a preference for medium-sized (0.5kg – 5kg) mammals. Breeding: April – July. Relevant threats: Foxes and cats prey on quolls and also compete with them for food.	**Low:** There is one record within 5km (1993). There is limited suitable habitat for the species within the study area which is highly fragmented from nearby vegetated areas.
Diomedea antipodensis	Antipodean Albatross	V,P	V	The species ranges across the southern Pacific Ocean, east to the coast of Chile and west to eastern Australia. Habitat and ecology: The majority of birds breed on Antipodes Island, with a small number of pairs breeding on Campbell Island. The Antipodean Albatross breeds biennially in colonies on ridges, slopes and plateaus of isolated subantarctic islands, usually in vegetation such as grass tussocks. Egg laying begins in January (Antipodes Island) and February (Campbell Island), and chicks usually fledge the following year in January and March. The annual breeding population is relatively small and has been estimated at 5,154 pairs. This species regularly occurs in small numbers off the NSW south coast from Green Cape to Newcastle during winter where they feed on cuttlefish. Although representing a small proportion on its total foraging area, potential forage in NSW waters is nonetheless considered significant for the species. Forage for the Antipodean Albatross is extremely patchy, both spatially and temporally, and individuals traverse great distances in search of food. This species feeds pelagically on squid, fish and crustaceans.	**Low:** There are no records of within 5km. There is no suitable habitat within the study area.
Diomedea exulans	Wandering Albatross	E1,P	E	Distribution & Ecology: visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and September. It has been recorded along the length of the NSW coast. At other times birds roam the southern oceans and commonly follow fishing vessels for several days. They spend the majority of their time in flight, soaring over the southern oceans. Foraging: They feed in pelagic, offshore and inshore waters, often at night, taking fish and cephalopods such as squid, crustaceans and carrion, and will often follow ships feeding on the refuse they trail. Breeding: on a number of islands just north of the Antarctic Circle, including the Australian owned Macquarie Island. Breeding takes place on exposed ridges and hillocks, amongst open and patchy vegetation. Roosting: bienially in small, loose colonies among grass tussocks, using a large mud nest.	**Low:** There are four records of within 5km (most recent 1994). There is no suitable habitat within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
^^***Falco hypoleucos***	Grey Falcon	E1,P,2		Chiefly found throughout the Murray-Darling Basin. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Foraging: Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops. Breeding: June – November. Utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water	**Low:** There are no records within 5km. The study area is outside the species known range and there is no suitable habitat present.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V,P		Distribution & Ecology: found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. It prefers moist habitats, with trees taller than 20 m. Roosting: Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hibernates in winter. Foraging: Hunts beetles, moths, weevils and other flying insects above or just below the canopy. Breeding: Females are pregnant in late spring to early summer. Notable Threats: disturbance to winter roosting and breeding sites	**Moderate:** One record within 5km (2011). There is some suitable roosting habitat present in the study area.
Fregetta grallaria	White-bellied Storm-Petrel	V,P	V	The species has a widespread range throughout the oceans of the Southern Hemisphere including the Pacific, Atlantic, and Indian Oceans, although little detail is known of its pelagic distribution.	**Low**: There are no records within 5km. There is no suitable habitat within the study area.
Gallinago hardwickii	Latham's Snipe	P	J,K	Distribution & Ecology: non- breeding visitor to south eastern Australia and is a passage migrant through northern Australia. They occur in a wide variety of permanent and ephemeral wetlands up to 2000 m above sea-level. Foraging: characterised by areas of mud and some form of cover. Omnivorous species that feeds on seeds and other plant material, and on invertebrates including insects (mainly flies and beetles), earthworms and spiders and occasionally molluscs, isopods and centipedes. Breeding: in Japan and far eastern Russia, in the northern hemisphere summer, and arriving in Australia from July. Nesting: on dry ground such as grassy hillsides and forest clearings. The nest is a shallow depression lined with grasses and leaves.	High: There are 23 records within 5km, only four of which are recent. There is come suitable foraging habitat for the species.
Glossopsitta pusilla	Little Lorikeet	V,P		Distribution & Habitat: Widely distributed across the coastal and Great Divide regions of eastern Australia. Nomadic movements are common, influenced by season and food availability. Foraging: primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Roosts: in treetops, often distant from feeding areas Breeding: May – September. Most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m).	**High:** There are six records within 5km, all of which are recent. The species was recorded in the previous Kogarah Study in 2012 (Total Earth Care). There is suitable habitat for the species within the study area.
Grantiella picta	Painted Honeyeater	V,P	V	Distribution & Ecology: nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. Foraging: A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nesting: small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches. Breeding: from spring to autumn. Notable Threats: land clearing, weed infestations, aggressive exclusion by Noisy Miners, inappropriate fire regimes.	**Low:** There are no records within 5km. There is little suitable habitat for the species within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Haematopus longirostris	Pied Oystercatcher	E1,P		The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish. Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.	**High:** There 797 records within 5km and suitable habitat for the species within the study area.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V,P		Distribution & Ecology: along the coastline (including offshore islands) of mainland Australia and Tasmania, occasionally extending inland along some of the larger waterways. Found in coastal habitats and around terrestrial wetlands. Habitats occupied are characterised by the presence of large areas of open water. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas. Foraging: generally forages over large expanses of open water; also forage over open terrestrial habitats Behaviour: generally seen singly or in pairs. Hunts its prey from a perch or whilst in flight. Breeding: June to September. Breeds in solitary and monogamous pairs that mate for life. Roosting: The nest is a large structure made of sticks and lined with leaves, grass or seaweed. They may be built in a variety of sites including tall trees, bushes, mangroves, cliffs, and rocky outcrops, crevices, on the ground or even on artificial structures. Relevant threats: Increased mortality or reduced breeding success due to non-target poisoning during vertebrate pest control, exposure to industrial chemicals and pesticides.	**High:** There are 70 records within 5km, numerous of which are recent. There is suitable habitat within the study area.
Heleioporus australiacus	Giant Burrowing Frog	V,P	V	Distribution & Ecology: distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Behaviour: Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individuals occupy a series of burrow sites, some of which are used repeatedly. When breeding, they will call from open spaces, under vegetation or rocks or from within burrows in the creek bank. Individuals move into the breeding site either immediately before or following heavy rain and occupy these sites for up to 10 days. Foraging: has a generalist diet and studies to date indicate that they eat mainly invertebrates including ants, beetles, cockroaches, spiders, centipedes and scorpions. Breeding: This species breeds mainly in autumn, but has been recorded calling throughout the year. Egg masses are foamy and are laid in burrows or under vegetation in small pools. After rains, tadpoles are washed into larger pools where they complete their development in ponds or ponded areas of the creekline. Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water. Notable Threats: chytrid fungus, reductions in water quality, disturbance to habitat and hydrology due to development.	**Moderate**: There are no records with the species, however some suitable habitat is present within the study area nearby creeks on sandstone geology.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Hieraaetus morphnoides	Little Eagle	V,P		Distribution & Ecology: found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. Occurs as a single population throughout NSW through open eucalypt forest, woodland or open woodland. Also uses She-oak or acacia woodlands and riparian woodlands of interior NSW. Foraging: Generalist predator, preying on birds, reptiles, and mammals; occasionally large insects and carrion. Breeding: in spring, with young fledging in early summer. Nesting: Pairs build a large stick nest in winter in tall living trees within a remnant patch of vegetation. Relevant threats: Secondary poisoning from rabbit baiting.	**High**: There are five records within 5km, four of which are recent within one record within the study area. Suitable habitat is present in the study area.
Hirundapus caudacutus	White-throated Needletail	P	V,C,J,K	Distribution & Ecology: Widespread in eastern and south-eastern Australia. Almost exclusively aerial. Occuring over most types of habitat, they are probably recorded most often above wooded areas, including open forest, heathlands and rainforest but less often over treeless areas, such as grassland or swamps. Foraging: aerially, often in areas of updraughts. They eat a wide variety of insects, including beetles, cicadas, flying ants, bees, wasps, flies, termites, moths, locusts and grasshoppers. Roosting: in trees in forests and woodlands, both among dense foliage in the canopy or in hollows. It has been suggested that they also sometimes roost aerially. Breeding: eastern Siberia, north-eastern China and Japan, leaving the breeding grounds from August. They begin appearing in Australia from September for the non-breeding season.	**High:** There are 11 records within 5km, seven of which are recent. Airspace contains general foraging habitat. Does not breed in Australia.
^^Hoplocephalus bungaroides	Broad-headed Snake	E1,P,2	V	Distribution & Ecology: largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. Found in rocky outcrops and adjacent sclerophyll forest and woodland. Most suitable sites occur in sandstone ridgetops. They prefer sites with a W to NW aspect, sheltering under thin (<20 cm) rocks on exposed sites, which fit closely with a rocky substrate. Occupied crevices have a sunny aspect and rocks used are those that receive the most warmth from the sun. In woodland, they shelter in hollows in a variety of tree species. Behaviour: Nocturnal. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in crevices or hollows in large trees within 500m of escarpments in summer. Diet: Feeds mostly on geckos and small skinks; will also eat frogs and small mammals occasionally. Breeding: Females produce 4-12 live young from January to March.	**Low:** There are no records within 5km, there is limited suitable habitat for the species.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E1,P	E	Distribution & Ecology: Patchily distributed, found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. Generally only found in heath or open forest with a heathy understorey on sandy or friable soils. Behaviour: active mainly after dusk and/or before dawn. Foraging: They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil. Nesting: 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. The upper surface of the nest may be mixed with earth to waterproof the inside of the nest. Breeding: Mating occurs any time of the year, usually following heavy rain. Two or three litters may be produced annually.	**Low:** There are no records within 5km. Within Sydney, the species is only known in the north.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Ixobrychus flavicollis	Black Bittern	V, P		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. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds. When disturbed, freezes in a characteristic bittern posture (stretched tall, bill pointing up, so that shape and streaked pattern blend with upright stems of reeds), or will fly up to a branch or flush for cover where it will freeze again. Generally solitary, but occurs in pairs during the breeding season, from December to March.	**High:** There are four records within 5km, all of which are recent. There is some suitable habitat particularly in small areas of Coastal freshwater wetlands and estuarine reedlands. A community member mentioned potentially seeing one in August 2020.
Lathamus discolor	Swift Parrot	E1,P,3	CE	Distribution & Ecology: occurs in woodlands and forests of NSW from May to August. Migrates from Tasmania to southeast Australia between March – October. Preferred non-breeding habitat is woodlands and riparian vegetation where there are winter flowering eucalypts such as the Swamp Mahogany, Eucalyptus robusta in coastal areas. Foraging: in eucalypt dominated forests, where eucalypts are flowering profusely or where there are abundant lerp infestations. They return to some foraging sites on a cyclic basis depending on food availability. Diet includes eucalypt nectar, pollen and associated insects. Breeding: September to January in Tasmania. Nesting: in old trees with hollows. Relevant threats: Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners	**Moderate:** There are six records within 5km, two of which are recent. There is some potential foraging habitat for the species, however nearby area (i.e. Holsworthy Military Area) are likely preferred.
Limosa lapponica baueri	Bar-tailed Godwit (bauera)	P	C,J,K,V	Distribution & Ecology: recorded in coastal areas of all Australian States. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. Breeding: late May through June, in Scandinavia, Russia, and north-west Alaska. Nest is a shallow cup in moss sometimes lined with vegetation. Foraging: usually near the edge of water or in shallow water, mainly in tidal estuaries and harbours. They appear not to forage at high tide and prefer exposed sandy substrates on intertidal flats, banks and beaches. Occasionally they have been known to forage among mangroves, or on coral reefs or rock platforms among rubble, crevices and holes. Roosting: The Bar-tailed Godwit usually roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh.	**High:** There 524 records within 5km, numerous are recent. There is some suitable habitat for the species along the Georges River.
Litoria aurea	Green and Golden Bell Frog	E1,P	V	Distribution & Habitat: Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spike rushes (Eleocharis spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (Gambusia holbrooki), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. Behaviour: active by day Breeding: in summer when conditions are warm and wet Relevant threats: predation by feral animals such as foxes.	**Moderate:** There are 751 records within 5km, numerous of which are recent. However, most recent records are within areas on known populations. There are no records within the study area.
Litoria littlejohni	Littlejohn's Tree Frog	V,P	V	Distribution & Ecology: includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. Foraging: hunts either in shrubs or on the ground. Breeding: triggered by heavy rain and can occur from late winter to autumn, but is most likely to occur in spring when conditions are favourable. Eggs are laid in loose gelatinous masses attached to small submerged twigs. Eggs and tadpoles are mostly found in slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools. Notable Threats: disturbance to the water quality or hydrology through human impact.	**Low:** There are no records within 5km. There is limited habitat within the study area due to being low within the watershed.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Lophoictinia isura	Square-tailed Kite	V,P,3		Distribution & Ecology: Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Foraging: a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy. Appears to occupy large hunting ranges of more than 100km2 Breeding: July to February. Nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	**High**: There are seven records within 5km, six of which are recent. There is suitable habitat within the study area.
Macronectes giganteus	Southern Giant Petrel	E1,P	E	Distribution & Ecology: has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW. Foraging: an opportunistic scavenger and predator, it scavenges from fishing vessels and animal carcasses on land. It is also an active predator of cephalopods and euphausiids, as well as smaller birds (particularly penguins) both at land and at sea. Breeding: Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory. Birds will desert their nests if disturbed at the breeding colony. A single chick is raised and although breeding occurs annually, approximately 30% of the potential breeding population does not nest. Notable Threats: long-line fishing, predation by feral cats and rats, habitat degradation by introduced species, oil spills.	**Low:** There are no records within 5km. There is no suitable habitat within the study area.
Macronectes halli	Northern Giant-Petrel	V,P	V	The Northern Giant-Petrel has a circumpolar pelagic distribution, usually between 40-64ºS in open oceans. Their range extends into subtropical waters (to 28ºS) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Habitat and ecology: Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer. Adults usually remain near the breeding colonies throughout the year (though some do travel widely) while immature birds make long and poorly known circumpolar and trans-oceanic movements. Hence most birds recorded in NSW coastal waters are immature birds. Northern Giant-Petrels seldom breed in colonies but rather as dispersed pairs, often amidst tussocks in dense vegetation and areas of broken terrain. At sea, both sexes are aggressive opportunists, feeding on fish, cephalopods, birds and crustaceans, including euphausiids or krill, and regularly scavenge on fishing vessels.	**Low:** There are no records within 5km. There is no suitable habitat within the study area.
Macropus parma	Parma Wallaby	V,P		Distribution & Ecology: Once occurred from north-eastern NSW to the Bega area in the southeast. Their range is now confined to the coast and ranges of central and northern NSW from the Gosford district to the Queensland border. Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. Foraging: Typically at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas. Shelter: During the day, in dense cover. Breeding: between February & June. Pouch life seven months. Notable Threats: predation by feral animals, vehicle strikes, loss of habitat.	**Low:** There are no records within 5km. There is limited suitable habitat within the study area. It is likely absent due to fragmentation within Sydney.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V,P		Distribution & Ecology: extends south from central Queensland, through NSW, Victoria into south eastern Australia. Widespread in NSW. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Also inhabits open forests of smooth-barked gums, stringybark, ironbark, river sheoaks and tea trees. Behaviour: gregarious species usually seen in pairs and small groups of up to 12 birds Foraging: rapid, moving quickly from tree to tree, probing for insects. Nectar is taken from flowers and honeydew gleaned from foliage. Breeding: June to December. Solitarily or co-operatively, with up to five or six adults. Cap-shaped nest placed high in the crown of a tree - preferentially river sheoaks. Relevant threats: May be excluded from smaller remnants by aggressive species such as the Noisy Miner.	**Moderate:** There are two records within 5k, one of which is recent. Although this is some suitable habitat within the study area, nearby habitats (i.e. Holsworthy Military Ara) are likely preferred.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V,P		Distribution & Ecology: found along the east coast from south Queensland to southern NSW. Occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Foraging: probably insectivorous. Roosting: mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally. Breeding: little known approximately its biology or ecology. Females with young have been observed in grey mangrove forests. Notable Threats: artificial light, pesticides, loss of habitat	**High**: There are three records within 5km, all of which are recent. One record is within the study area. There is suitable habitat within the study area.
Miniopterus australis	Little Bent-winged Bat	V,P		Distribution & Ecology: East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Prefers 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. Roosting: by day in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings. Foraging: at night, for small insects beneath the canopy of densely vegetated habitats. Breeding: Maternity colonies form in spring and birthing occurs in early summer. Males and juveniles disperse in summer. Only five nursery sites/maternity colonies are known in Australia. Often shares roosting sites with other Miniopterus species.	**High:** There are four records within 5km, all of which are recent. One record is within the study area. There is suitable habitat within the study area.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V,P		Distribution & Ecology: Occurs along the east and north-west coasts of Australia. Roosts: Caves are the primary roosting habitat but also use man-made structures. Breeding: Spring and Summer. Form discrete populations centered on large maternity caves. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within approximately 300 km range of maternity caves. Foraging: in forested areas, catching flying insects above the canopy. Behaviour: Cold caves are used for hibernation in southern Australia.	**High:** There are 37 records within 5km, most of which are recent. Several records are within the study area. There is suitable habitat within the study area.
^^Mixophyes balbus	Stuttering Frog	E1,P,2	V	Distribution & Ecology: occurs along the east coast of Australia, from Southern Queensland to north-eastern Victoria. Inhabits rainforest, Antarctic beech and wet sclerophyll forests but also found in moist gullies within areas of dry forest, sometimes utilising very small trickles of water which hardly flow. Depends on freshwater streams and riparian vegetation for breeding and habitation. Shelter: Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Foraging: insects and smaller frogs. Breeding: streams during summer after heavy rain. Eggs are laid on rock shelves or shallow riffles in small, flowing streams. Notable Threats: chytrid fungus, reduced water quality, predation of eggs and tadpoles by introduced species (i.e. Gambusia)	**Low:** There are no records within 5km. There is limited suitable habitat within the study area.
Monarcha melanopsis	Black-faced Monarch	P	B	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	**High**: There are 11 records within the study area, two of which are recent. The species has been recorded by the Oatley Flora and Fauna Conservation Society.
Monarcha trivirgatus	Spectacled Monarch	P	B	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. It is also found in Papua New Guinea, the Moluccas and Timor. The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	**Low:** There are no records within the study area and there is suitable habitat present within the study area.
Motacilla flava	Yellow Wagtail	P	C,J,K	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. It breeds from April to August, although this varies with latitude. The nest is a grass cup lined with hair and placed on or close to the ground in a shallow scrape.	**Low**: There are no records within 5km, and there is some suitable habitat for the species.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
				Normally it lays four to six eggs. It feeds on a wide variety of terrestrial and aquatic invertebrates as well as some plant material, particularly seeds. The species is almost wholly migratory with European populations wintering in sub-Saharan Africa, central and eastern populations mainly migrate to South Asia with some moving to Africa.	
Myiagra cyanoleuca	Satin Flycatcher	#N/A	#N/A	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is also found in New Guinea. The Satin Flycatcher is not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant. The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	**High**: There are no records within the study area, however the species has been recorded by the Oatley Flora and Fauna Conservation Society.
Myotis macropus	Southern Myotis	V,P		Distribution & Habitat: found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Foraging: over streams and pools catching insects and small fish by raking their feet across the water surface. Roosts: in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Breeding: In NSW, one young per year usually in November or December.	**High:** There are nine records within 5km, all of which are recent. There is suitable habitat within the study area.
Neophema pulchella	Turquoise Parrot	V,P,3		Distribution & Ecology: from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Foraging: Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. Nesting: in tree hollows, logs or posts, laying the eggs on a nest of decayed wood dust. Breeding: from August to December. Notable Threats: aggressive exclusion by Noisy Miners, predation by foxes & cats, illegal trapping.	**Low**: There is one record within 5km, however there is limited suitable habitat within the study area.
Ninox connivens	Barking Owl	V,P,3		Distribution & Ecology: Found throughout continental Australia except for the central arid regions. Occurs in a wide but sparse distribution in NSW. Inhabits Eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Flexible in habitat use. Foraging: preferentially hunts small arboreal mammals but will consume a variety of prey, with invertebrates predominant for most of the year, with birds and mammals becoming more important during breeding. Roosting: in shaded portions of tree canopies, including tall midstorey trees with dense foliage. Breeding: Begins mid-winter and spring. Nests in hollows of large, old living eucalypts. Laying during August and fledging in November. Notable Threats: secondary poisoning from rodenticide, loss of nesting hollows	**Moderate:** There are no records within 5km, however populations in nearby areas (i.e. Royal National Park) may use the study area as part of its larger forging range.
Ninox strenua	Powerful Owl	V,P,3		Distribution & Ecology: Endemic to eastern and south-eastern Australia. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest and requires large tracts of forest or woodland habitat but can occur in fragmented landscapes. Foraging: medium arboreal mammals in open or closed sclerophyll forest or woodlands Roosts: by day in dense vegetation Breeding: late autumn to mid-winter in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old Behaviour: monogamous and mate for life Relevant threats: Predation of fledglings by foxes, dogs and cats, and secondary poisoning	**High:** There are 217 records within 5km, many of which are recent and within the study area. Previous studies have identified the species (Total Earth Care 2012).

