Regional Detention Basin C and Regional Detention Basin V6

Species Impact Statement

Lendlease

22 November 2019

Final

(02) 9868 1933 | PO Box 2474 Carlingford Court NSW 2118 | cumberlandecology.com.au

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Report No. 17209RP2

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or commendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	21/11/2019	VO/TM	Draft issued to client
2	22/11/2019	VO	Final issued to client

Approved by:	Vanessa Orsborn
Position:	Senior Project Manager/Ecologist
Signed:	
Date:	22 November, 2019

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table of Contents

Glossary vii

Executive Summary ix

1. Introduction 1

1.1. Purpose 1
1.2. Approvals and Licences 2
1.3. CER Matters Which Have Been Limited or Modified 4

2. Contextual Information 6

2.1. Background 6
2.2. Description of the Proposal 11
2.3. Land Tenure Information 14
2.4. Vegetation 14
2.5. Plans and Maps 22

3. Initial Assessment 24

3.1. Endangered and Critically Endangered Ecological Communities 24
3.2. Threatened Species and Populations Records 24

4. Survey 47

4.1. Survey Background 47
4.2. Survey Methods 48
4.3. Survey Results 56
4.4. Habitat Corridors 79
4.5. Determining Affected C/EECs/Species 79

5. Impact Assessment 83

5.1. Assessment of Likely Impacts 83
5.2. Assessment of Critically Endangered and Endangered Ecological Communities and Species Likely to be Affected 84
5.3. Description of Habitat 86
5.4. Past Disturbance History of the Study Area 92
5.5. Description of Conservation Status 93
5.6. Discussion of Likely Effects of the Proposed Development 94
5.7. Description of Feasible Alternatives 101

6. Consistency of the Proposal with the Objectives of the Cumberland Plain Recovery Plan 103

6.1. Introduction 103
6.2. Species, Populations and Ecological Communities 103
6.3. Compliance of the Proposed Development with the Objectives and Actions of the Final Recovery Plan for the Cumberland Plain 106
6.4. Application of Recovery Plan to Proposal 111

7. Ameliorative Measures 113

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

7.1. Introduction 113
7.2. Long Term Management Strategies 114
7.3. Compensatory Measures 116
7.4. Monitoring 119
8. Assessments of Significance 121
8.1. Critically Endangered/Endangered Ecological Communities 121
8.2. Fauna 129
9. Additional Information 139
9.1. Qualifications and Experience 139
10. Conclusion 140
11. References 141

Table of Tables

Table 1 : Vegetation Present in the Study Area and Removed from the Subject Site xvi
Table 2 : Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence 26
Table 3 : Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence 31
Table 4 : Dates of Field Surveys 49
Table 5 : Modified Braun-Blanquet scores used in Quadrat surveys 51
Table 6 : Fauna Survey Methods and Effort 51
Table 7 : Tree Hollow Size Class 54
Table 8 : Summary of Weather Conditions during 2011 and 2019 survey period 55
Table 9 : Population estimates for *Pultenaea parviflora* and *Grevillea juniperina* subsp. *juniperina* within the St Marys Regional Park 69
Table 10 : Bat Survey Results 74
Table 11 : Bat survey definitions 74
Table 12 : Result summary of Kruskal-Wallis statistical analyses indicating significant differences in numbers of snails between Areas A, B and C 78
Table 13 : Significance results of post-hoc analyses (Mann-Whitney U tests) 78
Table 14. Comparative areas of Vegetation Communities to be removed from the subject site and conserved within the Regional Park 86
Table 15 : Threatened Biodiversity addressed in the Recovery Plan 103
Table 16 : Threatened Biodiversity identified in the Recovery Plan that have been addressed in this SIS 110
Table 17 : CER Compliance table A.3
Table 18 : History of survey effort on the SMDS relevant to the Western Precinct B.31
Table 19 : Detailed Methods and Records of Survey for Threatened Flora species on the SMDS B.37
Table 20 : Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS B.79
Table 21 : Flora species recorded in the Study Area C.94
Table 22 : Flora Species Recorded on the Subject Site C.103

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 23 : Fauna species recorded within the Study Area C.105
Table 24 : Snail survey records for the Study Area - CE 2011 ..... D.114
Table 25 : Habitat Assessment results in the Study Area D.115
Table 26 : Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity D.117
Table 27 : Statistical comparison of Cumberland Plain Land Snail numbers between different sections of the Study Area D.120
Table 28 : Compliance with Cumberland Plain Recovery Plan E.124

Table of Photographs

Photograph 1 : Aerial photograph of St Marys Development Site, 1947 7
Photograph 2 : Aerial photograph of St Marys Development Site, 1955 7
Photograph 3 : Aerial photograph of St Marys Development Site, 1965 8
Photograph 4 : Aerial photograph of St Marys Development Site, 1978 8
Photograph 5 : Mature CPW in the Regional Park 58
Photograph 6 : Regenerating CPW on the subject site 59
Photograph 7 : Intact Derived Native Grassland in the south western part of the study area 61
Photograph 8 : Low diversity Derived Native Grassland in the drainage land to the south of the study area 61
Photograph 9 : River-flat Eucalypt Forest in the study area 63
Photograph 10 : Wetland dam vegetation in Regional Park to the south of the Western Precinct 65

Table of Graphs

Graph 1 : Comparison of exotic and native plant composition in the development areas of the study area (Area A), regenerating Regional Park woodland (Area B) and mature Regional Park woodland (Area C) 66
Graph 2 : Comparative abundance of Cumberland Plain Land Snail within the degraded development zoned land, including the subject site (Area A), regenerating Regional Park woodland (Area B) and Mature Regional Park woodland (Area C). 78

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table of Appendices

APPENDIX A : Chief Executives Requirements
APPENDIX B : Survey Effort
APPENDIX C : Flora and Fauna Species Lists
APPENDIX D : Flora and Fauna Data Analysis
APPENDIX E : Actions Prescribed by the Final Recovery Plan for the Cumberland Plain
APPENDIX F : Staff CVs

Table of Figures

Figure 1 : Aerial Photograph of the St Marys Property
Figure 2 : Zoning of the St Marys Development Site (SREP 30 Amendment 2)
Figure 3 : Plan of the subject site identifying the Proposal
Figure 4 : Aerial view of the subject site and study area
Figure 5 : Vegetation Communities in the Locality (OEH, 2013)
Figure 6 : Topography of the Locality identifying land uses
Figure 7 : Aerial Photograph of the locality identifying areas of native vegetation
Figure 8 : OEH Threatened Flora records within the Locality
Figure 9 : OEH Threatened Fauna records within the Locality
Figure 10 : Flora survey locations
Figure 11 : Fauna survey locations
Figure 12 : Comparison of exotic and native plant composition in the development areas of the study area (Area A), regenerating Regional Park woodland (Area B) and mature Regional Park woodland (Area C)
Figure 13 : Comparative abundance of Cumberland Plain Land Snail within the degraded development zoned land, including the subject site (Area A), regenerating Regional Park woodland (Area B) and Mature Regional Park woodland (Area C).
Figure 14 : Threatened Flora and Fauna recorded in the Study Area
Figure 15 : Vegetation of the Study Area

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Glossary

Abundance: means a quantification of the population of the species or community.

Affected C/EECs/species: means subject species, populations and communities likely to be affected by the approved components of the project.

CEEC: Critically Endangered Ecological Community

Western Precinct: encompassing the land identified as such in **Figure 2.**

Chief Executive: the Environment agency head is the Chief Executive of the Office of Environment and Heritage

CER's: Chief Executives Requirements

Conservation status: is an indicator of how likely a species or community is to remain alive at present or in the near future. Many factors are used to assess a species' conservation status, including: the number remaining, the overall increase or decrease in the population over time, breeding success rates and known threats.

Development: as defined in the EP&A Act means:

- the use of land, and
- the subdivision of land, and
- the erection of a building, and
- the carrying out of a work, and
- the demolition of a building or work, and
- any other matter or thing referred to in section 26 that is controlled by an environmental planning instrument, but does not include any development of a class or description prescribed by the regulations for the purposes of this definition.

DPIE: the Department of Planning, Industry and Environment

EEC: Endangered Ecological Community

EES: Environment, Energy and Science Group (formerly OEH), part of the Department of Planning, Industry and Environment

Jordan Springs: The suburb of Jordan Springs, also referred to as the Western Precinct

LGA: Local Government Area;

Locality: means the area within a 10km^2 radius of the centre of the subject site.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

OEH: means the former NSW Office of Environment and Heritage (now the Environment, Energy and Science Group, part of the Department of Planning, Industry and Environment). The OEH is a division of the NSW Department of Planning and Environment

Proposed Development: is the development, activity or action proposed.

Region: as defined in the TSC Act, means for the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the Chief Executive under subsection (4)) to be appropriate for those purposes. In this case, the Bioregion refers to the Sydney Basin Bioregion.

SEAR's: means Secretary's Environmental Assessment Requirements for the preparation of an Environmental Impact Statement

Significant species: means species not listed in the TSC Act but considered to be of regional or local significance.

Study area: means the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly. For the purposes of this SIS, the study area includes proximate areas of the proposed St Marys Regional Park

Subject site: means the area encompassing the total development footprint of Regional Detention Basin C and Regional Detention Basin V6, including a proposed haul road between the basins, located within Lot 4 and Lot 5 in DP 1216994, as shown in Figure 1..

Subject species: means those threatened species that are known or considered likely to occur in the study area.

SEE: Statement of Environmental Effects

SREP 30: Sydney Regional Environment Plan 30, Amendment No. 2, as shown in **Figure 2**;

State Deed: The St Marys State Development Agreement

St Marys EPS: St Marys Environmental Planning Strategy 2000;

St Marys Development Site (SMDS): encompassing land marked in Figures 1 and 2. Also referred to the St Marys Development Site;

Wianamatta Regional Park: The name of the St Marys Regional Park ('Regional Park'), following the transfer of ownership to EES, National Parks and Wildlife Division, on completion of development of the SMDS.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Executive Summary

S1 PURPOSE

This document is a Species Impact Statement (SIS) that has been prepared to assess the impacts of the construction of Regional Detention Basins C and V6, Ninth Avenue, Llandillo (Lot 4 and Lot 5 in DP 1216994), within the St Marys Development Site(SMDS) in western Sydney (referred to as the 'subject site').

The development of the subject site will include construction of two drainage detention basins to address runoff and flooding issues from the adjoining residential areas of Jordan Springs. This includes Village 3 and Village 6, and all associated ancillary works, including battering for the basin, and creation of a temporary access track for construction and future maintenance tracks for each basin.

The main objectives of the SIS are to:

- Identify threatened species issues and identify and provide appropriate amelioration strategies to minimise adverse impacts resulting from the proposal;
- Assist consent and determining authorities in the assessment of the development applications under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- Assist the Secretary of the Department of Planning, Industry and Environment (DPIE) to assess the impacts of the Proposal on Biodiversity, as outlined in the SEARs;
- Assist the Executive Director of the Environment, Energy and Science group (EES) in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- Assist the Executive Director of the EES when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and
- Assist the Executive Director of the EES in the assessment of Section 91 License applications lodged under the *Threatened Species Conservation Act 1995* - repealed (TSC Act).

The NSW *Threatened Species Conservation Act 1995* (TSC Act) was repealed and replaced by the NSW Biodiversity Conservation Act 2016 (BC Act) on 25 August 2017; however, the associated *Biodiversity Conservation (Savings and Transitional) Regulation 2017 includes* a transitional period which allows DAs within the Penrith Local Government Area (LGA) to be assessed under the TSC Act for an additional fifteen months from 25 August 2017, and then a further 12 months from 25 November 2018. A DA for the subject site is expected to be submitted prior to 25 November 2019. Therefore, assessment of all ecological matters required under NSW legislation is assumed to be conducted under the TSC Act.

All listings for threatened species, populations and ecological communities have been legally transferred to the BC Act, however, for consistency, and to comply with the Chief Executives Requirements (CERs) issued for the preparation of this SIS, the TSC Act listings are referred to hereafter.

As described in the Precinct Plan for the Western Precinct (JBA 2009) approval under Commonwealth environmental law was granted to the development of the SMDS (in accordance with the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30)) under the *Environment Protection (Impact of Proposals) Act*

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

1974 (EPIP Act) prior to the gazettal of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Clarification of all related actions necessary for the carrying out of the approved development was thereafter granted by the Commonwealth under the *Environmental Reform (Consequential Provisions) Act 1999* (ERCP Act). As such, following the commencement of the EPBC Act, the Commonwealth confirmed that the EPIP Act approval and ERCP Act certification completed the Commonwealth environmental assessment and held that "***no further approvals***" [our emphasis] were required provided development was consistent with the established planning framework provided by the SREP 30. This SIS therefore does not address species, populations and communities listed under the EPBC Act, except where those species of relevance that are also listed under the TSC Act.

This SIS is a detailed assessment of the proposed works within Lot 4 and Lot 5 in DP 1216994 of the SMDS, located adjoining the Regional Park (to be referred to as Wianamatta Regional Park, when it is transferred to National Parks and Wildlife Services Division of EES). However, it also assesses the impacts of development of the Western Precinct (referred to as the suburb of Jordan Springs) as the drainage works directly relate to the cumulative impacts of development on the SMDS, as detailed in the approved Precinct Plan. It contains specific assessment of threatened species, populations and ecological communities listed in the schedules of the TSC Act - repealed.

S2 BACKGROUND

The former Australian Defence Industries (ADI) site at St Marys was endorsed by the NSW Government for inclusion on the Urban Development Program (UDP) in 1993. The site presented an opportunity to provide housing for Sydney's growing population within an environmentally sustainable framework.

Given that the site straddles the boundary between two Local Government Areas (Blacktown and Penrith) the NSW Government decided that a regional environmental plan should be prepared for the site. Technical investigations into the environmental values and development capability of the land commenced in 1994, and the Regional Environmental Plan for St Marys (SREP 30) was gazetted in January, 2001. The SREP 30 zoned the land into "urban", "employment", "regional open space", and "Regional Park" uses (Refer to **Figure 2**).

In view of the original scale of the residential and employment uses, a package of documents was prepared to guide and control development. These comprised SREP 30 (maps and written instrument) (DUAP 2001b), and an Environmental Planning Strategy (EPS) (DUAP 2001a) which set out performance objectives and strategies to address key aspects associated with the site, including: conservation, cultural heritage, water and soils, transport, urban form, energy and waste, human services, employment, and land contamination.

In addition, a State Development Agreement (State Deed) was entered into between the landowner and developers of the land (a Joint Venture comprising ComLand and Lendlease Development), and the NSW Government. The State Deed specifies a series of obligations to be provided during development of the SMDS. These obligations include, amongst other things, the following relevant contributions:

- the staged transfer and dedication of 900ha of land to the National Parks and Wildlife Division of the Environment, Energy and Science group (EES) (NPWS) as a Regional Park for the sum of $3 (three dollars);
- staged monetary contributions (c$6m) towards capital improvements within the 900ha Regional Park;
- monetary contributions towards a Plan of Management for the 900ha Regional Park; and
- the erection of stock proof fencing in stages along the boundaries of the 900ha Regional Park.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The State Deed was executed in December 2002. It provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader framework for the facilitation of future development of SMDS on an agreed basis.

Under SREP 30 development areas are referred to as "precincts" and the SMDS is subdivided into Eastern Precinct, Ropes Creek Precinct, Central Precinct, Western Precinct, Dunheved Precinct and Regional Park, Regional Open Space, Drainage Land and Roads. A Precinct Plan was prepared for each development precinct.

To date the Precinct Plans for the Eastern Precinct, Ropes Creek Precinct, Dunheved Precincts, Central Precinct, Western Precinct have been prepared, exhibited and adopted by the relevant Councils and development is being progressed on a staged basis. As a result, the SMDS is one of the largest single Greenfield Release Areas in the Metropolitan Development Program and critical to the delivery of housing for metropolitan Sydney.

A Precinct Plan was prepared for the Western Precinct and was approved by Penrith City Council in 2009. The Precinct Plan contained assessments of biodiversity, a plan for the management of weeds, and a strategy for management of domestic and feral animals. The Biodiversity Assessment for the Western Precinct predicted that development of the Precinct was not likely to have a significant negative impact upon threatened flora and fauna within the SMDS in the long-term due to the major conservation outcome provided by the creation of the 900ha Regional Park in the SMDS.

The development applications for Stage 1 of the Western Precinct development, referred to as the suburb of Jordan Springs, were submitted to Penrith City Council by Lendlease Pty Ltd in August 2009. Subsequent DAs for Stages 2, 3A and 3B were submitted by Lendlease in May 2011, for Stage 4 in August 2012, Stage 3C1 in June 2013, Stage 3C2 in August 2013, Village Centre Site 12 in February 2014, Stage 3C3 in April 2014 and Village 5 in July 2014. All applications were in accordance with the Precinct Plan and the broader statutory framework provided by the SREP 30, EPS and the State Deed.

As part of the Council's and the Joint Regional Planning Panel's consideration of the Central and Western Precinct development applications, further clarification has been sought on the assessment of Cumberland Plain Woodland (CPW) since its listing as a Critically Endangered Ecologically Community (CEEC) under the TSC Act (NSW Scientific Committee 2009). Cumberland Plains Woodland is also listed as a Critically Endangered Ecological Community under the EPBC Act (as Cumberland Plain Woodland and Shale Gravel Transition Forest).

The vegetation present in the subject site consists of a mix of mature CPW woodland, young, CPW woodland in various stages of regeneration. Although the development of the subject site will further fragment representatives of the CPW community from the Regional Park and will remove an area of CEEC, the removal of the small area of CPW (and other ecological communities) proposed, is not considered to constitute a significant impact within the meaning of Section 5A of the EP&A Act (7 Part Test). A large area of high quality CPW will still be conserved in the Regional Park, regardless of the previously approved and proposed DAs.

However, on a precautionary basis, it has been agreed with Council that all DAs for the Western Precinct/Jordan Springs development area, that will involve the removal of TSC Act listed species and communities, will be accompanied by a SIS. As Regional Basins C and V6 represents ancillary works relating to the development of the Western Precinct, the current proposal contributes to the cumulative impacts of the development as a whole. Although the collective impacts of the proposed DAs for the development of the subject site are not generally considered to be significant, a SIS has nonetheless been prepared.

S3 PROPOSAL

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6; the Jordan Springs development. The basins are located within the north-western extent of the SMDS and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m. Basin V6 will have a surface area of approximately 0.3 hectares and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access. A proposed haul route will be used during construction, which follows the existing unsealed track, which may require minor temporary upgrade works, to a total width of no more than 10m.

The location of the subject site and associated drainage works for Regional Basins C and V6 are mapped in the SIS (refer to **Figure 3**) and will be set out in detail in the relevant Environmental Impact Statement (EIS).

S4 VEGETATION OF THE STUDY AREA

Historically, the Western Precinct was used for ammunition storage bunkers and large numbers of concrete bunkers existed across the area until the 1990s. The Western Precinct was intensively mown and heavily grazed by kangaroos (Eastern Grey Kangaroo and Red Kangaroo) while it was used as a Defence site. However, with a change of ownership the storage bunkers were removed and mowing has been reduced to areas of the perimeter of the Regional Park and the boundaries of the SMDS. Under the provisions of SREP 30 the kangaroos have been subject to management and progressively reduced in numbers via implementation of a Macrofauna Management Plan (Cumberland Ecology 2004b). These land management changes since the late 1990s have allowed for regeneration of CPW across various parts of the SMDS. Whereas large areas were mown and heavily grazed and open in the early 1990s, there has been a greater level of regeneration in recent times: by way of example, within the Regional Park there are broad areas of young sapling regrowth of CPW trees and shrubs, creating additional habitat on site for various plants and animals. Such regrowth of habitat has only occurred due to land management practices prescribed and implemented by the proponent since the gazettal of SREP 30.

Consequently, the vegetation of the study area can now be separated into various sub-units of the following vegetation types:

Cumberland Plain Woodland

The vegetation of the Western Precinct contains Cumberland Plain Woodland (CPW) and grassland derived from the clearing of CPW ("derived native grassland"). CPW in the study area occurs in various conditions / forms as described below:

Mature CPW

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The CPW in the central portions of the Regional Park (which have been included in the study area for the purposes of this SIS) generally contain mature CPW and other woodland types (Refer to **Figure 15**). Mature CPW contains a higher diversity of native species and is generally more structurally intact than the CPW within the rest of the Western Precinct. The mature areas of CPW contain a shrub layer, mostly of *Bursaria spinosa* (Blackthorn) and *Dillwynia sieberi* (Parrot-pea), characteristic species of CPW. A patch of mature CPW is present to the south east and to south-west of the proposed basin, and to the north and north west of the proposed access track. All patches of mature CPW are relatively large, and extend into the adjoining parts of the Regional Park.

Regenerating CPW

The CPW present in the Western Precinct is a regenerating form of the community, which is highly simplified compared with the regeneration taking place in the Regional Park, possibly because of the historically higher levels of disturbance. There is a visually obvious and statistical difference between the condition (measured by abundance cover of exotic species in each stratum) and the diversity of species present in the CPW of the Western Precinct and that of the Regional Park. This includes woodland of a similar age of regeneration (the sampling area referred to as Area B in this SIS) as shown in the statistical analysis provided in **Section 4.3.2**. This observation is further supported by previous resilience assessment data collected by Ian Perkins in 1999 that resulted in modifications to the Regional Park boundary (as at the time of the surveys) to include Area B, which was historically cleared (prior to 1940) and maintained as open grassland with scattered mature trees through heavy kangaroo grazing and slashing until 2000 as with the land within the precinct limits. The regenerating CPW on the subject site is located at the western edge of the proposed basin and to the south of the access track, and continues further to the west and north within the Regional Park (Refer to **Figure 15**).

Derived Native Grassland

The open areas within the study area, including parts of the Regional Park, and the undeveloped portions of the Western Precinct, contains areas of grassland that have been derived from the clearing of CPW ("derived native grassland"). This grassland comprises a large zone dominated by exotic grasses (predominately *Axonopus fissifolius*) and few native herbs and shrubs. Smaller zones in the Regional Park are dominated by native grasses and the inclusion of a higher diversity of native herbs and shrubs. Although both forms of grassland are considered to be derived from the past clearing of CPW, the latter category is likely to have a higher resilience and is associated with the historically less disturbed portions of the SMDS. Within the subject site, grassland occurs as Low Diversity DNG in the northern parts of the proposed basin, and adjoining the existing access track, which is to be upgraded as part of the development.

Shale Gravel Transition Forest

As its name suggests, Shale Gravel Transition Forest (SGTF) is a transitional plant community which grades into CPW where the influence of gravel soil declines, and grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thicker. There is a natural continuum of soil in this spectrum, and it can be difficult to separate out these communities at the middle of the shale-gravel spectrum. In a new CEEC listing under the EPBC Act, a single community called *Cumberland Plain Woodland and Shale-gravel Transition Forest* is described.

The NSW Scientific Committee description for SGTF includes a slightly different species composition to CPW, based on the local presence of lateritic gravel in the soil (NSW Scientific Committee 2002c). The community is dominated by *Eucalyptus fibrosa* with *E. moluccana* also occurring less frequently. Shrub species are similar to

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

those found in CPW but more commonly include shrubs from the pea family, including threatened species such as Parrot pea, and has also been observed to contain high numbers of *Grevillea juniperina* subsp. *juniperina*.

Large areas of SGTF occur in the eastern portions of the SMDS, mostly to the east of the current study area extent. This community has been previously mapped (OEH, 2016) in the Regional Park, to the north of the Western Precinct.

River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) occurs in association with South Creek and Ropes Creek riparian corridors within the study area and on the subject site.

The vegetation in this community is patchy, with the eastern extent being more intact and exhibiting more of the indicative species of this community, while the western extent is more closely related to CPW. The canopy is mostly dominated by *Eucalyptus tereticornis* (Forest Red Gum) but also includes *Angophora floribunda* (Rough-barked Apple), *Casuarina glauca* (Swamp Oak) and *Eucalyptus amplifolia* (Cabbage Gum). In the more intact sections, a small tree layer occurs with *Melaleuca linariifolia* and *Acacia floribunda* being present. Within the subject site, degraded RFEF is present both sides of South Creek within the riparian corridor, and is heavily impacted by weeds.

Freshwater Wetlands

Small areas of Freshwater Wetland are present on the subject site as small depressions adjoining the riparian zone, with a low diversity of native and high abundance of exotic wetland species. A larger area of this habitat is present to the north west of the subject site, contained within the Regional Park.

S5 SUBJECT SITE, SUBJECT LAND AND AFFECTED FLORA AND FAUNA

For the purposes of this SIS, the land directly affected by the proposed development of Regional Drainage Basins C and V6, including the access track upgrade works, is defined as the "**subject site**" (refer to **Figure 3**).

The "**study area**" comprises the subject site, the subject land and adjacent areas that could be directly or indirectly impacted by the proposed development. This includes proximate areas of the Western Precinct and the Regional Park (Refer to **Figure 4**).

The "**locality**" is defined as the area within a 10km radius of the centre of the subject site, as determined by the CERs (refer to **Figure 5**).

This SIS evaluates subject flora and fauna, known or considered likely to occur in the locality ("subject C/EECs/species"), and then determines those which are most likely to be affected by the proposed development ("affected C/EECs/species"). Affected C/EECs/species means those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

The SIS distinguishes between "major" and "minor" affected C/EECs/species (this includes populations and communities). Major affected C/EECs/species are those that will definitely experience a measureable loss of habitat as a result of the proposed development. Minor affected C/EECs/species are those species that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, either directly or indirectly.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

S5.1 Major Affected C/EECs/species

In summary, the major affected C/EECs/species that are considered in detail in this SIS are:

- River-flat Eucalypt Forest;
- Cumberland Plain Woodland;
- Freshwater Wetlands; and
- Cumberland Plain Land Snail (*Meridolum corneovirens*).

All of these C/EECs/species occur on the subject site and will have habitat removed as a result of the development.

S5.2 Minor Affected C/EECs/species

The minor affected C/EECs/species include:

Endangered ecological communities

Shale Gravel Transition Forest EEC occurs in the study area but not within the subject site.

The minor affected EEC could experience very minor habitat loss or potential indirect impacts and is also considered in the following chapter.

Flora population

- *Marsdenia viridiflora* subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas: This species has been recorded in low numbers in the Regional Park and study area but has not been recorded on the subject site.

Flora species

- Grevillea juniperina subsp. juniperina;
- Pultenaea parviflora (Bush Pea); and
- *Pimelea spicata* (Spiked Rice-flower).

These flora species have been recorded in the study area, including several individuals located in close proximity to the subject site, but not from within the subject site.

Fauna species

Microbats: Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis)*, Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Bentwing Bat (*Miniopterus orianae oceanensis* (formerly *M. schreibersii oceanensis*)), Southern Myotis (*Myotis macropus*) and Greater Broad-nosed Bat (*Scoteanax rueppellii)*: These microbats have all been recorded on the SMDS, and mostly within the Regional Park. The habitats present on the subject site do not provide significant habitat for these species due to a lack of roosting habitat. However, they will experience a loss of foraging habitat to a relatively minor degree. For this reason, these microbats are considered to be minor affected C/EEC species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flying Fox: Grey-headed Flying-fox (*Pteropus poliocephalus*): As with the microbats, the subject site provides a relatively small area of foraging habitat for this species. No flying-fox camps are known to occur on or adjoining the study area.

Birds: Speckled Warbler (*Pyrrholaemus sagittata*), Varied Sittella (*Daphoenositta chrysoptera*), Diamond Firetail (*Emblema guttata*), Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), Hooded Robin (*Melanodryas cucullata*): These small woodland birds have been recorded on the SMDS and within the study area, although all within the Regional Park.

S6 IMPACTS OF THE PROPOSED DEVELOPMENT

The proposal will result in direct impacts, indirect impacts and will contribute to cumulative impacts of development of the Western Precinct as described below:

S6.1 Direct Impacts

S6.1.1 Vegetation communities

The proposed development will occur within a landscape that has been extensively altered since European settlement. The subject site is vegetated by River-flat Eucalypt Forest, Freshwater Wetlands and Low Diversity DNG, as shown in **Table S.1**. A conservative approach has been taken for this SIS and it is assumed that all vegetation within the subject site will be removed for the purposes of the proposed development.

Table 1 : Vegetation Present in the Study Area and Removed from the Subject Site

Vegetation Community	Present in the Study Area (ha)	Removed from the Subject Site (ha)
River-flat Eucalypt Forest (EEC)	113.05	0
Regenerating River-flat Eucalypt Forest (EEC)	14.22	0
Cumberland Plain Woodland (CEEC)	254.42	0.8
Regenerating Cumberland Plain Woodland (CEEC)	163.41	3.7
Low Diversity Derived Native Grassland (CEEC)	15.91	0
Freshwater Wetland (EEC)	2.20	0.00
Freshwater Wetland (Degraded)	0.33	03
Shale Gravel Transition Forest (EEC)	17.20	0.00
Regenerating Shale Gravel Transition Forest (EEC)	2.18	0.00
Weeds	0.05	0.00
Rural / Undetermined	117.63	0.00
Total	700.59	4.5

S6.2 Threatened species

The clearing of vegetation within the subject site will directly remove habitat for threatened species such as the Cumberland Plain Land Snail (*Meridolum corneovirens*). The Cumberland Plain Land Snail was recorded

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

within RFEF on the eastern bank of South Creek, within the eastern portion of the subject site during surveys. This species is likely to occur within the mature and regenerating RFEF and CPW patches within and adjoining the subject site. Several individuals are likely to be removed given that RFEF habitat is to be cleared. No other threatened flora or fauna species have been recorded within or immediately adjacent to the subject site. Some highly mobile fauna species, such as microbats, and some small woodland birds that are known from the study area may experience minor habitat loss. Notwithstanding this, none are expected to be impacted by the proposed DA. The subject site generally lacks important habitat features, such as hollow-bearing trees. This paucity of habitat features suggests that it would be unlikely for these species to be dependent on the habitats present. The Regional Park provides substantial habitat for these species.

Extensive mitigation measures will be implemented across the Western Precinct to minimise the impacts from development. Foremost amongst these is the 900 hectare Regional Park, which will conserve substantial habitat for all known species of threatened flora and fauna that have been recorded previously on the SMDS. Areas of CPW within the Regional Park, that are disturbed for minor access track upgrade works associated with the subject site will be rehabilitated following the construction of these works.

S6.3 Indirect Impacts

The subject site includes additional areas for works within the DA boundary. This includes areas for ancillary works and other disturbance such as battering. There is also the chance of indirect effects, such as the spread of weeds, to impact on native vegetation in this area.

The removal of the degraded edges of patches of RFEF, Freshwater Wetlands and CPW has the potential to indirectly impact on intact representatives of these communities through the increase of edge effects and weed invasion in the adjoining Regional Park. These indirect impacts also have the potential to affect the wetlands present in areas of the Regional Park adjacent to the subject site. However, such potential indirect impacts can be minimised through the implementation of comprehensive mitigation measures, as described in **Section 4.5** and detailed in the Western Precinct Biodiversity Assessment (Cumberland Ecology 2009).

Site specific mitigation measures for the protection of C/EEC vegetation should include the replanting of wetland vegetation post-construction, and species selection should be based on the list of species included in the community, and known to occur in the locality. Local provenance plants must be selected. Trees should be retained wherever practicable and the use of fertilisers avoided within the subject site, which adjoins the Regional Park. In combination with the comprehensive mitigation measures for the SMDS, it is considered that minimal indirect impacts are likely to occur as a result of the proposed development.

S6.4 Cumulative Impact of Development in the Western Precinct

The development of the subject site, for construction of two drainage detention basins, is required to address drainage requirements in relation to the Western Precinct development area, and ensure that water quality objectives are met and flooding is addressed within the Regional Park. For this reason, cumulative impacts have been assessed for the Western Precinct, and associated ancillary works, which includes the development of the subject site. As detailed in the approved Western Precinct Plan (JBA 2009), the remainder of the Western Precinct is zoned "Urban" and is development and/or proposed for residential development. The Precinct has been predominantly cleared under approved DA's to date, and this resulted in the removal of habitat for C/EECs and threatened species of relevance to the current proposal, consistent with the "balanced" outcome for the SMDS site as a whole completed under SREP 30. This will further fragment habitats in the study area to some degree, although the vegetation patches are already fragmented and the Western Precinct is already bounded

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

by residential and rural-residential land holdings. A summary of the area of vegetation removed as part of approved DAs within the Western Precinct is presented in **Table S.1** and is referred to further in the detailed impact assessments presented below.

S7 MITIGATION MEASURES

The foremost mitigation measure associated with the proposed development instituted under the established statutory planning framework provided by SREP 30, the EPS and the State Deed is the dedication of land for the creation of the 900 hectare Regional Park. This is supplemented by the provision of funding under the State Deed for the ongoing conservation, enhancement, management and rehabilitation of this land, which, together with proposed open space areas, will total over 900 hectares of retained and improved habitat. As described within the approved Western Precinct Plan, this area will contain representative and viable occurrences of all known threatened species that occur in the SMDS.

This is further supported by the following three documents prepared by the NSW Government:

- Draft Strategic Assessment Report for the Sydney Growth Centres Program (DoP 2010);
- Report on the methodology for identifying priority conservation lands on the Cumberland Plain (DECCW 2010); and
- Cumberland Plain Recovery Plan (DECCW 2011);

Importantly, the latter two of the listed studies above identify the SMDS Regional Park as a Priority Area/Priority Conservation Lands for the management and recovery of the Cumberland Plain.

As described within the Western Precinct Plan, there are a suite of management plans currently being implemented for weeds, domestic and feral animals, and macrofauna. Each of these plans contains multiple measures aimed at safeguarding the areas proposed for conservation within the 900ha Regional Park and open space areas of the SMDS.

Such mitigation measures are also considered as part of the offset package for the Western Precinct development, and ancillary works for drainage. Such measures go beyond those generally provided by traditional offsets, which usually require a more simplified level of contribution, dedication or management. The additional measures at SMDS include significant financial investment measures, including the funding of the Macrofauna Management Plan (MMP). The MMP manages the kangaroo and emu population through fertility control measures. This has greatly reduced the severity of grazing impacts on the regeneration of CPW and other C/EECs within the SMDS. Trials for kangaroo exclusion and grassy woodland recovery have also been funded by the proponent prior to the transfer of ownership to NPWS.

The above mitigation measures are explained in further detail within this SIS.

S8 CONCLUSION

The proposed development of the subject site will remove a relatively small area of Regenerating CPW and Mature CPW, and result in temporary disturbance to additional areas of CPW for access track upgrades. However, and with due consideration of the distribution of these C/EEC's in the region, the proposed development is not likely to have a significant impact on these communities such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

present in the Regional Park will be protected and enhanced through a range of mitigation measures identified and retained in perpetuity in public ownership.

The major affected C/EEC species impacted by the proposed development includes the Cumberland Plain Land Snail. The mature and young regenerating CPW on the subject site provide an area of approximately 4.5 ha of potential habitat for the Cumberland Plain Land Snail as well as some potential foraging habitat for wide ranging threatened fauna species. However, when directly compared with the habitats of the Regional Park, these areas of habitat are considered to be degraded and of a lesser significance due to the increased level of disturbance, sparse nature and comparatively small area. Therefore, the loss of this habitat on the subject site is not considered to be significant.

The impact of the proposed development will be more than balanced by the major conservation outcome resulting from of the creation of the 900ha Regional Park. The Regional Park comprises RFEF and CPW of quality and scale in a consolidated land holding, to be transferred into public ownership and subject to a fully funded Plan of Management.

When weighed against the conservation benefits, both direct and indirect, that will be derived from the 900ha Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna, the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposed development are considered to be of minor consequence. This SIS concludes that the proposed development of the subject site will not result in any local populations of threatened species or occurrences of ecological communities becoming extinct. Known occurrences of threatened flora and fauna within the SMDS are predicted to be secure in the long term as a result of the creation of the 900ha Regional Park and numerous supporting mitigation measures that are enshrined in a legal, statutory planning framework.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

1. Introduction

1.1. Purpose

This document is a Species Impact Statement (SIS) that has been prepared to assess the impacts of the construction of Regional Detention Basins C and V6, The Northern Road, Llandillo (Lot 1002 in DP 1215087), within the St Marys Development Site (SMDS) in western Sydney (referred to as the 'subject site').

The development of the subject site will include construction of two drainage detention basins to address run-off and flooding issues from the Jordan Springs development area to the north east, and all associated ancillary works, including battering for the basin, and the creation of a temporary access track for construction.

The SIS has been prepared in accordance with Section 109 and 110 of the *Threatened Species Conservation Act 1995* - repealed (TSC Act) and with the requirements of the Executive Director of EES (issued by the former Office of Environment and Heritage (OEH)), copies of which are provided in **Appendix A**.

The main objectives of this SIS are to:

- Identify threatened species issues and provide appropriate amelioration strategies to minimise adverse impacts resulting from the proposal;
- Provide an appropriate level of background information and assessment to facilitate determinations and licensing processes;
- Assist consent and determining authorities in the assessment of the development application under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- Assist the Secretary of the Department of Planning, Industry and Environment (DPIE) to assess the impacts of the Proposal on Biodiversity, as outlined in the SEARs;
- Assist the Executive Director of EES in deciding whether or not concurrence should be granted for the purposes of Part 4 or 5 of the EP&A Act;
- Assist the Executive Director of EES or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and
- Assist the Executive Director of EES in the assessment of Section 91 Licence applications lodged under the TSC Act.

The NSW *Threatened Species Conservation Act 1995* (TSC Act) was repealed and replaced by the NSW Biodiversity Conservation Act 2016 (BC Act) on 25 August 2017; however, the associated *Biodiversity Conservation (Savings and Transitional) Regulation 2017* includes a transitional period which allows DAs within the Penrith Local Government Area (LGA) to be assessed under the TSC Act for an additional fifteen months from 25 August 2017. A DA for the subject site is expected to be submitted in late 2018. Therefore, assessment of all ecological matters required under NSW legislation has been conducted under the TSC Act - repealed.

All listings for threatened species, populations and ecological communities have been legally transferred to the BC Act, however, for consistency, and to comply with the Chief Executives Requirements (CERs) issued for the preparation of this SIS, the TSC Act listings are referred to hereafter.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Throughout the SIS the section order and heading titles are replicated from the CERs. In order to demonstrate how each SIS section complies with statutory requirements a comprehensive compliance table is included in Appendix A.

1.2. Approvals and Licences

This SIS has been prepared in accordance with Sections 109 and 110 of the TSC Act, which describes the form and content of a SIS, with the exception of those matters limited or modified in the CERs as listed in **Section 1.4** below. The requirements of the Executive Director of EES were sought pursuant to Section 111 of the TSC Act.

As described in the Precinct Plan for the Western Precinct (JBA Urban Planning Consultants 2009), approval under Commonwealth environmental law was granted to the development of the SMDS (in accordance with the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30)) under the *Environment Protection (Impact of Proposals) Act 1974* (EPIP Act) prior to the gazettal of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Clarification of all related actions necessary for the carrying out of the approved development was thereafter granted by the Commonwealth under the *Environmental Reform (Consequential Provisions) Act 1999* (ERCP Act). As such, following the commencement of the EPBC Act, the Commonwealth confirmed that the EPIP Act approval and ERCP Act certification completed the Commonwealth environmental assessment and held that "***no further approvals***" [our emphasis] were required provided development was consistent with the established planning framework provided by the SREP 30. This SIS therefore does not address species, populations and communities listed under the EPBC Act, except where those species of relevance are also listed under the TSC Act-repealed.

1.2.1. State Government Instruments

Planning instruments that relate to the development of the Western Precinct include:

- Sydney Regional Environmental Plan 30 (SREP 30) (DUAP 2001b); and
- St Marys Environmental Planning Strategy 2000 (EPS 2000) (DUAP 2001a); and
- St Marys State Development Agreement December 2002.

1.2.1.1. SREP 30

Sydney Regional Environmental Plan No. 30 – St Marys provides a framework for sustainable development and management of land to which SREP 30 applies, including the Western Precinct. SREP 30 addresses proposals for a Regional Park, regional open space, urban and employment lands and establishes town planning, urban design and environmental conservation principles to guide the long-term development and conservation of the SMDS.

Under SREP 30, a draft Precinct Plan is to include proposals for and information about:

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

"management of the potential impacts of development on the existing physical and environmental characteristics of the land, including significant native flora and fauna habitat and soil characteristics. The information is to include specific details of those characteristics and to explain how development should be planned and configured to minimise adverse impacts on areas of significance for biodiversity."

Part 5 of SREP 30 outlines performance objectives for the development of the SMDS. Those outlined for conservation are:

1. A representative and significant proportion of the natural values of the land are to be conserved within a Regional Park in order to protect the variety of Western Sydney vegetation communities, native flora and fauna species and fauna habitat;

2. Urban design and site planning in the Employment and Urban zones are to have regard to significant stands of trees and, where practicable, retain those trees;

3. Adverse impacts on the vegetation and fauna habitats within the Regional Park and Regional Open Space zones resulting from the development of areas zoned Employment or Urban are to be minimised;

4. Infrastructure is to be designed and located to minimise potential adverse impacts on the conservation values of the land; and

5. Infrastructure and recreational facilities within the Regional Park are to be sited and constructed to minimise adverse impacts on the park's natural values.

1.2.1.2. EPS 2000

The EPS 2000 (DUAP 2001a) supports SREP 30 and outlines the strategies required to achieve the objectives outlined in SREP 30.

1.2.1.3. State Deed

The State Deed requires the delivery of a series of obligations during implementation of the SMDS. These obligations include the staged transfer and dedication of 900ha of land to the NPWS as a Regional Park, monetary contributions towards capital improvements and a Plan of Management and the erection of stock proof fencing.

The State Deed provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader statutory framework for the facilitation of future development of SMDS on an agreed basis.

At this point in time – substantially through the development of the SMDS - the first element of the Regional Park has already been dedicated (Wianamatta Regional Park), relevant monetary contributions made, a Plan of Management adopted and initial stock proof fencing erected.

1.2.2. Local Government Policies

The Western Precinct is located within the Penrith LGA. However, under the terms of the SREP 30, no Penrith LEP or DCP apply to the SMDS. Penrith City Council (Council) has produced a document entitled *Sustainability*

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Blueprint for Urban Release Areas (PCC, 2005). Whilst not an environmental planning instrument, this document outlines the key aims of Council in relation to ensuring the sustainability of future urban development. The objective of this document, as it relates to biodiversity, is "*to retain and conserve indigenous vegetation and wildlife habitat and corridors*" (PCC 2005). This requires areas of high conservation value to be identified within urban development areas and to be excluded from development; biodiversity corridors to be established that link corridors of regional significance; and requires the submission of a Flora and Fauna Strategy which outlines how indigenous vegetation and wildlife habitat will be retained and conserved. The objectives of the PCC document are addressed in the Western Precinct Plan and achieved across the SMDS site as a whole.

1.2.3. Australian Heritage Commission Register of National Estate

The majority of the 900ha Regional Park is listed on the Australian Heritage Commission Register of National Estate (Australian Heritage Commission 1999). The vegetation within this area is referred to in the National Estate as an important remnant of the vegetation communities that were once widespread on the Cumberland Plain and include Cumberland Plain Woodland and Castlereagh Woodland. The Register of National Estate place description also makes reference to significant flora and fauna, including threatened plants and examples of the Cumberland Plain Woodland bird assemblage. The developments approved for the Western Precinct adjoin Regional Park land along the eastern, western and northern boundary.

1.3. CER Matters Which Have Been Limited or Modified

The following Section 110 Matters need not be addressed by this SIS:

- Section 110(2)(g) and 110(3)(d). The matters raised in this section of the TSC Act have been clarified by the requirements below.

The following Section 110 matters need only be addressed where relevant:

- Threat abatement plans

At this time, no threat abatement plans have been approved that are relevant to this proposal.

- Recovery plans:
    - Bush Stone Curlew Recovery Plan
    - Cumberland Plain Recovery Plan
    - *Persoonia nutans* Recovery Plan
    - *Pimelea spicata* Recovery Plan

Of these recovery plans, only the Cumberland Plain Recovery Plan and the *Pimelea spicata* recovery plan are of relevance to the current proposal, due the presence, or potential presence of the species/communities on the subject site. Although *Pimelea spicata* has not been recorded on, or adjoining the subject site, there is potential for this species to occur, given the marginally suitable habitat present within the subject land, and the difficulty in detecting this cryptic herb. Consideration of the recovery plan has therefore been included in this SIS.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- Key Threatening Processes:
    - Clearing of native vegetation
    - High frequency fire
    - Loss of vegetation structure and composition
    - Loss of hollow-bearing trees
- Critical habitat

At this time, no areas of declared critical habitat are relevant to this proposal.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

2. Contextual Information

2.1. Background

2.1.1. St Marys Development Site

The SMDS comprises 1,545 ha of land which is situated north of St Marys and north-east of Penrith on the Cumberland Plain in Western Sydney. The SMDS incorporates areas of cleared agricultural land, developed areas and areas of regenerating Western Sydney Woodland vegetation (ERM 2000). The site is adjoined on three sides by urban development and to the north by land used for agricultural purposes.

Historically, there is evidence that the site was occupied continuously by Indigenous peoples prior to European settlement. From 1803 the site was surveyed, settled, cleared and used for farming purposes by Governor King's family.

Generally, farming in the St Marys area centred on cattle with the nearby St Marys saleyards being the second largest in rural New South Wales during the 60 years of its operation from the 1880s. The ruins of the former Beacroft Butchery and slaughter yard are located within the SMDS.

In 1924, the lands generally comprising the SMDS were consolidated into one parcel by a grazier, Mr JW Fisher. Following the outbreak of World War II, the Australian Government established an explosives and munitions filling factory on these lands, which had by then been resumed from various farmers, including JW Fisher. These manufacturing operations were established in two major waves during World War II and later during the 1950's. Extensive works were undertaken on the site involving the construction of more than 800 buildings, a transport network including roads and railway lines, as well as major services infrastructure and telecommunications facilities. The site was segregated into small areas by security fencing for both safety and security reasons. This complex of munitions factories operated until production ceased in 1994. The site has subsequently been decontaminated, and the great majority of the buildings and other infrastructure demolished and removed.

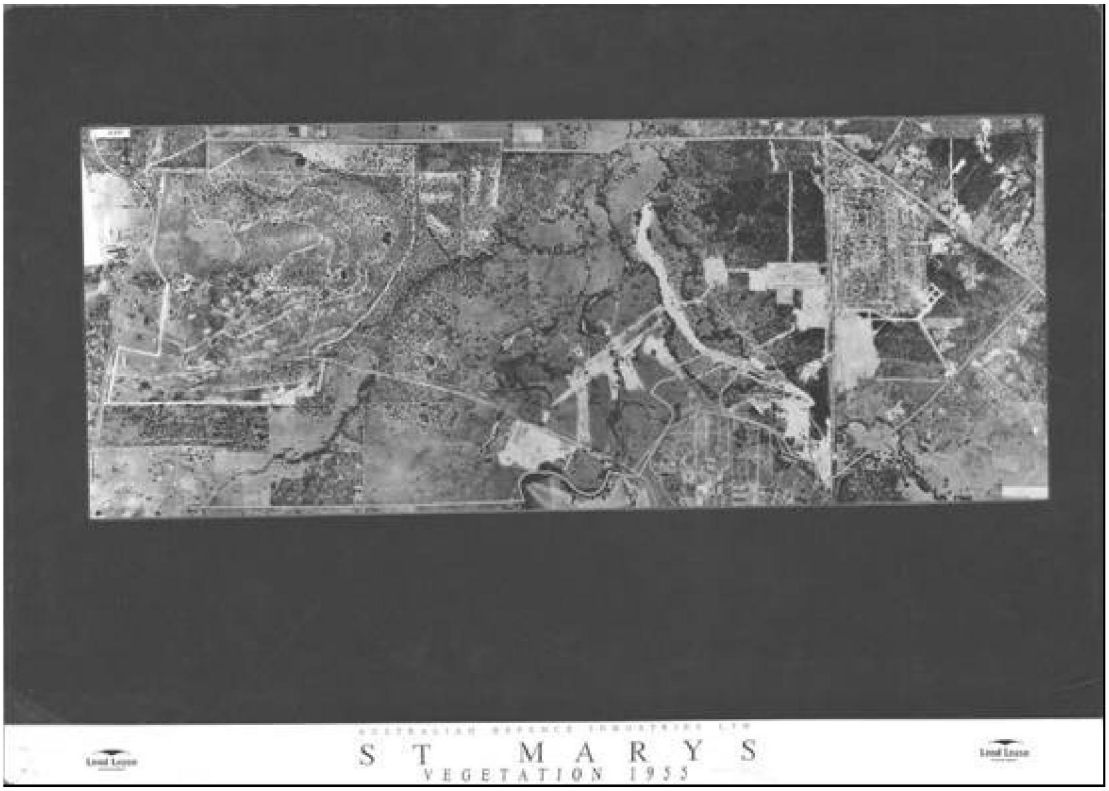
The flora and fauna of the SMDS have been extensively surveyed and analysed over the last 28 years (Gunninah 1991, 1995, Kinhill 1995, ERM 1997, Gunninah 1997, ERM 1998, 2000, Cumberland Ecology 2004c, 2005, 2009c, b). The native vegetation within the St Marys Development Site has survived decades of use and clearing since European settlement. The entire property experienced tree clearance and pastoral activities prior to the 1940s (ERM 2000). Most of the native vegetation is regenerating from earlier episodes of clearing (Gunninah 1995, 1997, NSW NPWS 2000). **Photographs 1 – 4** depict these transitions. Despite being shaped by these previous management actions, the remnant Cumberland Plain Woodland and other vegetation communities present on the site support flora and fauna species of acknowledged significant conservation value.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Photograph 1 : Aerial photograph of St Marys Development Site, 1947

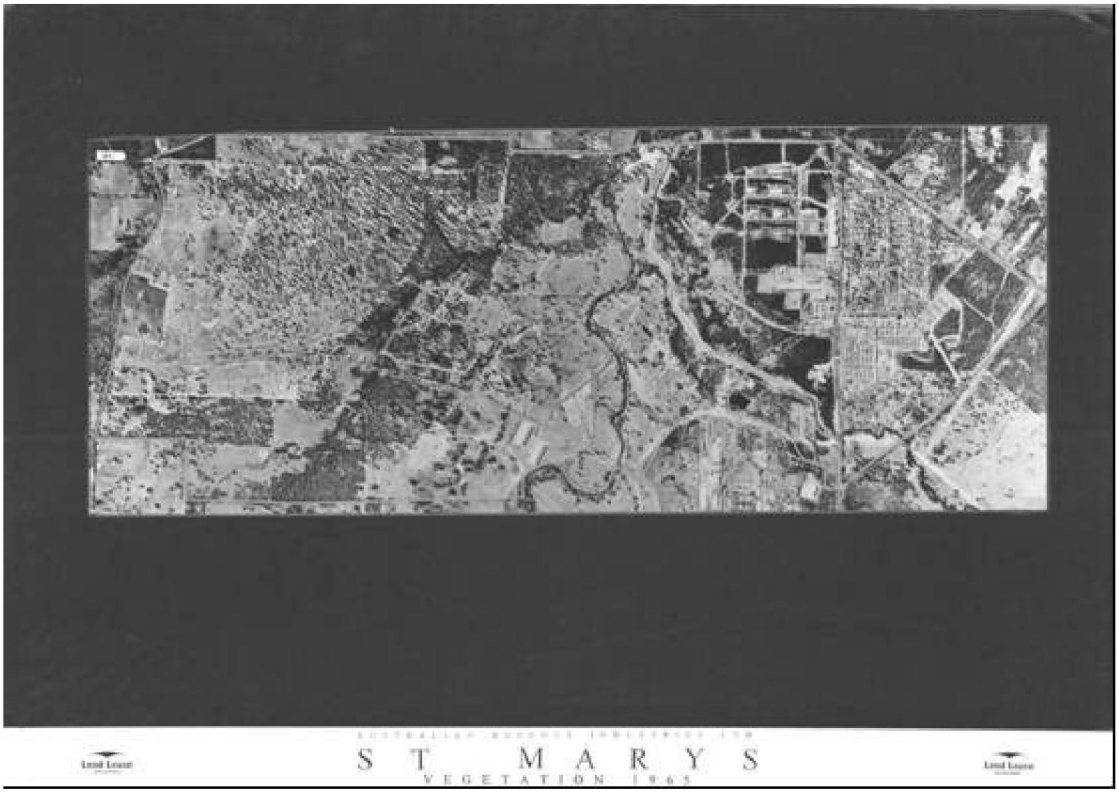


Photograph 2 : Aerial photograph of St Marys Development Site, 1955

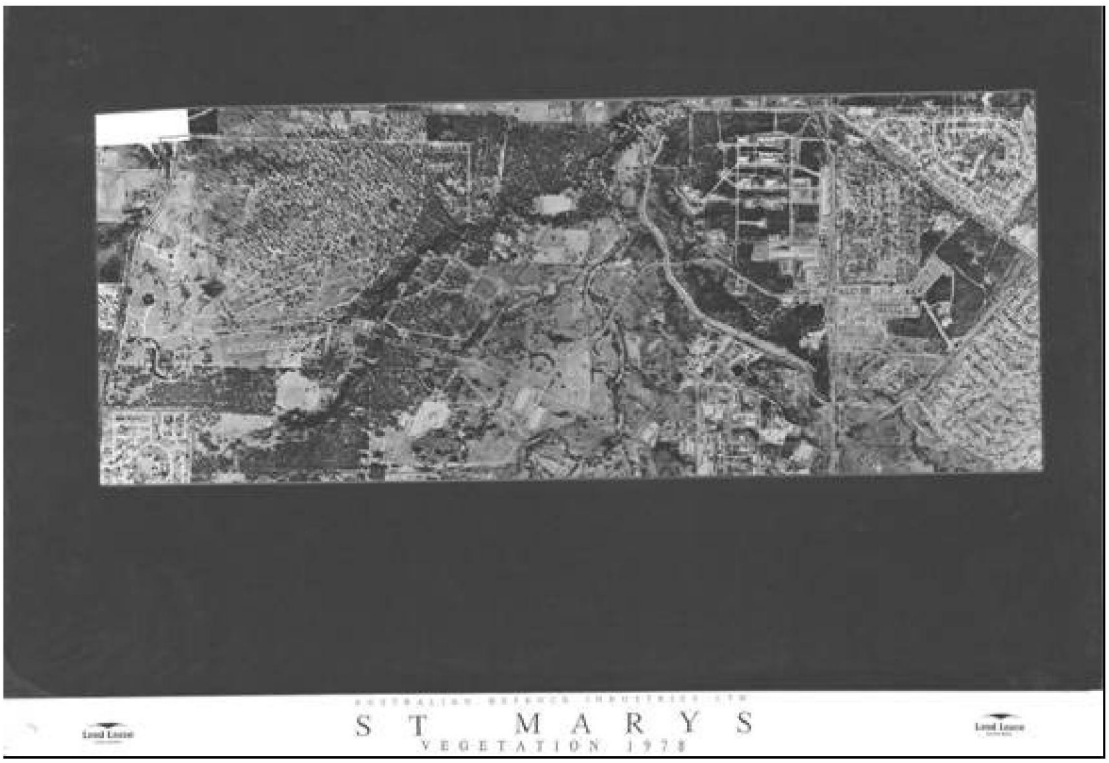


Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Photograph 3 : Aerial photograph of St Marys Development Site, 1965



Photograph 4 : Aerial photograph of St Marys Development Site, 1978



Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The former Australian Defence Industries (ADI) site at St Marys was endorsed by the NSW Government for inclusion on the Urban Development Program (UDP) in 1993. The site was seen to present an opportunity to provide housing for Sydney's growing population within an environmentally sustainable framework.

Given that the site straddles the boundary between two local government areas (Blacktown and Penrith); the Government decided that a regional environmental plan should be prepared for the site. Technical investigations into the environmental values and development capability of the land commenced in 1994, and the Regional Environmental Plan for St Marys (SREP 30) (DUAP 2001b) was gazetted in January, 2001. It zoned the land into "urban", "employment", "regional open space", and "Regional Park" uses (Refer to **Figure 2**).

In view of the original scale of the residential and employment uses, a package of documents was prepared to guide and control development. It comprised SREP 30 (maps and written instrument) (DUAP 2001b), and an Environmental Planning Strategy (EPS) (DUAP 2001a) which sets out performance objectives and strategies to address key aspects associated with the site, including: conservation, cultural heritage, water and soils, transport, urban form, energy and waste, human services, employment, and land contamination.

The State Development Agreement (State Deed) was entered into between the landowner and developers of the land (a Joint Venture comprising ComLand and Lendlease Development), and the NSW Government in December 2001. The State Deed sets out the specific obligations and responsibilities in providing, amongst other things, services, infrastructure, monitory contributions and land in support of the SMDS. These obligations include, amongst other things, the following relevant contributions:

- The staged transfer and dedication 900ha of land to the NPWS as a Regional Park for the sum of $3 (three dollars);
- Staged monetary contributions (c$6m) towards capital improvements within the 900ha Regional Park;
- Monetary contributions towards a Plan of Management for the 900ha Regional Park; and
- The erection of stock proof fencing in stages along the boundaries of the 900ha Regional Park.

The State Deed provides legal certainty for the delivery of obligations at specific milestones. Together with the SREP 30 and the EPS, the State Deed provides the broader framework for the facilitation of future development of SMDS on an agreed basis.

SREP 30 (DUAP, 2001b) identified 6 development "precincts" (known as the Western Precinct, Central Precinct, North and South Dunheved Precincts, Ropes Creek Precinct and Eastern Precinct) and requires a precinct plan be adopted by the relevant council prior to any development taking place.

To date the Precinct Plans for the Eastern Precinct, Ropes Creek Precinct, Dunheved Precincts, Central Precinct, Western Precinct have been prepared, exhibited and adopted by the relevant Councils and development is being progressed on a staged basis. As a result, the SMDS is one of the largest single Greenfield Release Area in the Metropolitan Development Program and critical to the delivery of housing for Metropolitan Sydney.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Planning for any precinct is to address all of the issues in SREP 30 and the EPS, including preparation of management plans for a range of key issues such as weed management, feral and domestic animal management and bushfire management.

A Macrofauna Management Plan for the entire site needed to be submitted before or at the same time as lodgement of the first Precinct Plan (Eastern Precinct), under section 4.4 (15) of the EPS. The plan is required to account for displacement of macrofauna through the loss of habitat that would occur as a result of development of the SMDS.

In March 2002, the Commonwealth Government advised that those areas of the site listed on the Register of the National Estate should be excluded from urban development. This had the effect of changing the boundaries of the areas to be set aside for conservation. The precincts for development are shown in **Figure 1**.

The Minister for Planning has declared the Eastern Precinct, North and South Dunheved Precincts, Ropes Creek, Central and Western Precinct as Release Areas for development. All Precinct Plans have been prepared, exhibited and adopted by the relevant Council. Development is substantially complete in the Eastern Precinct, Ropes Creek Precinct and the Western Precinct, while development of the Central Precinct is currently in progress. Since the endorsement of the Macrofauna Management Plan in 2004, 27 permanent kangaroo grazing monitoring plots have been surveyed annually in the Regional Park. These include grazing-excluded and open plots in CPW. The plots have been surveyed twelve times by Cumberland Ecology, resulting in a comprehensive flora species list for the community on the SMDS, as well as an indication of the condition of CPW in the Regional Park.

A compilation of survey methods and results from the reports available to Cumberland Ecology is found in **Chapter 4.**

2.1.2. Western Precinct

Following surveys completed for the EPS Environmental Planning Strategy and SREP 30 that covered the entire SMDS, the key surveys in the Western Precinct and Regional Park include those completed for the additions to the land on the Register of National Estate:

- ERM (1998) Addendum to Objection to Interim Listing of ADI St Marys Site in the Register of the National Estate Submission to the Australian Heritage Commission. Environmental Resources Management Australia, Sydney (ERM 1998); and
- Perkins, I. (1999) Flora Assessment of the Disputed Areas of Western Sydney Shale Woodlands Ian Perkins Consultancy Services, Sydney (Perkins 1999).