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Numenius madagascariensis	Eastern Curlew	P	CE,C,J,K	Distribution & Ecology: Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. They are rarely recorded inland. It is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes in saltworks and sewage farm. Foraging: mainly on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on salt flats and in saltmarsh, rock pools and among rubble on coral reefs, and on ocean beaches near the tideline. Diet includes crustaceans, small molluscs and insects. Roosting: on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. It occasionally roosts on reef-flats, in the shallow water of lagoons and other near-coastal wetlands. They are also recorded roosting in trees and on the upright stakes of oyster-racks. Breeding: Russia and north- eastern China, in early May to late June. Arrives back in Australia in August. Notable threats: wetland degradation	**Moderate:** There are 444 records within 5km, many of them are recent. However, only one record is within the study area (1998). Although there is potential habitat for the species, preferred habitat at the nearby Towra Point Nature Reserve, is preferred.
Numenius phaeopus	Whimbrel	P	C,J,K	Whimbrels are found mainly on the coast, on tidal and estuarine mudflats, especially near mangroves. They are sometimes found on beaches and rocky shores. Whimbrels are migratory, moving north from Australia to breed in the northern hemisphere, leaving the north and north east coasts by late April. On return to Australia, they move down the coast of east Asia, leaving the breeding areas in July, along the East Asian-Australasian Flyway, arriving in the north of Australia from August to October, then moving southwards along the east coast. Small numbers over-winter in Australia and there is some local movement.	**Moderate:** There are 160 records within 5km, many of them are recent, and however, none are within the study area. Although there is potential habitat for the species, preferred habitat at the nearby Towra Point Nature Reserve, is preferred.
Pandion cristatus	Eastern Osprey	V,P,3		Distribution & Ecology: right around the Australian coastline, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. Uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Foraging: Feed on fish over clear, open water. Breeding: from July to September in NSW. Nesting: Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. .	**High:** There are 25 records within 5km, all of which are recent. Ten records are within the study area. There is suitable habitat for the species in the study area.
Pachyptila turtur subantarctica	Fairy Prion		V	Fairy prions are numerous and circumpolar in their distribution, ranging north to subtropical waters during non-breeding periods. Garnett and Crowley (2000) report that the nominate subspecies of Fairy prions occurs through most of their range, with subantarctica restricted to Antipodes, Big South Cape and Snares Is., and Macquarie Islands. The breeding season broadly extends from September to March. Laying occurs from October through to December, depending on locality, the season being earlier in the northern colonies. The single egg is laid in a crevice, or burrow, and incubated for 44-55 days. The fledgling period is similar (43-56 days) and both parents share in feeding the chick.	**Low**: There are no records within 5km. the study area does not provide preferred habitat for the species.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Petauroides volans	Greater Glider	P	V	Distribution & Ecology: Endemic to eastern Australia. Eucalypt forests and woodlands. Favours forests with a diversity of eucalypt species. Studies suggest that the species needs at least 2-4 live den trees for every 2 ha of suitable forest habitat. Home ranges are typically relatively small with a low dispersal ability. Modelling suggests that they need native forest patches of at least 160 km² to maintain viable populations. Foraging: primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. Shelter: rest by day in tree hollows Breeding: March to June in large tree hollows. Relatively low reproductive rate.	**Low:** There are no records within 5km. The study area provides possible habitat, however is isolated from areas of preferred habitat and likely restricted due to fragmentation.
Petaurus norfolcensis	Squirrel Glider	V,P		Distribution & Ecology: The species is widely but sparsely distributed in eastern Australia, from northern Queensland to western Victoria. They inhabit mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Foraging: diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein. Breeding: June to January. Nesting: in bowl-shaped, leaf lined nests in tree hollows. Requires abundant tree hollows for refuge and nest sites.	**Low:** There are no records within 5km. The study area provides possible habitat, however is isolated from areas of preferred habitat and likely restricted due to fragmentation.
Petrogale penicillata	Brush-tailed Rock-wallaby	E1,P	V	Distribution & Ecology: The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. 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. They occupy rocky escarpments with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter: Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Foraging: browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Breeding: throughout the year with a peak in births between February and May, especially in the southern parts of the range and at higher altitudes.	**Low:** There are no records within 5km. There is no suitable habitat within the study area.
Phascolarctos cinereus	Koala	V,P	V	Distribution & Ecology: Eucalypt woodlands and forests. The only known Sydney population is in Campbelltown LGA. Behaviour: Inactive for most of the day, feeding and moving mostly at night. Foraging: Needs a large number of preferred food tree species, this differs depending on the region.	**Low:** There are 85 records (excluding wildlife rescue) within 5km, one of which is in the study area (however from 1989). All other records are from the other side of the Georges River in the Holsworthy Military Area. Due to the isolation and fragmentation of the LGA, it is unlikely koalas would be present.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Potorous tridactylus	Long-nosed Potoroo	V,P	V	Distribution & Ecology: found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. There are geographically isolated populations in western Victoria. 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. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. Foraging: The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of their diet. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil. They often dig small holes in the ground in a similar way to bandicoots. Behaviour: Mainly nocturnal, hiding by day in dense vegetation - however, during the winter months animals may forage during daylight hours. Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2 and 5 ha. Breeding: peaks typically occur in late winter to early summer and a single young is born per litter. Adults are capable of two reproductive bouts per annum.	**Low**: There are no records within 5km. Although there is some suitable habitat within the study area, due to the isolation and fragmentation of the LGA, it is unlikely koalas would be present.
Pseudomys novaehollandiae	New Holland Mouse	P	V	Distribution & Ecology: fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Now largely restricted to the coast of central and northern NSW, with one inland occurrence near Parkes. The species is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes, with deeper topsoils and softer substrates for digging burrows. Behaviour: The species peaks in abundance during early to mid stages of vegetation succession typically induced by fire. It is a social animal, living predominantly in burrows shared with other individuals. Foraging: nocturnal and omnivorous, with seeds forming the majority of their diet. Leaves, fungi, and invertebrates are also consumed, based on seasonal characteristics of individual sites. Breeding: between late winter and early summer, sometimes extending into autumn. Timings of breeding can be related to abundance and quality of food sources. Notable Threats: habitat loss, inappropriate fire regimes, predation by cats, foxes, and wild dogs.	**Low:** There are no records within 5km. Although there is some suitable habitat within the study area, due to the isolation and fragmentation of the LGA, it is unlikely koalas would be present.
Pseudophryne australis	Red-crowned Toadlet	V,P		Distribution & Ecology: restricted distribution, confined to the Sydney Basin. Occurs from Pokolbin (north) to Nowra (south) and Mt Victoria (west). Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or capping. Shelter: under rocks and amongst masses of dense vegetation or thick piles of leaf litter Breeding: congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Eggs are laid in moist leaf litter. Disperses outside the breeding period. Notable Threats: reduction in water quality near urban areas, chytrid fungus.	**High:** There are six records within 5km, three of which are recent. The species was recorded in the study area (Oatley) in 2012 (Total Earth Care).
Pterodroma leucoptera leucoptera	Gould's Petrel	V,P	E	Distribution & Ecology: The pelagic distribution is unknown, and it is seldom recorded away from its breeding island. Usually seen at sea singly or in pairs. They breed on both Cabbage Tree Island, 1.4 km offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding petrels are unknown. The first arrival on Cabbage Tree Island occurs from mid to late September. Principal nesting habitat is located within two gullies which are characterised by steeply, sloping rock scree with a canopy of Cabbage Tree Palms. Roosting: They nest predominantly in natural rock crevices among the rock scree and also in hollow fallen palm trunks, under mats of fallen palm fronds and in cavities among the buttresses of fig trees. They breed colonially and the nests are clumped and often less than 1 m apart. Breeding: Egg laying takes place over a six week period commencing in early November. Foraging: diet is poorly known but as a whole includes cephalods and fish.	**Low**: There are no records within 5km. There is no suitable habitat within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Pterodroma neglecta neglecta	Kermadec Petrel (west Pacific subspecies)	V,P	V	Ranges over subtropical and tropical waters of the South Pacific. Balls Pyramid (near Lord Howe Island) and Phillip Island (near Norfolk Island) are the only known breeding sites in Australian waters. The species lives in marine habitats. It breeds on islands across the South Pacific. In Australia it breeds on Ball's Pyramid and Phillip Island (near Norfolk Island). It nests in a crevice amongst rocks. It has a diet of squid and crustaceans. Vagrant birds occur in coastal NSW waters, particularly after storm events.	**Low:** There are no records within 5km. There is no suitable habitat within the study area.
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V	Distribution & Ecology: Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting: 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 Breeding: Annual mating commences in January and conception occurs in April or May; a single young is born in October or November Foraging: Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km	**High:** There are 1726 records within 5km, 287 of which are within the study area. There is a known camp at Oatley. The species was recorded at all sites in the 2012 study (Total Earth Care).
Ptilinopus regina	Rose-crowned Fruit-Dove	V,P		Distribution & Ecology: Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. They occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Foraging: in the canopy of rainforest trees in the morning or late afternoon. Feeding entirely on fruit from vines, shrubs, large trees and palms, they are thought to be locally nomadic as they follow the ripening of fruits. Some populations are migratory in response to food availability - numbers in north-east NSW increase during spring and summer then decline in April or May. Nesting: frail loosely woven cup of twigs and tendrils. Breeding: October to January, in rainforests with dense growth of vines. Notable Threats: rainforest clearing and logging	**Low:** There are no records within 5km, there is limited suitable habitat in the study area.
Ptilinopus superbus	Superb Fruit-Dove	V,P		The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic. There are records of single birds flying into lighted windows and lighthouses, indicating that birds travel at night. At least some of the population, particularly young birds, moves south through Sydney, especially in autumn.	**Moderate**: There are four records within 5km. One of which is recent (2007). Some suitable habitat within the study area.
Rostratula australis	Australian Painted Snipe	E1,P	E	The Australian Painted Snipe is restricted to Australia. Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Incubation and care of young is all undertaken by the male only.	**Low:** There are three records within 5km, two of which are recent. There is limited suitable habitat within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V,P		Distribution & Ecology: wide-ranging across northern and eastern Australia. Roosting: singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Breeding: December to mid-March Foraging: most habitats across its very wide range, with and without trees; appears to defend an aerial territory Behaviour: Seasonal movements are unknown; there is speculation approximately a migration to southern Australia in late summer and autumn.	**High:** There are five records within 5km, all of which are recent. It has been previously recorded in the study area (Total Earth Care 2012), recorded at Kyle Williams Reserve.
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P		Distribution & Ecology: found mainly in the gullies and river systems that drain the Great Dividing Range, from north eastern Victoria to the Atherton Tableland. It 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. Does not occur at altitudes above 500 m. Roosts: usually in tree hollows, it has also been found in buildings Foraging: after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m, searching for beetles and other large slow-flying insects. Breeding: Little is known of its reproductive cycle, however a single young is born in January. Notable threats: pesticides and herbicides, habitat loss	**High:** There are five records within 5km, all of which are recent. There is suitable habitat present in the study area.
Sterna hirundo	Common Tern	P	C,J,K	Distribution & Ecology: they are marine, pelagic and coastal. A non-breeding migrant in Australia, they are recorded in all marine zones, but are commonly observed in near-coastal waters, both on ocean beaches, platforms and headlands and in sheltered waters, such as bays, harbours and estuaries. Occasionally they are recorded in coastal and near-coastal wetlands, including lagoons, rivers, lakes, swamps and saltworks. Sometimes they occur in mangroves or saltmarsh and, in bad weather, in coastal sand-dunes or coastal embayment. Foraging: in marine environments, often close to the shore, including sheltered embayment and in the surf-zone, but also well out to sea. They also forage in near-coastal terrestrial wetlands, including estuaries, rivers and swamps. Diet is predominately small fish, crustaceans, insects and squid. Roosting: on un-vegetated, intertidal sandy ocean beaches, sandy islands, shores of estuaries or lagoons, and sandbars, as well as on rocky shores, rock platforms or rocks protruding above the surface of the water. Nesting: on the ground in the open, usually on bare substrates, occasionally near vegetation or in it, or on a floating mat of vegetation. They usually nest on islands, either marine or in lakes, only sometimes on mainland beaches. Breeding: North America and Eurasia in the boreal spring-summer with a large global population and vagrants recorded widely. Notable Threats: human disturbance from recreation and tourism.	**Moderate:** There are four records within 5km, three of which are recent. There is suitable habitat within the study area.
Sternula albifrons	Little Tern	E1,P	C,J,K	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to northern Queensland, and is seen until May, with only occasional birds seen in winter months. Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	**Moderate**: There are 1347 records within 5km, numerous are recent. All records are nearby in Towra Point. Although there are numerous records of the species nearby, it is unlikely that it would frequently enter the study area as it is not preferred habitat.
Thalassarche bulleri	Buller's Albatross	P	V	This albatross only nests on islands off New Zealand. The northern subspecies (platei) nests on islands off Chatham Island with an estimated population of around 18,200 breeding pairs. The southern subspecies (bulleri) breeds on the Snares and Solander islands with a total population of around 13,600 breeding	**Low:** There are no records within 5km of the study area. There is no suitable habitat for

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
				pairs. After breeding both subspecies migrate to the seas off Peru and Chile. In NSW waters it is a relatively common visitor between March and October, with few sightings outside this period. Occurs in both inshore and offshore waters, including the continental shelf break and pelagic waters. Feeds mainly on squid, fish, tunicates, octopus and crustacea.	the species within the study area.
Thalassarche cauta	Shy Albatross	V,P	V	This species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat. In Australian waters, the Shy Albatross occurs along the east coast from Stradbroke Island in Queensland along the entire south coast of the continent to Carnarvon in Western Australia. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park. Habitat and ecology This pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea. While at sea, it soars on strong winds and when calm, individuals may rest on the ocean, in groups during the breeding season or as individuals at other times. Occasionally the species occurs in continental shelf waters, in bays and harbours. The species feeds on fish, crustaceans, offal and squid and may forage in mixed-species flocks. Food may be caught by seizing prey from the water's surface while swimming, by landing on top of prey, diving for prey beneath the water and by scavenging behind fishing vessels. Known breeding locations include Albatross Island off Tasmania, Auckland Island, Bounty Island and The Snares, off New Zealand, where nesting colonies of 6-500 nests occur and may contain other species such as the Australian Gannet. Located on sheltered sides of islands, on cliffs and ledges, in crevices and slopes, nests are used annually and consist of a mound of mud, bones, plant matter and rocks. Parents are territorial while nesting, having both defensive and mating displays. Breeding occurs September-December, when a single egg is laid and incubated for 72 days. Both parents feed and guard the young for approximately 5 months before they fledge and become independent.	**Low:** There are no records within 5km of the study area. There is no suitable habitat for the species within the study area.
Thalassarche eremita	Chatham Albatross	P	E, B	The Chatham Albatross is a medium sized albatross, with a wing-span less than 2.1 m. The bright yellow bill has a distinctive black spot near the tip of the lower mandible, allowing discrimination from the similar Shy Albatross. The Chatam Albatross has a sooty grey wash over the crown, cheeks and neck, and a dark back and wings. Its blackish notch at the front of the wing, next to the body, is the darkest of the Shy Albatross complex. Breeding for the Chatham Albatross is restricted to Pyramid Rock, Chatham Islands, off the coast of New Zealand (Gales 1998). The principal foraging range for this species is in coastal waters off eastern and southern New Zealand, and Tasmania.	**Low**: There are no records within 5km of the study area. There is no suitable habitat for the species within the study area.
Thalassarche impavida	Campbell Albatross	P	V	The Campbell albatross breeds on the northern and western coastline of Campbell Island and the islet Jeanette Marie. When breeding they forage from South Island and the Chatham Rise to the Ross Sea. Juveniles and non-breeders will go only through south Australian water, the Tasman Sea, and southwestern Pacific Ocean. The Campbell albatross feeds on fish, squid, crustacea, carrion, and gelatinous organisms.	**Low:** There are no records within 5km of the study area. There is no suitable habitat for the species within the study area.
Thalassarche melanophris	Black-browed Albatross	V,P	V	The black-browed albatross is circumpolar in the southern oceans, and it breeds on 12 islands throughout that range. In the Pacific Ocean it breeds on Islas Ildefonso, Diego de Almagro, Islas Evangelistas, Campbell Island, Antipodes Islands, Snares Islands, and Macquarie Island. In the Indian Ocean it breeds on the Crozet Islands, Kerguelen Islands, Heard Island, and McDonald Island. The black-browed albatross feeds on fish, squid, crustaceans, carrion, and fishery discards. This species has been observed stealing food from other species. This species normally nests on steep slopes covered with tussock grass and sometimes on cliffs; however, on the Falklands it nests on flat grassland on the coast. They are an annual breeder laying one egg from	**Low:** There are no records within 5km of the study area. There is no suitable habitat for the species within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
				between 20 September and 1 November, although the Falklands, Crozet, and Kerguelen breeders lay approximately three weeks earlier. Incubation is done by both sexes and lasts 68 to 71 days. After hatching, the chicks take 120 to 130 days to fledge. Juveniles will return to the colony after two to three years but only to practice courtship rituals, as they start breeding around the 10th year.	
Thalassarche salvini	Salvin's Albatross	P	V		**Low:** There are no records within 5km of the study area. There is no suitable habitat for the species within the study area.
Thalassarche steadi	White-capped Albatross	P	V, B	The White-capped Albatross has a grey back and wings; faint or absent greyish wash on cheeks; and a white head, neck and rump. The underwing is mostly white with a narrow black margin and a small dark notch at the wing-pit. The bill is pale greyish straw colour, with a yellowish tip. The White-capped Albatross is probably common off the coast of south-east Australia throughout the year. Breeding colonies of the White-capped Albatross occur on a number of separate islands. The largest breeding colony occurs on Disappointment Island (70–80 000 pairs), with smaller colonies on Auckland Island (3000 pairs), Adams Island (100 pairs), Bollon's Island (Antipodes Islands group) (100 pairs) and Forty-fours Islands (Chatham Islands group).	**Low:** There are no records within 5km of the study area. There is no suitable habitat for the species within the study area.
Thalasseus bergii	Crested Tern	P	J	The greater crested tern occurs in tropical and warm temperate coastal parts of the Old World from South Africa around the Indian Ocean to the Pacific and Australia. The nests are located on low-lying sandy, rocky, or coral islands, sometimes amongst stunted shrubs, often without any shelter at all. When not breeding, the greater crested tern will roost or rest on open shores, less often on boats, pilings, harbour buildings and raised salt mounds in lagoons. It is rarely seen on tidal creeks or inland waters	**Moderate:** There are 1347 records within 5km, numerous are recent. All records are nearby in Towra Point. Although there are numerous records of the species nearby, it is unlikely that it would frequently enter the study area as it is not preferred habitat.
Thinornis cucullatus cucullatus	Eastern Hooded Plover		V	The hooded plover (eastern) is a small Australian beach nesting bird. It mainly occurs on wide beaches backed by dunes with large amounts of seaweed and jetsam, creek mouths and inlet entrances. Nests are found above the high water mark on flat beaches, on stony terraces, or on sparsely vegetated dunes. As the hooded plover occurs on beaches, it is easily disturbed by human activities, particularly off-leash domestic dogs.	**Low**: There are no records within 5km. There is no suitable habitat within the study area.
Tringa brevipes	Grey-tailed Tattler	P	C,J,K	Distribution & Ecology: Primarily northern coastal distribution and is found in most coastal regions. In NSW they are distributed along most of the coast from the Queensland border, south to Tilba Lake. It is more heavily distributed along coastal regions north of Sydney. Often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats, especially those ringed with mangroves. Foraging: usually in shallow water, on hard intertidal substrates, such as reefs and rock platforms, in rock pools and among rocks and coral rubble, over which water may surge. Also on exposed intertidal mudflats, especially with mangroves and possibly seagrass nearby. Diet consists of mainly worms, molluscs, crustaceans, insects and fish. Breeding: late May to August, in northern Siberia. Appearing in on the east coast of Australia from September. Nesting: shallow depression, often in a stony riverbed or occasionally deserted nests in trees. Roosting: at night, in the branches of mangroves. Rarely in dense stands of other shrubs, on snags of driftwood or rocks. Notable Threats: pollution, habitat loss	**High:** There are 110 records within 5km, numerous of which are recent. There is suitable habitat within the study area.
Tringa incana	Wandering Tattler	P	J	The Wandering Tattler is generally found on rocky coasts with reefs and platforms, points, spits, piers, offshore islands and shingle beaches or beds. It is occasionally seen on coral reefs or beaches, and tends to avoid mudflats. The Wandering Tattler does not breed in Australia. This species breeds in the extreme north-east of Siberia and from southern Alaska east to north-west British Columbia. It is present in the	**Low:** There is one record within 5km (1992). There is limited suitable habitat within the study area.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
				breeding range from late May to August, with eggs laid in June. Breeding is limited to the alpine zone, often along fast-flowing mountain streams	
Tringa nebularia	Common Greenshank	P	C,J,K	Distribution & Ecology: does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia. In NSW the species has been recorded in most coastal regions, and is widespread west of the Dividing Range. Found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. Foraging: The species is known to forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows around the edges of water often among pneumatophores of mangroves or other sparse, emergent or fringing vegetation, such as sedges or saltmarsh. It has been recorded eating molluscs, crustaceans, insects, and occasionally fish and frogs. Roosting: roosts and loafs round wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islets. Nesting: on the ground in the open, in a shallow scrape lined with plant material. Breeding: in the Palaearctic, arriving Australia from August for the non-breeding season.	**High:** There are 131 records within 5km, many of which are recent. Although there nearby Towra wetlands would be preferred habitat, some suitable habitat is present in the study area.
Tringa stagnatilis	Marsh Sandpiper	P	C,J,K	"Distribution & Ecology: found on coastal and inland wetlands throughout Australia. Resides in permanent or ephemeral wetlands of varying salinity. Breeding: from Eastern Europe to Eastern Siberia, mid-April to early September. Non-breeders may not migrate. Marsh Sandpipers are commonly seen singly, or in small to large flocks in fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	**Low:** There is one record within 5km (1983). There is limited suitable habitat within the study area.
Tyto novaehollandiae	Masked Owl	V,P,3		Distribution & Ecology: extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-west corner. It lives in dry eucalypt forests and woodlands from sea level to 1100 m. Foraging: often hunts along the edges of forests, including roadsides. Typical diet consists of tree-dwelling and ground mammals, especially rats. Nesting: in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. On the Nullarbor Plain where there are no large trees, they roost in caves, sinkholes or crevices in the limestone cliffs. Nests are bare chambers lined with soil, sand or soft wood mulch. Breeding: when conditions are favourable and food plentiful. Notable Threats: secondary poisoning from rodenticide, loss of nesting hollows.	**Moderate:** There are four records within 5km, three of which are recent. Although there is limited suitable habitat within the study area, it may be part of a larger range.
Tyto tenebricosa	Sooty Owl	V,P,3		"Distribution & Ecology: Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosting: Roosts by day in the hollow of a tall forest tree or in heavy vegetation. Territories are occupied permanently. Breeding: Nests in very large tree-hollows. Foraging: Hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum Notable Threats: secondary poisoning from rodenticides, loss of nesting hollows	**High:** There are twelve records within 5km, nine of which are recent. Although there is limited suitable habitat within the study area, it may be part of a larger range.