The main purpose of these assessments was to determine if any land in the western and central portion of the SMDS should be included in the listing of National Estate. The land on the Register of National Estate on the SMDS is included in land zoned as Regional Park.

Perkins completed a resilience survey over the SMDS that included analysis of canopy regeneration, proportion of native ground cover species and soil disturbance to determine viability of land that had been used for

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

grazing. The majority of the western and central portions of the SMDS had been cleared and grazed by sheep and kangaroos. Some areas at the time of assessment contained a scattering of large, old trees and the area of the denser coverage of trees was included on the Register of National Estate. This area was included as one large patch and did not include smaller scattered, isolated patches containing only a few trees.

The land on the Register of National Estate at SMDS lies wholly within the land zoned "Regional Park" in the SREP 30 (confirmed via SREP 30 Amendment 1). The remaining area not included on the Register of National Estate formed the various Precincts (zoned "Urban" in the SREP 30), Drainage areas and Regional Open Space.

The Western Precinct, along with the adjoining Regional Open Space and drainage areas (hereafter referred to collectively as the Western Precinct areas) are located in the middle of the SMDS. These areas are surrounded for the most part by the Regional Park, except to the south where there is residential development and a section of South Creek. The Western Precinct areas contain a network of tracks and roads, some of them sealed, that are a legacy of past land uses. Several buildings are present on the precinct, including sheds being used for ongoing macrofauna management activities and two large warehouses. Extensive areas of tall mesh fencing are present throughout the precinct due to ongoing macrofauna management activities. A large concrete stockpile is present in the precinct that has been formed by the stockpiling of concrete from building demolitions in the precinct and other parts of the SMDS.

The Western Precinct consists primarily of grassland, with scattered trees and some areas of regrowth canopy vegetation. Wooded communities in the precinct are limited, and are largely restricted to remnants occurring along the common border with the Regional Park and patches of regrowth in the middle of the precinct.

Much of the precinct areas are still heavily influenced by the history of sheep grazing, including a high cover of exotic pasture grasses and evidence of sheep camps where herbaceous weeds form thick coverage around the bases of large, old trees.

2.1.2.1. Western Precinct Plan

Further to the surveys undertaken across the SMDS from the early 1990s, Cumberland Ecology undertook vegetation surveys in 2007 and a condition assessment in 2008 as part of the Biodiversity Assessment prepared as part of the Western Precinct Plan (Cumberland Ecology 2008a). It should be noted that the Biodiversity Assessment took into account and made extensive use of previous surveys conducted across the SMDS.

The Western Precinct Plan was adopted in March 2009. This relates to a total of approximately 133.1ha of land, zoned "Urban" (38.4ha), and "Employment" (94.7ha) in SREP 30 (Amendment No. 2).

2.2. Description of the Proposal

2.2.1. Nature

The proposed works involve the construction of a detention basin to allow its future use for stormwater management, in accordance with the provisions of the SREP 30 and the Western Precinct Plan. Regional Detention Basin C will work in a coordinated fashion with Basin V6, and are located to the north-west of the SMDS.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The proposal involves the construction of two detention basins (Basins C and V6) to detain, treat and attenuate stormwater runoff from Village 3 and Village 6; the Jordan Springs development. The basins are located within the north-western extent of the St Marys Development Site and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m, and Basin V6 has a surface area of approximately 0.3 hectares and a notional depth of 1.6m.

Each basin is designed to contribute to the water quantity and quality management objectives under the *Sydney Regional Environmental Plan No. 30 – St Marys* (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with erosion protection and vegetated slopes to provide effective nutrient removal. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access. An access track along the side of each basin with access ramps will be constructed for regular inspection and maintenance access. A proposed haul route will be used during construction, which follows the existing unsealed track, which may require minor temporary upgrade works, to a total width of no more than 10m.

2.2.1.1. Buildings and other structures

The proposed development involves the construction of two drainage detention basins, and access tracks. No buildings or structures will be constructed as part of the proposal.

2.2.1.2. Installation and maintenance of utilities

No utilities will be required as part of proposal.

2.2.1.3. Access routes

Existing access routes will be used for the construction of the basin, which pass through the Regional Park. However, upgrade to the tracks are likely to be required, in order to support the heavily machinery required for the works. The existing access tracks will be upgraded to the minimum width required for a single lane gravel track. Clearing will be minimised to the greatest extent possible within mature and regenerating woodland.

2.2.1.4. Waste and Water Management

Waste management during construction will be conducted in accordance with all relevant Council regulations and will be specified in the EIS. Specific waste and water management plans, including requirements for the establishment of interim stormwater and sediment detention basins during construction will be detailed in the EIS. The Regional Detention Basins C and V6 will contribute to the overall water management measures implemented across the SMDS.

2.2.1.5. Changes in surface water flows

The development of the subject site is aimed at addressing the changes in surface water flow across the SMDS, and directly in relation to the residential land within the Western Precinct (the suburb of Jordan Springs). These changes are set out in detail in the approved Western Precinct Plan - Water, Soils and Infrastructure report.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

2.2.1.6. Fire protection zones

Asset Protection Zones (APZs) are required for all urban areas within 100 metres of a high or medium bushfire hazard and 30 metres of a low bushfire hazard. In accordance with the "Planning for Bushfire Protection 2006" guidelines and in agreement with the NSW Rural Fire Services (RFS), water storage areas do not require an APZ, and therefore the subject site does not make provisions for bushfire protection. However, the surrounding Regional Park will be managed to prevent the spread of bushfire into adjoining residential areas, and the Regional Detention Basin will provide an additional water storage for any fire-fighting requirements in the Regional Park in future.

2.2.1.7. Landscaping

Landscaping will include planting of wetland species within and adjoining the Detention Basin. This is required for bank stability and to assist with water cycle management. All species used in planting are selected from the list of species for Freshwater Wetlands and native wetland species that have been recorded on the SMDS. Species will be selected in accordance with Council requirements and avoid the use of species that may invade bushland.

2.2.2. Extent

As described above, this SIS has been prepared to address the impacts of Regional Drainage Basins C and V6. The extent of the works includes approximately 4.5 ha for the drainage basin construction . Ancillary works are considered temporary, and include minor track upgrade works within the Regional Park, to a width of no greater than 10m, centred on the existing tracks between the two proposed basins. The tracks will be restored to the satisfaction of NPWS, the future land manager of the Regional Park, post-construction.

2.2.3. Location

The proposed development is within land zoned 'Drainage' and 'Regional Park' under SREP-30, and directly adjoins the Regional Park, located within the greater St Marys Development project area, St Marys NSW 2760.

2.2.4. Timing

Anticipated start- of- works to implement the initial stages of the proposed development is forecast for late 2019 – early 2020. This timing is subject to planning consent being issued.

2.2.5. Layout

The layout of the proposed development area, identifying the subject site is shown in **Figure 3**. The layout conforms to the objectives, principles, and requirements of the strategic statutory framework (as set out in SREP 30, the EPS and the State Deed) and the local environmental planning instrument for the site (as set out in the, the Western Precinct Plan and Development Control Strategy (JBA 2009)) submitted to Penrith City Council in 2008. Modification to the configuration of the 'Drainage' and 'Regional Park' zoned land has been applied for as part of this current application, for which Secretaries Environmental Assessment Requirements (SEARs) have been issued by the Department of Planning and Infrastructure (DP&I). The revised Drainage zoning boundary contains the development layout.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

2.3. Land Tenure Information

The registered proprietor of the subject site is St Marys Land Limited. The 900ha Regional Park will be owned by the NSW Government and managed by the National Parks and Wildlife Service (NPWS) within the EES group of DPIE. Initial transfer has already taken place (Wianamatta Regional Park). The remainder of the Regional Park is anticipated for transfer to NPWS at a date yet to be determined, and subject to the developer completing works such as drainage, and remediation across the site.

2.4. Vegetation

The vegetation communities of the Cumberland Plain have been mapped by EES (then the Department of Environment, Climate Change and Water (DECCW) (Tozer 2003, DECCW 2007), including several updated versions based on more recent aerial photography (OEH 2013b), showing types and extent of canopy disturbance of vegetation communities, as shown in **Figure 5**. The EES (2013) map units have been verified and refined in parts of the study area by ground-truthing vegetation communities in the subject site (refer to **Figure 15**).

The following Critically Endangered and Endangered Ecological Communities, as listed under the TSC Act, are known to occur within the study area:

- Cumberland Plain Woodland (in the form of Shale Plains Woodland, as mapped by OEH, 2013);
- Shale-Gravel Transition Forest;
- River–flat Eucalypt Forest (in the form of Alluvial Woodland, as mapped by OEH, 2013);
- Swamp Oak Floodplain Forest (in the form of Alluvial Woodland, as mapped by OEH, 2013); and
- Freshwater Wetlands on Coastal Floodplains.

Within the locality, a much broader range of communities, including communities listed under the TSC Act, as mapped by DECCW in 2007, are known to occur. These include:

- Shale Hills Woodland (CPW – CEEC);
- Agnes Banks Woodland (EEC);
- Castlereagh Swamp Woodland (EEC);
- Cooks River/Castlereagh Ironbark Forest (EEC);
- Moist Shale Woodland;
- Riparian Forest (RFEF – EEC);
- Shale Sandstone Transition Forest (High Influence and Low influence variants – EEC);
- Castlereagh Scribbly Gum Woodland;

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- Upper Georges River Sandstone Woodland;
- Western Sandstone Gully Forest; and
- Sandstone Ridgetop Woodland.

The distribution of these communities in the locality is shown in **Figure 5**.

As specified in the CERs, the vegetation communities present within the locality have been described with reference to the Cumberland Plain vegetation mapping (NPWS 2002a, b) and recent updates (OEH 2013b), and relevant Scientific Committee determinations for C/EECs. All vegetation communities mapped by NPWS (2002a;b) were described by Tozer (2003), some of which were subsequently updated in Tozer et al. (2010), which have also been consulted during the preparation of the relevant ecological community descriptions, below.

2.4.1. Shale Plain Woodland - Cumberland Plain Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 10: Shale Plains Woodland along with descriptions by Tozer et al. (2010) for Map Unit GW p29 corresponds to the CEEC listing for Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (NSW Scientific Committee 2009).

Cumberland Plain Woodland – Shale Plain Woodland is described as a eucalypt woodland community with an open shrub layer and grassy groundcover, restricted to the Cumberland Plain, western Sydney. It occurs on clay-loam soils derived from Wianamatta shale at altitudes from 50-300m (Tozer et al. 2010).

The dominant canopy species are; *Eucalyptus moluccana* (Grey Box) and *Eucalyptus tereticornis* (Forest Red Gum), in association with *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Acacia implexa* (Hickory Wattle). Mid-storey dominants include; *Bursaria spinosa* (Blackthorn), *Rubus parvifolius* (Native Raspberry) and *Clematis glycinoides* (Headache Vine). The groundcover is dominated by *Dichondra repens* (Kidney Weed), *Brunoniella australis* (Blue Trumpet), *Desmodium varians* (Slender Tick Trefoil), *Aristida ramosa* (Purple Wiregrass), *Microlaena stipoides* (Weeping Meadow Grass), *Carex inversa*, *Themeda australis* (Kangaroo Grass), *Cyperus gracilis* (Slender Flat-sedge), *Dichelachne micrantha* (Shorthair Plumegrass), *Asperula conferta* (Common Woodruff), *Oxalis perennans, Cheilanthes sieberi* subsp. *sieberi* (Poison Rock Fern), and *Desmodium brachypodum* (Large Tick Trefoil).

It is estimated that over 90% of the original extent of this community has been cleared since European settlement. Threats to CPW include continued clearing, degradation, weed invasion and high fire frequency.

2.4.2. Shale Gravel Transition Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 103: Shale Plains Woodland along with descriptions by Tozer et al. (2010) for Map Unit DSF p502 corresponds to the EEC listing for Shale Gravel Transition Forest in the Sydney Basin Bioregion (SGTF) (NSW Scientific Committee 2002c).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Shale Gravel Transition Forest is described as a eucalypt woodland with an open layer of sclerophyll shrubs and grassy groundcover, restricted to the Cumberland Plain, western Sydney. It occurs on clay soils with a high concentration of iron-indurated gravel, derived mainly from Tertiary alluvium in areas where average annual rainfall varies from 750 – 950 mm (Tozer et al. 2010).

It has a dominant canopy species of *Eucalyptus fibrosa* (Broad-leaved Ironbark) but *E. moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum) may also occur. *Melaleuca decora* (Paperbark) dominates the understorey, with *Bursaria spinosa, Daviesia ulicifolia* (Gorse Bitter Pea) and *Lissanthe strigosa* (Peach Heath) in the shrub layer. Grasses and herbs occur in the ground layer. Shale-Gravel Transition Forest shares a number of species with Cumberland Shale Plains Woodland.

It is estimated that about 75% of the original extent of this community has been cleared since European settlement. Threats to SGTF include clearing, mining for gravel and weed invasion.

2.4.3. Alluvial Woodland – River-flat Eucalypt Forest

Parts of the Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 11: Alluvial Woodland along with descriptions by Tozer et al. (2010) for Map Unit FoW p33 corresponds to the EEC listing for River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (RFEF) (NSW Scientific Committee 2004k).

This community occurs on stream banks and alluvial flats on the Cumberland Plain and is restricted to the Hawkesbury-Nepean and Georges River systems on alluvial soils derived from Wianamatta Shale. The community occurs as woodland with an open shrub layer and a continuous groundcover of grasses and forbs.

The dominant canopy species are; *E. tereticornis*, *Angophora floribunda* (Rough-barked Apple), *Eucalyptus amplifolia* (Cabbage Gum), associated with *Eucalyptus eugenioides* (Thin-leaved Stringybark) and *Eucalyptus elata* (River Peppermint). Dominant mid-storey species include *Acacia parramattensis* (Parramatta Wattle), *Bursaria spinosa* and *Sigesbeckia orientalis*. Dominant groundcover species are *Microlaena stipoides*, *Oplismenus aemulus* (Basket Grass), *Dichondra repens*, *Entolasia marginata* (Bordered Panic), *Solanum prinophyllum* (Forest Nightshade), *Pratia purpurascens* (Whiteroot), *Echinopogon ovatus* (Forest Hedgehog Grass), *Desmodium varians*, *Commelina cyanea* (Native Wandering Jew) and *Veronica* plebeian (Trailing Speedwell) (Tozer et al. 2010).

It is estimated that 95% of the original extent of this community has been cleared since European settlement. Remnants of this community are threatened by land clearing, weed invasion, rubbish dumping and other processes of degradation.

2.4.4. Alluvial Woodland – Swamp Oak Forest

Parts of the Native Vegetation of the Cumberland Plain mapping (NSW NPWS 2002a) and descriptions by Tozer (2003) for parts of Map Unit 11: Alluvial Woodland correspond to the EEC listing for Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee, 2004l).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

This community generally occurs on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains in areas where the groundwater is saline or sub-saline. The structure of the community can vary from open forests to low woodlands or scrubs/reedlands with scattered trees. The composition of SOF is primarily determined by the frequency and duration of waterlogging and the level of salinity in the groundwater and can adjoin or intergrade with other coastal floodplain communities, including RFEF.

The dominant canopy species is *Casuarina glauca* (Swamp Oak) associated with *Acmena smithii* (Lilly Pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks). The understorey is characterised by frequent occurrences of vines such as *Parsonsia straminea*, a sparse shrub cover and a continuous groundcover of forbs, sedges, grasses and leaf litter. Groundcover composition under less saline conditions, as those found on the Cumberland Plain, include forbs such *Centella asiatica, Commelina cyanea, Persicaria decipiens* and *Viola banksii* and graminoids such as *Carex appressa, Gahnia clarkei, Lomandra longifolia* and *Oplismenus imbecillis*.

It is estimated that 75% of the original extent of this community has been cleared since European settlement. Remnants of this community are threatened by land clearing, weed invasion, flood mitigation and drainage works, and pollution from urban and agricultural runoff.

2.4.5. Freshwater Wetlands on Coastal Floodplains

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

This community is not described by any mapping projects of the Cumberland Plain.

2.4.6. Shale Hills Woodland - Cumberland Plain Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 9: Shale Hills Woodland along with descriptions by Tozer et al. (2010) for Map Unit p28 correspond to the CEEC listing for Cumberland Plain Woodland in the Sydney Basin Bioregion (CPW) (NSW Scientific Committee 2009).

Cumberland Plain Woodland – Shale Hills Woodland is closely related to Cumberland Shale Plains Woodland but typically occurs on steeper and more undulating terrain. It is found from 50 – 350m ASL in areas receiving 750 – 900mm mean annual rainfall occurs on clay/loam soils derived from Wianamatta Shale ridges in the area of north-east Sydney and is described as woodland with an open shrub layer and a grassy groundcover (Tozer et al. 2010).

The canopy is dominated by *Eucalyptus moluccana* and *E. tereticornis* and is associated with *E. crebra* and *E. eugenioides*). The mid-storey is dominated by *Bursaria spinosa*. The groundcover dominants are *Dichondra repens*, *Cheilanthes sieberi*, *Aristida vagans* (Three-awned Speargrass), *Microlaena stipoides*, *Themeda australis*, *Brunoniella australis*, *Desmodium gunnii, Opercularia diphylla*, *Wahlenbergia gracilis* (Sprawling Bluebell), *Dichelachne micrantha* (Shorthair Plumegrass), *Paspalidium distans*, *Eragrostis leptostachya* (Paddock Lovegrass) and *Lomandra filiformis* (Wattle Mat-rush) (Tozer et al. 2006).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

It is estimated that 95% of the original extent of this community has been cleared since European settlement.

2.4.7. Agnes Banks Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 8: Agnes Banks Woodland along with descriptions by Tozer et al. (2010) for Map Unit DSF p239 correspond to the EEC listing for Agnes Banks Woodland in the Sydney Basin Bioregion (NSW Scientific Committee 2000a).

Agnes Banks Woodland is described as a low eucalypt woodland with a sclerophyll shrub stratum and a groundcover dominated by sedges and forbs. The community is restricted to small areas of old podsolised sand deposits overlying Tertiary clays and gravels at Agnes Banks on the east bank of the Hawkesbury River (Tozer et al. 2010).

The canopy is dominated by species such as *Angophora bakeri* (Narrow-leaved Apple) and *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) with an underlying shrub layer consisting of *Banksia oblongifolia* (Fern-leaved Banksia), *Dillwynia sericea* (Showy Parrot-pea), *Leptospermum trinervium* (Slender Tea-tree) and *Pimelea linifolia* (Slender Rice Flower). Groundcover species include *Lepidosperma urophorum, Stylidium graminifolium* (Grass Trigger-plant) and *Trachymene incisa*.

Agnes Banks Woodland has a highly restricted distribution and this community is continues to be threatened by sand mining and rural residential development.

2.4.8. Castlereagh Swamp Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 4: Castlereagh Swamp Woodland along with descriptions by Tozer et al. (2010) for Map Unit DSF p4 correspond to the EEC listing for Castlereagh Swamp Woodland Community (NSW Scientific Committee 1999).

Castlereagh Swamp Woodland is a low woodland community that occurs in poorly drained depressions along intermittent watercourses between Castlereagh and Holsworthy on the Cumberland Plain, western Sydney.

The canopy is dominated by species such as *Melaleuca decora, E. parramattensis* (Parramatta Red Gum), and *Melaleuca linariifolia*. The groundcover is dominated by species that can tolerate waterlogged conditions such as *Goodenia paniculata* (Branched Goodenia), *Centella asiatica* (Indian Pennywort) and *Juncus usitatus*. Other common ground cover species include: *Cheilanthes sieberi, Opercularia diphylla, Pratia purpurascens, Themeda australis, Hydrocotyle peduncularis, Hypericum gramineum* (Small St Johns Wort), *Paspalidium distans, Eragrostis brownii* (Brown's Lovegrass) *and Fimbristylis dichotoma* (Common Fringe-sedge).

Castlereagh Swamp Woodland has a highly restricted distribution and remnant areas are all less than 100 hectares in area. This community is threatened by weed invasion related to nutrient enrichment from surrounding urban and rural areas as well as from direct destruction for hobby farm, rural and residential development.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

2.4.9. Cooks River/Castlereagh Ironbark Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 3: Cooks River/Castlereagh Ironbark Forest along with descriptions by Tozer et al. (2010) for Map Unit DSF p1 Castlereagh Ironbark Forest correspond to the EEC listing for Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (NSW Scientific Committee 2002a).

Cooks River/Castlereagh Ironbark Forest (CRCIF) occurs in the Holsworthy and Castlereagh areas, and in the eastern section of the Cumberland Plain on alluvial soils and can intergrade with Shale-Gravel Transition Forest.

The dominant canopy species are *E. fibrosa* and *Melaleuca decora*. The understorey is typically dense and contains *Melaleuca nodosa* (Prickly-leaved Paperbark), *Lissanthe strigosa, Dillwynia tenuifolia, Pultenaea villosa* (Hairy Bush-pea) and *Daviesia ulicifolia*. The ground layer consists of grasses and herbs.

The community is under threat from weed invasion, clearing, rubbish dumping and damage through vehicle access.

2.4.10. Moist Shale Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 14: Moist Shale Woodland along with descriptions by Tozer et al. (2010) for Map Unit GW p514 Cumberland Moist Shale Woodland correspond to the EEC listing for Moist Shale Woodland in the Sydney Basin Bioregion (NSW Scientific Committee 2002b).

This community is described as a eucalypt woodland with a sparse semi-mesic shrub layer and grassy groundcover, restricted to rugged areas with soils derived from Wianamatta Shale at higher elevations in the southern half of the Cumberland Plain

The dominant canopy species are *Eucalyptus tereticornis* and *E. moluccana* with a shrub layer consisting of *Breynia oblongifolia* (Coffee Bush), *Clerodendrum tomentosum* (Hairy Clerodendrum), *Sigesbeckia orientalis*, *Olearia viscidula* (Wallaby Weed) and *Bursaria spinosa*. Groundcover species include *Cayratia clematidea* (Native Grape), *Desmodium gunnii, Cyperus gracilis* (Slender Flat-sedge), *Brunoniella australis, Desmodium brachypodum* (Large Tick Trefoil), *Glycine clandestina Solanum prinophyllum, Microlaena stipoides, Einadia hastata* (Berry Saltbush), *Nyssanthes diffusa* (Barbwire Weed), *Plectranthus parviflorus* (Cockspur Flower) and *Rumex brownii* (Swamp Dock).

The community is under threat from rural-residential development, weed invasion, high frequency fire and grazing.

2.4.11. Riparian Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 12: Riparian Forest corresponds to the EEC listing for River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (RFEF) (NSW Scientific Committee 2004k).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

This community is not widely distributed, being limited to banks of the Hawkesbury-Nepean River or on the terraces immediately adjacent to the river.

Canopy species include: *Eucalyptus botryoides* (Bangalay), *E. elata, Angophora subvelutina* (Broad-leaved Apple) and *A. floribunda*. The understory often contains a small tree stratum consisting of species of Acacia, such as *Acacia binervia* (Coastal Myall), *A. floribunda* (White Sally Wattle) *and A. mearnsii* (Black Wattle). Common groundcover species include *Oplismenus aemulus* (Australian Basket Grass), *Pteridium esculentum* (Bracken Fern), *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Austrostipa ramosissima* (Stout Bamboo Grass) and *Echinopogon ovatus*.

As part of the RFEF community, is estimated that 95% of the original extent of this community has been cleared since European settlement.

2.4.12. Shale Sandstone Transition Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Units 1 and 2: Shale Sandstone Transition Forest (Low Sandstone and High Sandstone influence) along correspond to the EEC listing for Shale/Sandstone Transition Forest in the Sydney Basin Bioregion (NSW Scientific Committee 1998).

This community occurs on transitional shale-sandstone soils around the edge of the Cumberland Plain at altitudes up to 350m ASL and is a woodland with an open shrub layer and a grassy groundcover. Shale Sandstone Transition Forest (Low Sandstone Influence) occurs around the margins of the Cumberland Plain on soils derived from Wianamatta Shale while Shale Sandstone Transition Forest (High Sandstone Influence) occurs on the margins of the Cumberland Plain in close proximity to the sandstone/shale boundary

The dominant canopy species are; *Eucalyptus crebra*, *E. fibrosa* and *E. punctata* (Grey Gum), generally also in association with *E. globoidea* (White Stringybark) and *E. eugenioides*. Dominant understorey species include *Allocasuarina littoralis* (Black She-Oak), *Persoonia linearis* (Narrow-leaved Geebung), *Bursaria spinosa* subsp. *spinosa*, *Ozothamnus diosmifolius* (White Dogwood) and *Hibbertia aspera* (Rough Guinea Flower). Dominant groundcover species include *Lepidosperma laterale*, *Cheilanthes sieberi* subsp. *sieberi, Aristida vagans*, *Pratia purpurascens*, *Microlaena stipoides* var. *stipoides*, *Entolasia stricta* (Wiry Panic), *Lomandra multiflora* (Many-flowered Mat-rush), *Themeda australis*, *Panicum simile* (Two-colour Panic), *Echinopogon caespitosus* (Hedgehog Grass), *Pomax umbellata*, *Dichondra repens*, *Glycine clandestina*, *Billardiera scandens* (Hairy Apple Berry) and *Opercularia diphylla* (Tozer et al. 2006).

An estimate of the area of this vegetation type which has been cleared from its original extent is 80% since European settlement.

2.4.13. Castlereagh Scribbly Gum Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and descriptions by Tozer (2003) for Map Unit 6: Castlereagh Scribbly Gum Woodland correspond to the Vulnerable Ecological Community (VEC) listing for Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (NSW Scientific Committee 2010).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The canopy is dominated by *Eucalyptus parramattensis,* subsp. *parramattensis, Angophora bakeri* and *E. sclerophylla* along with an occasional small tree stratum of *Melaleuca decora*. The shrub stratum is well developed and consists of species such as *Banksia spinulosa subsp spinulosa* (Hairpin Banksia)*, Melaleuca nodosa, Hakea sericea* and *Hakea dactyloides* (Finger Hakea). The ground stratum contains a diverse range of forbs including *Themeda australis, Entolasia stricta, Cyathochaeta diandra, Dianella revoluta* subsp. *revoluta* (Blueberry Lilly)*, Stylidium graminifolium, Platysace ericoides, Laxmannia gracilis* (Slender Wire Lilly) and *Aristida warburgii*.

2.4.14. Upper Georges River Sandstone Woodland

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and Tozer (2003) have described Map Unit 32: Upper Georges River Sandstone Woodland as occurring predominantly on the Mittagong Formations typically on upper slopes and ridges. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The canopy is dominated by *Eucalyptus punctata* and *E. gummifera (*Red Bloodwood), with *E. sparsifolia* and *Allocasuarina littoralis*. Shrub species include *Acacia ulicifolia* (Prickly Moses), *Acacia terminalis* (Sunshine Wattle), *Acacia linifolia* (Narrow-leaved Wattle), *Persoonia linearis, Leptospermum trinervium* and *Exocarpos strictus* (Dwarf Cherry). The ground stratum is often dominated by grass species such as *Entolasia stricta*, *Themeda australis*, *Austrostipa pubescens, Aristida vagans* and *Austrodanthonia fluva*.

2.4.15. Western Sandstone Gully Forest

The Native Vegetation of the Cumberland Plain mapping (NPWS 2002a;b) and Tozer (2003) have described Map Unit 33: Western Sandstone Gully Forest as occurring on the lower slopes of sandstone gullies on Hawkesbury Sandstone and Mittagong Formations. This community does not correspond to a State or Commonwealth listed threatened ecological community.

The canopy is dominated by *Angophora costata, Corymbia gummifera* and *E. pilularis*, with occasional occurrences of *E. punctata*. A sparse layer of smaller trees is dominated by *Ceratopetalum gummiferum* (Christmas Bush) and *Allocasuarina littoralis*. Shrub species include *Acacia terminalis*, *Leptospermum trinervium, Persoonia linearis* and *Banksia spinulosa*. In the ground stratum, the fern species *Pteridium esculentum* is invariably present, along with the climber *Smilax glyciphylla* (Sweet Sarsaparilla).

2.4.16. Sandstone Ridgetop Woodland

Map Unit 31: Sandstone Ridgetop Woodland has been described by Tozer (2003) as occurring predominantly on sandstone ridgetops and plateaux, but may extend into shallow gullies. This community does not correspond to a State or Commonwealth listed threatened ecological community and is common in the locality.

Sandstone Ridgetop Woodland is dominated by *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum*)* with *Banksia serrata* (Saw Banksia) present in lower abundance. A diverse shrub layer commonly includes *Banksia spinulosa* var. *spinulosa* (Hairpin Banksia), *Isopogon anemonifolius* (Broad-leaf Drumsticks), *Leptospermum trinervium* (Slender Tea-tree)*, Phyllanthus hirtellus* (Thyme Spurge)*, Dillwynia retorta* and *Eriostemon australasius* subsp. *australasius*. The ground stratum features species such as *Lomandra obliqua, Cyathochaeta diandra, Dampiera stricta* and *Austrostipa pubescens*.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

2.4.17. Endangered Ecological Communities of the Cumberland Plain

Several EECs that are known to occur on the Cumberland Plain are absent from the study area and the wider locality. These include:

- Blue Gum High Forest in the Sydney Basin Bioregion (CEEC);
- Elderslie Banksia Scrub Forest Community (EEC);
- Sydney Turpentine Ironbark Forest (EEC); and
- Western Sydney Dry Rainforest (WSDR) in the Sydney Basin Bioregion (EEC)

These C/EECs have not been described further in this SIS as they do not occur within the locality of the study site.

2.5. Plans and Maps

The following maps are provided at the end of each chapter:

Chapter 1:

- Aerial photograph of the St Marys Development Site (**Figure 1**);
- Zoning of the St Marys Development Site (SREP 30 Amendment 2) (**Figure 2**).

Chapter 2:

- Plan of the subject site identifying the proposal (**Figure 3**);
- Aerial view of the subject site and study area (**Figure 4**);
- Vegetation communities in the locality (OEH, 2013) (**Figure 5**);
- Topography of the locality identifying land uses (**Figure 6**); and
- Aerial photograph of the locality identifying areas of native vegetation (**Figure 7**).

Chapter 3:

- EES (2019) threatened flora species records (**Figure 8**); and
- EES (2019) threatened fauna species records (**Figure 9**).

Chapter 4;

- Flora survey locations (**Figure 10**);
- Fauna survey locations (**Figure 11**);
- Threatened flora and fauna recorded in the study area (**Figure 14**); and

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- Vegetation of the study area (**Figure 15**).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

3. Initial Assessment

This initial assessment provides a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action. Based on habitat assessment and records from the locality and study area, this chapter determines the "subject species" and those species likely to be affected by the proposal ("affected C/EECs/species"). Affected C/EECs/species defines those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

3.1. Endangered and Critically Endangered Ecological Communities

The following endangered and critically endangered ecological communities (referred to collectively as C/EEC's) are known to occur within the study area:

- Cumberland Plain Woodland (CPW);
- River –flat Eucalypt Forest (RFEF);
- Shale-Gravel Transition Forest (SGTF); and
- Freshwater Wetlands on Coastal Floodplains (FWCF).

This SIS considers these C/EECs as subject communities. Of these four communities, only CPW is considered to occur within the subject site. The floristics of SGTF surveyed during the ground-truthing surveys within the subject land suggests that the vegetation patches are not substantially different from those of CPW across the subject land. This vegetation community is therefore considered to be CPW in this SIS, which is of higher conservation status under the TSC Act.

3.2. Threatened Species and Populations Records

3.2.1. Database Records

Threatened species, populations and ecological community records from within the locality were obtained from the Threatened Species Data Collection 'BioNet' (EES, 2019) . The search area was defined as within a 10 km radius of the subject site. These records are shown in **Figure 8** and **Figure 9**.

The number and age of records of threatened species recorded within a 10 km radius of the subject site provided a picture of the distribution for relevant species within the locality and was useful supplementary information when assessing the likelihood of occurrence of threatened species within the study area.

3.2.2. Literature Review

The Western Precinct, including the current study area, has been subject to a series of flora and fauna investigations from the early 1990s until the present date. These have involved literature reviews, database assessments, vegetation mapping, a general census of flora and fauna and targeted surveys for threatened species. A synthesis of the information from the relevant reports has been carried out as part of the Western Precinct Biodiversity Assessment (Cumberland Ecology 2009b) to determine the flora and fauna species which may be affected by any activity within the Western Precinct. A summary of the results of these surveys is shown in **Chapter 4**.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

A summary of more recent surveys conducted specifically for the Western Precinct Biodiversity Assessment and Flora and Fauna Assessments for development applications in the Western Precinct and this SIS is provided in **Chapter 4**.

Table 3.1 provides an initial assessment of the exhaustive list provided by the databases and literature review process. **Table 3.1** also identifies the "subject species", as described below.

3.2.3. Habitat Assessment

Habitat assessment and field surveys of the study area were used to determine the threatened species likely to occur, or occurring on the subject site. The results of this assessment are found in **Chapter 4**.

Based on this habitat assessment, and consideration of the species records for the study area, the threatened species or populations that occur or have potential to occur in the study area were identified (the "subject species").

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 2 : Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Acacia bynoeana	Bynoe's Wattle	E1	V	Found in heath and woodland on sandy soils. Scattered from coast to mountains, uncommon. Associated overstorey species include *Corymbia gummifera* (Red Bloodwood), *Eucalyptus haemastoma* (Scribbly Gum), *Eucalyptus parramattensis* (Parramatta Red Gum), *Banksia serrata* and *Angophora bakeri*.	Unlikely to occur. The study area does not contain sandy soils and the typical overstorey species are absent.	No
Acacia pubescens	Downy Wattle	V	V	Occur in open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland	Potential to occur. Suitable habitat is present in study area	Yes
Allocasuarina glareicola		E1	E	Castlereagh Woodlands on lateritic soils. Found in open woodland with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla* and *Melaleuca decora*. Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool.	Unlikely to occur. Open woodland habitat does not occur and the characteristic overstorey associated with this species are absent.	No
Asterolasia elegans			E	Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest	Unlikely to occur. Suitable habitat does not occur in study area	No
Cynanchum elegans			E	Climber or twiner found on the edge of dry rainforest communities. Also associated with littoral rainforest and Coastal Tea-tree - Coastal Banksia scrub.	Unlikely to occur. No suitable habitat present in study area	No

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Dillwynia tenuifolia		V	V	It has a core distribution within the Cumberland Plain, where it may be locally abundant within scrubby, dry heath areas within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland.	Likely to occur. This species has not been recorded on the subject site. This species has been widely recorded on the SMDS and suitable habitat is present in the study area.	Yes
Eucalyptus benthamii	Camden White Gum	V	V	Occurs in open forest and requires a combination of deep alluvial and a flooding regime that permits seedling establishment	Unlikely to occur. Lack of necessary flooding regime	No
Grevillea juniperina subsp. ***juniperina***	Juniper-leaved Grevillea	V		Restricted to red sandy to clay soils – often lateritic on Wianamatta Shale and Tertiary alluvium in Cumberland Plain Woodland and Castlereagh Woodland	This species has been recorded from the subject site in small numbers, as well as in study area in moderately high numbers. Tens of thousands of this species are estimated to occur in the Regional Park.	Yes
Grevillea parviflora subsp. ***parviflora***	Small Flower Grevillea	V	V	Occurs on sandy clay loam soils, often with lateritic ironstone gravels. Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Soil landscapes include Lucas Heights and Berkshire Park. Often occurs in open, slightly disturbed sites such as along tracks	Potential to occur. Suitable habitat for this species is present in the study area.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Hypsela sessiliflora		E1	X	Known to grow in damp places on Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain woodland	Suitable habitat available but Unlikely to occur due to rarity of species	No
Marsdenia viridiflora subsp. ***viridiflora***		E2		Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. Grows in vine thickets and open shale woodland	Likely to occur. This species has not been recorded on the subject site, although it is known from the study area.	Yes
Melaleuca deanei	Deane's Paperbark	V	V	Grows in heath on sandstone	Unlikely to occur. The study area is not located on sandstone geology and therefore does not provide suitable habitat	No
Micromyrtus minutiflora		E1	V	Restricted to the general area between Richmond and Penrith, western Sydney. Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments.	Likely to occur. This species has not been recorded on the subject site although it has been widely recorded on the SMDS and suitable habitat is present in the study area.	Yes
Persoonia nutans	Nodding Geebung	E1	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained. Also occurs in Shale Gravel Transition Forest and Castlereagh Ironbark Forest. Endemic to Western Sydney.	Likely to occur. This species has not been recorded on the subject site, although it is known from the study area.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
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	Unlikely to occur. The study area is not located on sandstone geology and therefore does not provide suitable habitat	No
Pimelea spicata	Spiked Rice-flower	E1	E	In western Sydney, it occurs on an undulating topography of well-structured clay soils, derived from Wianamatta shale. It is associated with Cumberland Plain Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines. Has been located in disturbed areas that would have previously supported CPW	This species has been historically recorded from the study area. The study area provides suitable habitat for this species.	Yes
Pomaderris brunnea			V	Shrub that grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines in association with *Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua*. Flowers Sept-Oct.	Unlikely to occur due to restricted distribution within NSW	No
Pterostylis gibbosa			E	Found in open forest or woodland, on flat or gently sloping land with poor drainage.	Unlikely to occur due to lack of suitable habitat and restricted distribution within NSW	No
Pterostylis saxicola	Sydney Plains Greenhood	E1		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 it occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils	Unlikely to occur. No suitable habitat components such as sandstone rock shelves occur in the study area	No

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Flora recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Pultenaea parviflora		E1	V	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in ecotone between these communities and Castlereagh Scribbly Gum Woodland.	This species has been recorded from the study area, and subject site and has also been widely recorded throughout the SMDS	Yes
Rhizanthella slateri			E	The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available	Unlikely to occur due to limited distribution within NSW	No
Syzygium paniculatum	Magenta Lilly Pilly	E1	V	Occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforests or on gravels, sands, silts and clays in riverside gallery rainforests	Unlikely to occur. Habitat requirements such as sandstone and rainforest not present in study area	No

Key: E/E1 = Endangered, E2 = Endangered population, V = Vulnerable, X – Extinct

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 3 : Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Invertebrates						
Meridolum corneovirens	Cumberland Plain Land Snail	E1		Primarily inhabits Cumberland Plain Woodland. This community is a grassy, open woodland with occasional dense patches of shrubs.	Potential to occur. This species has been recorded from the SMDS and potential habitat is present in the study area.	Yes
Amphibians						
Litoria aurea	Green and Golden Bell Frog	E1	V	Large permanent freshwater wetlands, with dense stands of reeds	Potential suitable habitat including permanent freshwater wetlands are present in the study area. However, this species is thought to be extinct in Western Sydney and is therefore highly unlikely to occur.	No
Heleioporus australiacus	Giant Burrowing Frog	E1	V	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Breeding habitat is generally soaks or pools within first or second order streams. During non-breeding periods, it burrows below the soil surface or in the leaf litter.	Unlikely to occur. Some potential habitat occurs in the study area, only 1 record exists for this species.	No
Aves						

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Actitis hypoleucos	Common Sandpiper		C, J, K	Abundant in mangrove inlets but also present in rocky shores and margins of coastal and inland wetlands	Unlikely to occur. Suitable habitat not present in study area	No
Anthochaera phrygia	Regent Honeyeater	E4A	E, M	Dry open forests, woodlands, especially red ironbark, yellow box, yellow gum	Potential to occur. Woodland habitat is present in the study area.	Yes
Apus pacificus	Fork-tailed Swift		C, J, K	Highly mobile whilst in Australia and almost exclusively aerial to 300m. Mostly found over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh of inland plains	Unlikely to occur. Individuals may fly over area while migrating to more suitable habitats	No
Ardea ibis	Cattle Egret		C, J	Inhabit shallow water and wetland habitats (such as inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial.	Unlikely to occur. Favours marine/estuarine habitats which do not occur within the study area	No
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V		In New South Wales the species is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. The Dusky Woodswallow is found in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. The species primarily eats invertebrates, mainly insects, which are	Potential to occur. This species has been recorded in the Regional Park in 2004 and 2011 within mature woodland habitat in the study area.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				captured whilst hovering and sallying above the canopy or over water.		
Botaurus poiciloptilus	Australasian Bittern	E1		Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes	Potential suitable habitat including permanent freshwater wetlands are present in the study area. Only one record for the area, so unlikely to occur	No
Burhinus grallarius	Bush Stone-curlew	E1		Well wooded floodplain forests, amongst fallen timber	Unlikely to occur. No suitable floodplain forest habitat for this species is present in the study area	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Wetter forests, and woodlands, from sea level to 2000m on divide. From timbered foothills and valleys to suburban gardens. Nests in large tree hollows.	Potential to occur. Potential foraging habitat for this species is present in the study area, although limited nesting habitat is present due to the lack of large hollow bearing trees.	Yes
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Eucalypt forests and woodlands and forage in *Casuarina* and *Allocasuarina* species. Nest in large tree hollows	Potential to occur. This species has been recorded from near the SMDS according to the Atlas of NSW Wildlife (DECCW 2010). However, the SMDS lacks suitable foraging habitat and large tall hollow-bearing trees for nesting, therefore is not likely to be a significant area of habitat.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Chthonicola sagittata	Speckled Warbler	V		Occurs in communities dominated by Eucalyptus, with a grassy understorey, most commonly occurring on rocky ridges and gullies.	Potential to occur. This species has been recorded from the SMDS and suitable habitat occurs in the study area.	Yes
Circus assimilis	Spotted Harrier	V		Grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Potential to occur. Suitable foraging habitat is present in the study area.	Yes
Daphoenositta chrysoptera	Varied Sittella	V		Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes
Ephippiorhynchus asiaticus	Black-necked Stork	E1		Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands, floodplains. Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with	Potential to occur. Some wetland habitat is present in the study area.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				short emergent vegetation and permanent billabongs and pools on floodplains.		
Gallianago hardwickii	Latham's Snipe		C, J, K	In Australia, inhabit permanent and ephemeral open, freshwater wetlands with low, dense vegetation up to 2000 m above sea-level. Forage in areas of mud (either exposed or beneath a very shallow covering of water) and some form of cover (e.g. low, dense vegetation).	Potential suitable habitat including permanent freshwater wetlands are present in the study area. May pass through the area so Potential to occur	No
Glossopsitta pusilla	Little Lorikeet	V		Mostly occurs in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees are also used.	Potential to occur. Potential woodland habitat is present in the study area.	Yes
Grantiella picta	Painted Honeyeater	V		A nomadic species that typically inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests with abundant mistletoe. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				and acacias, preferring *Amyema* sp. (mistletoe).		
Haliaeetus leucogaster	White-bellied Sea-Eagle		C	Australian distribution along the coastline and some larger inland waterways. Generally forage over large expanses of open water, in-shore waters and open terrestrial habitats.	Unlikely to occur. Favoured habitats not present in study area	No
Hieraaetus morphnoides	Little Eagle	V		The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch.	Potential to occur. Eucalypt woodland habitat is present in the study area.	Yes
Hirundapus caudacutus	White-throated Needletail		C, J, K	Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Occur over most types of habitat, particularly above wooded areas including open forest and rainforest, between trees or in clearings and below the canopy.	Unlikely to occur. Favoured habitats are not present in study area	No
Ixobrychus flavicollis	Black Bittern	V		Boggy marsh, wetland margins	Potential to occur. Wetland habitat is present in the study area.	Yes
Lathamus discolor	Swift Parrot	E1	E	Forests, woodlands, plantations, banksias, street trees and gardens	Potential to occur. Woodland habitat is present in the study area.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Limosa limosa	Black-tailed Godwit	V	C, J,K,	Primarily a coastal species, found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.	Unlikely to occur. No suitable mudflat/ sandflat habitat present	No
Lophoictinia isura	Square-tailed Kite	V		Diverse habitats from dry woodlands and open forests. Shows a particular preference to timbered watercourses	Potential to occur. Woodland foraging habitat is present in the study area and it may forage over the study area as part of a larger range	Yes
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	Potential to occur. Suitable habitat such as native grassland and woodland is present in the study area.	Yes
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V		Drier eucalypt forests, woodlands, timber on water courses, often no understorey, scrubs. Favours ironbark woodlands on western slopes.	Potential to occur. Woodland habitat is present in the study area.	Yes
Merops ornatus	Rainbow Bee-eater		J	Inhabit heathland, open forests and woodlands, shrublands, and various cleared or semi-cleared habitats, including farmland and areas of human habitation. Often occur in open, cleared or lightly-timbered areas	Potential to occur. This species occurs in a wide range of habitats and suitable habitat such as open areas, woodland and permanent water is present in the study area.	No

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				located in close proximity to permanent water.		
Neophema pulchella	Turquoise Parrot	V		Steep rocky ridges and gullies, rolling hills, valleys and river flats and the plains of the Great Dividing Range. It is associated with coastal scrubland, open forest and timbered grassland, especially low shrub ecotones between dry hardwood forests and grasslands with high proportion of native grasses and forbs.	Potential to occur. This species occurs in a wide range of habitats and suitable habitat such as native grassland and woodland is present in the study area.	No
Ninox connivens	Barking Owl	V		Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Is flexible in its habitat use and hunting can extend in to closed forest and more open areas. Requires very large permanent territories.	Unlikely to occur. Habitat and prey species present but territorial requirements may exceed availability, especially as potential breeding habitat (large tree hollows) is minimal.	No
Ninox strenua	Powerful Owl	V		Habitat for this species is widespread and is primarily tall moist eucalypt forest of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests occurring on undulating gentle terrain nearer the coast. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities	Unlikely to occur. Moist tall eucalypt forest is not present in the study area. Potential breeding habitat is minimal as no large tree hollows are present.	No

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
				of arboreal marsupials. Pairs occupy large, probably permanent home and nest in large hollows.		
Oxyura australis	Blue-billed Duck	V		Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached	Potential to occur. Wetland habitat is present in the study area.	Yes
Petroica boodang	Scarlet Robin	V		The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris.	Potential to occur. Woodland habitat is present in the study area and logs and woody debris are present.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Petroica phoenicea	Flame Robin	V		In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains	Potential to occur, particularly in winter when the species migrates to more open habitats	Yes
Petroica rodinogaster	Pink Robin	V		Inhabits rainforest and tall, open, eucalypt forest, particularly in densely vegetated gullies. It catches prey by pouncing from perches to the ground, feeding on insects and spiders.	Potential to occur Eucalypt forest present in the study area.	Yes
Rostratula australis	Australian Painted Snipe	E1	V	Inhabits fringes of shallow inland wetlands, swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Potential to occur. Wetland habitat is present in study area	Yes
Stagonopleura guttata	Diamond Firetail	V		Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands	Potential to occur. Suitable habitat is present in the study area.	Yes
Stictonetta naevosa	Freckled Duck	V		Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters	Potential to occur. Wetland habitat is present in the study area.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Tringa glareola	Wood Sandpiper		C, J, K	Uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes	Potential habitat does occur in study area. Species favours Western Australia so unlikely to occur	Yes
Tringa nebularia	Common Greenshank		C, J, K	Occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass	Unlikely to occur. Favoured habitat is not present in study area	No
Tyto novaehollandiae	Masked Owl	V		Occurs mainly in large areas of forests. Roosts in large hollow	Unlikely to occur. Dense forest habitat is not readily available in Western Sydney and there is a lack of records in the locality. Very limited breeding habitat is available due to the lack of large trees with hollows.	No
Tyto tenebricosa	Sooty Owl	V		Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species. Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. Typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows	Unlikely to occur. No suitable habitat such as wet old growth forest is present in the study area, and no large trees with hollows are present.	No
Mammals						

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Frequents low to mid-elevation dry open forest and woodland close to caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Hirundo ariel). Probably forages for small, flying insects below the forest canopy	Potential to occur. May forage over the study area however no suitable roosting habitat such as caves, cliffs or mines are present in the study area.	Yes
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Occurs in wide variety of habitats in large remnants. Dens in tree hollows, hollow logs or rock crevices	Potential to occur. Woodland habitat is present in the study area as are habitat resources such as hollow logs.	Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Usually roosts in tree hollows in the higher rainfall forests within its range.	Potential to occur. May forage over the study area however no suitable roosting habitat is present in the study area.	Yes
Miniopterus australis	Little Bent-winged Bat	V		Moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Potential to occur. May forage over the study area however suitable roosting habitat such as caves or mines are not present in the study area.	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		Forages above the canopy and eats mostly moths. Roosts in caves, old mines, road culverts	Potential to occur. May forage over the study area however no suitable	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
					roosting habitat such as caves or mines are present in the study area.	
Micronomus norfolkensis	EastCoastal Free-tailed Bat	V		Inhabits dry and wet sclerophyll forests, coastal woodland. Roosts in tree hollows and buildings. Have been found roosting under the bark of trees.	Potential to occur. May forage over the study area and suitable roosting habitat is present in the study area.	Yes
Myotis macropus	Southern Myotis	V		Known from a range of habitats close to water from lakes, small creeks to large lakes and mangrove lined estuaries	Potential to occur. Aquatic foraging habitat is present in the study area.	Yes
Petaurus australis	Yellow-bellied Glider	V		Patchily distributed in wet sclerophyll forest	Unlikely to occur. No wet sclerophyll forest is present in the study area.	No
Petaurus norfolcensis	Squirrel Glider	V		Associated with dry hardwood forest and woodlands. Habitats typically include gum barked and high nectar producing species, including winter flower species. The presence of hollow bearing eucalypts is a critical habitat value	Potential to occur. Woodland habitat is present in the study area.	Yes
Petrogale penicillata	Brush-tailed Rock-Wallaby	E1	V	Inhabit rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north.	Unlikely to occur. No suitable habitat present on site	No

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Phascolarctos cinereus	Koala	V		Widespread in sclerophyll forest and woodlands. Requires relatively large home ranges.	Potential to occur. Potential habitat occurs in the study area however this species has not been recorded. The habitat on the study area is relatively isolated and it is not likely to form part of a home range of a Koala.	Yes
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	Inhabits dry/wet sclerophyll forests or coastal heaths with dense understorey and occasional open areas	Unlikely to occur. No wet sclerophyll forest or coastal heath present in the study area	
Pseudomys novaehollandiae	New Holland Mouse		V	Inhabits open heathland, open woodland and vegetated sand dunes in coastal areas and up to 100 km inland on sandstone country up to 900m altitude.	Unlikely to occur. Has very specific habitat requirements that do not occur in the study area	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Roosts in large camps and disperses nightly up to 20km to feed in flowering eucalypts	Potential to occur. No roosting camps are present in the study area however potential foraging habitat is present in the study area.	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Roosts in tree hollows and buildings; utilises mammal burrows in treeless areas. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory	Potential to occur. May forage over the study area and some roosting habitat is available.	Yes

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Fauna recorded in the Locality and the Assessment of the Likelihood of Occurrence						
Scientific Name	**Common Name**	**Status**		**Habitat Requirements**	**Likelihood of occurrence**	**Subject Species?**
		TSC Act	**EPBC Act**			
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Usually in tall wet forest, extending into drier forest along gullies. Forages along forest edges. Roosts in tree hollows	Has been recorded, despite the lack of optimal wet forest habitat present in the study area.	Yes

Key: E/E1 = Endangered, E2 = Endangered population, E4A = Critically Endangered, V = Vulnerable, C - China-Australia Migratory Bird Agreement (CAMBA), J - Japan-Australia Migratory Bird Agreement (JAMBA), K - Republic of Korea - Australia Migratory Bird Agreement (ROKAMBA), M = Migratory species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

4. Survey

This chapter presents the background of ecological studies in the subject area, details of the procedures for the current surveys undertaken for the purposes of this SIS and the results of past and current surveys in relation to flora and fauna, vegetation communities and mapping and the occurrence of any threatened species, in accordance with CERs 4.1; *Requirement to Survey* and 4.2; *Documentation*.

4.1. Survey Background

4.1.1. Historical Surveys

The Former ADI Site and its surrounds have been subject to detailed flora and fauna studies since the area was rezoned in 1993. There has been considerable ecological survey effort within the locality of the study area in recent times by Government and Industry. The contemporary studies completed within the Western Precinct and within the locality were reviewed, including unpublished reports prepared for EES on the flora and fauna of both the Western Precinct and adjacent Regional Park. The reports utilised to inform this SIS include:

- ERM (2000) Assessment of the Implications of Development for Land Registered on the National Estate at St Marys NSW Report to ComLand Limited Environmental Resources Management Australia, Sydney.
- Gunninah (1991) Australian Defence Industries (ADI) Site, St Marys, Fauna Survey Gunninah Environmental Consultants, Sydney.
- Gunninah (1995) Australian Defence Industries St Marys Planning Study: Flora and Fauna Issues Gunninah Environmental Consultants, Sydney.
- Cumberland Ecology (2004a) St Mary's Eastern Precinct: Fauna and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications Cumberland Ecology, Sydney.
- Cumberland Ecology (2004c) Stage 1 Subdivision, St Mary's Eastern Precinct: Part Lot 2 DP 1038166 Species Impact Statement Cumberland Ecology, Sydney.
- Cumberland Ecology (2005) St Marys North and South Dunheved Precincts Plan: Biodiversity Assessment Cumberland Ecology, Epping.
- NPWS (2000a) The Native Vegetation of the Cumberland Plain, Western Sydney: Technical Report, NSW National Parks and Wildlife Service, Hurstville.
- DUAP (2001) Sydney Regional Environmental Plan No. 30: St Marys Department of Urban Affairs and Planning, Sydney.
- DUAP (2001) St Marys Environmental Planning Strategy 2000 Department of Urban Affairs and Planning, Sydney.
- Perkins, I. (1999) Flora Assessment of the Disputed Areas of Western Sydney Shale Woodlands Ian Perkins Consultancy Services, Sydney.
- Cumberland Ecology (2008) St Marys Property - Western Precinct: Biodiversity Assessment Cumberland Ecology, Epping.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- Cumberland Ecology (2004 – 2016) Analysis of the Response of Cumberland Plain Woodland to Grazing by Macrofauna on the SMDS: Floristic and Structural Changes (one – eleven) years after grazing exclosure. Cumberland Ecology, Epping.
- Cumberland Ecology (2012d) Village 4 development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Epping.
- Cumberland Ecology (2012b) Riparian Corridor Development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Epping.
- Cumberland Ecology (2014a). Development within the Central Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Carlingford Court, NSW.

4.1.2. Recent Surveys

Detailed surveys of the Western Precinct were completed in 2011, 2012 and 2013 to update existing knowledge of the biodiversity values within the Western Precinct in line with legislative changes (as applicable under the TSC Act), current survey guidelines and new protected species listings, and to provide baseline flora and fauna data. These surveys were completed in compliance with the EES guidelines for flora and fauna survey (DEC (NSW) 2004).

Additional surveys were conducted on the subject site and immediate surrounds within the Regional Park, as part of the preparation of this SIS on 6 November 2019, to update the existing data.

4.1.2.1. Vegetation Surveys

Vegetation mapping has previously taken place within the study area and across the whole St Mary's Property. However due to the increasing importance placed by government agencies on the conservation of CEECs under the TSC Act and EPBC Act (although the EPBC Act status is not applicable for the SMDS) there was a need for additional floristic surveys.

4.1.2.2. Targeted threatened species surveys

Based on the identification of threatened species from assessment of species records and the habitats present, targeted surveys were conducted for the following threatened species groups:

- Shrubs and herbs associated with Cumberland Plain Woodland (in particular *Pimelea spicata* and *Grevillea juniperina* subsp. *juniperina*); and
- Cumberland Plain Land Snail.

4.2. Survey Methods

4.2.1. Terrestrial Survey

4.2.1.1. Dates of Survey

The most recent surveys built upon an existing database of flora and fauna records that included data from the 1990s and 2000s. Recent survey data is also available from nearby areas of the Western Precinct and

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Central Precinct, being from those surveys undertaken to inform flora and fauna assessments in the Eastern Precinct. A summary of records and survey effort from earlier surveys is provided within **Appendix B**.

The detailed field surveys within the Regional Park took place over the 2011 autumn period and are summarised in **Table 4.1**. Both floristic and faunal surveys were conducted throughout this survey period. Further targeted flora surveys and fauna habitat assessments were also conducted along a road easement within the Regional Park, between the Central and Western Precincts on 2 August 2012. In September 2013 detailed flora surveys, fauna habitat assessments and targeted searches for threatened species were undertaken within the subject site and two proposed drainage basin areas within the study area.

Further targeted flora surveys and fauna habitat assessments were also conducted within the subject site and immediate surrounds on 6 November 2019 to verify current conditions and supplement the older survey data.

Table 4 : Dates of Field Surveys

Dates of Survey	Tasks completed
April 14, 2011	Flora Quadrats, targeted threatened flora searches
April 22, 2011	Flora Quadrats, targeted threatened flora searches
April 27-29, 2011	Diurnal bird surveys, snail searches, targeted threatened flora searches
August 2, 2012	Targeted threatened flora searches, fauna habitat assessment
September 5-6, 2013	Vegetation mapping, flora quadrats, targeted threatened flora and fauna searches
September 9-10, 2013	Vegetation mapping, flora quadrats, targeted threatened flora and fauna searches
September 13, 2013	Vegetation mapping, flora quadrats, targeted threatened flora and fauna searches
January, February and August 2018	Flora quadrats, targeted threatened flora and fauna searches for the Jordan Springs Retirement Village (southern part of the Western Precinct)
May 2018	Vegetation mapping, flora quadrats, threatened flora searches, Cumberland Plain Land Snail searches of the area for Regional Detention Basin I (south of the Western Precinct)
6 November 2019	Flora quadrats, targeted threatened flora and fauna searches, Cumberland Plain Land Snail searches, diurnal bird surveys within the current subject site

4.2.1.2. Flora Survey

i. Vegetation Mapping of the Central Precinct and Regional Park

Vegetation maps provided by DECC in the Mapping of the Cumberland Plain (2007) and the 2013 update (OEH, 2013) and ground-truthing that was undertaken by Cumberland Ecology in 2007-2008 to inform the Central Precinct Biodiversity Assessment (Cumberland Ecology, 2008) were used as a basis for the most recent investigations.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The vegetation mapping was ground-truthed across much of the study area, and included the subject site, in September 2013, and aligned with current descriptions of vegetation communities, in particular C/EEC descriptions under the TSC Act. Surveying for vegetation mapping for the current SIS was conducted in May 2018 and included extensive flora surveys within the subject site, through quadrat sampling (20m x 20m) located within all classes of the vegetation communities.

The resultant information was synthesised using Geographical Information Systems (GIS) to create a spatial database that was used to interpret and interpolate the data to produce a vegetation map of the Central Precinct. Mapping was updated using ArcG GIS (ESRI 2011) using a Windows XP 7 platform.

ii. Floristic Census and Targeted Surveys

The flora assemblage within the study area was recorded by quadrat sampling and through targeted searches for threatened species. The subject site and adjacent areas were traversed extensively during the 2011 and 2012 surveys. Nonetheless, an additional survey of the subject site was conducted on 2 May 2018 to determine conditions of vegetation within the subject site in light of recent development in adjacent areas.

The locations of all threatened species detected within the traverses during the 2011 - 2013 and the 2018 surveys were recorded, with estimates of the population size made. All vascular plants recorded or collected were identified using keys and nomenclature provided in Harden (1990-1993). Additionally, Richardson et al. (2006) (2006) was used to assist identification of selected plant taxa. Where known, taxonomic and nomenclatural changes have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2014). Any specimens that were not readily identifiable were lodged for identification with the National Herbarium of NSW at the Royal Botanic Gardens, Sydney.

iii. Quadrat Sampling

A total of 59 quadrats were sampled across the 2009 - 2013 survey periods in 20 x 20 metre plots, and an additional two (2) plots were surveyed in 2019 on the subject site and immediate surrounds. The locations of these quadrats were chosen so that sampling was conducted in areas most representative of the condition and composition of the vegetation patch. The quadrat locations are shown in **Figure 10**. Flora quadrat data is provided in **Appendix C**. In each quadrat, the following information was recorded as a minimum:

- All vascular flora species present within the plot or directly adjacent to the plot;
- The stratum in which each species occurred;
- The relative frequency of occurrence of each plant species;
- Vegetation structural data (i.e. height and percentage cover of each stratum);
- A waypoint to mark the location of the quadrat, using a handheld GPS; and
- Photographs of the quadrat.