Scientific Name	Common Name	BC Status	EPBC Status	Habitat Description	Likelihood
Varanus rosenbergi	Rosenberg's Goanna	V,P		Distribution & Ecology: occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. 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. Individuals require large areas of habitat. Foraging: Feeds on carrion, birds, eggs, reptiles and small mammals. Shelter: in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. Generally slow moving; on the tablelands likely only to be seen on the hottest days. Runs along the ground when pursued (as opposed to the Lace Monitor, which climbs trees). Breeding: Lays up to 14 eggs in a termite mound; the hatchlings dig themselves out of the mounds. Notable Threats: habitat loss and fragmentation, removal of habitat elements such as termite mounds, vehicle strikes, predation by feral animals including cats and dogs.	**Low**: There are four records within 5km, three of which are recent. However, they are located in Holsworthy Military area across the Georges River. Due to this isolation and the lack of suitable habitat, it is unlikely the species is within the study area.
Xenus cinereus	Terek Sandpiper	V,P	C,J,K	Distribution & Ecology: rare migrants to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. They prefer mud banks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools; Roosting: communally amongst mangroves or dead trees, often with related wader species. Foraging: Breaks up into smaller flocks or even solitary birds when feeding in open intertidal mudflats. The diet includes worms, crabs and other crustaceans, small shellfish and the adults and larvae of various flies, beetles and water-bugs. Feeding is undertaken by moving rapidly and erratically over soft, wet mud, pecking or probing at the surface. Breeding: Finland, Estonia, Latvia, Ukraine and northern Russia, arriving in Australia for the non-breeding season from August, and leaving in roughly April. Notable Threats: human disturbance, hydrological changes, pollution, rising sea levels.	**Moderate:** There are 1347 records within 5km, numerous are recent. All records are nearby in Towra Point. Although there are numerous records of the species nearby, it is unlikely that it would frequently enter the study area as it is not preferred habitat.

BC Act – *Biodiversity Conservation Act 2016* (NSW); EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
E4A – critically endangered; E – endangered species; V – vulnerable. CE - critically endangered; P – protected;
C – CAMBA, J – JAMBA, K – ROCKAMBA.
*The species was recorded by Total Earth Care (2012).

APPENDIX D – RECORDED SPECIES

Table A-6 and A-7 list the species recorded during the Biodiversity Study. Table A-8 lists the fauna species listed during the community engagement activities. However, note that species listed in Table A-8 have not been verified.

Fauna species

Table A 6. Summary of fauna species recorded during the Biodiversity Study

Scientific Name	Common Name	Exotic	BC Status	EPBC Status	Fauna group	Notes
Acanthiza nana	Yellow Thornbill		P		Bird	
Acanthiza pusilla	Brown Thornbill		P		Bird	
Acanthiza reguloides	Buff-rumped Thornbill		P		Bird	
Acanthorhynchus tenuirostris	Eastern Spinebill		P		Bird	
Alectura lathami	Australian Brush-turkey		P		Bird	
Alisterus scapularis	Australian King-Parrot		P		Bird	
Amegilla cingulata	Blue Banded Bee				Invertebrate	
Amphibolurus muricatus	Jacky Lizard		P		Reptile	
Anas castanea	Chestnut Teal		P		Bird	
Anas domesticus	American Pekin	*			Bird	
Anas gracilis	Grey Teal		P		Bird	
Anas superciliosa	Pacific Black Duck		P		Bird	
Anhinga novaehollandiae	Australasian Darter		P		Bird	
Anthochaera carunculata	Red Wattlebird		P		Bird	
Anthochaera chrysoptera	Little Wattlebird		P		Bird	
Ardea alba	Eastern Great Egret		P		Bird	
Austronomus australis	White-striped Freetail-bat		P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Butorides striatus	Striated Heron		P		Bird	
Cacatua galerita	Sulphur-crested Cockatoo		P		Bird	
Cacatua Hybrid	Galah/Pink Cockatoo		P		Bird	
Cacatua sanguinea	Little Corella		P		Bird	
Caligavis chrysops	Yellow-faced Honeyeater		P		Bird	
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo		P		Bird	
Canis lupus familiaris	Dog	*			Mammal	
Ceyx azureus	Azure Kingfisher		P		Bird	
Chalcites lucidus	Shining Bronze-Cuckoo		P		Bird	
Chalinolobus gouldii	Gould's Wattled Bat		P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Chenonetta jubata	Australian Wood Duck		P		Bird	
Chroicocephalus novaehollandiae	Silver Gull		P		Bird	
Columba livia	Rock Dove	*			Bird	

Coracina novaehollandiae	Black-faced Cuckoo-shrike		P		Bird	
Coracina tenuirostris	Cicadabird		P		Bird	
Cormobates leucophaea	White-throated Treecreeper		P		Bird	
Corvus coronoides	Australian Raven		P		Bird	
Cracticus tibicen	Australian Magpie		P		Bird	
Cracticus torquatus	Grey Butcherbird		P		Bird	
Crinia signifera	Common Eastern Froglet		P		Amphibian	
Cryptoblepharus virgatus	Cream-striped Shinning-skink		P		Reptile	
Cyprinus carpio	Carp	*			Fish	
Dacelo novaeguineae	Laughing Kookaburra		P		Bird	
Dicrurus bracteatus	Spangled Drongo		P		Bird	
Egretta novaehollandiae	White-faced Heron		P		Bird	
Eolophus roseicapillus	Galah				Bird	
Eopsaltria australis	Eastern Yellow Robin		P		Bird	
Eudynamys orientalis	Eastern Koel		P		Bird	
Eulamprus quoyii	Eastern Water-skink		P		Reptile	
Eurystomus orientalis	Dollarbird		P		Bird	
Falco longipennis	Australian Hobby		P		Bird	
Falco peregrinus	Peregrine Falcon		P		Bird	
Felis catus	Cat	*			Mammal	
Fulica atra	Eurasian Coot		P		Bird	
Gallinula tenebrosa	Dusky Moorhen		P		Bird	
Gambusia holbrooki	Mosquito Fish	*			Fish	
Geopelia humeralis	Bar-shouldered Dove		P		Bird	
Gerygone mouki	Brown Gerygone		P		Bird	
Glossopsitta concinna	Musk Lorikeet		P		Bird	
Grallina cyanoleuca	Magpie-lark		P		Bird	
Haliaeetus leucogaster	White-bellied Sea-Eagle		V,P	C	Bird	
Hirundo neoxena	Welcome Swallow		P		Bird	
Intellagama lesueurii	Eastern Water Dragon		P		Reptile	
Lampropholis guichenoti	Pale-flecked Garden Sunskink		P		Reptile	
Limax maximus	Giant Garden Slug	*			Invertebrate	
Limnodynastes peronii	Brown-striped Frog		P		Amphibian	
Limnodynastes tasmaniensis	Spotted Grass Frog		P		Amphibian	
Litoria fallax	Eastern Dwarf Tree Frog		P		Amphibian	
Litoria peronii	Peron's Tree Frog		P		Amphibian	
Malurus cyaneus	Superb Fairy-wren		P		Bird	
Malurus lamberti	Variegated Fairy-wren		P		Bird	
Manorina melanocephala	Noisy Miner		P		Bird	
Microcarbo melanoleucos	Little Pied Cormorant		P		Bird	

Micronomus norfolkensis	Eastern Coastal Free-tailed Bat		V,P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Miniopterus australis	Little Bent-winged Bat		V,P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Miniopterus orianae oceanensis	Large Bent-winged Bat		V		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Mormopterus ridei	Eastern Free-tailed Bat		P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Mus musculus	House Mouse	*			Mammal	
Myotis macropus	Southern Myotis		V,P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Myzomela sanguinolenta	Scarlet Honeyeater		P		Bird	
Ninox novaeseelandiae	Southern Boobook		P		Bird	
Ninox strenua	Powerful Owl		V,P,3		Bird	
Nycticorax caledonicus	Nankeen Night Heron		P		Bird	
Ocyphaps lophotes	Crested Pigeon		P		Bird	
Oriolus sagittatus	Olive-backed Oriole		P		Bird	
Pachycephala pectoralis	Golden Whistler		P		Bird	
Pardalotus punctatus	Spotted Pardalote		P		Bird	
Pelecanus conspicillatus	Australian Pelican		P		Bird	
Petaurus breviceps	Sugar Glider		P		Mammal	
Phalacrocorax sulcirostris	Little Black Cormorant		P		Bird	
Phalacrocorax varius	Pied Cormorant		P		Bird	
Platalea regia	Royal Spoonbill		P		Bird	
Platycercus elegans	Crimson Rosella		P		Bird	
Platycercus eximius	Eastern Rosella		P		Bird	
Podargus strigoides	Tawny Frogmouth		P		Bird	
Porphyrio porphyrio	Purple Swamphen		P		Bird	
Pseudocheirus peregrinus	Common Ringtail Possum		P		Mammal	
Psophodes olivaceus	Eastern Whipbird		P		Bird	
Pteropus alecto	Black Flying-fox		P		Mammal	
Pteropus poliocephalus	Grey-headed Flying-fox		V,P	V	Mammal	
Pteropus scapulatus	Little Red Flying-fox		P		Mammal	
Ptilonorhynchus violaceus	Satin Bowerbird		P		Bird	
Pycnonotus jocosus	Red-whiskered Bulbul	*			Bird	
Rattus rattus	Black Rat	*			Mammal	
Rhipidura albiscapa	Grey Fantail		P		Bird	
Rhipidura leucophrys	Willie Wagtail		P		Bird	
Scoteanax rueppellii	Greater Broad-nosed Bat		V,P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)

Scotorepens orion	Eastern Broad-nosed Bat		P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Scythrops novaehollandiae	Channel-billed Cuckoo		P		Bird	
Sericornis frontalis	White-browed Scrubwren		P		Bird	
Sphecotheres vieilloti	Australasian Figbird		P		Bird	
Strepera graculina	Pied Currawong		P		Bird	
Streptopelia chinensis	Spotted Turtle-Dove	*			Bird	
Sturnus tristis	Common Myna	*			Bird	
Tachybaptus novaehollandiae	Australasian Grebe		P		Bird	
Tachyglossus aculeatus	Short-beaked Echidna		P		Mammal	
Tetractenos hamiltoni	Toadfish (common)		P		Fish	
Threskiornis molucca	Australian White Ibis		P		Bird	
Thyreus nitidulus	Blue Cuckoo Bee				Invertebrate	
Tiliqua scincoides	Eastern Blue-tongue		P		Reptile	
Todiramphus sanctus	Sacred Kingfisher		P		Bird	
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet		P		Bird	
Trichoglossus haematodus	Rainbow Lorikeet		P		Bird	
Trichosurus vulpecula	Common Brushtail Possum		P		Mammal	
Turdus merula	Eurasian Blackbird	*			Bird	
Vanellus miles	Masked Lapwing		P		Bird	
Vespadelus vulturnus	Little Forest Bat		P		Mammal	Recorded by ultrasonic echolocation detection (Anabat)
Vulpes vulpes	Fox	*			Mammal	
Wallabia bicolor	Swamp Wallaby		P		Mammal	
Zosterops lateralis	Silvereye		P		Bird	

BC Act – *Biodiversity Conservation Act 2016* (NSW); EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
E4A – critically endangered; E – endangered species; V – vulnerable. CE - critically endangered; P – protected;
C – CAMBA, J – JAMBA, K – ROCKAMBA.