The relative abundance and cover of each species within the quadrat was approximated using a scoring system based on the Braun-Blanquet scoring system (Braun-Blanquet 1927). The scores used are provided in **Table 4.2**.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 5 : Modified Braun-Blanquet scores used in Quadrat surveys

Class	Cover-abundance	Notes
+	Rare (less than 1 % cover)	Herbs, sedges and grasses: within 4 m^2 Shrubs and small trees: less than 5 individuals.
1	Few Individuals (less than 5 % cover)	Herbs, sedges and grasses: within 20 m^2 Shrubs and small trees: 5 or more individuals Medium - large overhanging tree.
2	5 - less than 25 % cover	-
3	25 - less than 50 % cover	-
4	50 - less than 75 % cover	-
5	75 - 100 % cover	-

4.2.1.3. Fauna survey

Fauna surveys were conducted within the Regional Park areas, along with parts of the Central and Western Precincts of the SMDS, where possible, in accordance with EES guidelines for ecological assessment (DEC (NSW) 2004). Due to the extensive nature of these surveys, combined with data from historic surveys of the SMDS, further surveys for highly mobile fauna, such as birds and bats, were deemed unnecessary in 2019 for the entire study area, although updated diurnal birds surveys and targeted searches for the Cumberland Plain Land Snail were undertaken during the 2019 survey period within the subject site.

As EES survey guidelines are based upon stratification units, the study area was stratified using vegetation units as a surrogate for fauna habitat and survey effort was allocated accordingly. This was determined to constitute the following units:

- Sparse regenerating woodland and grassland, and disturbed habitats (referred to as Area A, being the development zoned land, including the Precincts, and Drainage land on the subject site);
- Regenerating woodland (continuous) (referred to as area B, being the regrowth woodland added to the Regional Park since 1990); and
- Mature Woodland (referred to area C, being the established mature woodland of the Regional Park).

A summary of sampling method and effort used are provided in **Table 4.3**. Fauna survey locations are shown in **Figure 11**.

Table 6 : Fauna Survey Methods and Effort

Survey Method	CE Survey Effort in Study Area
Amphibians	
Opportunistic call detection	Throughout survey period
Reptiles	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Survey Method	CE Survey Effort in Study Area
Opportunistic sightings	Throughout survey period
Diurnal Birds	
Walking transects	9 Hours (3 hours at 3 sites) for the study area, an additional 1 hour on the subject site in 2019
Opportunistic sightings	Throughout survey period
Nocturnal Birds	
Day habitat search	Throughout survey period
Non-flying Mammals	
Search for scats and signs	5 hours
Bats	
Ultrasonic call recording	6 nights
Snails	
Active habitat searches (spot assessment method)	300 sites + additional 2 sites on the subject site in 2019

i. Bat Surveys

Microchiropteran bats (microbats) were surveyed through the use of Anabat Z-caim units to record ultrasonic bat recordings.

Anabat Z-caim units were employed during the 2011 survey to record calls of microbats and were left at each survey location for two nights. Anabats were set before dusk each evening and set to automatically switch off after dawn. Calls recorded on each Anabat unit were analysed to determine which species were present within the study area.

ii. Diurnal Bird Surveys

Visual observation and call identification of diurnal birds was carried out during each survey period. Dawn surveys were conducted at several points throughout the Western Precinct, and in the adjacent Regional Park, through the use of 500m walking transects over a 1 hour time period. Stops were made throughout the transects to positively identify birds, and detect cryptic species in the vegetation adjacent to the transect. Diurnal birds were also identified and recorded as they were encountered throughout the Regional Park during the survey periods. GPS readings were taken near sightings of any threatened bird species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

iii. Cumberland Plain Land Snail Assessment –Spot Assessment Technique

A survey of Cumberland Plain Land Snail activity was conducted based on an adaption of the methodology known as the Regularised Grid-Based Spot Assessment Technique (RGB-SAT) protocol developed by Biolink (Biolink 2008), generally used to detect Koala scats. The spot assessment technique did not adhere strictly to a grid based protocol, but rather sampled five representative sites within each zone, at approximately equal spacing's from each site.

A total of 18 sampling points were taken, ten during the 2011 surveys and eleven during the 2013 surveys, three during the 2018 surveys, and one during the 2019 survey. Of the 2011 survey points, five each were located within regenerating (Area B) and mature (Area C) areas of CPW in the Regional Park.

Searches of five minutes in duration were made within the one metre of each of 20 trees for either live snails, or snail shells. Where there was no suitable habitat present, an appropriate habitat tree within a 100m radius of the sampling point was chosen. Trees that were targeted were those which provided suitable habitat for the species, predominantly those with a DBH of over 10cm and having a layer of bark around their base. Typical species included *Eucalyptus moluccana* (Grey Box) and to a lesser extent *Eucalyptus tereticornis* (Forest Red Gum).

Supplementary survey was undertaken on the subject site at one sampling point, using the same methods.

iv. Incidental Observations

Any incidental vertebrate fauna species that were heard calling, observed or otherwise detected on the basis of tracks or signs during 2011 fauna surveys. August 2012 traverses and 2013 surveys were recorded and listed in the total species list for the subject site. Incidental records of threatened flora and fauna from areas adjacent to the study area have also been included.

4.2.1.4. Habitat Assessment

The characteristic attributes of different types of fauna habitat generally influences the assemblage of fauna species that can be found within each habitat and also affects the general value of the habitat for fauna. The study area contains three broad habitat types that vary in their value for fauna. These are:

- Remnant woodland and open forest;
- Riparian vegetation associated with minor tributaries and drainage lines;
- Young regenerating woodland; and
- Grassland.

Habitat condition was assessed during the 2011 surveys (Regional Park), 2013 surveys of the Western Precinct and the November 2019 surveys of the subject site by noting ground and canopy cover, number and size of hollows present, habitat features such as bush rock and fallen trees, and signs of fauna usage such as scats and scratches.

Fauna habitat assessments also included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

areas such as creeks and soaks. An assessment of the structural complexity of vegetation, the age structure of the forest and the nature and extent of human disturbance throughout the study area was undertaken and considered.

i. Hollow Assessment

Hollows are used as a general indication of habitat quality for arboreal fauna, and hollow-dependent birds and bats. Hollow assessments were conducted at each of the 21 sampling points used for the above Cumberland Plain Land Snail assessment. Hollows observed during surveys were recorded and the general vegetation condition and tree maturity were used to predict whether trees on site are likely to contain hollows. Hollow size classes are defined in **Table 4.4** below. Indirect indicators of fauna use of the site such as droppings, diggings, footprints, scratches, nests, burrows, paths and runways were also noted.

Table 7 : Tree Hollow Size Class

Class	Diameter (cm)
Small	<10
Medium	10>-<30
Large	>30

Hollows were also searched for within each flora survey plot.

4.2.2. Statistical Analyses

Percentage composition of native and exotic flora species in the different study areas from current and previous surveys were calculated and plotted in Microsoft Excel.

Differences in Cumberland Plain Land Snail numbers between the different areas were analysed using the Statistical software package, SPSS (Version 17). Data was tested for normality and homogeneity of variance and then analysed using Kruskal-Wallis (K-W) tests as Analysis of Variance (ANOVA) requirements were not met even after data transformations. Mann-Whitney U-tests were used for post-hoc pair wise comparisons between areas for the K-W tests. As U-tests are not typical post-hoc tests, a Bonferroni adjustment was applied to the level of significance to avoid Type I errors. As three comparisons were run, this reduced the standard 0.05 level of significance to 0.017 (0.05/3).

4.2.3. Weather Conditions for Surveys by Cumberland Ecology

This report draws upon information collected by numerous ecologists over many years, including studies done across the 900ha Regional Park and both the Western and other Precincts. Surveys have therefore been conducted in all seasons and in a wide variety of weather conditions. This means that the resultant database of ecological information is detailed and reliable.

Weather conditions during surveys by Cumberland Ecology were generally appropriate for detection of a wide variety of flora and fauna.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

A summary of weather conditions in the locality of the study area during the 2011, 2013 and 2018 surveys is provided in **Table 4.5**. Weather conditions during the 2011 survey period stayed predominantly cool to mild, with the daily maximum temperature varying from 18.3°C to 25.7°C. Rainfall was recorded on two days, with most other days being overcast but remaining dry.

Conditions leading up to and during the 2011, 2013 and 2018 survey periods were generally warm with no rainfall.

The November 2019 surveys were conducted during dry weather, leading to a more limited diversity of flora species being recorded. However, conditions leading up to the surveys had been warm and dry, with below average rainfall recorded in the months prior. A summary of the conditions for the November 2019 surveys are shown in **Table 4.5**.

Table 8 : Summary of Weather Conditions during 2011 and 2019 survey period

Date	°C min	°C max	Rain (mm)
14/04/2011	9.9	24.1	0
22/04/2011	12	25.7	0
27/04/2011	14.5	18.9	5.4
28/04/2011	14.1	20.1	0.4
29/04/2011	13.9	20.8	2.8
02/05/2011	9.9	18.3	0
05/09/2013	8.3	28.3	0
06/09/2013	11.2	28.6	0
09/09/2013	14.0	27.2	0
10/09/2013	15.4	32.3	0
13/09/2013	9.0	18.9	0
2/05/2018	10.2	21.7	0
6/11/2019	8.5	31.5	0

4.2.4. Survey Limitations

Adequate ecological data exists for the assessment of the ecological impacts for the Project. There are no significant limitations to the data available.

The flora and fauna of the study area, the SMDS and immediate surrounds have been subject to a series of surveys over many years. Consequently, the ecology of the study area and indeed the flora and fauna of the locality is well known. There is an excellent baseline of flora and fauna data, including vegetation mapping, and information about individual species.

The SMDS and its surrounds have been subject to detailed flora and fauna studies since the area was rezoned in 1993. There has been considerable ecological survey effort within the locality of the Western Precinct in

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

recent years for baseline data by Government and Industry. The contemporary studies completed within the Western Precinct and within the locality were reviewed, including unpublished reports prepared for EES on the flora and fauna of both the Western Precinct and adjacent Regional Park. These included vegetation community mapping, targeted threatened species surveys listed in **Section 4.1.1** above.

At the time of the 2011, 2012, 2013, 2018 and 2019 surveys by Cumberland Ecology, and in the months before, the weather conditions had been favourable for plant growth and reproduction. Features such as flowers and fruits required for identification of most plants to species level was available. Grasses, herbs and creepers were readily identifiable in most instances. The 2019 survey was conducted during fairly dry weather, which may have resulted in a fewer species being identified, although this data is supported by the extensive existing flora data available.

A range of threatened flora species are known to occur in the locality, and the SMDS. The majority of these threatened flora species were not detected on the subject site or study area during the surveys to date. However, the habitats that are present in the subject site and study area have the potential to support the species. For this reason, where potential habitats were present, it was assumed that minor or negligible impacts to the species could occur, despite negative survey results. Species that have been recorded on the subject site are considered as major affected species in this SIS, and are assessed as such.

The comprehensive fauna surveys previously conducted on the SMDS were generally undertaken according to EES guidelines (DEC (NSW) 2004) (despite a number of the historic surveys being prior to this publication date). Targeted fauna surveys conducted for this SIS were not intended as baseline fauna surveys, due to this extensive prior survey data, but were conducted to supplement previous surveys and provide updated data for specific threatened species. The data produced by the surveys is intended to be indicative of the types of species that could occur and not an absolute census of all flora and fauna species of the study area.

4.3. Survey Results

This section presents the results of recent surveys and describes the flora and fauna of the study area, taking into account information obtained from previous surveys and surveys undertaken specifically for the Western Precinct Biodiversity Assessment, and for this SIS. Particular emphasis has been placed on threatened flora and vegetation communities that have been recorded from the SMDS or that could potentially occur.

This addresses the CERs 4.2; Documentation and subsections 4.2.3 Description and mapping of results of vegetation, flora and fauna surveys.

Detailed descriptions of each of the communities listed above are provided in the following sections.

4.3.1. Vegetation Communities of the Study Area

Cumberland Plain Woodland (CPW) is the dominant vegetation community occurring in the study area. Across much of the study area, its occurrence ranges from sparse open woodland interspersed with large patches of grassland to more intact, large areas of woodland. Within the Western Precinct, vegetation has largely been cleared, but included predominantly a low quality variant of the community known as CPW Low diversity Derived Native Grassland. All three variants of CPW are present within the subject site. Detailed descriptions of each of the communities listed above are provided in the following sections.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

For the purposes of this SIS, three sampling areas were identified:

- Area A: The development zoned land, including the Western Precinct and the Drainage zoned land on the subject site. The vegetation in this area include more sparse and degraded occurrences of the vegetation communities present in the study area. The current subject site is included within this area;
- Area B: The Regional Park; including areas of regenerating CPW that are of a similar age to Area A. This area was identified during very early surveys by Perkins as being of higher quality than CPW in Area A, and consequently the woodland was added to the larger 900ha Regional Park; and
- Area C: The Regional Park; including predominantly mature CPW and RFEF and some patches of grassland that historically experienced higher levels of disturbance than other parts of the Regional Park.

4.3.1.1. Cumberland Plain Woodland

i. Mature CPW in the Regional Park

The CPW in the central portions of the Regional Park, which has been included in the eastern extent of the study area for the purposes of this SIS, generally contained mature CPW and other woodland types. Quadrats conducted within this variation of CPW in the Regional Park were located within the mature and structurally complex woodland shown as Area C (or Quadrats labelled with C in **Figure 10**). A small number of plots within Areas A and B also conformed to this mature class of CPW. However, not all quadrats in area C conformed to this definition, as open-structured regenerating plots and some grassland plots were also surveyed for comparison with the subject land.

The canopy of the mature CPW in the Regional Park was open and almost exclusively dominated by *Eucalyptus moluccana* with soma areas also containing *E. fibrosa* (Broad-leaved Ironbark) and *E. tereticornis* with an average Projective Foliage Cover (PFC) of 10-40%. The midstorey was also dominated by sparse small trees of *E. moluccana*, *Acacia parramattensis* (Parramatta Wattle) with some areas including *E. tereticornis* with a slightly variable PFC of between 1-5% and occasionally up to 20%. A very sparse to moderate shrub layer was present in most quadrats, dominated by *Bursaria spinosa* (Blackthorn) and *Dillwynia sieberi* (Parrot-pea). The groundcover was dominated by native herbs and twiners typical of CPW; *Brunoniella australis* (Blue Trumpet), *Glossocardia bidens* (Cobbler's Tick), *Phyllanthus virgatus* (a spurge), *Hypochaeris radicata* (Flatweed), *Oxalis perennans*, *Dichondra repens* (Kidney Weed) and *Glycine tabacina* (Love Creeper) and a few exotic herbs also dominant; *Sida rhombifolia* (Paddy's Lucerne) and *Richardia stellaris*. Native grasses were abundant and included *Aristida vagans* (Three-awned Spear Grass), *Bothriochloa decipiens/macra* (Pitted Bluegrass/Red Leg Grass), *Chloris ventricosa* (Windmill Grass), *Sporobolus creber* (Slender Rat's Tail Grass) and *Paspalidium distans*.

Exotic groundcover abundance within quadrats was estimated to be approximately 1-20%. Mature CPW with a shrub layer of *Bursaria spinosa* is shown in **Photograph 5**.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Photograph 5 : Mature CPW in the Regional Park



ii. Regenerating CPW

Regenerating CPW occurs throughout a large portion of the study area. This variation of the community refers to both the regeneration (often prolific) of sapling and juvenile Grey Box and also the generally reduced diversity of native ground cover species that typify CPW, being a grassy open woodland community, as shown in **Photograph 6**.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Photograph 6 : Regenerating CPW on the subject site



Area B – Regional Park

Quadrats conducted within regenerating CPW that is located in the Regional Park were located within the dense regenerating woodland shown as Area B (or Quadrats labelled with B) in **Figure 10**. The canopy was very sparse and almost exclusively dominated by *Eucalyptus moluccana* with an overall Projective Foliage Cover (PFC) of 5-10%. The midstorey was also dominated by *E. moluccana* with some areas including *E. tereticornis* with a highly variable PFC of between 5-50%. A very sparse shrub layer was present in most quadrats, dominated by *E. moluccana* saplings and occasionally *Bursaria spinosa*. The groundcover was similar to that of mature CPW, described above, although the diversity of native groundcover species was slightly reduced, with several native herbs absent, including; *Phyllanthus virgatus and Oxalis perennans*.

Several of the herbs and grasses that were recorded to be present, but not dominant, in the Mature CPW were not present in this variation, including the characteristic species; *Lomandra filiformis* ssp. *filiformis* (Wattle Mat-rush), *Plantago debilis* and *Hypochaeris radicata* and some native grasses such as *Sporobolus creber* (Slender Rat's Tail Grass).

This variant of regenerating CPW was estimated to have an exotic ground cover of mostly between 5-10%.

Area A – Degraded and regenerating CPW

including Drainage zoned land, were located within the degraded and regenerating CPW shown as Area A (or Quadrats labelled with A) in **Figure 10**. This variant is similar to that described above, although the canopy is generally more open, with a PFC of 5-10% and a native shrub layer is often absent. The species were as above, although the diversity of native groundcover species was reduced, with several of the dominant native herbs absent, including; *Phyllanthus virgatus and Oxalis perennans.* Several of the herbs and grasses that were

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

recorded to be present, but not dominant, in the Mature CPW were not present in this variation, including characteristic species; *Lomandra filiformis* ssp. *filiformis, Plantago debilis* and *Hypochaeris radicata* and some native grasses such as *Sporobolus creber*.

iii. Derived Native Grasslands

Two main forms of grassland are recognised: areas supporting native herbs and some native grasses and areas supporting a far higher concentration of exotic species. Although both forms of grassland are considered to be derived from the past clearing of CPW, the former category is likely to have a higher resilience and is associated with the historically less disturbed portions of the SMDS. The photographs below (**Photograph 7 and Photograph 8**) indicate the two categories of derived native grassland.

Native dominated DNG

The canopy, midstorey and shrub layers were absent. The native herb layer was similar to that of CPW, although native herbs were less frequent. Dominant native species included herbs and grasses such as *Gnaphalium* sp., *Wahlenbergia gracilis* (Native Bluebell), *Fimbristylis dichotoma* (Common Fringe-sedge), *Bothriochloa decipiens/macra, Sporobolus creber, Eragrostis brownii, Cymbopogon refractus, Aristida ramosa* and *Aristida vagans*. Other dominant species included exotic grasses such as *Setaria parviflora*, *Eragrostis curvula* (African Lovegrass), and *Axonopus fissifolius* (Carpet Grass), as well as exotic herbs such as *Senecio madagascariensis* (Fireweed) and *Conyza bonariensis* (Flaxleaf Fleabane).

Low diversity DNG

The majority of low diversity derived native grassland (DNG) is within Area A and supports a far higher concentration of weeds than the native dominated sub-category, being dominated by a few species of exotic grasses; mainly *Axonopus fissifolius, Paspalum dilatatum, Setaria parviflora and Eragrostis curvula* and also *Cynodon dactylon* (Couch Grass). Exotic herbs were also common and included; *Senecio madagascariensis* and *Hypochaeris radicata*. Native species present include *Fimbristylis dichotoma, Eragrostis brownii, Themeda australis* (Kangaroo Grass) and *Wahlenbergia gracilis*.

Drainage depressions formed from historic soil scraping and the creation of contour banks within the study area, are generally considered to be part of the grassland category. Due to the high concentration of exotic species, these areas were not considered separately from the more exotic, low diversity variant of CPW derived native grassland described above.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Photograph 7 : Intact Derived Native Grassland in the south western part of the study area



Photograph 8 : Low diversity Derived Native Grassland in the drainage land to the south of the study area



Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

4.3.1.2. Shale Gravel Transition Forest

This community occurs predominantly in Area C in the Regional Park, but fragmented patches were found in the Western Precinct (prior to development). No Shale Gravel Transition Forest (SGTF) is present on the subject site.

As the name suggests, this is a transitional plant community which grades into Cumberland Plain Woodland where the influence of gravel soil declines, and grades into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick. There is a natural continuum of soil is this spectrum, and it can be difficult to distinguish these communities, towards the centre of the shale-gravel spectrum. In a new critically endangered listing under the EPBC Act, a single community called Cumberland Plain Woodland and Shale-gravel Transition Forest is described.

The NSW Scientific Committee description for SGTF includes a slightly different species composition from CPW, based on the local presence of lateritic gravel in the soil (NSW Scientific Committee 2002c). The community is dominated by *Eucalyptus fibrosa* with *E. moluccana* also occurring less frequently. Shrub species are similar to those found in CPW but more commonly include shrubs from the pea family, including threatened species such as Parrot pea, and has also been observed to contain high numbers of *Grevillea juniperina* subsp. *juniperina*.

Large areas of SGTF occur in the eastern portions of the SMDS, mostly to the east of the current study area extent. This community has previously been mapped in the Western Precinct. While floristic data from one quadrat, collated for the preparation of this SIS was strongly consistent with this community, most vegetation patches in the current study site are considered to conform more to the definition of CPW.

4.3.1.3. River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) had a limited distribution within the Western Precinct (prior to development), although more extensive areas of Alluvial Woodland occur in the Regional Park and Drainage zone along the tributary to South Creek.

Quadrats from the Regional Park and Drainage zoned land have been utilised to describe the occurrence of RFEF in the study area. Within the Drainage zoned land, RFEF is heavily weed infested, as this is closest to the creekline, and is likely to be impacted by increased nutrient levels, and was therefore included in Area A. Sections of the riparian corridor within the Regional Park, which was included in Area C, that are further from the creekline have fewer occurrences of weeds, are generally in good condition.

The canopy was mostly dominated by *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus tereticornis* (Forest Red Gum) or *Eucalyptus moluccana* (Grey Box) but also includes *Angophora floribunda* (Rough-barked Apple) and *Casuarina glauca* (Swamp Oak) and. In the more intact sections, a small tree layer occurs with *Melaleuca decora*, *Melaleuca linariifolia* and *Acacia floribunda* being present. This community is shown in **Photograph 9**.

The midstorey was sparse and absent in some areas, but dominated by juvenile *Eucalyptus moluccana* and *E. tereticornis* trees, *Allocasuarina littoralis* (Black She-oak), *Casuarina glauca* and *Acacia parramattensis* (Parramatta Wattle).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The shrub layer was dense in parts and dominated by saplings of the canopy and midstorey species including, *Bursaria spinosa*, *Daviesia ulicifolia* and *Grevillea juniperina* subsp. *juniperina* and exotic species such as *Senna pendula* var. *glabrata*, *Phoenix canariensis* (Canary Island Date Palm) and *Ligustrum lucidum* (Large-leaved Privet).

The ground cover tends to be weedy, dominated in places by exotic grasses such as *Eragrostis curvula* and *Cynodon dactylon*. The native grass *Microlaena stipoides* is common-dominant in some areas, and other native grasses such as *Aristida ramosa* are common in localised patches. Other native species occurring within the understorey in smaller numbers include *Cymbopogon refractus* (Barbed-wire Grass), *Oplismenus aemulus* (Basket Grass), and *Aristida ramosa*. Native herbs include *Pratia purpurascens* (Whiteroot), *Ranunculus lappaceus* (Forest Buttercup), and *Glycine tabacina* (Love Creeper).

Photograph 9 : River-flat Eucalypt Forest in the study area



As identified by the final determination (NSW Scientific Committee, 2004j), this community typically tends to form mosaics with other floodplain forest communities and treeless wetlands. River-flat Eucalypt Forest, in the form of Alluvial Woodland, is present on the SMDS, in association with South Creek and Ropes Creek. The drainage channels present in the study area are currently in a modified and degraded condition, but in the future, their connection with tributaries of South Creek will be enhanced. The regeneration of RFEF and wetland habitats will form part of the Riparian Corridor development, and will therefore increase the current extent of this EEC.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

4.3.1.4. Freshwater Wetlands

i. Wetland/dam

A large dam occurs in the study area, to the south of the Western Precinct. The dam comprises an arc shaped body of water that follows the local contours and a series of borrow pits from which soil was taken to construct the dam wall. Wetland species occur in the dam as well as the low lying borrow pits but would have only colonised the area since the dam was flooded. The area covered by the current extent of Freshwater Wetlands would have comprised Cumberland Plain Woodland and River-flat Eucalypt Forest prior to construction of the dam. An area at the north-eastern extent of the wetland contains vegetation that could be described as wet meadow.

Sections of this Freshwater Wetland can be seen in **Photograph 10**.

Wetland vegetation in the dam was concentrated at the northern end and mainly comprised *Eleocharis sphacelata* and *Marsilea hirsuta* (Nardoo). *Philydrum lanuginosum* (Frogsmouth) was common, and *Juncus* sp. formed a band around the margin and on the dam wall at the overflow zone.

The borrow pit vegetation varied from a small pond with dense *Eleocharis sphacelata* and sparse *Philydrum lanuginosum* and *Potamogeton tricarinarus*, to seepage zones with *Juncus* sp., *Ranunculus inundatus, Ludwigia peploides* and *Lythrum hyssopifolia*. Seepage zone vegetation occurred in many of the borrow pits and the south eastern end of the dam wall, that acted as a spillway.

Remnants of the original vegetation communities had regenerated on the slightly higher ground between borrow pit wetland zones. This was largely composed of large *Eucalyptus tereticornis* with *Angophora floribunda* and *Allocasuarina littoralis* (Black She-oak) understorey, and *Bursaria spinosa* shrub stratum with native grass ground cover.

The wet meadow zone was a low lying area that received periodic inundation, but apparently at a frequency less than required for most wetland plant species. It comprised *Microlaena stipoides* grassland with *Juncus* sp., *Persicaria decipiens*, *Centella asiatica* and *Lythrum hyssopifolia* being co-dominant. Common species included: *Ranunculus inundatus*, *Eclipta platyglossa* and exotic species of daisy (Asteraceae). Juveniles of the weed *Xanthium* sp. were recorded in significant numbers in this area. *Cynodon dactylon* was locally dominant, especially at the dry margins except along the northern side. Overall, exotic species ranged from 5-70% of the projective foliage cover of the ground cover in the wet meadow and borrow pit zones.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Photograph 10 : Wetland dam vegetation in Regional Park to the south of the Western Precinct



Large wetlands are uncommon in and around the SMDS and are considered to have moderate to high conservation significance. Where wetland species have colonised artificially created habitats, the area is still considered to be a degraded variant of the EEC.

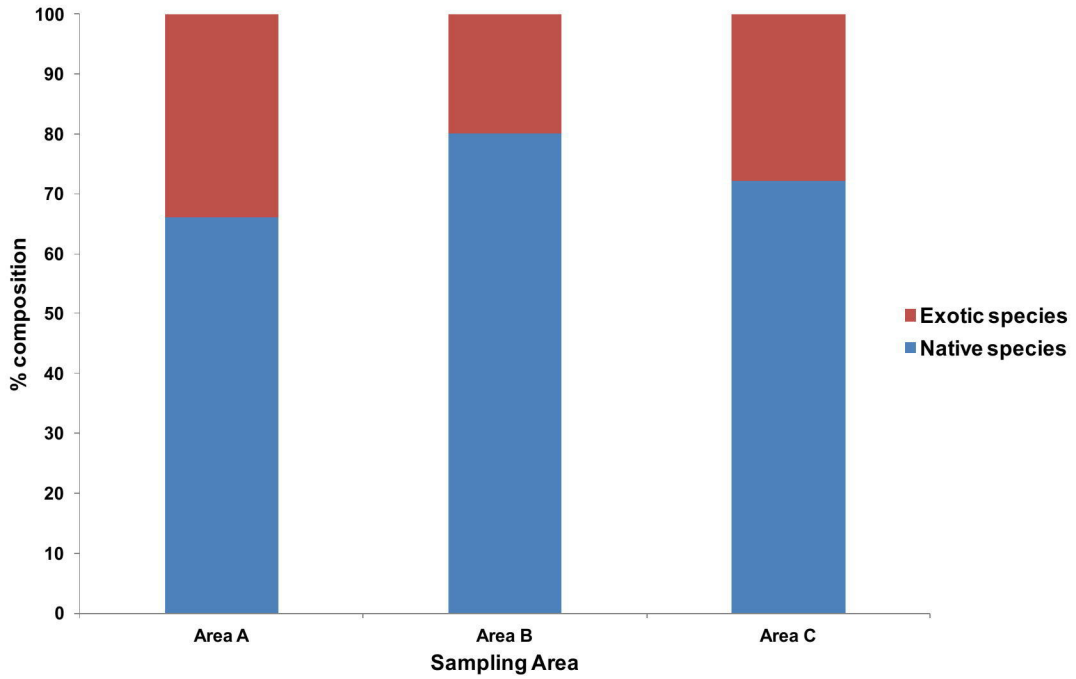
Wetlands have conservation value if they form part of a habitat corridor, provide habitat for aquatic species and resources for birds and mammals, provide habitat for threatened aquatic plants or maintain a seed bank of local provenance plants.

4.3.2. Statistical outcomes of vegetation composition comparisons

Statistical analyses of the data of for the study area found that the Western Precinct and other development areas including Drainage zoned land (Area A) had a higher exotic species composition (42.96%) than the regenerating woodland (Area B: 19.92%) or mature woodland (Area C: 27.85%) areas. These figures provide support to the decision to include the regenerating woodland (Area B) into the Regional Park as the lower exotic species composition is indicative of its higher conservation value. **Graph 1** (below) shows the relative proportions of native and exotic plant species in the different sampling areas.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Graph 1 : Comparison of exotic and native plant composition in the development areas of the study area (Area A), regenerating Regional Park woodland (Area B) and mature Regional Park woodland (Area C)



4.3.3. Threatened Flora Species

Numerous flora surveys have recorded a wide diversity of plants from the SMDS, including several threatened species. These are *Grevillea juniperina* ssp *juniperina, Pultenaea parviflora, Pimelea spicata, Dillwynia tenuifolia, Micromyrtus minutiflora, Marsdenia viridiflora* ssp. *viridiflora* (endangered population), and *Persoonia nutans*. The majority of these species are found in SGTF, primarily in the eastern portions of the SMDS, where the soil is characterised by large amounts of lateritic gravel. *Pimelea spicata, Marsdenia viridiflora* ssp. *viridiflora* are also found in CPW and *Grevillea juniperina* ssp. *juniperina* can be found in CPW or grassland areas where there is a gravel influence.

4.3.3.1. Recent surveys of the study area

Targeted surveys within the subject site and surrounds in 2019 did not record any threatened flora species.

Targeted threatened species searches conducted within the Regional Park in 2011 detected numerous populations and individuals of *Grevillea juniperina* ssp. *juniperina* and *Pultenaea parviflora*. Surveys in 2008 also detected a sub-population of *Marsdenia viridiflora* ssp. *viridiflora* within the Regional Park near the Western Precinct boundary. These records are summarised below.

i. *Grevillea juniperina* ssp. *juniperina*

Grevillea juniperina ssp. *juniperina* is listed as Vulnerable under the TSC Act. It is a dense shrub, 0.5-1.5m tall, found only in Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town (OEH, 2012f).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

No individuals of *Grevillea juniperina* ssp. *juniperina* were recorded within the subject site. Within the study area, occurrences of *Grevillea juniperina* ssp. *juniperina* were recorded. Based on counts in late 2007 and mid 2008 surveys by Cumberland Ecology, it was estimated that there are approximately 530 individuals of the species within the Western Precinct (Cumberland Ecology 2008) Large areas of habitat for this species are contained within the Regional Park, where over 250,000 *Grevillea juniperina* ssp. *juniperina* specimens are estimated to be located (Cumberland Ecology 2004a) with numerous sub-populations and individuals of the species being detected in the 2011 survey period. Previous surveys have indicated medium-high densities of this species found in the Regional Park (averaging up to 1300 plants/ha in less fragmented areas, and 750 plants/ha in fragmented areas, as discussed further below and shown in **Appendix B**. Locations of *Grevillea juniperina* ssp. *juniperina* within the study area are shown in **Figure 14.**

ii. Pultenaea parviflora

Pultenaea parviflora is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. It is a small, erect branching shrub to 1m high, endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps Creek and Pitt Town (OEH, 2013c).

Pultenaea parviflora was not recorded on the subject site. Large areas of habitat for this species are contained within the Regional Park, with numerous populations and individuals of the species being detected in the 2011 survey period. Locations of *Pultenaea parviflora* within the study area are shown in **Figure 14**.

iii. *Marsdenia viridiflora* ssp. *viridiflora*

Marsdenia viridiflora ssp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas is listed as an Endangered population under the TSC Act. It is a climber with twining stems up to 4m high that grows in vine thickets and open shale woodland, (OEH, 2013i).

Marsdenia viridiflora ssp. *viridiflora* was not found on the subject site although two occurrences of this species were recorded in the Regional Park near the boundary with the Central Precinct in 2008 and are shown in **Figure 14.** These sub-populations were not relocated and confirmed during the 2013 field surveys.

Large areas of habitat for this species are contained within the Regional Park and further occurrences of this species have been recorded within areas of the Regional Park outside the current study area.

4.3.3.2. Historic surveys of the study area and SMDS

Gunninah Consultants (Gunninah, 1995) and ERM (ERM, 2003) have previously counted threatened plants within quadrats of various sizes that have allowed for extrapolations or counts of threatened plants within the SMDS. This has been possible for – *Pultenaea parviflora*, and *Grevillea juniperina* ssp. *juniperina*. The Biodiversity Assessment of the Eastern Precinct (ERM, 2003) of the SMDS provided estimates of populations of these species based upon such counts. For the purposes of the Eastern Precinct SIS, Cumberland Ecology also counted plants in the Eastern Precinct and within the eastern tip of the Regional Park.

The various counts of threatened plants were undertaken at different times under differing seasonal conditions by different people. The densities of plants counted by Gunninah Consultants were generally the highest

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

(although they did not count *Grevillea*) and it is possible that additional seedlings were present during these counts to inflate the population estimates.

Due to the variation in numbers of plants between the different estimates, this SIS relies upon the lowest most conservative estimates of plant numbers within the Regional Park. The numbers should be interpreted as indicative only and reflect the scale and variability of the populations.

Table 9 below shows the assumed areas of habitat and population estimates for each of the threatened plants in the Regional Park.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 9 : Population estimates for *Pultenaea parviflora* and *Grevillea juniperina* subsp. *juniperina* within the St Marys Regional Park

Estimated Numbers of P. parviflora and G. juniperina in Regional Park	Surveyors:	Gunninah 1995	ERM 2001/02	ERM 2003	Cumberland Ecology 2004	Max Pop in Reg Pk	Min Pop in Reg Pk
	Plot size in metre square:	200	1000	10	10		
	Plot number:	32	4	91	35		
Pultenaea parviflora	Mean per hectare	436	1,162	1,933	1,371	260,955	58,860
	Standard Error	106	770	325	296	43,875	14,310
Grevillea juniperina ssp. ***juniperina***	Mean per hectare	not counted	467	2,822	714	987,700	249,900
	Standard Error		401	361	156	126,350	214,582

Gunninah 1995 = Gunninah Environmental Consultants report for Pyro Park; ERM 2001/02 = Biodiversity Assessment for Eastern Precinct; ERM 2003 = estimates from Remediation Works Assessment; Cumberland Ecology 2004 = surveys for the Eastern Precinct SIS

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

4.3.3.3. Pimelea spicata

Pimelea spicata is listed as Endangered under both the TSC Act and the EPBC Act. It is an inconspicuous flowering shrub that flowers sporadically (likely in response to rainfall), grows to 50 cm tall and is erect or somewhat prostrate in habit (DEC (NSW) 2006). *Pimelea spicata* has white, pink-tinged tubular flowers to 10mm long, with four spreading petals (OEH 2013c). The leaves are opposite and elliptical to 20mm long by 8mm wide. This species was once widespread on the Cumberland Plain, however now it only occurs in two disjunct areas, the Cumberland Plain and the Illawarra. Threats to this species include: loss of habitat to urban development; high frequency fire; and habitat modification such as mowing, grazing and weed invasion. A recovery plan has been prepared for this species which identifies the following objectives (DEC (NSW) 2006):

- Conserve *P. spicata* using land use and conservation planning mechanisms;
- Identify and minimise the operation of threats at sites where *P. spicata* occurs;
- Implement a survey and monitoring program that will provide information on the extent and viability of *P. spicata*;
- Provide the community with information that assists in conserving the species;
- Raise awareness of the species and involve the community in the recovery program; and
- Promote research questions that will assist future management decisions.

This species was not recorded during the September 2013 field surveys of the study area, or on the subject site in 2019. A population has been historically recorded in the Regional Park, although this population was not located and confirmed during the 2011 field surveys. While some pockets of marginal habitat occur within the subject site, this species is not considered likely to occur within the subject site.

4.3.4. Fauna Habitats within Study Area

4.3.4.1. Woodland Habitat

The dominant fauna habitat in the study area is woodland, and this occurs throughout the northern and western portions of the study area. The woodland falls within the Regional Park, and occurs in two distinct growth forms.

- Mature woodland; and
- Regenerating woodland.

All vegetation on the SMDS is regenerated vegetation, however the core area of the Regional Park is considered to be mature (regenerated) woodland. The core area has not been cleared within the last 50 years, and therefore has a higher degree of structural complexity than areas of woodland found within the younger regenerating woodland within the Regional Park, or that found within the development precincts (refer to **Section 4.3.3**). The stands of mature trees provide sheltering, foraging, nesting and breeding habitat for most fauna that may occur within the SMDS.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The remainder of the Regional Park consists of regenerating woodland. This area occurs to the west of the central portion of the Regional Park, and is sometimes referred to as the "Perkins Peninsula", due to the fact that the area was identified as regenerating Cumberland Plain Woodland by Ian Perkins in his submission to the Australian Heritage Commission (Perkins 1999). This area has been cleared more recently than other parts of the Regional Park, and therefore consists of less mature woodland, with a greater number of eucalypt saplings occurring within the mid stratum than in the mature woodland. This woodland currently provides some feed and shelter habitat, and will, in the future, form a large area of mature woodland.

4.3.4.2. Grassland Habitats

Grassland areas occur within the study area, primarily within the development areas, but also disturbed portions of the Regional Park and Drainage land, including the subject site. Grassland represents little value to native fauna, as there is little structural complexity that is necessary to provide roosting or nesting habitat for most species. The grassland areas within the study area may, in the future, regenerate to form additional woodland. Species that commonly occur in the grassland habitats are those that are generally abundant in agricultural areas where the native vegetation has been significantly modified or removed, or they are species that typically favour foraging in grassland. Such species include birds such as the Australian Raven (*Corvus coronoides*), Crested Pigeon (*Geophaps lophotes*), Galah (*Cacatua roseicapilla*), and mammals such as the Eastern Grey Kangaroo (*Macropus giganteus*).

4.3.4.3. Riparian Habitats and Wetlands

Significant riparian habitat occurs within the wider study area and Regional Park, and this includes the subject site. The South Creek riparian corridor, which includes the subject site, provides a movement corridor for fauna and foraging habitat for a range of species, including amphibians, bats, birds, and some mammals.

The wetland in the Regional Park is likely to provide a significant amount of habitat for common native species as it is a permanent source of water and supports significant amounts of fringing vegetation that provides habitat for wetland birds and amphibians.

Smaller areas of ephemeral wetlands occur throughout the Regional Park in low depressions often resulting from a scrape formed in the topsoil. These support common frog species including the Common Eastern Froglet (*Crinia signifera*) and Striped Marsh Frog (*Limnodynastes peronii*).

4.3.5. Fauna Habitat within the subject site

Habitats of value to native fauna on the subject site are generally associated with the largely regrowth woodland that occurs throughout the subject site, located to the north and south of the existing track, and extends into the Regional Park. As the subject site is located near the northern extremity of the Regional Park, and adjoins the Jordan Springs development area, connectivity is limited to the east, west and south. However, the value of this vegetation to hollow-dwelling native fauna is limited as the trees are mostly immature and offer limited roosting or nesting habitat. The majority of the woodland habitat that occurs on the SMDS will be conserved within the Regional Park.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

4.3.6. Fauna Species

A wide variety of fauna species have been recorded from the SMDS, including several threatened species. A complete fauna species list for the study area is provided in **Appendix C**.

4.3.6.1. Non-Flying Mammals

The most common and conspicuous mammals across the SMDS, are the Eastern Grey Kangaroo (*Macropus giganteus*) and Red Kangaroo (*Macropus rufus*). The kangaroos within the SMDS are not a naturally occurring population as they were introduced into the area by humans. Population numbers are dynamic but were estimated to be 2,185 animals in May 2007 across the entire SMDS (Cumberland Ecology 2007). These animals are subject to a Macrofauna Management Plan (Cumberland Ecology 2004b), which is currently being implemented across the SMDS and the population has been substantially reduced or retained in particular areas since implementation of the Plan in 2005.

Three arboreal mammals have been recorded within the SMDS; the Common Brush-tail Possum (*Trichosurus vulpecula*), the Common Ring-tail Possum (*Pseudocheirus peregrinus*), and the Sugar Glider (*Petaurus breviceps*). The Common Brush-tail Possum and Sugar Glider generally occur in low numbers on the SMDS which is likely to be a reflection of the lack of hollow-bearing trees. The Common Ring-tail Possum is more abundant, which is most likely due to its ability to build nests in tree foliage. The Echidna (*Tachyglossus aculeatus*) has also been recorded from the SMDS. These species are likely to be found predominantly in the Regional Park where large areas of intact woodland are present.

Several threatened mammals have been recorded within the locality (see **Figure 11**) or have potential habitat within the locality including the Spotted-tailed Quoll *(Dasyurus maculatus maculatus*), Koala (*Phascolarctos cinereus*) and Squirrel Glider (*Petaurus norfolcensis*). No recent, confirmed records for these species have been obtained for the SMDS, and it is unlikely that these species are present due to the limited availability of habitat, and the fencing of the SMDS.

No Koalas were detected in the study area during any of the field investigations conducted on the SMDS, nor were any traces of Koalas found such as scats or scratches on trees. According to members of staff who have worked on the site for many years, including Senior Development Managers Graham Duncan and Bill Mitchell of Delfin Lendlease, there have been no formal or verified reports of Koalas made within the site. This is consistent with the findings of earlier fauna surveys by Gunninah Consultants and ERM (Gunninah, 1991, ERM, 2003).

Several introduced species have been recorded from the SMDS including the European Red Fox (*Vulpes vulpes*), Feral Cat (*Felis catus*), dog (*Canis familiaris*), European Rabbit (*Oryctolagus cuniculus*), Brown Hare (*Lepus capensis*), Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*). The introduced species are the subject of a Feral and Domestic Animal Management Strategy for the Western Precinct, and will be controlled under the draft Wianamatta Regional Park Plan of Management (to be implemented by NPWS, following transfer of ownership), which includes recommendations for their control.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

4.3.6.2. Bats

Numerous bat surveys have been conducted on the SMDS and the species detected during these surveys are indicated in **Table 10** below. Of the species recorded, several are listed as threatened under the TSC Act and/or the EPBC Act including; the Grey-headed Flying-fox (*Pteropus poliocephalus*), Southern Myotis (also known as the Large-footed Myotis) (*Myotis macropus*), Eastern Bentwing Bat (*Miniopterus orianae oceanensis*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Coastal Free-tailed Bat (also known as the Eastern Freetail Bat) (*Micronomus norfolkensis*). Other species with potential to occur include the Little Bentwing-bat (*Miniopterus australis*) and the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

The subject site provides some suitable habitat for the Southern Myotis, within South Creek, as this species forages over open water for fish and insects, using its feet (DEC (NSW), 2005i)(OEH 2012h). Additionally, the dam and wetland area in the south western section of the Regional Park may provide suitable habitat for this species as it contains a relatively large area of open water where it may forage. This area will be protected for conservation in the long term as it is located in the Regional Park. The development of Regional Detention Basins C and V6 will increase the area of habitat for this species, providing a greater area of open water.

The Greater Broad-nosed Bat, Eastern False Pipistrelle and Eastern Coastal Free-tailed Bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail bat may have some limited potential roosting habitat on the subject site as they are known to roost in tree hollows (OEH 2012e, d, c). This kind of habitat is limited in the regenerating woodland present, and is restricted to the mature patches of RFEF within the subject site, and mature CPW in proximate parts of the Regional Park. A greater number of mature trees are conserved within adjacent areas of the Regional Park. The Greater Broad-nosed Bat has also been known to roost in buildings, and there are several derelict buildings within the study area that may provide habitat for this species.

The Greater Broad-nosed Bat has only had a possible detection within the Regional Park, and the Eastern Coastal Free-tailed Bat has been detected within the Regional Park. In addition, the Eastern False Pipistrelle has only had a single possible detection within the study area within the current surveys. These species may forage across the subject site but are not expected to rely upon the vegetation present.

The Eastern Bentwing Bat has been detected during 2011 surveys, and occurs within numerous locations in the study area. The species utilises caves as its primary roost habitat, and has occasionally been known to utilise artificial structures (OEH 2012b). Within the study area, the majority of historical artificial structures have been removed, with the exception of one large modern building in association with the former gatehouse. As such, there in little suitable roost habitat within the study area, however the species may still utilise the area as a foraging resource.

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as Vulnerable under both the TSC Act and the EPBC Act (OEH 2012f). This species is the largest Australian bat, and forages on the nectar, fruits and pollen of native trees, and roosts in large aggregations. The Grey-headed Flying-fox has been recorded from the locality and has the potential to forage on the SMDS; however, no roosting camps are present on the site. There is some limited habitat present on the subject site for this species in the form of regenerating and mature woodland. The species was not recorded during the 2011 fauna surveys.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 10 : Bat Survey Results

Date	27-Apr	27-Apr	28-Apr	27-Apr	28-Apr
Unit	1	2	2	3	3
Species					
Austronomus (formerly ***Tadarida australis***)	C	C	P	C	C
Micronomus norfolkensis		C	C	C	P
Mormopterus ridei (formerly sp. 2)		Po	Po	Po	Po
Chalinolobus gouldii	C		C	C	C
Chalinolobus morio	C	C	Po		
Falsistrellus tasmaniensis	Po				
Miniopterus orianae (formerly ***M. schreibersii oceanensis***)	C	C	C	C	C
Nyctophilus sp.	Po	P			
Scoteanax rueppelli					Po
Scotorepens orion	Po				Po
Vespadelus regulus				P	
Vespadelus vulturnus	C	C			
Total Passes	130	46	62	143	124

Note Bat Specialist; Glenn Hoye, who has identified the calls recorded on Anabat by Cumberland Ecology, has assigned a confidence level to each species record, depending on call quality and the ease of recognition between subspecies etc. As such, ***C = Confident, P = Probable and Po = Possible.*** *Abbreviations of species names are defined in* ***Table 4.10****. Unit locations are shown in* ***Figure 10****.*

Table 11 : Bat survey definitions

Abbreviation	Common	Scientific	Status
T. au	White-striped Mastiff Bat	*Austronomus* (formerly *Tadarida*) *australis*	P
M. no	Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V
M. sp	Eastern Freetail Bat	*Mormopterus ridei* (formerly sp. 2)	P
C. go	Gould's Wattled Bat	*Chalinolobus gouldii*	P
C. mo	Chocolate Wattled Bat	*Chalinolobus morio*	P

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Abbreviation	Common	Scientific	Status
F. ta	Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V
M. sc	Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V
N. sp.	Unidentified Long-eared Bat	*Nyctophilus* sp.	P
S. ru	Greater Broad-nosed Bat	*Scoteanax rueppelli*	V
S. or	Eastern Broad-nosed Bat	*Scotorepens orion*	P
V. re	Southern Forest Bat	*Vespadelus regulus*	P
V. vu	Little Forest Bat	*Vespadelus vulturnus*	P

As indicated by the results in **Table 4.7** above, the entire study area is likely to provide habitat for the majority of bat species, including the subject site.

4.3.6.3. Birds

Within the study area, the main habitats most suitable for birds are those associated with remnant and regrowth vegetation. However, the areas of regrowth are generally immature and structural diversity is low, thereby limiting the diversity of birds.

Mature woodland and riparian forest communities provide the most suitable habitats present in the study area, and these habitats are abundant in the Regional Park. Nonetheless, the vegetation is not structurally diverse, and lacks features such as fallen logs, and hollows. Mature vegetation supports common bird species, as recorded in the subject site in 2018, including; Black-faced Cuckoo Shrike (*Coracina papuenis*), Lewin's Honeyeater (*Meliphaga lewinii*) and Apostlebird (*Struthidea cinerea*). Other species were recorded in adjoining areas of degraded/open habitats, as described below.

Within the disturbed grasslands and open woodland, common bird species include the Australian Magpie-lark (*Grallina cyanoleuca*), Australian Raven (*Corvus coronoides*), Eastern Rosella (*Platycercus eximius*), Rainbow Lorikeet (*Trichoglossus haematodus*) and the Noisy Miner (*Manorina melanocephala*). These species are common in urban and rural environments and often out-compete smaller forest birds at the interface with woodland habitats. Emus (*Dromaius novaehollandiae*) are also present in the precinct within the grassland and open woodland areas. Although there are limited habitat areas for small birds, several common birds were recorded in woodland areas including the Weebill (*Smicrornis brevirostris*), Superb Fairy Wren (*Malurus cyaneus*), and the Spotted Pardalote (*Pardalotus punctatus*).

A number of bird species listed under the TSC Act and/or the EPBC Act, including migratory and non-migratory species, have been recorded from the SMDS and may utilise habitats within the study area.

Migratory species that may visit the site to forage include the Swift Parrot (*Lathamus discolour*). The Swift Parrot is listed under both the TSC Act and the EPBC Act as Endangered (OEH 2014d) and has been recorded from within the locality, although it has not been recorded from the SMDS. This species may visit the locality as part of a broad foraging area during some years of migration, however, it is far more likely to utilise the Regional Park, which includes a greater diversity of blossoming species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Lathams Snipe is listed as Migratory under the EPBC Act and was recorded during the 2007 field survey in the dam wetland area, directly adjacent to the Western Precinct, in the Regional Park. The wetland areas could potentially provide foraging habitat for this species but this is likely to be limited. As this species is not listed as threatened, further assessments have not been conducted for this species as EPBC Act approval is not required for this proposal.

The Speckled Warbler (*Pyrrholaemus sagittata*) is listed as Vulnerable under the TSC Act and has been recorded at the SMDS in 1991 (Gunninah, 1991), and most recently in 2006 by Cumberland Ecology when it was recorded in the western area of the Regional Park. This species forages on the ground in grassy woodlands, and requires large undisturbed remnants in order to persist (OEH 2012i). This species is most likely to occur within parts of the Regional Park where there is sufficient shelter in the grass and shrub layers, particularly in areas of mature CPW.

The Varied Sittella (*Daphoenositta chrysoptera*) is listed as Vulnerable under the TSC Act and has been recorded at the SMDS, specifically in the Regional Park, in August 2012 by Cumberland Ecology. This species inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland (OEH 2012j). This species is sedentary and is most likely to occur within parts of the Regional Park where there are sufficient mature trees and mallee habitat, including the mature CPW.

Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), a species the was listed as vulnerable under the TSC Act in 2016. This species was recorded on the broader SMDS site, in the Regional Park in 2004, and in the study area (Cumberland Ecology 2018). Additionally, there a several records of the species from large blocks of habitat located approximately 5km to the north of the subject site (DPIE 2019a).

The Diamond Firetail (*Emblema guttata*) is listed as Vulnerable under the TSC Act and was recorded on the SMDS in 1991 (Gunninah, 1991), however no subsequent records have been documented. The Diamond Firetail inhabits grassy eucalypt-dominated woodlands, nests in trees and bushes, and forages on the ground (OEH 2012a). The Regional Park provides potential habitat for this species, predominantly within mature CPW.

The Black Bittern is listed as Vulnerable under the TSC Act and may have been recorded close to the SMDS in 1985 in South Creek near the southern boundary of the SMDS (Bill Mitchell of Delfin Lendlease pers, comm.). The Black Bittern is found in wetland areas with permanent water and dense vegetation (OEH 2014b). There is no suitable habitat for this species within the subject site, although it could potentially occur in permanently wet areas in the adjacent Regional Park including areas of South Creek and Ropes Creek.

Other threatened aquatic birds including the endangered Black-necked Stork (*Ephippiorhynchus asiaticus*), which has been recorded in the locality (see **Figure 9**) but not on the SMDS, could potentially use the wetland associated with the dam in the south of the study area as it holds permanent water. This area will be protected for conservation in the long-term as it is located within the Regional Park.

Threatened forest and woodland bird species recorded from the locality but not the SMDS include: the Regent Honeyeater (*Anthochaera phrygia*), listed as Critically Endangered under the TSC Act (and Endangered under the EPBC Act); Painted Honeyeater (*Grantiella picta*), Square-tailed Kite (*Lophoictinia isura*) and the Glossy Black Cockatoo (*Calyptorhynchus lathami*), all listed as Vulnerable under the TSC Act. These species may forage in

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

the study area from time to time, although this would be likely part of a much bigger foraging range, including the large reserves to the north of the study area. The SMDS generally does not contain *Allocasuarina* tree species, and therefore is not likely to be suitable foraging habitat for the Glossy Black Cockatoo.

4.3.6.4. Reptiles and Amphibians

Reptiles that have been recorded at the SMDS and that may occur within the subject site include; the Red-bellied Black-snake (*Pseudechis porphyriacus*), Eastern Brown Snake (*Pseudonaja textilis*), Bearded Dragon (*Amphibolurus barbatus*) and the Delicate Garden Skink (*Lampropholis delicata*). These species are generally common in open grassland/open woodland habitats.

No threatened reptiles have been recorded on the SMDS. The Broad-headed Snake (*Hoplocephalus bungaroides*), listed as Endangered under the TSC Act and Vulnerable under the EPBC Act has been recorded from the locality, however it has not been recorded on the SMDS, and is unlikely to occur due to lack of suitable habitat. This species inhabits sandstone escarpments and none are present on the SMDS.

One amphibian listed as Endangered under the TSC Act and Vulnerable under the EPBC Act that has been recorded in the locality more than 20 years ago is the Green and Golden Bell Frog (*Litoria aurea*). However, this species has been targeted in surveys across the study area, and has not been detected. The degraded wetland habitats present on the subject site do not contain permanent water and this species is therefore not expected to occur. The area most suitable for this species is located to the north west of the subject site, within the Regional Park. However, established populations of Mosquito Fish (*Gambusia holbrooki*) are also present in this wetland, which are a known predator of Green and Golden Bell Frog eggs and tadpoles (DEC (NSW) 2005a). Mosquito Fish have been linked to declines in Green and Golden Bell Frog distribution and are likely to limit the suitability of the wetlands to provide habitat for this species. Furthermore, extensive past targeted surveys for this species have failed to detect it and no recent records occur in the locality. The Green and Golden Bell Frog is, therefore, not expected to occur on the SMDS.

4.3.6.5. Invertebrates

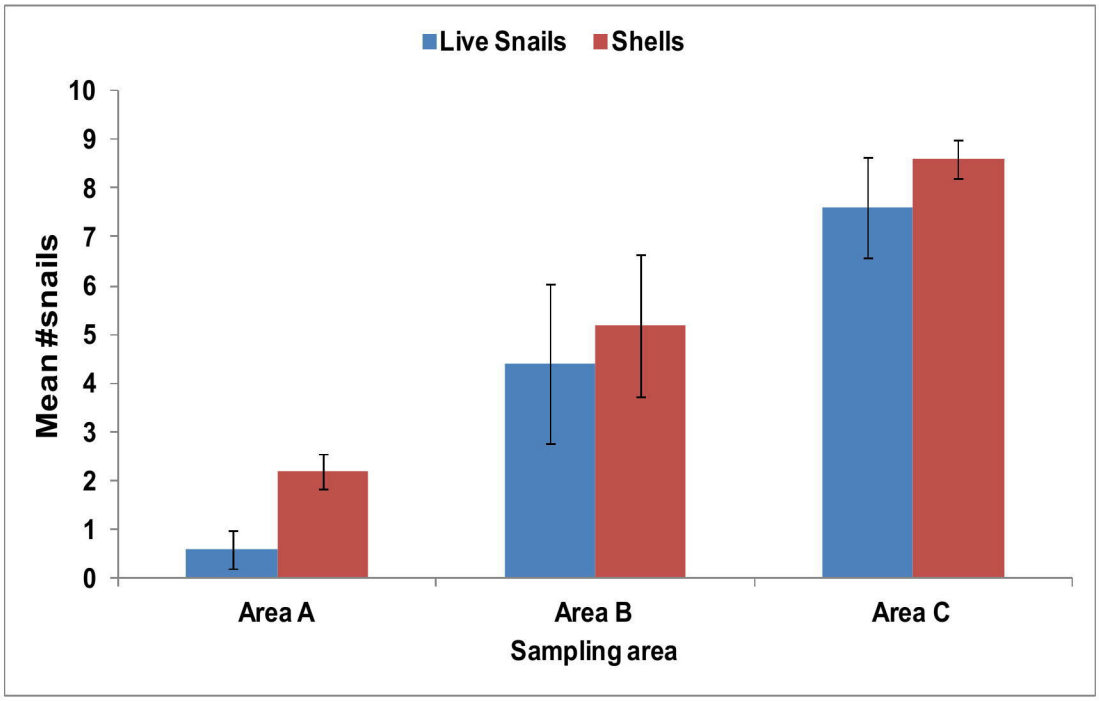
One invertebrate species listed as Endangered under the TSC Act has been recorded on the SMDS, the Cumberland Plain Land Snail (*Meridolum corneovirens*). This species lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps primarily within CPW but also occasionally within SGTF and the margins of RFEF (OEH 2013b).

The Cumberland Plain Land Snail was recorded on the subject site during targeted surveys in 2019, and has been recorded throughout the study area during previous surveys. A total of two shells and one live snail was recorded from the CPW present in the west of the subject site, beneath a single large *Eucalyptus moluccana* tree as shown in **Figure 14.**

The following graph shows the relative abundance of the Cumberland Plain Land Snail within the vegetation age classes present in the study area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Graph 2 : Comparative abundance of Cumberland Plain Land Snail within the degraded development zoned land, including the subject site (Area A), regenerating Regional Park woodland (Area B) and Mature Regional Park woodland (Area C).



The graph shows that there is a relatively lower abundance of the Cumberland Plain Land Snail within the Western Precinct (prior to development) and degraded riparian vegetation present on the subject site (Area A) than the other parts of the broader Study Area (Areas B and C). Statistical analyses confirmed that these differences in the number of live snails, snail shells and the total number of snails were significant (Kruskal Wallis: H = 6.517, p = 0.012) between the three sampling areas (**Table 12**).

Table 12 : Result summary of Kruskal-Wallis statistical analyses indicating significant differences in numbers of snails between Areas A, B and C

	X^2	P
Live snails	9.267	0.01
Shells	8.431	0.015
Total snails	11.616	0.003

Note: p<0.05 indicates differences between groups is significant

The mature woodland area in the Regional Park (Area C) had significantly higher numbers of snails than the subject site (Area A). The regenerating woodland area (Area B) also had significantly higher total numbers than the subject site. No significant differences in numbers were found between Area B and Area C. (**Table 13**).

Table 13 : Significance results of post-hoc analyses (Mann-Whitney U tests)

	A&B	A&C	B&C
Live snails	0.056	0.008	0.095

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

	A&B	A&C	B&C
Shells	0.095	0.008	0.151
Total snails	0.008	0.008	0.056

Bold indicates significant result after reduction of α-level of significance to 0.017 following Bonferroni adjustment.

The significantly greater snail numbers in Area C shows that the species is well conserved within the mature core of the Regional Park, with strong supporting numbers in the adjoining regenerating portion of the Regional Park. The habitat occurring within the subject site is fragmented, and consists predominantly of few large remnant trees surrounded by new re-growth, and therefore it is likely that the habitat within the subject site does not constitute core or high value habitat for the species.

Threatened species recorded in the locality are listed in **Table 2 and Table 3**. Records of recent surveys are shown in **Figure 14**.

4.4. Habitat Corridors

The study area forms part of a broad local corridor that extends to the north of the site, and to a lesser extent to the south via South Creek riparian corridor, as shown in **Figure 7**. The vegetation on the subject site is connected to vegetation in the Regional Park adjoining the Drainage zoned land in all directions. Development of the subject site will not sever connectivity between areas of existing native vegetation in the study area. To the north of the study area beyond Ninth Avenue, there are rural residential blocks and several patches of remnant vegetation.

4.5. Determining Affected C/EECs/Species

Affected C/EECs/species means those threatened species, populations and ecological communities that are likely to experience impacts from the proposal.

The SIS distinguishes between "major" and "minor" affected C/EECs/species. Major affected C/EECs/species are those that will definitely experience a measureable loss of habitat. Minor affected C/EECs/species are those species that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, either directly or indirectly.

The primary impact of the proposal in terms of flora and fauna is the reduction in potential habitat in the study area from native vegetation clearance. The following threatened species includes those that may be affected by the proposal and are therefore assessed in subsequent sections of this chapter.

This list of species has been refined from the list of subject species (see Chapter 3) based on their listing in the CERs, their known occurrence in the study area or their likelihood of occurrence. The remaining subject species listed in **Chapter 3** are not analysed further as they are not considered likely to occur in the study area (based on general species distribution information) and/or are not known to utilise the habitat types of the subject site.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

4.5.1. Major Affected C/EECs/species

Relatively few of the subject species are considered likely to be affected by the proposed development. The major affected C/EECs/species include those known from the subject site that will experience a loss of individuals from the population on the SMDS and are assessed in detail by the SIS.

In summary, the major affected C/EECs/species that are considered in detail within the following impact assessment chapter are:

- River-flat Eucalypt Forest;
- Cumberland Plain Woodland;
- Freshwater Wetlands; and
- Cumberland Plain Land Snail.

All of these C/EECS/species occur on the subject site and will have habitat removed as a result of the development.

River-flat Eucalypt Forest

RFEF present on the subject site consists of mature, but highly degraded riparian forest. The community occurrence on the subject site is centred on South Creek, and is highly weed infested, but it is adjoined by more intact RFEF within the broader riparian zone extending to the north and east within the Regional Park.

Cumberland Plain Woodland (CPW)

CPW on the subject site consists of a mix of mature woodland, young woodland in various stages of regeneration and grassland. Scattered patches of regenerating CPW occur mainly in the central areas of the subject site. A patch of mature CPW occurs along the south to south-western section of the subject site and extends to the west into the Regional Park.

Freshwater Wetlands

Small areas of Freshwater Wetland are present on the subject site as small depressions adjoining the riparian zone, with a low diversity of native and high abundance of exotic aquatic species. A larger area of this habitat is present to the north west of the subject site, contained within the Regional Park.

Cumberland Plain Land Snail

This species has been recorded within mature and regenerating RFEF and CPW across the entire study area. Individuals were detected within patches of RFEF to the east of the subject site and there is a high likelihood of occurrence within other patches across the subject site.

4.5.2. Minor Affected C/EECs/species

The minor affected C/EECs/species include:

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Endangered ecological communities

Shale Gravel Transition Forest EEC occurs in the study area but not within the subject site.

The minor affected EEC could experience very minor habitat loss or potential indirect impacts and is also considered in the following chapter.

Flora population

- *Marsdenia viridiflora* ssp. *viridiflora*: This species has been recorded in low numbers in the Regional Park, but has not been recorded on the subject site.

Flora species

- *Grevillea juniperina* ssp. *juniperina*; and
- *Pultenaea parviflora*

These flora species have been recorded in the study area, but are largely absent within or adjoining the subject site.

Fauna species

Microbats: Eastern Coastal Free-tailed Bat, Large-eared Pied Bat, Eastern False Pipistrelle, Large Bent-winged Bat, Southern Myotis and Greater Broad-nosed Bat: These microbats have all been recorded on the SMDS, and mostly within the study area. The habitats present on the subject land do not provide significant habitat for these species due to a lack of roosting habitat. However, they will experience a loss of foraging habitat to a relatively minor degree. For this reason, these microbats are considered to be minor affected C/EECs/species.

Flying Fox: Grey-headed Flying-fox: As with the microbats, the subject land provides a relatively small area of foraging habitat for this species. No flying-fox camps are known to occur on or adjoining the study area.

Birds: Speckled Warbler, Varied Sittella, Diamond Firetail, Dusky Woodswallow and Hooded Robin.

4.5.3. C/EECs/Species that are not affected

Habitat analysis and targeted surveys have indicated that several of these species do not appear to occur in the study area. The plants *Dillwynia tenuifolia*, *Persoonia nutans* and *Micromyrtus minutiflora* and *Pimelea spicata* have not been located in the study area. Although an incidental record for *Pimelea spicata* was recorded in 2004 near the study area boundary, the species could not be relocated despite intensive targeted surveys between 2011 and 2012 and the area with the 2004 record has since been cleared for development. For this reason, these plant species are not considered as affected C/EECs/species.

Very few of the birds listed as the subject species have ever been detected on the SMDS, and none were detected on the site during surveys of the study area. The majority of birds are therefore not considered as affected C/EECs/species, however, small grassy woodland associated species that are known from the SMDS are included as affected C/EECs/species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Additionally, Koalas, Spotted-tailed Quolls, Squirrel Gliders and Green and Golden Bell Frogs have not been found on the SMDS, though some marginal potential habitat occurs, and the species are not considered as affected C/EECs/species. Furthermore, the Green and Golden Bell Frog is considered likely to be extinct in this part of Western Sydney (DEC (NSW) 2005a).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5. Impact Assessment

This chapter addresses the impacts to species, populations and C/EECs in order to address CER Sections 5 and Section 6. The following summary of impact provides an indication of general impacts of the proposal.

5.1. Assessment of Likely Impacts

5.1.1. Direct Impacts of Development

5.1.1.1. Vegetation communities

The proposed development will occur within a landscape that has been extensively altered since European settlement took place. The RFEF present on the subject site consists of a degraded form of the community, which is heavily weed infested, but adjoins more intact RFEF within the South Creek riparian corridor of the Regional Park. All RFEF conforms to the endangered ecological community listing under the TSC Act. The CPW vegetation on the subject site consists of a mix of mature woodland, young, woodland in various stages of regeneration and derived native grassland which collectively conforms to the critically endangered listing under the TSC Act. A conservative approach has been taken for this SIS and it is assumed that all vegetation within the subject site will be removed for the purposes of the proposed development, although replanting will occur in association with the constructed basins, and temporary access tracks will be restored post construction.

The development of the subject site will result in the clearance of this vegetation, and will contribute to the cumulative impacts of development on the study area, as shown in **Table 14.**

5.1.1.2. Threatened species

The clearing of vegetation mentioned within the subject site will directly remove habitat for threatened species such the Cumberland Plain Land Snail (*Meridolum corneovirens*). The Cumberland Plain Land Snail was recorded within RFEF in the central area of the subject site and has a high potential to occur within other parts of this community, and within adjoining scattered patches of woodland within the subject site. Several individuals are likely to be removed given that habitat is to be cleared.

Some highly mobile fauna species such as microbats, and some small woodland birds that are known from the study area may experience minor habitat loss, however, the subject site generally lack important habitat features, such as hollow-bearing trees. This paucity of habitat features suggests that it would be unlikely for these species to be dependent on the habitats present. The Regional Park also provides substantial habitat for these species.

Extensive mitigation measures have been implemented across the Western Precinct to minimise the impacts from development, and this will be supported by the implementation of management measures outlined in the draft Wianamatta Regional Park Plan of Management (to be implemented by NPWS, following transfer of ownership). Foremost amongst these is the 900 hectare Regional Park, which will conserve substantial habitat for all known species of threatened flora and fauna that have been recorded previously on the SMDS. Areas of CPW within the Regional Park, that are disturbed for access associated with the current subject site will be rehabilitated following the construction of these works. Such mitigation measures are discussed further in **Chapter 7**.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5.1.2. Indirect Impacts

5.1.2.1. Subject site

The current proposal includes additional areas for works within the subject site boundary. This includes areas for ancillary works and other disturbance such as the creation of interim sediment and detention basins, and battering and retaining walls associated with drainage and track upgrade works. There is also the chance of indirect effects, such as the spread of weeds, to impact on native vegetation in this area.

The regenerating and mature CPW on the subject site occurs mainly adjoining the existing access tracks to the north and to the west, that will be upgraded for use during the construction phase. It is intended that the disturbed vegetation will be rehabilitated post construction, in conjunction with the land managers; NPWS. Other patches of mature and regenerating CPW are present adjoining the subject site to the north, south east and west, and extends into the neighbouring Regional Park.

The quality of RFEF and CPW vegetation greatly improves in the Regional Park and the removal of vegetation from the subject site has the potential to indirectly impact on CPW as well as riparian areas in the Regional Park via increases in edge effects and sedimentation or increases in the number of feral species. However, comprehensive mitigation measures, as described in **Section 4.5** and detailed in the Western Precinct Biodiversity Assessment (Cumberland Ecology, 2008) will be implemented to minimise potential impacts.

Site specific mitigation measures for the protection of C/EEC vegetation should include the implementation of a detailed Construction Environmental Management Plan (CEMP). The CEMP will specify the clearing limits and locations of exclusion and sediment fencing. Erosion and sediment control measures also need to be implemented to prevent surface run-off into the adjacent riparian areas in the Regional Park. In combination with the comprehensive mitigation measures for the SMDS, minimal indirect impacts are likely to occur as a result of the proposed development.

5.2. Assessment of Critically Endangered and Endangered Ecological Communities and Species Likely to be Affected

Major affected C/EECs/species are those that will experience a measureable loss of habitat as a result of the development. Relatively few of the subject C/EECs/species are considered likely to be affected by the proposed development. The major affected C/EECs/species include those known from the subject site that will experience a loss of individuals from the population on the SMDS and are assessed in detail in the sections below. These are:

Cumberland Plain Woodland; and

Cumberland Plain Land Snail (*Meridolum corneovirens*).

Minor affected EECs/species are those that occur (or are considered likely to occur) in the study area and which may experience small or very minor impacts to habitat, as identified in **Chapter 4**. The minor affected EECs, Freshwater Wetlands and River-flat Eucalypt Forest, are considered in more detail in the following sections, due to the potential for indirect effects, despite the small area of habitat present on the subject land. The EEC

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Shale-Gravel Transition Forest, is considered to be a minor affected EEC but is not considered in detail as the community has been incorporated into the assessments for CPW.

Minor affected species are not considered in detail in the following sections. Habitat descriptions are provided for these species in **Table 2 and Table 3** and impacts to these species are considered more in terms of impacts to their habitats/potential habitats.

5.2.1. Cumberland Plain Woodland

The NSW Scientific Committee made a final determination on the 18th December 2009 to list Cumberland Plain Woodland as 'critically endangered' under the TSC Act. The state listing includes derived native grasslands where they contain characteristic native non-woody species (NSW Scientific Committee 2009). It does not state minimum condition thresholds, patch size or project foliage cover requirements for Cumberland Plain Woodland or derived native grasslands.

Most of this community had been heavily cleared on the SMDS and is in various stages of regeneration in the study area. Cumberland Plain Woodland would have covered the study area prior to historical clearing for grazing, based on the soils and ground cover species present.

Although no strict definition of derived native grasslands is provided in the final determination, generally this term refers to areas of native vegetation where the tree and shrub layers have been removed, leaving a herbaceous ground cover layer.

5.2.2. River-flat Eucalypt Forest

River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is an EEC listed under the TSC Act (NSW Scientific Committee 2004k). In the Sydney Basin bioregion this community replaces the former EEC Sydney Coastal River-flat Forest.

The patch of this community on the subject site is regenerating after previous disturbances and it contains some significant weed infestations. Adjoining areas within the Regional Park are generally in better condition.

5.2.3. Freshwater Wetlands

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is an EEC listed under the TSC Act (NSW Scientific Committee 2004e). In the study area, it is predominately known from parts of the Regional Park adjacent to the southern extent. Only a small area of degraded wetland will be removed as part of the proposal.

5.2.4. Cumberland Plain Land Snail

The Cumberland Plain Land Snail is superficially similar to the exotic Garden Snail. The shell is between 25 mm and 30 mm in size and while it may be almost any shade of brown, it is always uniform in colour. The Cumberland Plain Land Snail has a more flattened shell that is very thin and fragile, compared with the thick shell of the Garden Snail. It primarily occurs in Cumberland Plain Woodland, which is a grassy open woodland with occasional dense patches of shrubs (OEH 2013a).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

This species has been recorded on the subject site and is estimated to occur in a low density in the development zoned areas (Area A), likely due to the regenerating form of CPW present which generally lacks significant leaf litter and debris due to the young age of most trees present.

5.3. Description of Habitat

The assessment of habitat for the communities described below also provides an assessment for affected C/EECs/species occurring or potentially occurring within the vegetation communities on the subject site. Areas of different vegetation communities, and thus habitat for flora and fauna species, conserved within the Regional Park are provided in **Table 14** below.

Table 14. Comparative areas of Vegetation Communities to be removed from the subject site and conserved within the Regional Park

Vegetation Community	Subject Site	Regional Park (ha)
Cumberland Plain Woodland (as mature CPW, regenerating CPW and DNG)	4.5	513.8

5.3.1. Cumberland Plain Woodland

The assessment of habitat for Cumberland Plain Woodland (CPW) also provides an assessment for affected C/EECs/species occurring within CPW on the subject site, which includes the Cumberland Plain Land Snail.

Threatened birds known from the study area, in particular small woodland birds including Speckled Warbler, Diamond Firetail, Dusky Woodswallow, Hooded Robin and Varied Sittella utilise this open woodland habitat type, are known from the SMDS and are likely to occur in the study area. However, these species generally require large undisturbed remnants in order to persist. Therefore, the sparse and fragmented woodland patches present on the subject site are not likely to represent suitable habitat and these species are more likely to be associated with the intact CPW in the Regional Park, where the records are from.

Likewise with microbats and the Grey-headed Flying-fox, the CPW present on the subject land provides some foraging resources, although only as part of a larger habitat matrix including the Regional Park. Roosting habitat is not readily available for microbats in the study area, as hollow-bearing trees are very uncommon and few buildings remain for cave/building roosting bats. No Grey-headed Flying-fox camps are known from the study area, with the closest being at Cabramatta Creek.

5.3.1.1. Habitat in the study area

i. Type

In the study area CPW occurs in the Shale Plains Woodland form, as referred to in **Chapter 2**. Its habitat is in gently undulating areas of the Cumberland Plain, in the driest areas of Sydney, receiving less than 800mm of rain a year (Benson and Howell 1990). It occurs on Wianamatta shales, some Holocene alluvium and occasionally Mittagong formation, Tertiary alluvium, Hawkesbury sandstone and Aeolian deposits (Tozer 2003).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Within the study area, the habitat for CPW and associated fauna species exists as larger tracts of mature woodland, which provides more connective habitat and structured woodland.

ii. Area

The total area of CPW within the subject site includes 0.8 ha of mature CPW and 3.7 ha of regenerating CPW, resulting in a total of approximately 4.5 ha of these two CPW variants within the subject site. This compares with a total of 756.2ha of core and support for core habitat throughout the SMDS, including CPW in the Regional Park, within areas listed on the Register of the National Estate (Australian Heritage Commission, 1999) and in open space areas. Throughout Western Sydney, 6745 (±968) ha of CPW in the form of Shale Plains Woodland existed in 1997 (Tozer, 2003).

iii. Condition

Previous assessments of the Western Precinct have classified grasslands with greater than 50% native groundcover abundance as being CPW derived native grassland whereas areas with less than 50% native cover abundance (or greater than 50% exotic cover abundance) were not classified as being part of the CEEC. The survey and detailed assessment of floristic data prepared specifically for this SIS has involved the comparison of quadrats at both ends of the spectrum of native and low diversity grassland using statistical analysis.

The analysis indicates that although the low diversity grasslands are unlikely to regenerate to woodland naturally, due to the historical disturbance experienced, they exhibit many of the native herb and grass species characteristic of CPW. Areas supporting grasslands close to the Regional Park boundary, were observed to contain a higher diversity of native herbs and grasses, which correlated with the areas of the study area where disturbance was historically less. These areas would be more likely to regenerate to woodland over time. This can be seen in the lower dissimilarity levels between Areas B and C which supports Area B having the potential to regenerate to a condition similar to that of Area C. In contrast, this is not observed in the statistical analysis for grasslands of Area A.

Visual observations further support this, as very limited areas of woodland have regenerated throughout much of the development zones of the SMDS, despite the removal of grazing and several years of high rainfall, and generally good conditions for plant growth.

Mature CPW within the Regional Park was identified as being in much better condition than the CPW in the Western Precinct and on the subject site. Despite the presence of some dominant weeds, namely Paddys Lucerne (*Sida rhombifolia)* and Fireweed (*Scenecio madagascariensis)*, a higher diversity of native groundcover species, particularly herbs and grasses were consistently recorded within the Regional Park. The overall condition of CPW in the study area was determined to be high.

5.3.1.2. Habitat in the locality

Mature and regenerating CPW occurs throughout much of the locality as the SMDS is well within the natural extent of this community, and not at the edge of its distribution. The majority of habitat is sparsely distributed and dissected by rural/residential developed across western, south western and parts of northern Sydney. To the north of the study area, similar regenerating CPW occurs between rural lands to the north and links with a very large block of habitat in the Air Services Australian Defence land. The Air Services site exists as a very large

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

block of high quality mature CPW and forms part of a major corridor of CPW habitat to the north linking with several National Parks and Nature Reserves.

5.3.1.3. Distribution of similar habitats in the region

Known areas of CPW within the region occur at Scheyville National Park, Windsor Downs Nature Reserve, Leacock Regional Park and Mulgoa Nature Reserve (NSW NPWS, 2001a) and also at Nelsons Ridge and Prospect Reservoir. In proximate sites to the study area, it is represented in Shanes Park and in other bushland remnants of Penrith and adjoining Blacktown Local Government Area, such as Prospect Reservoir, Nurragingy Reserve and intergrading with Sydney Coastal River Flat Forest at Bells and Eastern Creek (NSW NPWS 1997a).

The Cumberland Plain Land Snail has been found within the region at Scheyville National Park, Agnes Banks Nature Reserve, Castlereagh Nature Reserve, Windsor Downs Nature Reserve and in Gulguer Nature Reserve. Most occurrences, however, are not from conserved areas (NSW NPWS 2000). The species occurs in CPW and in Castlereagh Woodlands in Western Sydney and therefore is likely to occur at Shanes Park, to the north east of the SMDS, Prospect Reservoir, Marsden Park, Nurragingy Reserve, the Regional Park on the SMDS and in other smaller bushland remnants throughout the region (NSW NPWS 1997a).

This is further supported by the following three documents prepared by the NSW Government:

- Draft Strategic Assessment Report for the Sydney Growth Centres Program (DoP 2010); and
- Report on the methodology for identifying priority conservation lands on the Cumberland Plain (DECCW 2010); and
- Cumberland Plain Recovery Plan (DECCW 2011).

Importantly, the latter two of the studies listed above identify the SMDS Regional Park as a Priority Area/Priority Conservation Lands for the management and recovery of the Cumberland Plain.

5.3.1.4. Condition of similar habitat in the region

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility.

Castlereagh Nature Reserve, Windsor Downs Nature Reserve and Scheyville National Park all contain CPW and are assumed to be managed to provide good condition habitat for CPW and for the Cumberland Plain Land Snail.

Prospect Reservoir contains a large area of regrowth CPW. The area was grazed prior to becoming a reservoir and grazing was continued but increasingly restricted until the 1970s. Much of the vegetation has only regenerated since grazing ceased (NSW NPWS 1997a).

Shanes Park, adjacent to the corner of the north and north eastern boundaries of the SMDS, contains the second largest intact remnant of CPW (NSW NPWS 1997a). This remnant is a central area of core habitat in Blacktown LGA, with the potential to form corridors to other bushland remnants throughout the LGA.

Nurragingy Reserve contains some CPW of varying condition. Better condition CPW is contained in areas of the reserve only used for passive recreation (NSW NPWS 1997a).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5.3.1.5. National distribution

Cumberland Plain Woodland is only found on the Cumberland Plain of Western Sydney, in the LGAs of Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly (NSW Scientific Committee 2009).

5.3.2. River-flat Eucalypt Forest

Part of a patch of RFEF that surrounds an existing drainage channel occurs close to the southern end of the study area. The vegetation is in moderate condition and continues to the east through the Regional Park.

This riparian community represents foraging habitat for microbats, particularly for the Southern Myotis. This community may also provide habitat for Black Bittern, although this is likely to be restricted to the dense and connective riparian habitats of the study area. Small woodland birds may use this woodland for shelter as part of a matrix of woodland and forest habitats in the study area.

5.3.2.1. Habitat in the study area

i. Type

River-flat Eucalypt Forest (RFEF) is found on coastal floodplains and has a tall canopy of eucalypts. The most widespread canopy trees include *Eucalyptus tereticornis, E. amplifolia, Angophora floribunda* and *A. subvelutina*. It may have a layer of small trees and a scattering of shrubs. The ground cover consists of abundant forbs, scramblers and grasses. RFEF occurs on alluvial soils on river-flats of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Within the study area, the habitat for RFEF and associated fauna species exists as larger tracts of mature woodland, which provides more connective habitat and structured woodland.

ii. Area

A total of 265.3ha of core and support for core riparian habitat is present throughout the SMDS, including 217.7 ha of RFEF included in the Regional Park, within areas listed on the Register of the National Estate (Australian Heritage Commission, 1999) and in open space areas. Throughout Western Sydney, 4698 (±903)ha of Alluvial Woodland existed in 1997 (Tozer, 2003).

iii. Condition

The RFEF present in the South Creek corridor is highly degraded due to weed invasion. Further from the watercourse, the riparian vegetation located within the Regional Park is in good condition, being less impacted by weeds. The canopy exhibits past disturbance and although it is currently dominated by *Eucalyptus amplifolia* (Cabbage Gum), which is indicative of RFEF, with sub-dominant *E. molucana* (Grey Box) and *E. tereticornis* (Forest Red Gum) which is more indicative of CPW . The canopy height is 15-20m and projective foliage cover (PFC) 15-30% which is very open for this forest community.

Weeds are present, including *Ligustrum sinense* (Small-leaved Privet) and thickets of *Rubus fruticosus* species aggregate (Blackberry) although they do not dominate the understorey.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5.3.2.2. Habitat in the locality

Major watercourses in the study area and locality contain RFEF, including Ropes Creek and South Creek as shown in **Figure 15**. These first order streams are well vegetated in parts of their range, although significant weed invasion is present throughout. This community grades into several floodplain EECs including Swamp Oak Floodplain Forest, which is known to be present in the locality.

5.3.2.3. Distribution of similar habitats in the region

Larger corridors of Alluvial Woodland occur within the study area and the SMDS. Most of these areas will be conserved within the Regional Park. Small areas of RFEF occur at Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve, Mulgoa Nature Reserve and Marramarra National Park (NSW Scientific Committee, 2004l). In proximate sites to the study area, it is represented in the SMDS Regional Park, RAAF land at Orchard Hills, Rickabys Creek, Mulgoa Creek, South Creek, Prospect Reservoir, Nurragingy Reserve and at Bells Creek, near Townson Rd (NSW NPWS 1997b, a).

5.3.2.4. Condition of similar habitat in the region

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility.

Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve, Mulgoa Nature Reserve and Marramarra National Park all contain RFEF (NSW Scientific Committee 2004k). It is assumed that these Nature Reserves and National Parks are managed to provide and maintain RFEF in good condition.

Prospect Reservoir contains an area of regrowth RFEF. The area was grazed prior to becoming a reservoir and grazing was continued but increasingly restricted until the 1970s. Much of the vegetation has only regenerated since grazing ceased. Riparian habitats for RFEF are degraded due to weed invasion (NSW NPWS 1997a).

Nurragingy Reserve contains some RFEF of varying condition. RFEF is degraded in areas of unlimited pedestrian access. Weed invasion has also led to the degradation of this RFEF (NSW NPWS 1997a).

Royal Australian Airforce land at Orchard Hills contains good condition riparian areas of RFEF but this is under Defence ownership (NSW NPWS 1997b).

River-flat Eucalypt Forest along Rickabys Creek has been impacted by clearing for development and has been degraded by rubbish dumping and use of trail bikes in the area. Road construction has also damaged this bushland remnant (NSW NPWS 1997b).

River-flat Eucalypt Forest along Mulgoa Creek has been subject to poor land management and the negative effects of agriculture in the area. It has also been degraded by weed invasion (NSW NPWS 1997b).

The corridor of RFEF along South Creek varies in condition; with good condition RFEF occurring in the central section of the Regional Park. Southern sections of this creek, have been affected by clearing for agriculture and weed invasion (NSW NPWS 1997b).

An area of RFEF along Bells Creek, near Townson Rd is currently threatened by grazing and has been subject to weed invasion (NSW NPWS 1997a).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5.3.2.5. National distribution

RFEF is known from parts of the Local Government Areas of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley but may occur elsewhere in the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee 2004k).

5.3.3. Freshwater Wetlands

Small areas of Freshwater Wetland are present in the study area as small depressions adjoining the riparian zone, with a low diversity of native and high abundance of exotic wetland species. A larger area of this habitat is present to the south west of the Western Precinct, contained within the Regional Park.

This wetland community represents foraging habitat for microbats, particularly for the fishing bat; Southern Myotis as well as potential foraging habitat for passing migratory wetland birds. Once constructed, the Drainage Detention Basins C and V6 will contribute to the area of habitat for this species.

5.3.3.1. Habitat in the study area

i. Type

Freshwater Wetlands occurs in very small local patches throughout the study area, generally artificially created by a small scraping of the soil that results in a small depression. A larger area of Freshwater Wetlands has been mapped within the study area: an area surrounding the dam in the south western corner of the Regional Park, largely included in the Regional Park.

This kind of wetland is uncommon in and around the SMDS and is considered to have moderate to high conservation significance. Where wetland species have colonised artificially created habitats, the area is still considered to be a degraded variant of the EEC. Degraded wetlands have conservation value if they form part of a habitat corridor, provide habitat for aquatic species and resources for birds and mammals, provide habitat for threatened aquatic plants or maintain a seed bank of local provenance plants.

The wetlands provide small areas of habitat to common frog species and water resources for other animals, as well as local provenance plants. The wetland associated with the dam in the south west of the Regional Park is of high conservation value as it provides potential habitat for local and migratory bird species including Lathams Snipe (listed under the EPBC Act only), covers a relatively large area compared with wetlands/sedgelands formed in shallow depressions and is connected to other types of habitat through the Regional Park.

ii. Area

The large wetland in the south west of the Regional Park will not be removed, and totals approximately 2ha.

iii. Condition

Overall, exotic species ranged from 5-70% of the projective foliage cover of the ground cover for the study area, while on the subject site, the wetland is estimated to contain greater than 85% exotic cover.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5.3.3.2. Habitat in the locality

No significant occurrences of this EEC are known to occur in the locality. However, farm dams and other similar man-made wetlands are frequent throughout the locality, and are also likely to conform to a variant of Freshwater Wetlands, if only in a very simplified form, as with the study area.

5.3.3.3. Distribution of similar habitats in the region

Few good examples of this community are reserved in the region. This community is known to occur in Hexham Swamp and Pitt Town Nature Reserves and Scheyville National Park in the Region (NSW Scientific Committee 2004e).

5.3.3.4. Condition of similar habitat in the region

Condition of similar habitat within the region is likely to vary with disturbance history and human accessibility. There is likely to be other similar man-made habitats for this EEC in the locality and region that occur in a similar state to the study area habitat.

5.3.3.5. National distribution

Although Freshwater Wetland is known from along the majority of the NSW coast, it is distinct in the Sydney Basin where it is associated with sandplains. As a habitat, it has been extensively cleared and modified. In the 1990s the extent remaining was: 3% in the NSW North Coast bioregion, 66% in the lower Hunter – Central coast region, 40% on the Cumberland Plain, 70% in the Sydney – South Coast region, and 30% in the Eden region.

5.4. Past Disturbance History of the Study Area

Land parcels were granted for pastoralism on the Cumberland Plain in the early 1800s. Parts of the SMDS were included in these grants. Timber-getting took place in the South Creek area of the SMDS, in the 1860s, for sleepers and general construction associated with the extension of the western railway line (Kinhill 1995).

The SMDS was acquired by the Commonwealth in the 1940s for the manufacture and storage of munitions. Grazing continued on much of the SMDS in order to keep ground layer fuel levels low (Kinhill 1995).

The SMDS underwent demolition of most buildings and decontamination, including soil remediation works, in the 1990s (Kinhill 1995).

Much of the vegetation currently on the property has regenerated since the cessation of grazing and clearing from the mid 1940s onwards (ERM 2003). Such vegetation is now predominantly contained within the Regional Park.

5.4.1. Assessment of Ability of Affected C/EECs/Species to Recover to Pre-Disturbance Condition

Resilience, or the ability of native vegetation to recover to a pre-disturbance condition is assessed using the *In Situ Resilience and Anticipated Recovery Capacity Assessment* (Perkins, 2002). Refer to **Figure 15** for an indication of canopy cover and regeneration age of the forest, woodland and grassland in the study area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

All woodland and forest habitat types exhibit high resilience, evident from the regeneration of all community types. However, in the development zoned land, including that zoned for Drainage, where past disturbance was significant, all communities were found to contain a lower diversity of native species than in the Regional Park (Cumberland Ecology 2012c, a, d, 2014a, c, b). The woodland cover is more sparse and has less structure than the representatives in the Regional Park, however, it is likely that over time, these communities could have the potential to regenerate to a state similar to pre-disturbance.

The grasslands are however considered to be a more degraded form of the community from which they are derived, as no regeneration of midstorey and canopy layers are evident. This is not to say that areas of grassland are not in reasonable condition, as they contain a number of native groundcover species indicative of the original woodland. Overall, a reduced abundance of native species occurs on the subject site, which is likely as a result of the past disturbance.

The consistency of the Proposal with the objectives of the Recovery Plan for the Cumberland Plain (DECCW 2011) is discussed in detail in **Chapter 6**.

5.5. Description of Conservation Status

5.5.1. Cumberland Plain Woodland

Cumberland Plain Woodland is listed as critically endangered through both the TSC Act and EPBC Act and is therefore not considered likely to be well reserved. As previously discussed however, CPW is comparatively well reserved in the locality, as demonstrated by the high proportion of the study area that includes CPW. Further discussion of the state and regional conservation of this community is provided in **Section 5.3**. This CEEC is not at the limit of its known distribution in the study area.

The principal threat to the biodiversity of the Cumberland Plain is the further loss and fragmentation of habitat and the resulting indirect impacts (such as weed invasion). The proposed development will contribute to this threat, however, the retention of expansive areas of the high quality habitat in the Regional Park and the management of this vegetation are likely to significantly reduce the effect of the threat to this community in the locality.

Cumberland Plain Land Snail is at threat from the modification to CPW. The bulk of the known populations are small, isolated and vulnerable to impacts from clearing and habitat modification such as weed invasion, inappropriate fire management and removal of ground cover, as this removes shelter, breeding habitat and sources of food (OEH 2013a).

5.5.2. River-flat Eucalypt Forest

RFEF is listed as endangered under the TSC Act. It is likely to be well represented in the locality and is distributed throughout the region, and other parts of NSW. Further discussion of the state and regional conservation of this community is provided in **Section 5.3**.

The community has experienced a reduction in the area of habitat and the remaining area is likely to represent much less than 30% of its original range. Recently recorded, major occurrences include: about 2,000 ha in the

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

lower Hunter region; less than 10,000 ha on the NSW south coast from Sydney to Moruya, of which up to about three-quarters occurred on the Cumberland Plain in 1998 (NSW Scientific Committee 2004k).

The principles threats to this EEC of relevance to the study area include:

- Flood mitigation and drainage works;
- Landfilling and earthworks associated with urban and industrial development;
- Changes in water quality, particularly increased nutrients and sedimentation; and
- Weed invasion.

The proposed development of the Regional Detention Basins C and V6 has the potential to exacerbate the impact of threats to this community due to proposed drainage upgrade works. However, the basins are required as part of flood mitigation works, as well as for water quality management, due to the development of the Western Precinct. If left unmanaged, the increased flows in South Creek from uncontrolled run-off would further degrade the condition of RFEF in the study area, and downstream. For these reasons, as anticipated in the Western Precinct Biodiversity Assessment (Cumberland Ecology 2009a), improved drainage and water cycle management will benefit the EEC. Mature trees will be retained wherever possible on the banks of the channel and regeneration of the riparian corridor after structural works are completed will include extensive planting of RFEF and wetland species as part of landscaping.

5.5.3. Freshwater Wetlands

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change (NSW Scientific Committee 2004e).

The development of the subject site will not greatly exacerbate the effects of this threat to the larger examples of this EEC. Landscaping of the Regional Detention Basins C and V6 will include planting of Freshwater Wetland species, and will not include any exotic or invasive species. As with the RFEF, the community will benefit from flood management and water management in the study area.

5.6. Discussion of Likely Effects of the Proposed Development

5.6.1. Extent of Habitat Removal

The subject site is proposed for development via a single development application (DA). **Table 14** outlines the extent of the developable area for this DA within the subject site, as outlined within SREP 30.

The majority of riparian vegetation adjacent to South Creek and tributaries in the study area will be retained, and Regional Detention Basins C and V6 will adjoin this community, and contribute to the riparian zone.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

As detailed in **Table 14**, the proposed development of the subject site will remove habitat for the C/EECs and species described in this chapter. Of greatest significance is the direct removal of CPW which is described further below. Other species and EEC will experience habitat loss or modification to a lesser extent.

5.6.1.1. Cumberland Plain Woodland

The proposed development for the subject site will clear a total of approximately 4.5 ha of CPW consisting of 0.8 ha of mature CPW and 3.7ha of regenerating CPW.

This represents a small area of habitat for the Cumberland Plain Land Snail. However, a significantly greater density of snails is known to occur in the Regional Park, particularly within the mature woodland in the central sections of the park. The subpopulations of this species present in the regenerating CPW present on the subject site are likely to be permanently removed by the basin construction, and temporarily removed for the upgrade of the access track. However, the extent of such habitat removal for this species is not considered likely to cause the extinction of the local population centred on the Regional Park as sizable numbers occur within a secure and connective tract of woodland habitat.

The removal of this woodland type also represents foraging habitat for threatened bats and birds, although as previously discussed, such habitat is likely to form marginal support areas as part of a large habitat matrix centred on the Regional Park and proximate reserves. It is therefore expected that this habitat removal is a minor area of habitat for these highly mobile species.

5.6.1.2. River-flat Eucalypt Forest

The proposed development for the subject site will not clear any RFEF. The RFEF to be removed, modified or isolated as a result of the other developments within the subject land is not important to the long-term survival of the community within the locality. River-flat Eucalypt Forest of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

As with CPW, this community provides some habitat for the Cumberland Plain Land Snail, although is generally sub-optimal habitat for the species, and for threatened bats and birds known to occur in the study area. Habitat will not be greatly modified for these species.

5.6.1.3. Freshwater Wetlands

The proposed development for the subject site will not clear any Freshwater Wetlands. While there is potential for indirect impacts to the wetland in the adjacent Regional Park, these can be mitigated via appropriate control measures. The Freshwater Wetlands to be removed, modified or isolated as a result of the other developments within the subject land are not important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

This community provides some habitat for threatened bats and birds known to occur in the study area. This habitat will not be greatly modified for these species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5.6.1.4. Plant species

Approximately 700 specimens of *Grevillea juniperina spp. juniperina* were recorded in the Western Precinct during the field surveys. These are located at the northern and southern margins of the precinct. No individuals are present within the subject site.

It has been estimated that at least 249,000 (minimum) specimens of *G. juniperina* ssp. *juniperina* occur within the Regional Park, where extensive habitat has been conserved (ERM, 2003). These specimens will not be affected by development of the subject site and will be protected in perpetuity.

A single *Pultenaea parviflora* plant was recorded in the Western Precinct, to the south of the subject site, during the 2011 surveys in an area that is subject to an approved DA and has been cleared. This is not considered to be a significant part of the population which is centred on the Regional Park, where it is estimated that at least 50,000 of this species occur.

Two individuals of *Marsdenia viridiflora* ssp. *viridiflora* has been recorded from proximate parts of the Regional Park adjoining the Western Precinct, within Cumberland Plain Woodland. These plants will not be removed as part of the development of the subject site, and much greater numbers have previously been estimated from within the Regional Park.**Section 4.3.3** provides an estimate of the approximate number of those conserved in the Regional Park study area.

5.6.2. Significance within the Local Context

5.6.2.1. Cumberland Plain Woodland

The geography, soils, topography and associated species of CPW are specific to Western Sydney, although dominant canopy species are found elsewhere in NSW and Australia. Remnants are often small (<10ha) and vulnerable to disturbance and degeneration by humans (NSW NPWS 1997c). According to the JANIS report (Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee 1997), 15% of the pre-1750 distribution of any vegetation community should be conserved within the Comprehensive, Adequate and Representative (CAR) reserve system. As such, only 7.7(±1.1)% of the Pre-European extent of Shale Plains Woodland existed in 2003 (Tozer, 2003). Of this, significant areas are conserved within Windsor Downs Nature Reserve (NSW NPWS 1997c), Scheyville National Park, Leacock Regional Park and Mulgoa Nature Reserve (NSW Scientific Committee 2009).

Within the Region, there are core CPW remnants at Kemps Creek, Prospect Reservoir, Shanes Park, Orchard Hills RAAF base, the 900ha Regional Park on the SMDS, Hawkesbury Reserve, Lansdowne Park, Boral-Lower Canal (Prospect) and on the Wonderland site at Eastern Creek (NSW NPWS 1997c).

The long-term security of CPW in the SMDS, within the study area, will be assured with its inclusion in the Regional Park. The area of CPW to be included within the Regional Park is 531.8ha of core and support for core habitat. This includes core habitat CPW within the study area. The 900ha Regional Park will be transferred to State Government ownership and managed by the NPWS (ERM, 2003).

CPW occurring on the subject site occurs as sparse regenerating woodland patches and is moderately disturbed by the adjoining development to the north. Many small patches of CPW, such as those on the subject

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

site, occur throughout the Cumberland Plain. The area of CPW to be conserved within the Regional Park is of much greater area and quality and is one of the largest areas of CPW remaining.

5.6.2.2. River-flat Eucalypt Forest

The geography, soils, topography and associated species of RFEF are specific to Western Sydney, although dominant canopy species are found elsewhere in NSW and Australia. Much of the pre-European distribution of this community has been cleared for agriculture, as it occurs on fertile alluvial soils. According to the JANIS report (Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee, 1997), 15% of the pre-1750 distribution of any vegetation community should be conserved within the Comprehensive, Adequate and Representative (CAR) reserve system. As such, only 13(±2.5)% of the Pre-European extent of Alluvial Woodland existed in 2003 (Tozer, 2003). Of this, good representations of RFEF are conserved within Bents Basin State Recreation Area, Mulgoa Nature Reserve and Western Sydney Regional Park (NSW NPWS, 2001b), and small areas are conserved within Cattai National Park, Dharug National Park, Georges River National Park, Scheyville National Park, Gulguer Nature Reserve and Marramarra National Park (NSW Scientific Committee 2004k).

Within the region, there are core RFEF remnants at Prospect Reservoir, Orchard Hills RAAF base, the SMDS Regional Park, Rickabys Creek, Mulgoa Creek, South Creek, Nurragingy Reserve and along Bells Creek near Townson Road (NSW NPWS 1997b, a)

The long-term security of RFEF in the SMDS, within the study area, will be assured with its inclusion in the Regional Park. The area of RFEF to be included within the Regional Park is 217.7ha of core and support for core habitat. This includes core habitat RFEF within the study area. The Regional Park will be transferred to State Government ownership and managed by the NSW National Parks and Wildlife Service (ERM, 2003).

The area of RFEF proximate to the subject site is of little local significance. This representative occurs as a degraded form, being heavily impacted by weeds, in particular close to the watercourse, as found on the subject site. Larger areas of much higher quality exist in the locality and a large area will be conserved within the Regional Park. Notwithstanding this, the RFEF will be cleared to a minor extent in the study area, but will be conserved and rehabilitated as part of the South Creek riparian corridor as part of the future management of the Regional Park.

There is long-term security for the corridor of RFEF in the study area, as it is located within the riparian zone of South Creek, located within the Regional Park. The corridor will be rehabilitated as a result of management requirements for the riparian zone.

5.6.2.3. Freshwater Wetlands

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change (NSW Scientific Committee 2004e).

There is long-term security for the large wetland in the south of the study area as it occurs in the riparian zone adjacent to the proposed development. The wetland and riparian corridor will be rehabilitated and widened as a result of management requirements for the riparian zone.

5.6.2.4. Plant species

The three subject plant species are all shrubs endemic to the Cumberland Plain. *Pultenaea parviflora* is listed under the TSC as endangered, while *Grevillea juniperina* ssp. *juniperina* is listed as vulnerable, with relatively narrow total ranges. *Marsdenia viridiflora* ssp. *viridiflora* is listed as part of an endangered population, which includes the Penrith LGA. The Regional Park contains some of the largest known populations of these species, if not the largest known population of *P. parviflora* in existence.

The long-term security of these shrubs in the study area is assured with the dedication of large areas of habitat to the Regional Park, in particular, the eastern section of the Regional Park (outside of the current study area). The conservation of these shrubs within the Regional Park is important for its long-term security because of the large size of the populations of the species.

Within the region, *P. parviflora* is also conserved within Scheyville National Park, Windsor Downs Nature Reserve and Castlereagh Nature Reserve (NSW NPWS 2002). *Grevillea juniperina* ssp. *juniperina* is conserved within Castlereagh Nature Reserve (NSW Scientific Committee 2000b). Although other bushland remnants contain populations of these affected C/EECs/species, the gazetted National Parks and Nature Reserves referred to provide a higher level of protection as they are dedicated to the long-term security of the species.

5.6.2.5. Cumberland Plain Land Snail

The Cumberland Plain Land Snail only occurs on the Cumberland Plain. It is known from over 100 locations in Western Sydney. The area of habitat for the Cumberland Plain Land Snail coincides with occurrences of CPW and to a lesser extent RFEF, on the subject site. As referred to above, the areas of CPW and RFEF on the subject site are small and not high quality habitat, compared with CPW occurrences in the Regional Park and other parks and reserves within the locality. This area of habitat within the subject site is not ensured of long-term security, as vegetation clearing has been proposed for the subject site.

5.6.2.6. Bats and birds

Woodland habitat on the subject site is degraded and sparse for the wide ranging, minor affected fauna species. In the context of the locality, and the Regional Park, it is not considered likely that the subject site would form a significant area of habitat for local populations of these species, although it does contribute to the broader corridor of South Creek riparian zone, and is therefore valuable for connectivity. Wetland habitats within the subject site are also considered unlikely to form a significant area of habitat for local populations of bird and bat species due to their relatively small size.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

As the potential habitat on the subject site represents only a small portion of the area available to the species in the locality and the species are highly mobile, the habitat present is not considered to be critical to their survival, and hence is not significant in the local context.

5.6.3. Discussion of Connectivity

5.6.3.1. C/EECs and flora species

The study area forms part of a broad local corridor that extends to the north of the site, and to a lesser extent to the south via South Creek riparian corridor. The vegetation on the subject site is connected to vegetation in the Regional Park to the north, east, and west, but to the south is urban development, excluding the South Creek riparian corridor, which narrows beyond the SMDS. Development of the subject site will not sever connectivity between areas of existing native vegetation. To the north of the study area beyond Ninth Avenue, there are rural residential blocks and several patches of remnant vegetation.

The cumulative impacts of the development of the development zoned land on the SMDS is not expected to greatly limit gene flow of plant species between the north western parts of the Regional Park and the proximate areas of CPW to the north and north west. These areas of habitat are already fragmented and pollination between these areas of habitat is therefore slightly reduced from that of continuous woodland. Further fragmentation is not likely to reduce the viability of CPW, RFEF and Freshwater Wetlands and the subject plant species in the locality.

5.6.3.2. Bats and birds

Woodland habitat on the subject site is degraded, and sparse for the affected fauna species. The sparse patches do however provide some connectivity to the intact habitats in the Regional Park, as this forms part of the South Creek riparian zone. The development of the subject site, and SMDS as a whole is not likely to greatly reduce this connection, as it occurs at the western extent of the core area of habitat for these species and will not sever a significant connection that exists in the Regional Park.

As the potential habitat on the subject site represents only a small portion of the area available to the species in the locality and the species are highly mobile, the proposed development is not likely to decrease the movement of individuals and gene flow between areas of potential habitat throughout the locality or within or between local populations.

5.6.3.3. Cumberland Plain Land Snail

The Cumberland Plain Land Snail is not a mobile species and therefore does not depend on extensive movement of individuals to maintain a viable population. The species occurs in isolated populations throughout its highly restricted distribution. The habitat present on the subject site is connected to other areas of habitat in the study area, within the Regional Park, and will not fragment this habitat. Although numerous individuals are likely to be removed as part of the proposed development, the habitat present is degraded and small in comparison to the adjoining Regional Park. A viable large local population is expected to persist in the Regional Park, despite the minor habitat removal on the subject site.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

5.6.4. Consideration of Threatening Processes

The following Key Threatening Processes, listed under the TSC Act have been considered with respect to C/EECs and the affected C/EECs/species:

- Clearing of native vegetation;
    - Native vegetation will definitely be cleared (see above section) and the most significant impacts on CPW and the affected C/EECs/species will arise from vegetation clearance.
- Invasion of native plant communities by exotic perennial grasses;
    - There is potential for exotic perennial grasses to invade bushland in the Regional Park, particularly if there is runoff from the subject site to the Regional Park, or dumping of grass propagules in the Regional Park, from residential areas, on completion of the proposed development of the study area. Exotic grasses are currently in existence on the subject site, particularly dominating the grassland, and invading other habitats.
    - Active management of the Regional Park will reduce the effect of exotic grasses and minimise invasion into the Regional Park.
- Competition from Feral Honeybees;
    - Honeybees are established in the vegetation of the SMDS at present and are an ongoing threat. Honeybees can compete with native arboreal fauna and native bees for tree hollows. They can also compete with native pollinators for floral resources (NSW Scientific Committee 2004a).
- Infection of native plants by *Phytophthora cinnamomi*;
    - There is a potential threat to the vegetation to be conserved within the Regional Park. However, no dieback of the type caused by this plant pathogen has been observed within the SMDS and it is not generally regarded as a threat within Western Sydney vegetation (NSW Scientific Committee 2004h).
- Importation of red imported fire ants into NSW;
    - Fire ants, if established would be a major threat to terrestrial ecosystems. The proposed development is not likely to increase the risk of establishment of these ants.
- Introduction of the large earth bumblebee *Bombus terrestris;*
    - The large earth bumblebee, if established would be a major threat to terrestrial ecosystems. The proposed development is not likely to significantly increase the establishment of this species.
- Removal of dead wood and dead trees;
    - The proposed development will remove some dead wood and a small number of dead trees. However, most of the vegetation in the subject site is regrowth and so contains little dead wood. There is also

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

potential for new human residents of the subject site to gather wood from the Regional Park. This threat must be managed by the NPWS via the management plan for the Regional Park.

- Competition and grazing by the feral European Rabbit;
    - Rabbits are established across the SMDS. The proposed development will not increase the threat from rabbits. Moreover, the Western Precinct Plan has a Domestic and Feral Animal Management Strategy (Cumberland Ecology 2008a) that includes rabbit control measures. Such measures are currently being implemented in the SMDS.
- Ecological consequences of high frequency fires;
    - The SMDS has had a relatively high fire frequency in the past due to arson. This will need to be managed via the Regional Park Plan of Management. The proposed development is unlikely to significantly increase fire frequency.
- Predation by Plague Minnow (*Gambusia holbrooki*)
    - The Plague Minnow preys upon tadpoles and is a threat to a number of frog species. It occurs within South Creek and the smaller drainage-lines in the study area. The proposed development will entail construction of biofiltration and wetland detention basins. The permanent wetland detention basins have potential to be colonised by the Plague Minnow, but the ephemeral biofiltration areas have potential to create additional habitat for frogs that is free of Plague Minnow. Such artificial wetlands will provide additional foraging areas for bats, frogs and birds within the study area.

Measures to minimise the impacts of the proposed development on threatened species and communities are discussed further in **Chapter 7**.

5.7. Description of Feasible Alternatives

The proposed residential subdivision and subsequent development of the SMDS Western Precinct, and associated ancillary works for drainage, complies with the land use zoning as set out in SREP30 (DUAP 2001b). SREP30 was prepared, and land use zones identified, following significant investigations over many years into the biophysical, economic, social and ESD considerations of development via Section 22 and Joint Steering Committee processes. Alternatives to the proposal were considered in the Section 22 Advisory Committee Report (Department of Urban Affairs and Planning 1997). A conservation outcome was determined, and conservation areas to be included in the Regional Park (now 900ha in area) and Regional open space areas were determined before the developable area was defined. The following points were considered in order to determine the area for conservation:

- The relative size or area of habitat patches;
- Representation of a vegetation community on a regional scale;
- The presence of threatened flora and fauna species;
- Species diversity in habitat patches;

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- The relative naturalness of the habitat patch;
- Connectivity of habitat patches;
- Fragmentation of habitat patches;
- The ease of management of habitat patches, including amount of active management, feasibility and cost; and
- The strategic importance of the SMDS for biodiversity management within the locality.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

6. Consistency of the Proposal with the Objectives of the Cumberland Plain Recovery Plan

6.1. Introduction

A Final Recovery Plan (the Recovery Plan) for the communities and associated threatened species and populations of the Cumberland Plain has been prepared and adopted by the NPWS in January 2011 (DECCW 2011). The Draft Recovery Plan (DECCW (NSW) 2009) was in place between 2009 and 2011. The purpose of this chapter is to examine the consistency of the proposed development with the objectives and actions of the Recovery Plan for the purpose of considering whether there is likely to be a significant impact on threatened species. This analysis is undertaken under section 5A of the EP&A Act.

When considering whether to approve the proposed development under section 79C of the EP&A Act, Council is not required to act in a manner consistent with the objectives and actions in the Recovery Plan, but should take those objectives and actions into account when determining the development applications.

6.2. Species, Populations and Ecological Communities

The Recovery Plan (DECCW 2011) addresses the following threatened species, populations and ecological communities that are found on the Cumberland Plain, as shown in **Table 15**.

Table 15 : Threatened Biodiversity addressed in the Recovery Plan

Threatened Biodiversity	TSC Act Status	EPBC Act Status
Flora Species		
Allocasuarina glareicola	Endangered	Endangered
Dillwynia tenuifolia	Vulnerable	Vulnerable
Juniper-leaved Grevillea (*Grevillea juniperina* ssp. *juniperina*)	Vulnerable	-
Micromyrtus minutiflora	Endangered	Vulnerable
Sydney Plains Greenhood (*Pterostylis saxicola*)	Endangered	Endangered
Pultenaea parviflora	Endangered	Vulnerable
Fauna Species		
Cumberland Plain Land Snail (*Meridolum corneovirens*)	Endangered	-
Populations		
Dillwynia tenuifolia population in the Baulkham Hills LGA	Endangered	-
Dillwynia tenuifolia population at Kemps Creek	Endangered	-
Marsdenia viridiflora R. Br ssp. *viridiflora* population in the Bankstown, Blacktown, Camden, Fairfield, Holroyd, Liverpool and Penrith LGAs	Endangered	-

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Biodiversity	TSC Act Status	EPBC Act Status
Pomaderris prunifolia (a shrub) population in the Parramatta, Auburn, Strathfield and Bankstown LGAs	Endangered	-
Ecological Communities		
Agnes Banks Woodland	Endangered	-
Castlereagh Swamp Woodland	Endangered	-
Cooks River/Castlereagh Ironbark Forest	Endangered	-
Cumberland Plain Woodland (listed on EPBC Act as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest)	Critically Endangered	Critically Endangered
Moist Shale Woodland	Endangered	-
Shale Gravel Transition Forest (listed on EPBC Act as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest)	Endangered	Critically Endangered
Shale Sandstone Transition Forest	Endangered	Endangered
River-flat Eucalypt Forest (previously Sydney Coastal River Flat Forest)	Endangered	-
Western Sydney Dry Rainforest	Endangered	-

The management and recovery objectives for the flora and fauna species, populations and ecological communities listed above are addressed as part of the overall objectives for the communities of the Cumberland Plain as it is recognised that the recovery of the vegetation will facilitate the recovery of the associated flora and fauna species.

In addition to those listed above, the following threatened species and populations are found on the Cumberland Plain but are not specifically addressed in the Recovery Plan, as only a small proportion of their distribution occurs within the Cumberland Plain or a recovery plan already exists:

- *Acacia pubescens* (Downy Wattle);
- *Hibbertia superans*;
- *Pultenaea pedunculata* (Matted Bush-pea);
- *Persoonia nutans* (Nodding Geebung);
- *Pimelea curviflora* var. *curviflora*; and
- *Pimelea spicata* (Spiked Rice-flower).

Of the species listed above, only one; *Pimelea spicata* occurs in the study area. Although not covered by the Recovery Plan, this species is addressed in a species specific recovery plan (DEC (NSW) 2006). This species is dealt with at **Section 4.3.3iii** of this SIS.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The Recovery Plan also identifies a number of additional fauna species, including threatened microbats and birds that are likely to benefit from the implementation of the prescribed management actions. The SIS has dealt with these in **Section 4.3.6**.

The study area, including the subject site, contains some ecological communities and threatened species, or habitat for such species, of relevance to the plan, including;

- Cumberland Plain Woodland;
- River-flat Eucalypt Forest;
- *Grevillea juniperina* ssp. *juniperina*;
- *Pultenaea parviflora*; and
- Cumberland Plain Land Snail

The primary focus of the Recovery Plan is the preservation of threatened species, populations and communities in priority conservation lands. Priority conservation lands are identified in Figure 1 of the Recovery Plan and are said to represent the best remaining opportunities in the region to maximise biodiversity benefits. DECCW considers these lands to be the highest priority for future efforts to conserve the threatened biodiversity in the region. The 900 ha proposed Regional Park is identified in the Recovery Plan as priority conservation land.

While the subject site is not priority conservation lands, the Recovery Plan nevertheless identifies as a responsibility of, in this case, Council, the promotion and adoption of best practice standards for bushland management on private land outside the identified priority conservation lands. These best practices standards are set out in Appendix 2 to the Recovery Plan and are considered in **Section 6.3** below and **Appendix E**. In relation to private land, the Recovery Plan contemplates the preparation of site action or management plans which address the management of threatened biodiversity in accordance with the Recovery Plan. The action and management plans addressing the management of threatened biodiversity for the subject land are also discussed in **Section 6.3** below.

Chapter 5 considers the impacts of the proposed development on threatened species, populations and ecological communities, including those listed in the Recovery Plan. The clearing of vegetation within the subject site will directly remove habitat for a small number of threatened flora species that have been recorded in the study area and wider SMDS, but not within the subject site. Notwithstanding this, the potential impacts of the proposed development on these species and populations have been considered.

Further to this, a total area of 4.5 ha of woody vegetation, consisting of 0.8 ha of mature CPW and 3.7 ha of regenerating CPW, which constitutes potential habitat for the Cumberland Plain Land Snail will be removed from the subject site as part of the proposed development. Significant and higher quality habitat for the threatened species will remain in the proposed Regional Park. Such impacts have been assessed in detail in **Chapter 5** and **Chapter 8** of this SIS.

The Recovery Plan identifies the proposed Regional Park; now named the Wianamatta Regional Park, as priority conservation lands. The Regional Park adjoins the subject site to the north, east and west. Partial transfer of

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Wianamatta Regional Park ownership to the National Parks and Wildlife Services has been gazetted, this being the Eastern portion, fronting Forrester Road and Palmyra Avenue. The balance of the land zoned Regional Park is still owned by St Marys Land Limited a LendlLease Company. The Wianamatta Regional Park Plan of Management was adopted by the Minister for Climate Change and the Environment on the 15th of February 2011. The Regional Park forms the primary mitigation measure for the development of the SMDS and the subject site, consistently with the planning framework which has regulated the development of the SMDS for over two decades.

6.3. Compliance of the Proposed Development with the Objectives and Actions of the Final Recovery Plan for the Cumberland Plain

The Recovery Plan identifies the principal threat to the biodiversity of the Cumberland Plain as being the further loss and fragmentation of habitat. Clearing for rural and residential developments, industry, and agricultural land uses has led to increasingly isolated small remnants which are more susceptible to degradation, provide less habitat values and support fewer species.

The Recovery Plan makes clear that there are other areas of local conservation significance, including areas which provide buffers, corridors and ecological linkages for the priority conservation lands, which must be the subject of best practice management (p11). Likewise, (p12) the Recovery Plan notes that the significance of remnant vegetation outside the priority conservation lands should not be underrated, and that best practice management should be implemented on other areas of local conservation significance. It is clear, therefore, that actions to be taken do not relate exclusively to priority conservation lands.

6.3.1. Objectives

The objectives of the Final Recovery Plan are to improve the conservation of the communities of the Cumberland Plain and protect significant remnants in the long-term. The objectives are as follows:

- Recovery Objective 1: To build a protected area network, comprising public and private lands focused on the priority conservation lands (PCL);
- Recovery Objective 2: To deliver best practice management for threatened biodiversity across Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation;
- Recovery Objective 3: To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program; and
- Recovery Objective 4: To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner.

The responsibility for the implementation of these objectives is with NPWS (Formerly DECCW). However, the proposed development of the subject site is consistent with these objectives. The proposed Wianamatta Regional Park has been designated as priority conservation lands and will therefore address Objectives 1 and 2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The community awareness of the Cumberland Plain's threatened biodiversity is enhanced through the creation of the Regional Park. This will assist in achieving Recovery Objective 3.

The Regional Park also allows for the continued increase of knowledge of threats to the threatened biodiversity of the Cumberland Plain, and therefore assists in the implementation of Recovery Objective 4.

6.3.2. Actions

The responsibilities imposed upon the Council in the implementation of the Recovery Plan require the following:

- Action 1.4 requires the Council to have regard to Priority Conservation Lands in identifying areas for inclusion into environment protection and regional open space zones. This has been achieved by Council through the making of SREP 30 by the Minister for Planning and the reservation of the proposed Regional Park, as discussed above and in **Chapter 7**;
- Action 1.5 is directed to "circumstances where impacts on the threatened biodiversity listed in Table 1 (of the Recovery Plan) are unavoidable, as part of any consent, approval or license that is issued, ensure that offset measures are undertaken within the priority conservation lands where practicable ..." It is noted that Council is not listed as a responsible authority for this action. However, the above action has been included for completeness. In any event, any loss of ecological communities on the subject site is overcome by the offset measures proposed by the proposed Regional Park, as discussed in detail in **Chapter 7** of this SIS;
- Action 2.2 requires that Council support and promote the adoption of best practice standards for bushland management and restoration (as specified in Appendix 2) on public and private lands within the Cumberland Plain. The best practice standards are set out in Appendix 2 of the Recovery Plan.

6.3.3. Guidelines

Appendix 2 of the Recovery Plan includes guidelines for the best practice standards for bushland management. The guidelines relate to three types of bushland reserved within the Cumberland Plain:

- Bushland on public lands within or outside of priority conservation lands which have conservation as a primary management objective;
- Bushland on public lands outside the priority conservation lands where conservation is not a primary management objective but is compatible with the primary objective; and
- Bushland on private lands

The Wianamatta Regional Park falls under both the categories of "bushland on public lands within priority conservation lands where conservation is the primary management objective" and "bushland on private lands within priority conservation lands where conservation is the primary management objective". The management of this land is governed by the Wianamatta Plan of Management (DEC (NSW) 2007), the implementation of which is the responsibility of NPWS and Lendlease. Regional Park ownership will be transferred to NPWS progressively through the life of the development of the SMDS.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Only small areas of land within the subject site will conform to the description of the second point: "bushland on public lands outside of the priority conservation lands", where parklands are created and bushland retained in the development areas. However, presently, any bushland retained in the Drainage zoned land conforms to "bushland on private lands".