Flora species

Table A 7. Summary of flora species recorded during the Biodiversity Study

Scientific name	Common name	Exotic	BC Act	EPBC Act
Abelia spp.		*		
Acacia binervata	Two-veined Hickory			
Acacia decurrens	Black Wattle			
Acacia falcata				
Acacia falciformis	Broad-leaved Hickory			
Acacia floribunda	White Sally			
Acacia hispidula				
Acacia implexa	Hickory Wattle			
Acacia linearifolia	Narrow-leaved Wattle			
Acacia linifolia	White Wattle			
Acacia longifolia subsp. longifolia	Sydney Golden Wattle			
Acacia parramattensis	Parramatta Wattle			
Acacia prominens	Gosford Wattle		E2	
Acacia suaveolens	Sweet Wattle			
Acacia terminalis	Sunshine Wattle			
Acacia terminalis subs. glabourous form	Sunshine Wattle			
Acacia terminalis subsp. angustifolia				
Acacia terminalis subsp. longiaxialis				
Acacia ulicifolia	Prickly Moses			
Acetosa sagittata	Rambling Dock	*		
Acmena smithii	Lilly Pilly			
Actinotus helianthi	Flannel Flower		P	
Actinotus minor	Lesser Flannel Flower			
Adiantum aethiopicum	Common Maidenhair		P	
Adiantum hispidulum	Rough Maidenhair		P	
Aegiceras corniculatum	River Mangrove			
Afrocarpus falcatus		*		
Agapanthus spp.		*		
Agave spp.		*		
Ageratina adenophora	Crofton Weed	*		
Ageratina riparia	Mistflower	*		
Allocasuarina distyla				
Allocasuarina littoralis	Black She-Oak			
Allocasuarina torulosa	Forest Oak			
Alocasia brisbanensis	Cunjevoi			
Alternanthera philoxeroides	Alligator Weed	*		
Amyema cambagei	Needle-leaf Mistletoe			
Angophora costata	Sydney Red Gum			
Angophora floribunda	Rough-barked Apple			
Anisopogon avenaceus	Oat Speargrass			
Anredera cordifolia	Madeira Vine	*		

Scientific name	Common name	Exotic	BC Act	EPBC Act
Anredera cordifolia	Madeira Vine	*		
Apium prostratum	Sea Celery			
Araucaria heterophylla	Norfolk Island Pine	*		
Araujia sericifera	Moth Vine	*		
Archontophoenix alexandrae	Alexandra Palm	*		
Archontophoenix cunninghamiana	Bangalow Palm		P	
Aristida vagans	Threeawn Speargrass			
Arundo donax	Giant Reed	*		
Asparagus aethiopicus	Asparagus Fern	*		
Asparagus asparagoides	Bridal Creeper	*		
Asparagus plumosus	Climbing Asparagus Fern	*		
Asplenium australasicum	Bird's Nest Fern		P	
Atriplex australasica		*		
Atriplex prostrata				
Atriplex spp.	A Saltbush			
Austromyrtus tenuifolia				
Austrostipa mollis	Soft Speargrass			
Austrostipa puberula				
Austrostipa pubescens		*		
Avena barbata	Bearded Oats	*		
Avicennia marina subsp. australasica	Grey Mangrove			
Banksia ericifolia	Heath-leaved Banksia			
Banksia integrifolia	Coast Banksia			
Banksia serrata	Old-man Banksia			
Banksia spinulosa	Hairpin Banksia		P	
Bauera microphylla				
Baumea articulata	Jointed Twig-rush			
Baumea juncea				
Bidens pilosa	Cobbler's Pegs	*		
Billardiera scandens	Hairy Apple Berry			
Blechnum cartilagineum	Gristle Fern			
Bolboschoenus fluviatilis	Marsh Club-rush			
Bolboschoenus spp.				
Bossiaea prostrata				
Bossiaea scolopendria				
Bouteloua dactyloides	Buffalo Grass	*		
Brachychiton acerifolius	Illawarra Flame Tree			
Breynia oblongifolia	Coffee Bush			
Briza maxima	Quaking Grass	*		
Bromus catharticus	Praire Grass	*		
Brunoniella australis	Blue Trumpet			
Bryophyllum delagoense	Mother of millions	*		
Bryophyllum x houghtonii				
Bursaria spinosa	Native Blackthorn			

Scientific name	Common name	Exotic	BC Act	EPBC Act
Buxus spp.		*		
Callicoma serratifolia	Black Wattle			
Callistemon citrinus	Crimson Bottlebrush			
Callistemon linearis	Narrow-leaved Bottlebrush			
Callistemon salignus	Willow Bottlebrush			
Callistemon sieberi	River Bottlebrush			
Callistemon viminalis	Weeping Bottlebrush			
Callitris rhomboidea	Port Jackson Pine			
Calochlaena dubia	Rainbow Fern			
Calodendrum capense	Cape Chestnut	*		
Camellia sasanqua	Sasanqua Camellia	*		
Canna spp.		*		
Capsella bursa-pastoris	Shepherd's Purse	*		
Cardiospermum grandiflorum	Balloon Vine	*		
Carex appressa	Tall Sedge			
Carex inversa	Knob Sedge			
Cassytha glabella		*		
Cassytha pubescens	Downy Dodder-laurel			
Casuarina cunninghamiana subsp. cunninghamiana	River Oak			
Casuarina glauca	Swamp Oak			
Caustis flexuosa	Curly Wig		P	
Cayratia clematidea	Native Grape			
Celtis sinensis	Japanese Hackberry	*		
Cenchrus clandestinus	Kikuyu Grass	*		
Centella asiatica	Indian Pennywort			
Ceratopetalum apetalum	Coachwood			
Ceratopetalum gummiferum	Christmas Bush			
Cestrum parqui	Green Cestrum	*		
Chamaesyce hirta	Asthma Plant	*		
Chenopodium album	Fat Hen	*		
Christella dentata	Binung			
Cinnamomum camphora	Camphor Laurel	*		
Cissus antarctica	Water Vine			
Cissus hypoglauca	Giant Water Vine			
Clematis aristata	Old Man's Beard			
Clematis glycinoides	Headache Vine			
Clerodendrum tomentosum	Hairy Clerodendrum			
Cocos nucifera	Coconut Palm	*		
Colocasia esculenta	Taro, Black Stem Elephant Ear	*		
Commelina cyanea	Native Wandering Jew			
Conyza bonariensis	Flaxleaf Fleabane	*		
Conyza spp.	A Fleabane	*		
Coreopsis lanceolata	Coreopsis	*		
Correa reflexa	Native Fuschia			

Scientific name	Common name	Exotic	BC Act	EPBC Act
Corymbia aparrerinja	Ghost Gum	*		
Corymbia gummifera	Red Bloodwood			
Corymbia maculata	Spotted Gum			
Cotoneaster glaucophyllus		*		
Cryptocarya glaucescens	Jackwood			
Cryptostylis erecta	Tartan Tongue Orchid		P	
Cupaniopsis anacardioides	Tuckeroo			
Cupressus spp.		*		
Cyathea australis	Rough Treefern		P	
Cyathea cooperi	Straw Treefern		P	
Cylindropuntia imbricata	Devil's Rope Pear			
Cynodon dactylon	Common Couch			
Cyperus alterniflorus				
Cyperus congestus		*		
Cyperus eragrostis	Umbrella Sedge	*		
Cyperus gracilis	Slender Flat-sedge			
Cyperus rotundus	Nutgrass	*		
Daucus carota	Wild Carrot	*		
Delairea odorata	Cape Ivy	*		
Dendrobium linguiforme	Tongue Orchid		P	
Desmodium brachypodum	Large Tick-trefoil			
Desmodium rhytidophyllum				
Desmodium varians	Slender Tick-trefoil			
Dianella caerulea	Blue Flax-lily			
Dianella caerulea var. caerulea				
Dianella caerulea var. producta				
Dianella longifolia	Blueberry Lily			
Dianella revoluta	Blueberry Lily			
Dichondra repens	Kidney Weed			
Dicksonia antarctica	Soft Treefern		P	
Digitaria sanguinalis	Crab Grass	*		
Dillwynia retorta				
Diploglottis australis	Native Tamarind			
Dipodium variegatum			P	
Dodonaea triquetra	Large-leaf Hop-bush			
Dodonaea viscosa	Sticky Hop-bush			
Doodia aspera	Prickly Rasp Fern			
Doryanthes excelsa	Gymea Lily		P	
Echinopogon caespitosus	Bushy Hedgehog-grass			
Echinopogon caespitosus var. caespitosus	Tufted Hedgehog Grass			
Ehrharta erecta	Panic Veldtgrass	*		
Ehrharta longiflora	Annual Veldtgrass	*		
Elaeocarpus reticulatus	Blueberry Ash			
Eleocharis sphacelata	Tall Spike Rush			

Scientific name	Common name	Exotic	BC Act	EPBC Act
Eleusine indica	Crowsfoot Grass			
Empodisma minus				
Entolasia marginata	Bordered Panic			
Entolasia stricta	Wiry Panic			
Epacris longiflora	Fuchsia Heath			
Eragrostis brownii	Brown's Lovegrass			
Eragrostis curvula	African Lovegrass			
Eriochloa crebra	Cup Grass, Tall Cupgrass			
Erythrina crista-galli	Cockspur Coral Tree	*		
Erythrina spp.				
Erythrina x sykesii	Coral tree	*		
Eucalyptus botryoides	Bangalay			
Eucalyptus botryoides <--> saligna	#N/A	*		
Eucalyptus camaldulensis	Eucalyptus camaldulensis			
Eucalyptus cinerea	Argyle Apple			
Eucalyptus crebra	Narrow-leaved Ironbark			
Eucalyptus globoidea	White Stringybark			
Eucalyptus haemastoma	Broad-leaved Scribbly Gum			
Eucalyptus microcarpa	Western Grey Box			
Eucalyptus microcorys	Tallowwood			
Eucalyptus paniculata	Grey Ironbark			
Eucalyptus pilularis	Blackbutt			
Eucalyptus piperita	Sydney Peppermint			
Eucalyptus punctata	Grey Gum			
Eucalyptus resinifera	Red Mahogany			
Eucalyptus robusta	Swamp Mahogany			
Eucalyptus saligna	Sydney Blue Gum			
Eucalyptus siderophloia	Grey Ironbark			
Eucalyptus tereticornis	Forest Red Gum			
Euphorbia peplus	Petty Spurge	*		
Eustrephus latifolius	Wombat Berry			
Exocarpos cupressiformis	Cherry Ballart			
Ficinia nodosa	Knobby Club-rush			
Ficus coronata	Creek Sandpaper Fig			
Ficus macrophylla				
Ficus rubiginosa	Port Jackson Fig			
Ficus superba var. henneana	Deciduous Fig			
Gahnia aspera	Rough Saw-sedge			
Gahnia clarkei	Tall Saw-sedge			
Gahnia sieberiana	Red-fruit Saw-sedge		P	
Galinsoga parviflora	Potato Weed	*		
Geitonoplesium cymosum	Scrambling Lily			
Geranium homeanum				
Geranium solanderi	Native Geranium			

Scientific name	Common name	Exotic	BC Act	EPBC Act
Geranium spp.				
Gleditsia triacanthos	Honey Locust	*		
Glochidion ferdinandi	Cheese Tree			
Glycine clandestina	Twining glycine			
Glycine tabacina	Variable Glycine			
Gomphocarpus fruticosus	Narrow-leaved Cotton Bush	*		
Gonocarpus teucrioides	Germander Raspwort			
Goodenia hederacea	Ivy Goodenia			
Goodenia ovata	Hop Goodenia			
Grevillea mucronulata				
Grevillea robusta	Silky Oak			
Grevillea sericea	Pink Spider Flower			
Grevillea sericea subsp. sericea				
Grevillea speciosa	Red Spider Flower			
Hakea dactyloides	Finger Hakea			
Hakea gibbosa				
Hakea salicifolia	Willow-leaved Hakea			
Hakea sericea	Needlebush			
Hardenbergia violacea	False Sarsaparilla			
Hedera helix	English Ivy	*		
Hedychium gardnerianum	Ginger Lily	*		
Hibbertia dentata	Twining Guinea Flower			
Hibbertia scandens	Climbing Guinea Flower			
Homalanthus populifolius				
Hovea linearis				
Hydrocotyle bonariensis		*		
Hypochaeris radicata	Catsear	*		
Imperata cylindrica	Blady Grass			
Ipomoea indica	Morning Glory	*		
Isolepis inundata	Club-rush			
Isopogon anemonifolius	Broad-leaf Drumsticks		P	
Isopogon anethifolius	Narrow-leaf Drumsticks		P	
Jacaranda mimosifolia	Jacaranda	*		
Jasminum mesnyi	Primrose Jasmine	*		
Juncus acutiflorus		*		
Juncus acutus subsp. acutus	Sharp Rush	*		
Juncus kraussii subsp. australiensis	Sea Rush			
Juncus usitatus				
Kennedia rubicunda	Dusky Coral Pea			
Kunzea ambigua	Tick Bush		P	
Lagenophora spp.				
Lagunaria patersonia	Norfolk Island Hibiscus			
Lambertia formosa	Mountain Devil			
Lantana camara	Lantana	*		