According to Appendix 2, bushland on public lands outside the priority conservation lands where conservation is not a primary management objective but is compatible with the primary management objective requires an adopted management system or policy (or similar planning document) which addresses:

- management of threatened biodiversity and is consistent with the recovery plan;
- the land to be managed such that the objectives of the management system or policy are met;
- monitoring to be undertaken periodically to determine the status of threatened entities, or to assess the effectiveness of threat abatement measures being implemented (for guidance see the Monitoring manual for bitou bush control and native plant recovery (Hughes et al. 2009) at *www.environment.nsw.gov.au/bitouTAP/monitoring.htm*); and
- management is consistent with the following documents, and any additional best practice documents that DECCW may promote at a later date:
    - Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a);
    - the recommended fire regimes in the Appendix 3; and
    - a landscape-scale response to African Olive invasion on the Cumberland Plain (as per completion of action 2.6).

For bushland on private lands to meet best practice standards for management, Appendix 2 indicates the following measures:

- a site action or management plan to be prepared which addresses the management of threatened biodiversity and is consistent with the recovery plan;
- the land to be managed in accordance with the site action or management plan; and
- management to be consistent with the following documents, and any other best practice documents that DECCW may promote at a later date:
    - Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland; and
    - The recommended fire regimes in Appendix 3.

The document *Recovering Bushland on the Cumberland Plain - Best Practice Guidelines for the Management and Restoration of Bushland* (DEC (NSW) 2005b) ("the DEC Guidelines") is referred to in Appendix 2, which

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

requires management to be consistent with the DEC Guidelines in order to reach "best practice standards for management" of bushland on private lands. Relevantly, the DEC guidelines include the following provisions:

- " ... protect any retained native vegetation from further degradation by fencing it so it can be managed as a separate unit..." (p 16);
- "...actively manage all retained and protected native vegetation ..." (p 16); and
- "It is extremely important that [remnants of native vegetation] are retained and effort is made to link them across the landscape" (p 17) (emphasis in original).

Page 24 of the DEC Guidelines is headed "Checklist: Ten simple guidelines for making your land fauna friendly". It relevantly includes the following principles:

- Local native vegetation should cover at least 30 per cent of the total area;
- Exclude high impact land uses from at least 30 per cent of the area;
- Maintain native grasses... for grassy woodland areas, it has been recommended that at least half the area contain native grass and herb species ...;
- Native vegetation cover ideally should be in patches of at least 5 to 10 hectares and linked by strips at least 25-50 metres wide;
- Manage at least 10 per cent of the area for wildlife. Of the 30 per cent of the area that is local native vegetation, one third (10 per cent) should be managed primarily for wildlife; and
- Maintain understorey cover over at least a third of the area within a patch of trees. Ensure that approximately one-third of the area managed for wildlife has a high diversity of locally occurring understorey species (herbs, grasses and shrubs) (emphasis in original).

These provisions have been collectively satisfied by the management plans described in the following section.

6.3.4. Management Plans Regulating Development of the SMDS

Several management plans have been approved and adopted for the bushland across the SMDS and of specific relevance to this SIS, within the Western Precinct. These areas are already being managed in accordance with these management plans to the extent required. These management plans are consistent with the objectives and requirements of the Recovery Plan, as outlined above.

In addition to the Wianamatta Regional Park Plan of Management, the management plans include the following which have been approved and adopted by Council as part of the statutory planning framework:

- Weed Management Plan (WMP) (Cumberland Ecology 2008b);
- Feral and Domestic Animal Management Strategy (FDAMS) (Cumberland Ecology 2008a);
- Bushfire Hazard Reduction Plan (BES 2008);

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- Landscape Management Plan (Riparian Restoration) (Environmental Partnership 2008); and
- A Plan of Management for Eastern Grey Kangaroos, Red Kangaroos and Emus (Referred to as a Macrofauna Management Plan - MMP) (Cumberland Ecology 2004b).

The MMP relates to the entire SMDS, including the proposed Wianamatta Regional Park, and was approved by DEC (2005) and stipulates the humane management of macrofauna across the SMDS.

The other management plans listed above were prepared as part of the Western Precinct Plan and were adopted by Council in April 2009. The plans are consistent with relevant best practice guidelines for the management of bushland and were prepared in consultation with relevant government departments. Despite the differing publication dates, a review of the purpose and objectives of these guidelines demonstrates that the principles established are collectively satisfied by the management plans.

The recommended fire regimes in Appendix 3 of the Recovery Plan are not considered relevant to bushland subject site, as the riparian lands are not suitable for this kind of management.

Table 26 in **Appendix E** provides a summary of the best practice standards for bushland management, as stated in Appendix 2 of the Recovery Plan and indicates the applicable management plan and section that addresses each point.

6.3.5. Assessment of Threatened Species, Populations and Ecological Communities within this SIS

Several threatened species, populations and ecological communities recorded from the subject site and subject land are covered in the Recovery Plan. These species and populations have been considered in the SIS, and impacts from the proposed development on these species and populations have been assessed. **Table 16** indicates the relevant sections in the SIS where these species have been addressed.

The management and recovery objectives for the flora and fauna species, populations and ecological communities listed in **Table 16** are addressed as part of the overall objectives for the ecological communities of the Cumberland Plain as it is recognised that the recovery of the vegetation will facilitate the recovery of the associated flora and fauna species.

Table 16 : Threatened Biodiversity identified in the Recovery Plan that have been addressed in this SIS

Threatened Biodiversity listed in the Recovery Plan	Addressed in SIS
Cumberland Plain Woodland	Identified as a Subject and Affected Communities in **Section 4.5** of the SIS. Impacts to this community are assessed in **Sections 5.2, 5.3** and **5.6**
River-flat Eucalypt Forest	Identified as a Subject and Affected Community in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Threatened Biodiversity listed in the Recovery Plan	Addressed in SIS
Grevillea juniperina ssp. ***juniperina***	Identified as a Subject and Affected Species in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**
Pultenaea parviflora	Identified as a Subject and Affected Species in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**
Marsdenia viridiflora R. Br ssp. *viridiflora* population in the Bankstown, Blacktown, Camden, Fairfield, Holroyd, Liverpool and Penrith LGAs	Identified as a Subject Species in **Section 4.5** of the SIS. Impacts to this species are not assessed in detail, due to the lack of records in the subject site.
Cumberland Plain Land Snail (*Meridolum corneovirens*)	Identified as a Subject and Affected Species in **Section 4.5** of the SIS. Impacts to this species are assessed in **Sections 5.2, 5.3** and **5.6**

As discussed in detail within **Chapter 8** of this SIS, the proposed Regional Park. The main actions proposed in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best areas of high quality biodiversity in the SMDS will be conserved within the proposed Regional Park, adding to the protected area network with opportunity to deliver best practice management. The area of habitat for threatened biodiversity proposed to be cleared is comparatively small and is of lower biodiversity value compared to that of the Regional Park.

6.4. Application of Recovery Plan to Proposal

As discussed briefly above, when considering whether to grant development consent to the proposed development, Council is not required to act in a manner consistent with the objectives and actions in the Recovery Plan. Those objectives and actions should however be taken into account, as follows:

- Under sections 5A and 79C of the EP&A Act, Council is required to take into account whether the Proposal is consistent with the objectives and aims of the Recovery Plan. Under section 79C Council retains the discretion to approve or refuse the Proposal so long as mandatory matters have been taken into account. Under Section 69 of the TSC Act Council is not required to strictly apply each action for which it is said to be responsible in the Recovery Plan when determining a development application.
- The main actions proposed in the Recovery Plan include:

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The Proposed development is consistent with these actions because:

1. The largest and best areas of high quality biodiversity in the SMDS will be conserved within the proposed Regional Park, adding to the protected area network with opportunity to deliver best practice management;
2. The area of habitat for threatened biodiversity proposed to be cleared is comparatively small and is of lower biodiversity value compared to that of the Regional Park; and
3. Management plans regulating the development of the SMDS have been approved and adopted that are consistent with the objectives and requirements of the Recovery Plan.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

7. Ameliorative Measures

7.1. Introduction

Measures have been put in place to mitigate adverse effects on the species, populations and ecological communities that exist or may occur in the study area during and after the construction of the Western Precinct and associated Regional Detention Basins C and V6 (the subject site). Long term management strategies, compensatory management strategies and monitoring plans have been developed in order to minimise the impacts of the proposed development on the flora and fauna of the subject site, including affected C/EECs/species and ecological communities. These management strategies and plans will minimise and control the key threatening processes outlined in **Chapter 5**.

This chapter provides a summary of the mitigation measures proposed and the extent of implementation that has occurred to date.

7.1.1. SMDS/Regional Park

- The statutory planning framework established for the SMDS provides the foundation for the sustainable development and management of the SMDS:
    - The SREP30 (DUAP, 2001b) zones 900ha of land for the purpose of a Regional Park to conserve a representative and significant proportion of the natural values of the SMDS in order to protect the variety of Western Sydney vegetation communities, native flora and fauna species and fauna habitat. Clause 37(1)(b) of SREP 30 provides a relevant objective of this zoning is to "conserve and enhance the range and variety of ecological communities...within the area". Development for the purpose of any land use authorised under the *National Parks and Wildlife Act 1974* (NPW Act) is permissible without consent, and any other land use is prohibited: cl 37(2) ; The EPS2000 establishes amongst other things the environmental conservation principles to guide the long term development and conservation of the SMDS. Section 4.2 provides that the Regional Park will provide for the conservation of EECs including CPW. Section 4.3 provides performance objectives amongst which is the objective of minimising adverse impacts on the vegetation habitats within the Regional Park resulting from the development of areas zoned "Urban"; and
- The State Deed provides for the transfer of land to NPWS, provision of funding and the obligation to gazette land as Regional Park under the NPW Act.
- The Regional Park Plan of Management, adopted under S.75A of the NPW Act.
    - The approved St Marys Macrofauna Management Plan (Cumberland Ecology 2004b);

7.1.2. Western Precinct

- The Western Precinct Weed Management Plan (Cumberland Ecology, 2008a);
- The Western Precinct Feral and Domestic Animal Management Strategy (Cumberland Ecology, 2008b);
- The Western Precinct Landscape Concept Plan (Environmental Partnership 2009); and
- Vegetation Management Plan for Riparian Corridors (Environmental Partnership 2008)

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

7.2. Long Term Management Strategies

Long-term management strategies to protect the high quality habitats of the study area from impacts prior to, during and post construction of developments in the Western Precinct, as detailed in the Precinct Plan (JBA 2009). Such measures include the implementation of the following plans:

7.2.1. The Landscape Masterplan

A number of principles have been adopted in relation to the Landscape Masterplan for the Western Precinct (Environmental Partnership 2009) including;

- Maximising natural functioning of the watercourses, incorporating bed and bank stability;
- Maximising corridor functions for native fauna and flora of the riparian areas;
- Maximise water quality functions;
- Maximising biological functions within riparian areas;
- Minimising movement of undesirable flora within the riparian areas; and
- Minimising future salinity impacts for the whole site.

7.2.1.1. Seed collection

The seed from local native plants will be collected for use in the revegetation plans for riparian zone and open space areas. This will ensure preservation of the local genetic material of the flora.

7.2.1.2. Retention of significant trees

Street trees are an important element of the streetscape and open space system. Street trees assist in reinforcing the biodiversity values of the St Marys Development. The following strategies are to be used wherever possible in the subsequent planning phases to respond to retain individual trees and stands of existing trees through the site;

Existing significant trees shall be incorporated into the planting design at key locations within parks and streetscapes; and

Street trees are predominantly native trees indigenous to Western Sydney.

7.2.1.3. Environmental Considerations

The environmental values of both the subject site and the Western Precinct will be reinforced through appropriate revegetation from local seed stock and protection of natural features. The natural features that will be protected in the Western Precinct include watercourses, mature trees, fire cycle maintenance, and the soil seed bank.

The revegetation of the riparian zone will incorporate indigenous plant species predominantly propagated from seed stock collected from the site and from local seed stock collected by other organisations. This will ensure that the creek and environmental corridors are revegetated with genetically appropriate plant species

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

to maintain genetic integrity of the local biodiversity. The maintenance of naturally functioning watercourses increases the environmental value of the site by increasing creek bank stability and water quality. Moreover, naturally functioning watercourses protects from future degradation of the site from invasive weeds, nutrient run-off and high salinity.Although riparian zones will be excluded from fire management, the maintenance of the natural fire regimes in the Regional Park is important for the preservation of floral diversity in the Regional Park and will be implemented by NPWS.

7.2.2. Weed Management Plan

A Weed Management Plan has been developed and adopted by Penrith City Council for the Western Precinct, and this will be adopted for the subject site, in order to provide for the following objectives:

- Identification and management of weeds during and after construction to prevent the spread of weeds into the Regional Park;
- Specify control measures for noxious weeds of significance in the SMDS specifically identified in the EPS, NSW *Biosecurity Act 2016* and Weeds of National Significance;
- Set out requirements for revegetation after disturbance or construction to reduce the potential spread and establishment of weeds;
- Prepare prescriptions for the control of significant weed species within development areas during and after construction;
- Detail a weed control program for the development area;
- Make provision for weed control guidelines for building and landscaping and education material for future residents;
- Outline strategies to ensure that the relevant objectives outlined in SREP 30 and St Marys EPS Environmental Planning Strategy and State Deed are met; and
- The WMP will be implemented and enforced via conditions of consent on DAs.

7.2.3. Feral and Domestic Animal Management Strategy

A Feral and Domestic Animal Management Strategy has been developed and adopted by PCC for the Western Precinct, and will be adopted for the subject site, in order to provide for the following objectives:

- To ensure that development does not directly increase populations of, or improve habitats for, feral/exotic pest animals and over-abundant native species;
- To ensure that development does not indirectly increase populations of feral animals such as European Red Foxes and Feral Cats by creating abundant prey;
- To ensure that development does not exacerbate any Key Threatening Process;
- To minimise the potential for domestic animals within the development areas to impact on native flora and fauna values at the SMDS;

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

- To minimise the potential for feral/exotic pests, over-abundant native and domestic animals to impinge on the conservation values of the adjoining Regional Park; and
- This strategy will be implemented and enforced via conditions of consent on DAs.

7.2.4. Bushfire Management Plan

The Bushfire Management Plan is being implemented progressively in the Western Precinct to reduce the bushfire hazard to life and property within the precinct and reduce the adverse effects of frequent bushfires on the Regional Park.

7.2.5. Macrofauna Management Plan

The St Marys Macrofauna Management Plan (for kangaroos and emus) for the entire SMDS has been endorsed by NPWS and is now being implemented, which will ultimately result in a decrease in grazing pressure in the Regional Park and exclusion of macrofauna from the development precincts.

The key objectives of the MMP include:

- Minimisation of risks to macrofauna from human activities and from macrofauna to humans on the SMDS;
- Provision of a protocol for the treatment of sick or injured macrofauna on the SMDS;
- Justification of management options for the macrofauna population;
- Provision of short term prescriptions for management of macrofauna in relation to proposed developments within the development precincts of the SMDS;
- Provision of medium term and long term prescriptions for management of macrofauna within the Regional Park and open space areas of the SMDS; and
- Provision of appropriate mechanisms for monitoring, review and revision of the MMP as required for adaptive management of the macrofauna populations.

7.2.6. Habitat Enhancement within Subject Site

Planting of the riparian corridor and the banks of the detention basins will occur as part of onsite mitigation. A Landscape Character and Visual Impact Assessment (Clouston Associates, 2019) shows the future landscape character of the completed Basins C and V6. A vegetation management plan will be been prepared for the subject site, and includes all native, local provenance species, which are known from the RFEF and Freshwater Wetlands communities, and are recorded on the SMDS.

7.3. Compensatory Measures

Compensatory strategies have been put in place to minimise impacts on threatened species and C/EECs.

The foremost mitigation measure for threatened species and ecological communities is the establishment of the 900ha Regional Park, to be managed by NPWS. The Regional Park will conserve extensive, viable tracts of

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

forest and woodland, and habitats of threatened and regionally significant species. The Regional Park comprises the best representative parts of the C/EECs in the SMDS.

In addition to the reservation of this land, regeneration (assisted if required) of endangered ecological communities and threatened flora will occur within degraded parts of the Regional Park using local seed stock (this has been addressed within the Regional Park Plan of Management). The establishment of the Regional Park is further supported by the extensive plans of management of relevance to the long-term management of this large conservation area. The following plans have been implemented for the Regional Park:

7.3.1. Regional Park Plan of Management

A Plan of Management for the 900ha Regional Park (DEC (NSW), 2007) has been prepared and recently endorsed by NPWS. The Regional Park will be managed to maintain the remnant vegetation communities and associated biodiversity and will include the protection of significant cultural and scenic values. Visitor and research opportunities will be provided that are consistent with the conservation values of the Park. The key objectives of this plan include:

- Protection and enhancement of the natural heritage of the Park, particularly the endangered ecological communities and the threatened flora and fauna species through the management of fire, disturbed areas, drainage, introduced species, access and visitor use;
- Protection of the catchment values of South and Ropes Creeks through managing any disturbances, particularly those associated with fire, access and drainage;
- Provision of recreational facilities that are appropriate in a regional context and are designed, located and managed to protect the natural and cultural heritage and visual values of the Park;
- Provision of interpretive and educational opportunities through signage, park brochures and activities to assist visitor understanding and enjoyment of the Park; and
- Improving knowledge of natural and cultural heritage, corresponding threats and the evaluation of management programs through research and monitoring. Working with local government, other agencies and authorities, the community and commercial interests to maximise community interest and involvement in the conservation of the Park, and the implementation of sympathetic conservation measures in the neighbouring environment.

7.3.2. Macrofauna Management Plan

Significant financial investment has been made by the proponent to contribute to the overall compensatory "package". The population management of kangaroo and emu populations in the 900ha Regional Park (and other areas of the SMDS) has allowed for the regeneration of CPW and other woodland types due to the significant reduction in grazing animals present. There has also been investment in the monitoring of impacts from grazing over a number of years, as described in **Section 7.4** below.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

7.3.3. Principles for Offsetting

The compensatory measures against state-wide standards in offsetting utilised for the development of the SMDS is specified by EES in '*Guidelines for Biodiversity Certification of Environmental Planning Instruments Working Draft – Department of Environment and Climate Change, October 2007' (DECC 2007)*. The Principles for offsetting (DECC 2007) require that offsets be underpinned by sound ecological principles and must:

- Include the consideration of structure, function and compositional elements of biodiversity, including threatened species;
- Enhance biodiversity at a range of scales;
- Consider the conservation status of ecological communities; and
- Ensure the long-term viability and functionality of biodiversity.

Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.

The dedication of 900ha of land to create Regional Park, monetary contributions towards capital costs of the Regional Park, fencing and additional measures, such as the implementation of management plans described above, satisfies these principles.

7.3.4. Alternative Compensatory Measures

The options for the SMDS have been considered over many years and they range from the "complete conservation option", which would involve designating the entire SMDS as a conservation reserve, through to options that would see the majority of the site developed and used for urban development.

The "complete conservation option" has not been considered feasible due to the extensive disturbance of the former industrial portions of the subject site and the high costs (and impracticalities) of restoration of such land. More extensive development of the SMDS is also not warranted as this would likely require clearing of at least some relatively undisturbed woodland and forest and impact upon areas listed on the Register of National Estate.

The conservation outcome for the SMDS provided for under SREP 30 was determined by the detailed deliberations of a statutory committee convened by the NSW Minister for Planning under Section 22 of the NSW EP&A Act (Department of Urban Affairs and Planning, 1997). This outcome was added to in more recent years by the inclusion of all areas of National Estate into an expanded Regional Park. Due to the high conservation values of portions of the site, conservation outcomes were considered in detail and provided for as the first priority for planning the future of the property.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The major alternatives to the development of the property would be more conservation/less development or more development/less conservation. However, currently SREP 30 and the subsequent amendments to expand the Regional Park provide for conservation of approximately 900 hectares of the 1545 hectare site and include the vast majority of the high and medium conservation value lands.

In the context of the SMDS, and the study area, the subject site is a highly disturbed area. While the subject site could in theory be added to the conservation reserve for the SMDS, this is not a practical alternative to the current proposed development owing to the high level of disturbance to the site. Such an alternative would also substantially reduce the developable area of the subject site without adding substantially to the conservation of threatened flora and fauna.

7.4. Monitoring

The effectiveness of the mitigation measures is determined by ongoing monitoring. The objective of the ongoing monitoring of the affected C/EECs/species will be to ascertain whether the predicted impacts on the species occur. Monitoring will also detect other unexpected impacts and where necessary, measures to prevent further impacts can be implemented. The method of monitoring, reporting framework, duration and frequency is outlined in detail. The effectiveness of mitigation measures is generally proven by experimental design allowing adaptive management and appropriate monitoring. Details of the monitoring for all flora and fauna within the SMDS, including macrofauna, weeds, feral animals and threatened species, will be provided within a Monitoring Plan prepared in conjunction with the Regional Park Plan of Management.

7.4.1. Weed Management Plan

A vital component of weed control strategy is follow-up work and monitoring. The review and monitoring of weed control is outlined in this plan. Short term monitoring will be undertaken as a follow-up to weed control operations, ensuring that weed control has been successful. The long-term monitoring program is to provide sufficient feedback on the success of the overall weed control strategies including suppression and prevention of weed spread and establishment. Detailed short-term and long-term monitoring objectives and methods are outlined in the plan. An annual review of the plan will be undertaken to assess the effectiveness of the plan, during the first three years. The detailed reporting framework is also outlined in the plan.

7.4.2. The St Marys Macrofauna Management Plan

The Macrofauna Management Plan (MMP) is based upon an adaptive management approach and regular monitoring and review. This will ensure that the kangaroo and emu populations are managed in an optimal way that ensures animals are removed from development areas and where retained, they are maintained in a healthy humane condition at densities that do not unsustainably impact upon the condition and use of the Regional Park. Kangaroos and emus will be counted on a quarterly basis for the first five years of the MMP. The counts of kangaroos and emus will, where possible, be related to data from fox baiting programs conducted on the SMDS. Detailed short-term and long-term monitoring objectives and methods are outlined in the MMP. The findings of monitoring work for the MMP and results of various adaptive management procedures will be summarised within an annual report, submitted to NPWS. This annual report will be used as the basis for the annual revision of the MMP.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

It is a condition of the MMP that vegetation will be monitored in these plots annually in autumn for the life of the MMP. Baseline flora surveys of these plots were completed between March and July 2005. Vegetation within the plots was then re-surveyed between March and July from 2008 - 2014. Reports have been completed, analysing the floristic and structural changes within the first (Cumberland Ecology 2006), and all other subsequent years up to 2016 after grazing exclosure. This research has assisted in the conservation efforts for CPW.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

8. Assessments of Significance

8.1. Critically Endangered/Endangered Ecological Communities

8.1.1. Cumberland Plain Woodland

Cumberland Plain Woodland (CPW) occurs in two forms; Shale Hills Woodland and Shale Plains Woodland. Shale Hills Woodland occurs in the south of the Cumberland Plain in more elevated areas. Shale Plains Woodland is more widely distributed, occurring throughout the drier areas of the Cumberland Plain (NSW NPWS 2000). Dominant canopy species include *Eucalyptus moluccana*, *E. tereticornis*, *E. crebra*, *Corymbia maculata* and *E. eugenoides*. The shrub layer is dominated by *Bursaria spinosa*. Grasses dominate the ground layer (Benson and Howell, 1990).

The community is well adapted to fire and drought but is now under threat from disturbance triggering weed invasion, increased soil nutrients, rubbish dumping and altered fire regimes.

In December 2009, the NSW Scientific Committee released a final determination for the listing of Cumberland Plain Woodland as a critically endangered ecological community (NSW Scientific Committee 2009). The definition of the community in this final determination includes areas of derived native grasslands, referring to areas where trees and shrubs have been cleared but a native understorey typical of Cumberland Plain Woodland still exists.

CPW within the subject site consists of a mix of mature woodland, and young woodland in various stages of regeneration. CPW within the subject site totals an area of approximately 4.5 ha (0.8 ha of mature CPW and 3.7 ha of regenerating CPW). Larger patches and more intact tracts of CPW occur on the SMDS, with the largest and best quality areas conserved within the Regional Park.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

The proposed development of the subject site will collectively remove an area of approximately 4.5 ha of CPW. However, this overestimates the clearing, to allow for construction impacts, and much of the subject site will

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

be revegetated, and therefore the removal is temporary, with rehabilitation proposed in conjunction with NPWS, where applicable.

This is not likely to have an adverse effect on the extent of the community such that its local occurrence is likely to be placed at risk of extinction because the community is well-represented within the adjacent Regional Park where it has a higher conservation value and is in better condition.

There is a possibility that the composition of CPW may be modified in the adjoining areas of the Regional Park due to an increase in edge effects from the drainage basins and during temporary upgrade works for the access track during construction. However, a suite of mitigation measures will be implemented to reduce impacts from the proposed development and adjoining Regional Park including fencing and comprehensive drainage and waste management strategies. Any edge-effects that may occur are expected to be localised, and would not be expected to adversely modify composition so as to place the local occurrence at risk of extinction.

d) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

It is assumed that all CPW within the subject site, totalling approximately 4.5 ha, will be removed or substantially modified for the proposed development, however, it is likely that some will not be removed, or will be revegetated, pending final detailed design of the basins.

This is compared with the large areas of intact CPW/Cumberland Plain Vegetation Communities totalling more than 411ha/746ha respectively (DEC (NSW) 2007) to be conserved in perpetuity in the 900ha Regional Park as an offset to development of the SMDS development precincts.

The CPW of the subject site occurs at the northern edge of a larger patch that extends into the Regional Park to the south, east and west, and will not isolate any patches of woodland that occur outside of the development area. The sparse regenerating woodland on the subject site occurs at the outer edge of a continuous patch that extends into the Regional Park. The proposed development will however contribute to the increasing fragmentation of habitat adjoining the Regional Park. The temporary track upgrade works are likely to increase fragmentation of local patches of CPW, to a minor extent, although the track is existing, and will not be widened by more than 2m.

The CPW to be removed or modified as a result of the proposed development is not likely to be of great importance to the long-term survival of the community within the locality. Cumberland Plain Woodland of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the subject site as it has higher resilience, is more structurally intact and has higher species diversity.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat for this endangered ecological community has currently been identified by the Executive Director of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Recovery Plan for the Cumberland Plain has been adopted. The main actions in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of CPW in the SMDS will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The patches and sparse patches of CPW in the study area are comparatively small and degraded compared to the representation in the Regional Park and will not greatly add to the viability of the community if retained, once the study area is developed for urban purposes.

There are no threat abatement plans relevant to CPW.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in the threatening process 'Clearing of native vegetation'. However, the vegetation to be cleared consists predominantly of degraded and sparsely regenerating CPW and higher quality examples of the community will be conserved within the Regional Park.

Other key threatening processes that may be increased as a result of the proposed development include:

- Competition and grazing by the Feral European Rabbit;
- Ecological consequence of high frequency fires; and
- Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct, and on the subject site, to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMDS.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The plan of management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Conclusion

The development of the subject site will remove approximately 4.5 ha of this community. However, the proposed development is not likely to have a significant impact on Cumberland Plain Woodland such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected through a range of mitigation measures and retained in perpetuity in public ownership.

8.1.2. River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) is found on coastal floodplains and has a tall canopy of eucalypts. The most widespread canopy trees include *Eucalyptus tereticornis, E. amplifolia, Angophora floribunda* and *A. subvelutina*. It may have a layer of small trees and a scattering of shrubs. The ground cover consists of abundant forbs, scramblers and grasses. RFEF occurs on alluvial soils on river-flats of the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee 2004k).

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The area of RFEF present in the study area will not be removed or modified by the proposed development, but is to remain connected to a larger section of RFEF in the Regional Park. Consequently, the development is not likely to have an adverse effect on the extent of the community such that its local occurrence is likely to be placed at risk of extinction. The community is well-represented within the adjacent Regional Park where it has a higher conservation value and is in better condition.

For this reason, it is not expected that the proposed development will adversely modify composition to place the local occurrence at risk of extinction because of the retention of RFEF in the Regional Park.

d) In relation to the habitat of a threatened species, population or ecological community:

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No area of RFEF will be removed on the subject site. However future works within the subject site will include the establishment of two detention basins and enhancement of the riparian corridor, which will include regeneration of this community.

Intact RFEF in proximate areas to the subject site will remain connected to other areas of native vegetation through the Regional Park, to the north and south within South Creek corridor. The works will therefore not act to isolate or fragment the remaining habitat for this community in the Regional Park.

The RFEF present in proximate parts of the study area will not be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the community within the locality. River-flat Eucalypt Forest of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land as it is in better condition and is more intact.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat for this endangered ecological community has currently been identified by the Executive Director of EES.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

The Recovery Plan for the Cumberland Plain has been adopted. The main actions in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

The proposed development is consistent with these actions because the largest and best quality areas of RFEF in the SMDS will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The patches and sparse patches of RFEF in the study area are comparatively small and degraded compared to the representation in the Regional Park and will not greatly add to the viability of the community if retained, once the study area is developed for urban purposes.

There are no threat abatement plans relevant to RFEF.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in Clearing of native vegetation. However, the vegetation to be cleared does not consists of RFEF and higher quality examples of the community will be conserved within the Regional Park. Other key threatening processes that may be increased as a result of the proposed development include:

- Competition and grazing by the feral European rabbit;
- Ecological consequence of high frequency fires; and
- Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct and the subject site to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMDS.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The Plan of Management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

Conclusion

The proposed development is not likely to have a significant impact on River-flat Eucalypt Forest.

8.1.3. Freshwater Wetlands

Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions occurs on low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes. It is dominated by herbaceous plants including sedges, emergent plants, floating and submerged plants (NSW Scientific Committee 2004e).

The community is threatened by land clearing, fragmentation, flood mitigation, land-filling, pollution from runoff, weed invasion, damage from livestock and feral animals, acid sulphate soils, rubbish dumping and climate change.

A small and degraded representative of Freshwater Wetlands occurs in proximate parts of the study area. Other larger areas of Freshwater Wetlands are conserved within the Regional Park.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The proposed development for the subject site will not remove Freshwater Wetlands.The Freshwater Wetlands present within the study area is not important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

Consequently, the proposed development is not likely to adversely modify the composition of this community such that it would place a local occurrence at risk of extinction.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No area of Freshwater Wetlands will be removed or substantially modified for the proposed development. However, post construction, planting of species indicative of this community will form part of landscaping, replacing some of the vegetation removed.

Intact Freshwater Wetlands in the study area will remain connected to other areas of native vegetation as the community intergrades with CPW, through the Regional Park The development of the subject site will not act to fragment this habitat present in the Regional Park.

The Freshwater Wetlands present in the study area is not important to the long-term survival of the community within the locality. Freshwater Wetlands of high conservation significance will be conserved within the Regional Park and managed for conservation. The vegetation within the Regional Park is considered to be more important than that within the Drainage zoned land, as it is in better condition and is more intact.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

No critical habitat for this endangered ecological community has currently been identified by the Executive Director of EES.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

The Recovery Plan for the Cumberland Plain has been adopted. The main actions in the Recovery Plan include:

- Building the protected area network;
- Delivering best practice management;
- Promoting awareness, education and engagement; and
- Enhancing information, monitoring and enforcement.

Quality areas of Freshwater Wetlands in the SMDS will be conserved within the Regional Park, adding to the protected area network with opportunity to deliver best practice management. The patches and sparse patches in the study area are comparatively small and degraded compared to the representation in the Regional Park and will not greatly add to the viability of the community if retained, once the study area is developed for urban purposes.

There are no threat abatement plans relevant to Freshwater Wetlands.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in Clearing of native vegetation. However, no area of Freshwater Wetlands will be cleared and higher quality examples of the community will be conserved within the Regional Park. Other key threatening processes that may be increased as a result of the proposed development include:

i. Competition and grazing by the feral European rabbit;
ii. Ecological consequence of high frequency fires; and
iii. Invasion of native plant communities by exotic perennial grasses.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct and subject site to ensure that the effects of rabbits are not exacerbated by the proposed development and to decrease the impacts from rabbits as they currently exist on the SMDS.

The Bushfire Management Plan has been designed to mitigate factors that could lead to high frequency fires. The plan of management for the Regional Park will also ensure that this process is not exacerbated.

The Weed Management Plan will be implemented to reduce the impacts of exotic perennial grasses.

Conclusion

The proposed development will not have a significant impact on Freshwater Wetlands.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

8.2. Fauna

8.2.1. Cumberland Plain Land Snail

The Cumberland Plain Land Snail inhabits a very small area on the Cumberland Plain west of Sydney from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains (OEH 2013a). It primarily occurs in Cumberland Plain Woodland which is a grassy open woodland with occasional dense patches of shrubs. It lives under litter or bark, leaves and logs or shelters in loose soil around grass clumps (OEH 2013a). The Cumberland Plain Land Snail is listed as Endangered under the TSC Act (NSW Scientific Committee 1997).

The Cumberland Plain Land Snail was recorded on the subject site during targeted surveys in 2019, and has been recorded throughout the study area during previous surveys. A total of two shells and one live snail were recorded from the CPW present in the east of the subject site.

a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Little is known about the range of the Cumberland Plain Land Snail and the area required for a viable population, but it is thought that the remaining total population on the Cumberland Plain consists of several disjunct populations (NSW Scientific Committee 1997). The SMDS is likely to support one large population or subpopulation of this species. The Cumberland Plain Land Snail is present within most or all of the larger patches of CPW on the SMDS and is represented within the Regional Park which contains more than 400ha of potential habitat.

The Cumberland Plain Land Snail was recorded on the subject site in low numbers, and has been recorded in large numbers in adjoining areas of the Regional Park. As an indication of relative abundance, surveys of comparative CPW in the Regional Park indicate a significantly higher number of snails in mature CPW. The habitat on the subject site is sparse, within patches of mature CPW. The species is also likely to occur in the CPW present on the subject site in low numbers, within regenerating woodland. Based on the assessments in the Regional Park, it can be assumed that approximately 400ha of habitat is present, which would suggest potentially hundreds of thousands of snails.

Because the CPW on the subject site is located at the fringe of the development precinct and is considered to be sub-optimal habitat, it is questionable as to whether the subpopulation would be viable in the long term as it may not survive stochastic events such as a flooding. CPW within the subject site is in both a mature and a regenerating form, and therefore is less likely to support this species than mature woodland zones in the Regional Park. The conservation of large, intact areas of habitat for the species in the Regional Park is considered an adequate conservation measure for the long term viability of the species on the SMDS.

b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

There are no populations of this species listed as endangered under the TSC Act.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

A total of 4.5 ha of potential habitat (in the form of regenerating and mature CPW) will be removed on the subject site. It can therefore be assumed that all of the potential habitat for this species on the subject site will be removed or substantially modified as a result of the proposed development.

The potential habitat for this species occurs in patches adjoining the Regional Park. The removal of habitat on the subject site will not isolate the retained habitat in the Regional Park, although it will contribute to the increased fragmentation in the study area.

The habitat to be removed, modified or isolated as a result of the proposed development may be important to the long-term survival of the species within the locality. However, areas of known high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this species has currently been identified by the Executive Director of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan has not been prepared for this species. No threat abatement plans are relevant to this species.

The Cumberland Plain Recovery Plan (DECCW 2011) focuses primarily on vegetation that constitutes habitat for this species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Clearing of native vegetation resulting in the loss of habitat is a listed threatening process under the TSC Act. Small, degraded patches of potential habitat will be cleared for the proposed development. However, over 400ha of known habitat for the species will be contained within the Regional Park, which will be managed to improve fauna habitat on the SMDS.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

Conclusion

The proposed development is not likely to have a significant impact on the Cumberland Plain Land Snail. The development of the subject site will remove an area of habitat for this species, although large tracks of habitat will remain in the adjoining Regional Park. However, the proposed development is not likely to have a significant impact on Cumberland Plain Land Snail such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected through a range of mitigation measures and retained in perpetuity.

8.2.2. Woodland Birds

The following vulnerable listed woodland bird species have been recorded in the study area, and have similar habitat requirements, are assessed in the Assessment of Significance below:

- Speckled Warbler (*Pyrrholaemus sagittata*);
- Diamond Firetail (*Stagonopleura guttata*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) and
- Hooded Robin (*Melanodryas cucullata cucullata*).

The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. The Speckled Warbler lives in a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or in gullies (OEH 2012i). The Speckled Warbler is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee , 2004k).

The Diamond Firetail occurs in Eucalypt woodlands including Box-Gum and Snow Gum woodlands. It also occurs in open forest, mallee, natural temperate grasslands and derived grasslands, often in riparian areas (OEH 2012a). It is widely distributed across NSW. The Diamond Firetail is threatened by habitat loss through clearing, invasion of weeds and firewood collection, and predation of eggs and nestlings by the Pied Currawong. The Diamond Firetail is listed as Vulnerable on Schedule 2 of the TSC Act.

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Its distribution in NSW is nearly continuous from the coast to the far west (OEH 2012j). The Varied

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades.

The Dusky Woodswallow is distributed throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding takes place on the western slopes of the Great Dividing Range (DPIE 2019b). This medium-sized, grey-brown bird with a distinctive black-brown mask, and white-edged wings, 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 a ground-cover of grasses or sedges and fallen woody debris (DPIE 2019b). The Dusky Woodswallow is listed as Vulnerable under Schedule 2 of the TSC Act.

The Hooded Robin is found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. The south-eastern form (subspecies *cucullata*) is found from Brisbane to Adelaide and throughout much of inland NSW. The species prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas and requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (OEH 2014c).

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Development of the subject site may impact on some potential habitat for these small woodland bird species that have been recorded in the study area (or similar habitats on the SMDS) during past surveys. Although none have been recorded on the subject site, and areas of better quality habitat occur within the Regional Park. The proposed development is not likely to place a local population of the species at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

There are no populations of the species that are listed as endangered under the TSC Act.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

All of the known and potential habitat for the species on the subject site will be removed or substantially modified as a result of the proposed development. This is a small area in comparison to that of the adjoining Regional Park.

The potential habitat for the species on the subject site occurs as a degraded habitat that is at the edge of, but connected to the larger occurrences in the Regional Park. The proposed development will however increase the effects of existing fragmentation.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this species has currently been identified by the Executive Director of EES.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The Red Fox threat abatement plan is relevant to this species, although the birds are not a priority species listed in the plan. The proposed development is consistent with the objectives of the plan.

No recovery plan has been prepared for the species.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development will result in Clearing of native vegetation. However, the vegetation to be cleared consists of degraded habitat for the species. Larger areas of better quality habitat will be conserved within the Regional Park.

Other key threatening processes that may be increased as a result of the proposed development include:

- Predation by the European Red Fox; and
- Predation by the Feral Cat.

The Feral and Domestic Animal Management Strategy will be implemented in the Western Precinct to ensure that the effects of foxes and cats are not exacerbated by the proposed development.

Conclusion

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The proposed development will not have significant impact on the woodland bird species such that a local population would be placed at risk of extinction.

8.2.3. Microchiropteran Bats

The following Assessments of Significance demonstrates apply to the following species of microchiropteran bats known to occur in the locality:

- Large Bent-winged Bat (*Miniopterus orianae oceanensis* (formerly *M. schreibersii* oceanensis);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Coastal Freetailed Bat (*Micronomus norfolkensis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Southern Myotis (*Myotis macropus*); and
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

The Eastern Bentwing Bat occurs along the east and north-west coasts of Australia. It roosts in caves, derelict mines, stormwater tunnels, buildings and other man-made structures. It forages above the canopy in forested areas. The Eastern Bentwing Bat forms maternity colonies in caves and populations usually centre on such caves (OEH 2012b). The Eastern Bentwing Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004b).

The Eastern False Pipistrelle is found on the south eastern coast and ranges of Australia from southern Queensland to Victoria and Tasmania (OEH 2012c). It prefers moist habitats and generally roosts in eucalypt hollows, but has been found under loose bar on trees or in buildings. The Eastern False Pipistrelle is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004c).

The Eastern Coastal Free-tailed Bat (also known as the Eastern Freetail Bat) occurs from southern Queensland to southern NSW, in dry sclerophyll forest and woodland (Churchill 2008). It roosts in tree hollows and sometimes under bark or in man-made structures (OEH 2012d). The Eastern Coastal Free-tailed Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004d) (NSW Scientific Committee, 2004d).

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW (OEH 2012g). This species roosts in caves, crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. This species is found in well-timbered areas containing gullies. The Large-eared Pied Bat is listed as Vulnerable on Schedule 2 of the TSC Act and Vulnerable under the EPBC Act (NSW Scientific Committee 2004i).

The Southern Myotis occurs in coastal areas from north western Australia to south western Victoria (OEH 2012h). It roosts close to water in caves, mine shafts, tree hollows, stormwater channels, buildings, under

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

bridges and in dense foliage. It forages over streams and pools by raking its feet across the surface for insects and small fish. The Southern Myotis is listed as Vulnerable (as Large-footed Myotis) on Schedule 2 of the TSC Act (NSW Scientific Committee 2004j).

The Greater Broad-nosed Bat occurs from the Atherton Tableland to north eastern Victoria in gullies and river systems that drain the Great Dividing Range. It roosts in tree hollows and sometimes in buildings. It occurs in woodland to moist and dry eucalypt forest and rainforest but is most common in tall wet forest (OEH 2012e). The Greater Broad-nosed Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004f)

The Yellow-bellied Sheathtail Bat is a large species of microchiropteran bat that is characterised by rich shiny black fur on the back and contrasting bright white or yellow fur on the belly (Churchill 2008). It occurs across northern and eastern Australia but it is a rare visitor in the southern parts of this range, including Victoria, south western NSW and eastern South Australia. It roosts in tree hollows and buildings and forages in most habitats. The Yellow-bellied Sheathtail Bat is listed as Vulnerable on Schedule 2 of the TSC Act (NSW Scientific Committee 2004l).

a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

There is very limited potential roosting habitat for the hollow-dwelling species of these microchiropteran bats in the study area and no potential roosting habitat for cave-dwelling species. These species are likely to primarily utilise the study area as foraging habitat as part of a larger range. Potential habitat will be retained in the Regional Park, where extensive areas of roosting and foraging habitat are located. As 900ha of potential roosting and foraging habitat will be conserved within the Regional Park, it is not likely that the proposed development will affect the life cycle of these species such that a viable local population is placed at risk of extinction.

b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

There are no populations of these species listed as endangered under the TSC Act.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

All of the known and potential habitat for these species on the subject site will be removed or substantially modified as a result of the proposed development.

The potential habitat for microchiropteran bat species on the subject site occurs as a degraded habitat that is at the edge of, but connected to the larger occurrences in the Regional Park. The proposed development will however increase the effects of existing fragmentation.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of these species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for these species has currently been identified by the Executive Director of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plans have been prepared for these species. No threat abatement plans are relevant to these species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.

Clearing of native vegetation and Loss of hollow-bearing trees are listed key threatening processes under the TSC Act. No old-growth trees with hollows were recorded and limited mature trees occur on the subject site, which would provide foraging and potential roosting habitat, may be removed for the proposed development. However 900 ha of vegetation, including hollow bearing trees, will be conserved within the Regional Park. Future management of the Regional Park will also be designed to protect fauna habitats. The extent of clearing proposed is therefore not considered to be a threat to microchiropteran bat species in the precinct.

No other key threatening process that may be exacerbated by the proposed action will affect these species.

Conclusion

The proposed development will not have a significant impact on threatened microchiropteran bats.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

8.2.4. Grey-headed Flying-fox

The Grey-headed Flying-fox is found along the east coast of Australia from Bundaberg to Melbourne. It occurs in subtropical and temperate rainforests, tall sclerophyll forest and woodlands, heaths, swamps, gardens and orchards. The species roosts in camps with high site fidelity. The Grey-headed Flying-fox is threatened by loss of foraging habitat, disturbance to camps, unregulated shooting and electrocution on power lines (OEH 2012f). It is listed as vulnerable under the TSC Act and the EPBC Act (NSW Scientific Committee 2004g).

a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The study area consists only of potential foraging habitat for the Grey-headed Flying-fox as this species roosts in camps, the locations of which are well-known in the Sydney region. No camps occur on the SMDS. The proposed development is unlikely to place a local population of the species at risk of extinction as it will result in the removal of a small area of low quality foraging habitat.

b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

There are no populations of this species listed as endangered under the TSC Act.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

All of the known and potential habitat for this species on the subject site will be removed or substantially modified as a result of the proposed development.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

The potential habitat for the species on the subject site occurs as a degraded habitat that is at the edge of, but connected to the larger occurrences in the Regional Park. The proposed development will however increase the effects of existing fragmentation.

The habitat to be removed, modified or isolated as a result of the proposed development is not important to the long-term survival of the species within the locality. Areas of high quality habitat occur within the Regional Park and will be conserved within the Regional Park and managed for conservation.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat for this species has currently been identified by the Executive of EES.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for this species. No threat abatement plans are relevant to the species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.

Clearing of native vegetation is a listed key threatening process under the TSC Act. A relatively small number of mature eucalypt trees occur on the subject site, which provide potential foraging habitat, will be removed for the proposed development. However 900 ha of vegetation, will be conserved within the Regional Park. Future management of the Regional Park will also be designed to protect fauna habitats. The extent of clearing proposed is therefore not considered to be a threat to the Grey-headed Flying-fox in the precinct.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

Conclusion

The proposed development will not have a significant impact on the Grey-headed Flying-fox.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

9. Additional Information

9.1. Qualifications and Experience

The Cumberland Ecology staff involved with the compilation of this SIS have many years of experience in ecology, flora and fauna assessments and threatened species legislation. The sub-consultants are specialist in their area of expertise. The details of the qualifications of key Cumberland Ecology staff involved in the preparation of this SIS, and relevant sub-consultants, are provided in **Appendix F**.

9.1.1. Other Approvals Required for the Development or Activity

The works related to the construction of Basins C and V6 requires the removal of more than 30,000 cubic metres of soil, meaning it is Designated Development for the purposes of the EP&A Act in accordance with Schedule 3 Clause 4 of the EP&A Regulations.

In addition, pursuant to Section 91 of the *Water Management Act 2000*, the proposed development is considered Integrated Development for the purposes of Section 91 of the EP&A Act.

Penrith City Council will be the consent authority for the proposed development, although as Integrated Development, it will also require approval from the Office of Water. The development application will be lodged concurrently with this SIS.

The proposed works will affect the quantity or flow of water to South Creek. Therefore, the proposed works will require a water management work approval and controlled activity approval under Section 91 of the *Water Management Act 2000*. This application will be made separately to the DA.

The development of the SMDS has been assessed by the Commonwealth under the provisions of the *Environment Protection (Impacts of Proposals) Act 1974*. Associated certification of related actions under the Environmental Reform (Consequential Provisions) Act 1999 has also been granted.

9.1.2. Licence Matters

The actions necessitate the clearing of land and the removal of threatened plant species. These actions are permitted with the approval of licence applications under State and Commonwealth legislation. The following licence applications are to be submitted concurrently with this SIS:

- EPBC Permit (Section 201) – Licence to kill, injure, take, trade, keep or move a listed threatened species or ecological community.

Cumberland Ecology currently holds the following licences:

- Scientific licence (Section 132 C) (*National Parks and Wildlife Act 1974*)

9.1.3. Section 110 (5) Reports

Impact assessment was conducted after due consideration for the Environmental Impact Assessment Guidelines for relevant threatened species and the condition of potential habitats in the study area. Section 110 (5) reports utilised in preparation of this SIS are included in the References section below.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

10. Conclusion

The proposed development of the subject site will disturb a total area of approximately 4.5 ha of CPW (in the form of 0.8 ha of mature CPW and 3.7 ha of regenerating CPW. However, and with due consideration of the restricted distribution of this CEEC in the region, the proposed development is not likely to have a significant impact such that the large and viable representatives in the Regional Park would be placed at risk of extinction. The large and continuous remnants present in the Regional Park will be protected and enhanced through a range of mitigation measures identified and retained in perpetuity.

The major affected species impacted by the proposed development is the Cumberland Plain Land Snail. The mature and regenerating CPW on the subject site provide an area of habitat for this species. However, when directly compared with the habitats of the Regional Park, this area of habitat is considered to be degraded and of a lesser importance due to the increased level of disturbance, sparse nature and its comparatively small area. Therefore, the loss of this habitat in the subject site and subject land is not considered to be significant.

The impact of the proposed development will be more than balanced by the major conservation outcome resulting from of the creation of the 900ha Regional Park. The Regional Park comprises CPW of quality and scale in a consolidated land holding, to be transferred into public ownership and subject to a Plan of Management.

When weighed against the conservation benefits, both direct and indirect, that will be derived from the 900ha Regional Park, together with the various mitigation measures afforded by the management strategies for weeds, feral and domestic animals and macrofauna, the relatively small areas of natural and semi-natural vegetation to be cleared as a result of the proposed development are considered to be of minor consequence.

The construction of Drainage Detention Basins C and V6 will mitigate the impacts of increased stormwater from the Western Precinct, and will further improved drainage and water quality outcomes for the Regional Park. In the southern part of the South Creek, the vegetation is heavily weed infested, and therefore the weed management proposed throughout the riparian corridor, and future landscaping, for construction of the basins will benefit the community in the Regional Park.

The proposed development is unlikely to result in any threatened species or ecological community becoming extinct. Known occurrences of threatened flora and fauna within the SMDS are predicted to be secure in the long term as a result of the creation of the 900ha Regional Park and numerous supporting mitigation measures that are enshrined in the legal, statutory planning framework.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

11. References

Australian Heritage Commission. 1999. Register of the National Estate: Western Sydney Shale Woodland St Marys, Forrester Road, St Marys, NSW. Department of the Environment and Heritage.

Benson, D. and J. Howell. 1990. Taken for Granted. The Bushland of Sydney and its Suburbs. Kangaroo Press, Sydney.

BES. 2008. Bushfire Hazard Reduction Plan: St Marys Property Central and Western Precincts. Bushfire and Environmental Services, Helensburgh.

Biolink. 2008. The utility of regularised, grid-based SAT (RGB-SAT) sampling for the purposes of identifying areas being utilised by koalas (*Phascolarctos cinereus)* in the South-east Forests of NSW - A Pilot Study. Biolink, NSW.

Birds Australia. 2011. Birds Australia [Electronic resource].

Botanic Gardens Trust. 2014. PlantNET. National Herbarium of NSW, Royal Botanic Garden, Sydney.

Braun-Blanquet, J. 1927. Pflanzensoziologie Wien Springer.

Churchill, S. 2008. Australian Bats. Second edition. Allen & Unwin, Crowes Nest, NSW.

Clarke, K. R. 1993. Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology **18**:117-143.

Cumberland Ecology. 2004a. St Mary's Eastern Precinct: Fauna and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications. Cumberland Ecology, Epping.

Cumberland Ecology. 2004b. St Marys Macrofauna Management Plan: A Plan of Management for Eastern Grey Kangaroos, Red Kangaroos and Emus. Cumberland Ecology, Sydney.

Cumberland Ecology. 2004c. Stage 1 Subdivision, St Mary's Eastern Precinct: Part Lot 2 DP 1038166 Species Impact Statement. Cumberland Ecology, Epping.

Cumberland Ecology. 2005. St Marys North and South Dunheved Precincts Plan: Biodiversity Assessment. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2006. Analysis of the response of Cumberland Plain Woodland to grazing by macrofauna at St Marys: Floristic and structural changes 1 year after grazing exclosure. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2007. Macrofauna Management on St Marys Property - Annual Report on the Macrofauna Management Plan. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2008a. St Marys Property- Western Precinct: Feral and Domestic Animal Management Strategy. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2008b. St Marys Property - Western Precinct: Weed Management Plan. Cumberland Ecology, Carlingford Court, NSW.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Cumberland Ecology. 2009a. St Marys Property - Central Precinct: Biodiversity Assessment. Carlingford Court, NSW.

Cumberland Ecology. 2009b. St Marys Property - Western Precinct: Biodiversity Assessment. Carlingford Court, NSW.

Cumberland Ecology. 2009c. St Marys Western Precinct Stage 1A Development Application Flora and Fauna Assessment. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2012a. North Lake Access Road in the Western Precinct, St Marys Property. Cumberland Ecology, Epping.

Cumberland Ecology. 2012b. Riparian Corridor Development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2012c. Village 2 and Village 3 Developments in the Western Precinct, St Marys Property. Cumberland Ecology, Carlingford Court.

Cumberland Ecology. 2012d. Village 4 Development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2014a. Development within the Central Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2014b. Village 5 Development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Carlingford Court, NSW.

Cumberland Ecology. 2014c. Village 6 Development of Jordan Springs in the Western Precinct, St Marys Property: Species Impact Statement. Cumberland Ecology, Carlingford Court, NSW.

DEC (NSW). 2004. Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft). New South Wales Department of Environment and Conservation, Hurstville, NSW.

DEC (NSW). 2005a. Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*). Department of Environment and Conservation (NSW), Hurstville, NSW.

DEC (NSW). 2005b. Recovering bushland on the Cumberland Plain: Best Practice Guidelines for the Management and Restoration of Bushland. Department of Environment and Conservation (NSW), Sydney.

DEC (NSW). 2006. *Pimelea spicata R. Br.* Recovery Plan. Department of Environment and Conservation (NSW), Hurstville, NSW.

DEC (NSW). 2007. Wianamatta Regional Park Draft Plan of Management. Department of Environment and Conservation (NSW), Hurstville.

DECC. 2007. Guidelines for Biodiversity Certification of Environmental Planning Instruments Working Draft. Department of Environment and Climate Change (NSW), Sydney.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

DECC. 2009. BioBanking Assessment Methodology and Credit Calculator Operational Manual. Department of Environment and Climate Change, Hurstville, NSW.

DECCW. 2007. Change in the distribution of Cumberland Plain Woodland. DECCW, Hurstville.

DECCW. 2010. Methodology Report: Report on the methodology for identifying priority conservation lands on the Cumberland Plain. Department of Environment, Climate Change and Water, Sydney South, NSW.

DECCW. 2011. Approved Cumberland Plain Recovery Plan. DECCW, Hurstville.

DECCW (NSW). 2009. Draft Recovery Plan for the Cumberland Plain. Department of Environment, Climate Change and Water (NSW), Sydney, NSW.

Department of Urban Affairs and Planning. 1997. Report for the Section 22 Advisory Committee for the ADI Site St Marys. Department of Urban Affairs and Planning, Sydney.

DoP. 2010. Sydney Growth Centres Strategic Assessment - Draft Assessment Report. NSW Department of Planning, Sydney.

DUAP. 2001a. St Marys Environmental Planning Strategy 2000. Department of Urban Affairs and Planning, Sydney.

DUAP. 2001b. Sydney Regional Environmental Plan No. 30: St Marys. Department of Urban Affairs and Planning, Sydney.

Environmental Partnership. 2008. Western Precinct Vegetation Management Plan; Proposed riparian corridor and associated drainage and vegetation corridors. Environmental Partnership (NSW) Pty Ltd, Birchgrove, NSW.

Environmental Partnership. 2009. Western Precinct: Landscape Masterplan strategy report. Environmental Partnership (NSW) Pty Ltd, Birchgrove, NSW.

ERM. 1997. Objection to National Estate Listing of the ADI St Marys site. Environmental Resources Management Australia, Sydney.

ERM. 1998. Addendum to Objection to Interim Listing of ADI St Marys Site in the Register of the National Estate. Environmental Resources Management Australia, Sydney.

ERM. 2000. Assessment of the Implications of Development for Land Registered on the National Estate at St Marys NSW. Environmental Resources Management Australia, Sydney.

ERM. 2003. St Marys Eastern Precinct Plan: Biodiversity Assessment. Environmental Resources Management Australia, Sydney.

ESRI. 2011. ArcGIS Desktop: Release 10.4.1.

Environmental Systems Research Institute, Redlands, CA.

Gunninah. 1991. Australian Defence Industries (ADI) Site, St Marys, Fauna Survey. Gunninah Environmental Consultants, Sydney.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Gunninah. 1995. Australian Defence Industries St Marys Planning Study: Flora and Fauna Issues. Gunninah Environmental Consultants, Sydney.

Gunninah. 1997. ADI Site St Marys. Biological Assessment Report. Volume 1-3: Responses to Issues Raised by the Section 22 Committee. Gunninah Environmental Consultants, Sydney.

Harden, G. J. 1990-1993. Flora of NSW Volumes 1-4. New South Wales University Press, Kensington.

JBA Urban Planning Consultants. 2009. St Marys Central Precinct: Precinct Plan.

Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee. 1997. Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia. Commonwealth of Australia.

Kinhill. 1995. Australian Defence Industries Site - St Marys, Regional Environment Study Technical report Number 4: Characteristics of the Site. Kinhill Engineers Pty Ltd, Sydney.

NPWS. 2002a. Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney. NSW National Parks and Wildlife Service, Hurstville.

NPWS. 2002b. Native Vegetation Maps of the Cumberland Plain Western Sydney. NSW National Parks and Wildlife Service, Sydney.

NSW NPWS. 1997a. Flora Appendices 2 of Western Sydney Urban Bushland Biodiversity Survey. NSW National Parks and Wildlife Service, Hurstville.

NSW NPWS. 1997b. Flora Appendices 3 of Western Sydney, Urban Bushland Biodiversity Survey. NSW National Parks and Wildlife Service, Hurstville.

NSW NPWS. 1997c. Native Flora of Western Sydney, Urban Bushland Biodiversity Survey. NSW National Parks and Wildlife Service, Hurstville.

NSW NPWS. 2000. The Native Vegetation of the Cumberland Plain, Western Sydney: Technical Report. NSW National Parks and Wildlife Service, Hurstville.

NSW NPWS. 2002. Threatened Species Information: *Pultenaea parviflora*. NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee. 1997. Cumberland Plain Land Snail - endangered species listing. NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee. 1998. Shale/Sandstone Transition Forest - endangered ecological community listing. Department of Environment and Conservation (NSW), Hurstville, NSW.

NSW Scientific Committee. 1999. Castlereagh swamp woodland community, DEC, Husrtville.

NSW Scientific Committee. 2000a. Agnes Banks Woodland in the Sydney Basin Bioregion - endangered ecological community listing. NSW National Parks and Wildlife Service, Hurstville.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

NSW Scientific Committee. 2000b. *Grevillea juniperina* R. BR. subsp. *juniperina* (a shrub) - vulnerable species listing. NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee. 2002a. Cooks River/Castlereagh ironbark forest in the Sydney Basin Bioregion - endangered ecological community listing. NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee. 2002b. Moist Shale Woodland in the Sydney Basin Bioregion - endangered ecological community listing. Department of Environment and Conservation (NSW), Hurstville, NSW.

NSW Scientific Committee. 2002c. Shale gravel transition forest in the Sydney Basin Bioregion - endangered ecological community listing. NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee. 2004a. Competition from feral honeybees - key threatening process declaration. Department of Environment & Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004b. Eastern bentwing-bat - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004c. Eastern false pipistrelle - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004d. Eastern freetail-bat - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004e. Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004f. Greater broad-nosed bat - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004g. Grey-headed Flying-fox - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004h. Infection of native plants by *Phytophthora cinnamomi* - key threatening process declaration. Department of Environment and Conservation (NSW), Hurstville, NSW.

NSW Scientific Committee. 2004i. Large-eared Pied Bat - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville, NSW.

NSW Scientific Committee. 2004j. Large-footed myotis - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004k. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing. Department of Environment and Conservation (NSW), Hurstville, NSW.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

NSW Scientific Committee. 2004l. Yellow-bellied sheathtail bat - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville, NSW.

NSW Scientific Committee. 2009. Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing. Department of Environment, Climate Change and Water (NSW), Hurstville.

NSW Scientific Committee. 2010. Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion - vulnerable ecological community listing. NSW National Parks and Wildlife Service, Hurstville.

OEH. 2012a. Diamond Firetail - profile. NSW Office of Environment and Heritage, Hurstville.

OEH. 2012b. Eastern Bentwing-bat - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012c. Eastern False Pipistrelle - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012d. Eastern Freetail-bat - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012e. Greater Broad-nosed Bat - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012f. Grey-headed Flying-fox - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012g. Large-eared Pied Bat - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012h. Southern Myotis - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012i. Speckled Warbler - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012j. Varied Sittella - profile. Office of Environment and Heritage, Hurstville.

OEH. 2013a. Cumberland Plain Land Snail - profile. Office of Environment and Heritage, Hurstville.

OEH. 2013b. Remnant Vegetation Mapping of the Cumberland Plain.*in* O. o. E. a. Heritage, editor., NSW.

OEH. 2013c. Spiked Rice-flower - profile. Office of Environment and Heritage, Hurstville.

OEH. 2014a. Atlas of NSW Wildlife.

OEH. 2014b. Black Bittern - profile. Office of Environment and Heritage, Hurstville.

OEH. 2014c. Hooded Robin - profile. NSW Office of Environment and Heritage, Hurstville.

OEH. 2014d. Swift Parrot - profile. Office of Environment and Heritage, Hurstville.

PCC. 2005. Sustainability Blueprint for Urban Release Areas. Penrith City Council, Penrith.

Perkins, I. 1999. Flora Assessment of the Disputed Areas of Western Sydney Shale Woodlands. Ian Perkins Consultancy Services, Sydney.

Richardson, F. J., R. G. Richardson, and R. C. H. Shepherd, editors. 2006. Weeds of the South-east: An identification guide for Australia. R.G. and F.J. Richardson, Victoria.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Tozer, M. 2003. The Native Vegetation of the Cumberland Plain, western Sydney: Systematic classification and field identification of communities. Cunninghamia **8**:1-75.

Tozer, M. G., K. Turner, D. A. Keith, D. Tindall, C. Pennay, C. Simpson, B. MacKenzie, P. Beukers, and S. Cox. 2010. Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Cunninghamia **11**:359-406.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

APPENDIX A :

Chief Executives Requirements

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 17 : CER Compliance table

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
1 FORM OF THE SPECIES IMPACT STATEMENT		
	1.1 A species impact statement must be in writing (Section 109 (1))	The SIS is written
	1.2 A species impact statement must be signed by the principal author of the statement and by:	Refer to page i
	a. the applicant for the licence, or	
	b. if the species impact statement is prepared for the purposes of the *Environmental Planning and Assessment Act 1979*, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) Section 109(2)).	
	The applicant or proponent must sign the following declaration: "I…[insert name], of ..[address], being the applicant for the development consent…[insert DA number, Lot & DP numbers, street, suburb and LGA names] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal."	
2. CONTEXTUAL INFORMATION		
The description must include information of the following forms or types:	2.1 Description of proposal, subject site and study area The following are further requirements related to your obligation under Section 110(1) to address the following: A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout A comprehensive description of the nature, extent and timing of all components and associated or consequent actions of the proposal must be provided, including actions that have effects both	Ref to Section 2.2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	on and off the subject land as a result of the proposal. These actions detailed must include, but are not to be restricted to construction or ongoing use and maintenance of proposed: • buildings or other structures • utilities such as for sewage, electricity, gas or water • access routes; • dams/ponds, pipes/channels or other infrastructure for drainage, waste water/effluent management or erosion control • any structure or activity that may change surface or subterranean water movements • wastewater disposal • bush fire hazard reduction and protection measures, such inner and outer protection areas of asset protection zones (APZs), etc. • landscaping.	
	2.2 Land tenure information A legal description of the land (lot and deposited plan numbers) and information about the land tenure across the study area must be provided.	Ref to Section 2.3.
	2.3 Vegetation Vegetation present within the locality must be mapped and described, including documentation of the areal extent of each vegetation community. The descriptions should refer to: • Scientific Committee determinations (http://www.environment.nsw.gov.au/determinations/); • The OEH Vegetation Types Database (http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm); and. • The Cumberland Plain vegetation mapping. (http://www.environment.nsw.gov.au/surveys/CumberlandPlainVegetationMappingProject.htm);	Ref to Section 2.4.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	2.4 Plans and maps An aerial photograph or reproduction of such a photograph (preferably colour), of the locality, indicating scale and clearly delineating the subject site must be provided. A map or maps must be provided, showing:	Ref to page 2.16 for a list of Figures in each chapter of this SIS.
	i. in the locality, • any locally significant areas for threatened biodiversity. • the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3).	
	ii. in the study area, • the location, size and dimensions of the study area. • the full extent of the proposed works as described in section 2.1 at a scale of not less than 1:1000. • the locations and types of vegetation and cleared areas (with reference to the description required in section 2.3). • the current activities/usage of this land.	
	All maps must indicate scale and have an explanatory legend of any symbols used.	
	2.5 Threatened Species A list of all the threatened species or populations found in the database searches referred to in Section 3.1.1.	Refer to table 2 and 3 and Figures 8 and 9.
3 INITIAL ASSESSMENT	The following are further requirements related to your obligation under Section 110(2)(a) to address the following: a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action.	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	and the requirements under Section 110(3)(a) to address the following: a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action	
	3.1 Identifying subject threatened species, populations and ecological communities ('subject species')	Refer to Chapter 3.
	3.1.1 Assessment of available information In determining the species, populations and ecological communities likely to be present (the subject species) consideration must be given to the records and known distribution of species and to habitat types present within the study area. OEH recommends that a comprehensive habitat assessment across the whole site, identifying key habitat features for both flora and fauna, should first be conducted, following the guidelines at www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm be used. Additionally, the OEH threatened species profiles, any available recovery plans and or draft recovery plans, and vegetation assessment and mapping by State or local government agencies must be consulted. For obtaining known records flora and fauna databases such as the OEH Atlas of NSW Wildlife should be consulted. Use of the BioBanking Credit Calculator (www.environment.nsw.gov.au/biobanking/calculator.htm) is also recommended to supplement the list of threatened species that possibly occur on the site In determining the subject species, any available recovery plans or draft recovery plans, and vegetation assessment and mapping by State or local government agencies must be consulted. The following vulnerable, endangered or critically endangered species should be considered as a subject species: *Dillwynia tenuifolia* *Grevillea juniperina* ssp *juniperina*	Ref to Chapter 3.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	*Persoonia nutans**	
	*Pimelea spicata**	
	*Pultenaea parviflora**	
	Anthochaera phrygia (Regent Honeyeater)	
	Burhinus grallarius (Bush Stone-curlew)	
	Callocephalon fimbriatum (Gang-gang Cockatoo)	
	Calyptorhynchus lathami (Glossy Black-cockatoo)	
	Chthonicola sagittata (Speckled Warbler)	
	Circus assimilis (Spotted Harrier)	
	Daphoenositta chrysoptera (Varied Sittella)	
	*Dasyurus maculatus** (Spotted-tailed Quoll)	
	Ephippiorhynchus asiaticus (Black-necked Stork)	
	Glossopsitta pusilla (Little Lorikeet)	
	Hieraaetus morphnoides (Little Eagle)	
	*Lathamus discolor** (Swift Parrot)	
	Litoria aurea (Green and Golden Bell Frog)	
	Lophoictinia isura (Square-tailed Kite)	
	Melithreptus gularis gularis (Black-chinned Honeyeater)	
	Meridolum corneovirens (Cumberland Plain Land Snail)	
	Miniopterus australis (Little Bent-wing Bat)	
	Miniopterus schreibersii oceanensis (Eastern Bent-wing Bat)	
	Micronomus norfolkensis (Eastern Free-tail-bat)	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	Myotis macropus (Southern Myotis) *Ninox strenua* (Powerful Owl) *Oxyura australis* (Blue-billed Duck) *Petroica boodang* (Scarlet Robin) *Petroica phoenicea* (Flame Robin) *Phascolarctos cinereus** (Koala) *Scoteanax rueppellii* (Greater Broad-nosed Bat) *Stagonopleura guttata* (Diamond Firetail) *Stictonetta naevosa* (Freckled Duck) *Tyto tenebricosa* (Sooty Owl) The following endangered populations must be considered as a subject species (endangered population):\ *Marsdenia viridiflora* ssp *viridiflora* The following endangered or critically endangered ecological communities must be considered as a subject species (ecological community): Cumberland Plain Woodland in the Sydney Basin Bioregion* River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales, North Coast, Sydney Basin and South East Corner Bioregions Shale Gravel Transition Forest in the Sydney Basin Bioregion* Sydney Freshwater Wetlands in the Sydney Basin Bioregion Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	*Listed on the Environment Protection and Biodiversity Conservation Act	
Species Lists		
	These lists are not exhaustive. One of the roles of the SIS is to determine which species may be utilising the study area given the limitations of existing databases. Also be aware that additional species, populations, and ecological communities could be added to the schedules of the TSC Act between the issue of these requirements and the granting of consent. If this occurs, these additional entities will need to be addressed in the SIS and considered by the consent, determining, or concurrence authority. This requirement does not apply to the listing of a vulnerable ecological community (s5D EP&A Act). This requirement does not apply to the new listing of a vulnerable species unless the development application has not been determined by the consent authority within the period of 12 months after the date the application was made (s.105A EP&A Act).	
4 SURVEY		
	4.1 Requirement to survey Targeted surveys for subject species and their habitats must be undertaken within the study area to provide information on distribution, population/sub-population sizes and density, and area of habitat (known and potential), noting variations across the study area. This data is necessary to support the impact assessment requirements of section 5 and factors (a) and (d) of the assessment of significance. The techniques and timing of these surveys should be commensurate with the biology/ecology of these species and ecological communities in order to maximise the likelihood and accuracy of detection. Guidance on appropriate methodologies and level and timing of survey efforts for some other species can be obtained from OEH's Threatened Species Survey and Assessment Guidelines for survey and assessment (www.environment.nsw.gov.au/topics/animals-and-	Ref to Chapter 4, Sections 4.1 – 4.2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	plants/threatened-species/about-threatened-species/surveys-and-assessments), environmental impact assessment guidelines (see section 9.4), draft or approved recovery plans (see section 9.4), scientific or environmental management journals, biodiversity surveys and other sources. The information required to identify the type of impacts and assess their significance on threatened species is the key determinant for the level of survey effort required. Any modifications to the recommended or required survey methods or levels of survey effort require justification of their adequacy. This justification should be scientifically valid and refer to relevant scientific literature. Previous surveys (yours or others) can contribute to fulfilling the requirements of section 4, but only if they have been conducted and documented in accordance with the provisions specified in that section, e.g. with respect to the type, location, duration, spacing/density, appropriate season and weather conditions, etc. of the surveys. Documentation and mapping of these attributes, as required by section 4.2, applies equally to any previous surveys used. The currency of any previous surveys used to fulfil these requirements is a matter that will need to be considered by the consent authority in determining the adequacy of the SIS. Species of taxonomic uncertainty must have their identification confirmed by a recognised authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.	
	4.2 Documentation	
	4.2.1 Description of survey techniques and survey locations Survey technique(s) must be described and, where possible, a reference supporting the survey technique employed is to be provided. The size, orientation and dimensions of plots, transects or other sampling units should be clearly documented for each type of survey technique undertaken. Full AMG grid references for the survey site(s) should be noted. Survey site(s) should be shown on a map or maps, at a scale of	Refer to Section 4.2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	not less than 1:2000, which indicate scale and have an explanatory legend of all information shown and symbols used.	
	4.2.2 Documenting survey effort and results Each and every survey must be documented. Name(s) of surveyor(s) and other personnel must be recorded. Other persons who identified records (e.g., by analysis of Anabat recordings, hair tubes, scats) should also be named. The date and time and environmental conditions experienced during each survey must be documented. Survey proformas for a range of standard fauna survey techniques can be provided separately by email from the nominated contact officer upon request. These forms have provision for the types of information required to be documented. These or equivalent forms must be used by field staff when undertaking fauna surveys. Completed data sheets are to be included as an appendix to the SIS. Additionally, the time invested in applying each different survey technique – e.g. number of person hours/transect, duration of call playback, number of nights traps set – must be summarised in the SIS. It is not acceptable to document only the aggregate time spent on all survey techniques combined. Any limitations (e.g. denied access to private land) to sampling across the study area are to be documented.	Ref to Section 4.3-4.5.
	4.2.3 Description and mapping of results of vegetation, flora and fauna surveys The locations of any newly recorded threatened species or endangered populations resulting from additional surveys must be mapped and described. The mapping of vegetation required under section 2.3 must reflect any new information resulting from additional surveys.	Refer to Section 4.3 and Figures 12 and 13.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS	Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed: buildings or other structures; utilities such as for sewage, electricity, gas or water; routes for access and egress; dams and associated infrastructure; pipelines; drainage infrastructure and changes made to surface water flows; bush fire hazard reduction and protection measures; landscaping; and ongoing maintenance Assessment must include the direct and indirect impacts of these activities which may occur both on or off the subject land. To assess the impacts from the provision bushfire protection (e.g. if there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland), proponents should consider recommendations in 'Planning for Bushfire Protection' (NSW Rural Fire Service 2006) and consider the use of situating required access roads around the roads as an option to meet those requirements but reduce impacts on retained bushland.	Refer to Chapter 5.
	5.1 Assessment of species likely to be affected The following are further requirements related to your obligation under Section 110(2)(b) to address the following: an assessment of which threatened species or population known or likely to be present in the area are likely to be affected by the action.	Refer to Sections 4.5 and 5.2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	This requires you to refine the list of subject threatened species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or endangered populations may be affected directly or indirectly (including cumulatively), by the proposal. This is to be done taking account of the requirements outlined previously in section 4 of these requirements and information in any relevant Scientific Committee determinations, OEH threatened species profiles, recovery plans or draft recovery plans, and vegetation assessment and mapping. Detailed rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the species does not occur in the study area, or if not resident, will not utilise habitats on site on occasion, or if off-site, be influenced by off-site impacts of the activity, that species does not have to be considered further. Otherwise all species/populations likely to occur in the study area (based on general species distribution information), and known to utilise those habitat types, should be assessed as if they are present. The requirements in the remainder of this section need only be addressed for those species that are likely to be affected by the proposal. Subsequently this information should be used in an Assessment of Significance (as required in section 8) for each of those species or populations.	
	5.2 Discussion of local and regional abundance and distribution The following are further requirements related to your obligation under Section 110(2)(d) to address the following: an estimate for the local and regional abundance of those species or populations	Refer to Section 5.3.
	5.2.1 Discussion of other known local populations A discussion of other known populations in the locality must be provided. An estimate of the numbers of individuals of each threatened species or population utilising the area and the relative significance of the population(s) in the study area to the populations in the locality must be included.	Refer to Section 5.3.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	5.3 Assessment of habitat The following are further requirements related to your obligation under Section 110(2)(f) to address the following: a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region (Section 110 (2)(f)).	Refer to Section 5.3.
	5.3.1 Description of habitat values Specific habitat features must be described (e.g. frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks etc) and the density of understorey vegetation and groundcover. The condition of the habitat within the study area must be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of erosion, prevalence of rubbish dumping. Details of the subject site's fire history (eg frequency, time since last fire, intensity) and the source of fire history (e.g. observation, local records), must be provided.	Refer to Sections 4.3 and 5.3.
	5.3.2 Discussion of habitat utilisation A discussion of how individuals use the area (eg residents, transients, adults, juveniles, nesting, foraging) and discussion of the significance of the habitat of the study area to the viability of the threatened species or endangered population in the locality must be included.	
	5.4 Discussion of conservation status The following are further requirements related to your obligation under Section 110(2)(c) to address the following:	Refer to Section 5.5.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it and to your obligation under Section 110(2)(e) to address the following: an assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region and to your obligation under Section 110(2)(e1) to address the following: an assessment of whether any of those species or populations is at the limit of its known distribution The relative significance of the subject site for threatened species or endangered populations in the locality must be discussed. In particular, discussion of other known populations must be provided. Such an assessment must consider and compare the differences in the type, condition, and tenure and long-term security of other areas of known habitats in the locality with those in the study area. The discussion must also relate to the threatening processes (see section 5.5.3) that affect the conservation status of the ecological community. Known occurrences in the locality and region of the extinction or degradation of local populations of each affected threatened species or population and of fragmentation, decrease in extent or degradation of its habitat should be documented.	
	5.5 Discussion of the likely effect of the proposal at local and regional scales	Refer to Section 5.6.
	5.5.1 Significance within a local context The significance of impacts in the study area for conservation of affected threatened species or endangered populations in the locality must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in the type, condition, and the	Refer to Section 5.6.2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	tenure and long-term security, of other areas of known habitats in the locality with those in the study area.	
	5.5.2 Discussion of connectivity The potential of the proposal to increase fragmentation of the habitat or decrease the ability for movement of individuals and/or gene flow between habitats or populations of a threatened species or population must be appraised.	Refer to Section 5.6.
	5.5.3 Consideration of threatening processes Assessment of effects must not be limited only to threats that are recognised as key threatening processes, but must include other threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.	Refer to Section 5.6.4.
	5.6 Description of feasible alternatives The following are further requirements related to your obligation under Section 110(2)(h) to address the following: a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development. Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF as long as the document referred to is provided with the SIS. The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.	Refer to Section 5.7

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
6 ASSESSMENT OF LIKELY IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES	Assessment of impacts must consider the nature, extent and timing of the proposal and all associated actions, including but not restricted to construction, provision and ongoing maintenance of approved or proposed: buildings or other structures; utilities such as for sewage, electricity, gas or water; routes for access and egress; dams and associated infrastructure; pipelines; drainage infrastructure and changes made to surface water flows; bush fire hazard reduction and protection measures; landscaping; and ongoing maintenance Assessment must include the direct and indirect impacts of these activities which may occur both on or off the subject land. To assess the impacts from the provision bushfire protection (e.g. if there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland), proponents should consider recommendations in 'Planning for Bushfire Protection' (NSW Rural Fire Service 2006) and consider the use of situating required access roads around the roads as an option to meet those requirements but reduce impacts on retained bushland.	Refer to Section 5.1.
	6.1 Assessment of critically endangered or endangered ecological communities likely to be affected The following are further requirements related to your obligation under Section 110(3)(a) to address the following:	Refer to Section 5.2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action. This requires you to refine the list of subject ecological communities (given the outcome of survey and analysis of likely impacts) in order to identify which critically endangered or endangered ecological communities (C/EECs) may be affected, directly or indirectly (including cumulatively), by the proposal. This must include reference to the ecological community as described by the NSW Scientific Committee, and to the requirements outlined previously in section 4 of these requirements, and take into account information any relevant C/EEC profile, recovery plan or draft recovery plan, and vegetation assessment and mapping. Adequate rationale should be provided to demonstrate how the list was derived. If adequate surveys/studies have been undertaken to categorically demonstrate the C/EEC does not occur in the study area, or will not utilise habitats on site, or if off-site, be influenced by off-site impacts of the activity, that C/EEC does not have to be considered further. Otherwise all C/EECs likely to occur in the study area (based on general distribution information), and known to occupy those habitat types, should be assessed as if present. The requirements in the remainder of this section need only be addressed for those C/EECs that are likely to be affected by the proposal.	
	6.2 Description of habitat The following are further requirements related to your obligation under Section 110(3)(c) to address the following: a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region.	Refer to Section 5.3.
	6.2.1 Study area An assessment of habitat the study area is required to include: a description of each C/EEC, including:	Refer to Section 5.4.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	• a description those areas where the community may only be represented by soil stored seed with no or few above-ground components, and • description of disturbance history and recovery capacity. If the site shows signs of disturbance, details should be provided of the site's disturbance history. An assessment should be made of the ability of the ecological community to recover to a state representative of its pre-disturbance condition. This assessment will include consideration of the site's in-situ and migratory resilience and will be accompanied by a map of the recovery capacity of the ecological community across the site. Consideration should be given to the results (preliminary or otherwise) of restoration projects being undertaken at other sites that contain the ecological community when assessing its recovery capacity. comparison of the affected community with the C/EEC as determined by the NSW Scientific Committee. reference to any relevant available recovery plans or draft recovery plans and vegetation assessment and mapping. maps, consistent with the descriptions provided, showing of the extent and condition of the C/EEC.	
	6.2.2 Locality A discussion of other occurrences of each C/EEC populations in the locality must be provided. This must include: a comparison of other known occurrences and their habitats with those of the study area in terms of remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances). the tenure and long-term security of other occurrences and its habitat. the relative significance of the subject site for each C/EEC in the locality and region.	Refer to Section 5.3.
	6.3 Discussion of conservation status	Refer to Section 5.5.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	The following are further requirements related to your obligation under Section 110(3)(b) to address the following: for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it The following are further requirements related to your obligation under Section 110(3)(b1) to address the following: an assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region The following are further requirements related to your obligation under Section 110(3)(b2) to address the following: an assessment of whether any of those ecological communities is at the limit of its known distribution The relative significance of the subject site for each C/EEC in the locality must be discussed. In particular, discussion of other known occurrences of each affected C/EEC must be provided. Such an assessment must consider and compare the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area. The discussion must also relate to the threatening processes (see section 6.4.4) that affect the conservation status of the ecological community. Known occurrences in the locality and region of fragmentation, decrease in extent or degradation of each C/EEC or its habitat should be documented.	
	6.4 Discussion of the likely effect of the proposal at local and regional scales	Refer to Section 5.3.
	6.4.1 Significance within a local context	Refer to Section 5.3.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	The significance of impacts in the study area for conservation of affected C/EEC in the locality must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area.	
	6.4.2 Extent of habitat removal or modification The location, nature and extent of habitat removal or modification which may result from the proposed action including the cumulative loss of habitat from the study area (including all proposed DAs and those areas in the subject area already with development consent or identified for development) and the impacts of this on the viability of the C/EEC in the locality. This must include an assessment of the proportion of the C/EEC to be affected by the proposal, in relation to the total extent of the C/EEC, and the impact of this on the viability of the endangered ecological community at the local level.	Refer to Section 5.6.
	6.4.3 Discussion of connectivity The potential of the proposal to increase fragmentation of each C/EEC, its relation to adjoining vegetation and to exacerbate edge effects or to decrease the ability for movement of individuals and/or gene flow between habitats must be discussed. The impact on habitats in the proximate reserved lands, must be discussed. If connectivity between adjacent remnants of C/EECs is likely to be affected, the impact of the proposal on connectivity must also be discussed.	Refer to Section 5.6.
	6.4.4 Consideration of threatening processes Assessment of effects must not be limited to threats that are determined to be key threatening processes', but must also include threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or	Refer to Section 5.6.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.	
	6.4 Description of feasible alternatives The following are further requirements related to your obligation under Section 110(3)(e) to address the following: a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development. Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF. The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.	Refer to Section 5.7.
7 AMELIORATIVE AND COMPENSATORY MEASURES		
	7.1 Description of ameliorative measures The following are further requirements related to your obligation under Sections 110(2)(i) and 110(3)(f) to address the following: a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations [s.110(2)(i)] [or] ecological community [s.110(3)(f)] including a compilation (in a single section of the statement) of those measures. OEH strongly supports the view that development proposals should, in order of preference:	Refer to Chapter 6.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	i. Avoid any impacts; ii. Minimise on- and off-site impacts such that a significant impact is not likely. Measures proposed to avoid, reduce or ameliorate impacts should only be proposed where it can be clearly demonstrated that they have been successfully applied elsewhere. The likely efficacy of such measures with respect to the current proposal should be assessed in detail.	
	7.1.1 Long term management strategies Consideration must be given to developing long term management strategies to protect areas within the study area which are of particular importance for the threatened species or endangered populations likely to be affected. This may include proposals to restore or improve habitat on site where possible.	Refer to Section 6.3.
	7.1.2 Compensatory strategies Where the proposal will still result in loss to threatened species or habitats, strategies to compensate (offset) for the loss(es) should be considered. These may include other off-site or local area proposals that contribute to long term conservation of the threatened species. Any offsetting measures should be developed in accordance and be consistent with the "Principles for the Use of Biodiversity Offsets in NSW" (www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm). OEH advocates us of the Biobanking Assessment Method (www.environment.nsw.gov.au/biobanking/assessmethodology.htm) which affords a transparent, consistent and scientifically-based method to inform the calculation of sufficient offset areas and appropriate management actions to ensure maintenance or improvement of threatened biota. Where such proposals involve other lands, or where the involvement of community groups is envisaged in such proposals, such groups are to be consulted and proposals should contain evidence of support from these stakeholders and from relevant land managers.	Refer to Section 6.3.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of mechanisms of how they might best occur.	
	7.1.3 Translocation OEH does not consider the translocation of threatened species, populations or ecological communities to be an ameliorative measure for the purposes of considering impacts of a particular development/activity and translocation is usually only supported by OEH in specific conservation programs (e.g. recovery planning), but only as a last resort after in-situ conservation options have been exhausted. Translocation should only be considered following extensive investigation of alternative options to avoid and mitigate the impacts of the development and a demonstrated long term financial commitment by the applicant.	Translocation is not considered in this SIS or as part of the proposal.
	7.1.4 Ongoing monitoring Any proposed pre- or post-development monitoring plans of the effectiveness of the mitigation or compensatory measures must be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not been proved effective should be undertaken under experimental design conditions and appropriately monitored.	Refer to Section 6.4.
8. ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION	8.Assessment of Significance of Likely Effect of Proposed Action Based on the detailed assessment and consideration of alternatives and/or ameliorative measures proposed in the SIS, a re-assessment of the significance of impact (section 5A EP&A Act) is to be carried out for each of the entities (threatened species, population or ecological community) identified in the SIS as being likely to be affected. This assessment must be carried out in accordance with the Threatened species assessment of significance guidelines (DECC 2007) (www.environment.nsw.gov.au/threatenedspecies/tsaguide.htm) and must incorporate the relevant information from sections 5.1 to 7 of these SIS requirements. For each entity an overall	Refer to Chapter 7.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	conclusion must be drawn as to whether the proposal is still considered likely to have a significant effect.	
9 ADDITIONAL INFORMATION		
	9.1 Qualifications and experience The following is your obligation under Sections 110(4) to address the following: a species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement	Refer to Chapter 8, Section 8.1
	9.2 Other approvals required for the development or activity The following are further requirements related to your obligation under Sections 110(2)(j) and 110(3)(g)) to address the following: a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community	Refer to Section 8.1
	Other approvals under NSW law In providing a list of other approvals the following must be included: • Where a consent is required under Part 4 of the Environmental Planning and Assessment Act 1979, the name of the consent authority and the timing of the development application should be included; or • Where an approval(s) is required under Part 5 of the Environmental Planning and Assessment Act 1979, the name of the determining authority(ies), the basis for the approval and when these approvals are proposed to be obtained should be included.	
	Approval under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	A development or action will require referral to, and may require the approval of, the Federal Minister for the Environment (in addition to any local or state government consent or approval) if that action will have, or is likely to have, a significant impact on the environment or on a matter of national environmental significance (NES matter). Threatened species and communities listed in the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) are considered to be matters of national environmental significance, as are migratory species and a number of other matters. It is the responsibility of the proponent to assess whether the development is likely to have a significant impact on an NES matter. Information regarding matters of national environmental significance and guidelines to assist whether to refer the action can be obtained from the Commonwealth Government Department of Environment and Energy (DEE) at www.environment.gov.au/epbc/protect/index.html or by contacting DEE on (02) 6274 1111. A proponent can also make a referral if they are unsure whether approval is needed under the Act or if it needs certainty. To minimise delays in getting approvals under the Commonwealth and State processes, it is best, and in the interest of the proponent, if the development is referred early to DEE's Environment Assessment Branch to obtain a decision on whether it is a controlled action before the SIS is exhibited under the EP&A Act.	
	Further information regarding the operation of the EPBC Act in NSW can be found in the NSW Department of Planning and Infrastructure's website at http://planning.nsw.gov.au/Policy-and-Legislation/Government-Agreements-and-Forum	
	9.3 Licensing matters relating to conducting surveys Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:	Refer to Section 8.1.2.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

CER Compliance Table		
Main Heading	**Subsections**	**Our Response**
	National Parks and Wildlife Act 1974: • General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna). • Licence to pick protected native plants (Section 131). • Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes. Biodiversity Conservation Act 2016: • Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91). Animal Research Act 1985: • Animal Research Authority to undertake fauna surveys.	
	9.4 Section 110 (5) reports Section 110(5) of the *Threatened Species Conservation Act 1995* has the effect of requiring OEH to provide that information it has regarding the State-wide conservation status of the subject species is made available, in order to satisfy ss.110(2) & (3) of the Act. To this end, OEH provide this information via www.threatenedspecies.environment.nsw.gov.au). Detailed species profiles and environmental impact assessment guidelines for threatened species, populations and ecological communities are available via this website. Proponents and consultants should note that OEH has no further published information available to satisfy s.110(5) of the Act and that purchase or receipt and use of the above profiles can be taken to have satisfied the requirements of ss.110(2) & (3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.	Refer to Section 8.1.3 and References Section.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

APPENDIX B :
Survey Effort

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 18 : History of survey effort on the SMDS relevant to the Western Precinct

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Oct-93	James, T.A.	Vegetation Survey - Australian Defence Industries St Mary's Facility	Regional Park (eastern section)	Inspected to identify plant communities and to compile a plant species list. Both native and the more significant exotic plant species were recorded.	Inspected on 3 occasions during August and September.	n/a	n/a
Jun-91	Gunninah Consultants	Fauna Survey - Australian Defence Industries (ADI) Site, St Mary's	Across the SMDS (including Regional Park and Western Precinct)	n/a	n/a	Daytime searches for native animals in all vegetation communities. Record kept of all native bird species sighted, searches for cryptic species such as frogs and reptiles, and for indirect evidence of all native animals (diggings, footprints, burrows, scats, bones, scratchings etc) and recording sightings	200 person hours of field survey over 8 days. Elliotts: 1200 trap nights, Harps: 26 trap nights, Pitfalls: 60 trap nights

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
						of animals. Elliott A trapping, live pitfall traps, harp-type bat traps, spotlight surveys.	
Aug-94	Gunninah Consultants	Environmental Review - Australian Defence Industries (ADI) Site, St Mary's					
Apr-95	Gunninah Consultants	Distribution of Endangered Flora: Pyro Park - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (eastern section)	A fixed, marked grid based on transect lines placed at 50m centres were surveyed for threatened flora species. Tagging was conducted until it was deemed not to be feasible. Transect surveys undertaken after this point.		n/a	n/a
Apr-95	Gunninah Consultants	Flora Survey: Bomb and North Bomb Sectors - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (central section)	Detailed walked surveys throughout the Bomb and North Bomb sites, describing and mapping the vegetation communities present, establishing a flora	Over a period of three days.	n/a	n/a

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
				species inventory, and identifying plant species of conservation concern or interest.			
Aug-95	Gunninah Consultants	Fauna and Flora Issues - Australian Defence Industries (ADI) Site, St Mary's - Planning Study	Across the SMDS (including Regional Park and Western Precinct)	Supplementary flora field surveys to provide more detailed vegetation community descriptions, to locate endangered plant species, and confirm the accuracy and consistency of available information. Quadrats surveyed.		n/a	n/a
Jan-96	Gunninah Environmental Consultants	Flora Survey: Ropes Creek Area - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (Ropes Creek Area)	Detailed walked surveys throughout the Ropes Creek Area, describing and mapping the vegetation communities present, establishing a flora species inventory, searching for and identifying plant species of conservation concern or interest.		n/a	n/a

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Nov-96	Gunninah Environmental Consultants	Vegetation Communities - Australian Defence Industries (ADI) Site, St Mary's Facility	Across the SMDS (including Regional Park and Western Precinct)	Quadrats (20m x 20m) were defined within each study area and were placed at 1ha intervals, except from those areas in which the community/floristic group varied within the range of 1ha. Dominant species from each stratum were recorded. Species of conservations significance recorded		n/a	n/a
Jan-97	Gunninah Environmental Consultants	Flora Survey: Northern Sector - Australian Defence Industries (ADI) Site, St Mary's Facility	Regional Park (Northern Sector)	Walked surveys throughout the Northern Sector describing and mapping the vegetation communities present. A flora species inventory was also established and plant species of conservation concern or interest were identified and located.	Surveyed for one day to compile a flora inventory identifying endangered plant species, native and exotic species.		

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Feb-99	Ian Perkins	Flora Assessment of the Disputed Areas of the Western Sydney Shale Woodlands	Regional Park (North western section and Western Precinct)	15 Quadrats (20x20m) in the north western section and western sections of the Regional Park, and in the Western Precinct. A flora species list was made for each quadrat.	15 quadrats surveyed over 5 days.	n/a	n/a
May-09	Cumberland Ecology	St Marys Property Western Precinct Stage 1A Development Application Flora and Fauna Assessment	Western Precinct	Transects with spot assessments to determine vegetation community type and vegetation condition	83 5x5m quadrats between 2007 and 2008	Bird transects, fauna habitat assessments, incidental fauna records throughout site	16 person hours targeted bird surveys
Apr-11	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct and Regional Park	Quadrats (20m x 20m) placed within the subject site, subject land and study area. Targeted searches throughout subject site, subject land and study area.	35 Quadrats, Targeted searches	Daytime searches for native animals in all vegetation communities. Record kept of all native bird species sighted and for indirect evidence of all native animals (diggings, footprints, burrows, scats, bones,	9 Person Hours Targeted Bird Transects, 6 nights Anabat survey, 300 trees with potential snail habitat.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
						scratchings etc) and recording sightings of animals. 500m Bird transects within subject site, subject land and study area. Targeted snail searches at 15 sites, 5 within the subject land, each containing 20 sample trees. Anabat detectors within subject site, subject land and study area.	
Feb- 12	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct - Village 4	Quadrats (20m x 20m) and Targeted searches across subject site (Village 4).	4 Quadrats, 2km of targeted searches	n/a	n/a
Mar–12	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct – North Lakes Access Road	Quadrats (20m x 20m) and vegetation condition assessment of the subject site	3 Quadrats	n/a	n/a

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

History of survey effort on the SMDS relevant to the Western Precinct							
Date	**Author**	**Report**	**Location***	**Flora Methods**	**Flora Effort**	**Fauna Methods**	**Fauna Effort**
Aug- 12	Cumberland Ecology	Jordan Springs Trunk Sewer	St Marys Western Precinct eastern border and Regional Park	n/a	n/a	Threatened species searches	
Mar- 13	Cumberland Ecology	St. Marys Western Precinct SIS	Western Precinct – Stage 3C(1) and Stage 3C(2)	Quadrats (20m x 20m) and vegetation condition assessment of the subject site	1 Quadrat		

Table 19 : Detailed Methods and Records of Survey for Threatened Flora species on the SMDS

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney -	*Dillwynia tenuifolia*	Eastern section of RP. Common throughout eastern end of the ADI site, particularly in open sites within the Ironbark forest communities and along tracks.	Common	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Environmental Review				
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	*Dillwynia tenuifolia*	Eastern section of RP. Was found more widely over the eastern RP study area, and its occurrence appears to be highly correlated with sites of disturbance.	249 in 0.64ha of Section 3. Across all Pyro Park: approx range 1803 - 6075.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m2 area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - Flora Survey Ropes Creek Area	*Dillwynia tenuifolia*	Ropes Creek - Study area A, B and E (eastern portion, northern portion).	Infrequent in area B. Considerable numbers in cleared areas in area E (eastern portion).	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for and identifying plant species of conservation concern or interest.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					Patchily distributed in area E (northern portion). Few specimens along dirt track, and in greater numbers along main road.	
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Dillwynia tenuifolia*	Unavailable		Quadrats (20m x 20m) were defined within each study area and were placed at 1ha intervals, except from those areas in which the community/floristic group varied within the range of 1ha. Quadrats were assessed and plant species recorded.
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Dillwynia tenuifolia*	Northern Sector of RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Dillwynia tenuifolia*	Eastern Precinct	Population in study area = 140,295; development area = 30,754. High densities found in Regional Park (averaging up to 790 plants/ha in less fragmented areas), while lower densities found in the fragmented areas of the Regional Park and the development area (190 plants/ha and 165 plants/ha respectively).	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Dillwynia tenuifolia*	Eastern Precinct	The population within the study area is estimated to be 140,295 plants. Of this, approximately 30,754 plants (~22% of the total population) are estimated to be in the proposed development area. High densities of this species are found in the less fragmented portions of the Regional Park (averaging 790 plants/ha)	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					while low densities are found in the fragmented portions of the Regional Park and proposed development area (290 and 165 plants/ha respectively).	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Dillwynia tenuifolia*	Southern section Eastern precinct	3229 per hectare (796 standard error). Area B - 4 plants/400 square metres. Area C - 8 specimens.	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2005	Cumberland Ecology	St Marys Property - Eastern Precinct - Flora and Fauna Risk Assessment for the	*Dillwynia tenuifolia*	Eastern Precinct.	Stockpile 3 = 17, Stockpile 4 = 27, Stockpile 5 = 135,	The entire area of each proposed stockpile location was inspected for threatened flora species by walking parallel transects across each area, and all individual plants of all

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		demolition of buildings, removal of existing roads and stockpiling material			Stockpile 6 = 330 (part estimated), Stockpile 7 = 11, Stockpile 8 = 2, Stockpile 9 = 8. Total = 761.	maturities were counted. A variation in this methodology was required for Stockpile Number 6. Estimates of plant numbers were undertaken in this stockpile owing to the dense occurrences in certain sections.
2005	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment of Proposed Subdivision and Construction Works for a Village Centre.	*Dillwynia tenuifolia*	Eastern Precinct. Land within the proposed re-subdivision of proposed Lot 3 in the subdivision of Lot 4 in DP 1079444 (ref DA 05-2323 and DA 05-2960).	Less than 30 plants on subject site.	Inspected the subject site to assess the vegetation condition and identify areas where threatened flora occurred and estimated population numbers of these species.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Dillwynia tenuifolia*	Fenceline between Eastern and Ropes Creek Precincts, and Regional Park		The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2005	Cumberland Ecology	Eastern Precinct, St Marys Property - Flora and Fauna Assessment for a Residential Subdivision within Lot 4 in DP107944 (in DA 04-1669)	Dillwynia tenuifolia	Lot 4 in DP107944 Eastern Precinct	In CRCIF: 167/ha (SE 17.08), estimated 1503. In Remediated Areas: 657/ha (SE 460.76), estimated 10512. Abundance in each quadrat - Q1:4; Q2:1; Q3:1; Q4:3; Q5:2.	Quadrats were placed to sample the vegetation communities present. Three 20 m x 20 m quadrats were randomly placed in woodland and three quadrats were placed in disturbed/open areas and traversed.
2005	Cumberland Ecology	Letter: Zone Substation Flora and Fauna Assessment; Ropes Creek Precinct, SMDS.	Dillwynia tenuifolia	Zone Substation, Ropes Creek.	1	Inspected the area covered by the Zone Substation, Ropes Creek, identifying any additional threatened species issues.
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	Dillwynia tenuifolia	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 6, Woodland = 8. Total = 14.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for a Private School in the Eastern Precinct	Dillwynia tenuifolia	Village North development area Eastern Precinct.	Approximately 200 to be removed.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for Level 1 Park Earthworks in the Eastern Precinct.	Dillwynia tenuifolia	Eastern Precinct. Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites.	Approximately 200 on subject site.	A botanist surveyed Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites, for the presence of threatened shrub species which are known to occur in large numbers in the Eastern Precinct and throughout the Regional Park
2006	Cumberland Ecology	Ropes Creek Precinct - Biodiversity Assessment	Dillwynia tenuifolia	Ropes Creek Precinct.	Estimated that no more than 500 individuals	A targeted threatened flora survey was conducted within the precinct.
2007	Cumberland Ecology	Proposed Subdivision of Stage 2G Eastern Precinct SMDS - Flora and Fauna Assessment	Dillwynia tenuifolia	Eastern Precinct, northern section.	Approximately 25 on subject site.	
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora	Dillwynia tenuifolia	Lands located adjacent to Palmyra Avenue in the north-east of the Eastern Precinct of the SMDS.	Only small numbers were recorded; approximately	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		and Fauna Assessment			900 specimens occur within areas proposed for subdivision.	
			Dillwynia tenuifolia			
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Grevillea juniperina* ssp. *juniperina*	Eastern section RP		Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Flora Survey Bomb & North Bomb Sectors	*Grevillea juniperina* subsp. *juniperina*	Central section RP		Walked surveys throughout the Bomb and North Bomb sites establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed over a period of three days.
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys	*Grevillea juniperina*	Ropes Creek	Infrequent in area B. Commonly	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Facility - Flora Survey Ropes Creek Area	subsp. *juniperina*		represented in area E (eastern portion)	and identifying plant species of conservation concern or interest.
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Grevillea juniperina* ssp. *juniperina*	Northern Sector, western section, eastern section, central section RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct	Population in study area = 494,611; development area = 37, 326. Medium-high densities found in Regional Park (averaging up to 1300 plants/ha in less fragmented areas, and 750 plants/ha in	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					fragmented areas, and lower densities (200 plants/ha) in development area.	
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Grevillea juniperina* sp. *juniperina*	Eastern Precinct	The population within the study area is estimated to 494,611 plants with approximately 37,326 within the proposed development area (~7.5%). Medium to high densities are found throughout the Regional Park (averaging up to 1,300	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS								
Year	**Author**	**Title**	**Scientific name**	**Location***			**Numbers**	**Method**
							plants/ha in less fragmented areas, and 750 plants/ha in fragmented areas) and lower densities (200 plants/ha) in the proposed development area and other disturbed habitats.	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Southern precinct	section	Eastern	714 per hectare (156 standard error). Area A - few. Area B - 1 plant/400 square metres. Area C - 130 specimens. Area E - 2	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					specimens. 1 specimens east of Area E.	
2005	Cumberland Ecology	St Marys Property - Eastern Precinct - Flora and Fauna Risk Assessment for the demolition of buildings, removal of existing roads and stockpiling material	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct.	Stockpile 3 = 1, Stockpile 5 = 16, Stockpile 8 = 24, Stockpile 9 = 102. Total = 143.	The entire area of each proposed stockpile location was inspected for threatened flora species by walking parallel transects across each area, and all individual plants of all maturities were counted. A variation in this methodology was required for Stockpile Number 6. Estimates of plant numbers were undertaken in this stockpile owing to the dense occurrences in certain sections.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	North and South Dunheved Precincts. Found predominantly in the Cumberland Plain Woodland in the northern tip of Dunheved but plants were also found along the eastern edge.		Targeted searches for threatened species.
2005	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment of Proposed Subdivision and	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct.	30-60 plants on subject site.	Inspected the subject site to assess the vegetation condition and identify areas where threatened flora occurred and estimated population numbers of these species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Construction Works for a Village Centre.				
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Grevillea juniperina* ssp. *juniperina*	Fenceline between Eastern and Ropes Creek Precincts, and Regional Park		The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2005	Cumberland Ecology	Eastern Precinct, St Marys Property - Flora and Fauna Assessment for a Residential Subdivision within Lot 4 in DP107944 (in DA 04-1669)	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct	In CRCIF: 83/ha (SE 64.55), estimated 747. In Remediated Areas: 308/ha (SE 169.12), estimated 4928. Abundance in each quadrat - Q2:1; Q4:4.	Quadrats were placed to sample the vegetation communities present. Three 20 m x 20 m quadrats were randomly placed in woodland and three quadrats were placed in disturbed/open areas and traversed.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2005	Cumberland Ecology	Letter: Eastern Precinct - Proposed subdivision DA - Stage 1(E) - Flora and fauna assessment. 9/6/05. To Rob Bennett.	*Grevillea juniperina* ssp. *juniperina*	Located in Stage 1(e), Eastern Precinct.		Inspected the area covered by Stage 1(e) identifying any additional threatened species issues.
2005	Cumberland Ecology	Letter: Eastern Precinct - Proposed subdivision DA - Stage 1(F) - Flora and fauna assessment. 9/6/05. To Rob Bennett.	*Grevillea juniperina* ssp. *juniperina*	Located in Stage 1(f), Eastern Precinct.		Inspected the area covered by Stage 1(f) identifying any additional threatened species issues.
2005	Cumberland Ecology	Letter: Zone Substation Flora and Fauna Assessment; Ropes Creek Precinct, SMDS.	*Grevillea juniperina* ssp. *juniperina*	Zone Substation, Ropes Creek.	Less than 10 plants.	Inspected the area covered by the Zone Substation, Ropes Creek, identifying any additional threatened species issues.
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 57, Woodland = 78. Total = 135.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for a Private School in the Eastern Precinct	*Grevillea juniperina* ssp. *juniperina*	Village North development area Eastern Precinct.	Approximately 100 to be removed.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for Level 1 Park Earthworks in the Eastern Precinct.	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct.	Approximately 200 on subject site.	A botanist surveyed Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites, for the presence of threatened shrub species which are known to occur in large numbers in the Eastern Precinct and throughout the Regional Park
2006	Cumberland Ecology	Proposed Concrete Recycling Facility - Flora and Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Central Precinct stockpile.	Several specimens.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	Ropes Creek Precinct - Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Ropes Creek Precinct.	Estimated that no more than 500 individuals	A targeted threatened flora survey was conducted within the precinct.
2006	Cumberland Ecology	St Marys Property - Penrith Local Government Area - Assessments of	*Grevillea juniperina* ssp. *juniperina*	Fenceline between Central and Western Precinct, and Regional Park	34	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Significance of the impacts of long term macrofauna fencing upon threatened flora and fauna				
2007	Cumberland Ecology	Proposed Subdivision of Stage 2G Eastern Precinct SMDS - Flora and Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct northern section.	Approximately 80 on subject site.	
2008	Cumberland Ecology	St Mary Property - Western Precinct Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Western Precinct. Northern and southern margins of the Precinct. (See report for GPS locations)	Approximately 700. Populations of 60, 40, 410, 23, 50 and 120.	A targeted threatened flora survey was conducted within the precinct during the flora survey.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Western Precinct northern section	Approximately 150.	A field survey of each area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS								
Year	**Author**	**Title**	**Scientific name**	**Location***			**Numbers**	**Method**
		Conservation Act 1999						
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Western section	Precinct	northern	Rarely in this section.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Western section	Precinct	northern	Approximately 50.	A field survey of each area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Central Precinct.	Approximately 1000.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Central Precinct	Over 100.	A field survey of each area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Central Precinct.	Several specimens.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Northern boundary of the Ropes Creek Precinct.	Few specimens	A field survey of each area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Grevillea juniperina* ssp. *juniperina*	Ropes Creek Precinct.	Approximately 200.	A field survey of each area.
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity	*Grevillea juniperina* ssp. *juniperina*	Regional Park (near Ropes Creek Precinct).	Approximately 1000.	A field survey of each area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Conservation Act 1999				
2008	Cumberland Ecology	St Marys Property - Central Precinct Biodiversity Assessment	*Grevillea juniperina* ssp. *juniperina*	Central Precinct. 3 locations (see report for GPS)	Approximately 530. Populations of 150, 380 and 2.	A targeted threatened flora survey was conducted within the precinct during the flora survey.
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora and Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern Precinct northern section.	Common throughout most of the study area and approximately 2,500 specimens are estimated to occur within areas proposed for subdivision.	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.
2003	ERM	Remediation Action Plan for the Eastern Sector of the St Marys Property - Flora & Fauna Assessment	*Grevillea juniperina* ssp. *juniperina*	Eastern section RP		

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	cluster along north-western boundary of SMDS	Over 30	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	cluster along north-western boundary of SMDS	Over 30	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	along fence line on western side of Western Precinct	Approximately 20	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline and exclosure fencing in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline and exclosure fencing in Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Adjacent to creekline and exclosure fencing in Western Precinct	approximately 55	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Directly to the east of the drainage line, in the north west of the western precinct	Less than 10 plants	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Within Regional Park, adjacent to track	25 Pultenaea, 44 Grevillea	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Grevillea juniperina* ssp. *juniperina*	Within Regional Park	approximately 10 plants	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2005	Cumberland Ecology	Letter: New records of *Marsdenia viridiflora* subsp *viridiflora:* Eastern Precinct, SMDS. 15/5/05. To David Aynsley.	*Marsdenia viridiflora* ssp. *viridiflora*	Located in the most southern corner of Stage 1(e). The exact location of these plants was in the centre of a drainage reserve, which forms part of a secondary open space corridor. The two groups were located approximately 10 metres apart.	12 plants/suckers. 2 groups of 6.	During work on the Vegetation Rehabilitation Plan (VRP) specimens were detected.
2006	Cumberland Ecology	Analysis of the responses of Cumberland Plain Woodland to grazing by macrofauna at St Marys - Floristic and structural changes 1	*Marsdenia viridiflora* ssp. *viridiflora*	Exclosure plot		Exclosure plot methodology.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		year after grazing exclosure				
2006	Cumberland Ecology	St Marys Property - Penrith Local Government Area - Assessments of Significance of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Marsdenia viridiflora* ssp. *viridiflora*	Fenceline between Central and Western Precinct, and Regional Park	<30 on fenceline, >100 in Regional Park in immediate vicinity of fence.	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2007	Cumberland Ecology	Analysis of the responses of Cumberland Plain Woodland to grazing by macrofauna at St Marys - 2006-2007 Floristic and structural changes two years after grazing exclosure	*Marsdenia viridiflora* ssp. *viridiflora*	Exclosure plot 6Do and 6Eo.	Approximately 5 plants	Exclosure plot methodology.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2008	Cumberland Ecology	St Marys Property Proposed Regional Park Boundary Changes - Ecological Assessment for Sydney Regional Environmental Plan 30 and Environment Protection and Biodiversity Conservation Act 1999	*Marsdenia viridiflora* ssp. *viridiflora*	Central Precinct.		A field survey of each area.
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Micromyrtus minutiflora*	Eastern section RP		Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	*Micromyrtus minutiflora*	Eastern section RP	265 in 0.64ha of Section 3. Across all Pyro Park: approx range 604-1810.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
						specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m2 area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - Flora Survey Ropes Creek Area	*Micromyrtus minutiflora*	Ropes Creek	Patchily distributed.	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for and identifying plant species of conservation concern or interest.
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Micromyrtus minutiflora*			
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Micromyrtus minutiflora*	Northern Sector RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Micromyrtus minutiflora*	Eastern Precinct	Population in study area = 1340; development area = 150.	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Micromyrtus minutiflora*	Eastern Precinct.	The population within the study area is estimated to be approximately 1340 plants with approximately 150 plants (11% of the total	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					population) occurring within the proposed development area.	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Micromyrtus minutiflora*	Eastern Precinct southern section	41 per hectare (29 standard error)	Targeted survey for threatened species that were known to be present or considered a possibility to be present.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Micromyrtus minutiflora*	Fenceline between Central and Western Precinct, and Regional Park	4	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2006	Cumberland Ecology	Flora and fauna assessment for future learning and	*Micromyrtus minutiflora*	Eastern Precinct, proposed residual lots 17, 18, 20 and 21.	Exotic grassland = 5, Woodland = 48. Total = 53.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		community uses in the Eastern Precinct				
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora and Fauna Assessment	*Micromyrtus minutiflora*	Eastern Precinct northern section.	A single localised population was recorded near the western end of the subject site, and the population was estimated to comprise approximately 200 plants.	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Persoonia nutans*	Eastern section RP	2 specimens	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution	*Persoonia nutans*	Eastern section RP	2 specimens	Not available

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		of Endangered Flora, Pyro Park				
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Persoonia nutans*	Not available	Not available	Not available
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Persoonia nutans*	Northern Sector RP	Not available	Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were surveyed on one day. Survey quadrats were 20m in diameter.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Persoonia nutans*	Eastern section RP	Persoonia nutans has been recorded at 3 locations in the study area.	
2012	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Pimelea spicata*	Along slope adjacent to creek towards Southern edge of Village 4.	None recorded	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
1994	Gunninah Consultants	Australian Defence Industries St Marys Facility Western Sydney - Environmental Review	*Pultenaea parviflora*	Eastern section RP	Common	Wide-ranging walked inspections of the Pyro Park area recording all species encountered.
1995	Gunninah Consultants	Australian Defence Industries St Marys Facility - Distribution of Endangered Flora, Pyro Park	*Pultenaea parviflora*	Eastern section RP	284 in 0.64ha of Section 3. Across all Pryo Park: approx range 3370 - 11080.	Two approaches. The first was to tag each individual specimen, however this approach was abandoned. The second approach was a transect-based survey of the specimens using the grid lines to be surveyed through the Pyro Park area. This involved botanists surveying transects and recording the densities of the specimens. Four transects (100m long, spaced 25m apart-later to 50m). Plants were surveys at specified survey points (10m diameter: 78.5m2 area) at 10m intervals along each transect, and the density of specimens was noted at a scale of 1-6 (1: 91-100, 2 = 50-90, 3=21-50, 4=5-20, 5=5-3, 6=2-1 plants per survey point).
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - Flora Survey Ropes Creek Area	*Pultenaea parviflora*	Ropes Creek	Infrequent in area B. Considerable numbers in	Detailed walked surveys throughout the Ropes Creek study area. Involved establishing a flora species inventory and searching for

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					cleared areas in area E (eastern portion). Patchily distributed in area E (northern portion). Few specimens along dirk track, and in greater numbers along main road.	and identifying plant species of conservation concern or interest.
1996	Gunninah Environmental Consultants	Australian Defence Industries St Marys - Vegetation Communities	*Pultenaea parviflora*	Unavailable		Quadrats (20m x 20m) were defined within each study area and were placed at 1ha intervals, except from those areas in which the community/floristic group varied within the range of 1ha. Quadrats were assessed and plant species recorded.
1997	Gunninah Environmental Consultants	Australian Defence Industries St Marys Facility - 'Northern Sector' Flora Survey	*Pultenaea parviflora*	Northern Sector RP		Walked surveys throughout the 'Northern Sector' establishing a flora species inventory and identifying plant species of conservation concern or interest. The study sites were

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
						surveyed on one day. Survey quadrats were 20m in diameter.
2003	ERM	St Marys Eastern Precinct Plan - Biodiversity Assessment	*Pultenaea parviflora*	Eastern Precinct	Population in study area = 112,183; development area = 29,966. High densities found in Regional Park (averaging up to 665 plants/ha in less fragmented areas), while lower densities found in the fragmented areas of the Regional Park and the development area (115 plants/ha and	In order to obtain data on the abundance of threatened plants within the SMDS, quadrat sampling for threatened plant species was undertaken. 45 survey locations were haphazardly marked on a map, 14 of these were in the study area. An additional 20m by 50m quadrat was also surveyed. The number of all threatened plant species within this quadrat. An additional 10 20m by 50m quadrats were surveyed. Quadrat sampling was supplemented by traversing the study area and noting the distribution of plants that were not included in quadrats.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					160 plants/ha respectively).	
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Pultenaea parviflora*	Eastern Precinct.	The population within the study area is estimated to be 112,183 plants. Of this, approximately 29,966 plants (~27% of the total population) are estimated to be in the proposed development area. High densities of this species are found in the less fragmented portions of the Regional Park	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					(averaging 665 plants/ha), while low densities are found in the fragmented portions of the Regional Park and proposed development area (115 and 160 plants/ha respectively).	
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Pultenaea parviflora*	Eastern Precinct	1371 per hectare (296 standard error). Area A - 1 plant/400 square metres. Area B - 160 plants/400 square metres. Area C - 32 specimens. Area D - 8	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
					specimens. Area E - 30 specimens. 14 specimens east of Area E.	
2005	Cumberland Ecology	St Marys Property - Eastern Precinct - Flora and Fauna Risk Assessment for the demolition of buildings, removal of existing roads and stockpiling material	*Pultenaea parviflora*	Eastern Precinct.	Stockpile 3 = 186, Stockpile 4 = 48, Stockpile 5 = 17, Stockpile 6 = 435 (part estimated), Stockpile 7 = 22, Stockpile 8 = 42, Stockpile 9 = 11. Total = 761	The entire area of each proposed stockpile location was inspected for threatened flora species by walking parallel transects across each area, and all individual plants of all maturities were counted. A variation in this methodology was required for Stockpile Number 6. Estimates of plant numbers were undertaken in this stockpile owing to the dense occurrences in certain sections.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Pultenaea parviflora*	North and South Dunheved Precincts. Recorded on site, along the eastern edge of the development area.	One individual plant	Targeted searches for threatened species.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2005	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment of Proposed Subdivision and Construction Works for a Village Centre.	*Pultenaea parviflora*	Eastern Precinct.	Less than 30 plants on subject site.	Inspected the subject site to assess the vegetation condition and identify areas where threatened flora occurred and estimated population numbers of these species.
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon threatened flora and fauna	*Pultenaea parviflora*	Fenceline between Eastern and Ropes Creek Precincts, and Regional Park		The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.
2005	Cumberland Ecology	Eastern Precinct, St Marys Property - Flora and Fauna Assessment for a Residential Subdivision within	*Pultenaea parviflora*	Eastern Precinct	In CRCIF: 25/ha (SE 11.16), estimated 225. In Remediated Areas: 290/ha (SE 133.21), estimated	Quadrats were placed to sample the vegetation communities present. Three 20 m x 20 m quadrats were randomly placed in woodland and three quadrats were placed in disturbed/open areas and traversed.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
		Lot 4 in DP107944 (in DA 04-1669)			4640. Abundance in each quadrat - Q1:2; Q2:1; Q3:3; Q4:4.	
2006	Cumberland Ecology	Flora and fauna assessment for future learning and community uses in the Eastern Precinct	*Pultenaea parviflora*	Eastern Precinct	Exotic grassland = 400, Woodland = 153. Total = 553.	Surveyed proposed Residue Lots 17, 18, 20, 21 of the future Learning and Community sites, for the presence of threatened shrub species. Plants were counted in this area.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for a Private School in the Eastern Precinct	*Pultenaea parviflora*	Eastern Precinct northern section.	Approximately 50 to be removed.	A threatened species search was made concurrently with the general flora survey.
2006	Cumberland Ecology	St Marys Project Site - Eastern Precinct - Flora and Fauna Assessment for Level 1 Park Earthworks in the Eastern Precinct.	*Pultenaea parviflora*	Eastern Precinct.	Approximately 900 on subject site.	A botanist surveyed Residue Lots 19, 20 and 21 and the surrounding Learning and Community sites, for the presence of threatened shrub species which are known to occur in large numbers in the Eastern Precinct and throughout the Regional Park

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2006	Cumberland Ecology	Ropes Creek Precinct - Biodiversity Assessment	*Pultenaea parviflora*	Ropes Creek Precinct.	Estimated that no more than 500 individuals	A targeted threatened flora survey was conducted within the precinct.
2007	Cumberland Ecology	Proposed Subdivision of Stage 2G Eastern Precinct SMDS - Flora and Fauna Assessment	*Pultenaea parviflora*	Eastern Precinct northern section.	Approximately 80 on subject site.	
2008	Cumberland Ecology	Eastern Precinct Development Application - Flora and Fauna Assessment	*Pultenaea parviflora*	Eastern Precinct northern section.	Occurs variably through the study area, with approximately 1,400 specimens estimated to occur within areas proposed for subdivision.	During the field survey an estimate made of the numbers of threatened flora recorded from the SMDS occurring within the subject site.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Pultenaea parviflora*	Located in grassland in centre of Western Precinct	single plant	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Flora species on the SMDS						
Year	**Author**	**Title**	**Scientific name**	**Location***	**Numbers**	**Method**
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Pultenaea parviflora/ Grevillea juniperina* ssp. *juniperina*	Located in Regional Park in an area surrounded by large earth mounds, adjacent to road	>100 individuals of both species present	Targeted survey for threatened species that were known to be present or considered a possibility to be present.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 20 : Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	*Scoteanax rueppellii*	Greater Broad-nosed Bat			Harp-type bat traps (approximately 2m x 2m), ranging from 0-3 nights of survey for 16 survey sites.
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	*Sericornis sagittatus*	Speckled Warbler	Site 10 (Woodland - vegetation community 2A). Site 15 (Woodland - vegetation community 2A)		Daytime searches for native animals were conducted in all vegetation communities. A record of all bird species sited was kept.
1991	Gunninah Consultants	Australian Defence Industries (ADI) site, St Marys - Fauna Survey	*Stagonopleura guttata*	Diamond Firetail	During investigation on SMDS, or incidental by staff.		Daytime searches for native animals were conducted in all vegetation communities. A record of all bird species sited was kept.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Meridolum corneovirens*	Cumberland Plain Land Snail	North and South Dunheved Precincts. Found in patches of Cumberland Plain Woodland in the	Thirteen individual shells were recorded.	Searches were made for live snails around the bases of trees within Cumberland Plain Woodland and within Sydney Coastal River Flat.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
					northern part of Dunheved Section.		The searches were conducted by two people for nearly two hours, giving 3.5 hours of search time. During this time, leaf litter, logs and other woodland floor debris were searched around the base of approximately 20 trees, including Grey Box (*Eucalyptus moluccana*).
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Mormopterus* sp	Unidentified freetail bat	Ropes Creek, Eastern Precinct.	1 Probable, 1 Possible	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Nyctophilus* species and/or *Myotis adversus*	Unidentified longeared bat; and/or southern large-footed myotis	Sewage works outflow, Dunheved Precinct.	43 Probable	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2005	Cumberland Ecology	St Marys North and South Dunheved Precincts Plan - Biodiversity Assessment	*Miniopterus shreibersii* and/or *Vespadelus regulus*	Common Bentwing Bat and/or Southern Forest Bat	Ropes Creek, Eastern Precinct and sewage works outflow, Dunheved Precinct.	6 Probable in Ropes Creek, Eastern Precinct. 7 Probable in Sewage works outflow, Dunheved Precinct.	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Mormopterus* sp.	Unidentified freetail bat	Ropes Creek, Eastern Precinct.	1 Probable, 1 Possible	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Nyctophilus* species and/or *Myotis adversus*	Unidentified longeared bat; and/or southern large-footed myotis	Sewage works outflow, Dunheved Precinct.	43 Probable	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Miniopterus shreibersii* and/or *Vespadelus regulus*	Common Bentwing Bat and/or Southern Forest Bat	Ropes Creek, Eastern Precinct and sewage works outflow, Dunheved Precinct.	6 Probable in Ropes Creek, Eastern Precinct. 7 Probable in Sewage works outflow, Dunheved Precinct.	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek, Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	St Marys Eastern Precinct - Flora and Fauna Assessment for Proposed Lot 2 and Lot 5 Development Applications	*Meridolum corneovirens*	Cumberland Plain Land Snail			
2005	Cumberland Ecology	St Marys Property - Eastern Sector Blacktown LGA - Eight part test assessment of the impacts of long term macrofauna fencing upon	*Meridolum corneovirens*	Cumberland Plain Land Snail	Along fence.	3 shells under 1 tree	The survey was based on information recorded along a series of transects along the proposed route of the macrofauna fence.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
		threatened flora and fauna					
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Mormopterus* sp.	Unidentified freetail bat	Ropes Creek, Eastern Precinct.	1 Probable, 1 Possible	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek,