Scientific name	Common name	Exotic	BC Act	EPBC Act
Lantana spp.		*		
Lepidium bonariense	Argentine Peppercress	*		
Lepidium virginicum	Virginian Peppercess	*		
Lepidosperma cf. laterale				
Lepidosperma laterale	Variable Sword-sedge			
Lepidosperma urophorum				
Leptomeria acida	Sour Currant Bush			
Leptospermum grandifolium	Woolly Teatree			
Leptospermum polygalifolium	Tantoon			
Leptospermum spp.	#N/A		#N/A	#N/A
Lepyrodia muelleri				
Leucopogon juniperinus	Prickly Beard-heath			
Ligustrum lucidum	Large-leaved Privet	*		
Ligustrum sinense	Small-leaved Privet	*		
Lindsaea linearis	Screw Fern			
Livistona australis	Cabbage Palm		P	
Lobelia anceps				
Lobelia andrewsii	Trailing Lobelia			
Lobelia purpurascens	whiteroot			
Lomandra confertifolia subsp. rubiginosa				
Lomandra filiformis	Wattle Matt-rush			
Lomandra glauca	Pale Mat-rush			
Lomandra longifolia	Spiny-headed Mat-rush			
Lomandra obliqua				
Lomandra spp.	Mat-rush			
Lomatia myricoides	River Lomatia			
Lomatia silaifolia	Crinkle Bush		P	
Lonicera japonica	Japanese Honeysuckle	*		
Lophostemon confertus	Brush Box			
Macrozamia communis	Burrawang		P	
Macrozamia spiralis			P	
Marsdenia rostrata	Milk Vine			
Marsdenia suaveolens	Scented Marsdenia			
Megathyrsus maximus		*		
Melaleuca armillaris subsp. armillaris	Bracelet Honey-myrtle			
Melaleuca decora				
Melaleuca ericifolia	Swamp Paperbark			
Melaleuca linariifolia	Flax-leaved Paperbark			
Melaleuca nodosa				
Melaleuca quinquenervia	Broad-leaved Paperbark			
Melaleuca styphelioides	Prickly-leaved Tea Tree			
Melia azedarach	White Cedar			
Microlaena stipoides	Weeping Grass			
Mirabilis jalapa	Four-o'clock Flower			

Scientific name	Common name	Exotic	BC Act	EPBC Act
Modiola caroliniana	Red-flowered Mallow	*		
Monotoca elliptica	Tree Broom-heath			
Monotoca scoparia				
Monstera deliciosa	Fruit Salad Plant	*		
Morus alba	White Mulberry	*		
Myoporum boninense subsp. australe				
Myrsine variabilis				
Nandina domestica	Japanese Sacred Bamboo	*		
Nephrolepis cordifolia	Fishbone Fern			
Nerium oleander	Oleander	*		
Notelaea longifolia	Large Mock-olive			
Notelaea ovata				
Notelaea venosa	Veined Mock-olive			
Nymphoides geminata	Entire Marshwort			
Ochna serrulata	Mickey Mouse Plant	*		
Olea europaea	Common Olive	*		
Olea europaea subsp. cuspidata	African Olive	*		
Opercularia aspera	Coarse Stinkweed			
Ophiopogon spp.		*		
Oplismenus aemulus	Basket Grass			
Oplismenus imbecillis				
Oxalis corniculata	Creeping Oxalis	*		
Oxalis latifolia		*		
Oxalis rubens				
Oxalis spp.				
Pandorea pandorana	Wonga Wonga Vine			
Panicum simile	Two-colour Panic			
Parietaria judaica	Pellitory	*		
Parsonsia straminea	Common Silkpod			
Paspalidium criniforme				
Paspalidium distans				
Paspalum dilatatum	Paspalum	*		
Paspalum urvillei	Vasey Grass	*		
Passiflora suberosa	Cork Passionfruit	*		
Pelargonium australe	Native Storksbill			
Persicaria decipiens	Slender Knotweed			
Persicaria orientalis	Princes Feathers			
Persicaria spp.	Knotweed			
Persoonia laurina	Laurel Geebung		P	
Persoonia levis	Broad-leaved Geebung		P	
Persoonia linearis	Narrow-leaved Geebung		P	
Petrophile sessilis			P	
Phoenix canariensis	Canary Island Date Palm			
Phoenix dactylifera	Date Palm	*		

Scientific name	Common name	Exotic	BC Act	EPBC Act
Phragmites australis	Common Reed			
Phyllanthus tenellus	Hen and Chicken	*		
Pimelea linifolia	Slender Rice Flower			
Pinus radiata	Radiata Pine	*		
Pinus spp.		*		
Pittosporum revolutum	Rough Fruit Pittosporum			
Pittosporum undulatum	Sweet Pittosporum			
Plantago lanceolata	Lamb's Tongues	*		
Plantago major	Large Plantain	*		
Plantago spp.	Plantain			
Platanus hispanica 'Acerifolia'	Hybrid Plane	*		
Platanus orientalis		*		
Platylobium formosum				
Platysace lanceolata	Shrubby Platysace			
Platysace linearifolia				
Plectranthus spp.				
Poa affinis				
Poa labillardierei var. labillardierei	Tussock			
Podocarpus elatus	Plum Pine			
Podocarpus spinulosus	Spiny-leaf Podocarp			
Polyosma cunninghamii	Featherwood			
Polyscias sambucifolia	Elderberry Panax			
Pomaderris vellea				
Pomax umbellata	Pomax			
Prunus cerasifera	Cherry Plum	*		
Pseuderanthemum variabile	Pastel Flower			
Pteridium esculentum	Bracken			
Pteris tremula	Tender Brake			
Pultenaea daphnoides	Large-leaf Bush-pea			
Pultenaea retusa				
Pyrus calleryana	Callery pear	*		
Quercus spp.		*		
Ranunculus inundatus	River Buttercup			
Rhododendron spp.	Rhododendron, Azalea	*		
Ricinus communis	Castor Oil Plant	*		
Rosa spp.		*		
Rubus spp.				
Rumex obtusifolius	Broadleaf Dock	*		
Rytidosperma fulvum	Wallaby Grass			
Rytidosperma spp.				
Rytidosperma tenuius	A Wallaby Grass			
Salix spp.		*		
Sambucus australasica	Native Elderberry			
Samolus repens	Creeping Brookweed			

Scientific name	Common name	Exotic	BC Act	EPBC Act
Sarcocornia quinqueflora subsp. quinqueflora				
Sarcopetalum harveyanum	Pearl Vine			
Schefflera actinophylla	Umbrella Tree	*		
Schelhammera undulata				
Schinus areira	Pepper Tree	*		
Schinus terebinthifolius	Brazilian Pepper Tree	*		
Senecio madagascariensis	Fireweed	*		
Senecio pterophorus				
Senna occidentalis	Coffee Senna	*		
Senna pendula var. glabrata		*		
Setaria palmifolia	Palm Grass	*		
Setaria viridis	Green Pigeon Grass	*		
Sida rhombifolia	Paddy's Lucerne	*		
Sigesbeckia orientalis subsp. orientalis	Indian Weed			
Smilax glyciphylla	Sweet Sarsparilla			
Solanum aviculare	Kangaroo Apple			
Solanum mauritianum	Wild Tobacco Bush	*		
Solanum nigrum	Black-berry Nightshade	*		
Solanum pseudocapsicum	Madeira Winter Cherry	*		
Solanum seaforthianum	Climbing Nightshade	*		
Sonchus oleraceus	Common Sowthistle	*		
Sonchus spp.	Sowthistle	*		
Sporobolus virginicus				
Sporobolus virginicus var. virginicus	Sand Couch			
Stellaria media	Common Chickweed	*		
Stenotaphrum secundatum	Buffalo Grass	*		
Stephania japonica	Snake vine			
Sticherus flabellatus var. flabellatus	Umbrella Fern		P	
Strelitzia nicolai		*		
Strelitzia reginae		*		
Stylidium productum				
Suaeda australis				
Syncarpia glomulifera	Turpentine			
Syzygium paniculatum	Magenta Lilly Pilly		E1	V
Taraxacum officinale	Dandelion	*		
Tetragonia tetragonioides	New Zealand Spinach			
Tetratheca neglecta				
Themeda triandra				
Thunbergia alata	Black-eyed Susan			
Thysanotus tuberosus	Common Fringe-lily			
Tillandsia usneoides				
Trachymene incisa	Trachymene	*		
Tradescantia fluminensis	Wandering Jew	*		
Trema tomentosa var. aspera	Native Peach			

Scientific name	Common name	Exotic	BC Act	EPBC Act
Triadica sebifera	Chinese Tallowood	*		
Trifolium repens	White Clover	*		
Triglochin procera	Water Ribbons			
Triglochin striata	Streaked Arrowgrass			
Tristaniopsis laurina	Kanooka			
Tylophora barbata	Bearded Tylophora			
Typha orientalis	Broad-leaved Cumbungi			
Ulmus parvifolia	Chinese Elm	*		
Urochloa mutica	Para Grass	*		
Verbena bonariensis	Purpletop	*		
Vicia sativa	Common vetch	*		
Viola hederacea	Ivy-leaved Violet			
Viola odorata	Sweet Violet	*		
Wahlenbergia gracilenta	Annual Bluebell			
Woollsia pungens				
Xanthorrhoea arborea			P	
Xanthorrhoea media			P	
Xanthorrhoea spp.	#N/A		P	
Xanthosia pilosa	Woolly Xanthosia			
Xanthosia spp.				
Xanthosia tridentata	Rock Xanthosia			
Yucca spp.				
Zantedeschia aethiopica	Arum Lily	*		
Zieria pilosa	Pilose-leafed Zieria			

BC Act – *Biodiversity Conservation Act 2016* (NSW); EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
E4A – critically endangered; E – endangered species; E2- endangered population; V – vulnerable. CE - critically endangered; P – protected;
C – CAMBA, J – JAMBA, K – ROCKAMBA.

Species from Community Engagement

Table A 8. Summary of fauna species recorded from the Community Engagement

Scientific Name	Common Name	Exotic	BC Status	EPBC Status	Fauna group	Less than 10 historical records
Acanthiza pusilla	Brown Thornbill		P		Bird	
Acanthorhynchus tenuirostris	Eastern Spinebill		P		Bird	
Accipiter novaehollandiae	Grey Goshawk				Bird	
Alectura lathami	Australian Brush-turkey		P		Bird	
Alisterus scapularis	Australian King-Parrot		P		Bird	
Amegilla cingulata	Blue Banded Bee				Invertebrate	*
Anas castanea	Chestnut Teal		P		Bird	*
Anas superciliosa	Pacific Black Duck		P		Bird	
Anguilla australis	Short-finned Eel				Fish	
Apis mellifera	European honey bee	*			Invertebrate	*
Argiope keyserlingi	St Andrews Cross Spider				Invertebrate	*
Aythya australis	Hardhead				Bird	*
Cacatua galerita	Sulphur-crested Cockatoo		P		Bird	
Cacatua Hybrid	Galah/Pink Cockatoo		P		Bird	
Cacatua sanguinea	Little Corella		P		Bird	
Cacatua tenuirostris	Long-billed Corella				Bird	*
Caligavis chrysops	Yellow-faced Honeyeater		P		Bird	
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo		P		Bird	*
Chelodina longicollis	Eastern Long-necked Turtle				Reptile	
Chenonetta jubata	Australian Wood Duck		P		Bird	
Coccinella septempunctata	Spotted Ladybird				Invertebrate	*
Coenagrion lyelli	Swamp Bluet				Invertebrate	*
Columba leucomela	White-headed Pigeon				Bird	*
Coracina novaehollandiae	Black-faced Cuckoo-shrike		P		Bird	
Corvus coronoides	Australian Raven		P		Bird	
Cracticus tibicen	Australian Magpie		P		Bird	
Cracticus torquatus	Grey Butcherbird		P		Bird	
Cygnus atratus	Black swan				Bird	
Dacelo novaeguineae	Laughing Kookaburra		P		Bird	
Danaus plexippus	Monarch Butterfly				Invertebrate	*
Dendrelaphis punctulata	Green tree snake				Reptile	*
Diplacodes bipunctata	Wandering Percher				Invertebrate	*
Diplacodes haematodes	Scarlet Percher				Invertebrate	*
Diplacodes melanopsis	Black-faced Percher				Invertebrate	*
Egretta novaehollandiae	White-faced Heron		P		Bird	
Enallagma cyathigerum	Common Blue Damselfly				Invertebrate	*
Eopsaltria australis	Eastern Yellow Robin		P		Bird	

Eriophora transmarina	Garden Orb Weaver				Invertebrate	*
Eudynamys orientalis	Eastern Koel		P		Bird	
Eulamprus quoyii	Eastern Water-skink		P		Reptile	
Eurystomus orientalis	Dollarbird		P		Bird	
Family Tipulidae	Crane Fly				Invertebrate	*
Family: Aeshnidae	Australian Emperor Dragonfly				Invertebrate	*
Family: Asilidae	Robber Fly				Invertebrate	*
Family: Cicadoidea	Cicadas				Invertebrate	*
Family: Coenagrionidae	Red and Blue Damselfly				Invertebrate	*
Family: Coenagrionidae	Eastern Billabongfly				Invertebrate	*
Family: Dolichopodidae	Green Long-legged Fly				Invertebrate	*
Family: Lygaeidae	Milkweed Bug				Invertebrate	*
Family: Mantidae	Praying Mantis				Invertebrate	*
Family: Nymphalidae	Meadow Argus Butterfly				Invertebrate	*
Family: Oxyopidae	Lynx Spider				Invertebrate	*
Family: Pentatomidae	Green Shield Bug				Invertebrate	*
Family: Pseudococcidae	Mealybug				Invertebrate	*
Family: Pyrgomorphidae	Vegetable Grasshopper				Invertebrate	*
Family: Reduviidae	Assassin Bug				Invertebrate	*
Family: Sarcophagidae	Flesh Eating Fly				Invertebrate	*
Family: Sparassidae	Huntsman Spider				Invertebrate	*
Family: Syrphidae	Hoverfly				Invertebrate	*
Family: Tettigoniidae	Bush Cricket				Invertebrate	*
Family: Tettigoniidae	Katydid				Invertebrate	*
Fulica atra	Eurasian Coot		P		Bird	*
Gallinula tenebrosa	Dusky Moorhen		P		Bird	
Glossopsitta concinna	Musk Lorikeet		P		Bird	*
Grallina cyanoleuca	Magpie-lark		P		Bird	
Graphium sarpedon	Blue Triangle Butterfly				Invertebrate	*
Haliaeetus leucogaster	White-bellied Sea-Eagle		V,P	C	Bird	
Hemiaspis signata	Marsh Snake				Reptile	*
Hirundo neoxena	Welcome Swallow		P		Bird	
Hydromys chrysogaster	Rakali				Mammal	*
Ictinogomphus australis	Australian Tiger Dragonfly				Invertebrate	*
Ictinogomphus australis	Australian Tiger Dragonfly				Invertebrate	*
Intellagama lesueurii	Eastern Water Dragon		P		Reptile	
Ischnura aurora	Aurora Bluetail Damselfly				Invertebrate	*
Ixobrychus flavicollis	Black Bittern		V,P		Bird	
Libellula vibrans	Blue Skimmer Dragonfly				Invertebrate	*
Limax maximus	Giant Garden Slug	*			Invertebrate	*
Limnodynastes dumerilii	Eastern Banjo Frog				Amphibian	*
Limosa lapponica	Bar-tailed Godwit			V	Bird	

Litoria peronii	Peron's Tree Frog		P		Amphibian	
Lopholaimus antarcticus	Topknot Pigeon				Bird	*
Lucilia sericata	Green Bottle Fly				Invertebrate	*
Malurus cyaneus	Superb Fairy-wren		P		Bird	
Malurus lamberti	Variegated Fairy-wren		P		Bird	
Manorina melanocephala	Noisy Miner		P		Bird	
Microcarbo melanoleucos	Little Pied Cormorant		P		Bird	
Morelia spilota	Carpet Python				Reptile	*
Ninox novaeseelandiae	Southern Boobook		P		Bird	
Ninox strenua	Powerful Owl		V,P,3		Bird	
Nycticorax caledonicus	Nankeen Night Heron		P		Bird	*
Ocybadistes walkeri	Grass Dart Skipper Butterfly				Invertebrate	*
Opisthoncus parcedentatus	Garden Jumping Spider				Invertebrate	*
Orthetrum villosovittatum	Fiery Skimmer Dragonfly				Invertebrate	*
Pandion cristatus	Eastern Osprey		V,P		Bird	
Pantala flavescens	Wandering Glider				Invertebrate	*
Pardalotus punctatus	Spotted Pardalote		P		Bird	
Pelecanus conspicillatus	Australian Pelican		P		Bird	
Phaedyma shepherdi	White-banded Plane Butterfly				Invertebrate	*
Phalacrocorax carbo	Great Cormorant				Bird	
Phalacrocorax sulcirostris	Little Black Cormorant		P		Bird	
Phylidonyris novaehollandiae	New Holland Honeyeater				Bird	
Platalea regia	Royal Spoonbill		P		Bird	
Platycercus elegans	Crimson Rosella		P		Bird	
Platycercus eximius	Eastern Rosella		P		Bird	
Plumbago sp.	Zebra Blue Butterfly				Invertebrate	*
Podargus strigoides	Tawny Frogmouth		P		Bird	
Porphyrio porphyrio	Purple Swamphen		P		Bird	
Pseudocheirus peregrinus	Common Ringtail Possum		P		Mammal	
Psittacula krameri	Indian ring-necked parakeet	*			Bird	
Pteropus poliocephalus	Grey-headed Flying-fox		V,P	V	Mammal	
Ptilotula penicillatus	White-plumed Honeyeater				Invertebrate	*
Rattus fuscipes	Bush Rat				Mammal	*
Rhipidura albiscapa	Grey Fantail		P		Bird	
Rhipidura leucophrys	Willie Wagtail		P		Bird	
Rhyothemis graphiptera	Graphic Flutterer Dragonfly				Invertebrate	*
Ropalidia plebeiana	White-faced Brown Paper Wasp		P		Bird	
Sericornis frontalis	White-browed Scrubwren		P		Bird	
Sphecotheres vieilloti	Australasian Figbird		P		Bird	
Strepera graculina	Pied Currawong		P		Bird	
Tachybaptus novaehollandiae	Australasian Grebe		P		Bird	*

Tachyglossus aculeatus	Short-beaked Echidna		P		Mammal	
Threskiornis molucca	Australian White Ibis		P		Bird	
Thyreus nitidulus	Blue Cuckoo Bee				Invertebrate	*
Thyreus nitidulus	Neon Cuckoo Bee				Invertebrate	*
Tiliqua scincoides	Eastern Blue-tongue		P		Reptile	
Todiramphus sanctus	Sacred Kingfisher		P		Bird	
Trachemys scripta elegans	Red-eared Slider	*			Reptile	
Tramea loewii	Common Glider Dragonfly				Invertebrate	*
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet		P		Bird	*
Trichoglossus haematodus	Rainbow Lorikeet		P		Bird	
Trichosurus vulpecula	Common Brushtail Possum		P		Mammal	
Tursiops truncatus	Bottlenose dolphin		P		Mammal	*
Vanellus miles	Masked Lapwing		P		Bird	
Varanus varius	Lace Monitor		P		Reptile	*
Wallabia bicolor	Swamp Wallaby		P		Mammal	
Zosterops lateralis	Silvereye		P		Bird	

APPENDIX E – NATIVE VEGETATION COMMUNITY DESCRIPTIONS

The following plant community descriptions are derived from *The Native Vegetation of the Sydney Metropolitan Area. Volume 2: Vegetation Community Profiles* (OEH 2013). These are generic descriptions of the communities. Specific descriptions of the vegetation communities at each surveyed site are provided in Volume 2.

Coastal Enriched Sandstone Dry Forest

Coastal Enriched Sandstone Dry Forest is commonly encountered on the upper slopes and dry gullies of Sydney urban areas. It is a tall open eucalypt forest with an understorey of dry sclerophyll shrubs with ferns and forbs amongst the ground cover. The commonly recorded eucalypts are smooth-barked apple (*Angophora costata*), red bloodwood (*Corymbia gummifera*) and Sydney peppermint (*Eucalyptus piperita*). Blackbutt (*Eucalyptus pilularis*) is common on gully slopes of the north shore and Hacking River valley while broad-leaved white mahogany (*Eucalyptus umbra*) replaces this species along the Warringah and Pittwater escarpments. A sparse layer of small trees such as *Allocasuarina littoralis* and old-man banksia (*Banksia serrata*) is common above a variety of wattles, tea-trees, gee bungs and grass trees. In long unburnt areas sweet pittosporum (*Pittosporum undulatum*) may be prevalent. It is widespread on the Hornsby plateau in areas that receive greater than 1000 millimetres of mean annual rainfall and are at elevations less than 200 metres above sea level. It extends north of the Sydney area into the hinterland of the Central Coast.

Figure A-1. Coastal Enriched Sandstone Dry Forest at Carss Bush Park

Estuarine Mangrove Forest

Stands of mangroves form a low closed to open forest on mudflats in Sydney's harbour, river coves and estuaries. There are two mangrove species found in Sydney. Grey mangrove (*Avicennia marina*) is the taller and more common, often seen in pure stands. Stands of grey mangrove comprise very few species other than the canopy, with the understorey mostly an open mudflat sometimes with scattered saltmarsh herbs. The second mangrove species is river mangrove (*Aegiceras corniculatum*). It is more often a small tree or shrub

found scattered amongst swathes of grey mangrove or along upper reaches of coastal riverbanks. It occurs where freshwater influences from runoff or rivers cause lower salinity levels.

Figure A-2. Estuarine Mangrove Forest at Gannons Park and Heinrick Reserve

Sydney Hinterland Exposed Sandstone Woodland

This is an exposed sandstone community distributed across the central and north-western Woronora Plateau and the western margin of the Hornsby plateau in north-west Sydney. It comprises a low-growing open eucalypt canopy with a dense shrub layer and an open ground cover of sedges and forbs. Common dominant tree species are red bloodwood (*Corymbia gummifera*), scribbly gums (*Eucalyptus racemosa/Eucalyptus haemastoma* complex and *Eucalyptus sclerophylla*) and stringybark (*Eucalyptus oblonga*). On the margins of the Georges River grey gum (*Eucalyptus punctata*) may be prominent, while on dry exposed slopes Sydney peppermint (*Eucalyptus piperita*) may join the canopy. The shrub layer is an array of common sandstone heath species such as banksias, wattles, tea-trees, hakeas and conesticks, though it is less diverse than sandstone communities found closer to the coast where mean annual rainfall is higher. For example heath-leaved banksia (*Banksia ericifolia subsp. ericifolia*) is generally absent from this community compared to sandstone heaths and woodlands further to the east.

Figure A-3. Sydney Hinterland Exposed Sandstone Woodland (OEH 2016)

Sydney Hinterland Apple-Blackbutt Gully Forest

This community is a moderately tall eucalypt forest with an understorey comprising dry shrubs, ferns and forbs. It occurs in the enriched sandstone gullies of the western Woronora Plateau and the tributaries of the Georges River between Wilton and Sandy Point. A large proportion of the extant area of this community occurs within the south-west Sydney area which experiences rainfall of 850-1050 millimetres per annum. The community occurs at elevations between four and 250 metres above sea level.

Typically the canopy is dominated by smooth-barked apple (*Angophora costata*) and blackbutt (*Eucalyptus pilularis*), with red bloodwood (*Corymbia gummifera*) common though less abundant. Grey gum (*Eucalyptus punctata*) may also be locally common in the western parts of the range with Sydney peppermint (*Eucalyptus piperita*) frequent in the east. A sparse layer of tall casuarinas (*Allocasuarina littoralis/Allocasuarina torulosa*) is often present just beneath the height of the eucalypts. Beneath these trees is a sparse sclerophyllous shrub layer that includes many species common in sandstone environments.

Figure A-4. Sydney Hinterland Apple-Blackbutt Gully Forest at Cedar Street Reserve

Seagrass Meadows

Seagrass Meadows are marine vegetation in estuaries and lagoons. Seagrass meadows here cover four separate genera, each of which may dominate individual patches at discrete locations. The most widespread are eelgrass species in the family Zosteraceae. *Zostera capricorni* is most common. In the Georges River for example, eelgrass is extensive around Towra Point and the lower reaches of the river, although it is found some distance from the coast on Cabramatta Creek. Seagrass (*Posidonia australis*) is the largest of the seagrasses in the study area and has a more restricted distribution. It prefers the lower reaches of river systems where there is large tidal exchange (West et al. 1985). It was once common in Botany Bay but the original cover is smaller in area since the exposure to wave action has been increased following dredging (Watford and Williams 1998). Sea wracks (*Halophila spp.)* are less common again and have been recorded growing in combination with eelgrass at Towra Point and in Penrhyn Bay. A closely related group of species are the seatassels (*Ruppia spp.)* which are not associated with sea water but are recorded in lagoons and lakes that are occasionally inundated by salt water.

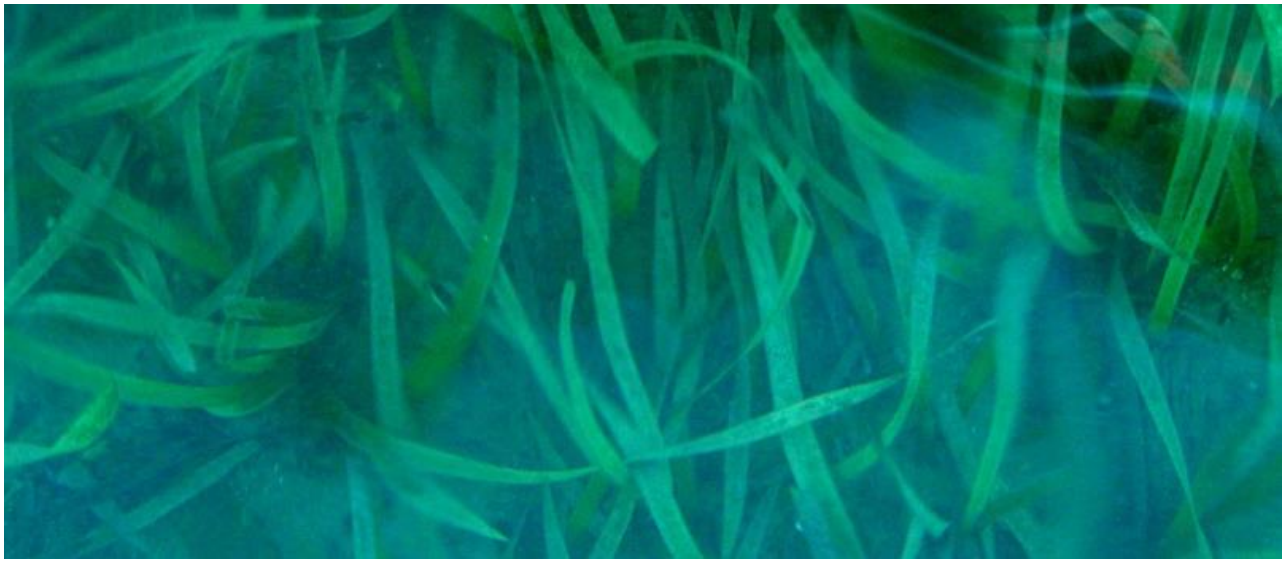

Figure A-5. Seagrass Meadows (OEH 2016)

Coastal Shale-Sandstone Forest

Coastal Shale-Sandstone Forest is often a tall open eucalypt forest with a sparse layer of dry sclerophyllous shrubs and a grassy ground cover. It occurs on clay-influenced soils associated with residual shale or lateritic capping, shale bands in the sandstone bedrock or downslope shale wash on exposed sandstone slopes. The eucalypts that occur consistently are tall red bloodwood (*Corymbia gummifera*) and smooth-barked apple (*Angophora costata*), but it is the local abundance of blackbutt (Eucalyptus pilularis), turpentine (*Syncarpia glomulifera*) and mahogany (*Eucalyptus resinifera, E. umbra*) that make the forest distinctive from the surrounding sandstone woodlands. A tall sparse layer of casuarinas (*Allocasuarina littoralis*) is found above an open layer of dry shrubs including banksias, wattles, hakeas and geebungs. A diverse combination of grasses, rushes and herbs provide a continuous ground cover. In some areas the forest may form a low open woodland comprising smooth-barked apple, brown stringybark (*Eucalyptus capitellata*) and scribbly gum (*Eucalyptus racemosa*) amongst other species. A thin layer of clay soil is sufficient to retain the grassy ground covers that help to distinguish the community. Some stands of this forest have been described as a variant of Duffys Forest Ecological Community, an Endangered Ecological Community under the NSW TSC Act. Coastal Shale-Sandstone Forest is found in areas that receive an average of more than 900 millimeteres of rainfall per annum and are between two and 372 metres above sea level.