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Nyctophilus* species and/or *Myotis adversus*	Unidentified longeared bat; and/or southern large-footed myotis	Sewage works outflow, Dunheved Precinct.	43 Probable	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek,

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Miniopterus shreibersii* and/or *Vespadelus regulus*	Common Bentwing Bat and/or Southern Forest Bat	Ropes Creek, Eastern Precinct and sewage works outflow, Dunheved Precinct.	6 Probable in Ropes Creek, Eastern Precinct. 7 Probable in Sewage works outflow, Dunheved Precinct.	Surveys were made for microchiropteran bats using ZCAIM bat detector units. Two units were set each night for four nights, for 12 hours of recording time each night between the 19th and 23rd of April 2004. The two units were placed at different locations and sampled each of the major forest types on the subject site as follows: Sydney Coastal River Flat Forest along St Marys sewage outflow, South Dunheved Precincts – 4 ZCAIM nights; and Sydney Coastal River Flat Forest along Ropes Creek,

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
							Eastern Precinct – 4 ZCAIM nights.
2004	Cumberland Ecology	Stage 1 Subdivision, St Marys Eastern Precinct: Part Lot 2 DP 1038166 - Species Impact Statement	*Meridolum corneovirens*	Cumberland Plain Land Snail	See figure in report	3 shells	Searches were made for live snails and shells around the bases of trees within Cumberland Plain Woodland and within Sydney Coastal River Flat Forest.
2001	ERM	???	*Miniopterus orianae* (formerly M. *schreibersii) oceanensis)*	Eastern Bentwing-bat	Western Precinct (Regional Park - riparian habitats; Western Village - dam/riparian habitats)	RP riparian habitats - 9 calls. WV dam/riparian habitats - 6 calls	Anabat surveys.
2001	ERM	???	*Mormopterus norfolkensis*	Eastern Freetail-bat	Western Precinct (Regional Park - riparian habitats and woodland/forest habitats; Western Village - dam/riparian habitats and grassland/woodland habitats)	RP riparian habitats - 2 calls, woodland/forest habitats - 1 call. WV dam/riparian habitats - 13 calls, grassland/woodland habitats 12 calls.	Anabat surveys.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Detailed Methods and Records of Survey for Threatened Fauna species on the SMDS							
Year	**Author**	**Title**	**Scientific name**	**Common name**	**Location**	**Numbers**	**Method**
2001	ERM	???	*Scoteanax rueppellii*	Greater Broad-nosed Bat	Western Precinct (Western Village - dam/riparian habitats)	WV dam/riparian habitats - 2 calls.	Anabat surveys.
2011	Cumberland Ecology	St Marys Western Precinct Species Impact Statement	*Meridolum corneovirens*	Cumberland Plain Land Snail	3 sites within the Western Precinct, 9 sites within the Regional Park.	17 live snails and 7 snail shells within Western Precinct, 60 live snails and 69 snail shells within the Regional Park	Surveys were conducted at 5 locations within the Western Precinct, and 10 locations within the Regional Park. 20 trees per site with suitable snail habitat (fallen bark around base) were searched for 5 minutes per tree, or until a live snail or shell was detected.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

APPENDIX C :
Flora and Fauna Species Lists

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 21 : Flora species recorded in the Study Area

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Acacia falcata	+	-	-	-
Acacia floribunda	+	-	-	-
Acacia implexa	+	-	-	-
Acacia parramattensis	+	+	-	+
Acer negundo	+	-	-	-
Ajuga australis	-	+	+	+
Allocasuarina littoralis	+	-	-	-
Alternanthera denticulata	-	-	-	+
Alternanthera nana	+	-	+	+
Alternanthera nodiflora	+	-	+	+
Amyema miquelii	+	+	-	+
Anagallis arvensis	+	+	-	+
Angophora floribunda	+	+	-	+
Apium prostratum	+	-	-	-
Araujia sericifera	+	+	-	+
Aristida ramosa	+	+	-	-
Aristida sp.	+	-	-	-
Aristida vagans	+	+	+	+
Aristida warburgii	-	-	-	+
Arthropodium milleflorum	-	+	+	+
Arthropodium sp.	+	+	-	+
Asparagus aethiopicus	-	+	-	-
Asparagus asparagoides	+	+	-	+
Asperula conferta	+	-	+	+
Aster subulatus	+	-	-	+
Astroloma humifusum	+	-	-	+
Atriplex semibaccata	+	-	-	-
Austrodanthonia bipartita	+	-	-	-
Austrodanthonia fulva	+	-	-	-
Austrodanthonia sp.	+	-	-	+
Axonopus fissifolius	+	+	+	+
Bidens pilosa	+	+	+	+

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Bidens subalternans	-	-	-	+
Bossiaea buxifolia	-	+	-	+
Bossiaea prostrata	+	-	-	-
Bothriochloa decipiens/macra	+	+	+	+
Brachychiton populneus	+	-	-	-
Brassica sp.	+	-	-	+
Breynia oblongifolia	+	-	-	-
Briza minor	+	-	-	-
Briza subaristata	+	+	-	-
Brunoniella australis	+	+	+	+
Bursaria spinosa ssp. spinosa	+	+	-	+
Calotis cuneifolia	+	+	+	+
Calotis lappulacea	+	-	+	+
Carex appressa	+	+	-	-
Cassinia arcuata	-	+	-	-
Casuarina glauca	+	+	-	-
Centaurium erythraea	+	-	-	-
Centaurium sp.	-	-	-	+
Centaurium tenuiflorum	+	-	-	-
Centella asiatica	+	+	+	+
Cerastium glomeratum	+	-	-	-
Cestrum parqui	+	-	-	+
Chamaesyce drummondii	+	+	-	-
Chamaesyce sp.	-	-	+	+
Cheilanthes sieberi	+	+	+	+
Chloris gayana	+	-	-	-
Chloris truncata	-	-	+	-
Chloris ventricosa	+	+	+	+
Chorizema parviflorum	-	-	-	+
Cinnamomum camphora	-	+	-	-
Cirsium vulgare	+	+	+	+
Clematis glycinoides	+	+	-	+
Commelina cyanea	-	-	+	+

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Conyza bonariensis	+	+	+	+
Croton sp	+	-	-	-
Cupressus sp.	-	+	-	-
Cyclospermum leptophyllum	+	-	-	-
Cymbonotus lawsonianus	+	+	+	+
Cymbopogon refractus	+	+	+	+
Cynodon dactylon	+	+	-	+
Cyperus brevifolius	-	-	-	+
Cyperus eragrostis	+	+	-	+
Cyperus gracilis	-	+	+	-
Cyperus sp.	+	-	-	-
Datura ferox	+	-	-	-
Daviesia ulicifolia	+	-	-	+
Desmodium varians	+	-	+	+
Dianella longifolia	+	-	-	+
Dichanthium sericeum	-	-	+	+
Dichelachne micrantha	+	+	+	-
Dichondra repens	+	+	+	+
Dichopogon fimbriatus	-	+	-	-
Digitaria sp.	+	-	-	-
Dillwynia sieberi	+	+	+	+
Dodonaea viscosa subsp. cuneata	+	-	-	-
Doodia caudata var. caudata	-	-	-	+
Drosera sp.	+	-	-	-
Echinopogon caespitosus	+	+	+	+
Echinopogon ovatus	+	-	-	+
Echium plantagineum	+	-	-	-
Eclipta platyglossa	+	+	-	-
Einadia hastata	+	-	-	-
Einadia polygonoides	-	+	+	+
Einadia trigonos	+	-	-	-
Eleocharis sphacelata	-	+	-	-

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Enchylaena tomentosa	+	-	-	-
Entolasia stricta	+	-	-	-
Epaltes australis	-	-	-	+
Eragrostis brownii	+	+	+	+
Eragrostis curvula	+	+	-	+
Eragrostis leptostachya	+	-	+	+
Eremophila deblis	+	+	+	+
Eriochloa pseudoacrotricha	-	-	+	+
Eucalyptus amplifolia	+	-	-	+
Eucalyptus crebra	+	-	-	+
Eucalyptus eugenioides	+	-	-	-
Eucalyptus fibrosa	+	-	+	+
Eucalyptus moloccana	+	+	+	+
Eucalyptus tereticornis	+	+	+	+
Euchiton sphaericus	+	-	+	-
Facelis retusa	+	-	-	-
Fimbristylis dichotoma	+	+	+	+
Gamochaeta purpurea	-	+	-	-
Geranium solanderi	+	-	+	-
Geranium sp.	+	-	-	-
Glochidion ferdinandi	+	-	-	-
Glossocardia bidens	-	-	+	+
Glycine clandestina	-	-	-	+
Glycine microphylla	+	-	+	+
Glycine tabacina	+	+	+	+
Gnaphalium sp.	+	+	+	+
Gomphocarpus fruticosus	+	-	-	+
Goodenia bellidifolia	+	+	-	+
Goodenia hederacea	+	+	+	+
Grevillea juniperina ssp juniperina	+	+	-	-
Grevillea robusta	+	-	-	-
Hakea sericea	+	-	-	-

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Hardenbergia violacea	-	+	-	+
Heliotropium amplexicaule	+	-	+	+
Hibbertia diffusa	+	+	-	+
Hibbertia obtusifolia	+	-	-	-
Hydrocotyle pedicellosa	+	-	-	-
Hypericum gramineum	+	-	+	+
Hypericum perforatum	+	+	-	+
Hypochaeris microcephala var. albiflora	+	+	-	+
Hypochaeris radicata	+	+	+	+
Imperata cylindrica	+	-	-	-
Juncus acutus	+	-	-	-
Juncus australis	+	-	-	-
Juncus cognatus	+	+	-	-
Juncus effusus	+	-	-	-
Juncus mollis	+	-	-	-
Juncus polyanthemus	+	-	-	-
Juncus sp.	+	+	-	+
Juncus usitatus	+	+	-	+
Lagenophora sp.	-	-	-	+
Lantana camara	+	+	-	-
Laxmannia gracilis	+	-	+	-
Ligustrum lucidum	+	+	-	+
Ligustrum sinense	+	+	-	+
Linum marginale	+	-	-	-
Lissanthe strigosa	+	-	-	-
Lomandra filiformis ssp. filiformis	+	+	+	+
Lomandra longifolia	-	-	-	+
Lomandra multiflora	+	-	-	-
Lonicera japonica	-	+	-	-
Lotus australis	+	-	-	-
Lotus sp.	+	-	-	-

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Lotus suaveolens	+	+	-	-
Ludwigia peploides subsp. montevidensis	+	-	-	-
Lycium ferocissimum	+	+	-	-
Lythrum hyssopifolia	-	-	-	+
Maclura pomifera	-	+	-	+
Marsdenia rostrata	+	-	-	-
Marsilea drummondii	+	-	-	-
Medicago polymorpha	-	-	+	-
Melaleuca styphelioides	-	-	+	-
Melia azedarach	+	+	-	+
Melinis repens	+	-	-	-
Mentha satureoides	-	-	+	+
Microlaena stipoides	+	+	+	+
Modiola caroliniana	+	-	+	+
Nothoscordum gracile	+	-	-	-
Ochna serrulata	-	+	-	-
Olea europaea ssp. cuspidata	+	+	-	+
Opercularia diphylla	+	+	+	+
Oplismenus aemulus	+	+	-	+
Opuntia aurantiaca	-	-	-	+
Opuntia stricta	+	-	-	-
Oxalis exilis	-	-	-	+
Oxalis perennans	+	-	+	+
Ozothamnus diosmifolius	+	+	-	+
Paspalidium distans	+	+	+	+
Paspalum dilatatum	+	+	+	-
Passiflora herbertiana	+	-	-	-
Pavonia hastata	+	-	-	-
Pennisetum clandestinum	+	-	-	-
Persicaria decipiens	+	+	-	-
Persicaria hydropiper	+	-	-	-
Persicaria sp.	-	-	-	+

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Phyllanthus virgatus	-	-	+	+
Pimelea curviflora var. Sericea	-	+	-	-
Pimelea curviflora var. subglabrata	-	-	+	-
Pimelea sp.	-	-	-	+
Pistacia chinensis	-	+	-	-
Plantago debilis	+	+	+	+
Plantago gaudichaudii	-	-	+	-
Plantago lanceolata	+	+	-	-
Poa labillardieri	+	-	-	-
Pomax umbellata	+	+	-	+
Poranthera microphylla	+	+	-	-
Portulaca oleracea	-	-	-	+
Pratia purpurascens	+	+	+	+
Prunus sp.	+	-	-	-
Pterostylis bicolor	-	+	-	-
Ranunculus inundatus	+	-	-	-
Ranunculus lappaceus	+	+	-	+
Richardia stellaria	+	+	+	+
Romulea rosea	+	-	-	-
Rorippa nasturtium-aquatica	+	+	-	-
Rosa rubiginosa	+	-	-	-
Rubus fruticosus	+	-	-	-
Rumex brownii	+	-	-	+
Rumex crispus	+	+	-	-
Scleria mackaviensis	-	+	-	-
Senecio madagascariensis	+	+	+	+
Senecio pterophorus	+	-	-	-
Senecio quadridentatus	+	-	-	-
Setaria parviflora	+	+	+	+
Sida corrugata	-	+	-	+
Sida rhombifolia	+	+	+	+
Sigesbeckia orientalis	-	-	+	-

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Solanum nigrum	+	-	-	-
Solanum prinophyllum	+	+	+	+
Solanum pseudocapsicum	+	+	+	+
Solanum seaforthianum	+	+	-	-
Solanum sisymbriifolium	+	-	-	-
Solenogyne bellioides	+	+	+	+
Sonchus oleraceus	+	+	-	+
Spergularia sp.	+	-	+	+
Sporobolus creber	+	+	+	+
Sporobolus elongatus	+	+	-	+
Sporobolus sp.	+	-	-	-
Stackhousia viminea	+	+	+	-
Stellaria media	+	-	-	-
Tagetes minuta	+	-	-	+
Taraxacum officianale	+	-	-	-
Themeda australis	+	-	+	-
Tradescantia fluminensis	-	-	-	+
Trema tomentosa var. aspera	+	-	-	+
Tricoryne simplex	-	+	-	-
Trifolium dubium	-	-	+	+
Trifolium repens	+	-	-	-
Trifolium sp.	+	-	-	-
Typha orientalis	+	+	-	-
Verbena bonariensis	+	-	-	-
Verbena officinalis	+	+	+	+
Verbena rigida	+	-	-	-
Verbena sp.	+	-	-	-
Vernonia cinerea	-	-	+	+
Veronica calycina	-	-	+	-
Vicia sativa	+	-	-	-
Viola betonicifolia	+	-	-	-
Vittadinia sp.	-	-	+	+
Wahlenbergia communis	-	-	+	+

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora species recorded in the Study Area				
Species Name	**Central Precinct area**	**Drainage Basins**	**Regional Park (Area B)**	**Regional Park (Area C)**
Wahlenbergia gracilis	+	-	+	+
Wahlenbergia sp	+	-	-	-
Wurmbea dioica	+	+	-	-
Xanthium sp.	-	-	-	+
Zornia dictiocarpa	-	-	+	+

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 22 : Flora Species Recorded on the Subject Site

Flora Species Recorded on the Subject Site										
Family	Exotic	Scientific Name	Common Name	NSW Status	Comm. Status	High Threat Weed	Plot 1		Plot 2	
							Cover	Abundance	Cover	Abundance
Apocynaceae	*	Araujia sericifera	Moth Vine			YES			0.1	3
Poaceae		Aristida vagans	Threeawn Speargrass			#N/A	30	1000	15	500
Rubiaceae		Asperula conferta	Common Woodruff			#N/A	0.1	10		
Acanthaceae		Brunoniella australis	Blue Trumpet			#N/A	2	200	1	100
Pittosporaceae		Bursaria spinosa	Native Blackthorn			#N/A	5	15	0.5	5
Anthericaceae		Caesia parviflora	Pale Grass-lily			#N/A	0.1	5		
Cyperaceae		Carex inversa	Knob Sedge			#N/A	0.1	20	0.2	35
Pteridaceae		Cheilanthes distans	Bristly Cloak Fern			#N/A	0.1	30	0.2	100
Pteridaceae		Cheilanthes sieberi subsp. sieberi	Rock Fern			#N/A	0.1	10		
Poaceae		Chloris ventricosa	Tall Chloris			#N/A	0.2	20	0.5	50
Fabaceae (Faboideae)		Chorizema parviflorum	Eastern Flame Pea			#N/A	0.1	2	0.1	15
Poaceae		Cymbopogon refractus	Barbed Wire Grass			#N/A	10	500	1	50
Poaceae		Cynodon dactylon	Common Couch			#N/A	0.2	25		
Cyperaceae		Cyperus gracilis	Slender Flat-sedge			#N/A	0.1	10	0.2	35
Fabaceae (Faboideae)		Daviesia ulicifolia	Gorse Bitter Pea			#N/A			0.1	1
Convolvulaceae		Dichondra repens	Kidney Weed			#N/A	1	100	1	100
Sapindaceae		Dodonaea viscosa subsp. cuneata	Wedge-leaf Hop-bush			#N/A	0.1	1		
Poaceae		Echinopogon caespitosus	Bushy Hedgehog-grass			#N/A			0.2	25
Poaceae	*	Eragrostis curvula	African Lovegrass			YES	0.2	5	0.2	15
Myrtaceae		Eucalyptus moluccana	Grey Box			#N/A	30	60	25	55
Myrtaceae		Eucalyptus tereticornis	Forest Red Gum			#N/A	10	17	1	3
Euphorbiaceae	*	Euphorbia prostrata				#N/A	0.1	1		
Asteraceae		Glossocardia bidens	Cobbler's Tack			#N/A	0.1	5		
Fabaceae (Faboideae)		Glycine clandestina	Twining glycine			#N/A			0.1	5
Fabaceae (Faboideae)		Glycine microphylla	Small-leaf Glycine			#N/A	0.1	5	0.2	35
Fabaceae (Faboideae)		Glycine tabacina	Variable Glycine			#N/A	0.5	50	0.2	35
Goodeniaceae		Goodenia hederacea	Ivy Goodenia			#N/A	0.1	20	0.1	20
Asteraceae	*	Hypochaeris albiflora				#N/A	0.1	5		

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Flora Species Recorded on the Subject Site										
Family	Exotic	Scientific Name	Common Name	NSW Status	Comm. Status	High Threat Weed	Plot 1		Plot 2	
							Cover	Abundance	Cover	Abundance
Anthericaceae		Laxmannia gracilis	Slender Wire Lily			#N/A	0.1	5		
Campanulaceae		Lobelia purpurascens	whiteroot			#N/A			0.1	20
Poaceae	*	Lolium perenne	Perennial Ryegrass			#N/A	0.5	50		
Lomandraceae		Lomandra filiformis subsp. filiformis				#N/A	0.5	50	0.5	20
Lomandraceae		Lomandra multiflora subsp. multiflora	Many-flowered Mat-rush			#N/A	1	10	0.1	10
Poaceae		Microlaena stipoides	Weeping Grass			#N/A	1	100	1	100
Rubiaceae		Opercularia diphylla	Stinkweed			#N/A	0.1	10	0.1	5
Oxalidaceae		Oxalis perennans				#N/A			0.1	10
Asteraceae		Ozothamnus diosmifolius	White Dogwood			#N/A	1	6		
Poaceae		Paspalidium distans				#N/A	0.1	10		
Phyllanthaceae		Phyllanthus virgatus	Wiry Spurge			#N/A	0.1	2	0.1	15
Plantaginaceae		Plantago debilis	Shade Plantain			#N/A			0.1	2
Asteraceae	*	Senecio madagascariensis	Fireweed			#N/A	0.1	3	0.1	5
Malvaceae	*	Sida rhombifolia	Paddy's Lucerne			#N/A	0.5	25	0.2	20
Solanaceae	*	Solanum nigrum	Black-berry Nightshade			#N/A			0.1	5
Solanaceae		Solanum prinophyllum	Forest Nightshade			#N/A			0.1	2
Asteraceae		Vittadinia muelleri	A Fuzzweed			#N/A	0.1	1		

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 23 : Fauna species recorded within the Study Area

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Acanthizidae	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	P	X		X	X				
Acanthizidae	Acanthiza lineata	Striated Thornbill	P	X		X					
Acanthizidae	Acanthiza nana	Yellow Thornbill	P	X	X	X	X		X	X	X
Acanthizidae	Acanthiza pusilla	Brown Thornbill	P	X	X					X	
Acanthizidae	Acanthiza reguloides	Buff-rumped Thornbill	P			X					
Acanthizidae	Gerygone olivacea	White-throated Gerygone	P				X				
Acanthizidae	Pyrrholaemus saggitatus	Speckled Warbler	V	X							
Acanthizidae	Sericornis frontalis	White-browed Scrubwren	P			X					
Acanthizidae	Smicrornis brevirostris	Weebill	P			X	X		X	X	X
Accipitridae	Accipiter cirrocephalus	Collared Sparrowhawk	P	X		X					
Accipitridae	Accipiter fasciatus	Brown Goshawk	P			X					X
Accipitridae	Accipiter novaehollandiae	Grey Goshawk	P					X			
Accipitridae	Aquila audax	Wedge-tailed Eagle	P		X		X				
Accipitridae	Aviceda subcristata	Pacific Baza	P							X	
Accipitridae	Elanus axillaris	Black-shouldered Kite	P	X	X						
Accipitridae	Haliastur sphenurus	Whistling Kite	P	X							
Aegothelidae	Aegotheles cristatus	Australian Owlet-nightjar	P	X							
Agamidae	Pogona barbata	Bearded Dragon	P	X	X						
Alcedinidae	Ceyx azureus	Azure Kingfisher	P	X							
Alcedinidae	Dacelo novaeguineae	Laughing Kookaburra	P	X	X	X	X			X	
Anatidae	Anas castanea	Chestnut Teal	P			X					
Anatidae	Anas gracilis	Grey Teal	P			X	X				
Anatidae	Anas superciliosa	Pacific Black Duck	P	X		X	X				
Anatidae	Aythya australis	Hardhead	P				X				
Anatidae	Biziura lobata	Musk Duck	P	X							
Anatidae	Chenonetta jubata	Australian Wood Duck	P	X		X	X				
Anatidae	Cygnus atratus	Black Swan	P	X							
Ardeidae	Ardea alba	Great Egret	P	X							
Ardeidae	Ardea intermedia	Intermediate Egret	P	X							

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Ardeidae	Bubulcus ibis	Cattle Egret	P	X							
Ardeidae	Egretta novaehollandiae	White-faced Heron	P	X		X	X				
Artamidae	Artamus cyanopterus	Dusky Woodswallow	P			X					X
Artamidae	Cracticus torquatus	Grey Butcherbird	P	X	X	X			X	X	X
Artamidae	Gymnorhina tibicen	Australian Magpie	P	X	X	X	X	X		X	X
Artamidae	Strepera graculina	Pied Currawong	P	X	X	X	X				
Cacatuidae	Cacatua galerita	Sulphur-crested Cockatoo	P	X	X	X	X				
Cacatuidae	Cacatua sanguinea	Little Corella	P	X		X					
Cacatuidae	Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	P	X	X	X					
Cacatuidae	Eolophus roseicapillus	Galah	P	X	X	X	X				
Camaenidae	Meridolum corneovirens	Cumberland Plain Land Snail	E1			X			X	X	X
Campephagidae	Coracina novaehollandiae	Black-faced Cuckoo-shrike	P	X	X	X	X		X		
Campephagidae	Lalage tricolor	White-winged Triller	P				X				
Canidae	Canis lupus familiaris*	Dog	U		X				X		
Canidae	Vulpes vulpes*	Fox	U	X	X				X		
Casuariidae	Dromaius novaehollandiae	Emu	P	X	X	X	X	X		X	
Charadriidae	Elseyornis melanops	Black-fronted Dotterel	P	X							
Charadriidae	Vanellus miles	Masked Lapwing	P	X	X	X		X			
Climacteridae	Cormobates leucophaea	White-throated Treecreeper	P			X					
Columbidae	Columba livia*	Rock Dove	U	X	X						
Columbidae	Geopelia placida	Peaceful Dove	P	X							
Columbidae	Ocyphaps lophotes	Crested Pigeon	P	X		X	X				
Columbidae	Phaps chalcoptera	Common Bronzewing	P			X	X			X	
Columbidae	Streptopelia chinensis*	Spotted Turtle-Dove	U	X	X	X	X	X		X	
Coraciidae	Eurystomus orientalis	Dollarbird	P	X							
Corcoracidae	Corcorax melanorhamphos	White-winged Chough	P	X	X	X	X			X	
Corcoracidae	Struthidea cinerea	Apostlebird	P				X				
Corvidae	Corvus coronoides	Australian Raven	P	X	X	X	X	X	X	X	X
Cuculidae	Cacomantis flabelliformis	Fan-tailed Cuckoo	P	X	X						
Cuculidae	Chalcites lucidus	Shining Bronze-Cuckoo	P	X		X					

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Cuculidae	Cuculus pallidus	Pallid Cuckoo	P				X				
Dicaeidae	Dicaeum hirundinaceum	Mistletoebird	P			X					
Dicruridae	Grallina cyanoleuca	Magpie-lark	P	X	X	X	X		X	X	X
Dicruridae	Myiagra inquieta	Restless Flycatcher	P			X					
Dicruridae	Rhipidura albiscapa	Grey Fantail	P	X	X	X	X		X	X	X
Dicruridae	Rhipidura leucophrys	Willie Wagtail	P	X	X	X	X		X		X
Dicruridae	Rhipidura rufifrons	Rufous Fantail	P	X							
Elapidae	Pseudechis porphyriacus	Red-bellied Black Snake	P	X	X				X		
Elapidae	Pseudonaja textilis	Eastern Brown Snake	P	X	X						
Estrildidae	Lonchura castaneothorax	Chestnut-breasted Mannikin	P	X							
Estrildidae	Neochmia temporalis	Red-browed Finch	P	X	X	X	X				
Estrildidae	Stagonopleura guttata	Diamond Firetail	V	X							
Estrildidae	Taeniopygia bichenovii	Double-barred Finch	P	X		X	X		X		
Estrildidae	Taeniopygia guttata	Zebra Finch	P	X							
Falconidae	Falco cenchroides	Nankeen Kestrel	P	X							
Falconidae	Falco longipennis	Australian Hobby	P			X					
Felidae	Felis catus*	Cat	U	X		X					
Hirundinidae	Hirundo neoxena	Welcome Swallow	P	X		X	X		X		X
Hirundinidae	Petrochelidon ariel	Fairy Martin	P	X							
Hirundinidae	Petrochelidon nigricans	Tree Martin	P	X							
Hylidae	Litoria dentata	Bleating Tree Frog	P			X					
Hylidae	Litoria peronii	Peron's Tree Frog	P		X						
Hylidae	Litoria verreauxii	Verreaux's Frog	P		X						
Leporidae	Lepus capensis*	Brown Hare	U	X	X	X					
Leporidae	Oryctolagus cuniculus*	Rabbit	U	X	X	X			X		
Macropodidae	Macropus giganteus	Eastern Grey Kangaroo	P	X	X	X		X		X	X
Macropodidae	Macropus robustus	Common Wallaroo	P								X
Macropodidae	Macropus rufus	Red Kangaroo	P	X	X	X					
Maluridae	Malurus cyaneus	Superb Fairy-wren	P	X	X	X	X		X	X	X
Meliphagidae	Acanthorhynchus tenuirostris	Eastern Spinebill	P	X	X	X					

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Meliphagidae	Anthochaera carunculata	Red Wattlebird	P			X	X				
Meliphagidae	Anthochaera chrysoptera	Little Wattlebird	P		X						
Meliphagidae	Lichenostomus chrysops	Yellow-faced Honeyeater	P	X	X	X				X	X
Meliphagidae	Lichenostomus penicillatus	White-plumed Honeyeater	P	X		X					
Meliphagidae	Manorina melanocephala	Noisy Miner	P	X	X	X	X	X	X	X	
Meliphagidae	Melithreptus brevirostris	Brown-headed Honeyeater	P			X	X				
Meliphagidae	Melithreptus lunatus	White-naped Honeyeater	P	X		X					
Meliphagidae	Myzomela sanguinolenta	Scarlet Honeyeater	P	X		X					
Meliphagidae	Philemon corniculatus	Noisy Friarbird	P	X		X	X				
Molossidae	Mormopterus ridei (formerly "Species 2")	Eastern Freetail Bat	P			X					
Molossidae	Mormopterus norfolkensis	East-coast Freetail-bat	V		X						
Molossidae	Mormopterus sp.?	A Freetail-bat	P		X						
Molossidae	Tadarida australis	White-striped Freetail-bat	P		X						
Motacillidae	Anthus australis	Australian Pipit	P	X							
Muridae	Mus musculus*	House Mouse	U	X							
Muridae	Rattus rattus*	Black Rat	U	X							
Myobatrachidae	Crinia signifera	Common Eastern Froglet	P		X	X			X		X
Myobatrachidae	Limnodynastes ornatus	Ornate Burrowing Frog	P	X							
Myobatrachidae	Limnodynastes peronii	Brown-striped Frog	P			X					
Myobatrachidae	Limnodynastes tasmaniensis	Spotted Grass Frog	P			X					
Neosittidae	Daphoenositta chrysoptera	Varied Sittella	V	X	X	X					
Oriolidae	Oriolus sagittatus	Olive-backed Oriole	P	X		X					
Pachycephalidae	Colluricincla harmonica	Grey Shrike-thrush	P	X	X	X				X	
Pachycephalidae	Falcunculus frontatus	Eastern Shrike-tit	P	X	X	X					
Pachycephalidae	Monarcha melanopsis	Black-faced Monarch	P	X							
Pachycephalidae	Pachycephala pectoralis	Golden Whistler	P	X	X	X	X		X	X	X
Pachycephalidae	Pachycephala rufiventris	Rufous Whistler	P				X				
Pardalotidae	Pardalotus punctatus	Spotted Pardalote	P	X	X	X	X		X		
Pardalotidae	Pardalotus striatus	Striated Pardalote	P			X	X				
Petauridae	Petaurus breviceps	Sugar Glider	P	X							

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Petroicidae	Eopsaltria australis	Eastern Yellow Robin	P	X	X	X					
Petroicidae	Melanodryas cucullata	Hooded Robin	V		X	X	X				
Petroicidae	Microeca fascinans	Jacky Winter	P			X					X
Petroicidae	Petroica rosea	Rose Robin	P	X		X				X	X
Phalacrocoracidae	Phalacrocorax melanoleucos	Little Pied Cormorant	P	X		X	X				
Phalangeridae	Trichosurus vulpecula	Common Brushtail Possum	P	X		X		X			
Phasianidae	Coturnix ypsilophora	Brown Quail	P	X							
Podargidae	Podargus strigoides	Tawny Frogmouth	P	X							
Podicipedidae	Tachybaptus novaehollandiae	Australasian Grebe	P	X		X	X				
Pseudocheiridae	Pseudocheirus peregrinus	Common Ringtail Possum	P	X	X						
Psittacidae	Glossopsitta concinna	Musk Lorikeet	P							X	
Psittacidae	Platycercus adscitus eximius	Eastern Rosella	P	X	X	X	X	X		X	
Psittacidae	Platycercus elegans	Crimson Rosella	P	X	X	X					
Psittacidae	Psephotus haematonotus	Red-rumped Parrot	P	X		X	X				
Psittacidae	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	P	X							
Psittacidae	Trichoglossus haematodus	Rainbow Lorikeet	P	X		X	X	X			
Ptilonorhynchidae	Ptilonorhynchus violaceus	Satin Bowerbird	P				X				
Pycnonotidae	Pycnonotus jocosus*	Red-whiskered Bulbul	U	X		X					
Rallidae	Fulica atra	Eurasian Coot	P	X		X	X				
Rallidae	Gallinula tenebrosa	Dusky Moorhen	P	X		X	X				
Rallidae	Porphyrio porphyrio	Purple Swamphen	P	X		X	X				
Scincidae	Lampropholis guichenoti	Pale-flecked Garden Sunskink	P	X	X						
Scincidae	Tiliqua scincoides	Eastern Blue-tongue	P	X					X		
Scolopacidae	Gallinago hardwickii	Latham's Snipe	P				X				
Strigidae	Ninox boobook	Southern Boobook	P	X							
Sturnidae	Acridotheres tristis*	Common Myna	U	X		X	X	X			
Sturnidae	Sturnus vulgaris*	Common Starling	U	X		X	X				
Tachyglossidae	Tachyglossus aculeatus	Short-beaked Echidna	P	X							
Threskiornithidae	Platalea flavipes	Yellow-billed Spoonbill	P	X		X					
Threskiornithidae	Platalea regia	Royal Spoonbill	P	X							

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Fauna species recorded within the Study Area											
Family	**Scientific Name**	**Common Name**	**Legal Status**	**Gunninah 1991**	**ERM 2003**	**CE 2004-2006**	**CE 2007-2008**	**CE 2009**	**Cumberland Ecology 2011**		
									Subject Land	Study Area - Regrowth CPW	Study Area - Mature CPW
Threskiornithidae	Threskiornis spinicollis	Straw-necked Ibis	P	X							
Vespertilionidae	Chalinolobus gouldii	Gould's Wattled Bat	P		X	X		X			
Vespertilionidae	Chalinolobus morio	Chocolate Wattled Bat	P	X	X						
Vespertilionidae	Miniopterus orianae (formerly schreibersii) oceanensis	Eastern Bentwing-bat	V	X	X	X		X			
Vespertilionidae	Myotis macropus	Large-footed Myotis	V			X					
Vespertilionidae	Nyctophilus geoffroyi	Lesser Long-eared Bat	P	X	X						
Vespertilionidae	Nyctophilus sp.	long-eared bat	P		X	X					
Vespertilionidae	Scoteanax rueppellii	Greater Broad-nosed Bat	V	X	X						
Vespertilionidae	Scotorepens orion	Eastern Broad-nosed Bat	P		X						
Vespertilionidae	Vespadelus darlingtoni	Large Forest Bat	P		X						
Vespertilionidae	Vespadelus regulus	Southern Forest Bat	P		X	X					
Vespertilionidae	Vespadelus vulturnus	Little Forest Bat	P	X	X						
Zosteropidae	Zosterops lateralis	Silvereye	P	X	X	X			X		

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

APPENDIX D :
Flora and Fauna Data Analysis

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 24 : Snail survey records for the Study Area - CE 2011

	Area A – Regenerating CPW- subject land					Area B - Regenerating CPW- Regional Park					Area C-Mature CPW- Regional Park				
	A-SQ1	A-SQ2	A-SQ3	SQ4	SQ5	B-SQ6	B-SQ7	B-SQ8	B-SQ9	B-SQ10	C-SQ11	C-SQ12	C-SQ13	C-SQ14	C-SQ15
Total trees	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Live snails	8	8	0	1	0	4	5	3	0	10	9	11	6	6	6
Snail Shells	2	4	0	1	0	1	9	4	8	4	10	9	8	8	8
Total Snails	10	12	0	2	0	5	14	7	8	14	19	20	14	14	14
Ave for Area	4.8					9.6					16.2				
St Dev	5.76194					4.15933					3.03315				
St Err	2.57682					1.86011					1.35647				

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 25 : Habitat Assessment results in the Study Area

Habitat Assessment results in the Study Area																
	Habitat Features	Area A-Regenerating CPW - study area					Area B - Regenerating CPW- Regional Park					Area C - Mature CPW - Regional Park				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15
Projective Cover (total % cover = 100%)	Vegetation	95	92	80	85	20	95	83	85	80	70	70	40	80	65	70
	Logs	0	0	1	0	1	1	2	0	5	2	1	5	2	0	1
	Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Litter	1	5	9	12	55	2	4	10	5	15	15	25	10	15	12
	Soil	2	1	0	0	5	0	4	0	3	3	2	10	0	5	2
	Bark	2	2	10	3	19	2	7	5	7	10	12	20	8	15	15
Hollows	Small	0	4	3	2	1	1	5	3	2	2	1	3	3	2	3
	Medium	1	1	0	0	0	0	1	0	1	1	0	0	1	0	0
	Large	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Main Tree Species	*E.molucanna*	X	X	X	X		X		X	X	X	X	X	X	X	X
	E. teretecornis		X			X		X	X	X						
	E. fibrosa				X											
Main Understory Species	Native Grasses	X	X	X	X	X		X	X	X	X		X	X		
	Exotic Grasses			X												
	Native Shrubs					X						X			X	X
	Native Herbs						X				X	X			X	X

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Habitat Assessment results in the Study Area																	
	Habitat Features	**Area A-Regenerating CPW - study area**					**Area B - Regenerating CPW- Regional Park**					**Area C - Mature CPW - Regional Park**					
	Regenerating Eucalypts																
	Exotic Herbs																
Flowering Tree		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
Signs of fauna activity		Nil	Macropod scats	Macropod scats	Nil	Macropod scats	Nil	Macropod scats,	Macropod scats	Emu scats, Macropod scats	Macropod scats	Nil	Macropod scats	Macropod scats	Nil	Emu scats, Macropod scats	

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 26 : Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity

Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity				
Data type	**Habitat**	**Group similarity (%)**	**Main contributing species**	**% contribution to similarity**
All Quadrats – flora abundance data	Grassland	42.86	*Axonopus fissifolius*	9.79
			Senecio madagacariensis	7.94
			Setaria parviflora	7.34
	Woodland	44.52	*Aristida vagans*	6.48
			Sida rhombifolia	5.45
			Brunoniella australis	4.98
	Riparian	15.55	*Microlaena stipoides*	18.59
			Sida rhombifolia	8.59
			Angrophora floribunda	8.40
All Quadrats – Native flora abundance data	Grassland	36.37	*Cynodon dactylon*	14.51
			Fimbristylis dichotoma	13.95
			Centella asiatica	12.20
	Woodland	44.43	*Aristida vagans*	8.23
			Brunoniella australis	6.32
			Cymbopogon refractus	6.20
	Riparian	14.09	*Microlaena stipoides*	30.21
			Angophora floribunda	13.02
			Dichelachne micrantha	8.32

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity				
Data type	**Habitat**	**Group similarity (%)**	**Main contributing species**	**% contribution to similarity**
All Quadrats – Exotic species abundance data	Grassland	50.73	*Axonopus fissifolius*	18.89
			Senecio madagascariensis	15.63
			Setaria parviflora	14.49
	Woodland	44.19	*Sida rhombifolia*	27.48
			Senecio madagascariensis	20.38
			Richardia stellaris	14.97
	Riparian	19.85	*Axonopus fissifolius*	24.65
			Eragrostis curvula	20.13
			Sida rhombifolia	16.54
All Quadrats – flora abundance data	A	36.64	*Senecio madagacariensis*	7.77
			Setaria parviflora	6.84
			Axonopus fissifolius	6.36
	B	56.43	*Aristida vagans*	7.19
			Cymbopogon refractus	5.21
			Glossocardia bidens	4.88
	C	30.79	*Aristida vagans*	6.97
			Sida rhombifolia	5.23
			Senecio madagascariensis	5.02
	A	32.36	*Cymbopogon refractus*	10.36

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Results of Group Similarity Analyses (SIMPER) of Flora data by habitat and primary species contributing to Similarity				
Data type	**Habitat**	**Group similarity (%)**	**Main contributing species**	**% contribution to similarity**
All Quadrats – Native flora abundance data			*Fimbristylis dichotoma*	10.09
			Cynodon dactylon	8.69
	B	56.02	*Aristida vagans*	8.93
			Cymbopogon refractus	6.46
			Glossocardia bidens	6.07
	C	28.60	*Aristida vagans*	10.21
			Cymbopogon refractus	6.53
			Bothriochloa decipiens/macra	6.06
All Quadrats – Exotic flora abundance data	A	42.81	*Senecio madagascariensis*	19.51
			Setaria parviflora	17.03
			Axonopus fissifolius	13.65
	B	57.62	*Richardia stellaria*	25.94
			Sida rhombifolia	24.85
			Senecio madagascariensis	17.57
	C	34.81	*Sida rhombifolia*	17.82
			Senecio madagascariensis	16.79
			Richardia stellaria	14.65

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 27 : Statistical comparison of Cumberland Plain Land Snail numbers between different sections of the Study Area

Data type	Normality test (Shapiro – Wilks test)	Homogeneity of Variances test (Levene's test)	Comparative test utilised	Test statistic	Test statistic p-value	Post Hoc tests					
						A & B		A & C		B & C	
						U	p	U	p	U	p
Live	✓	✓	ANOVA	1.984	0.180	n/a	n/a	n/a	n/a	n/a	n/a
Shells	✓	×	Kruskal – Wallis	8.916	0.012	3.50	0.055	0.00	0.008	5.00	0.104
Totals	✓	×	Kruskal - Wallis	8.873	0.012	6.00	0.172	0.00	0.008	3.00	0.034

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

APPENDIX E :

Actions Prescribed by the Final Recovery Plan for the Cumberland Plain

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Table 28 : Compliance with Cumberland Plain Recovery Plan

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
Building the protected area network	Page 14 - Recovery Objective 1: To build a protected area network, comprising public and private lands, focused on the priority conservation lands (PCL)	Recovery objective subdivided into several actions. 1.1, 1.2. 1.3 and 1.6 not applicable to management plan as they are responsibility of OEH (listed as DECCW in CPW plan). Actions 1.4 and 1.5 potentially applicable to management plans as they refer to acquisition of lands for inclusion into protection and assurance of offsets where impacts are unavoidable respectively	Possible statement in management plan acknowledging that appropriate local council/govt dept will be contacted in the event of future rezonation/change of development plans	Feral and Domestic Animal Management Stragety (FDAMS) - No	FDAMS not really applicable as area covered by plan is not a PCL. Only potential relevance may be Action 1.5 - offsets where impacts are unavoidable - which has a note on offsets in Growth Centres. May need to state in sections 3.1.3 (Pg 3.2) and 3.1.6 (Pg 3.4) that planting of native shurbs is in accordance with the Growth Centres Biodiversity Certification Order as well as Asset Protection Zone requirements?
				Weed Management Plan (WMP) - No	WMP not really applicable as area covered by plan is not a PCL. Action 1.5 may have some relevance as clearing for development will remove native vegetation as well as the weeds.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
					Could make statement in Section 4.2.3 (Pg 4.4) and/or 4.3.1 (pg 4.5) that loss/disturbance of native vegetation within development site does not affect local long-term survival of native species as adjacent Regional Park has sustainable populations (refer to 2009 WP Biodiversity assessment)
				Macrofauna Management Plant (MFMP) - Yes	MFMP indirectly addresses Action 1.4 as Chapter 1, Section 1.3.1 (pg 1.9) states that St Mary's Property has been zoned into urban development and Regional Park areas, thus lands for inclusion into protection are acquired. Action 1.5 (offsets) not relevant as plan deals with fauna. Presence of park indicates offset area for flora

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
Delivery of best practise management strategies	Page 16: Recovery Objective 2: To deliver best practice management for threatened biodiversity across Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation	Recovery objective subdivided into several actions. 2.1, 2.4, 2.6, 2.7 not applicable to management plan as they are govt dept responsibilities or refer to Priority Conservation lands. Actions 2.2, 2.3 and 2.5 all refer to best management practices outlined in Appendix 2 which has relevant sections detailed below. Actions 2.3 and 2.5 not directly relevant as they refer to local, state and Australian govenment lands. Action 2.2 highly relevant as it refers to public and private lands	Responses to relevant sections of Appendix 2 required. Point 2 is relevant as it refers to public lands compatible with primary management objective. Point 3 also relevant as it deals with private land.	FDAMS - Yes WPS - Yes MFMP - Yes	Detailed in following points
Appendix 2 - Best practice standards	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with	Requirement 1: a site action or management plan to be prepared which addresses the management of threatened	Development of management plan	FDAMS - Yes	FDAMS: Chapter 3, Section 3.1.1 (Pg 3.1) and 3.2 (Pg 3.6) Overall management strategy acknowledges that threatened

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
for bushland management	primary management objective	biodiversity and is consistent with the recovery plan	consistent with recovery plan		flora, fauna and EECs have to be protected from feral/stray and domestic animals
				WMP - Yes	WMP: Chapter 4, Section 4.1 (Pg 4.1) acknowledges the different threats weeds pose to native vegetation and habitats
				MFMP - yes	Chapters 4 and 5 cover issues that necessitate fauna population management. While they deal with macrofauna, these comply with recovery plan as they indirectly aid in protecting/regeneration of the CEEC.
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with	Requirement 2: the land to be managed in accordance with the site action or management plan	Procedures/Strategies to execute management plan	FDAMS - Yes	FDAMS - Chapter 3, Sections 3.1.2 - 3.1.8 and Section 3.2 outline procedures for MP execution to prevent feral/domestic animals effects on native flora/fauna and

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	primary management objective				prevent/reduce access to adjacent PCL.
				WMP - Yes	WMP - Chapter 4, Sections 4.2, 4.3 and Appendix C provide details on procedures to remove/reduce spread of weeds. Explicit mention of protecting adjacent Regional Park by preventing weed infestations mentioned on pg 4.3.
				MFMP - yes	Chapters 7 - 12 outline various protocols/stategies for implementing management issues identified in Chapters 4-5.
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with	Requirement 3: Monitoring to be undertaken periodically to determine the status of threatened entities, or to assess the effectiveness of threat abatement measures being	Periodic monitoring using monitoring methods listed in Hughes article	FDAMS - No	No mention of ongoing monitoring of feral population numbers or of corresponding responses of native flora/fauna species. Hughes article not really applicable as it deals with

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	primary management objective	implemented (for guidance see the Monitoring manual for bitou bush control and native plant recovery (Hughes et al. 2009) at www.environment.nsw.gov.au/bitouTAP/monitoring.htm)			methods for monitoring flora not fauna
				WMP - Yes	Monitoring of weed populations along with ongoing review of strategy outlined in Chapter 5 with timeline for procedures outlined in Appendix E. Methodolgy for Long term Monitoring (Section 5.2) not specificially mentioned but it is stated that methods used in this WMP (transects - which is one of the methods listed in Hughes 2009) be used. No methods/reference link for methods mentioned for Short term monitoring (Section 5.1)
				MFMP - yes	Methods for ongoing monitoring for macrofauna as well as flora outlined in Sections 13.1.1 - 13.1.4

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	Page 31: Appendix 2, Point 2: Bushland on public lands compatible with primary management objective	Requirement 4: Management to be consistent with the following documents [Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a); recommended fire regimes in Appendix 3], and any other best practice documents that OEH (DECCW) may promote at a later date. A landscape-scale response to African Olive invasion on the Cumberland Plain (as per completion of action 2.6)	Appropriate references have to be incorporated/references in management plan	FDAMS - No	FDAMS - N/A as fire regimen not included in MP. May need to reference the DEC document with regard to planting of native shrubs? Action 2.6 is responsibility of OEH (DECCW) and is not applicable to this MP as the focus is on fauna
				WMP - Yes	WMP - Fire regimes N/A as it is not used as a weed control method. Action 2.6 is responsibility of OEH (DECCW) but plan is in compliance as control and removal of African Olive is covered (Appendix C, Section C.3) Recovering Bushland document not referenced. Important/Relevant sections of Recovering Bushland document are chapter 2 (pg 16, pg 21, pg 25?) and Chapter 4 (pg 38,)

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
				MFMP - yes	Recovering bushland documents highlights need to reduce overgrazing (and it's side effects like erosion). Reducing of grazing pressure is explicitly stated in Chapter 12, Section 12.3 as an outcome of controlling Macrofauna populations. However previous section does state that some weed species may increase (pg 12.3, dot point 4) which may be contradictory. Fire regimen and African Olive invasion N/A as plan is focussed on macrofauna
Appendix 2 - Best practice standards for bushland management	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 1: a site action or management plan to be prepared which addresses the management of threatened biodiversity and is consistent with the recovery plan	Development of management plan consistent with recovery plan	FDAMS - Yes	FDAMS: Chapter 3, Section 3.1.1 (Pg 3.1) and 3.2 (Pg 3.6) Overall management strategy acknowledges that threatened flora, fauna and EECs have to be protected from feral/stray and domestic animals

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
				WMP - Yes	WMP: Chapter 4, Section 4.1 (Pg 4.1) acknowledges the different threats weeds pose to native vegetation and habitats
				MFMP - yes	Chapters 4 and 5 cover issues that necessitate fauna population management. While they deal with macrofauna, these comply with recovery plan as they indirectly aid in protecting/regeneration of the CEEC.
	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 2: the land to be managed in accordance with the site action or management plan	Procedures/Strategies to execute management plan	FDAMS - Yes	FDAMS - Chapter 3, Sections 3.1.2 - 3.1.8 and Section 3.2 outline procedures for MP execution to prevent feral/domestic animals effects on native flora/fauna and prevent/reduce access to adjacent PCL.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
				WMP - Yes	WMP - Chapter 4, Sections 4.2, 4.3 and Appendix C provide details on procedures to remove/reduce spread of weeds. Explicit mention of protecting adjacent Regional Park by preventing weed infestations mentioned on pg 4.3.
				MFMP - yes	Chapters 7 - 12 outline various protocols/stategies for implementing management issues identified in Chapters 4-5.
	Page 31: Appendix 2, Point 3: Bushland on private lands	Requirement 3: Management to be consistent with the following documents [Recovering bushland on the Cumberland Plain – Best practice guidelines for the management and restoration of bushland (DEC 2005a); recommended fire regimes in	Appropriate references have to be incorporated/references in management plan	FDAMS - Yes	FDAMS - N/A as fire regimen not included in MP. May need to reference the DEC document with regard to planting of native shrubs?
				WMP - Yes	WMP - Fire regimes N/A as it is not used as a weed control method. Recovering Bushland document not referenced.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
		Appendix 3] , and any other best practice documents that OEH (DECCW) may promote at a later date			Important/Relevant sections of Recovering Bushland document are chapter 2 (pg 16, pg 21, pg 25?) and Chapter 4 (pg 38,)
				MFMP - yes	Recovering bushland documents highlights need to reduce overgrazing (and it's side effects like erosion). Reducing of grazing pressure is explicitly stated in Chapter 12, Section 12.3 as an outcome of controlling Macrofauna populations. However previous section does state that some weed species may increase (pg 12.3, dot point 4) which may be contradictory. Fire regimen N/A as plan is focussed on macrofauna
Community awareness	Page 17: Recovery Objective 3: To develop an	Recovery objective subdivided into several actions. Actions 3.1, 3.2, 3.3, 3.6 and 3.7 not relevant	Statement in management plan communication section	FDAMS - Yes	FDAMS: Section 2.2 (Pg 2.8); Section 3.1.1 (pg 3.1); Section 3.2 (Pg 3.6) and Section 3.3 (Pg 3.7)

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program	as they are council or OEH responsibilities. Actions 3.4 and 3.5 may have some relevance as they refer to OEH and local councils working collaboratively with landowners and other organisations to increase awareness of best practice standards and opportunities for further involvement/participation in the recovery program	addressing potential methods for raising awareness of issues in recovery plan if necessary	WMP - Yes	WMP: Chapter 4, Section 4.2.4 (Pg 4.5). Could potentially be expanded to have more regular updates/awareness programs on importance of weed control.
				MFMP - yes	Initiation of a environmental education program explicitly mentioned in Chapter 7, section 7.10. However this is not clearly divided into separate programs for the Park area and the development area
Continued research/monitoring and data updates	Page 19: Recovery Objective 4: To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve	Recovery objective subdivided into several actions. Actions 4.1, 4.2 and 4.6 not relevant as they are council or OEH responsibilities. Action 4.4 not directly relevant but deals with compliance and enforcement programs dealing with unauthorised clearing of	Make a statement in management plan that all required permits for clearing were acquired thus removing any potential issues with regard to Action 4.4. Actions 4.3 and 4.5 can be addressed via	FDAMS - No	FDAMS - N/A as all actions are to be carried out by government bodies. However could add statement in Conclusion that MP strategy will be reviewed and revised according to feral animal responses
				WMP - Yes	WMP - Chapter 5 and Appendix E specify ongoing monitoring,

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Compliance with Cumberland Plain Recovery Plan					
Topics to address	**CPW recovery plan objectives**	**Relevant sections**	**Required action**	**Objective addressed in Cumberland Ecology management plan**	**Relevant Cumberland Ecology Management plan/section**
	capacity to manage these in a strategic and effective manner	bushland. Local councils and OEH responsible for carrying out Actions 4.3 and 4.5 respectively, which deal with reviewing biodiversity strategies and establishing development notification frameworks. But these may be relevant as they include areas around the priority conservation lands	statements indicating ongoing development of management plans and proper communication within legal channels of any future changes in development plans.		annual reviews and adaptive management timeframes for weed control which will ultimately aid in protecting adjacent Park
				MFMP - yes	MFMP has been developed as an adaptive management plan and Chapter 13 covers multiple issues that will contribute to ongoing development and improvement of management plan (including liasions and reviews) thus indirectly complying with requirement of improving management capacity/strategy

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

PAGE INTENTIONALLY LEFT BLANK

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

APPENDIX F :
Staff CVs

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

David Robertson

Director

Experience

Dr David Robertson is a senior ecologist with more than 30 years' experience in ecological survey, impact assessment, and research. David is the director of Cumberland Ecology.

Recent consultancy work has included:

- Senior consultant for numerous mining projects in Australia and in the Philippines;
- Court appointed expert for the NSW Land and Environment Court;
- Flora and fauna investigations for Environmental Impact Assessments;
- Development of ecological management plans and habitat reconstruction;
- Negotiations about the level of mitigation and offset measures required for flora and fauna impacts.

Key Industry Sectors

- Residential development;
- Extractive industry;
- Power generation;
- Water; and
- Transport.

Relevant Experience

Environmental Impact Assessment
Directed numerous large ecological assessments for major projects in a variety of service sectors in Australia and internationally. These include the power industry, water supply, road construction and mining.

Threatened Species Assessments
Directed or managed numerous threatened species assessments in Australia and overseas to address legislative requirements. Projects were conducted in numerous jurisdictions. Work on threatened species has included preliminary survey and impact assessment, detailed impact assessment and mitigation, monitoring and plans of management.

Provision of Strategic Ecological Advice
Strategic ecological advice has been provided to aid the selection of potential development sites in Australia, Hong Kong, Philippines, Thailand, Sri Lanka and China. Included development of selection criteria (e.g. biodiversity status, land use, conservations principles such as connectivity, fragmentation, island theory, edge effects, potential for restoration).

Aquatic Studies
Conducted wide range of aquatic studies, including fish, macro-invertebrates, aquatic and intertidal vegetation (saltmarsh, mangroves); Wetland creation and management projects and aquatic impact assessments.

Statements of Evidence and Expert Testimony
Dr David Robertson is a highly experienced and credible expert witness and is capable of providing expert evidence in both terrestrial and aquatic areas of ecology. David has provided expert evidence for Australian Senate Select Committees, Australian Heritage Commission, Commissions of Inquiry, Land and Environment Court hearings and at Mining Wardens inquiries.

Education

- Bachelor of Science (Honours), Ecology.
  University of Melbourne, 1980.
- Doctor of Philosophy, Ecology.
  University of Melbourne, 1986.
- BioBanking Assessors Training Course.
  TAFE Northern Sydney Institute, 2009 (Accredited September 2009)
- BAM Accredited Assessor Training.
  Muddy Boots, 2017 (Accredited August 2017)

Professional Affiliations

- Ecological Society of Australia (ESA),
- Certified Environmental Practitioner Scheme (CENvP), and
- Environment Institute of Australia and New Zealand (EIANZ).

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Vanessa Orsborn

Project Manager / Ecologist

Vanessa Orsborn has worked as an ecological consultant since 2005, and has extensive experience in ecology and project management. She primarily manages flora and fauna assessments under the EP&A Act and the EPBC Act. As an accredited BAM Assessor, Vanessa assists in the preparation of offset agreements.

Recent consultancy experience has included:

- Assessments for infrastructure upgrades; Transport for NSW (TfNSW) and Roads and Maritime Services (RMS);
- Negotiation of offsets for resources sector project using the BAM, BBAM or BCAM tools;
- Provision of strategic advice for legal privilege;
- Impact Assessments for urban development; and
- Preparation of management plans for offset lands.

Fields of Competence

- Accredited BAM Assessor;
- Commonwealth and State environmental approvals;
- Ecological survey and monitoring; and
- Report writing and liaison with stakeholders.

Key Industry Sectors

- Urban development
- Infrastructure development; and
- Resources

Education

BEnvSci. Australian Catholic University, 2004.

Key Projects

Offset Assessments and Negotiations

As an accredited BAM Assessor, Vanessa has been involved in several project in NSW that are in the process of negotiating biodiversity offsets. The application of the Biodiversity Assessment Methodology (BAM), both for formal and informal offset 'credit' calculations, have been used for a variety of projects.

Legal Projects

BP Australia V Tweed Shire Council: Vanessa assisted in the preparation of documentation prepared as part of the Conciliation process for the Class 1 Appeal of BP Australia V Tweed Shire Council. This included peer review, updating vegetation data and mapping, investigation of offset options, and negotiations with Council.

Japara Healthcare V Northern Beaches Council: The Class 1 Appeal by Japara Healthcare Limited was approved by the Courts, with all ecological issues resolved through 'without prejudice' liaison with Council, for which Vanessa was involved in.

Urban Development Projects

Impact assessments have been prepared by Vanessa for projects across the greater Sydney area and the NSW north and south coasts. Recent Species Impact Statement (SIS) reports for sites in Sydney's north and west have assessed impacts to Critically Endangered Ecological Communities, and have involved offsetting.

Resources Projects

Vanessa has worked on a number of ecological assessments for mining modification projects, including for Integra Mine in the Hunter Valley. Additionally, Vanessa has contributed to Independent Environmental Audits, acting as an ecological specialist assisting the Accredited Auditor, which has included Invincible Mine.

Vanessa has a keen interest in renewable energy projects, and has recently worked on assessments for a Solar Farm in western NSW.

Ecological Management Projects

Vanessa has prepared numerous ecological management plans; for vegetation management, pest species management and also over-abundant native species management.