Figure A-6. Coastal Shale-Sandstone Forest at Oatley Point Reserve

Sydney Turpentine-Ironbark Forest

Sydney Turpentine-Ironbark Forest is a tall open forest found on shale and shale-enriched sandstone soils on the coast and hinterland of Sydney. It has been extensively cleared but was once widely distributed between Sutherland and the Hornsby plateau with outlying examples found on shale-rich deposits at Campbelltown, Menai, Kurrajong and Heathcote. The primary distribution of this forest is in areas receiving between 900 and 1250 millimetres of mean annual rainfall at elevations between 10 and 180 metres above sea level.

The forest is characterised by open midstrata of mesic and sclerophyllous shrubs and small trees with a grassy ground cover. The composition of the canopy is variable depending on location and substrate. Typically it is recognised by a canopy dominated by turpentine (*Syncarpia glomulifera*), red mahogany (*Eucalyptus resinifera*) and various ironbarks of which Grey Ironbark (*Eucalyptus paniculata*) is most often recorded. On the north shore these forests are found on shale-enriched sheltered sandstone slopes where ironbarks are less common and blackbutt (*Eucalyptus pilularis*) is prevalent. In the western suburbs drier forms of this forest are found at Concord, Bankstown and Auburn although remnants are small and highly disturbed.

Sydney Turpentine-Ironbark Forest is a component of the TEC ‘Sydney Turpentine Ironbark Forest’ which is critically endangered under the BC Act and EPBC Act.

Figure A-7. Sydney Turpentine-Ironbark Forest at Poulton Park

Estuarine Swamp Oak Forest

In the zonation from mangroves to terrestrial sclerophyll and mesophyll forests and woodlands, Estuarine Swamp Oak Forest occurs immediately above tidal influence. It fringes the margins of saline waterbodies that include rivers, lagoons and tidal lakes. Swamp oak (*Casuarina glauca*) forms dense monospecific stands above a thick ground cover of salt tolerant herbs, rushes and sedges. The shrub layer is low-growing and sparse, comprising a mix of terrestrial species while others typical of wetlands. It is a community of relatively low species diversity.

Estuarine Swamp Oak Forest is widespread along the coast of the Sydney basin where it is rarely found at more than two meters above sea level.

Estuarine Swamp Oak Forest is a component of the following TECs:

- Swamp Oak Floodplain Forest – Endangered under the BC Act
- Coastal Swamp Oak (*Casuarina glauca*) Forest – Endangered under the EPBC Act.

Figure A-8. Estuarine Swamp Oak Forest at Riverwood Park

Coastal Enriched Sandstone Moist Forest

Coastal Enriched Sandstone Moist Forest is a tall open eucalypt forest with a distinctive mesic shrub and small tree layer. The canopy may be dominated by various combinations of eucalypts although smooth-barked apple (*Angophora costata*) is invariably present. On the north shore and inner harbours turpentine (*Syncarpia glomulifera*), blackbutt (*Eucalyptus pilularis*) and Sydney blue gum (*Eucalyptus saligna*) are dominant trees while on the Warringah and Pittwater escarpments bangalay (*Eucalyptus botryoides*) and mahoganies (*Eucalyptus umbra/scias*) are more prevalent.

Elsewhere, Sydney peppermint (*Eucalyptus piperita*) may dominate. A tall stand of forest oak (*Allocasuarina torulosa*) is often present below the eucalypt canopy. Tall small trees tend to be rainforest plants such as coachwood (*Ceratopetalum apetalum*), blueberry ash (*Elaeocarpus reticulatus*) and occasionally cabbage tree palms (*Livistona australis*). The forest floor is covered by a sparse to dense cover of ferns and twiners.

Figure A-9. Coastal Enriched Sandstone Moist Forest at H.V. Evatt Park

Sydney Foreshores Shale Forest

Sydney Foreshores Shale Forest is found on localised patches of shale-enriched sandstone which occur on crests and slopes of minor sandstone scarps adjoining the coastal waterways of Sydney. It is a tall open eucalypt forest with a sparse shrub layer and a dense cover of graminoids (grasses, rushes and sedges). The canopy generally includes grey gum (*Eucalyptus punctata*) and smooth-barked apple (*Angophora costata*) while forest red gum (*Eucalyptus tereticornis*) may dominate locally. Often the shrub and small tree layer is only a sparse cover of wattles or casuarinas. In contrast the ground cover is characterised by dense clumps of spiny-headed mat-rush (*Lomandra longifolia*) above a low cover of other grasses and herbs.

Sydney Foreshores Shale Forest is restricted to the Sydney region where it occurs at elevations between six and 20 metres above sea level and where mean annual rainfall exceeds 1100 millimetres. Patches are small and discontinuous, often surrounded by sandstone forests and woodlands.

Figure A-10. Sydney Foreshores Shale Forest (OEH 2016)

Coastal Sandstone Foreshores Forest

Coastal Sandstone Foreshores Forest is found on sheltered sandstone slopes along the foreshores of Sydney's major waterways and coastal escarpments. It is an open forest with a moist shrub layer and a ground cover of ferns, rushes and grasses. The flora of this community has a maritime influence given its exposure to prevailing sea breezes. The canopy can be dominated by pure stands of smooth-barked apple (*Angophora costata*), though more regularly this is found in combination with other tree species. Localised patches of bangalay (*Eucalyptus botryoides*) and coast banksia (*Banksia integrifolia*) occur closest to the coast, whereas Sydney peppermint (*Eucalyptus piperita*) and blackbutt (*Eucalyptus pilularis*) prefer more protected locations and in the case of the latter some minor shale enrichment in the soil. A prominent layer of hardy mesic small trees and shrubs is present. These include sweet pittosporum (*Pittosporum undulatum*), cheese tree (*Glochidion ferdinandi*) and blueberry ash (*Elaeocarpus reticulatus*). In the suburban environment the proliferation of these species in the understorey at long unburnt sites has generated considerable debate, particularly as there appears to be strong correlation between time since fire and their density. It is also appears that these species are more common in these littoral zones than in other sheltered sandstone forests situated further away from the coast.

Figure A-11. Coastal Sandstone Foreshores Forest at Ray Street Reserve

Riverflat Paperbark Swamp Forest

This community is found on low-lying alluvial flats of the Hawkesbury-Nepean, Parramatta and Georges river systems. Only small stands remain in Sydney, with more extensive areas situated near the Hawkesbury River. It is an open to closed forest of tall paperbarks (Me*laleuca linariifolia/Melaleuca styphelioides*). The paperbarks are joined by a range of hardy mesic small trees such as black wattle (*Callicoma serratifolia*), cheese tree (*Glochidion ferdinandi*) and grey myrtle (*Backhousia myrtifolia*). A sparse cover of emergent eucalypts is common though not ubiquitous. Sample sites near Holsworthy contain bangalay (*Eucalyptus botryoides*) though more commonly it is the closely related swamp mahogany (*Eucalyptus robusta*) that occurs, sometimes with cabbage gum (*Eucalyptus amplifolia*). Light is mostly excluded from the forest floor and as result there is only a sparse cover of sedges, ferns and grasses. Local swampy depressions may favour sedge species over grasses and ferns.

This riverflat forest is most frequently found near backswamps in the narrow headwaters and inlets of alluvial flats not far from major waterways. Most remnants are situated at the interface with sandstone escarpments and as a result species typical of the surrounding community may be included. This community is restricted to the Sydney region where it extends from the rim of the Cumberland Plain near Kurrajong to the coast. It is known from a narrow elevational gradient between three and 50 metres above sea level. Remnant patches are small and isolated.

This community is a component of the TEC ‘River Flat Eucalypt Forest’ which is vulnerable under the BC Act.

Figure A-12. Riverflat Paperbark Swamp Forest (OEH 2016)

Coastal Saltmarsh

Saltmarshes consist of low succulent herbs and rushes on tidally inundated land. These marshes form plains that adjoin open water and mangroves. Throughout the marsh salinity varies greatly according to tidal influence, evaporation and fresh water accumulation. Some of the areas are flooded regularly, while at slightly higher elevations flooding is rare.

After rain fresh water accumulates and adds extra water to the marsh, leaving pools of standing water when the tide recedes. Chenopod species dominate areas more frequently inundated by the tides, while sea rush (*Juncus kraussii*) occupies the more elevated terrestrial margin. Local scalds occur in small depressions where intensely saline deposits accumulate from the evaporation of tidal waters preventing the growth of any plants at all.

Like many estuarine vegetation communities, large areas have been reclaimed for industrial, recreational and urban land use. Many examples that remain in Sydney are small in size, highly fragmented and patchy in distribution. Historical photographs taken in 1943 across much of the Sydney area clearly indicates that some former saltmarshes and mud flats are now colonised by dense stands of mangroves. This is particularly visible along the Georges and Parramatta rivers.

Coastal Saltmarsh is a component of the following TECs:

- Coastal Saltmarsh – Endangered under the BC Act
- Subtropical and Temperate Coastal Saltmarsh – Vulnerable under the EPBC Act.

Figure A-13. Coastal Saltmarsh at Riverwood Park

Coastal Sandstone Riparian Forest

Narrow sandstone gorges and minor creek lines of the sandstone plateaus carry a sandstone gully forest containing a suite of riparian and rainforest species. Often only narrow in width, this forest is dominated by smooth-barked apple (*Angophora costata*) and Sydney peppermint (*Eucalyptus piperita*). The small tree layer tends to feature a mix of species common to riparian scrubs and hardy rainforest communities. This includes low-growing coachwood (*Ceratopetalum apetalum*), water gum (*Tristaniopsis laurina*) and tea-tree (*Leptospermum* spp.). Also present is river lomatia (*Lomatia myricoides*). The ground is invariably rocky and covered in small-leaved ferns such as umbrella fern (*Sticherus flabellatus*) and coral fern (*Gleichenia* spp.).

This forest is widespread along the gully lines of the major sandstone plateaus, although very restricted in extent. Often this community forms a mosaic with other riparian vegetation. It extends across other sandstone plateaus north of the Hawkesbury River.

Figure A-14. Coastal Sandstone Riparian Forest at Oatley Park

Estuarine Reedland

Estuarine Reedland is characterised by tall dense swards of the common reed (*Phragmites australis*). It is found in environments inundated by saline or brackish water. These include low-lying swamps on riverbanks, riverflat depressions, and banks on coastal lagoons that are open to tidal influence. This community is commonly encountered on the landward side of saltmarsh flats. Several salt-tolerant species are shared with saltmarshes including sea rush (*Juncus kraussii*), bare twig-rush (*Baumea juncea*) and the small herb creeping brookweed (*Samolus repens*).

In the Sydney metropolitan area this community is patchily distributed along lagoon fringes and riverflats of the Georges, Parramatta and Hacking rivers and in major brackish lagoons such as the Narrabeen Lakes. The common reed can be a vigorous recolonising species in disturbed environments. Estuarine Reedland is common and widespread along estuarine environments of the New South Wales coastline.

Estuarine Swamp Oak Forest is a component of the following TECs:

- Swamp Oak Floodplain Forest – Endangered under the BC Act
- Coastal Swamp Oak (*Casuarina glauca*) Forest – Endangered under the EPBC Act.

Figure A-15. Estuarine Reedland (OEH 2016)

Coastal Freshwater Wetland

Coastal Freshwater Wetland is associated with freshwater lagoons and swamps on alluvial flats and sand depressions across the New South Wales east coast. Lagoons have fluctuating levels of standing water that gives rise to a varied assemblage of species. They include a range of sedges, rushes and aquatic herbs with woody shrubs and small trees found only on the margins of the wetlands in low abundance. Tall reedlands (reaching over three metres in height) may dominate individual wetlands. Cumbungi (*Typha orientalis*) is typically dominant in urban wetlands and may be joined by common reed (*Phragmites australis*). Other tall reeds include *Eleocharis sphacelata* and tall sedges such as twig-rushes (*Baumea spp*.). The margins of open water carry a range of aquatic herbs such as *Isachne gibbosa* and *Persicaria decipiens*. Less frequently inundated wetlands support only a few species of sedges or rushes such as *Carex appressa* and or *Baumea spp.* which do not reach the height of the taller reedlands found elsewhere.

In the Sydney metropolitan area Coastal Freshwater Wetland is most commonly found at low elevations less than five metres above sea level on coastal plains and flats. Several swamps occur on highly disturbed floodplains of the Cumberland Plain where elevations reach 20 metres above sea level. Many of the remaining swamps are situated amongst intensely developed urban landuses. In these environments drainage patterns have been altered and weeds may be prolific.

This community is a component of the TEC ‘Freshwater Wetlands on Coastal Floodplains’ which is endangered under the BC Act.

Figure A-16. Coastal Freshwater Wetland at Lime Kiln Bay

Coastal Escarpment Littoral Rainforest

Coastal Escarpment Littoral Rainforest is found on protected escarpment slopes and gullies along the New South Wales coast. It prefers clay soils that derive either from shale layers in sandstone bedrock or from down-slope enrichment from shale capping above. Unlike other rainforests in the Sydney area it can occur some distance from the sea in protected situations at the foot slopes of major scarps or in deep, protected harbour gullies. Inland sites are all exposed to maritime influences arising from low-lying harbour-side positions or from strong sea breezes that blow across the coastal plain.

Depending on the degree of exposure the rainforest canopy may be tall or wind-sheared and at some sites may have a sparse cover of emergent eucalypts. The floristic composition of this rainforest reflects both littoral and warm temperate influences. Lilly pilly (*Acmena smithii*), cabbage tree palm (*Livistona australis*), sweet pittosporum (*Pittosporum undulatum*), scentless rosewood (*Synoum glandulosum*) and cheese tree (*Glochidion ferdinandi*) are the most frequently recorded trees although a wide variety of other rainforest species are encountered less consistently.

Coastal Escarpment Littoral Rainforest is a component of the following TECs:

- Littoral Rainforest – Endangered under the BC Act
- Littoral Rainforest and Coastal Vine Thickets – Critically endangered under the EPBC Act.

Figure A-17. Coastal Escarpment Littoral Rainforest at H.V. Evatt Park