Infrastructure Upgrade Projects

Vanessa has prepared assessments for a number of road and infrastructure upgrade projects being conducted by RMS and TfNSW. The assessment has included consideration of the relevant RMS and TfNSW Biodiversity Offset Guidelines.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Dr. Rohan Mellick

Project Manager / Botanist

Dr Rohan Mellick is a researcher with over ten years experience in botanical surveying. He is a Project Manager and Botanist at Cumberland Ecology, based in Sydney. Rohan is an accredited Biodiversity Assessment Method (BAM) Assessor that is proficient in ecosystem credit calculation using the BAM Calculator.

Rohan recently finished his Postdoctoral Research Fellowship for CSIRO where he focused on Landscape Genomics, Ecological Niche Modelling and Population Ecology of eucalypt species. He has a PhD in Evolutionary Ecology and a Bachelor of Applied Science (Honours) from Southern Cross University in Natural Resource Management.

Rohan has undertaken research for the Office of Environment and Heritage, the Department of Primary Industry (QLD), Southern Cross University, University of Adelaide, Royal Botanic Gardens (Sydney) and CSIRO.

Recent consultancy work has involved Biodiversity Stewardship Agreements, Biodiversity Development Assessment Reports, Flora and Fauna Impact Assessments, Vegetation and Bushland Management Plans, Fire Management and Grazing Assessments.

He has undertaken vegetation mapping, botanical surveys and contributed to various projects in residential and industrial, mining and infrastructure developments within the Greater Sydney Metropolitan Area and throughout NSW.

Education

- CSIRO Postdoctoral Research Fellowship (2014 – 2017).
- Doctor of Philosophy, Evolutionary Ecology, University of Adelaide, 2013.
- BASc. (Hons), Eucalypt Forestry, Southern Cross University, 2000.
- BASc. Natural Resource Management, Southern Cross University, 1999.

Relevant Experience

Field Surveys

- Vegetation Mapping and Botanical Field Surveys throughout NSW.
- Biodiversity Stewardship Agreement site assessment at Minnamurra, NSW.
- Biodiversity Development Assessment Report site assessment at Harden, NSW.
- Fire Management and Grazing Assessments at Offset Properties in the Upper Hunter, NSW.
- Bushland Management Plans and Vegetation Management Plans site assessments in the Sydney Metropolitan Area
- Undertaken botanical collections and field surveys throughout the East Coast of Australia and regional NSW for the Royal Botanic Gardens (Sydney) and CSIRO.

Ecological Assessment

- Ecosystem credit calculation using the Biodiversity Assessment Method Calculator.
- Contribution to Species Impact Statements within the Greater Sydney Metropolitan Area
- Ecological assessments throughout coastal and regional NSW.
- Bushland and Vegetation Management Plans throughout the Greater Sydney Metropolitan Area
- Flora and Fauna Impact Assessment within Port Stephens Council Local Government Area.
- Niche Modelling including a review of occupancy modelling for endangered marsupials at Groote Islet in the Northern Territory.
- Surveys and impact assessment for renewable energy development in Leeton Shire Council.
- Offset site assessments: fire, weed and grazing assessments within the Upper Hunter Valley.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Michael Davis

GIS Specialist

Michael Davis is a Sydney based GIS specialist at Cumberland Ecology. Michael is responsible for the administration, development and implementation of spatial data. Michael has extensive technical knowledge and experience in the interpretation and production of mapping products for ecological projects as well as classification and feature extraction using aerial photography and satellite imagery.

Michael has experience managing small to large scale projects and is the primary author of a variety of ecological assessments. He has experience in the use of the Bio-Certification Assessment Methodology (BCAM) calculator, the BioBanking Assessment Methodology (BBAM) calculator and has completed the Biodiversity Assessment Methodology (BAM) training course.

Recent consultancy work has included:

- GIS mapping and analysis for various projects for Environmental Assessments, Biodiversity Management Plans, NSW Part 4 development applications and Referrals under the Commonwealth EPBC Act.
- Vegetation mapping, threatened flora and fauna mapping and development footprint mapping for small and large development projects.
- Flora and Fauna surveys and impact assessment including the production of 5-part Tests, Flora and Fauna Assessment Reports (FFA) and Biodiversity Development Application Reports (BDAR).

Fields of Competence

- Geographic Information Systems (GIS)
- Image and spatial data analysis
- Data and project management
- Ecological surveys of flora, fauna and ecological communities within the Sydney region.
- Flora, fauna and ecological community impact assessments

Key Industry Sectors

- Urban development;
- Mining and Extraction industries;
- Government Utilities.

Education

Bachelor of Biodiversity and Conservation, Macquarie University (2015).

Statement of Attainment in ArcGIS & Reporting for Environmental Resource Management, TAFE NSW Ryde (2017).

BAM Accredited Assessor Training. Muddy Boots, 2017.

Key Projects

NSW Development GIS Projects

Michael is responsible for providing GIS deliverables for several small to large scale projects throughout Australia. He is experienced in utilising GIS for vegetation mapping, mapping of threatened flora and fauna species, production of field maps and image analysis.

Flora and Fauna Survey and Assessment

Michael has been actively involved in flora and fauna surveys and impact assessment as part of development applications for a variety of projects in the greater Sydney Metropolitan area. Michael is experienced in performing field assessments under the BioBanking Scheme and the Biodiversity Assessment Methodology. Recent clients include Aver Development and Project Management, Legacy Property, Colliers International and APP Property and Infrastructure Specialists.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

FIGURES

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

Figure 1 : Aerial Photograph of the St Marys Property

Figure 2 : Zoning of the St Marys Development Site (SREP 30 Amendment 2)

Figure 3 : Plan of the subject site identifying the Proposal

Figure 4 : Aerial view of the subject site and study area

Figure 5 : Vegetation Communities in the Locality (OEH, 2013)

Figure 6 : Topography of the Locality identifying land uses

Figure 7 : Aerial Photograph of the locality identifying areas of native vegetation

Figure 8 : OEH Threatened Flora records within the Locality

Figure 9 : OEH Threatened Fauna records within the Locality

Figure 10 : Flora survey locations

Figure 11 : Fauna survey locations

Figure 12 : Comparison of exotic and native plant composition in the development areas of the study area (Area A), regenerating Regional Park woodland (Area B) and mature Regional Park woodland (Area C)

Figure 13 : Comparative abundance of Cumberland Plain Land Snail within the degraded development zoned land, including the subject site (Area A), regenerating Regional Park woodland (Area B) and Mature Regional Park woodland (Area C).

Figure 14 : Threatened Flora and Fauna recorded in the Study Area

Figure 15 : Vegetation of the Study Area

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

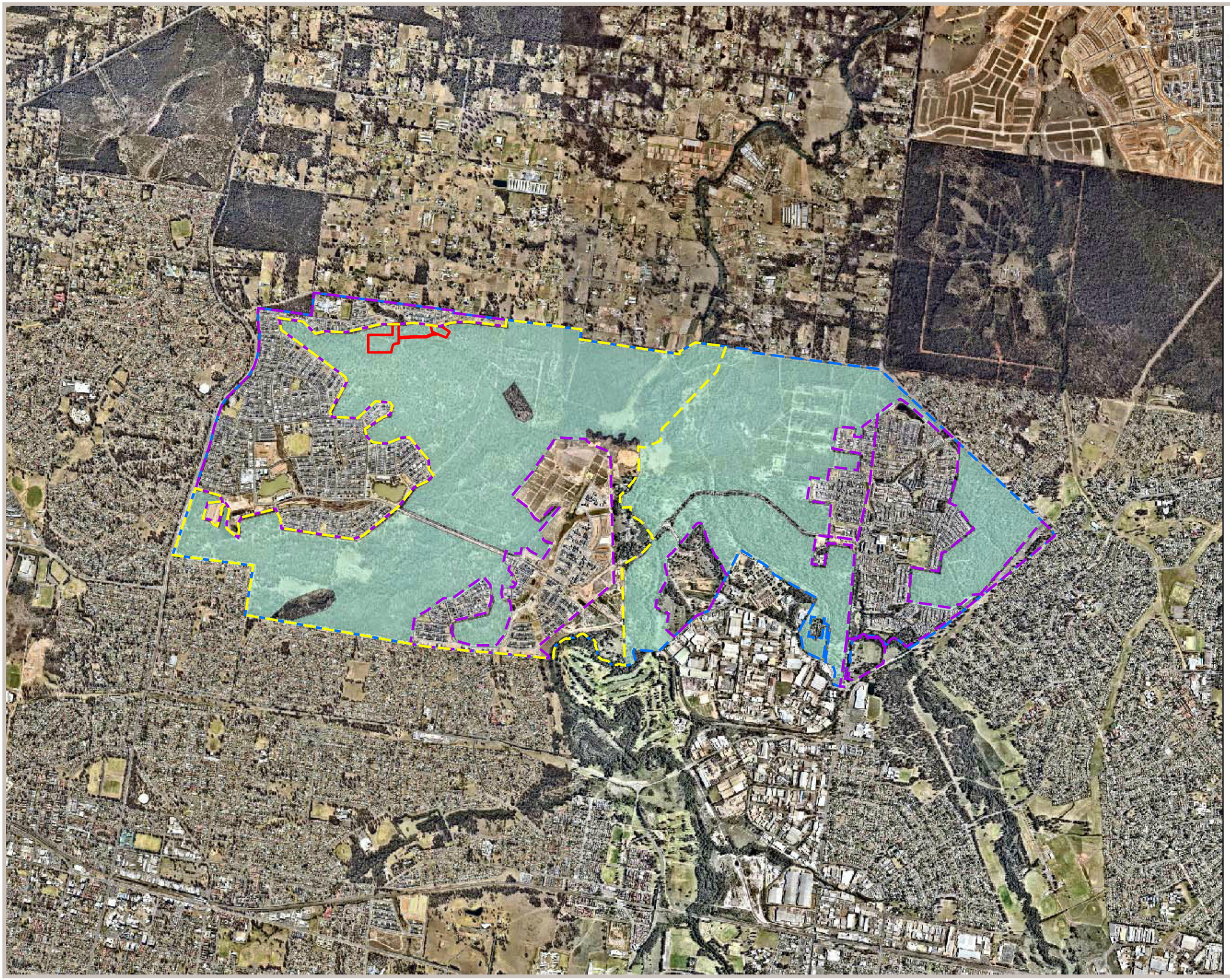
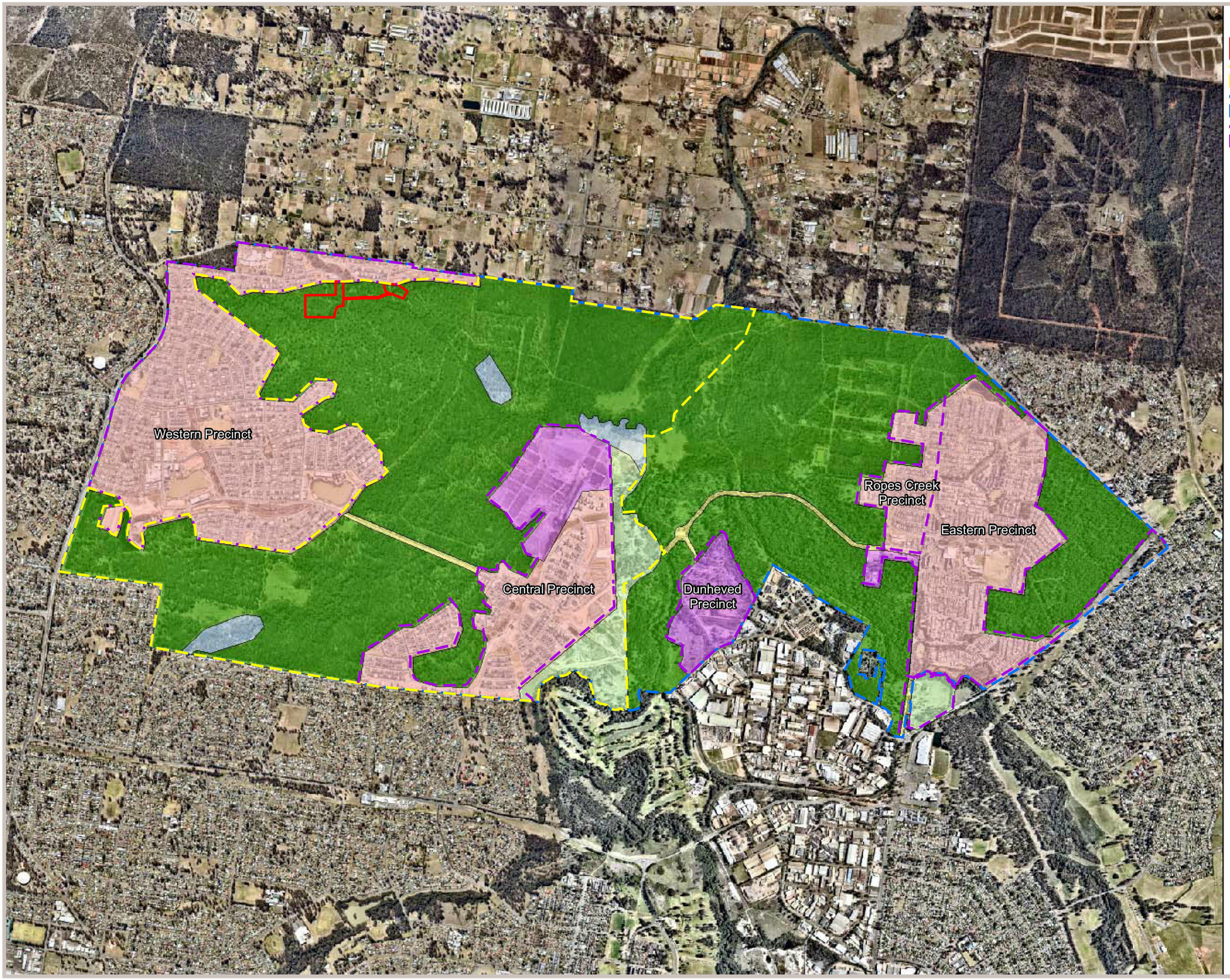


Figure 1. Aerial Photograph of the subject land

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Precinct Boundary

SREP No. 30 - St Marys Land Use Zoning

- Employment
- Road and Road Widening
- Drainage
- Regional Park
- Regional Open Space
- Urban

Image Source:
Image © Nearmap (2019)
Dated: 27/10/2019

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

I:\...\17209\Figures\RP2\20191121\Figure 2. Zoning_Subject Land

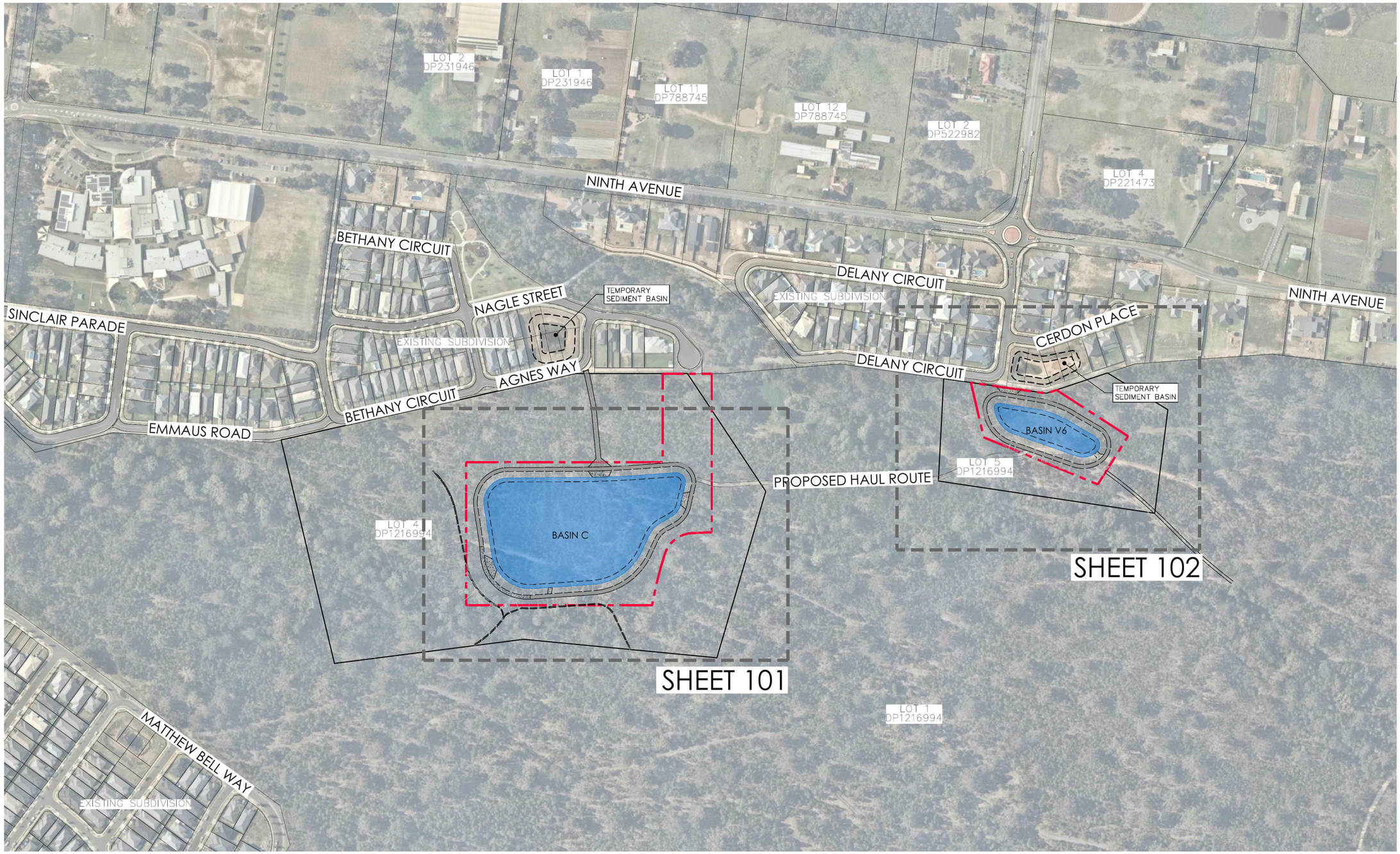
0 250 500 750 1,000 m

Figure 2. Zoning of the St Marys Property (SREP 30 Ammendment 2)

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

300225-CENG-003

M.G.A.



OVERALL PLAN
SCALE 1: 2000

LEGEND
- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY

DIAL 1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:2000 | 0 50 100m | A3 1:4000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project
ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

Plot Scale: 1.0000 Plot Date: 18/11/19 7:26:39PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-003.DWG

adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

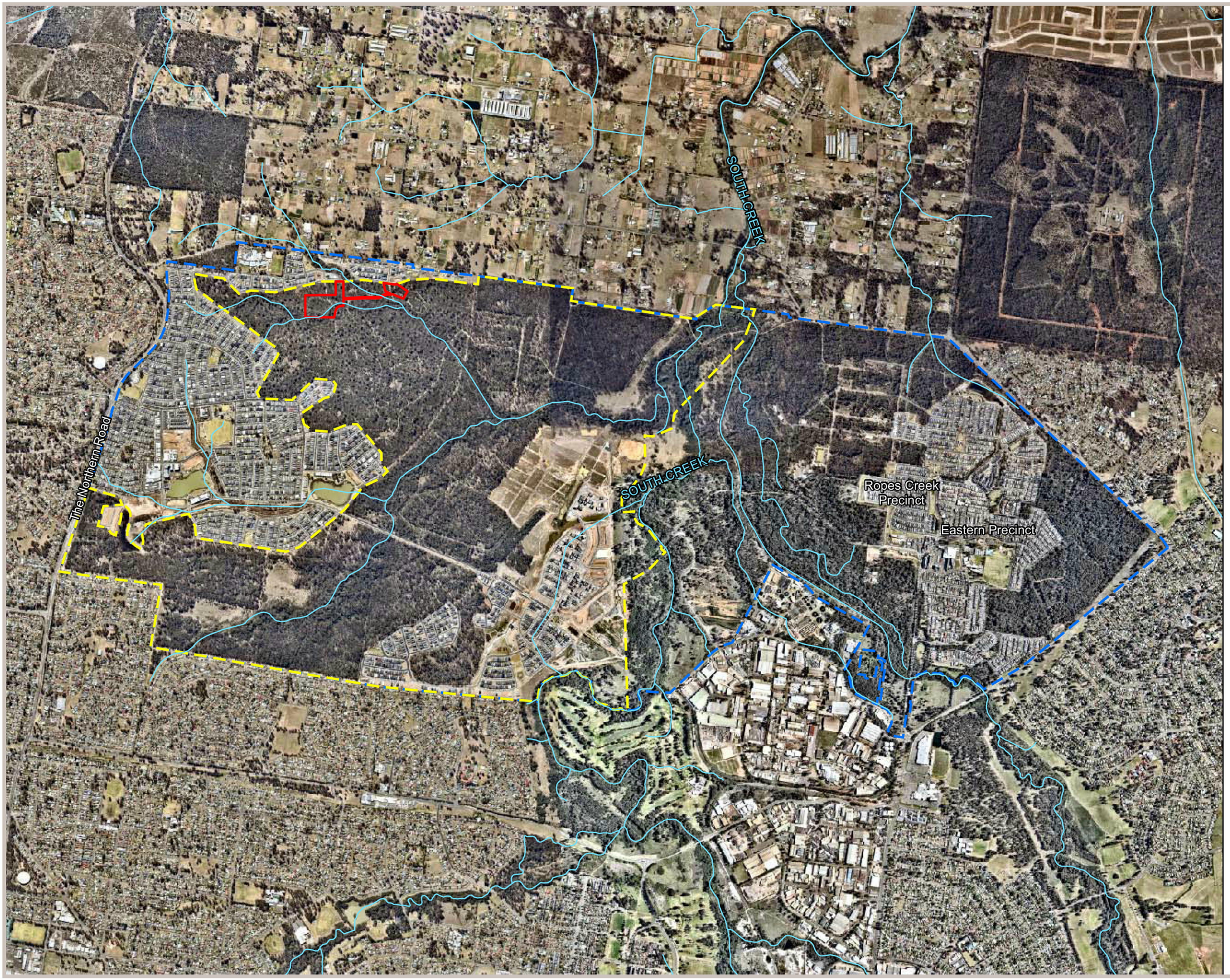
PLAN TITLE: OVERALL SITE PLAN

DRAFT

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	003	A

100mm AT FULL SIZE
This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Waterway

Image Source:
Image © Nearmap (2019)
Dated: 27/10/2019

Spatial Services,
NSW Department of Finance and Services (2017)

Coordinate System: MGA Zone 56 (GDA 94)

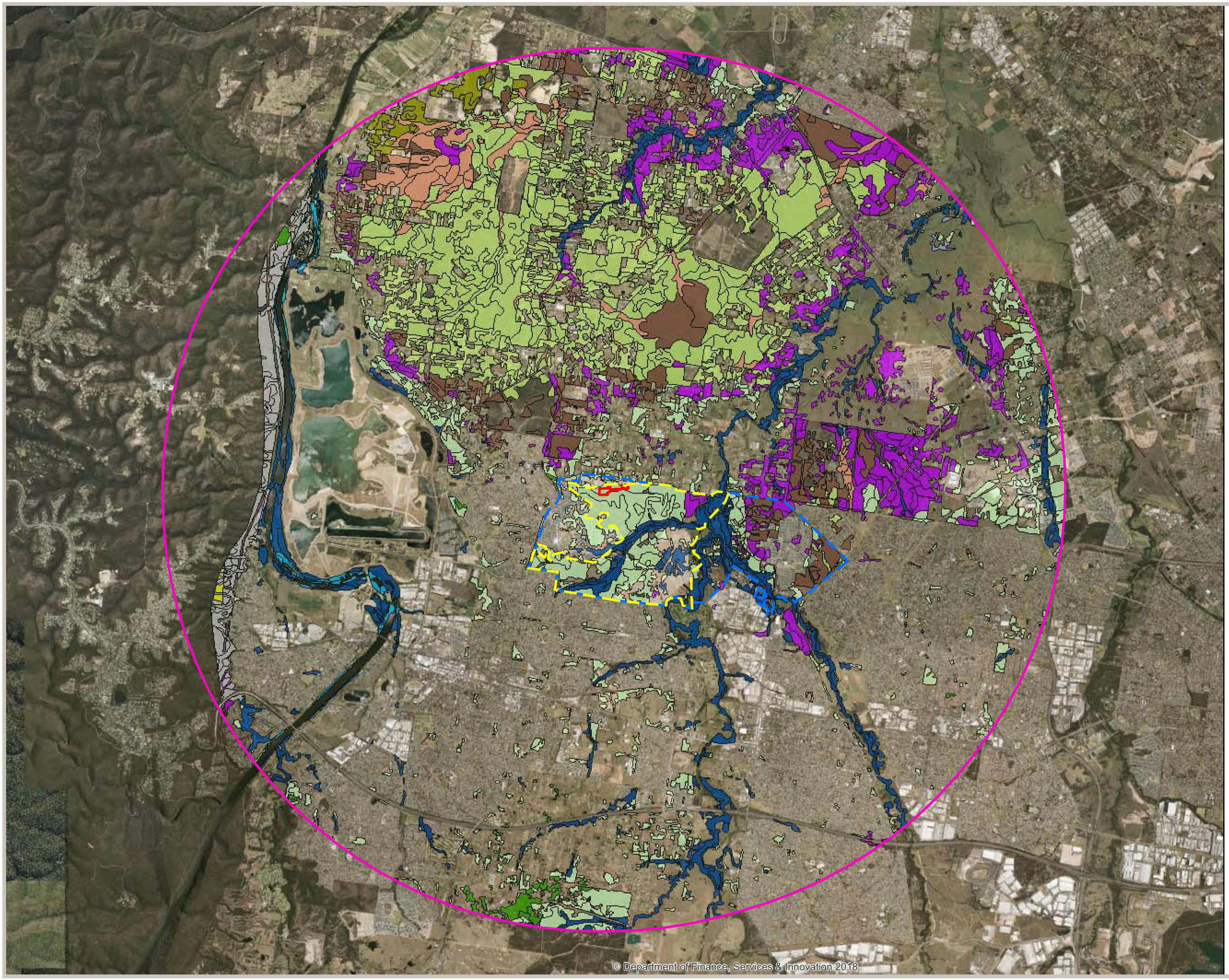
cumberland ecology

0 250 500 750 1,000 m

I:\...\17209\Figures\RP1\20191121\Figure 4. Aerial_Subject Site_Study Area

Figure 4. Aerial veiw of the subject site and study area

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Locality (10 km)

Vegetation Community (DECCW 2013)

- 1 - Shale Sandstone Transition Forest (Low Sandstone Influence)
- 10 - Shale Plains Woodland
- 103 - Shale/Gravel Transition Forest
- 11 - Alluvial Woodland
- 12 - Riparian Forest
- 13 - Western Sydney Dry Rainforest
- 14 - Moist Shale Woodland
- 15 - Turpentine-Ironbark Forest
- 152 - Blue Gum High Forest
- 2 - Shale Sandstone Transition Forest (High Sandstone Influence)
- 3 - Cooks River Castlereagh Ironbark Forest
- 31 - Sandstone Ridgetop Woodland
- 32 - Upper Georges River Sandstone Woodland
- 33 - Western Sandstone Gully Forest
- 35 - Riparian Scrub
- 36 - Freshwater Wetlands
- 37 - Elderslie Banksia Scrub Forest
- 4 - Castlereagh Swamp Woodland
- 43 - Turpentine-Ironbark Margin Forest
- 6 - Castlereagh Scribbly Gum Woodland
- 8 - Agnes Banks Woodland
- 9 - Shale Hills Woodland
- 9999 - Unclassified Vegetation

Data Source:
NSW NPWS (2002).
Native Vegetation Maps of the Cumberland Plain, Western Sydney. Final Edition - DECCW 2013 Update.

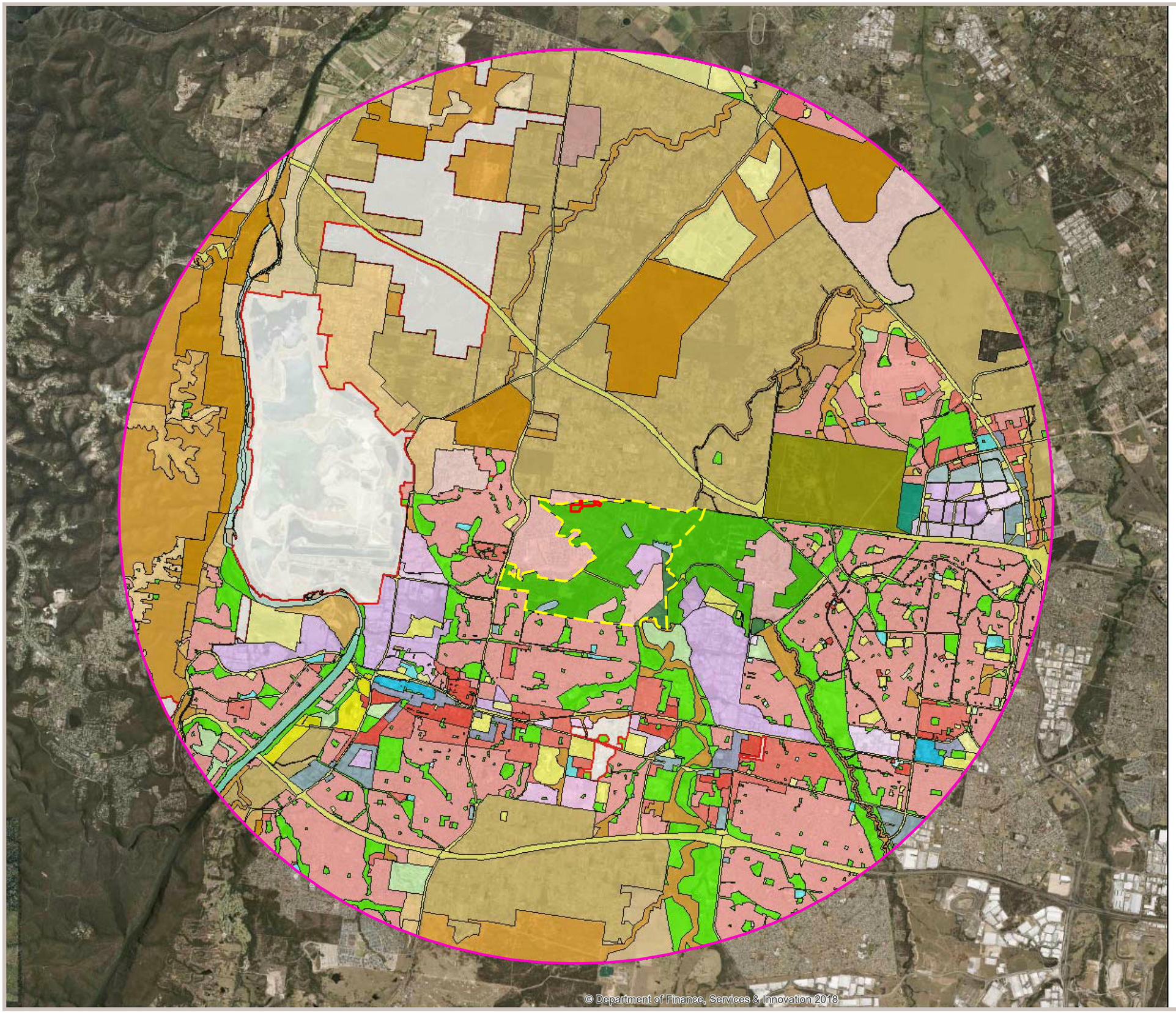
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 850 1,700 2,550 3,400 m

I:\...\17209\Figures\RP2\20191121\Figure 5. Vegetation Communities_Locality

Figure 5. Vegetation Communities in the Locality (DECCW 2013)



Legend

- Subject Site
- Study Area
- Locality (10 km)

State Environmental Planning Policy Land Use Zoning

- Environmental Conservation
- Pubic Recreation - Regional

SREP No. 30 - St Marys Land Use Zoning

- Drainage
- Employment
- Regional Open Space
- Regional Park
- Road and Road Widening
- Urban

Land Use Zone

- B1 Neighbourhood Centre
- B2 Local Centre
- B3 Commercial Core
- B4 Mixed Use
- B5 Business Development
- B6 Enterprise Corridor
- B7 Business Park
- B8 Metropolitan Centre
- E1 National Parks and Nature Reserves
- E2 Environmental Conservation
- E3 Environmental Management
- E4 Environmental Living
- IN1 General Industrial
- IN2 Light Industrial
- IN3 Heavy Industrial
- IN4 Working Waterfront
- R1 General Residential
- R2 Low Density Residential
- R3 Medium Density Residential
- R4 High Density Residential
- R5 Large Lot Residential
- RE1 Public Recreation
- RE2 Private Recreation
- RU1 Primary Production
- RU2 Rural Landscape
- RU3 Forestry
- RU4 Primary Production Small Lots
- RU5 Village
- RU6 Transition
- SP1 Special Activities
- SP2 Infrastructure
- SP3 Tourist
- W1 Natural Waterways
- W2 Recreational Waterways
- W3 Working Waterways
- UL Unzoned Land
- DM Deferred Matter
- BestImageryDates

Coordinate System: MGA Zone 56 (GDA 94)

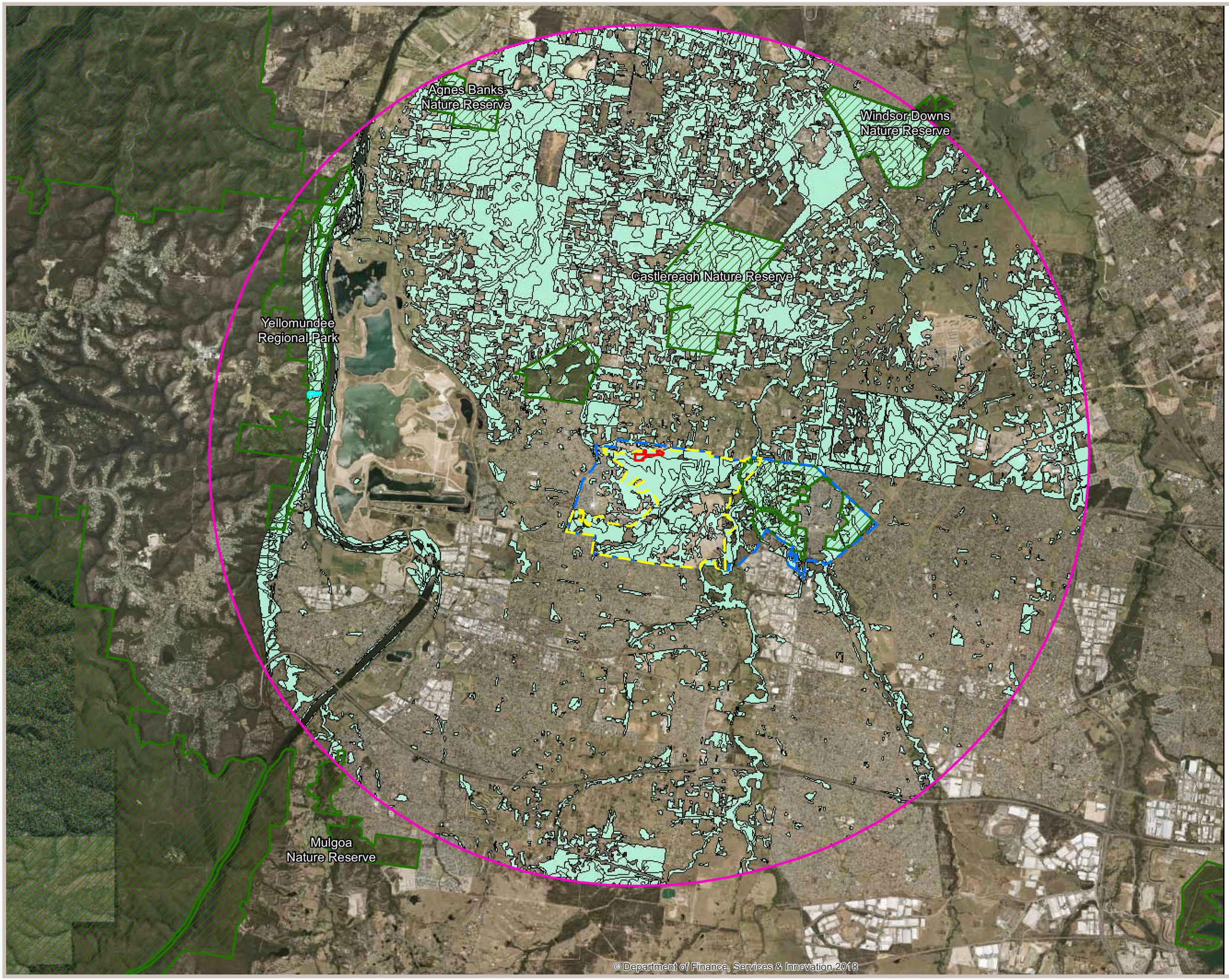
cumberland ecology

0 1 2 3 4 km

I:\...\17209\Figures\RP2\20191121\Figure 6. Zoning_Locality

Figure 6. Land Use Planning Zoning of the Locality

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Locality (10 km)
- National Parks and Reserves
- Native Vegetation (DECCW 2013)

Data Source:
NSW NPWS (2002).
Native Vegetation Maps of the Cumberland Plain, Western Sydney. Final Edition - DECCW 2013 Update.
Blue_Mountains_LGA_VISmap_2239;
Change in the distributionof Cumberland Plain Woodland 2008;

Coordinate System: MGA Zone 56 (GDA 94)

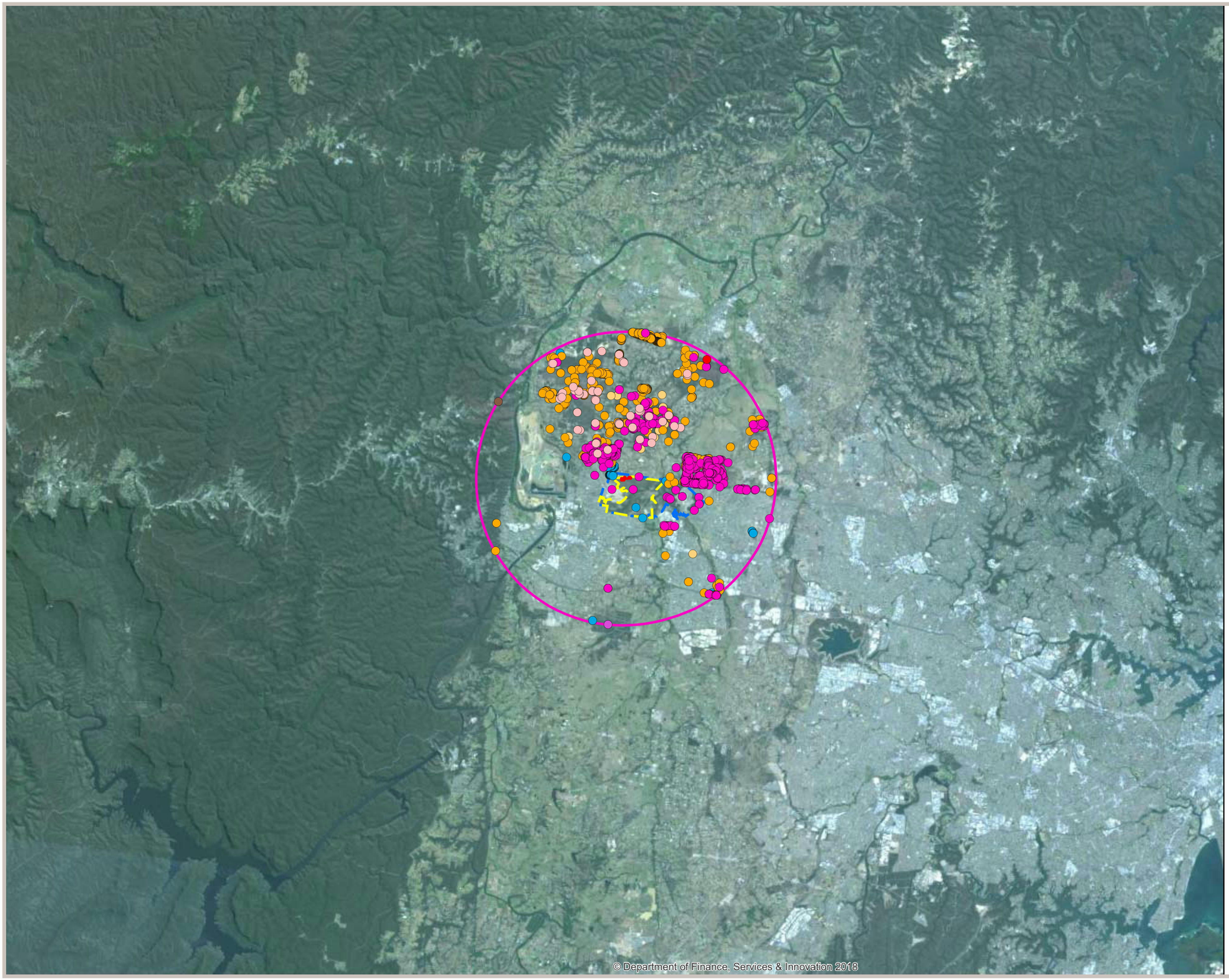
cumberland ecology

0 850 1,700 2,550 3,400 m

I:\...\17209\Figures\RP2\20191121\Figure 7. Native Vegetation_Locality

Figure 7. Aerial photograph of the locality identifying areas of native vegetation

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Locality (10 km)

Threatened Flora

- Acacia bynoeana
- Acacia pubescens
- Allocasuarina glareicola
- Dillwynia tenuifolia
- Grevillea juniperina subsp. juniperina
- Grevillea parviflora subsp. parviflora
- Hibbertia puberula
- Isotoma fluviatilis subsp. fluviatilis
- Leucopogon fletcheri subsp. fletcheri
- Marsdenia viridiflora subsp. viridiflora
- Micromyrtus minutiflora
- Persoonia hirsuta
- Persoonia nutans
- Pimelea spicata
- Pultenaea parviflora
- Pultenaea villifera
- Syzygium paniculatum

Data Source:
BioNet Atlas of NSW Wildlife
© NSW Office of Environment and Heritage
(22/10/2019)
Map Scale: 1:250,000

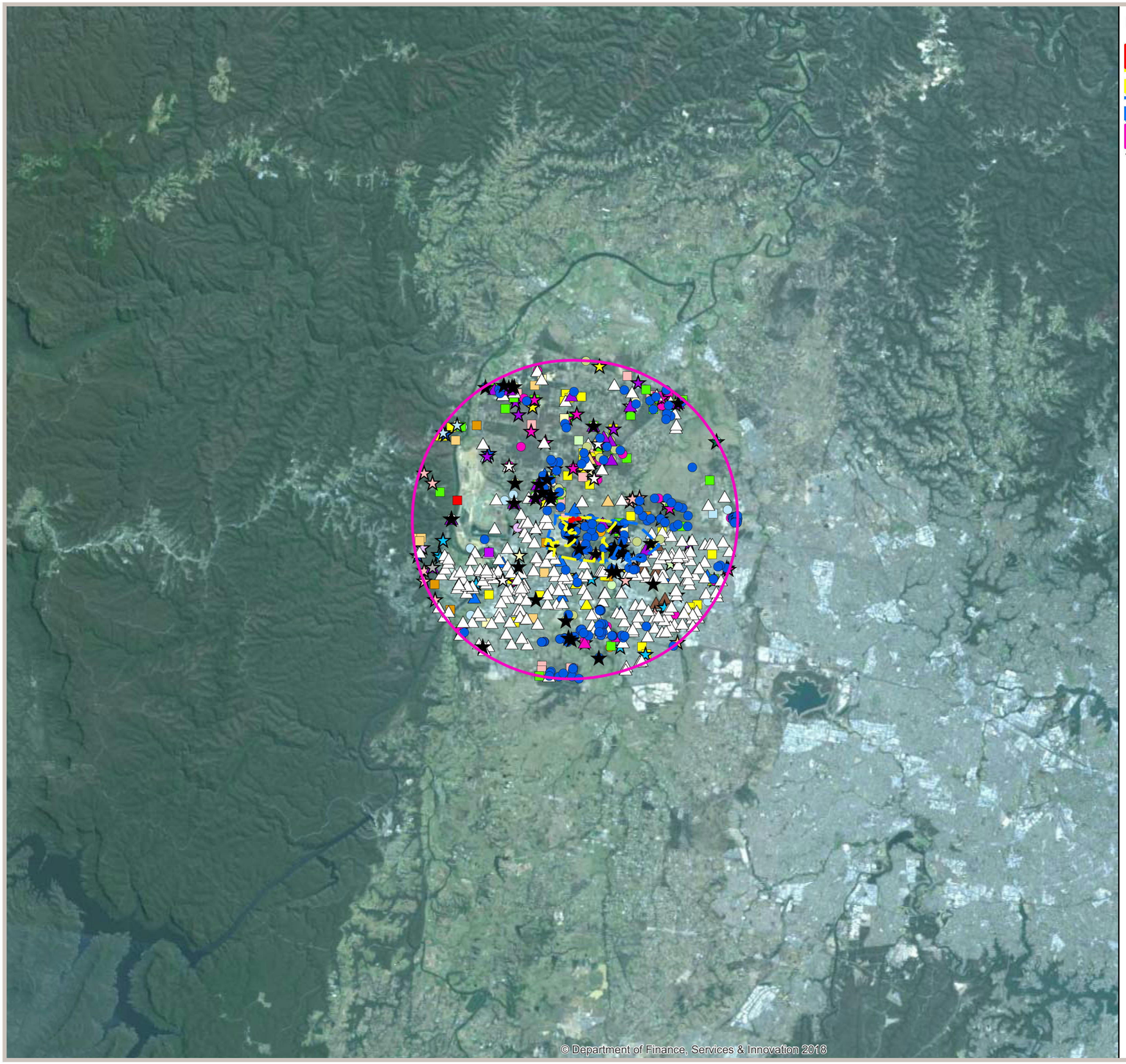
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 2.5 5 7.5 10 km

I:\...\17209\Figures\RP2\20191121\Figure 8. OEH Threatened Flora_Locality

Figure 8. OEH Threatened Flora records within the locality



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Locality (10 km)

Threatened Fauna

- Australasian Bittern
- Australian Painted Snipe
- Barking Owl
- Black Bittern
- Black Falcon
- Black-chinned Honeyeater (eastern subspecies)
- Black-necked Stork
- Bush Stone-curlew
- Cattle Egret
- Common Sandpiper
- Cumberland Plain Land Snail
- Diamond Firetail
- Dural Woodland Snail
- Dusky Woodswallow
- Eastern Bentwing-bat
- Eastern Coastal Free-tailed Bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Pygmy-possum
- Flame Robin
- Fork-tailed Swift
- Freckled Duck
- Gang-gang Cockatoo
- Giant Burrowing Frog
- Giant Dragonfly
- Glossy Black-Cockatoo
- Glossy Ibis
- Greater Broad-nosed Bat
- Greater Glider
- Green and Golden Bell Frog
- Grey-headed Flying-fox
- Koala
- Large Bent-winged Bat
- Large-eared Pied Bat
- Latham's Snipe
- Little Bent-winged Bat
- Little Bentwing-bat
- Little Eagle
- Little Lorikeet
- Marsh Sandpiper
- Masked Owl
- Painted Honeyeater
- Pectoral Sandpiper
- Pink Robin
- Powerful Owl
- Rainbow Bee-eater
- Red-crowned Toadlet
- Red-necked Stint
- Regent Honeyeater
- Scarlet Robin
- Sharp-tailed Sandpiper
- Sooty Owl
- Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Square-tailed Kite
- Squirrel Glider
- Swift Parrot
- Turquoise Parrot
- Varied Sittella
- White-bellied Sea-Eagle
- White-throated Needletail
- Wood Sandpiper
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

Data Source:
BioNet Atlas of NSW Wildlife
© NSW Office of Environment and Heritage
(22/10/2018)
Map Scale: 1:250,000

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 2.5 5 7.5 10 km

I:\...\17209\Figures\RP2\20191121\Figure 9. OEH Threatened Fauna

Figure 9. OEH Threatened Fauna records within the locality



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site
- Quadrat Locations

**includes surveys of previously approved developments*

Image Source:
Image © Nearmap
(20/01/2018)

Coordinate System: MGA Zone 56 (GDA 94)

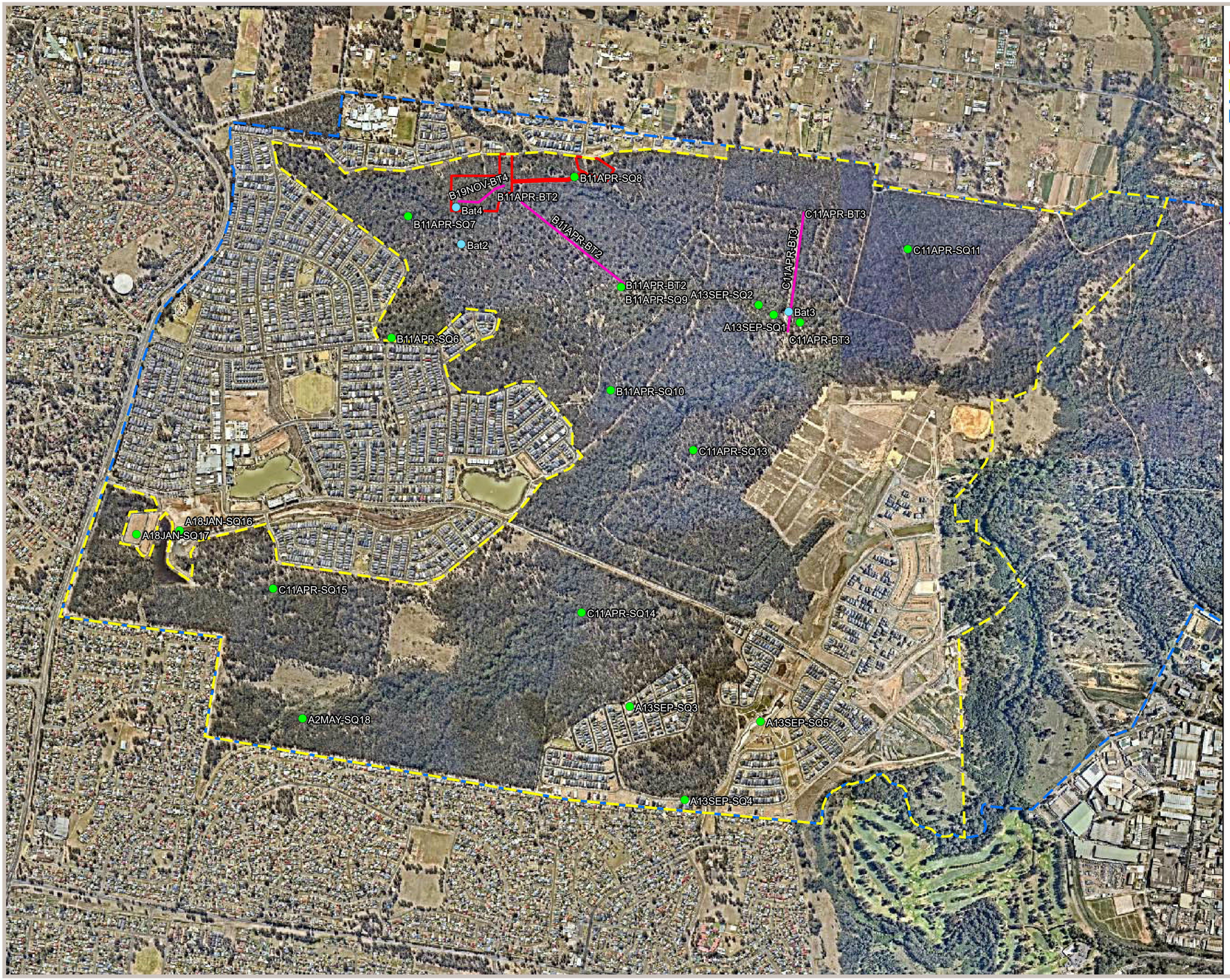
cumberland ecology

0 150 300 450 600 m

I:\...\17209\Figures\RP2\20191121\Figure 10. Flora survey

Figure 10. Flora survey locations

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019



Legend

- Subject Site
- Study Area
- Subject Land - St Mary's Development Site

Fauna Survey Locations

- Anabat
- Cumberland Plain Land Snail Search Centre Point
- Bird Transect

*includes surveys of previously approved developments

Image Source:
Image © Nearmap (2019)
Dated: 27/10/2019

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 150 300 450 600 m

I:\...\17209\Figures\RP2\20191121\Figure 11. Fauna survey

Figure 11. Fauna survey locations

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

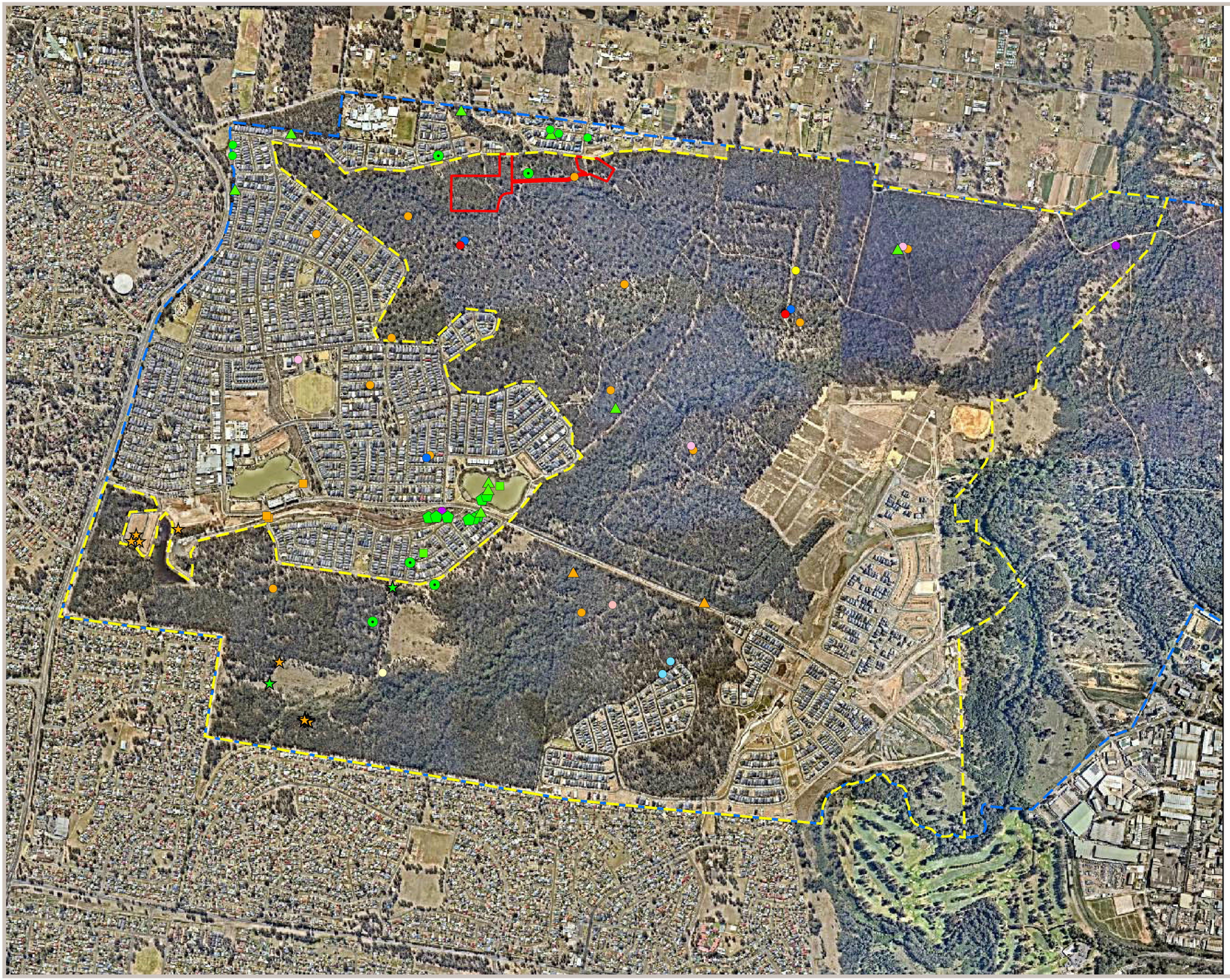


Figure 14. Threatened Flora and Fauna Recorded in the Study Area

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019

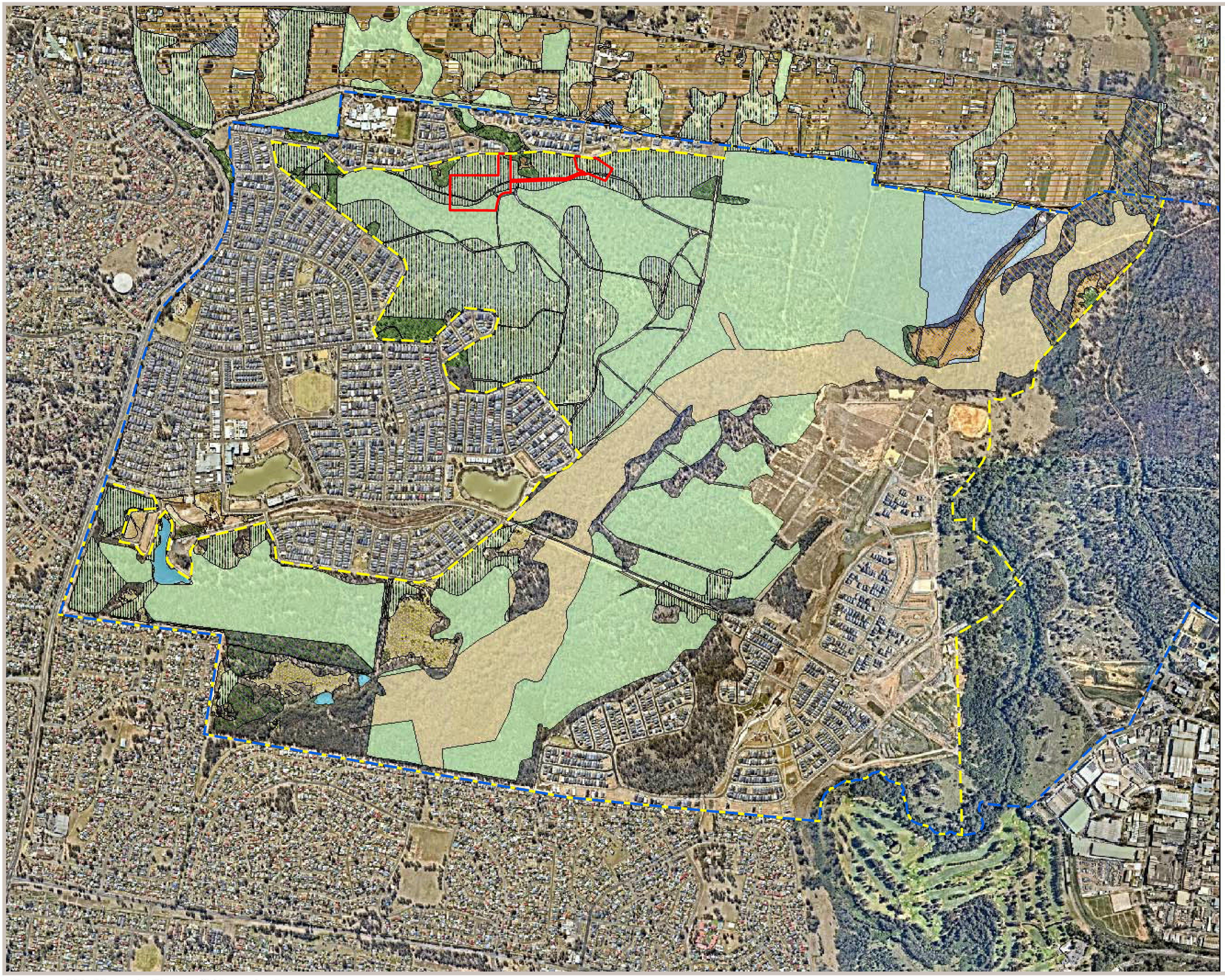


Figure 15. Vegetation of the study area

Document Set ID: 8944815
Version: 1, Version Date: 28/11/2019